Commercial Success through Commercials? Advertising and Pay TV Operators

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Abstract

The US pay television service market had been dominated by cable operators until the nationwide entry of satellite operators in the early 1990s. The latter have been consistently growing their footprints since. This study documents the role of television advertising to explain the success. Using data on US households' subscription choices and operators' advertising decisions, the authors document both demand- and supply-side conditions conducive to the growth of the satellite operators. First, the authors find consumers in this market were sensitive to advertising, and especially so to that of the satellite operators (ad-elasticities of about .05-.06 for satellite operators vs. .02 for cable operators). The authors employ a border strategy to demonstrate advertising-elastic demand and discuss its robustness to potential threats to identification. Second, the authors provide suggestive evidence that a form of asymmetric cost efficiencies in television advertising benefited the entrants more than the incumbents. Specifically, the unit costs of local advertising tend to be higher than of national advertising, which likely allowed the satellite operators to better leverage their national presence with (cheaper) national advertising. Overall, this study highlights the interaction between advertising efficiencies and the scale of entry in explaining the competition between market incumbents and entrants.

Keywords: Advertising; Television service market; Cost advantage; Border strategy

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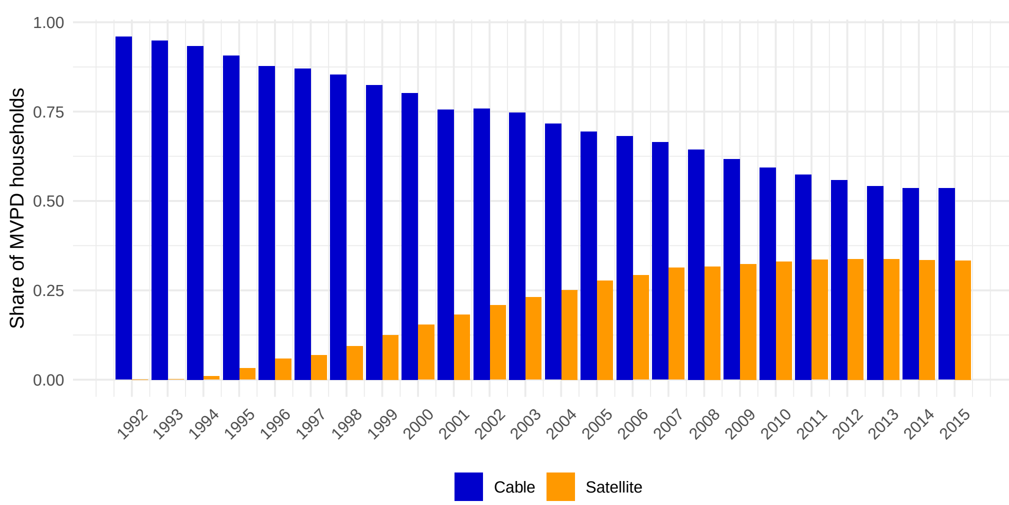
1 Introduction

Since cable television subscription services became available in the US in 1949, the pay television service market had been dominated by cable operators. Each cable service provider (or cable operator) operated virtually as a monopoly supplier in its own cable market where it had exclusive franchise. The lack of competitor entry was due in part to the large investments required, including large fixed costs of installing cable-distribution lines in individual cable markets. Not only was entry by new player unlikely, so was expansion by existing cable operators.[1] In 1996, the Congress passed the Telecommunications Act, which was designed to create a pro-competitive, deregulatory atmosphere in the telecommunications market by eliminating direct price regulation and "let[ting] anyone enter any communications business" (FCC, 1996). However, the Act managed to generate only few attempts at entry.

It was not until the arrival of satellite operators in the early 1990s that the US public was provided with more choices for television services. The operators entered on a national scale and made their services available to US households across cable markets. Technology facilitated large-scale entry as firms could broadcast directly from satellites orbiting the Earth to dish receivers located at individual residences. While this necessitated substantial upfront investments, it obviated the need for large *marginal* investments as experienced by cable operators entering new local geographic markets. The new entrants achieved considerable success in the market, growing their footprints to achieve a national market share of nearly 30% in 2015 (Figure 1).

Figure 1: Evolution of market share of the incumbents versus the entrants



Note: Figure shows the share of MVPD (multichannel video programming distributor) households who subscribed to cable versus satellite operators between 1992 and 2015. MVPD households represent households that subscribe to one of the followings: cable, satellite and telephone company.
Sources: FCC Annual Video Competition Reports (1992-2015)

[1]For cable operators, while one potential way to enter a new market is via mergers or acquisitions (e.g., Charter's acquisition of Time Warner in 2015), this option was not always viable. Comcast withdrew its attempt to purchase Time Warner in 2015 as the Department of Justice was reportedly planning an antitrust lawsuit against the firms.

There were clearly many factors that contributed to the success of the satellite operators such as the quality of the service itself and the broader geographic market coverage (especially in more remote areas) (Goolsbee and Petrin, 2004; Chu, 2010). In this paper, we focus on the role of one particular factor, advertising, specifically television advertising, that could partially explain the success of the new entrants (satellite operators) in a market where the entrenched incumbents (cable operators) commanded a near 100% market share and firms had to make large investments for entry. Both cable and satellite operators primarily use television advertising to reach their audiences. According to the Nielsen data, DirecTV (a satellite operator) and Comcast (a cable operator) spent a total of 1.9 billion USD and 1.0 billion USD on television advertising between 2004 and 2010, respectively. However, despite the television service operators' significant investments in advertising, the role of advertising has received little or no attention in the literature.

We hypothesize the success of satellite operators, vis-a-vis advertising, can be attributed to both demand- and supply-side factors, as well as to institutional features. On the demand side, while the pay television services have traditionally had strong state dependence, our hypothesis is that consumers are sensitive to advertising (as evidenced by heavy spending by the firms). On the supply side, we hypothesize that the differences in geographic coverage between operators disproportionately benefit the entrants (satellite operators) in television advertising. Specifically, the incumbents (cable operators), who are more "local" in their operations (as they operate in specific geographic markets) are likely to spend more on local advertising as they do not want to spend on advertising in areas in which they do not operate. The entrants, who are more "national" (the satellites can beam signals to all areas of the country including to remote locations), would have been able to leverage national advertising. Since unit costs for local advertising are higher than for national advertising, at least in the large media markets, our hypothesis is that satellite operators were able to leverage the cost efficiency in national advertising with their national presence.[2]

An important institutional feature of this market facilitates an operator's ability to reach a household currently subscribed to a competing operator: operators buy ad time from television networks who control the air times on their channels. Therefore, a subscriber to Comcast tuned to CNN can see a DirecTV ad, even though it is being carried on the Comcast network. This feature likely benefited the entrants more than the incumbents. For the entrants to survive in the market in which the established incumbents were serving more than 95% of the pay-television households in the US, it was necessary to steal the incumbents' customers. We conjecture that in such a situation, the ability to reach competitors' current customers allowed the entrants to reap larger gains of advertising compared to the incumbents.

[2]This relative cost advantage of national advertising has been recognized as one source of (pecuniary) economies of scale in advertising, which can work as an entry barrier (e.g., Comanor and Wilson, 1969; Porter, 1976; Brown, 1978; Schmalensee et al., 1989; Bresnahan, 1984). Recently, Thomas (2020) leveraged firms' utilization of this cost advantage as quasi-experimental variation to identify television advertising effects. Another source of cost advantages for national firms can include ad production and distribution since a single commercial can be aired nationwide. In this sense, the scale economies in television advertising is also related to economies of density (Caves et al., 1984; Holmes, 2011), which refers to the declining unit distribution cost with an increase in service density within a network of a given size.

To examine our hypotheses, we assemble data on (i) the demand side—households' subscription choices over time that would help us measure advertising elasticities while accounting for for state dependence and for endogeneity; and (ii) the supply side—ad spending and viewership for the various players. Specifically, we merge the Forrester Technographics Survey Data on US households' television service choices between 2006 and 2010 with the Nielsen advertising data between 2004 and 2010. Using these data, we separately conduct demand- and supply-side analyses, which together suggest advertising-elastic demand and the relevance of market coverage in operators' advertising decisions.

For the demand-side, we ask whether consumer demand in our empirical setting is advertising-elastic. We answer the question by measuring the extent to which television advertising influences households' choices for television services. To this end, we estimate a model of household demand for television services in the presence of advertising and switching costs (via state dependence). To identify advertising effects separately from the fixed effects we include, we propose and implement a border strategy that relies on local cable markets that span the border across multiple media markets, which we call *border cable markets*. The strategy utilizes each border cable market as a quasi-experiment to identify the advertising effect.[3] An important feature of our identification strategy is that one need not be concerned about price and quality effects: because a cable market has the same set of operators on both sides of the border, the price and quality effects are absorbed (as we show later) in the fixed effects we include.

For the supply-side, we ask whether operators recognize and take into account cost efficiencies in television advertising. Specifically, we provide suggestive evidence that firms' advertising decisions can be characterized as a function of two relevant variables: (i) market coverage and (ii) cost of advertising. The intuition is, if the two variables indeed shaped firms' advertising decisions, it is likely the cost difference in the two advertising channels (national vs. local) disproportionately benefited the late entrants (satellite operators), due to the difference in their technologies (satellite vs. cable). In other words, the relationship between advertising decisions and the two variables represent two necessary supply-side conditions for satellite operators to have advantages in television advertising.[4] In a setting where firms do not take these variables into account when making advertising decisions, the difference in market coverage likely had little or no role in explaining the success of new entrants. Collectively, our supply-side analyses suggest that the difference in market coverage, which is driven by the technologies owned by operators, may have played an important role in advertising competition between the incumbents and the entrants.

We conclude the paper with a general discussion of our findings, focusing on the interaction between advertising and technology. Specifically, we illustrate how the scale of entry, as a function of technology possessed by entrants, affects the extent to which the firms are able to leverage cost

[3]Our approach can be viewed as a variant on the border strategy used in recent studies using border *counties* (e.g., Shapiro, 2018; Tuchman, 2019; Wang et al., 2018; Shapiro et al., 2020).

[4]Another channel through which market coverage can affect market outcomes, other than cost efficiencies, is the quality of product offerings, which is beyond the scope of this paper.

efficiencies in advertising. In addition, we discuss other settings where entrants' technologies allowed them to expand market coverage more cost-effectively than incumbents, thereby determining the size of advertising costs.

This paper contributes to the advertising literature in marketing and economics in three ways: (1) documenting the role of advertising in the television service market, (2) providing empirical evidence on the interaction between scale of entry and cost efficiencies in advertising, (3) applying a variation of the border strategy to a new context and discussing its advantages as well as potential threats to identification.

The television service market has been studied extensively by scholars and regulators.[5] Our focus is on the entry of the satellite operators into this market and the subsequent competition with incumbent cable operators. Related topics range from its impact on consumer welfare through its impact on pricing and product quality of cable services (Goolsbee and Petrin, 2004; Chu, 2010) to consumers' switching costs between cable and satellite services (Wise and Duwadi, 2005; Shcherbakov, 2016). These rich discussions are focused on market outcomes of the entry and competition, but not on the process of entry itself. We highlight the potential role of advertising in explaining the successful entry and survival of the satellite operators through demand generation and competition with cable incumbents. Further, the television service market in and of itself provides an interesting setting for studying advertising effect. To the best of our knowledge, the effect in service industries has received relatively little attention, compared to a wide range of CPG markets (e.g., Shapiro et al., 2020).[6] This paper adds to the literature of advertising by providing evidence on an important role advertising may have played in the context of a service market.

Second, this paper contributes to the studies on the scale economies in advertising. The cost differences between national and local television advertising have long been recognized as an entry barrier (e.g., Porter, 1976; Spence, 1980; Hilke and Nelson, 1989).[7] The topic of advertising scale economies has usually been explored in contexts where market incumbents operate on a large scale, whereas entry tends to occur on a smaller scale (e.g., Porter, 1976; Porter et al., 1979; Bresnahan, 1984). Contrary to earlier views that advertising scale economies likely benefit national incumbents, recent entries of new services do not necessarily occur on a smaller scale, perhaps due to advances in digital technologies. Our context is more relevant to the case in which entry occurs on a larger scale. The literature reflects a lack of studies that empirically explore the role of the cost advantage of national advertising in a setting where new firms enter on a national scale and compete with local incumbents. This paper utilizes the US television service market in which satellite operators, facilitated by new technology, entered the market on a national scale, while cable operators (i.e.,

[5]The topics studied include: market outcomes and welfare effects of vertical integration of television networks and television operators (Waterman and Weiss, 1996; Chipty, 2001; Crawford et al., 2018), bundling of program channels (Crawford and Yurukoglu, 2012) and potential competition (Savage and Wirth, 2005).

[6]A few exceptions are Shapiro (2020) and Kim and KC (2020), which focus on the healthcare industry.

[7]Porter (1976) finds that "network rates range from approximately 10 to 70 percent of the sum of the individual station rates," and Hilke and Nelson (1989) confirms the existence of sizable cost savings associated with the use of network rather than spot television advertising.

the market incumbents) were limited to operate at the local level.

Third, this paper adds to the recent empirical literature on the use of border strategies to estimate advertising effects on demand (e.g., Shapiro, 2018; Tuchman, 2019; Wang et al., 2018). The underlying idea of this estimator is to compare adjacent markets (e.g., counties) across DMA borders with a maintained assumption that the markets share similar characteristics and shocks but differ in advertising intensity. This paper adds another layer to the idea by leveraging the geographic definition of cable markets. That is, the comparison we make is *within* a cable market that spans multiple media markets, whereas the comparison is made between counties in the aforementioned studies. One advantage of our approach is that households within a cable market face the same set of choice alternatives (i.e., pay-television services) and the characteristics of choice alternatives are fixed across households, except advertising intensity. This obviates the need to control for product characteristics, prices and product quality once an appropriate fixed effect is included in the analysis.[8] The principal reason is that since the original border strategy is applied to collection of counties on either side of the DMA border, these counties can span several cable markets (as a typical cable market is smaller than a collection of counties[9]) across which cable providers and their offerings can vary. Unless explicitly controlled for, the presence of these factors can impact the estimated advertising effects. We expect the underlying idea to be applicable not only to the cable markets we study, but also to other contexts. A prominent example would be digital advertising (upon data availability), which can generate interesting discontinuities across groups of individuals due to its enhanced targetability. For instance, digital ad campaigns targeted at the city level will generate different ad levels for households near city limits.

2 The US Television Service Market

This section explains why the television service market is particularly appropriate and interesting for the study of how differential benefits of national and local advertising shape competition between national and local firms across markets. To this end, we illustrate the US television service market's key features focusing on operators, followed by a description of the markets for national and local television ads.

2.1 National and Local Firms in the Television Service Market

Our empirical analysis focuses on the US television service market in 2004-2010. Television has been a staple of the American home and has become even more so during the sample period. The total number of households with at least one television capable of tuning to at least one channel

[8]For instance, to identify the effect of television advertising on store-level sales of CPG brands, Shapiro et al. (2020) controls for prices of focal and competing brands at the store-week level.

[9]An average cable market consists of 22,000 households (Source: Warren's Factbook 2010), whereas an average county has about 36,000 households (Source: U.S. Censure Bureau).

within the US climbed by 5 million from 109.6 million in 2004 to 114.9 million in 2010, accounting for 98% of all US households (Nielsen, 2009). All television-equipped households, if not subscribed to any pay services, receive television programming via antenna and can watch local broadcast channels for free. They can choose to subscribe to pay services such as cable and satellite. The percentage of television households that subscribe to a pay service increased from 84% in 2004 to 88% in 2010 (Leichtman Research Group, 2017).

In the television service market, pay television services are offered by national and local firms. Satellite operators are national firms that can serve all households in the US, with only a few exceptions; television signals cannot reach some regions via satellite, and hence, cannot be served. DirecTV and Dish Network are two leading satellite operators, which we will focus on in our empirical analyses. Cable operators such as Comcast and Time Warner are local firms (albeit large, with a combined pay television market share of 30-40% between 2004 and 2010), whose services can be sold only to a limited subset of US households. Each cable operator operates in a collection of local markets across the nation, called *cable markets*. We discuss cable markets in greater detail in the next section as we make use of that market definition throughout the paper.

The television service market provides a unique setting for studying the cost differences in advertising for market entrants and incumbents, considering how the market has expanded. The topic has usually been explored in contexts where market incumbents operate on a large scale, whereas entry occurs on a smaller scale (e.g., when a large national brand—Dannon or Yoplait—faced off against an initially local player—Chobani). In those contexts, cost differences in advertising serve as one of the mechanisms to explain entry barriers for potential entrants, as they translate into cost disadvantages for entrants. That is, entrants face spot rates higher than network rates, which would prevent them from effectively competing with incumbents facing network rates (e.g., Porter, 1976; Porter et al., 1979; Bresnahan, 1984). In contrast, what is interesting about our empirical setting is cable operators (the incumbents) operated on a local scale, whereas satellite operators (the entrants) entered the market on a national scale. Thus, incumbents might have found it less efficient to utilize national advertising that charges less per unit, whereas entrants might have been better able to avail themselves of this cost advantage. We use our setting to understand how the entry of a firm on a national scale benefits the entrants in its competition with incumbents.

2.2 Cable Markets and Media Markets

We make use of two types of markets throughout the paper: cable market and media market. Because the difference in the market definitions will be utilized to identify the effect of advertising, we discuss in detail how each market is defined.

A cable market is a geographic area in which a population receives the same cable service from the same cable operator. A cable market can be a city, town or a collection of cities or towns. A cable market is typically served by one cable operator, and therefore, no head-to-head competition among cable operators likely exists.[10] On the other hand, a media market, also known as a DMA (Designated Market Area), is a geographic area in which a population receives the same (or similar) television offerings. Because the local ads of our focus are purchased at the DMA-level, television households in a given DMA are exposed to the same set of local ads.

There are 210 DMAs and more than 6,000 cable markets in the US. A cable market is typically far smaller than a DMA. Although smaller in size, the cable markets are not necessarily subsets of the DMAs (and vice versa), and therefore, there are some cable markets that belong to more than a single DMA. We exploit this feature in our demand analysis to identify the effect of advertising on households' choices of television service.

2.3 Markets for Television Advertising

Despite the growth of "cord-cutters" and "cord-nevers," television advertising has remained highly relevant as a key vehicle through which firms reach consumers. In 2019, about 96.1% of US households received traditional television signals and these households, on average, spent 3 hours and 27 minutes per day watching television (Nielsen, 2019, 2020). In terms of dollars spent, approximately $69.87 billion or 31.6% of the total media ad spending in the US in 2018 was on television advertising (eMarketer, 2019).

From a conversation with an industry expert at one of the leading operators, we obtained some insight into how television service operators make ad-buying decisions throughout the year. Specifically, these are decisions by, for instance, DirecTV, to attract more subscribers to its service. The marketing department of the operator is given a fixed budget for overall television advertising for the year, and decides what portion of the budget will be allocated to national and local advertising. National ads are shown to all households in the US that tune into a particular program at a particular time, whereas local ads are shown to households in particular DMAs. The industry expert said the firm uses local ads to target based on various factors, such as demographics, market share, and competitors' advertising, and to react to market-specific temporary demand shifts. The operator buys television ads from television networks (e.g., CBS), who control the air times on their channels, often with the help of media buying agencies for advertising rate and schedule negotiations. Since the same network (i.e., CBS) is present on subscription services provided by different cable and satellite operators (Comcast, Time Warner, Dish, DirecTV, etc.), advertising by one player (e.g., DirecTV) will be seen by subscribers of competing operators (e.g., Comcast).

Operators can purchase *national ads* from television networks in two markets, upfront and scatter. The two markets differ mainly in the timing. The upfront market happens in mid-May for about one to two weeks when networks have finalized their programming for the upcoming

[10] An exception is *overbuild*, which refers to a situation in which a new cable operator has entered a market that had already been served by another cable operator. Overbuilds account for only about 2% of cable markets (Warren's Factbook 2010) probably due to high entry costs and fierce competition between incumbents and entrants, although one cannot rule out the possibility of tacit collusion (see Brodkin, 2014).

Table 1: Average CPM for national and local advertising

	National		*Local (Top 100 DMAs)*	
Year	Broadcast network	Cable network	Prime time	Late News
2006	N/A	N/A	$28.08	$16.61
2007	N/A	N/A	$34.48	$17.53
2008	$16.80	$9.17	$27.67	$15.80
2009	$16.09	$8.74	$30.33	$17.97
2010	$17.52	$9.60	$26.76	$15.17
2011	$19.48	$10.61	$28.00	$15.99
2012	$20.96	$11.31	$32.08	$17.75
2013	$22.32	$12.09	$34.83	$18.19
2014	$23.46	$12.77	$33.85	$18.39
2015	$24.40	$13.34	$37.35	$21.47

Note: The first set of columns labeled "National" shows the average national upfront advertising CPMs, and the second set of columns labeled "Local" shows the average CPM of a 30-second ad in Top 100 DMAs, whenever the corresponding statistics are available. Prime times refer to the block of time between 8pm-11pm in Eastern and Pacific Time or 7pm-10pm in Central and Mountain Time. Late news refers to 11pm in Eastern and Pacific Time or 10pm in Central and Mountain Time.
Sources: (i) National CPMs: MediaPost. "N/A" indicates that no corresponding data are available, (ii) Local CPMs: FCC Annual Video Competition Reports (`https://www.fcc.gov/reports-research/reports/video-competition-reports`)

broadcast season that begins in September. In the upfront market, networks sell about 80% of their ad inventories, including most of their prime-time slots (i.e., 8-11 p.m., Eastern/Pacific Time; 7-10 p.m., Central/Mountain Time). The scatter market operates throughout the broadcast season and ads that are not sold in the upfront market are traded at the prevailing rate. To advertise, operators buy from the advertising inventory of television networks in specific programs. Their ads then run during commercial breaks throughout the runtime of the program.

Operators can purchase *local ads* both upfront and throughout the year (scatter) from local television networks. For instance, Comcast can buy ad units on local affiliates of broadcast networks such as KDVR (FOX) in Denver. Transaction of local ads is generally on a DMA-by-DMA basis. According to our industry expert, local upfront buying becomes especially appealing in election years (midterm and Presidential) as political dollars flood the market. The expert also said local ad buying allows the operator to flexibly adjust the level of advertising according to local events such as college football games. We discuss in our demand analysis how we address such demand shocks to specific geographic markets and specific time periods in estimating the effects of television advertising.

The key difference between national and local ads is in the unit cost of advertising. The cost to reach 1,000 viewers (CPM) is generally lower for national ads than local ads. Table 1 compares the average CPMs for national and local advertising between 2006 and 2015 whenever the data are available. The CPMs for national advertising were, on average, lower than the CPMs for local advertising, although some variance in rates exists across network types and dayparts.

Specifically, the rates for local advertising during prime time were the highest, while the rates during late newscasts were lower and almost on par with the rates charged by national broadcast networks. National cable networks charged the lowest rates. These figures explain why advertisers, or television service operators in our context, may have an incentive to purchase national ads, even when they do not operate on a national scale. The cost advantage of national advertising exists and is particularly prominent for advertisers who wish to run ads in prime time or who want to target consumer segments with greater preference for cable network channels.

