Size Effects and Bargaining Power in the Multichannel Television Industry

Nikolay Doudchenko[*]   Ali Yurukoglu[†‡]

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Abstract

We quantify how bargaining power derived from firm size affects the analysis of downstream mergers and the profitability of new downstream entrants. We estimate an empirical model of the television industry which features negotiations between upstream content and downstream distributors of varying size. We estimate that large distributors like Comcast are able negotiate about 25% lower content fees than smaller downstream firms. We evaluate the short-run welfare effects of several large proposed or consummated mergers. In conjunction, we assess the degree to which size based bargaining power creates contracts which are a barrier to entry for new distribution firms.

Keywords: bilateral oligopoly, multilateral bargaining, barriers to entry, wholesale price discrimination, merger analysis

[*]Graduate School of Business, Stanford University.

[†]Graduate School of Business, Stanford University and NBER.

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"It is the single biggest impediment [to Google Fiber's deployment]. [Video content] is the single biggest piece of our cost structure. We operate at a very significant difference than incumbents we compete against. We may be paying in some markets double what incumbents are paying for the same programming."[1]

– Milo Medin, Head of Google Fiber, 2014

1 Introduction

This paper quantifies the effect of size-based bargaining power on the welfare effects of mergers and the profitability of new entrants in the multichannel television industry. Over the past decade, the industry has seen significant new entry into wire-based distribution networks by Verizon, AT&T, Google, as well as actual and rumors of entry into over-the-top (OTT) streaming Internet video packages by Sony, Intel, Amazon, and Apple. Simultaneously, there has been a wave of consolidation involving existing distributors. In 2014 and 2015, Comcast sought regulatory approval for its $45B acquisition of Time Warner Cable, AT&T sought and received regulatory approval for its $49B acquisition of DirecTV, Charter Communications made a $55B bid for Time Warner Cable[2] and Brighthouse Networks, and Altice Communications acquired Suddenlink Communications for $9B and sought regulatory approval for its $18B acquisition of Cablevision.

The existence of size-based price discrimination in content fees derived from size-based bargaining leverage is central to understanding both the entry and the consolidation episodes in the downstream distribution segment of this industry. With respect to entry, size-based bargaining power creates a barrier to entry for new entrants who, being necessarily small at the time of entry, face a cost disadvantage relative to incumbents. With respect to consolidation, size-based bargaining power generates a natural marginal cost efficiency from downstream mergers by reducing the cost of upstream content to the merging parties.[3] The two effects also interact. To the extent that downstream consolidation increases the bargaining power of the merging entity, new entrants face a larger

[1] `https://www.washingtonpost.com/news/the-switch/wp/2014/10/06/video-is-holding-google-fiber-back/`

[2] This bid followed Comcast dropping its bid for Time Warner Cable in the face of regulatory scrutiny.

[3] Whether this cost reduction is associated with a monopsonistic distortion in quality is important for assessing whether these cost reductions represent a social efficiency. In this industry, the marginal cost of serving content is negligible. However, there may be effects on the introduction or quality of content which are outside the scope of our current analysis.

disadvantage than absent the consolidation. Quantifying these effects is important for policy makers deciding on whether to approve mergers or to regulate wholesale price discrimination.

To carry out the analysis, we add size-based bargaining power into a model of the industry that accounts for consumer viewership of channels, consumer subscriptions to cable and satellite distributors, pricing by cable and satellite distributors, and bilaterally oligopolistic negotiations between content and distribution over the terms of carriage following Crawford and Yurukoglu (2012) and Crawford et al. (2015). On the consumer side, households with heterogenous tastes for channels allocate their time into viewing the channels to which they have access. The households trade-off the value created from viewership against price and other characteristics to choose a distributor to subscribe to, or not to subscribe to subscription television. The distributors set prices and negotiate with the channels over the per-subscriber fee they pay for offering their subscribers access to the channel under negotiation. We parameterize the bargaining parameters to depend on the identity of the content provider, the overall size of the downstream firm as measured by total subscribers, and a time trend.

While we directly parameterize the bargaining parameters to depend on size, in Section 3.3.1, we review a theory due to Katz (1987) based on cost advantages in backwards integrating into content that would generate such an effect. We also present descriptive empirical evidence on the existence of size effects. Our formulation directly parameterizes the bargaining parameters for simplicity. The estimated bargaining parameter effects should be interpreted as a reduced form for the larger model featuring the possibility of entry into specific programming niches by distributors in the case of disagreement, or any other economy of scale in seeking alternative supply. This approach is analogous to interpreting residuals or firm effects in production function estimation as productivity where the productivity measure is a reduced form for effects such as management practices or un-modeled input quality differences.