3 Data

We assemble data from two primary sources: Nielsen's Ad Intel Data and Forrester Technographics Survey Data. First, the Ad Intel Data cover ad occurrences for various media types across the US. Each row of the data set records an airing of an ad by a given firm in a given DMA at a given television network with information on ad spending and viewership (i.e., the number of households tuned in to the ads). We focus on television ads for television service firms (i.e., cable and satellite operators) aired between 2004 and 2010.[11]

Second, the Forrester Technographics Survey data (hereafter Forrester data) record survey responses of household panels on questions related to television service choices such as operator-level subscription status (e.g., terrestrial, Comcast, DirecTV). The data is used to obtain operator market shares. We have the data between 2006 and 2010, which allows us to observe households' choices over time. As the survey is conducted between January and February in each year, we assume the survey results represent households' choices in the previous year. Accordingly, our demand data go from 2005 to 2009. The Forrester data also provides households' demographic information such as zip code, household size and income, as well as survey responses regarding television watching behavior (which we use to construct one of the advertising proxies).

As a primary goal of this paper is to study the role of television advertising in the growth of satellite operators in the presence of cable operators, it is important to precisely identify the effect of television advertising. The use of Forrester data, relative to other available data, comes with at least three advantages in this regard. First, because the data allows us to observe households' subscription choice for *both* cable and satellite services from a single source (unlike others that record shares for either cable or satellite, but not both), we are less concerned about source-specific measurement errors such as errors introduced by inherent features of the data collection process. Second, because the data records households' choice at the *operator* level, we can link each operator's television advertising to the share of the operator, which is often not possible for

[11]Television service operators used television as the primary outlet for advertising in our sample period. For instance, the total ad spending by DirecTV and Dish Network in 2009 was $420 million and $310 million USD, respectively (source: `https://seekingalpha.com/article/216166-dish-network-vs-directv-the-money-race`). Comparing these numbers to those in Table 2, DirecTV and Dish Network spent about 92% and 85% of their total ad budget on television, respectively.

satellite services using aforementioned alternative data. Last, the Forrester data allows us to assign households to a cable market using households' zip code information, which is an essential step for our identification strategy (explained later). Such an exercise is not possible using alternative data that records operator share at the state or DMA level. We discuss the representativeness of the Forrester data relative to other data sources in the Web Appendix Section A.1.

3.1 Advertising Measure

For each insertion of ad, the Ad Intel data reports the estimated viewership (i.e., number of households that viewed the ad), the duration of the ad, the estimated cost of advertising, and whether the ad was delivered via national or local channel. Using the data, we construct various proxies for advertising intensity at the operator-market-year level, where a market is defined as one of the 210 DMAs or the national market. The proxies capture either *delivery* of ads only (e.g., insertion, duration, spend) or *viewership* of ads (e.g., GRPs).

We consider three proxies that capture the delivery of ads. First, *insertion* indicates how many times an operator's ads are aired in a market-year. Second, *duration* is the sum of the durations (in seconds) of all the insertions of an operator in a market-year. Third, *spend* is the total expenditure (in USD) for running ads by an operator in a market-year. For a national ad, each of these measures takes the same value across all DMAs; for a local ad, the value represents advertising intensity in the corresponding DMA.

Our last proxy for advertising, gross rating points (GRPs), captures not only the delivery of ads, but also varying viewership of those ads across markets. Specifically, the GRPs of an ad, either local or national, represent the impressions (the number of households tuned in to the ad in a given market) normalized by market size (the number of television households in a given market). The impressions of an ad are projected based on television-watching behavior of a stratified sample of households in a given DMA, which is reflected in the ratings of the program. This projection creates variation in impressions across DMAs. Accordingly, even for national ads, the GRPs would take different values across DMAs. Further, by leveraging the Forrester survey, we construct a new measure, weighted GRPs, which varies across households (discussed later).

3.2 Summary Statistics

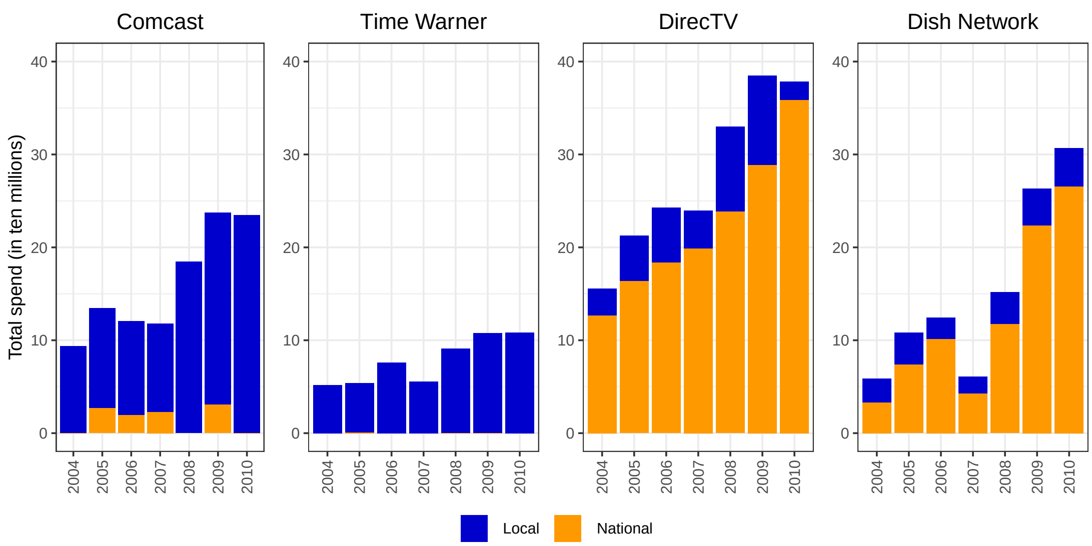
Table 2 and Figure 2 summarize the Ad Intel data, and Tables 3 and 4 summarize the Forrester data. Table 2 reports the spending on television advertising by major operators in the US television service market. As shown, the spending on television advertising nearly tripled during our observation period—from 385.4 million USD in 2004 to 1.07 billion USD in 2010. While ad spending increased at the firm level for all operators, a temporary industry-wide slowdown in growth rate appears to have occurred in 2007. For instance, Dish Network more than halved its spending from 124.1 million USD in 2006 to 60.7 million USD in 2007, which rebounded to 152.1 million USD in 2008.

Table 2: Summary statistics: Ad spending on television

	Ad spending on television (in million USD)						
	2004	2005	2006	2007	2008	2009	2010
Cable operators							
Comcast	93.5	134.8	120.8	118.0	184.6	237.4	234.5
Time Warner	51.7	53.6	76.1	55.6	90.7	107.4	108.3
Cox	18.5	19.3	11.2	12.0	23.0	31.9	31.8
Charter	5.7	3.8	3.2	3.7	5.2	13.8	12.7
Mediacom	1.4	1.7	2.6	2.4	1.6	1.8	1.8
Subtotal	170.8	213.2	214.0	191.7	305.1	392.3	389.1
Satellite operators							
DirecTV	155.8	212.9	243.0	239.2	329.8	384.6	378.5
Dish Network	58.9	108.1	124.1	60.7	152.1	263.1	306.7
Subtotal	214.6	321.0	367.2	299.9	481.9	647.7	685.2
Total	385.4	534.2	581.1	491.6	787.1	1040.1	1074.3

Note: Table reports the advertising expenditure on television of select firms in the US television service market based on the Nielsen's Ad Intel Data between 2004-10.

Figure 2: Local and national advertising expenditure by operators



Note: Figure reports four operators' expenditure on local and national advertising across years based on the Nielsen's Ad Intel data, 2004-10.

Figure 2 shows how each firm allocates its spending across local and national ads between 2004 and 2010. The first two plots are for local operators and the last two are for national operators. Note that we show only two of the local operators, Comcast and Time Warner, which had the largest market shares, on average, among local firms during the sample period. On average, national firms spent more on television advertising than local firms. This finding shows the incentive to advertise may be closely tied to the size of the potential market. Another observation is that both local and national firms use a mix of local and national advertising. In particular, local firms (e.g.,

Table 3: Summary statistics: Market share

	Market share				
	2005	2006	2007	2008	2009
Cable operators	0.572	0.576	0.537	0.523	0.488
Comcast	0.189	0.199	0.196	0.194	0.186
Time Warner	0.088	0.123	0.109	0.108	0.101
Charter	0.055	0.055	0.054	0.047	0.041
Cox	0.053	0.046	0.038	0.041	0.041
Adelphia*	0.047	0.000	0.000	0.000	0.000
Mediacom	0.013	0.012	0.012	0.011	0.008
Other	0.127	0.140	0.128	0.121	0.111
Satellite operators	0.247	0.250	0.273	0.271	0.286
DirecTV	0.126	0.133	0.149	0.151	0.162
Dish Network	0.117	0.112	0.120	0.116	0.121
Other	0.005	0.005	0.004	0.004	0.003
Phone companies	0.000	0.011	0.021	0.039	0.071
AT&T (U-verse)	0.000	0.002	0.004	0.013	0.027
Verizon (Fios)	0.000	0.004	0.011	0.021	0.036
Other	0.000	0.005	0.006	0.005	0.008
Terrestrial	0.180	0.163	0.169	0.167	0.155
Obs.	56,425	45,182	48,911	41,004	30,459

Note: Table reports the market shares of select firms in the US television service market based on the Forrester Technographics Survey between 2006-10. The number of observations declined as the data provider kept reducing the panel size due to rising costs. In 2011, the company switched to an online survey.
* Adelphia was acquired by Comcast and Time Warner in 2005.

Comcast) use some national advertising, which indicates firms in this market do leverage the cost advantage of that advertising vehicle. The pattern of combining national and local advertising is more pronounced for national firms. Although national firms mostly invested in national ads, their spending on local ads was not insignificant, possibly to respond effectively to local demand shocks, as noted by an industry expert at one of the leading satellite operators.

Table 3 reports the market shares of major operators based on the Forrester Technographics Survey. Note the number of observations in the Forrester Technographics Survey Data declined over our observation period as the data provider was reducing the panel size due to increasing costs of administering the survey.[12] The table shows the market share of cable services gradually decreased as the share of satellite services increased. Phone companies such as AT&T (U-verse) and Verizon (Fios) entered the market during our observation period but had not gained sufficient market share to affect our analysis especially in the markets we consider. One important observation is that the market share of Adelphia is zero from 2006 onwards, because the fifth-largest cable operator back then was acquired by Comcast and Time Warner. Later, we discuss the acquisition in one of our supply analyses and investigate how the event affected firms' advertising decisions.

[12]The company switched its main survey entirely to an online one in 2011.

Table 4: Retention probabilities of the Forrester households

		Year $t+1$			
		Cable	Satellite	Phone	Terrestrial
Year t	Cable	0.921	0.032	0.004	0.044
	Satellite	0.109	0.834	0.002	0.054
	Phone	0.499	0.174	0.245	0.082
	Terrestrial	0.139	0.068	0.003	0.790

Table 4 reports the operator retention probabilities for the Forrester households. The table is based on 52,277 out of 148,207 households who participated in the survey more than once between 2006 and 2010. Operators are grouped into four categories: cable, satellite, phone companies and terrestrial. Overall, we find strong state dependence, especially for cable subscribers with retention probabilities of 0.921, as opposed to 0.834 for satellite, 0.245 for phone companies, and 0.790 for terrestrial. We report the retention probabilities of households used in our demand estimation in Table A.1 in the Web Appendix Section A.4.

4 Demand-side Evidence on Advertising Effect

The goal of this section is to explore whether the demand for television service is advertising-elastic. To this end, we estimate a model of households' television service choices, which specifies advertising as a utility shifter. We begin with our empirical strategy for identification and model specification. After presenting the estimation results, we discuss potential threats to our identification strategy and present a series of robustness checks.

4.1 Empirical Strategy

To understand our empirical strategy, consider the choice of household i that receives a certain level of advertising from operator j in cable market m in year t. Recall a cable market is geographic area in which a population receives the same cable service from the same cable operator. Let A_{jmt} and $u_{ijmt}(A_{jmt})$ denote the level of advertising and the utility of household i in cable market m in year t by choosing the service of operator j, respectively. Households' choice is also a function of other characteristics of operator j's service such as price and quality, which we summarize using a vector δ_{jmt}. Let Θ_i denote a set of parameters that characterizes household i's preferences. Then, the full utility function can be written as $u_{ijmt}(A_{jmt}, \delta_{jmt}; \Theta_i)$. Given the level of utility, household i makes a decision of whether to choose j's service and we denote the mapping between utility to choice as $y_i[u_{ijmt}(A_{jmt}, \delta_{jmt}; \Theta_i)] \in \{0, 1\}$.[13]

[13]For brevity in exposition, we suppress y_i's dependency on other choice alternatives, i.e., $j' \in J, j' \neq j$. In our empirical model specification, we employ a discrete choice model framework to deal with the presence of multiple choice alternatives.

Our goal is to investigate whether different levels of advertising shift the household's choice. This can be done by evaluating the following expression:

$$\Delta_i = y_i[u_{ijmt}(A^{(1)}_{jmt}, \delta^{(1)}_{jmt}; \Theta_i)] - y_i[u_{ijmt}(A^{(2)}_{jmt}, \delta^{(2)}_{jmt}; \Theta_i)], \tag{1}$$

where $A^{(1)}_{jmt}$ and $A^{(2)}_{jmt}$ represent two different levels of advertising. A *test* for advertising-elastic demand is to check whether following statement holds: if $A^{(1)}_{jmt} > A^{(2)}_{jmt}$ and $\delta^{(1)}_{jmt} = \delta^{(2)}_{jmt}$, then $\Delta_i > 0$. In other words, we need to relate the variation in household choices to the variation in advertising, while other service characteristics are held fixed. An endogeneity problem arises when δ_{jmt} co-varies with advertising (i.e., if $A^{(1)}_{jmt} \neq A^{(2)}_{jmt}$ then $\delta^{(1)}_{jmt} \neq \delta^{(2)}_{jmt}$). This is likely true in our setting because, like advertising, some components of δ_{jmt} are also set by operators. For instance, operators may strategically align their advertising and pricing decisions in a given market.

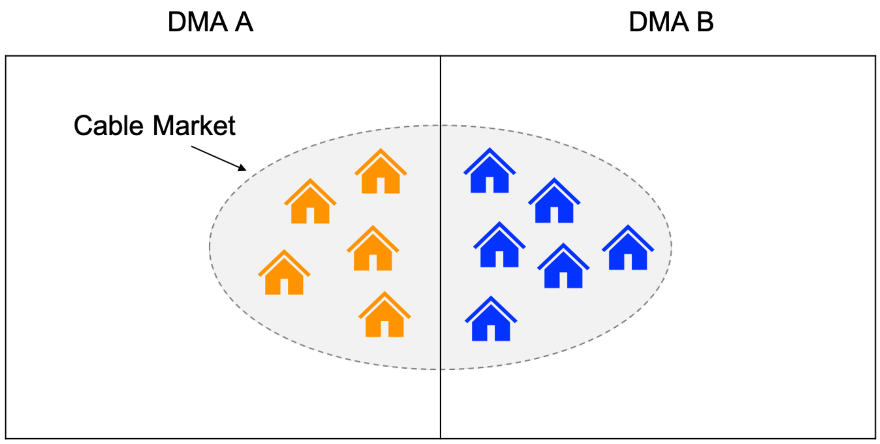
Our proposed empirical strategy is to find a series of market-year pairs in our data, in which we can reasonably assume variation in A_{jmt} exists within each pair while δ_{jmt} are fixed. To this end, we leverage the difference in the geographic boundaries between cable markets and media markets (i.e., DMAs). A typical cable market is served by a single cable operator (e.g., Comcast) and it is thus likely that all households in a cable market would experience the same level of quality and price of the cable service. The same is true for the satellite operators whose service qualities are likely similar for households in the same cable market.[14] Accordingly, δ_{jmt} are not likely to vary across households within a cable market-year pair for every j. On the other hand, the level of advertising typically varies across DMAs based on characteristics of households that reside in each DMA. While the majority of cable markets belong to a single DMA (because a cable market is typically smaller than a DMA), there are some cable markets that span multiple DMAs. Therefore, households in those cable markets receive different ads depending on which DMA they belong to. We define such markets as *border cable markets*.[15] Given the small size of a cable market and geographic similarities, households in each of the border cable markets likely share similar preferences and they face the same set of choice alternatives (i.e., operators), where prices and quality of services are comparable. Therefore, if there is any variation in advertising across different sides of a border, it is unlikely due to the differences in the observed characteristics of these households. That is, any variation in advertising across the border can be regarded as being random, i.e., *exogenous*. Figure 3 provides a visual illustration of our empirical strategy.

Our identification assumption is that absent television advertising, demand for each operator in a given cable market has the identical trend across the DMA borders once observables are controlled for. The parallel trends assumption is likely to hold in our setting, because the definition of DMA is not correlated with television service demand, and therefore δ_{jmt} is the same for either side of a given border cable market. Thus, each border cable market can serve as a quasi-experiment

[14] There are some cases in which the quality of satellite service across cable markets could differ. We discuss the issue later in the robustness checks section.

[15] See Section A.2 in the Web Appendix for further discussion on border cable markets.

Figure 3: Identification strategy



Note: Households in the same cable market face the same characteristics of each brand (e.g., price, customer service), but may receive television ads of different intensity depending on which side of the DMA border they belong to. Each cable market can be thought of as a quasi-experiment in which households in one DMA (e.g., orange households in DMA A) serve as a control group for households in the other DMA (e.g., blue households in DMA B).

for identifying the advertising effect. Our empirical strategy can be viewed as a variant of a similar approach (i.e., parallel trends across border *counties*) in identifying the effects of television advertising (e.g., Shapiro, 2018; Tuchman, 2019; Wang et al., 2018; Shapiro et al., 2020). The main difference is that previous studies impose a parallel trends assumption across a set of neighboring counties across a DMA border, whereas the comparison we make is within a cable market that spans multiple DMAs. A cable market is typically smaller in size than "a set of counties," so we view that the parallel trends assumption is also likely to hold in our case.[16]

Model specification Consider the utility of household i in cable market m for operator j in year t:

$$u_{ijmt} = \delta_{jmt} + \beta \cdot g(A_{j,d(m),t}) + \gamma_k \cdot \mathbb{I}[y_{i,t-1} = k, k \neq j] + \varepsilon_{ijmt}, \tag{2}$$

where j is one of four alternatives: cable, DirecTV, Dish Network and terrestrial.[17] The household's choice set includes both DirecTV and Dish Network, as their services are available to all US households. We treat terrestrial as an outside option and normalize its mean utility (δ_{jmt}) to zero. The terms on the right-hand side are explained below.

[16]In the Web Appendix Section A.3, we provide supporting evidence for the assumption by showing that different sides of a border cable market evolve similarly over time in terms of an observable market characteristic other than television service demand (income).

[17]We drop overbuilds, which account for 2% of cable markets, so that each cable market has only one cable operator. The overbuilds tend to be larger than non-overbuilds. According to Warren's Factbook 2010, the average number of households in overbuilds and non-overbuilds are about 46,000 (with standard deviation 107,000) and 22,000 (with standard deviation 112,000), respectively.

- δ_{jmt} are operator-cable market-year fixed effects, which absorb any effects from factors that vary at the operator-cable market-year level such as price, service quality, and local tastes toward specific operators. Overall, this term represents the mean utility from choosing operator j in cable market-year, mt.[18]

- $A_{j,d(m),t}$ is the level of advertising in year t for operator j in the DMA d that belongs to cable market m. $g(\cdot)$ represents some transformation of the ad level. We take the natural logarithm of our advertising measure to capture decreasing returns, or concave response, to advertising. β is the main parameter of our interest.

- $\mathbb{I}[y_{i,t-1} = k, k \neq j]$ is an indicator of whether household i chose operator k in year $t-1$ and k was different from j. Hence, γ_k captures the effect of switching costs which we allow to vary across origin operators to account for asymmetric switching costs.

- ε_{ijmt} is a random utility disturbance, which is assumed to be i.i.d. type-I extreme value with location parameter 0 and scale parameter 1.

Note that this specification is consistent with our empirical strategy. To see this, consider two groups of households i_1 and i_2 in a given market-year, each group is located in a different DMA within the cable market. Since both i_1 and i_2 are in the same cable market, δ_{jmt} is constant across both groups by definition. However, the level of advertising can be different depending on which part of the cable market the households are located in. The parameter of interest, β, is identified from a comparison of the two groups of households.[19]

Residual variation in advertising In our setting, identification comes from the variation in advertising on different sides of the DMA borders within a cable market, beyond the operator-cable market-specific time trend (δ_{jmt}). To evaluate the extent of the residual variation in advertising, we plot the residuals from a regression wherein we regress the log of advertising (either *insertions* or GRPs), aggregated to the level of operator-DMA-year, on a set of operator-cable market-year fixed effects (δ_{jmt}) (Figures D.1 and D.2 in the Web Appendix). There exists residual variation in advertising in both ad proxies, but to a lesser extent for *insertions* than for GRPs, which is not surprising because the *insertions* of national ads do not vary across markets. Further, we find a greater residual variation for the cable operators than the satellite operators that primarily rely on national advertising. These suggest that our empirical strategy likely relies more on variation in

[18]The inclusion of δ_{jmt} also addresses concerns about an omitted variable bias. For instance, when allocating advertising budgets across markets, cable and satellite operators may have private information about local demand, which cannot be fully captured by observables. δ_{jmt} captures both observable and unobservable operator-market-year-specific factors.

[19]While this model explains households' decision to switch between operators, the model does not capture the effect of advertising on their decision to upgrade or downgrade service within an operator. While failure to consider tier switching may lead us to under-estimate the effect of advertising on firm profit, the focus of this paper is on the role of advertising in explaining market share of the entrants and the incumbents. We view the current specification as parsimoniously representing our main objectives.

local ads and/or the variation in ads by cable operators. Nonetheless, variation from both types of advertising and operators appears to remain, which we leverage in the estimation.

4.2 Estimation Results

We use only cable markets that span multiple media markets. Our final data set consists of the subscription choices of 3,076 households in 152 cable market-year pairs.[20] We use a discrete choice model framework to estimate Equation 2. Assuming that the errors follow the type 1 extreme value distribution, we obtain the choice probability and the sample log-likelihood and search for a set of parameters that maximizes the sample log-likelihood.

As our main advertising proxy, we use *insertions*. This variable captures the delivery of ads. We run robustness checks with other advertising proxies later in this section.[21] Table 5 reports the estimation results. Across various model specifications, advertising is a statistically significant and positive utility shifter for households' television service choices. We note that while estimates from some specifications (Columns (2), (3) and (4)) are significant only at the 10 percent level, even rejecting the hypothesis of null effect has been documented to be challenging when it comes to ad effects (e.g., Shapiro et al., 2020; Lewis and Rao, 2015; Blake et al., 2015). This challenge is also reflected in Lodish et al. (1995), where the 20-percent significance level was chosen to provide evidence of advertising effects. Column (1) reports parameter estimates when consumer switching costs are not accounted for, whereas the subsequent columns report the estimates when switching costs are taken into account. For instance, Column (2) assumes the same switching costs for all pay television services (non-terrestrial), and Column (3) assumes operator-specific switching costs. We find that switching costs are higher for the satellite than for the cable operators.[22] Next, in Column (4), we consider a model that accounts for heterogeneity in households' preferences for different operators. Specifically, we introduce a term α_{ij} in Equation 2 and estimate the term using a latent-class framework. The pattern of advertising-elastic demand is found to be robust (see the Web Appendix B.1 for more details). Lastly, Column (5) reports the results when we only utilize the variation in local advertising.