We estimate all the model parameters jointly by the generalized method of moments to match observed ratings by channel, observed distributor market shares, observed average input costs, survey data on programming costs for small and large distributors, and observed margins of video revenue over programming costs reported in publicly available financial reports for a subset of firms. The degree of size advantage in negotiations is a key outcome of the estimation. The estimated size of the effect is such that Comcast, the largest firm with 23 million subscribers in 2010, is able to negotiate fees that are about

25% lower than smaller downstream firms such as Cablevision with 3 million subscribers. The observed ratios of programming costs to video revenue are particularly informative for this estimate. In the raw data, we see that larger distributors have lower ratios of programming costs to video revenues. If all distributors offered the same content and quality and faced the same demand conditions, this would be direct evidence of size-based bargaining power. We use the demand, oligopoly pricing, and bargaining model in conjunction with these data to account for quality and content offering and demand differences and recover the implied size-induced bargaining advantage.

We use the estimated model in 2010 to simulate several large mergers in the industry: the proposed-then-aborted Comcast acquisition of Time Warner Cable, the Charter acquisition of Time Warner Cable, and the consummated acquisition of DirecTV by AT&T. The key innovation in these merger analyses is that our model captures the marginal cost synergy achieved by increasing downstream size changing bargaining leverage. These lowered costs are passed on to consumers and must be weighed against any market power effects that arise from the merger. In the case of DirectTV-AT&T, we measure the horizontal market power effect that pushes consumer prices up.[4] We estimate that the Comcast acquisition of Time Warner Cable would have led to 9.57% lower content costs for the merged entity relative to their average prior to the merger. In turn, consumer prices would decrease by 2.45%, and consumer welfare would increase by 1.33%. Content providers are hurt as their fee revenue decreases by 6.8% in aggregate. However, some of this is partially offset by a 0.82% increase in advertising revenue due to having more subscribers in the market. In sum, total welfare increases by 0.47%.

Next, we consider the effects of size-based bargaining leverage on new entrants. The existence of size-based leverage creates a difficulty for new entrants. To achieve competitive content costs, they need to scale. However, to scale, they need competitive input costs. These concerns are real. Intel had plans for an Internet Protocol (IP)-based streaming video platform with content that is typically available in a cable television package. Industry press reports chronicle the progression from excitement around product inception[5] to struggles in content negotiations[6] to abandonment of the investment by Intel because of content costs.[7] In 2014, Brian Krzanich, CEO of Intel, described the challenges in

[4]A complete analysis should also consider the effects on investment in content, as well as any effects in other markets such as broadband provision, however these margins are outside the scope of our analysis.

[5]http://www.businessinsider.com/intels-new-iptv-might-kill-cable-2013-1

[6]http://www.fiercecable.com/story/intel-willing-pay-premium-iptv-content/2013-06-10

[7]http://www.multichannel.com/news/content/intel-lacked-volume-ott-tv-play/356602,

procuring content rights for Intel's project:

> *"When you go and play with the content guys, it's all about volume. And we come at it with no background, no experience, no volume."*

The story of Intel's aborted entry into video distribution, and the quote from Google Fiber in the epigraph suggest that size-based bargaining leverage can retard entry by new competitors which would otherwise lead to benefits for consumers from competition. To quantify these effects, we simulate the profits of Verizon and AT&T, two wire-based providers who entered the industry in 2007, with and without size-based bargaining leverage. We find that video profits for Verizon and AT&T would have been 4.79% higher if bargaining power did not depend on scale of the downstream firm. This profit increase is generated by a 8.48% reduction in marginal costs, a 2.92% decrease in average price, and an 11.37% increase in market share.

2 Related Literature

Horn and Wolinsky (1988), Hart and Tirole (1990), and McAfee and Schwartz (1994) provide theoretical foundations of business-to-business negotiations between upstream and downstream firms. Katz (1987) shows that larger downstream firms will receive better input prices when there are economies of scale to seeking alternative sources of supply. Chipty and Snyder (1999) generate size based advantages with a condition the gross surplus function created by the upstream and downstream firm trading is concave. A number of other papers explore when downstream size affects input prices, including Raskovich (2003) and Inderst and Valletti (2009). These papers provide rigor to and qualify the classical hypothesis in Galbraith (1952) that, in some circumstances, larger downstream firms can obtain lower input costs, and that this may or may not benefit society.

This paper is related to reduced form investigations of size effects in bargaining. Chipty (1995) estimates that larger downstream firms have lower marginal costs using cross-sectional data from the multichannel television industry in 1995. However, Chipty and Snyder (1999) find that advertising revenue is convex in subscribers, and use this to argue that larger buyers have worse bargaining positions in the multichannel television

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http://newsroom.intel.com/community/intel_newsroom/blog/2014/01/21/verizon-to-purchase-intel-media-assets industry. Hill et al. (2015) asserts that the Department of Justice investigations during the review of the Comcast acquisition of Time Warner Cable revealed that "Across a wide range of regressions the relationship of interest was consistent and statistically significant: larger video distributors pay meaningfully lower per subscriber fees to programmers." Size effects on input prices have been documented in other industries including health insurance (Sorensen, 2003) and retail drug stores (Ellison and Snyder, 2010). Buyer power as a rationale for horizontal mergers is also a focus of the finance literature who employ cross-industry evidence (Fee and Thomas, 2004; Shahrur, 2005; Bhattacharyya and Nain, 2011).

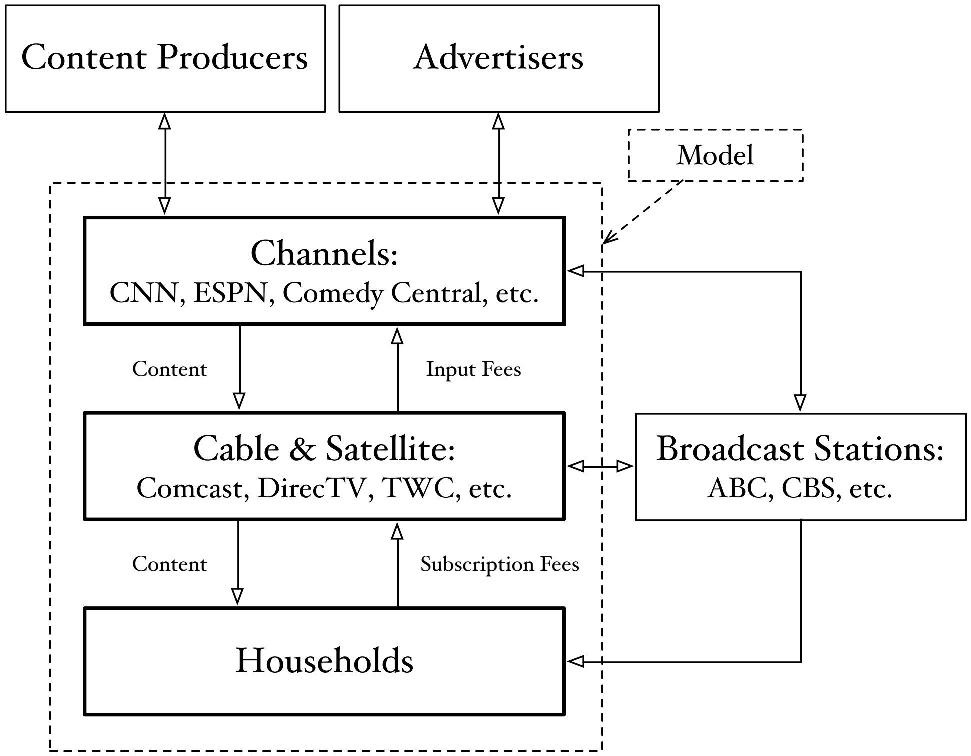
We also build upon the estimation of bilateral oligopoly models featuring business-to-business negotiations (Draganska, Klapper, and Villas-Boas, 2010; Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo, and Town, 2015; Crawford, Lee, Whinston, and Yurukoglu, 2015; Ho and Lee, 2015). Draganska et al. (2010) parameterizes the bargaining power parameter into the effects of several variables including the sizes of the negotiating firms. They find a positive effect of retailer size in the market for coffee purchased in grocery in Germany. Here we further consider the implications of size effects on downstream mergers and entrant's profits. On the methodological side, we jointly estimate the bargaining parameter and size effects with the demand parameters to improve efficiency. Crawford and Yurukoglu (2012) partially model size effects, but consider only two discrete sizes: large and small, and do not explore the implications of size effects on merger analysis or profitability of entry. Grennan (2013) analyzes the effects of banning wholesale price discrimination in the market for coronary stents, but does not consider downstream competition, size effects, nor the effect on entrants' profits. Gowrisankaran et al. (2015) consider how input markets for hospital services change when upstream market structure changes, but abstract away from downstream competition and do not consider size effects. Ho and Lee (2015) consider how input markets for hospital services change when downstream market structure changes, but do not consider size effects nor effects on new entrants.