[20] The sample covers 51 cable markets between 2005-09. We do not have 255 (51×5) cable market-year pairs, because a cable market-year pair was included in the sample only if at least one household from the corresponding cable market-year participated in the Forrester survey. More details about sampling procedure and summary statistics for the estimation sample are reported in the Web Appendix Section A.4.

[21] We choose *insertions* as our main advertising proxy over GRPs because of two implicit assumptions that accompany the use of GRPs. We elaborate on this in the robustness checks section.

[22] For households that participated in the survey only once, we impute their values for switching variables. The estimates in Table 5 are obtained with the assumption that all single-observation households did not switch. We check the robustness of the ad effect to the specification of the switching variables. Specifically, we create two hypothetical data sets assuming two extreme scenarios: (1) 100% switching of single-observation households, (2) 100% loyalty of single-observation households. We find that the advertising effects are robust to these extremes—the estimates are 0.071 (0.030) and 0.070 (0.030) in the first and second scenarios, respectively.

Table 5: Evidence for advertising-elastic demand from a border strategy

	Ad: Insertion				
	Total (1)	Total (2)	Total (3)	Total (4)	Local only (5)
β: Advertising	0.070**	0.057*	0.063*	0.072*	0.055**
	(0.030)	(0.031)	(0.033)	(0.038)	(0.022)
γ: From Terrestrial		−3.038***			
		(0.208)			
γ: From Non-Terrestrial		−1.638***			
		(0.194)			
γ: From Terrestrial			−2.988***	−2.981***	−2.990***
			(0.206)	(0.234)	(0.206)
γ: From Cable			−2.162***	−2.159***	−2.162***
			(0.162)	(0.170)	(0.162)
γ: From Satellite			−3.650***	−3.798***	−3.653***
			(0.220)	(0.245)	(0.220)
Operator-Cable Market-Year FE	Yes	Yes	Yes	Yes	Yes
Latent-class	No	No	No	Yes	No
Observations	16,928	16,928	16,928	16,928	16,928
No. parameters	609	611	612	620	612
−Log-likelihood	3,963	3,725	3,327	3,253	3,326
BIC	13,855	13,399	12,614	12,542	12,611

Note: Table reports the estimation results of Equation 2. Column (1) reports the estimates when switching costs are not considered, whereas (2)-(4) report the estimates when switching costs are taken into account. In Column (2), we assume the same switching costs for all pay television services, whereas Column (3) assumes operator-specific switching costs. In Column (4), household heterogeneity in operator preference is accounted for via a latent-class framework. Column (5) reports the results when the model in Column (3) is estimated using local advertising only. In estimation, we add a small value 1 to the advertising proxy to avoid taking log of 0, which is undefined. Thus, $g(A_{j,d(m),t})$ in Equation 2 is $\ln(1 + A_{j,d(m),t})$. Significance level: *p<0.1; **p<0.05; ***p<0.01.

Advertising elasticities Using the estimated advertising effect β in Column (4) of Table 5, which provides the best model fit, we compute advertising elasticities with respect to market share. The advertising coefficient has a p-value of 0.058, which is very close to 0.05. The mean and median advertising elasticities across the sample households are reported in Table 6. The own-operator advertising tends to be more effective for satellite operators than cable operators, reflected in the difference in absolute magnitude of own advertising elasticities. In particular, a 10% increase in insertion of cable ads leads to, on average, a 0.211% increase in cable operators' market share, whereas a 10% increase in insertion of own-operator ads brings a 0.547-0.592% market share lift for the two satellite operators. Further, an increase in cable ads appears to have a more destructive effect on satellite market share than the reverse. A 10% increase in cable operators' ads reduces the satellite market share by 0.484% and 0.365% for DirecTV and Dish Network, respectively. On the other hand, when the satellite operators increase their advertising by 10%, cable market share drops by 0.033-0.088%. The pattern that satellite ads have larger own elasticities but smaller

Table 6: Advertising elasticities

$k \backslash j$	Cable	DirecTV	Dish Network	Terrestrial
Cable	0.0211 (0.0194)	−0.0484 (−0.0537)	−0.0365 (−0.0403)	−0.0432 (−0.0473)
DirecTV	−0.0088 (−0.0064)	0.0592 (0.0635)	−0.0016 (−0.0007)	−0.0069 (−0.0042)
Dish Network	−0.0033 (−0.0024)	−0.0010 (−0.0004)	0.0547 (0.0628)	−0.0080 (−0.0052)

Note: Table reports the mean (median) elasticities of own and cross advertising across sample households based on the parameter estimates of specification (4) in Table 5. The cross elasticities are a percentage change in market share of operator j in case of a percentage change in operator k's ads.

cross elasticities compared to cable ads arises in part from the fact that cable operators had larger shares than satellite operators across the markets. Thus, a 1% change in cable's market share should be larger in magnitude than a 1% change in the market share of DirecTV or Dish Network. Taken together, satellite ads were better at offense (acquisition of new customers), while worse at defense (retention of existing customers) than cable ads. Given that the entrants' market shares were smaller than the incumbents during the sample period and one way to grow was to steal the incumbents' shares, this finding can explain the satellite operators' active use of television ads as an instrument to reach customers, as shown in Figure 2.[23]

Overall, we find a slightly larger impact of television advertising in the television service market than in the market for grocery goods. A recent study by Shapiro et al. (2020) reports the mean elasticity of 0.0258 and the median elasticity of 0.0136 as their long-run elasticities in the grocery market. To account for the difference in the unit of observation, we compare our yearly, short-run advertising effects to their weekly, long-run advertising effects (with advertising carryover effects considered). Our estimates of advertising elasticities are smaller than the advertising elasticities reported in earlier meta-analyses, such as 0.22 of Assmus et al. (1984), 0.13 of Lodish et al. (1995), and 0.12 of Sethuraman et al. (2011).

Decomposition of national versus local ads effects Now that we have established that television advertising overall has a positive and statistically significant effect on households' choice of television service, we explore how the effect varies between national and local advertising. One potential source of the difference is ad content: local ads may highlight local price promotions, available bundling packages or diversity of channels, whereas national ads may be intended more for brand-building purposes.

To decompose the advertising effects, we would separate national and local advertising into different variables and estimate the parameters for each. However, because *insertion* or other ad-delivery measures of national ads take the same value across markets, no variation in national

[23] Previous studies on the relationship between order of entry and advertising effect present mixed results. Bowman and Gatignon (1996) do not find any statistically significant difference between advertising elasticities between incumbents and entrants in both durable and non-durable categories. Parker and Gatignon (1996) find that incumbents are likely to have lower advertising elasticities than "immediate" followers, although the difference tends to diminish for later entrants in the hair styling products category.

advertising would be left to identify the effect of national advertising.[24]

To this end, we take two approaches. First, we compare the effect of total advertising (local and national combined) to that of just local advertising by estimating Equation 2 using only local advertising to construct an advertising proxy. In Column (5) of Table 5, we find the magnitude of the ad coefficient is smaller when only local advertising is used. The results suggest that the market share response curve with respect to advertising is steeper at the level of total advertising than that of local advertising, i.e., an incremental benefit of operators' additional ad spending through the national channel. Nonetheless, this approach does not allow us to compare the magnitudes of national and local ad effects.

Another approach is to use GRPs as an ad proxy and rely on an estimator that does not exploit the border cable markets. Unlike the proxies for ad delivery (e.g., insertion), GRPs provide across-market variation even for national ads, which allows for separate estimation of national and local ad effects. Specifically, we estimate a linear probability model in which we regress households' operator choices on GRPs along with various fixed effects using all households in non-border cable markets (see Web Appendix Section B.2 for more details). We find a larger ad coefficient of national advertising compared to local advertising.

Overall, the two analyses provide consistent evidence that national advertising has a larger effect on market share than local advertising. Recall that compared to the cable operators, the satellite operators have a wider geographic coverage and thus have a stronger incentive to run ads at a national scale. This suggests that the national advertising channel may have disproportionately benefited the entrants through its greater marginal effect on market share, contributing to their successful entry and survival in the market.

4.3 Representativeness of the Border Cable Markets

As long as our identification assumptions are satisfied, our proposed strategy would maximize the internal validity of the estimate for ad effect because it carefully leverages a subset of data that enables the identification of the true causal effect of advertising. However, our confidence in internal validity is achieved at the expense of external validity. A border strategy, an application of the regression discontinuity approach, by design, makes use of a narrow subset of data collected at the borders which may not be representative of the entire market. Thus, the estimates from our empirical strategy may be "local" to households in the border cable markets and not generalizable to the population. Indeed, Li et al. (2020) observes that the ad effect estimates based on border markets tend to be smaller than the estimates based on the entire market. While we do not intend to extrapolate our estimates to the US as a whole, the problem of unrepresentative sample might be of concern if it leads us to over-state or under-state the effect of television advertising.

[24]For this reason, it is also challenging to identify the ad effect for the cable operators separately from the satellite operators who invest in local advertising to a limited extent (see Figure 2).

We discuss two pieces of evidence that suggest the pattern of advertising-elastic demand may generalize to a larger subset of the population than border households. First, various subsets of households used in estimation do not differ substantially in terms of demographics, either among themselves or from the nationwide survey participants.[25] To the extent that the survey participants are representative of the US population, our results may be extrapolated to the population. Second, we estimate a set of fixed effects regressions based on more comprehensive (Forrester) samples that are not restricted to border cable markets (details are in Section B.2 in the Web Appendix). We run the regressions at both aggregate and household levels. One advantage of the fixed effects regressions compared to the border strategy is as we make use of a wider set of households in estimation and no longer rely on the identification assumption of the border strategy, we can use as an ad proxy GRPs that provide variation even for national ads. The results not only provide additional support for advertising-elastic demand in the television service market, but also suggest a larger effect of national than local advertising.[26]

Note that estimates from the fixed effects regressions would only serve as descriptive evidence. In particular, the specification cannot separately identify the advertising effect ($A_{j,d(m),t}$) and operator-cable market-year observables and unobservables (which are captured by δ_{jmt} in our main model), and therefore fails to fully address potential advertising endogeneity. Nevertheless, the results provide some reassurance on the robustness of advertising-elastic demand in the market.

4.4 Additional Robustness Checks

Alternative measure of advertising The pattern of advertising-elastic demand is robust to the use of two alternative proxies of ad delivery, *Spend* and *Duration*. In addition, it is robust to a proxy of ad viewership, GRPs (see the Web Appendix Section B.3). The evidence is stronger for GRPs than for *Spend* and *Duration*, with p-values of 0.004-0.005 for GRPs, 0.005-0.116 for *Spend* and 0.019-0.091 for *Duration*. Note that, while GRPs may approximate more precisely the actual viewership of ads, the use of GRPs may not resonate with our identification strategy. Because GRPs are projected based on the average television-watching behavior of households in a given DMA, the measure accompanies two implicit assumptions. First, by construction, the use of GRPs implies different television-watching behavior of households across DMAs, even within a border

[25] Table D.1 in the Web Appendix Section D compares the demographics of the sample households across different subsets of the Forrester data and those of the 2005 Current Population Survey (CPS) participants. The Forrester survey participants in general tend to be more white, have a larger household size, have higher income and be more educated than the CPS participants or the national average. Among the Forrester survey participants, the demographics of border cable market households are highly consistent with the demographics of households in all border counties or in all counties.

[26] The fixed effects regressions also allow us to address another concern specific to our border strategy: phone companies cannot be included in the estimation sample. Despite their increasing footprints between 2006-2010 (Table 3), the market shares of individual phone companies were still very small (0-2.7% for AT&T and 0-3.6% for Verizon), which resulted in zero shares of the operators in a large number of border cable markets. As the fixed effects regressions permit the use of households outside of border cable markets, we observe more instances of phone company choices and thus are able to consider them in the model.

cable market across the DMA border. This is inconsistent with the identification assumption of the border strategy that households in a given border cable market are similar. We attempt to alleviate the concern by including DMA fixed effects, in addition to operator-cable market-year fixed effects. The underlying assumption here is that the variation in viewership across DMAs conditional on fixed effects (including DMA fixed effects) is attributable more to random factors such as channel numbering.

Second, GRPs assume the same television-watching behavior across households in a given DMA. We worry that the assumption may not hold due to potential differences between border households and DMA households in general. To the extent that the television-watching behavior of border households deviates from the DMA average, the measurement error in the proxy would increase and cause attenuation bias. To alleviate this concern, we construct a new measure, weighted GRPs, that permits different television-watching behavior of households within a given DMA. Specifically, we scale the GRPs by the intensity of individual households' television watching relative to households in the entire DMA. We do this using a question from the same Forrester survey as the one from which we obtain our television subscription data which elicits information on the average number of hours per day a household spends watching television. We find that the pattern of advertising-elastic demand is robust to the use of both GRPs and weighted GRPs as proxies (see the Web Appendix Section B.3). Further, we indeed find a larger effect size when weighted GRPs are used, compared to GRPs, which suggests the presence of attenuation bias in the GRPs.

Cross-border treatment spillovers We consider the possibility that households on one side of a border cable market can be treated with the advertising from a different side of the market. Although this is not likely given the regulations that deter signal overlapping across cable markets (see the Web Appendix Section A.2 for more details), we cannot fully refute the possibility due to the relatively close geographic proximity to adjacent DMAs. To address the concern, we artificially reduced identifying variation in advertising across the two (or more) sides within a cable market by varying degrees, and re-estimate Equation 2 based on the simulated advertising data. We find the estimated advertising effect remains positive and statistically significant (p-values ranging from 0.046 and 0.069). See the Web Appendix Section B.4 for more details.

Availability and quality of satellite service Some technical constraints on service provision faced by the operators may imply that not all of the pay television services considered in the model (i.e., cable, DirecTV, Dish Network) were available to the sample households and the quality of satellite service may vary across geographic regions (e.g., Goolsbee and Petrin, 2004). In our sample, cable operators were a viable alternative in all cable markets, evidenced by the fact that at least one sample household in each cable market chose the corresponding cable operator. However, there are two cable markets in which none of the sample households chose either DirecTV or Dish Network during the sample period, which could suggest the unavailability of satellite services in those markets. To investigate the extent of the concern, we estimate Equation 2 based on a sample that excludes the two cable markets and find the parameter estimates are robust to the exclusion. See the Web Appendix Section B.5 for more details.

5 Supply-side Evidence on Advertising Cost Efficiencies

In this section, we provide two pieces of descriptive evidence that suggest firms in our empirical setting recognize and take into account cost efficiencies in advertising. First, we show firms' advertising decisions are a function of their geographic coverage by comparing cable operators' advertising volumes before and after a merger and the concomitant exchange of cable markets among Adelphia, Comcast and Time Warner. Second, we show firms in our context are sensitive to advertising costs by leveraging the US political cycle as a cost shock to the television advertising market. We also show cable and satellite operators react differently to this industry-wide cost shock, consistent with expectations regarding the role of geographic coverage in advertising decisions. We elaborate on each of these below.

5.1 Advertising Decisions and Geographic Coverage

During our observation period, Comcast and Time Warner, the nation's largest and second-largest cable operators at the time, purchased Adelphia, the fifth-largest cable operator. On May 18, 2005, the three operators submitted joint applications for the transactions to the FCC, and the FCC approved the license transfer on July 13, 2006. Prior to acquisition, Adelphia served about 5 million basic subscribers in its cable systems spanning 31 states, with "significant operations in and around Los Angeles, western Pennsylvania, Ohio, western New York, New England, southeast Florida, Virginia and Colorado Springs" (see FCC Docket 05-192). As a result of the acquisition, Comcast gained about 1.7 million basic subscribers and Time Warner gained approximately 3.3 million basic subscribers. Table 7 summarizes the transactions.

One interesting feature of the acquisition is that Comcast and Time Warner not only acquired cable markets that had been served by Adelphia, but also *swapped* some of cable markets between themselves.[27] For instance, Comcast gave Time Warner its cable markets in Los Angeles, Dallas, and Cleveland in exchange for Time Warner's cable markets in Philadelphia (see Table D.2 in the Web Appendix for a full list of exchanges). Further, in a given market that experienced the exchange, one acquirer either completely exited or claimed all the cable subscribers that had been served by the other acquirer in the market. For instance, Comcast transferred all of its 529,856 subscribers in Dallas to Time Warner, and Time Warner transferred all of its 202,472 subscribers in Minneapolis to Comcast.

[27] More precisely, Comcast acquired cable markets (1) directly from Adelphia, (2) from Adelphia through Time Warner, and (3) directly from affiliates of Time Warner. Similarly, Time Warner acquired cable markets (1) directly from Adelphia; (2) from Adelphia through Comcast; and (3) directly from Comcast.

Table 7: Summary of Adelphia-Comcast-Time Warner transactions

	Comcast	Time Warner
# DMAs in which the operator gained subscribers	30	65
Average change in subscribers	89,533	66,507
Largest change in subscribers	308,000 (West Palm Beach)	1,548,771 (Los Angeles)
# DMAs in which the operator lost subscribers	4	12
Average change in subscribers	−275,905	−65,683
Largest change in subscribers	−529,856 (Dallas)	−202,472 (Minneapolis)

Note: Table is constructed on the basis of a letter filed by Time Warner Cable, Comcast Corporation and Adelphia Communications Corporation to the Federal Communications Commission in June 20, 2005 (Proceeding: MB 05-192; ID 5513036896; link: `https://www.fcc.gov/ecfs/filing/5513036896`). Numbers are as of April 2005.

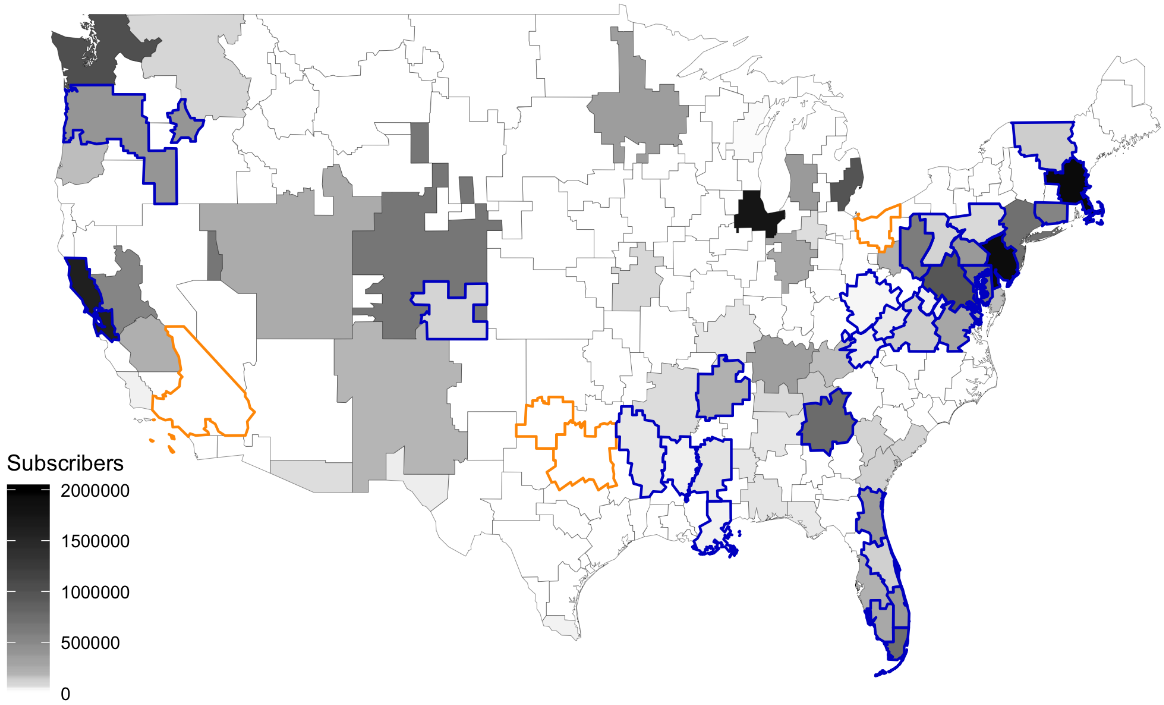
What might have motivated Comcast to give up its Los Angeles and Dallas markets, both of which are large, and likely lucrative, markets? Similarly, Time Warner transferred to Comcast its entire Philadelphia market, which is also large. It turns out that when making the swapping decisions, the operators put into the equation not only the revenue effects (implied by its market size), but also the cost effects. Notice that the transactions improved the geographic clustering of each operator's service areas, as each claimed cable markets that adjoin or lie close to cable markets it had already owned.[28] Figure 4 illustrates the distribution of markets in which Comcast gained and lost subscribers as a result of the transactions,[29] and clearly shows enhanced geographic concentration of Comcast's service areas after the transaction. The resulting increase in concentration of service areas allowed Comast and Time Warner to take advantage of cost efficiencies in operations. For instance, as Comcast had its headquarters in center city Philadelphia, obtaining the entire Philadelphia market from Time Warner might have resulted in a great efficiency gain by allowing the firm to share staff and equipment across adjacent markets. The presence of cost advantage was recognized by then-chairman of Time Warner, Dick Parsons, who said in announcing the completion of transactions "We are very pleased to continue to build value by significantly enhancing our scale, subscriber clusters, and operating efficiencies" (Comcast, 2006).

The geographic concentration also led the operators to enjoy cost efficiencies in advertising. Specifically, as subscribers of a given cable service became more concentrated in a given region as a result of the transactions, that cable operator became able to serve a greater *portion* of households in the region. Recall that cable markets are typically smaller than media markets (DMAs). Thus, when running a local ad in this DMA, the cable operator would incur less "waste" of impressions, or impressions delivered to households that belong to cable markets served by other cable operators (and thus, could not be served by the cable operator). In other words, the transactions allowed the cable operators to make better use of local advertising. Further, because local advertising is

[28]These swapping exercises were criticized for being allegedly anti-competitive. One of the main grounds for such criticism is that by clustering their cable systems geographically, the acquirers were able to operate as local monopolies in many key markets (e.g., New York, Los Angeles, and Washington D.C.), which could undermine competition among cable operators in the markets (Wax, 2007).

[29]Figures D.3 and D.4 in the Web Appendix compare the distribution of subscribers pre- and post-transaction for Comcast and Time Warner, respectively.

Figure 4: Change in the distribution of subscribers as a result of the transactions (Comcast)



Note: Shaded areas in the map are the DMAs Comcast had been serving prior to the transactions. The darker the shade in the map, the more subscribers Comcast had in the region. The DMAs whose borders are in blue (orange) indicate markets in which Comcast gained (lost) subscribers, either from (to) Adelphia or Time Warner.

the primary television advertising vehicle for cable operators (see Figure 2), the reduction in local impression wastage would imply an improvement in cost efficiency for the operators.