3 Industry Overview and Data

3.1 Industry Overview

Figure 1 displays a simplified structure of the industry.

Figure 1: Multichannel Television Industry



In 2013, the four largest downstream firms by number of subscribers, Comcast, DirecTV, Dish Network, and Time Warner Cable, served approximately 60% of the total number of television households in the United States.[8] Their combined revenues amounted to almost $70 billion in 2013.[9] This revenue is generated by means of monthly subscription fees paid by the consumers of the final good to the cable and satellite companies. The downstream firms pay the negotiated input fees to the upstream firms (per subscriber per month). Advertising is another source of revenue for upstream firms.

There are three types of downstream firms: those with wire-based infrastructure (such as Comcast, Time Warner Cable, AT&T U-Verse, Verizon FiOS, etc.) satellite companies (DirecTV and Dish Network), and over-the-top streaming providers (eg Playstation Vue). The satellite companies provide nationwide service while each wire-based firm operates in a number of geographic areas. The choice set[10] and the prices are the same for every

[8]About 85% of all housing units in the United States subscribe to multichannel television.

[9]These data comes from the companies' 10k reports. For Comcast, DirecTV, and Time Warner Cable we include the revenue from the television services only. For Dish Network we take "Subscriber-related revenue."

[10]Each service provider offers several bundles of channels.

household within an area, but often differ across areas even within firm. We call each of these distinct areas served by a particular service provider a cable system. We define a local market as an intersection of several cable systems corresponding to different service providers. In other words, in each local market two different households can choose from the same set of service providers and bundles and face the same prices. Our data cover the period before the entry of OTT services.

Local markets are highly concentrated. More than 88% of the market-years in our dataset are served by three downstream firms,[11] one of the wire-based providers and the two satellite providers. In the markets served by three downstream firms, the median market share of the cable provider is 64% while the median market shares of DirecTV and Dish Network are 9% and 6% respectively.

3.2 Data

Our final data set spans the years 2000 to 2010. In total, we consider 10 distributors[12] and 37 cable channels.[13] The data we employ follow closely those used in Crawford et al. (2015). We make two key additions to the data used there. The first is the addition of individual level provider choice data from personal bank and card transactions (Yodlee). This allows us to incorporate markets with more than one wire-based distributor so that we can analyze the entry of Verizon and AT&T. The second is to employ data on programming cost differences from annual reports filed to the SEC to measure video programming costs against video programming revenue and from survey data by SNL. These provide key moments for estimating a bargaining size effect for distributors.

3.2.1 Downstream Market Data

The downstream market data includes quantities (the number of subscribers to each service providers in each marker), downstream prices, product characteristics (the list of

[11]Among the remaining markets, just over 10% are served by four downstream companies.

[12]Comcast, Time Warner Cable (TWC), Charter Communications, Cablevision, Cox Communications, RCN Corporation, Verizon FiOS, AT&T U-Verse, DirecTV, and Dish Network. The rest of the distributors are aggregated into an additional downstream firm.

[13]ABC Family Channel, American Movie Classics AMC, Animal Planet, Arts Entertainment, BET, Bravo, Cartoon Network, CMT, CNBC, CNN, Comedy Central, Discovery Channel, Disney Channel, E! Entertainment TV, ESPN, ESPN 2, ESPN Classic Sports, Food Network, Fox News Channel, FX, Golf Channel, Hallmark Channel, HGTV, History Channel, Lifetime, MSNBC, MTV, Nickelodeon, SyFy, TBS, TLC, truTV, Turner Classic Movies, TNT, USA, VH1, and Weather Channel.

channels offered by each bundle), markup data, and channel viewership data. We also use the state-specific satellite tax as a price instrument.