If the operators took into account the potential for better or worse use of local advertising, as the cable operators' market coverage within a DMA changed, their optimal *allocation* of ad budget across DMAs would have changed. If this was the case, we should be able to observe a change in their advertising decisions after the transactions. Recall that the two cable operators expanded their coverage of service in some DMAs while the coverage shrank (or completely disappeared) in other markets. So we would see more (less) advertising delivered to the DMAs where the coverage expanded (shrank). We check whether this is indeed the case with our advertising data by estimating the following equation:

$$L_{jmt} = \theta_{jm} + \delta_{mt} + \tau_{jt} + (\mu_j \mathbb{I}^+_{jm} + \nu_j \mathbb{I}^-_{jm}) \cdot \text{Post}_t + \epsilon_{jmt}. \quad (3)$$

L_{jmt} is the level of *local* advertising delivered by operator j to DMA m in year t. θ_{jm}, δ_{mt}, and τ_{jt} are operator-market, market-year, and operator-year fixed effects, respectively, that account for the unobserved characteristics of operators, markets, time, and their interactions in a flexible way. Post_t equals 1 if $t \geq 2006$, and 0 otherwise. $\mathbb{I}^+_{jm}$ ($\mathbb{I}^-_{jm}$) equals 1 if the coverage of j in DMA m

Table 8: Changes in the level of local advertising after the Adelphia transactions

	DV: log(1+Advertising)			
	(1)	(2)	(3)	(4)
	Insertion	Duration	Spend	GRPs
μ_j : Comcast	2.085***	2.292***	2.765***	2.494***
	(0.372)	(0.519)	(0.627)	(0.466)
ν_j : Comcast	−4.475***	−5.541***	−5.630***	−4.558***
	(1.467)	(1.606)	(2.134)	(1.650)
μ_j : Time Warner	0.976***	1.447***	1.835***	1.231***
	(0.243)	(0.391)	(0.431)	(0.285)
ν_j : Time Warner	−2.842***	−3.812***	−4.304***	−3.034***
	(0.700)	(0.959)	(1.145)	(0.817)
Operator-DMA FE	Yes	Yes	Yes	Yes
DMA-Year FE	Yes	Yes	Yes	Yes
Operator-Year FE	Yes	Yes	Yes	Yes
Observations	7,350	7,350	7,350	7,350
R^2	0.883	0.849	0.845	0.870
Adjusted R^2	0.828	0.778	0.772	0.810

Note: Table reports the estimation results of Equation 3 using different measures of advertising. Standard errors are clustered at the operator and DMA level. Significance level: *p<0.1; **p<0.05; ***p<0.01.

expanded (shrank) by the acquisition, and 0 otherwise. μ_j and ν_j are the parameters of interest.

Table 8 reports the estimation results. The estimating data include the advertising decisions of five major operators (Comcast, Time Warner, Charter, Cox, and Mediacom) between 2004 and 2010. We use four different measures of advertising: insertion, duration, spend and GRPs. All the variables are of the expected sign and are significant at the 1 percent level. Specifically, we find both Comcast and Time Warner increased the level of advertising in the DMAs where their coverage expanded and decreased it in the DMAs in which their coverage shrank.

The results suggest that the local firms (i.e., cable operators) benefited from expanding geographic coverage even within a DMA. To illustrate the point, we provide back-of-the-envelope calculations on select DMAs in Table 9. As shown, both Comcast and Time Warner expanded their market coverage within a DMA in which they gained more subscribers. For instance, Comcast served 85.8% of households in Boston before the swap and spent about 4.9 million USD to deliver its ads to the market. While all households in Boston could see Comcast ads, Comcast was not available for 14.2% of the households. In other words, 14.2% of ad spend is wasted. After the swap, however, Comcast's market coverage increased to 94.4%, resulting in about 5.6% less waste, which is 60.6% smaller than before.

This reduction in ad-spend wastage is equivalent to a decrease in the *unit cost of reaching*

Table 9: A back-of-the-envelope calculation: Adelphia-Comcast-Time Warner transactions

	Percent of Homes Covered		Ad-spend	Wasted Ad-spend			
DMA	Pre	Post	in USD (2005)	Pre	Post	Change	% change
			Comcast				
San Francisco	91.00%	91.70%	11,646,459	1,048,181	966,656	−81,525	−7.8%
Philadelphia	79.20%	80.90%	8,723,556	1,814,500	1,666,199	−148,300	−8.2%
Washington DC	45.90%	61.00%	7,197,363	3,893,773	2,806,972	−1,086,802	−27.9%
Boston	85.80%	94.40%	4,923,532	699,142	275,718	−423,424	−60.6%
Pittsburgh	41.60%	66.60%	4,000,850	2,336,496	1,336,284	−1,000,213	−42.8%
Atlanta	49.60%	55.10%	3,411,395	1,719,343	1,531,716	−187,627	−10.9%
Miami	61.50%	69.40%	1,377,520	530,345	421,521	−108,824	−20.5%
Jacksonville	66.40%	84.30%	690,008	231,843	108,331	−123,511	−53.3%
			Time Warner				
Columbus OH	50.10%	58.40%	1,636,499	816,613	680,784	−135,829	−16.6%
Cincinnati	61.90%	68.90%	1,505,718	573,679	468,278	−105,400	−18.4%
Cleveland	44.20%	77.80%	1,392,916	777,247	309,227	−468,020	−60.2%
San Diego	26.90%	35.70%	1,366,907	999,209	878,921	−120,288	−12.0%
Charlotte	57.60%	63.80%	1,302,919	552,438	471,657	−80,781	−14.6%

Note: Table reports back-of-the-envelope calculations of the changes in the wasted ad spend before and after the transaction. The number of households served by Comcast and Time Warner (in column Percent of Homes Passed) are reported for select DMAs in the FCC MB Docket No. 05-192.
Sources: (1) Percent of Homes Covered: Economic Appendix, App. D, Section III, Table A-2 (Homes Passed); `https://www.adr.org/sites/default/files/document_repository/FCC%20Memorandum%20Opinion%20and%20Order%2006-105%20of%207-13-2006_0.pdf`, (2) Ad-spend in USD (2005): Nielsen Ad Intel.

the intended audience via television advertising. Note that with the same level of local advertising as pre-transaction, the firms would already be better off. However, the operators increased their ad spend in these markets (Table 8), so we expect the decrease in wasted ads would be greater. We find a similar pattern from the Charter-Time Warner Cable-Bright House Network merger in 2016, which created New Charter (Spectrum). In the DMAs that were served by two or more operators among the three firms pre-merger, the merger resulted in increased the market coverage of Spectrum. In these markets, we find that the level of advertising by Spectrum after the merger is greater than the sum of advertising by the operators before the merger. On the other hand, the level of advertising, on average, did not change in the markets served by a single operator that experienced no change in the market coverage (see the Web Appendix Section C for more details). Overall, these results show that market coverage is an important factor of firms' local advertising decisions, which suggests the potential importance of cost efficiencies in advertising.

5.2 Advertising Decisions and Advertising Costs

In this subsection, we ask two questions. We first ask whether television service providers are sensitive to the costs of advertising. One necessary condition for the cost efficiencies to be relevant in our empirical context is that operators take into account relative cost differences between national and local advertising when making advertising decisions. Then, we ask, if they are cost-sensitive, whether and how national and local operators react differently to a change in the relative cost difference. We expect the response to depend on the interaction between the operator's market coverage and the direction of the change.

The key empirical challenge in answering the questions is that we as researchers do not observe the prices paid by advertisers to television networks (i.e., cost of advertising) at the transaction level. Even if we do observe the cost at any granular level, it would still be challenging to identify the causal effect of advertising costs on advertising decisions, because the price is endogenously determined based on negotiation between networks and advertisers (or their media-buying agencies) (e.g., Hristakeva and Mortimer, 2021). Contractual complexity adds another layer of complications.

We overcome the empirical challenges by leveraging a plausibly exogenous cost shifter for advertising: the political cycle in the US. Proposed by Sinkinson and Starc (2019), the instrument is a variation in the price of non-political advertising during election seasons.[30] A sharp increase in political advertising during the period leads to a decrease in residual advertising space for other product categories and raises the price of advertising in general. Importantly, the magnitude of the price change may vary across the markets as a function of attractiveness of the markets to political advertisers and resulting intensity of political advertising. This feature creates an interesting variation relevant to our setting, namely, exogenous changes in the relative cost of national and local advertising in a given market. While any change in the cost of national advertising affects all markets uniformly, the changes in the price of local advertising would vary across markets depending on the intensity of political advertising in the market.

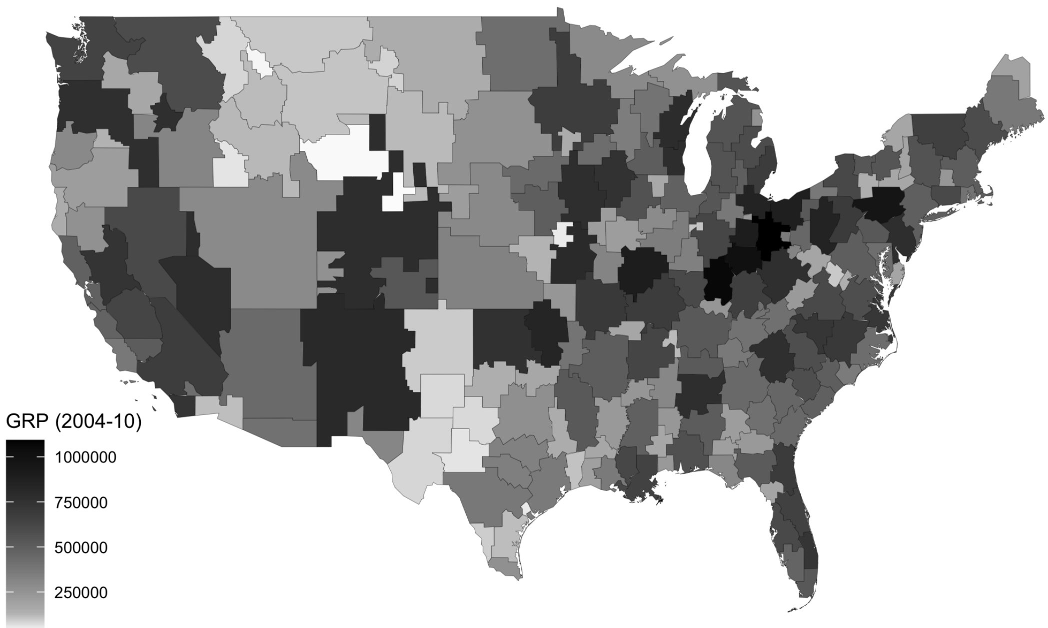
Our hypothesis is that if television service operators take into account the relative costs of national and local advertising, they would substitute away from local toward national advertising in markets where the cost of local advertising relative to national advertising increased due to the influx of political ads. Because we do not observe the actual price of advertising faced by advertisers, we assume that the markets in which the intensity of crowding-out effect due to political money was greater experienced a greater relative price increase in local advertising as in Sinkinson and Starc (2019) and Moshary et al. (2021). We then examine how television service operators adjust their advertising decisions to the intensity difference.[31] To proxy the intensity of cost difference between national and local advertising, we use Nielsen's Ad Intel data on political advertising and compute the local GRPs of political advertising at the DMA-month level. Figure 5 illustrates the variation across and within DMAs during our observation period, between 2004 and 2010.

[30] More recently, Moshary et al. (2021) lay out the economic and econometric properties of the instrument.

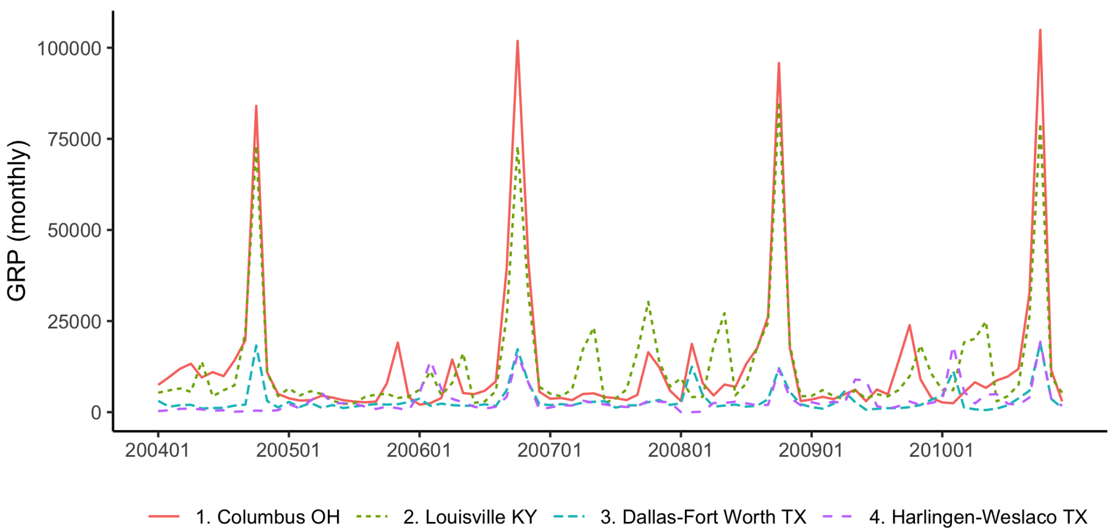
[31] Our exercise can be viewed as the first stage of an instrumental variable estimation in Sinkinson and Starc (2019) and Moshary et al. (2021). We also attempted to use this strategy to identify the advertising effect on demand (i.e., the second stage). However, with our yearly demand data, the variation in annual political advertising does not explain the *operator*-level, annual advertising decisions well.

Figure 5: Variation in political advertising

(a) Across DMAs



(b) Within DMAs



Note: Figure illustrates the variation in political advertising, measured in GRPs, across and within DMAs. Panel 5a reports the sum of GRPs in each of the 210 DMAs during the period of 2004-10. Panel 5b reports the changes in monthly GRPs in the two DMAs with the highest intensity of political advertising (Columbus OH and Louisville KY) and the two DMAs with the lowest intensity (Dallas-Fort Worth TX and Harlingen-Weslaco TX) among the Top 100 populous DMAs. Political advertising data is from Nielsen's Ad Intel.

Using the data, we estimate the following equation:

$$\ln(A_{mt}^{TVservice} + 1) = \alpha \cdot \ln(A_{mt}^{Political} + 1) + \mu_m + \tau_t + \epsilon_{mt}, \tag{4}$$

where $A_{mt}^{TVservice}$ is the level of advertising by television service operators in DMA m in month t and $A_{mt}^{Political}$ is the level of political advertising in DMA m in month t. Both are measured in terms of log of GRPs. μ_m and τ_t are DMA and year-month fixed effects, respectively. Note that we focus on the industry-wide change in the level of advertising, because $A_{mt}^{Political}$ is a common shock to all operators in a given DMA-month.

As shown in Equation 5, we also break down the association into cable and satellite operators and report the estimates separately.

$$\begin{aligned}\ln(A_{mt,Tech}^{TVservice} + 1) =& (\alpha_1 \cdot \mathbb{I}[Tech = Cable] + \alpha_2 \cdot \mathbb{I}[Tech = Satellite])) \cdot \ln(A_{mt}^{Political} + 1) \\ &+ \mu_{m,Tech} + \tau_t + \epsilon_{mt,Tech},\end{aligned} \tag{5}$$

where the subscript $Tech$ represents the technology used by TV service operators (either cable or satellite).[32]

Table 10 reports the estimation results of Equations 4 and 5 using the top 100 DMAs by population. The first three columns report the association between political advertising and television service advertising when three different measures of advertising are used: (1) national advertising only, (2) local advertising only, and (3) national and local advertising combined. Consistent with our hypothesis, the television service operators reduced local advertising and increased national advertising more in the markets that experienced a greater influx of political advertising and presumably, a greater change in the relative cost of local to national advertising. The evidence is weaker for local advertising, the coefficient being significant at the 10 percent level. However, we find that the absolute magnitude of the coefficient is quite similar to that of national advertising and there is no significant change in total advertising. Together, these suggest that the operators on average might have substituted away from local to national advertising.

Columns (4)-(6) of Table 10 report the results when the association is decomposed by technology type. The coefficients of national advertising are positive for both types of operators, although it is not statistically significant for the cable operators. Both types of operators reduced local advertising, although the degree of reduction in local advertising is smaller for the cable operators (as reflected in the magnitude of the coefficients) and is significant only at the 10 percent level. This result suggests that the national operators, whose reliance on the local advertising channel was lower compared to the local operators, were able to respond more flexibly to the industry-wide cost shock. On the other hand, the cable operators, who were "locked in" to their geographic coverage, may have been more conservative in adjusting their levels of local advertising.

[32] We also explored the association at a more granular unit of analysis (e.g., operator). We find the lack of precision in the estimates makes it difficult to give any meaningful interpretation to them.

Table 10: Associations between advertising for television service and political advertising

	DV: Television service ad (GRP, in log)					
	(1)	(2)	(3)	(4)	(5)	(6)
	National	Local	Total	National	Local	Total
Political Ad (GRP, in log)	0.035***	−0.036*	−0.003			
	(0.010)	(0.020)	(0.013)			
× Cable				0.010	−0.051*	−0.052***
				(0.013)	(0.026)	(0.017)
× Satellite				0.073***	−0.083***	0.051***
				(0.011)	(0.027)	(0.011)
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
DMA FE	Yes	Yes	Yes	No	No	No
DMA-Technology FE	No	No	No	Yes	Yes	Yes
Observations	8,366	8,366	8,366	16,539	16,539	16,539
R^2	0.889	0.423	0.575	0.815	0.451	0.405
Adjusted R^2	0.886	0.411	0.565	0.811	0.442	0.395

Note: Table reports the estimation results of Equation 4 using three different measures of advertising. Standard errors are clustered at the DMA level. Significance level: *p<0.1; **p<0.05; ***p<0.01.

Overall, Table 10 suggests the television service operators adjust their advertising decisions in response to changes in the relative costs of national and local advertising. This finding is not too surprising but rather reassuring. Importantly though, the operators of different technologies respond differently to the industry-wide cost shock. The satellite operators whose reliance on local advertising is lower respond more flexibly by reducing the level of local advertising to a greater extent than the cable operators. While this exercise is clearly not a direct test of whether the operators make advertising decisions subject to cost efficiencies in different advertising channels, we view it suggests the relevance of cost factor in explaining the success of satellite operators.

6 Discussion

Our findings in the previous sections show that (i) advertising seems to have influenced the demand for the satellite providers more than they influenced the demand for the cable operators; and (ii) the satellite providers experienced cost efficiencies in their advertising spend. Together, these findings suggest that advertising's demand effects and the presence of cost efficiencies in national advertising likely benefited the entrants more than the incumbents. In other words, in the absence of television advertising, the satellite operators would have experienced a slower growth, relative to the the cable operators. With no cost efficiencies in national advertising, the entrants would have had to spend more to deliver the same level of ads. That is, not only do asymmetric cost efficiencies exist in the television advertising market, but the entrants were in a position to better take advantage of them.

More generally, we have provided evidence that the scale of entry, which is a function of technology, affects the extent to which firms are able to leverage the cost efficiencies in national advertising. In our empirical context, the entrants (satellite operators) entered the television market on a national scale, whereas the incumbents (cable operators) were constrained to operate at a local level. Prior to the entry by the satellite operators, entry to the television service market had been extremely rare. Even expansion by incumbents was deterred by large entry costs such as the upfront investment in installing cable-distribution lines in individual local markets. Thus, the industry had been mostly served by only a few multimedia giants. In such a situation, the satellite operators' entry on a national scale was possible due to their technology of broadcasting directly from satellites to households; the technology made it unnecessary for the entrants to incur large fixed costs beyond the satellites themselves.

Their large-scale entry and operation put the satellite operators in a better position to leverage the cost advantages of national advertising compared to their local incumbent rivals. The availability of national advertising likely allowed the entrants to steal market share from the incumbents as well as advertise in a more cost-effective manner. Further, the fact that their key rivals operated on a local scale conferred a cost advantage on the satellite operators as the rivals could not leverage the cost efficiencies in national advertising given their smaller market coverage.

Accordingly, we conjecture that if the satellite operators possessed a different type of technology that still enabled them to offer higher-quality service than incumbents but not on a national scale, their survival or growth in the market would have been more challenging. Put another way, if the pre-satellite television market had been served by national players, the satellite operators would not have been able to enjoy the relative cost advantage of national advertising as much.

Earlier discussions of advertising scale economies focused on its benefits to national incumbents against local entrants. However, recent entries of new services have not necessarily occurred on smaller scales, perhaps due to advances in digital technologies. An earlier example would be the entry of Amazon in the early 90s into the book market in which each local market had been dominated by local bookstores (especially in more rural areas). As Amazon's entry was via the online channel (hence, national or even international), it might have incurred large up-front costs but smaller marginal costs than its local competitors. Also consider the US taxi industry as an example. In 2011, Uber made its first entry at the local level in San Francisco, whereas most traditional taxi operators were regional. That is, this market was characterized by local incumbents and local entrants. The entrant has aggressively expanded into new markets since and now operates in 785 metropolitan areas worldwide. A key difference between Uber and traditional taxi companies was in its core technology to build an extensive geographic network through its app-based platform without having to incur significant fixed costs (e.g., purchasing taxis) and operational costs (e.g., maintaining taxis and full-time drivers). This technology allowed the entrant to expand into new markets in a more cost-effective manner compared to their local rivals, which further allowed them to achieve significant scale economies in advertising. In 2018, Uber ran ads on various media including television, and during the NBA playoff and finals games and prime-time TV shows (Anand, 2018). Further, the firm utilized nationally aired television ads to effectively manage its reputation in a time of bad press (The Drum, 2018). These examples highlight that the type of technology entrants possess determines the extent to which they can leverage the cost efficiencies in national advertising; and that incumbents' geographic market coverage mediates the entrants' competitive advantage in terms of advertising costs.

7 Conclusion

In this paper, we explained one driver of the success of satellite operators (entrants) in a market where the cable operators (entrenched incumbents) commanded a near 100% market share and firms had to make large investments for entry. To this end, we highlighted the role of television advertising in making the success possible. We discussed three factors that contributed to the success. First, on the demand-side, consumers in the television service market were sensitive to advertising, although subscription-based pay television services have traditionally had strong state dependence. This finding not only rationalizes heavy ad spending by firms in the market, but also suggests that the ability to run ads cost-effectively would confer a player a significant competitive advantage relative to competitors. Indeed, on the supply-side, our analyses suggest that the cost efficiencies in national advertising benefited the entrants more than the incumbents: compared to the cable operators, the satellite operators were likely better able to leverage their national presence or larger market coverage with national advertising, which allowed them to enjoy lower unit costs of advertising. Lastly, the ability of an operator to reach competitors' current customers may have allowed the entrants to reap larger gains to advertising compared to the incumbents who were already serving almost all the television households in the US at the time of entry.

Although this paper takes a step toward a better understanding of the role of advertising in the television service market, our analysis is limited by the availability of data. For instance, we would like to have had data that would allow us provide direct evidence on the relative role of advertising to other margins of adjustments (e.g., pricing), as well as how operators allocate their overall advertising budget to different media types and other margins of adjustments (e.g., pricing and quality investment). Studying the intensive and extensive margin adjustments by firms (e.g., Danaher and Dagger, 2013; Danaher, 2017; Danaher et al., 2020), in response to the changing cost advantage of mass advertising, is an important area for future research as the technology of running "more local ads" has become available across all types of media from television to online advertising. Relatedly, future research is needed to investigate the potential differential roles and effects of national and local advertising, as well as possible substitutability and complementarity between them. For instance, investigating whether the ad content of national and local advertising differ and how the differences manifest the net ad effect on consumers would be valuable (e.g., Guitart and Stremersch, 2021).

Lastly, while this paper focused specifically on the television service market, we believe the economic incentives regarding usage of the advertising channel as a function of market coverage could be generalized and could operate in other settings. For instance, we expect the intuition is applicable to other advertising markets in which a form of quantity discount is present. Firms targeting broader segments of consumers (either due to broader geographic coverage or due to some specificities of their product attributes) could benefit from a lower unit cost of advertising. An examination of whether the discussed incentives exist in other markets and how the incentives are moderated by product characteristics such as market appeal and positive externalities in consumption would be valuable.

References

Anand, P. (2018, June 5). Uber to spend up to $500 million on ad campaign. *The Information*. `https://www.theinformation.com/articles/uber-to-spend-up-to-500-million-on-ad-campaign`.

Assmus, G., J. U. Farley, and D. R. Lehmann (1984). How advertising affects sales: Meta-analysis of econometric results. *Journal of Marketing Research 21*(1), 65–74.

Blake, T., C. Nosko, and S. Tadelis (2015). Consumer heterogeneity and paid search effectiveness: A large-scale field experiment. *Econometrica 83*(1), 155–174.

Bowman, D. and H. Gatignon (1996). Order of entry as a moderator of the effect of the marketing mix on market share. *Marketing Science 15*(3), 222–242.

Bresnahan, T. F. (1984). The demand for advertising by medium: Implications for the economies of scale in advertising. *Empirical Approaches to Consumer Protection Economics. Federal Trade Commission, Washington, DC*, 135–163.

Brodkin, J. (2014, September 24). Comcast says it's too expensive to compete against other cable companies. *Ars Technica*. `https://arstechnica.com/information-technology/2014/09/comcast-says-its-too-expensive-to-compete-against-other-cable-companies`.

Brown, R. S. (1978). Estimating advantages to large-scale advertising. *The Review of Economics and Statistics*, 428–437.

Caves, D. W., L. R. Christensen, and M. W. Tretheway (1984). Economies of density versus economies of scale: why trunk and local service airline costs differ. *The RAND Journal of Economics*, 471–489.

Chipty, T. (2001). Vertical integration, market foreclosure, and consumer welfare in the cable television industry. *American Economic Review 91*(3), 428–453.

Chu, C. S. (2010). The effect of satellite entry on cable television prices and product quality. *The RAND Journal of Economics 41*(4), 730–764.

Comanor, W. S. and T. A. Wilson (1969). Advertising and the advantages of size. *The American Economic Review 59*(2), 87–98.

Comcast (2006, July 31). Time Warner and Comcast complete Adelphia Communications transactions. *Comcast*. `https://corporate.comcast.com/news-information/news-feed/time-warner-and-comcast-complete-adelphia-communications-transactions-2`.

Crawford, G. S., R. S. Lee, M. D. Whinston, and A. Yurukoglu (2018). The welfare effects of vertical integration in multichannel television markets. *Econometrica 86*(3), 891–954.

Crawford, G. S. and A. Yurukoglu (2012). The welfare effects of bundling in multichannel television markets. *American Economic Review 102*(2), 643–85.

Danaher, P. J. (2017). Advertising effectiveness and media exposure. In *Handbook of marketing decision models*, pp. 463–481. Springer.

Danaher, P. J. and T. S. Dagger (2013). Comparing the relative effectiveness of advertising channels: A case study of a multimedia blitz campaign. *Journal of Marketing Research 50*(4), 517–534.

Danaher, P. J., T. S. Danaher, M. S. Smith, and R. Loaiza-Maya (2020). Advertising effectiveness for multiple retailer-brands in a multimedia and multichannel environment. *Journal of Marketing Research*.

eMarketer (2019, March 28). US TV ad spending to fall in 2018. *eMarketer*. `https://www.emarketer.com/content/us-tv-ad-spending-to-fall-in-2018`.

FCC (1996). Telecommunications Act of 1996. *Wireline Competition Bureau, Federal Communications Commission*. `https://www.fcc.gov/general/telecommunications-act-1996`.

Goolsbee, A. and A. Petrin (2004). The consumer gains from direct broadcast satellites and the competition with cable tv. *Econometrica 72*(2), 351–381.

Guitart, I. A. and S. Stremersch (2021). The impact of informational and emotional television ad content on online search and sales. *Journal of Marketing Research 58*(2), 299–320.

Hilke, J. C. and P. B. Nelson (1989). An empirical note from case documents on the economies of network television advertising. *Review of Industrial Organization 4*(1), 131–145.

Holmes, T. J. (2011). The diffusion of wal-mart and economies of density. *Econometrica 79*(1), 253–302.

Hristakeva, S. and J. H. Mortimer (2021). Legacy discounts in the market for national television advertising. *Working paper*.

Kim, T. T. and D. KC (2020). The impact of hospital advertising on patient demand and health outcomes. *Marketing Science 39*(3), 612–635.

Leichtman Research Group (2017). 79% of TV households subscribe to a pay-tv service. https://www.leichtmanresearch.com/79-of-tv-households-subscribe-to-a-pay-tv-service.

Lewis, R. A. and J. M. Rao (2015). The unfavorable economics of measuring the returns to advertising. *The Quarterly Journal of Economics 130*(4), 1941–1973.

Li, X., W. R. Hartmann, and T. Amano (2020). Preference externality estimators: A comparison of border approaches and ivs. *Available at SSRN*.

Lodish, L. M., M. Abraham, S. Kalmenson, J. Livelsberger, B. Lubetkin, B. Richardson, and M. E. Stevens (1995). How tv advertising works: A meta-analysis of 389 real world split cable tv advertising experiments. *Journal of Marketing Research 32*(2), 125–139.

Moshary, S., B. T. Shapiro, and J. Song (2021). How and when to use the political cycle to identify advertising effects. *Marketing Science 40*(2), 283–304.

Nielsen (2009, August 29). 114.9 million U.S. television homes estimated for 2009-2010 season. *Nielsen Global Media*. https://www.nielsen.com/us/en/insights/article/2009/1149-million-us-television-homes-estimated-for-2009-2010-season.

Nielsen (2019, August 27). Nielsen estimates 120.6 million TV homes in the U.S. for the 2019-2020 TV season. *Nielsen Global Media*. https://www.nielsen.com/us/en/insights/article/2019/nielsen-estimates-120-6-million-tv-homes-in-the-u-s-for-the-2019-202-tv-season.

Nielsen (2020, February 11). The Nielsen total audience report: February 2020. *Nielsen Global Media*. https://www.nielsen.com/us/en/insights/report/2020/the-nielsen-total-audience-report-february-2020.

Parker, P. M. and H. Gatignon (1996). Order of entry, trial diffusion, and elasticity dynamics: An empirical case. *Marketing Letters 7*(1), 95–109.

Porter, M. E. (1976). Interbrand choice, media mix and market performance. *The American Economic Review 66*(2), 398–406.

Porter, M. E. et al. (1979). The structure within industries and companies' performance. *Review of Economics and Statistics 61*(2), 214–227.

Savage, S. J. and M. Wirth (2005). Price, programming and potential competition in us cable television markets. *Journal of Regulatory Economics 27*(1), 25–46.

Schmalensee, R., M. Armstrong, R. D. Willig, and R. H. Porter (1989). *Handbook of Industrial Organization*, Volume 3. Elsevier.

Sethuraman, R., G. J. Tellis, and R. A. Briesch (2011). How well does advertising work? generalizations from meta-analysis of brand advertising elasticities. *Journal of Marketing Research 48*(3), 457–471.

Shapiro, B., G. J. Hitsch, and A. Tuchman (2020). Generalizable and robust tv advertising effects. *NBER Working Paper* (w27684).

Shapiro, B. T. (2018). Positive spillovers and free riding in advertising of prescription pharmaceuticals: The case of antidepressants. *Journal of Political Economy 126*(1), 381–437.

Shapiro, B. T. (2020). Advertising in health insurance markets. *Marketing Science 39*(3), 587–611.

Shcherbakov, O. (2016). Measuring consumer switching costs in the television industry. *The RAND Journal of Economics 47*(2), 366–393.

Sinkinson, M. and A. Starc (2019). Ask your doctor? direct-to-consumer advertising of pharmaceuticals. *The Review of Economic Studies 86*(2), 836–881.

Spence, A. M. (1980). Notes on advertising, economies of scale, and entry barriers. *The quarterly journal of Economics 95*(3), 493–507.

The Drum (2018, May 24). Tv ad spend weekly: Uber CEO is 'forward' looking in new spot. *The Drum*. `https://www.thedrum.com/news/2018/05/23/tv-ad-spend-weekly-uber-ceo-forward-looking-new-spot`.

Thomas, M. (2020). Spillovers from mass advertising: An identification strategy. *Marketing Science 39*(4), 807–826.

Tuchman, A. E. (2019). Advertising and demand for addictive goods: The effects of e-cigarette advertising. *Marketing Science 38*(6), 994–1022.

Wang, Y., M. Lewis, and D. A. Schweidel (2018). A border strategy analysis of ad source and message tone in senatorial campaigns. *Marketing Science 37*(3), 333–355.

Waterman, D. and A. A. Weiss (1996). The effects of vertical integration between cable television systems and pay cable networks. *Journal of Econometrics 72*(1-2), 357–395.

Wax, G. (2007). Cable company monopoly: Comcast and time warner control the board. *Loy. LA Ent. L. Rev. 28*, 159.

Wise, A. S. and K. Duwadi (2005). Competition between cable television and direct broadcast satellite: the importance of switching costs and regional sports networks. *Journal of Competition Law and Economics 1*(4), 679–705.

Web Appendix

Commercial Success through Commercials? Advertising and Pay TV Operators

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A. Data Appendix

B. Demand Estimation Appendix

C. The Charter-Time Warner Cable-Bright House Networks Merger

D. Additional Tables and Figures

A Data Appendix

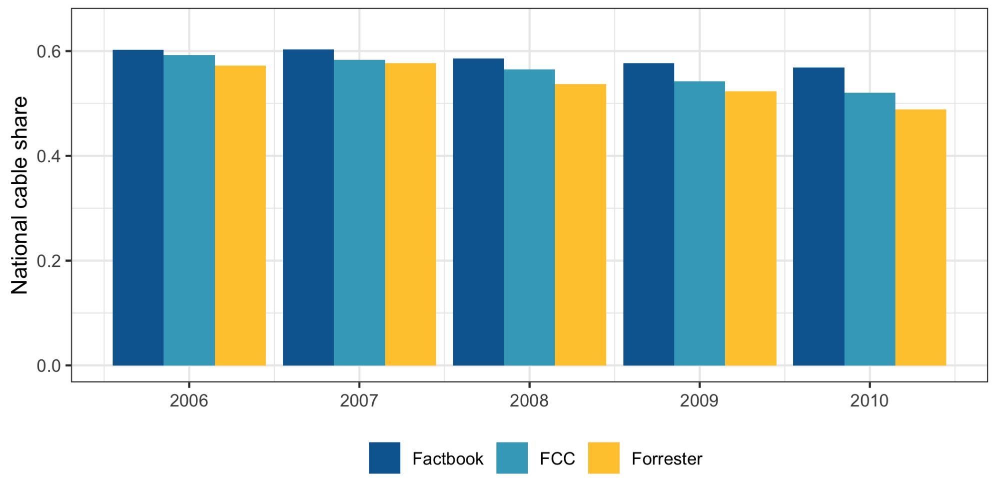
A.1 Representativeness of Forrester Data

To evaluate the representativeness of the Forrester data, we examine to what extent the market landscape depicted by the Forrester data is consistent with the landscape depicted by two other data, Warren's Factbook data and the FCC (Federal Communications Commission) data. Figure A.2 shows the combined market shares of all cable operators in the data during the sample period.

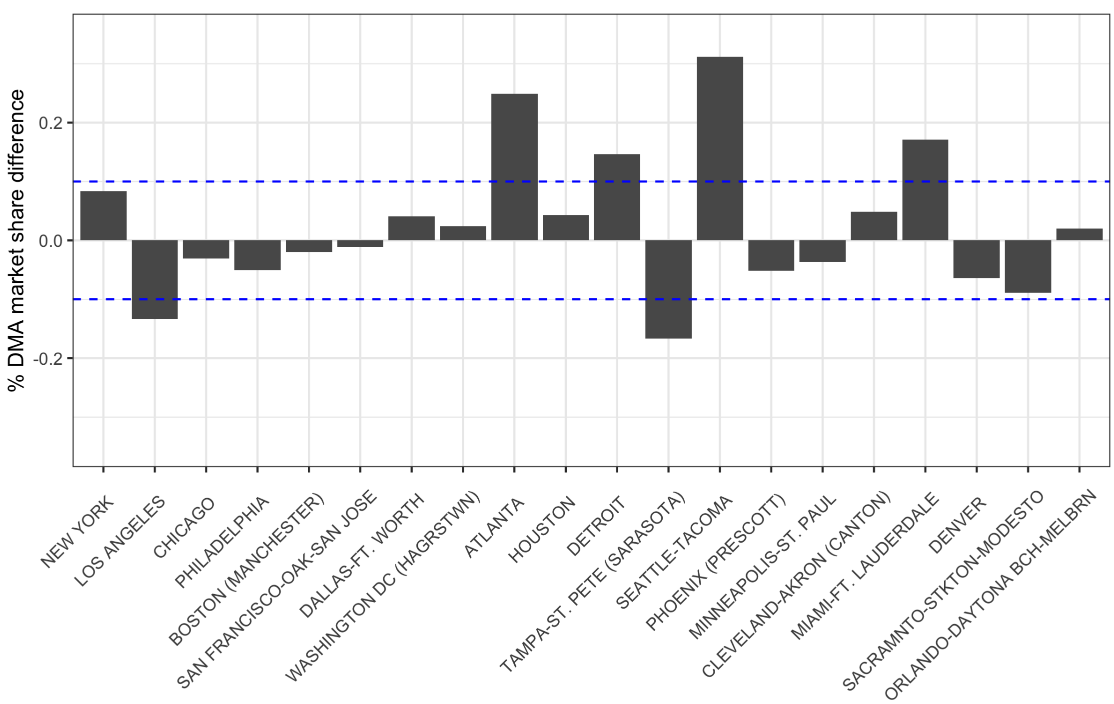
Panel A.1a compares national shares of cable operators across the data sets, and shows that the national shares in the Forrester data exhibit similar *trends* as the national shares in the FCC data, despite the magnitude difference. The correlations of the Forrester data with the Factbook and the FCC data are 0.990 and 0.978, respectively. The Factbook data reveals relatively less variation in market share across the years, which may reflect two acknowledged weaknesses of the data, persistent non-updating of entries and incomplete observations, as pointed out in the Web Appendix of Crawford and Yurukoglu (2012). Panel A.1b plots the percentage difference in the 2006 DMA-level shares between the Forrester and the FCC data, focusing on Top 20 most populous DMAs. We find that the share difference is not large even at the DMA level, with the difference lying between $\pm 10\%$ for 14 out of the 20 DMAs.

Figure A.1: Cable market shares across data sets

(a) Combined national share of cable operators



(b) Difference in DMA share of cable operators



Note: Market shares from each data are based on all cable operators considered in the data, not restricted to Comcast and Time Warner. National shares are calculated as the number of subscribers divided by the number of TV households (i.e., households that have at least one operable TV/monitor with the ability to deliver video via traditional means of antennae, cable set-top-box or satellite receiver and/or with a broadband connection). That is, TV households include households that do not subscribe to pay television, but use antennae to watch television. DMA shares are similarly calculated as the number of subscribers in a DMA divided by the number of TV households of the DMA. For DMA shares, we compare the Forrester and the Factbook data as the FCC data does not provide DMA-level market share.

A.2 More on Border Cable Markets

While the majority of cable markets belong to a single DMA (because a cable market is typically smaller than a DMA), there are some cable markets that happen to span multiple DMAs. Therefore, households in those cable markets receive different ads depending on which DMA they belong to. We define such markets as *border cable markets*. We discuss institutional details that give rise to border cable markets and argue each of the border cable markets resembles an experiment where advertising is quasi-randomized.

The television stations carried by television operators generally vary by the DMAs the operators belong to. Through the stations, the operators are not allowed to offer households broadcast signals that do not originate from DMAs in which the households reside, according to the FCC policies. The restriction is quite strict that even those signals that provide in-state local content cannot be provided. For instance, a resident of a county in the state of West Virginia located in the Pittsburgh DMA would receive the programming of Pennsylvania stations that deliver local news of Pennsylvania. Shapiro (2018) points out that even over-the-air signals are regulated to be localized in the corresponding DMA by the Federal Communications Commission (see, for instance, `http://www.sbca.com/dish-satellite/dma-tv.htm`).

Accordingly, which channels and programs a household sees on television, and therefore, which television ads they see, are determined by which DMA the household belongs to. Although operators in some markets used to offer channels from multiple DMAs (e.g., provide two ABC-affiliated channels), there is ample anecdotal evidence that such practice did not last long.[1] Meanwhile, households in each of the border cable markets likely share similar preferences and they face the same set of choice alternatives (i.e., operators), where prices and quality of services other than channel lineups are held fixed. For instance, customer service and signal quality would be identical across the border within a cable market. Therefore, if there is any variation in advertising across different sides of a border, it is unlikely due to the differences in the observed characteristics of these households, which creates *exogenous* variation in advertising.

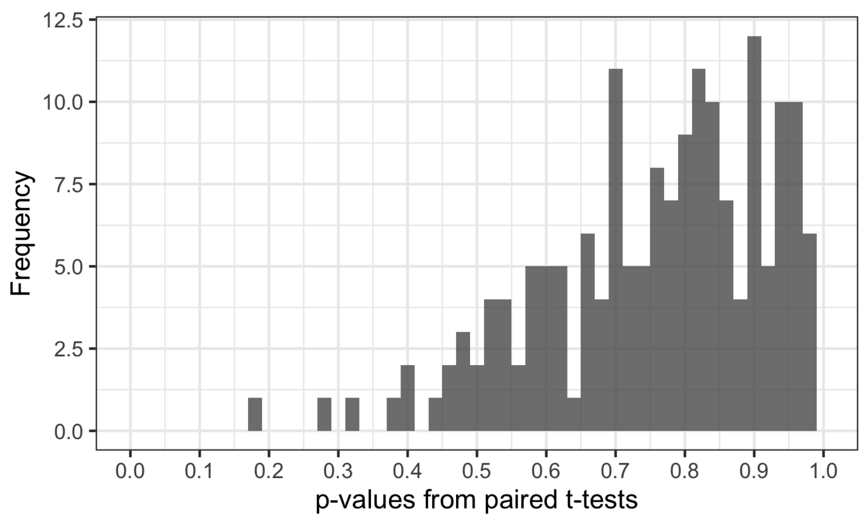
[1] Exceptions are households in "dual DMAs" who might have received channels from multiple DMAs more than temporarily. As a robustness check, we discuss the implications of such markets and check robustness of our findings.

A.3 Parallel Trends Assumption

To examine the trends based on sufficiently long time-series data, we obtain census data on household income between 1993 and 2018.[2] Data for 1994 and 1996 are missing, so we use 24-year-long data. Because the data is available at the county-level, we use data on counties that overlap border cable markets. In specific, we obtain estimates of household income in a given border cable market-DMA-year as the population-weighted average of median household income of the overlapping counties that fall into the DMA in the year. Accordingly, for each border cable market-DMA, we have a time series of median household income over the 24-year period. For easier comparison within a cable market, we focus on border cable markets that straddle no more than two DMAs.

For each cable market, we perform a paired t-test between the time series of incomes in the two DMAs. We make use of a larger set of border cable markets (173 markets) than used in the estimation sample for the border strategy, because the filters applied to the latter are not necessary for this analysis. The range of the 173 p-values is between 0.173 and 0.994, with a median of 0.791, mean of 0.759 and standard deviation of 0.165 (see Figure A.2). This supports that within a cable market, different sides of the border evolved in a similar fashion between 1993 and 2018, which further supports the parallel trends assumption.

Figure A.2: Distribution of p-values from the 173 paired t-tests



[2] Source: Small Area Income and Poverty Estimates (SAIPE), US Census Bureau. (`https://www.census.gov/programs-surveys/saipe/data/datasets.html`).

A.4 Sampling Procedure and Estimation Data Set

The key challenge in constructing the estimation sample is to assign each household in the Forrester data to a cable market. Unfortunately, to the best of our knowledge, there is no clean way to do this due to the lack of precise geographic information about cable markets. We overcome this challenge by utilizing auxiliary data. First, we obtain a list of cable markets from Warren's Television & Cable Factbook (hereafter, Warren's Factbook). Among 6,979 cable markets, we drop 230 markets with multiple cable operators (i.e., overbuilds). Further, we focus on cable markets served by one of the following cable operators: Comcast, Time Warner, Cox, Charter, and Mediacom. These markets represent 74%-78% of the cable markets served by a single operator during the sample period (based on Homes Passed in Warren's Factbook).

Next, Warren's Factbook provides the name of city or town that each cable market is geographically based (called "principal community"). Using the mapping between principal communities and five-digit ZIP codes,[3] we assign the Forrester households to cable markets (we drop about 50% of ZIP codes that belong to multiple communities). Lastly, we link households to media markets using Nielsen's ZIP code-media market mapping. ZIP codes that belong to multiple media markets are dropped (which account for less than 5% of all ZIP codes).

Summary statistics Table A.1 reports retention probabilities of the sample households during the sample period. Among 3,076 sample households, 2,202 participated in the Forrester survey only once during the sample period and therefore we observe their subscription choices only once. Among the remaining 874 households, 128 customers ever switched from one alternative to another. Overall, we find strong state dependence, especially for cable subscribers. The sample choice shares range between 0.727 and 0.789 for cable operators and between 0.211 and 0.273 for satellite operators. This pattern is consistent with Figure 1 that reports cable and satellite shares based on a different data set.

Table A.1: Retention probabilities of sample households

		Year $t+1$			
		Cable	DirecTV	Dish Network	Terrestrial
Year t	Cable	0.932	0.018	0.010	0.041
	DirecTV	0.100	0.776	0.065	0.059
	Dish Network	0.069	0.069	0.812	0.050
	Terrestrial	0.151	0.026	0.020	0.803

Note: Table is based on 874 households that participated in the Forrester survey more than once during the sample period.

[3] We thank Crawford et al. (2018) for providing the link between principal communities and ZIP code.

B Demand Estimation Appendix

B.1 Household Heterogeneity and Sample Likelihood

To account for the potential difference in baseline operator preferences, we consider an alternative specification of the utility function:

$$u_{ijmt} = \delta_{jmt} + \beta \cdot g(A_{j,d(m),t}) + \gamma_k \cdot \mathbb{I}[y_{i,t-1} = k, k \neq j] + \alpha_{ij} + \varepsilon_{ijmt}, \tag{B.1}$$

where α_{ij} captures household i's baseline preference for operator j.