Quantities come from Nielsen FOCUS dataset (2000–2010), survey data from Mediamark Research & Intelligence[14] (2000–2007) and Simmons (2008–2010), and individual bank and card transaction data from Yodlee (2011–2013).[15] We add up the subscribers to all bundles offered by a particular service provider focusing on the downstream firm choice rather than bundle choice.[16] The computed market shares from Nielsen FOCUS and the surveys are averaged whenever the number of subscribers to each service provider in the market in that year exceeds 40 in the survey data. Nielsen FOCUS, MRI, and Simmons report the total number of subscribers to each bundle in each system. Therefore, when a system contains several markets (i.e. when two or more systems overlap) it is impossible to say how many households subscribe to each service provider in each market. For this reason, Crawford and Yurukoglu (2012) and Crawford, Lee, Whinston, and Yurukoglu (2015) limit their analysis to the non-overlapping systems which reduces the observed effect of direct downstream competition. We add the individual level data from Yodlee to compute the number of subscribers to each service provider in each zip code for years 2006–2010.

Yodlee is a bank and card transaction aggregator that serves both individual customers and banks. The dataset contains bank and card transactions of more than 5 million individuals.[17] There are no individual level characteristics in the Yodlee dataset. However, each transaction has a field that contains the location of the merchant. We estimate the zip code where a particular Yodlee member lives as the zip code of the most popular grocery store among those visited by this individual during the current year. The assumption is that even if the estimated zip code does not coincide with the actual zip code where the person lives, they belong to the same cable market. Then, based on the payments for cable and satellite services we estimate the person's service provider.[18]

[14]Also referred to as MRI.

[15]Though our final sample only spans the years 2000-2010, the Yodlee data is combined with national subscriber data and assumptions which we detail to help estimate market shares in relevant years.

[16]Henceforth we use "firm" and "bundle" interchangeably when referring to a downstream firm.

[17]Selection bias may be an issue. However, some of the corporate clients of Yodlee dump all of their customers' transactions into the system which may mitigate the selection problem.

[18]We limit our attention to those individuals who pay more than $500 per year for utilities (assuming that these people are the heads of their households) and those who have both bank and card transactions in the Yodlee dataset.

We have Yodlee data for years 2011–2013.[19] To use these data to aid the estimation the quantities for 2006–2010 we take the quantities in 2012 and interpolate them backwards. We assume that if downstream firm f entered zip code k in year t, the number of subscribers to firm f in this zip code in year $t+s$ is $q_{fkt}(1+r_{f1})\dots(1+r_{fs})$, where $r_{f\tau}$ are assumed to be the same across zip codes. We estimate the initial quantities, q_{fkt}, and the growth rates, $r_{f\tau}$, using the national subscriber numbers and the zip code level numbers for 2012. Appendix B provides details of this procedure.

We compute the total number of households in each market using 2010 Census data.[20]

The downstream prices come from several sources including manual searches on the Internet archive (`http://archive.org/web/`), newspaper archives, archives of service providers' "rate cards" and the TNS Bill Harvesting database.[21] The TNS data set also provides the state-specific satellite tax from which we use within-state-over-time changes as an instrumental variable for price. Service providers usually offer three different bundles: (i) a limited basic bundle which offers the broadcast stations available over-the-air, (ii) an expanded basic bundle that contains the most popular cable channels, and (iii) a digital bundle that offers additional channels. The prices and bundle compositions (from the Nielsen dataset) that we use are those of the expanded basic bundle which is the most popular type of service.

We compute the markups using the distributors' 10k financial reports publicly available on the companies' websites. Comcast, Time Warner Cable, Charter, Suddenlink, Cox, DirecTV, and Dish Network separated out their video programming revenue and their video programming costs for various years in our time sample.

The viewership data (that contains for each channel the fraction of households that watches this channel and the average watching time) comes from MRI (2000–2007), Simmons (2008–2010), and Nielsen (2000–2010). When several sources are available, we use the average ratings.

Tables 10–13 in the Appendix report some of the descriptive statistics of the downstream market data.

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[19] We also have the data for the second half of 2010, but it is less reliable due to the limited number of observations.

[20] The number of households in each zip code is assumed to be fixed in 2000–2010.

[21] The TNS Bill Harvesting database contains households' cable and satellite expenditures. When prices from the web archive, newspapers and "rate cards" are unavailable, we use the mean expenditure whenever the number of respondents attributed to a particular cable system in that year exceeds 5.

3.2.2 Upstream Market Data

The upstream market data contains the input fees paid by the downstream firms to the upstream firms and the advertising revenues per subscriber. Both are taken from the SNL Kagan database.

We observe the input fees paid to each channel in each year from 2000 to 2010 averaged across service providers.

The aggregate advertising revenue (of each channel in each year) is divided by the total number of households that have access to the channel multiplied by 12 to obtain the average advertising revenue per subscriber per month.