We estimate α_{ij} by employing a latent-class framework. We allow α_{ij}, as well as the ad sensitivity, β, in Equation B.1 to have a discrete distribution with a finite number of supports, S. That is, α_{sj} and β_s are the values of α_{ij} and β at support s, respectively, and π_s is the corresponding probabilities of belonging to support s. We then jointly search for $\{\alpha_{sj}\}_s$, β_s and $\{\pi_s\}_s$ with δ_{jmt} for a given value of S, which yields the choice probability as

$$P_{ijmt}\left(\Theta_s\right) = \frac{e^{\delta_{jmt} + \beta_s \cdot g(A_{j,d(m),t}) + \gamma_k \cdot \mathbb{I}[y_{i,t-1}=k, k\neq j] + \alpha_{sj}}}{\sum_{l \in J} e^{\delta_{lmt} + \beta_s \cdot g(A_{l,d(m),t}) + \gamma_k \cdot \mathbb{I}[y_{i,t-1}=k, k\neq l] + \alpha_{sl}}}, \tag{B.2}$$

where $\Theta_s = \{\{\delta_{jmt}\}_{j,m,t}, \{\beta_s\}_s, \{\gamma_k\}_k, \{\alpha_{sj}\}_{s,j}, \pi_1, \ldots, \pi_{S-1}\}$ where $\pi_S = 1 - \sum_{s=1}^{S-1} \pi_s$. We also normalize the weighted α_s to sum to zero (i.e., for every operator j we set $\sum_{s=1}^{S} \pi_s \alpha_{sj} = 0$) since our model includes operator-market-year fixed effects. The sample log-likelihood function is

$$-LL\left(\Theta\right) = -\sum_{i=1}^{N} \ln \left\{ \sum_{s=1}^{S} \pi_s \cdot \left(\prod_{t=2005}^{2009} \prod_{j \in J} P_{ijmt}(\Theta_s)^{y_{ijmt}} \right) \right\}. \tag{B.3}$$

We search for a set of parameters Θ that minimizes the log-likelihood in Equation B.3 using `nlm` optimizer in `R-3.3.3`. We report the estimation results in Column (4) of Table 5 in the paper.

B.2 Results from Fixed Effects Regressions

In this section, we use an alternative estimator to provide additional evidence on advertising-elastic demand. Specifically, we consider a series of fixed effects regressions at the levels of both aggregate demand (with varying definition of markets) and household demand. The results not only provide additional support for the advertising-elastic demand in the television service market, but also suggest that the effect of national advertising tends to be greater than that of local advertising.

B.2.1 Aggregate demand

We estimate the effect of advertising on aggregate demand using the following equation:

$$\log(s_{jmt}) = \beta \log(A_{j,d(m),t} + 1) + \mu_{jm} + \tau_{mt} + \varepsilon_{jmt}, \tag{B.4}$$

where the dependent variable is the log of operator j's aggregate share in market m in year t, and $A_{j,d(m),t}$ is operator j's advertising in market m in year t measured in GRPs. We use GRPs, instead of insertion, because our estimation sample is not restricted to border cable markets. We explain our estimation sample in greater detail below. β represents the effect of television advertising on the aggregate demand. μ_{jm} are a set of operator-market fixed effects that capture operator-market-specific match values such as price and quality, and τ_{mt} are a set of market-year fixed effects that capture market-specific time trend that is common to all operators (e.g., average consumer preferences). Note that the advertising estimates of the model should not be given a causal interpretation, as operators' advertising decision in market m is likely to be correlated with ε_{jmt}. Further, the model does not take into account households' outside option, switching costs and heterogeneity in operator preference.

We estimate the model under various definitions of market: county, county (border) and cable market. County represents the most representative sample of households that cover the largest geographic market, followed by county (border) and then by cable market. Specifically, county indicates we use all county-DMA-year observations with more than 30 Forrester survey respondents and use as a dependent variable operator j's market share in county m in year t. Similarly, county (border) includes all border county-DMA-year observations (where border county is defined according to Shapiro (2018)'s definition) with more than 30 Forrester respondents. Cable market indicates all cable markets that are not necessarily border cable markets are used in estimation.

Table B.1 reports estimation results. The top panel uses the sum of local and national advertising as an advertising proxy. In the bottom panel, we estimate models separately for local and national advertising. This is because when local and national advertising are considered in a model concurrently, the precision of the estimates could be undermined if an operator's advertising decisions regarding the two types of ads are highly correlated.

Overall, advertising effects are positive and statistically significant at the 1 percent level across specifications. The effect of national advertising tends to be larger than the effect of local advertising. Although it is difficult to make an apples-to-apples comparison of the estimates between the border strategy and the fixed effects regressions, we find that the evidence of advertising-elastic demand in the television service market is robust to the use of larger, more representative samples.

B.2.2 Household demand

To estimate the effect of advertising on household demand, we use the Forrester data in 2006-10, which records household choices made in 2005-2009. We focus on households for whom we observe which DMA they belong to and who chose one of the ten following alternatives: terrestrial, Comcast, Time Warner, Cox, Charter, Mediancom, DirecTV, Dish Network, AT&T and Verizon. For household-level analysis, it is important to construct a choice set that was actually faced by individual households. That is, we need to know which cable market a given household belongs to and which cable operator served the market. We match households to a cable market and to a cable operator based on their zip codes. The data set consists of 128,1721 unique households and 189,123 household-year observations.

We estimate the effect of advertising on household demand using the linear probability model:

$$y_{ijmt} = \beta \log(A_{j,d(m),t} + 1) + \gamma_k \cdot \mathbb{I}[y_{ijm,t-1} = 0] + \tau_{jt} + \mu_m + \nu_i + \varepsilon_{jmt}, \tag{B.5}$$

where the dependent variable is an indicator that is equal to 1 if household i in market m chose operator j in year t.[4] $A_{j,d(m),t}$ is operator j's advertising in market m measured in GRPs. β represents the effect of television advertising on the household demand. $\mathbb{I}[y_{ijm,t-1} = 0]$ captures the switching cost that a household incurs if its subscription choice in a given year is different from the choice in the previous year. τ_{jt} are a set of operator-year fixed effects that capture operator-specific time trend that is common to all households in the sample. μ_m are a set of market fixed effects that controls for cross-market variation in service quality. ν_i are a set of household fixed effects that allow us to examine within-household changes in subscription choice. Note that because μ_m and ν_i are not separately identified, we include each one of them at a time.

Table B.2 reports estimation results. Again, advertising effects are positive and statistically significant at the 1 percent level across all specifications. The pattern of larger effect of national advertising than local advertising is consistent with what is observed in the aggregate demand model. Although we cannot make any causal claim about the effect of national and local advertising, the results offer additional supporting evidence for advertising-elastic demand in the television service market.

[4] A choice set of each household consists of terrestrial, a cable operator that was available in the corresponding market, the two satellite operators (DirecTV and Dish Network) and the two phone companies (AT&T and Verizon).

Table B.1: Fixed effects regressions results: aggregate demand

	(1)	(2)	(3)
Unit of Obs.	County	County (Border)	Cable Market
β: Total GRPs	0.045***	0.037***	0.122***
	(0.005)	(0.008)	(0.009)
Operator-Market FE	Yes	Yes	Yes
Market-Year FE	Yes	Yes	Yes
Border-Year FE		Yes	
N	6,960	1,209	1,240
No. HH	81,213	14,458	14,038
No. HH-Year Obs.	116,735	16,968	19,672
R^2	0.954	0.954	0.951
Adj. R^2	0.914	0.952	0.904

	(4)	(5)	(6)	(7)	(8)	(9)
Unit of Obs.	County	County	County (Border)	County (Border)	Cable Market	Cable Market
β: National GRPs	0.093***		0.144***		0.276***	
	(0.012)		(0.025)		(0.029)	
β: Local GRPs		0.035***		0.036***		0.105***
		(0.004)		(0.008)		(0.009)
Operator-Market FE	Yes	Yes	Yes	Yes	Yes	Yes
Market-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Border-Year FE			Yes	Yes		
N	6,960	6,960	1,209	1,209	1,240	1,240
No. HH	81,213	81,213	14,458	14,458	14,038	14,038
No. HH-Year Obs.	116,735	116,735	16,968	16,968	19,672	19,672
R^2	0.954	0.954	0.985	0.984	0.945	0.948
Adj. R^2	0.913	0.914	0.954	0.952	0.893	0.899

Note: (1) In estimation, nine operators are considered: five cable operators (Comcast, Time Warner, Cox, Charter and Mediacom), two satellite operators (DirecTV and Dish Network) and two phone companies (AT&T and Verizon). (2) Estimates are obtained using weighted least squares (WLS), where (share $\times$ $(1 - \text{share})/N)^{-1}$ is used as a weight. (3) Significance level: *p<0.1; **p<0.05; ***p<0.01.

Table B.2: Fixed effects regressions results: household demand

	(1)	(2)	(3)
β: Total GRPs	0.005***	0.006***	0.006***
	(0.0003)	(0.001)	(0.0004)
γ: Switching	−0.008***	−0.004***	−0.0004
	(0.001)	(0.001)	(0.0003)
Operator-Year FE	Yes	Yes	Yes
Cable market FE		Yes	
Household FE			Yes
N	366,288	127,283	366,288
R^2	0.161	0.192	0.175
Adj. R^2	0.161	0.180	0.064

	(4)	(5)	(6)	(7)	(8)	(9)
β: National GRPs	0.011***		0.010***		0.012***	
	(0.001)		(0.002)		(0.001)	
β: Local GRPs		0.004***		0.005***		0.005***
		(0.0003)		(0.001)		(0.0003)
γ: Switching	−0.008***	−0.008***	−0.004***	−0.004***	−0.0002	−0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0003)	(0.0003)
Operator-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cable market FE			Yes	Yes		
Household FE					Yes	Yes
N	366,288	366,288	127,283	127,283	366,288	366,288
R^2	0.160	0.161	0.191	0.192	0.174	0.175
Adj. R^2	0.160	0.161	0.179	0.180	0.063	0.063

Note: (1) Table reports the estimation results of linear probability models with various fixed effects specifications. (2) In estimation, nine operators are considered: five cable operators (Comcast, Time Warner, Cox, Charter and Mediacom), two satellite operators (DirecTV and Dish Network) and two phone companies (AT&T and Verizon). (3) Standard errors are clustered at the household-level and reported in parentheses; *p<0.1; **p<0.05; ***p<0.01.

B.3 Robustness: Alternative Advertising Measures

Table B.3: Robustness of advertising-elastic demand to alternative proxies of delivery

	Ad: log(Duration+1)		*Ad: log(Spend+1)*	
	(1) Total Adv.	(2) Local Adv.	(3) Total Adv.	(4) Local Adv.
β: Advertising	0.044*	0.040**	0.044	0.042***
	(0.026)	(0.017)	(0.028)	(0.015)
γ: From Terrestrial	−2.988***	−2.991***	−2.989***	−2.990***
	(0.206)	(0.206)	(0.207)	(0.207)
γ: From Cable	−2.162***	−2.161***	−2.160***	−2.162***
	(0.162)	(0.162)	(0.162)	(0.162)
γ: From Satellite	−3.649***	−3.652***	−3.650***	−3.653***
	(0.220)	(0.220)	(0.220)	(0.220)
Operator-Market-Year FE	Yes	Yes	Yes	Yes
Observations	16,928	16,928	16,928	16,928
No. parameters	612	612	612	612
−Log-likelihood	3,328	3,326	3,328	3,325
BIC	12,614	12,612	12,614	12,609

Table B.4: Robustness of advertising-elastic demand to alternative proxies of viewership

	Ad: log(GRPs+1)			*Ad: log(Weighted GRPs+1)*		
	(1) Total Adv.	(2) Total Adv.	(3) Local Adv.	(4) Total Adv.	(5) Total Adv.	(6) Local Adv.
β: Advertising	0.060***	0.060***	0.053***	0.155***	0.155***	0.140***
	(0.021)	(0.021)	(0.019)	(0.019)	(0.019)	(0.018)
γ: From Terrestrial	−2.989***	−2.990***	−2.990***	−2.961***	−2.961***	−2.956***
	(0.206)	(0.206)	(0.207)	(0.208)	(0.208)	(0.208)
γ: From Cable	−2.162***	−2.162***	−2.162***	−2.150***	−2.150***	−2.149***
	(0.162)	(0.162)	(0.162)	(0.163)	(0.163)	(0.163)
γ: From Satellite	−3.654***	−3.654***	−3.654***	−3.668***	−3.668***	−3.668***
	(0.220)	(0.220)	(0.220)	(0.221)	(0.221)	(0.221)
Operator-Market-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
DMA FE	No	Yes	No	No	Yes	No
Observations	16,928	16,928	16,928	14,772	14,772	14,772
No. parameters	612	677	612	608	670	608
−Log-likelihood	3,325	3,325	3,325	2,771	2,771	2,775
BIC	12,609	13,242	12,610	11,379	11,974	11,388

Note: To construct weighted GRPs, we first compute a household-specific coefficient as the average number of hours the household spent watching television per day divided by the average of the DMA the household belongs to, and multiply the GRPs by the coefficient. Thus, the weighted GRPs vary at the household level. In doing so, we use the Forrester survey response regarding television watching behavior. For weighted GRPs, we use fewer observations because we drop households with missing responses. Significance level: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

B.4 Robustness: Cross-border Treatment Spillovers

There are two channels through which households on one side of a border cable market can be treated with the advertising from a different side of the market. First, households may receive broadcast signals originating from other side(s) of the markets, and are therefore exposed to ads run in multiple DMAs. Although the chance of signal overlap is extremely slim due to laws and regulations (see Section A.2 for more details), households at the border of DMAs relative to households in the center of DMAs might be more subject to overlapping signals due to their geographic proximity to adjacent DMAs. An extreme example includes regions categorized as "dual DMAs" that are authorized by the Federal Communications Commission (FCC) to receive television signals from multiple DMAs.[5] Second, if border households' scope of activity extends to the DMA outside of their own DMAs (e.g., commuting between two DMAs), the households may be exposed to ads beyond the ads run in their own DMA.

In both cases, cross-border treatment spillovers take place, which can cause the estimates to be biased. This is because the presence of treatment spillovers would make the data *over-state* true variation in advertising intensity. Suppose broadcast signals overlap around the DMA border so that households in DMA A receive signals from DMA B, and the reverse is also true. In the extreme case, households in both DMAs would receive exactly the same level of advertising. While the true variation, and thus true advertising effect, is zero, any variation in the subscription choices could lead us to infer a non-zero advertising effect.

To examine to what extent such measurement error might have affected the estimated advertising effect, we simulate a series of artificially reduced identifying variation in advertising by varying degrees, and re-estimate Equation 2 based on the simulated advertising data. That is, in each cable market-year, the difference in advertising intensity across the DMA border is reduced either by increasing the intensity in a DMA with lower observed intensity or by decreasing the intensity in a DMA with higher observed intensity.

We report the estimation results in Table B.5. We find the estimated advertising effect remains positive and statistically significant across the data sets with varying identifying variation (p-values ranging from 0.046 and 0.069), while the magnitude of the estimated coefficients also varies. This suggests that the evidence of advertising-elastic demand in the television service market we find is not likely an artifact of over-stated variation in advertising, although it might have affected the magnitude of the estimates.

[5] As a DMA is not a subset of a state or vice versa, residents of some counties cannot receive broadcast signals that originate from their state operators. In rare instances, operators or counties would file a petition with the FCC to add or delete communities from a DMA to ensure the residents receive relevant local news.

Table B.5: Robustness of advertising-elastic demand to variation in advertising

	Decrease from the higher observed log(Insertion+1)					
	−5%	−10%	−15%	−20%	−25%	−30%
β: Advertising	0.066**	0.069*	0.073*	0.079*	0.081*	0.086*
	(0.033)	(0.038)	(0.040)	(0.041)	(0.044)	(0.046)
γ: From Terrestrial	−2.988***	−2.988***	−2.988***	−2.987***	−2.988***	−2.988***
	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)
γ: From Cable	−2.162***	−2.162***	−2.162***	−2.163***	−2.162***	−2.162***
	(0.162)	(0.162)	(0.162)	(0.162)	(0.162)	(0.162)
γ: From Satellite	−3.649***	−3.650***	−3.650***	−3.650***	−3.650***	−3.649***
	(0.220)	(0.220)	(0.220)	(0.220)	(0.220)	(0.220)
Operator-Cable Market-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,928	16,928	16,928	16,928	16,928	16,928
No. parameters	612	612	612	612	612	612
−Log-likelihood	3,327	3,327	3,327	3,328	3,327	3,328
BIC	12,614	12,614	12,614	12,614	12,614	12,614
	Increase from the lower observed log(Insertion+1)					
	+5%	+10%	+15%	+20%	+25%	+30%
β: Advertising	0.066*	0.071*	0.075*	0.080*	0.085*	0.092*
	(0.035)	(0.037)	(0.039)	(0.042)	(0.044)	(0.047)
γ: From Terrestrial	−2.988***	−2.988***	−2.988***	−2.988***	−2.988***	−2.988***
	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)
γ: From Cable	−2.162***	−2.162***	−2.162***	−2.162***	−2.162***	−2.162***
	(0.162)	(0.162)	(0.162)	(0.162)	(0.162)	(0.162)
γ: From Satellite	−3.649***	−3.650***	−3.649***	−3.649***	−3.649***	−3.649***
	(0.220)	(0.220)	(0.220)	(0.220)	(0.220)	(0.220)
Operator-Cable Market-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,928	16,928	16,928	16,928	16,928	16,928
No. parameters	612	612	612	612	612	612
−Log-likelihood	3,327	3,327	3,327	3,327	3,327	3,327
BIC	12,614	12,614	12,613	12,614	12,614	12,614

Note: (1) We create synthetic data sets in the following way. For a given operator-cable market-year, we observe $A_{j,d(m),t}$ in at least two DMAs. Assume there are two DMAs, A and B, and $A_{j,d(m)=A,t} > A_{j,d(m)=B,t}$ without loss of generality. The identifying variation, $A_{j,d(m)=A,t} - A_{j,d(m)=B,t}$, can be reduced either by increasing the value of $A_{j,d(m)=B,t}$ (i.e., advertising in the DMA with higher observed intensity) or decreasing the value of $A_{j,d(m)=A,t}$ (i.e., advertising in the DMA with lower observed intensity). We vary the change amount from 5% to 30% to create six synthetic data sets for each case and estimate the model in Equation 2 based on the data. (2) Significance level: *p<0.1; **p<0.05; ***p<0.01.

B.5 Robustness: Availability and Quality of Satellite Service

Some technical constraints on service provision faced by the operators may imply that not all of the pay television services considered in the model (i.e., cable, DirecTV, Dish Network) were available to the sample households. The quality of satellite services could have been limited in some markets: households whose view toward satellite was obstructed by mountains or buildings would have not had satellite services in their choice set as a satellite dish must have a clear line-of-sight to the satellite to receive satellite signals (Goolsbee and Petrin, 2004). The availability of cable services could also have been limited. There is anecdotal evidence that satellite TV was first adopted by rural households that had not been served by any existing cable systems: some households that did not subscribe to cable services did so as the services were not available to them.

Including those markets in estimation may lead to biased estimates of the true advertising effect. In our estimation sample, cable operators were a viable alternative in all cable markets, which is reflected in the fact that at least one sample household in each cable market chose the corresponding cable operator. However, there are two cable markets in which none of the sample households chose either DirecTV or Dish Network during the sample period, which could be due to the unavailability of satellite services in those markets. To investigate the extent of the concern, we estimate Equation 2 based on a sample that excludes the two cable markets and find the parameter estimates are robust to the exclusion. In specific, under the same specification as (3) in Table 5, the advertising effect is estimated to be 0.064 with standard error of 0.033. The magnitude and statistical significance of the switching cost parameters remain unchanged.

Table B.6: Robustness of advertising-elastic demand to availability of satellite service

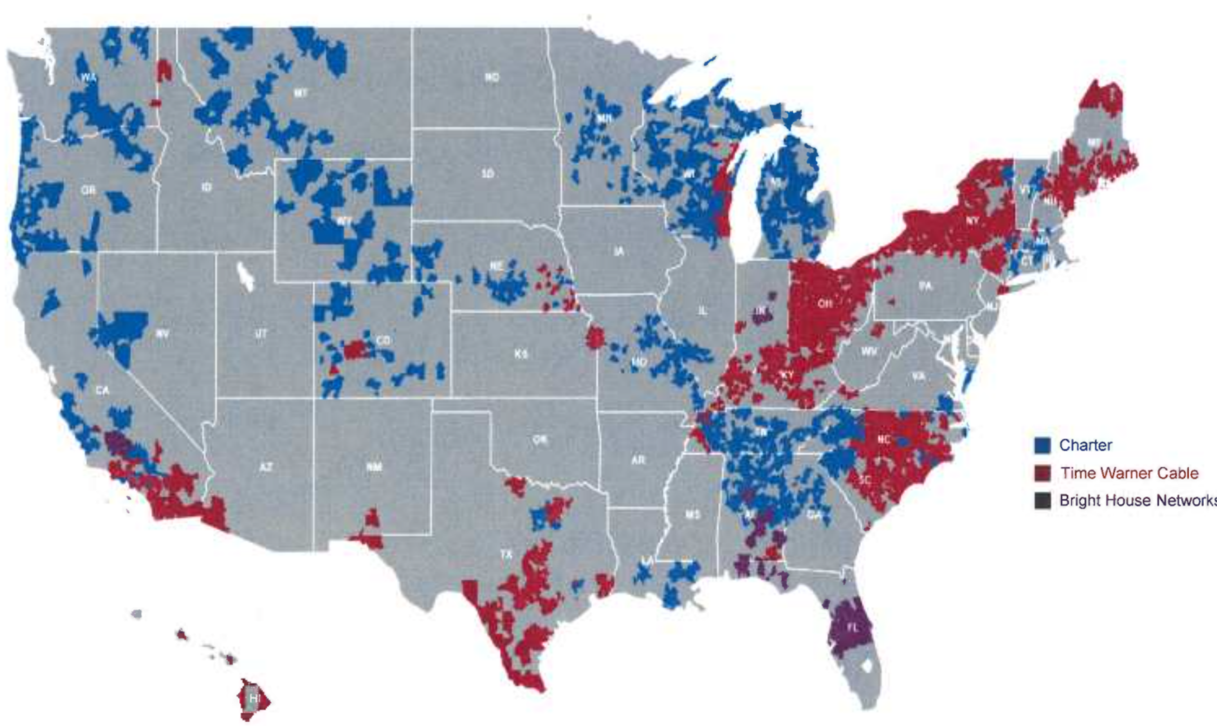
	Ad: Insertion
β: Advertising	0.064*
	(0.033)
γ: From Terrestrial	−2.988***
	(0.206)
γ: From Cable	−2.162***
	(0.162)
γ: From Satellite	−3.650***
	(0.220)
Operator-Market-Year FE	Yes
Latent-class	No
Observations	16,928
No. parameters	604
−Log-likelihood	3,325
BIC	12,530

C The Charter-Time Warner Cable-Bright House Networks Merger

On May 26th, 2015, Charter Communications announced its intent to acquire Time Warner Cable (TWC) and Bright House Networks (BHN) in a deal valued at $78.7 billion and $10.1 billion USD, respectively. About a month later on June 25th, the three operators submitted joint applications to the Commission seeking consent, which was approved by the Department of Justice and FCC on April 25th, 2016. On May 18th, 2016, the acquisition was completed and a new company "New Charter" was launched, which has provided the Spectrum service across the United States.

Figure C.1 visualizes the market coverage of the three operators. As shown, the merger increased the geographic coverage of New Charter in markets such as Los Angeles (CA), Dallas-Ft. Worth (TX), Charlotte (NC), Raleigh-Durham (NC) and Milwaukee (WI). Indeed, one supporting argument for the merger was that increased geographic coverage after the merger will make advertising spending more efficient. For instance, one of the FCC document argues that "Along with increased scale, the post-merger firm will have increased geographic scope. Its increased geographic scope will make certain types of investments more efficient. For example, New Charter will have an increased incentive to invest in attracting and maintaining its subscribers using mass market advertising. Because mass market advertising like television ads are purchased for an entire DMA, the value of the mass market advertising to New Charter increases as New Charter's geographic

Figure C.1: Market coverage of the three operators



Source: FCC's Public Interest Statement for Application of Charter Communications,Inc., Time Warner Cable Inc.,and Advance/Newhouse Partnership For Consent to the Transfer of Control of Licenses and Authorizations (MB Docket No. 15-149) coverage within a DMA increases. New Charter will be more likely to spend resources using mass marketing to attract and maintain its subscribers because each advertisement will reach a larger number of subscribers or potential subscribers" and "The post-merger firm's increase in geographic scope will make the per-subscriber advertising cost of mass market advertising fall. As such,the post-merger firm will have an increased incentive to advertise, which will intensify competition with rivals and benefit consumers."[6]

In this section, we present two empirical analyses based on the merger to further provide evidence on the relationship between market coverage and advertising. First, we design a difference-in-differences analysis to check whether New Charter's advertising decision is consistent with the cost efficiencies in national advertising we discuss in the paper (also described in the quotes above). Second, we conduct a simple back-of-the-envelope calculation to quantify changes in the extent of wasted advertising before and after the merger. We elaborate on these below.

Consider a market (DMA) that is served by both Charter and TWC before the merger. Since a cable market does not geographically overlap (expect overbuilds), the merger results in an increased the market coverage for New Charter. For instance, if Charter and TWC served 20% and 30% of the DMA previously, New Charter serves 50% of the market. We ask whether the level of advertising by New Charter in these *treated* markets are greater than the sum of advertising by Charter and TWC before the merger. To account for time trend, we use DMAs that were served by a single operator among Charter, TWC or BHN as *control* markets. In these markets, the operators' market coverage remains unchanged after the merger. Focusing on the top 100 popular DMAs, we estimate the following equation.

$$\log(1 + Ad_{mt}) = \beta_0 \cdot \text{Post}_t + \beta_1 \cdot \text{Post}_t \times \text{Treated}_m + \mu_m + \varepsilon_{mt}. \tag{C.1}$$

Here Ad_{mt} is the level of advertising (measured by insertion, duration, spend or GRPs) by the operators in DMA m in year-month t. During the pre-merger period, we take the sum of advertising if two or three operators co-served the DMA. Post_t equals one if t is May 2016 or after, or zero otherwise. Treated_m equals one if m was served by multiple operators among the three before the merger, or zero otherwise. μ_m is DMA fixed effect.[7]

For estimation, we drop two months around the approval of the merger and the official launch of New Charter (April-May 2016).[8] For the pre-merger period, we use the period from January 2015 to March 2016. For the post-merger period, we vary the window size. Table C.1 reports

[6]Source: Statement of Dr. Fiona Scott Morton re the Merger of Charter, TWC, and BHN; `https://ecfsapi.fcc.gov/file/60001332668.pdf` (page 71, lines 210 and 212).

[7]Alternatively, we can replace the market fixed effects with Treated_m. The results and our interpretation do not change.

[8]In April-May 2016, we observe the operators drastically increased their presence on the national advertising. Before the merger the operators' ads appeared less than 20 times a month. In April 2016, there were 1,634 insertions of their ads in the national advertising channel, followed by 177 insertions in May 2016. The number dropped to 1, 6, 9, and 1 in the subsequent months. We suspect that this was a part of the operators' intention to inform the start of New Charter to a broad audience using national advertising.

Table C.1: Changes in the level of local advertising after the Charter-TWC-BHN merger

	DV: log(1+Advertising)			
	(1) Insertion	(2) Duration	(3) Spend	(4) GRPs
β_1: Post×Treated	0.292**	0.165***	0.197**	0.212**
	(0.117)	(0.062)	(0.087)	(0.090)
β_0: Post	−0.093	0.043	−0.077	0.072
	(0.116)	(0.079)	(0.108)	(0.194)
DMA FE	Yes	Yes	Yes	Yes
Observations	1,458	1,458	1,428	848
R^2	0.967	0.941	0.967	0.849
$Adj.R^2$	0.965	0.938	0.965	0.835

Note: Table reports the estimation results of Equation C.1 using different measures of advertising. Standard errors are clustered at the year-month and DMA level. Significance level: *p<0.1; **p<0.05; ***p<0.01.

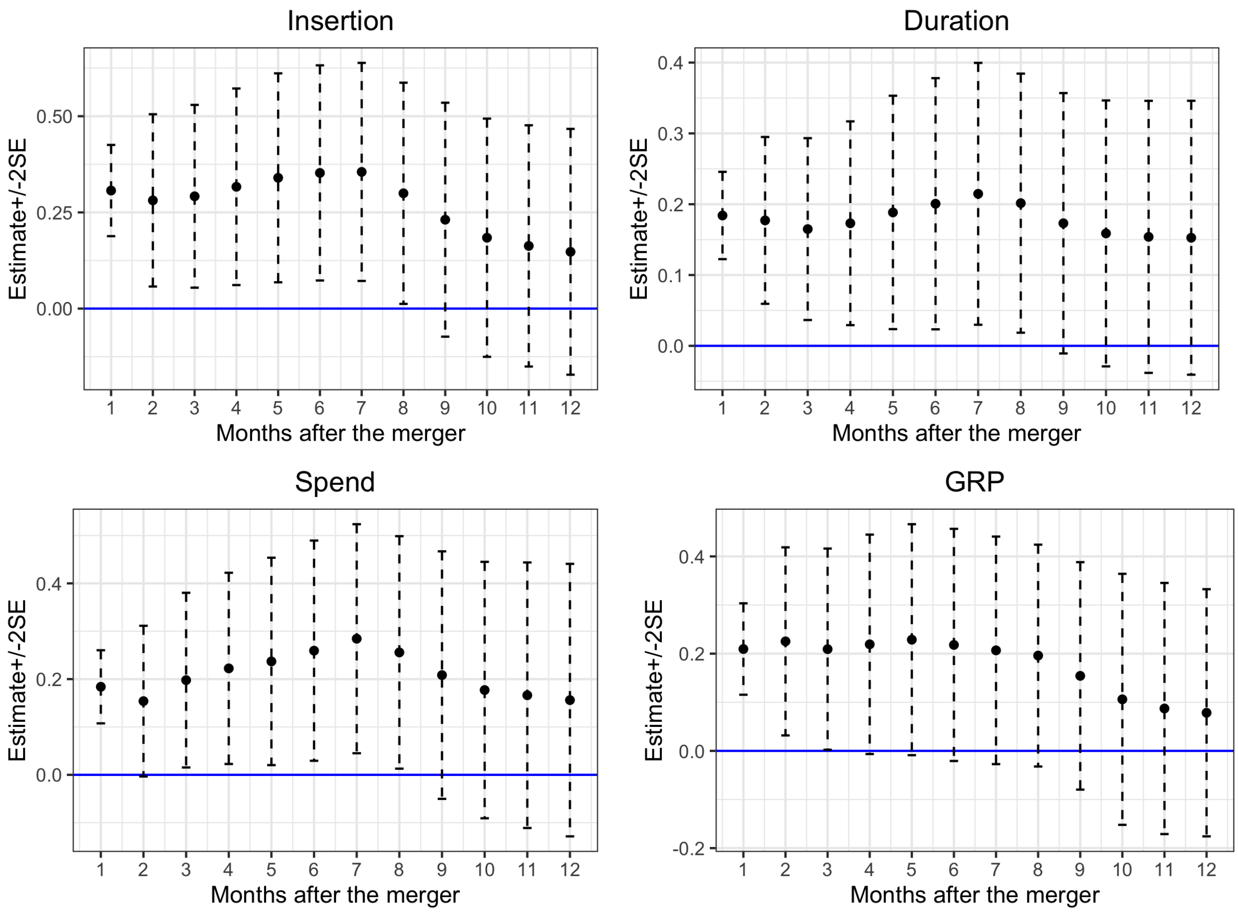
the estimation results in which we report the change in the monthly advertising during the three months after the merger.

As shown, we find the level of advertising increased in the treated markets after the merger (captured by β_1). The effects are statistically significant and ranged between 17% to 29% across our four proxies of advertising level. On the other hand, we do not see a statistically significant change in the control market (captured by β_0), which suggest that the increase in treated market is less likely due to New Charter reallocate the ad spend by the three operators that participated to the merger. Rather, the results suggest that New Charter increased its overall spend on television advertising and they prioritize the treated markets to spend the additional dollars. In Figure C.2, we report the estimated treatment effect (i.e., $\hat{\beta}_1$) by varying the window size after the merger from one to twelve months. Although we see a modest decrease after around the seventh month, the effects stay positive.

We present a back-of-the-envelope calculation in Table C.2. The table reports the changes in the market coverage before and after the merger in five large DMAs. For the five markets, we have data on the number of subscribers to the three operators, as well as the number for other operators.[9] Using the numbers, we compute the market share, which we assume to represent the market coverage for each of the three operators in a given market. We compute the expected wasted ad spend as the total ad spend multiplied by the market share before and after the merger. For instance, Time Warner Cable and Charter served 72.7% and 14.1% of Los Angeles DMA, respectively. After the merger, New Charter covers 86.7% of the market, resulting in about 57.8% less waste in ad spend.

[9] Source: Number of subscribers and market coverage: Statement of Dr. Fiona Scott Morton re the Merger of Charter, TWC, and BHN; `https://ecfsapi.fcc.gov/file/60001332668.pdf` (page 72, Table 14)

Figure C.2: Estimated β_1 in equation C.1 with varying window size



Note: Figure reports the estimated β_1 in equation C.1 with varying window size after the merger from one to twelve months. Each panel corresponds to one of the four proxies for advertising level.

Overall, the results reassure what we report from the Adelphia-Comcast-TWC transactions in the paper, that market coverage can render firms' local advertising decisions. In markets where an operator serves a greater portion, the unit cost of advertising is lower due to the reduction in wasted ad spend. Consequently, all else being equal, firms are incentivized to allocate more ad budget to these markets, which we confirm with the 2006 Adelphia-Comcast-TWC transactions, as well as with the 2016 Charter-TWC-BHN merger.

Table C.2: A back-of-the-envelope calculation: Charter-TWC-BHN merger

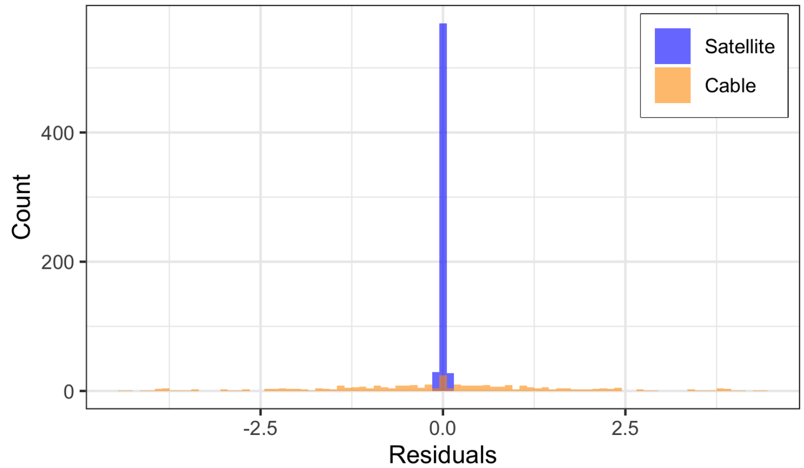
	Markets				
	Los Angeles	Dallas-Ft. Worth	Charlotte	Raleigh-Durham	Milwaukee
Number of Subscribers					
Time Warner Cable	1,277,907	309,688	361,935	405,770	296,920
Charter	247,454	107,385	80,940	30,119	68,845
Bright House	-	-	-	-	-
Other cable	233,264	76,040	59,595	26,334	820
Total	1,758,625	493,113	502,470	462,223	366,585
Market share (pre)					
Time Warner Cable	72.7%	62.8%	72.0%	87.8%	81.0%
Charter	14.1%	21.8%	16.1%	6.5%	18.8%
Market share (post)					
New Charter	86.7%	84.6%	88.1%	94.3%	99.8%
Ad spend in 2015					
Time Warner Cable	48,104,089	24,579,347	4,355,430	2,551,121	1,292,382
Charter	3,592,921	2,749,615	31	75,969	-
Wasted ad spend (pre)					
Time Warner Cable	13,149,194	9,142,867	1,218,163	311,578	245,601
Charter	3,087,365	2,150,833	26	71,019	-
Total	16,236,560	11,293,700	1,218,189	382,597	245,601
Wasted ad spend (post)					
New Charter	6,857,091	4,214,235	516,576	149,672	2,891
Percent change	-57.8%	-62.7%	-57.6%	-60.9%	-98.8%

Notes: The table reports the changes in the market share before and after the 2016 Charter-TWC-BHN merger in five large DMAs. We compute the wasted ad spend as the total ad spend in a given DMA multiplied by the market share.
Sources: (1) Number of subscribers and market coverage: Statement of Dr. Fiona Scott Morton re the Merger of Charter, TWC, and BHN; `https://ecfsapi.fcc.gov/file/60001332668.pdf` (page 72, Table 14), (2) Ad-spend in USD (2015): Nielsen Ad Intel.

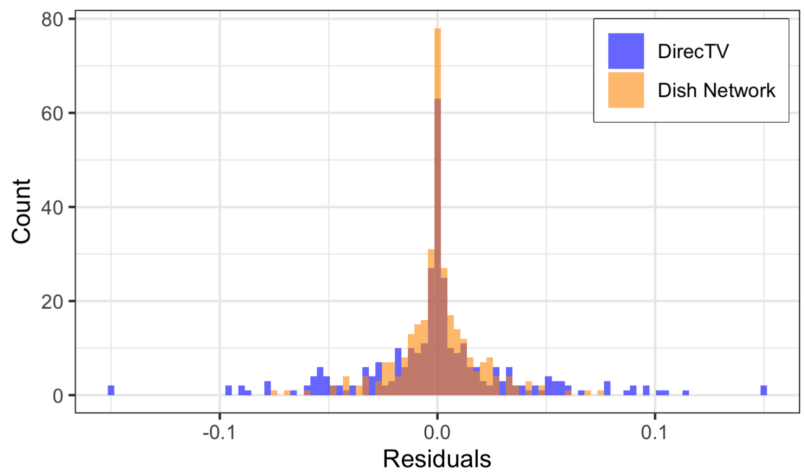
D Additional Figures and Tables

Figure D.1: Residual variation in advertising (Insertion)

(a) Cable vs. satellite operators



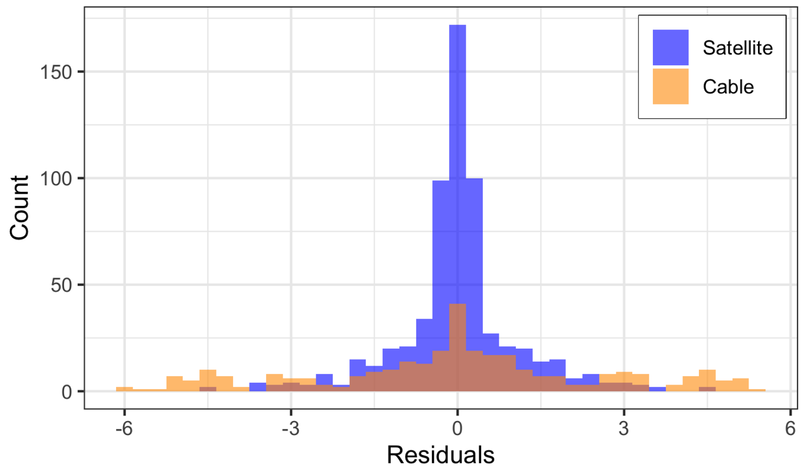
(b) DirecTV vs. Dish Network



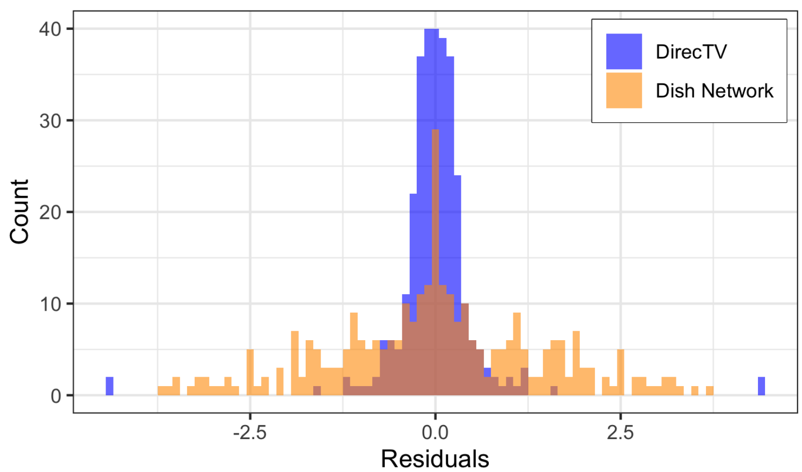
Note: We regress the log of $insertion$ aggregated to operator-DMA-year-level on a set of operator-cable market-year fixed effects (δ_{jmt}). Panel D.2a plots the residuals separately for the cable and satellite operators, and Panel D.2b separately for the two satellite operators, DirecTV and Dish Network.

Figure D.2: Residual variation in advertising (GRPs)

(a) Cable vs. satellite operators



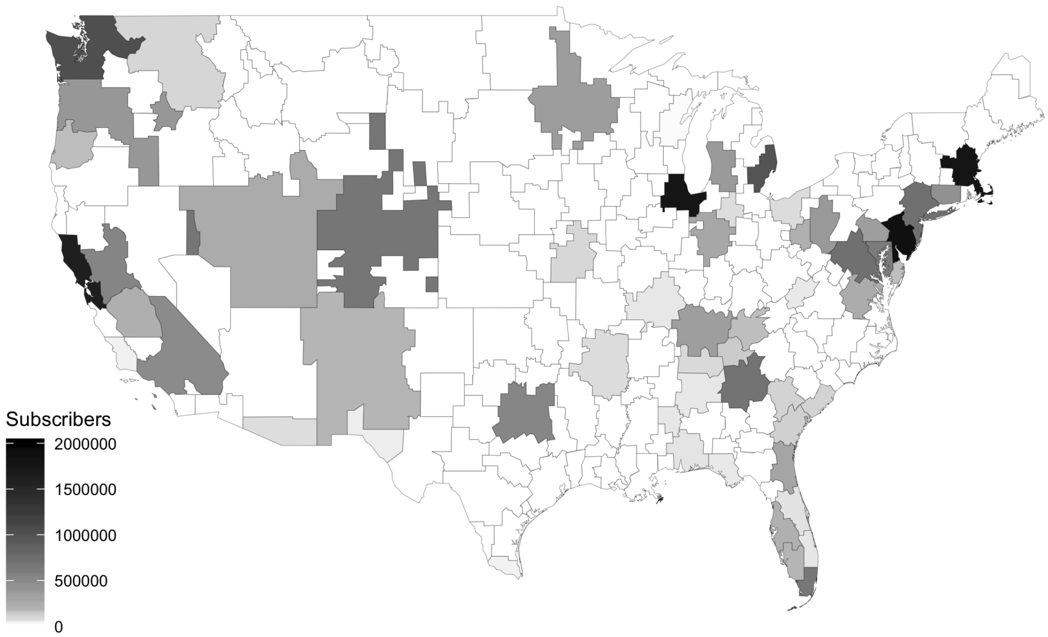
(b) DirecTV vs. Dish Network



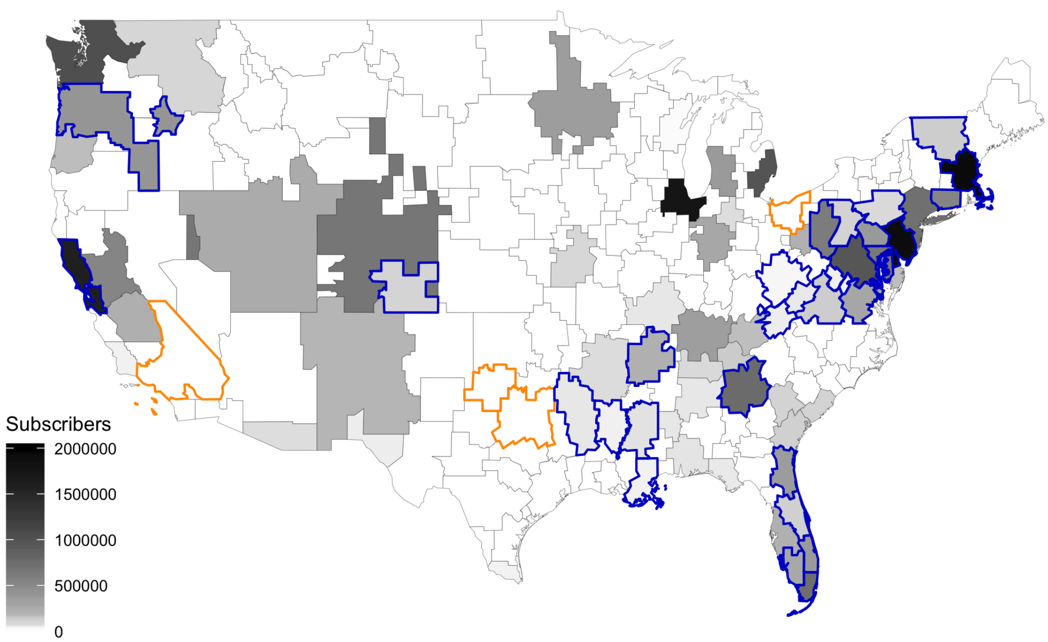
Note: We regress the log of GRPs aggregated to operator-DMA-year-level on a set of operator-cable market-year fixed effects (δ_{jmt}). Panel D.2a plots the residuals separately for the cable and satellite operators, and Panel D.2b separately for the two satellite operators, DirecTV and Dish Network.

Figure D.3: Changes in number of subscribers across DMAs: pre- and post-transactions (Comcast)

A. Pre-transactions



B. Post-transactions



Note: Figures illustrate the changes in the number of Comcast subscribers across DMAs before and after the Adelphia-Comcast-Time Warner Transactions. The DMAs whose borders are in blue (orange) indicate markets in which Comcast gained (lost) subscribers, either from (to) Adelphia or Time Warner.

Table D.1: Summary statistics for sample households across different data sets

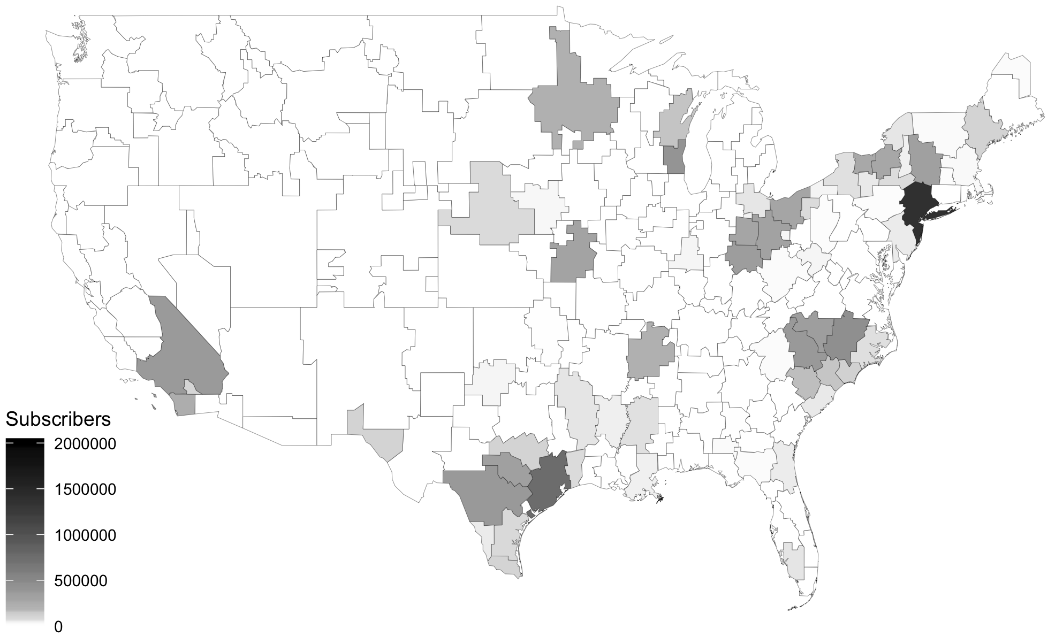
	Data sets			
	Cable Market	County (Border)	County	2005 Census
Race				
White	0.877	0.898	0.853	0.819
Black or African American	0.081	0.042	0.081	0.122
American Indian and Alaska Native	0.004	0.005	0.005	0.007
Asian	0.015	0.025	0.027	0.036
Other	0.009	0.012	0.016	0.015
Household size				
1-2	0.546	0.599	0.587	0.622
3-4	0.358	0.310	0.323	0.288
5-6	0.087	0.080	0.081	0.079
7 or more	0.010	0.009	0.009	0.011
Annual household income				
Under $22,500	0.168	0.146	0.178	0.253
$22,500-$39,999	0.208	0.190	0.202	0.202
$40,000-$59,999	0.236	0.227	0.229	0.175
$60,000-$89,999	0.254	0.238	0.252	0.176
$90,000 or over	0.134	0.199	0.140	0.194
Educational attainment				
No high school diploma	0.009	0.009	0.007	0.149
High school or equivalent	0.224	0.209	0.191	0.303
Some college, less than 4-yr degree	0.242	0.250	0.247	0.271
Bachelor's degree or higher	0.306	0.329	0.311	0.277
N	14,038	14,458	81,213	113,343

Sources: (1) Census: US Census Bureau, Current Population Survey (data retrieved at the household level), (2) Cable Market, County (Border) and County: Forrester survey (based on the reported demographic information in the year of first survey participation during the sample period).

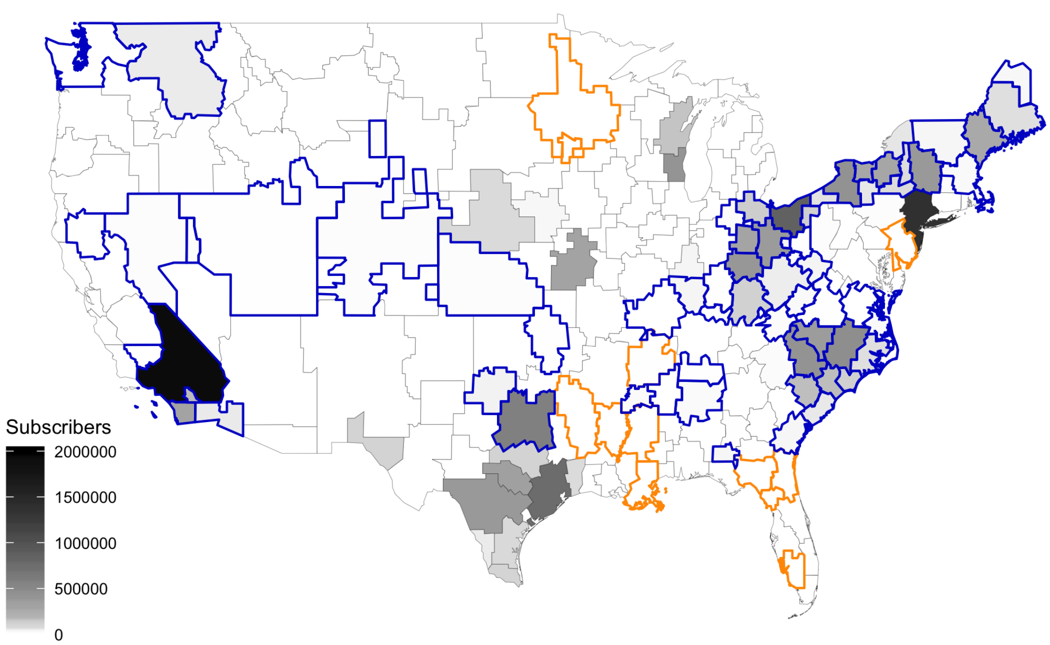
We do not compare the distribution of age and gender, because while data from both the Forrester survey and the CPS used here are usually at the household level, age and gender are recorded for the individual who answered the survey questions. For categorical variables for which the Forrester survey and the census do not have the same set of categories, we aggregate the values into larger categories for comparison purposes. We do not report the proportion of no answer and therefore, the values of a metric may not sum to 1.

Figure D.4: Changes in number of subscribers across DMAs: pre- and post-transactions (Time Warner)

A. Pre-transactions



B. Post-transactions



Note: Figures illustrate the changes in the number of Time Warner subscribers across DMAs before and after the Adelphia-Comcast-Time Warner Transactions. The DMAs whose borders are in blue (orange) indicate markets in which Time Warner gained (lost) subscribers, either from (to) Adelphia or Comcast.

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
1	NEW YORK	720,139.00	-	720,139.00	1,379,086.00	-	1,379,086.00
2	LOS ANGELES	485,561.00	(485,561.00)	-	369,975.00	1,548,771.00	1,918,746.00
3	CHICAGO	1,760,735.00	-	1,760,735.00	-	-	-
4	PHILADELPHIA	1,865,925.00	41,000.00	1,906,925.00	49,387.00	(49,387.00)	-
5	BOSTON (MANCHESTER)	1,760,608.00	177,000.00	1,937,608.00	14,300.00	1,859.00	16,159.00
6	SAN FRANCISCO-OAK-SAN JOSE	1,595,716.00	13,000.00	1,608,716.00	-	-	-
7	DALLAS-FT. WORTH	529,856.00	(529,856.00)	-	-	579,750.00	579,750.00
8	WASHINGTON DC (HAGRSTWN)	721,979.00	238,000.00	959,979.00	-	-	-
9	ATLANTA	692,072.00	77,000.00	769,072.00	-	-	-
10	DETROIT	981,693.00	-	981,693.00	-	-	-
11	HOUSTON	-	-	-	753,857.00	-	753,857.00
12	SEATTLE-TACOMA	1,030,982.00	-	1,030,982.00	-	918.00	918.00
13	TAMPA-ST. PETE (SARASOTA)	203,743.00	-	203,743.00	-	-	-
14	MINNEAPOLIS-ST. PAUL	346,088.00	-	346,088.00	202,472.00	(202,472.00)	-
15	PHOENIX (PRESCOTT)	-	-	-	-	-	-
16	CLEVELAND-AKRON (CANTON)	85,473.00	(85,473.00)	-	283,109.00	570,968.00	854,077.00
17	MIAMI-FT. LAUDERDALE	654,534.00	85,000.00	739,534.00	-	-	-
18	DENVER	665,945.00	-	665,945.00	-	4,704.00	4,704.00
19	SACRAMNTO-STKTON-MODESTO	535,240.00	-	535,240.00	-	-	-
20	ORLANDO-DAYTONA BCH-MELBRN	70,965.00	45,000.00	115,965.00	-	-	-
21	ST. LOUIS	-	-	-	-	-	-
22	PITTSBURGH	378,967.00	228,000.00	606,967.00	6,463.00	-	6,463.00
23	BALTIMORE	619,301.00	30,000.00	649,301.00	-	-	-
24	PORTLAND OR	392,139.00	15,000.00	407,139.00	-	-	-
25	INDIANAPOLIS	270,728.00	-	270,728.00	1,108.00	-	1,108.00
26	SAN DIEGO	-	-	-	227,513.00	73,842.00	301,355.00

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
27	HARTFORD & NEW HAVEN	438,759.00	108,000.00	546,759.00	-	-	-
28	CHARLOTTE	-	-	-	384,882.00	41,199.00	426,081.00
29	RALEIGH-DURHAM (FAYETVLLE)	-	-	-	460,097.00	11,183.00	471,280.00
30	NASHVILLE	334,612.00	-	334,612.00	-	-	-
31	KANSAS CITY	98,608.00	-	98,608.00	303,350.00	-	303,350.00
32	MILWAUKEE	-	-	-	416,684.00	-	416,684.00
33	CINCINNATI	-	-	-	349,323.00	39,658.00	388,981.00
34	COLUMBUS OH	-	-	-	313,258.00	51,715.00	364,973.00
35	GREENVLL-SPART-ASHEVLL-AND	-	-	-	8,131.00	-	8,131.00
36	SALT LAKE CITY	244,436.00	-	244,436.00	-	2,044.00	2,044.00
37	SAN ANTONIO	-	-	-	384,016.00	-	384,016.00
38	GRAND RAPIDS-KALMZOO-B.CRK	369,623.00	-	369,623.00	-	-	-
39	WEST PALM BEACH-FT. PIERCE	60,374.00	308,000.00	368,374.00	-	-	-
40	BIRMINGHAM (ANN TUSC)	57,840.00	-	57,840.00	-	11,133.00	11,133.00
41	NORFOLK-PORTSMTH-NEWPT NWS	-	-	-	-	14,468.00	14,468.00
42	HARRISBURG-LNCSTR-LEB-YORK	340,823.00	37,000.00	377,823.00	-	-	-
43	NEW ORLEANS	-	32,000.00	32,000.00	34,716.00	(34,716.00)	-
44	MEMPHIS	-	201,000.00	201,000.00	204,018.00	(202,319.00)	1,699.00
45	OKLAHOMA CITY	-	-	-	-	-	-
46	BUFFALO	-	-	-	75,788.00	357,543.00	433,331.00
47	ALBUQUERQUE-SANTA FE	186,514.00	-	186,514.00	-	-	-
48	GREENSBORO-H.POINT-W.SALEM	-	-	-	340,210.00	11,598.00	351,808.00
49	PROVIDENCE-NEW BEDFORD	-	-	-	-	-	-
50	LOUISVILLE	-	-	-	-	3,335.00	3,335.00
51	LAS VEGAS	-	-	-	-	-	-
52	JACKSONVILLE	281,671.00	76,000.00	357,671.00	44,989.00	(44,989.00)	-
53	WILKES BARRE-SCRANTON	-	95,000.00	95,000.00	6,250.00	-	6,250.00

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
54	AUSTIN	-	-	-	316,594.00	-	316,594.00
55	ALBANY-SCHENECTADY-TROY	-	-	-	319,639.00	61,061.00	380,700.00
56	DAYTON	-	-	-	284,024.00	11,968.00	295,992.00
57	LITTLE ROCK-PINE BLUFF	83,648.00	-	83,648.00	-	-	-
58	FRESNO-VISALIA	208,365.00	-	208,365.00	-	-	-
59	KNOXVILLE	160,911.00	-	160,911.00	-	-	-
60	TULSA	-	-	-	2,193.00	1,935.00	4,128.00
61	RICHMOND-PETERSBURG	237,389.00	41,000.00	278,389.00	-	358.00	358.00
62	CHARLESTON-HUNTINGTON	-	22,000.00	22,000.00	9,980.00	33,337.00	43,317.00
63	MOBILE-PENSACOLA (FT WALT)	65,040.00	-	65,040.00	-	-	-
64	LEXINGTON	-	-	-	-	111,973.00	111,973.00
65	FLINT-SAGINAW-BAY CITY	-	-	-	-	-	-
66	WICHITA-HUTCHINSON PLUS	-	-	-	-	5,011.00	5,011.00
67	ROANOKE-LYNCHBURG	-	124,000.00	124,000.00	284.00	1,385.00	1,669.00
68	FT. MYERS-NAPLES	187,726.00	72,000.00	259,726.00	62,493.00	(62,493.00)	-
69	GREEN BAY-APPLETON	9,967.00	-	9,967.00	147,981.00	-	147,981.00
70	TOLEDO	-	-	-	61,121.00	63,591.00	124,712.00
71	HONOLULU	-	-	-	397,253.00	-	397,253.00
72	TUCSON (SIERRA VISTA)	80,310.00	-	80,310.00	-	-	-
73	DES MOINES-AMES	-	-	-	-	-	-
74	PORTLAND-AUBURN	-	-	-	109,478.00	145,704.00	255,182.00
75	ROCHESTER NY	-	-	-	259,744.00	5,124.00	264,868.00
76	OMAHA	-	-	-	19,054.00	-	19,054.00
77	SYRACUSE	-	-	-	264,185.00	15,943.00	280,128.00
78	SPRINGFIELD MO	-	-	-	-	-	-
79	PADUCAH-CAPE GIRARD-HARSBG	58,191.00	-	58,191.00	-	795.00	795.00
80	SPOKANE	98,989.00	-	98,989.00	-	47,137.00	47,137.00

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
81	SHREVEPORT	-	57,000.00	57,000.00	62,132.00	(62,132.00)	-
82	CHAMPAIGN&SPRNGFLD-DECATUR	-	-	-	-	-	-
83	COLUMBIA SC	-	-	-	163,260.00	359.00	163,619.00
84	HUNTSVILLE-DECATUR (FLOR)	93,485.00	-	93,485.00	-	4,464.00	4,464.00
85	MADISON	-	-	-	-	-	-
86	CHATTANOOGA	129,448.00	-	129,448.00	-	-	-
87	SOUTH BEND-ELKHART	-	-	-	-	-	-
88	CEDAR RAPIDS-WTRLO-IWC&DUB	-	-	-	-	-	-
89	TRI-CITIES TN-VA	-	43,000.00	43,000.00	-	8,175.00	8,175.00
90	BURLINGTON-PLATTSBURGH	-	126,000.00	126,000.00	13,018.00	9,198.00	22,216.00
91	JACKSON MS	-	70,000.00	70,000.00	76,382.00	(76,382.00)	-
92	COLORADO SPRINGS-PUEBLO	-	107,000.00	107,000.00	-	-	-
93	HARLINGEN-WSLCO-BRNSVL-MCA	30,107.00	-	30,107.00	105,113.00	-	105,113.00
94	DAVENPORT-R.ISLAND-MOLINE	-	-	-	-	-	-
95	WACO-TEMPLE-BRYAN	-	-	-	109,812.00	-	109,812.00
96	BATON ROUGE	-	-	-	-	-	-
97	JOHNSTOWN-ALTOONA	-	110,000.00	110,000.00	-	-	-
98	SAVANNAH	114,401.00	-	114,401.00	-	22,477.00	22,477.00
99	EVANSVILLE	-	-	-	-	24,618.00	24,618.00
100	EL PASO (LAS CRUCES)	42,181.00	-	42,181.00	108,501.00	-	108,501.00
101	CHARLESTON SC	109,495.00	-	109,495.00	53,161.00	1,462.00	54,623.00
102	YOUNGSTOWN	-	-	-	89,094.00	27,199.00	116,293.00
103	LINCOLN & HASTINGS-KRNY	-	-	-	90,338.00	-	90,338.00
104	FT. WAYNE	81,291.00	-	81,291.00	3,765.00	3,974.00	7,739.00
105	GREENVILLE-N.BERN-WASHNGTN	-	-	-	77,606.00	1,760.00	79,366.00
106	SPRINGFIELD-HOLYOKE	-	-	-	6,628.00	-	6,628.00
107	FT. SMITH-FAY-SPRNGDL-RGRS	-	-	-	-	-	-

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
108	MYRTLE BEACH-FLORENCE	-	-	-	142,818.00	23,781.00	166,599.00
109	TALLAHASSEE-THOMASVILLE	-	-	-	8,395.00	(8,395.00)	-
110	LANSING	-	-	-	-	-	-
111	TYLER-LONGVIEW(LFKN&NCGD)	-	-	-	-	-	-
112	TRAVERSE CITY-CADILLAC	-	-	-	-	-	-
113	MONTGOMERY-SELMA	-	-	-	-	-	-
114	RENO	-	-	-	-	5,097.00	5,097.00
115	AUGUSTA	108,513.00	-	108,513.00	-	-	-
116	SIOUX FALLS(MITCHELL)	-	-	-	-	-	-
117	PEORIA-BLOOMINGTON	-	-	-	-	-	-
118	FARGO-VALLEY CITY	-	-	-	-	-	-
119	MACON	-	-	-	-	-	-
120	EUGENE	164,600.00	-	164,600.00	-	-	-
121	SANTABARBRA-SANMAR-SANLUOB	34,457.00	-	34,457.00	-	-	-
122	BOISE	-	-	-	-	-	3,370.00
123	LAFAYETTE LA	-	-	-	-	-	-
124	MONTEREY-SALINAS	-	-	-	-	-	-
125	COLUMBUS GA	-	-	-	2,403.00	-	2,403.00
126	YAKIMA-PASCO-RCHLND-KNNWCK	-	-	-	-	-	-
127	LA CROSSE-EAU CLAIRE	-	-	-	-	-	-
128	BAKERSFIELD	-	-	-	-	1,191.00	1,191.00
129	CORPUS CHRISTI	-	-	-	92,549.00	-	92,549.00
130	AMARILLO	-	-	-	-	-	-
131	CHICO-REDDING	-	-	-	-	1,041.00	1,041.00
132	COLUMBUS-TUPELO-WEST POINT	-	-	-	-	639.00	639.00
133	WAUSAU-RHINELANDER	-	-	-	-	-	-
134	ROCKFORD	-	-	-	-	-	-

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
135	MONROE-EL DORADO	-	36,000.00	36,000.00	39,748.00	(39,748.00)	-
136	DULUTH-SUPERIOR	-	-	-	-	-	-
137	TOPEKA	-	-	-	-	-	-
138	BEAUMONT-PORT ARTHUR	-	-	-	89,091.00	-	89,091.00
139	COLUMBIA-JEFFERSON CITY	-	-	-	-	-	-
140	WILMINGTON	-	-	-	112,813.00	4,263.00	117,076.00
141	MEDFORD-KLAMATH FALLS	-	-	-	-	-	-
142	ERIE	-	-	-	28,293.00	41,090.00	69,383.00
143	SIOUX CITY	-	-	-	-	-	-
144	WICHITA FALLS & LAWTON	2,730.00	(2,730.00)	-	24,689.00	6,762.00	31,451.00
145	LUBBOCK	-	-	-	-	-	-
146	JOPLIN-PITTSBURG	-	-	-	-	-	-
147	ALBANY GA	-	-	-	-	-	-
148	BLUEFIELD-BECKLEY-OAK HILL	53,418.00	-	53,418.00	-	14,093.00	14,093.00
149	TERRE HAUTE	-	-	-	24,461.00	-	24,461.00
150	SALISBURY	162,441.00	-	162,441.00	-	-	-
151	BANGOR	-	-	-	-	77,314.00	77,314.00
152	WHEELING-STEUBENVILLE	201,694.00	-	201,694.00	-	3,610.00	3,610.00
153	ROCHESTR-MASON CITY-AUSTIN	-	-	-	-	-	-
154	BINGHAMTON	-	-	-	84,703.00	4,653.00	89,356.00
155	ANCHORAGE	-	-	-	-	-	-
156	BILOXI-GULFPORT	-	-	-	-	-	-
157	MINOT-BISMARCK-DICKINSON	-	-	-	-	-	-
158	ODESSA-MIDLAND	-	-	-	-	-	-
159	PALM SPRINGS	-	-	-	103,145.00	65,078.00	168,223.00
160	PANAMA CITY	55,084.00	-	55,084.00	-	-	-
161	SHERMAN-ADA	-	-	-	-	-	-

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
162	GAINESVILLE	-	-	-	1,051.00	(1,051.00)	-
163	ABILENE-SWEETWATER	-	-	-	-	-	-
164	IDAHO FALLS-POCATELLO	-	-	-	-	-	-
165	CLARKSBURG-WESTON	-	-	-	25,279.00	488.00	25,767.00
166	UTICA	-	-	-	36,587.00	47,962.00	84,549.00
167	QUINCY-HANNIBAL-KEOKUK	-	-	-	-	-	-
168	HATTIESBURG-LAUREL	-	-	-	-	-	-
169	MISSOULA	-	-	-	-	-	-
170	BILLINGS	-	-	-	-	-	-
171	YUMA-EL CENTRO	-	-	-	-	51,215.00	51,215.00
172	DOTHAN	-	-	-	12,160.00	10,189.00	22,349.00
173	ELMIRA (CORNING)	-	-	-	55,206.00	2,454.00	57,660.00
174	JACKSON TN	-	-	-	-	-	-
175	WATERTOWN	-	-	-	61,611.00	-	61,611.00
176	ALEXANDRIA LA	-	-	-	-	-	-
177	LAKE CHARLES	-	-	-	-	-	-
178	RAPID CITY	-	-	-	-	-	-
179	JONESBORO	-	-	-	-	-	-
180	MARQUETTE	-	-	-	-	-	-
181	HARRISONBURG	-	39,000.00	39,000.00	-	-	-
182	BOWLING GREEN	-	-	-	-	54.00	54.00
183	GREENWOOD-GREENVILLE	-	-	-	-	13,238.00	13,238.00
184	MERIDIAN	55,963.00	-	55,963.00	-	-	-
185	CHARLOTTESVILLE	-	33,000.00	33,000.00	-	-	-
186	LAFAYETTE IN	-	-	-	-	-	-
187	PARKERSBURG	-	-	-	-	3,540.00	3,540.00
188	GREAT FALLS	-	-	-	-	-	-

Continued on next page

Table D.2: Changes in number of subscribers: pre- and post-Adelphia/Comcast/Time Warner Transactions

		Comcast			Time Warner		
Rank	DMA	Pre-merger	Net Gain/(Loss)	Post-merger	Pre-merger	Net Gain/(Loss)	Post-merger
189	GRAND JUNCTION-MONTROSE	-	-	-	-	-	-
190	LAREDO	-	-	-	47,652.00	-	47,652.00
191	TWIN FALLS	-	-	-	-	-	-
192	EUREKA	-	-	-	-	-	-
193	BUTTE-BOZEMAN	-	-	-	-	-	-
194	LIMA	-	-	-	29,452.00	1,125.00	30,577.00
195	CHEYENNE-SCOTTSBLUF	-	-	-	-	-	-
196	SAN ANGELO	-	-	-	-	-	-
197	BEND OR	-	-	-	-	-	-
198	CASPER-RIVERTON	-	-	-	-	-	-
199	MANKATO	-	-	-	4,106.00	(4,106.00)	-
200	OTTUMWA-KIRKSVILLE	-	-	-	-	-	-
201	ST. JOSEPH	-	-	-	-	-	-
202	ZANESVILLE	-	-	-	22,176.00	1,458.00	23,634.00
203	PRESQUE ISLE	-	-	-	8,379.00	8,988.00	17,367.00
204	FAIRBANKS	-	-	-	-	-	-
205	VICTORIA	-	-	-	-	-	-
206	HELENA	-	-	-	-	-	-
207	JUNEAU	-	-	-	-	-	-
208	ALPENA	-	-	-	-	-	-
209	NORTH PLATTE	-	-	-	-	-	-
210	GLENDIVE	-	-	-	-	-	-

Note: Table is constructed based on a letter filed by Time Warner Cable, Comcast Corporation and Adelphia Communications Corporation to the Federal Communications Commission in June 20, 2005 (Proceeding: MB 05-192; ID 5513036896; link: `https://www.fcc.gov/ecfs/filing/5513036896`). Numbers are as of April 2005.