Tables 13–14 in the Appendix report the summary statistics for the upstream market data.

3.3 Where do Size Effects Come from in Multichannel Television?

In this section, we make two related points. First, we use empirical and institutional evidence to argue that size effects in negotiations are the reality in the multichannel television industry. As the actual contracts are confidential and the SNL Kagan data do not break down channel subscriber fee revenue by downstream firm, we must infer size effects from publicly available data such as these. Second, we discuss the theory of buyer power arising from size which is plausible for this industry.

3.3.1 Preliminary Evidence on the Existence of Size Effects

First, previous studies (Crawford and Yurukoglu, 2012; Chipty, 1995) estimate that larger downstream firms have lower marginal costs. The main evidence for these findings is that prices are lower for larger downstream firms, conditional on measures of quality. As input costs for programming are the largest component of marginal costs, this suggests that input costs are lower for larger downstream firms.

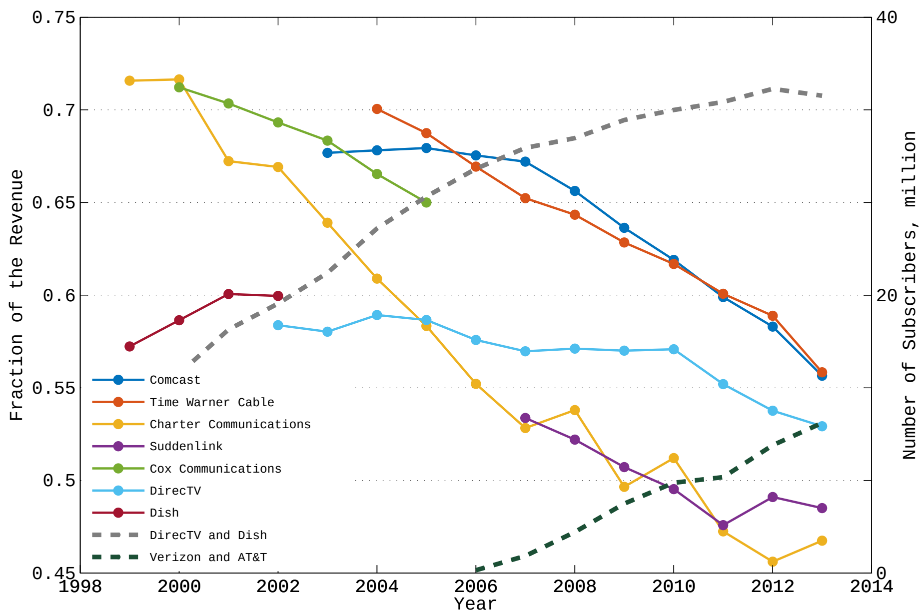
As a second piece of preliminary evidence, we examine data on video revenues and video programming costs for publicly traded downstream firms. While our model later accounts for differences in demand conditions, channels offered, and market power amongst these firms, the raw comparisons are suggestive. Figure 2, using the data from the firms' financial reports, plots the downstream markups (the left vertical axis) measured as

$$\text{Markup} = \frac{\text{Revenue} - \text{Programming Costs}}{\text{Revenue}}.$$

It shows that smaller downstream firms (Charter Communications, Suddenlink, and Cox Communications) generally have lower markups than the larger firms (Comcast, Time Warner Cable, DirecTV, and Dish Network).

The graph also shows that in 1999–2013 the markups were shrinking over time. During that period the downstream competition was growing as demonstrated by the dashed lines which show the total number of subscribers (the right axis) to the satellite companies (DirecTV and Dish Network) and the telecom companies (AT&T U-Verse and Verizon FiOS).[22] Whether the increasing downstream competition can explain the time trend in the markups is one of the questions addressed in our paper.

Figure 2: Downstream Markups



Finally, the size effect is considered common knowledge in the industry. For instance, Ross J. Lieberman, Senior Vice President of Government Affairs, American Cable Association, in his April 2014 statement before the Judiciary Committee on the proposed

[22]According to Nielsen, the total number of television households grew from 102.2 million in season 2000–2001 to 115.6 million in season 2013–2014.

AT&T and DirecTV merger, said:

> *"For most MVPDs,[23] the single largest cost of providing video service is programming cost, and the relative cost of programming for smaller MVPDs is significantly higher than for larger MVPDs because of the discriminatory pricing practices of the large programmers. The spread between the largest and smallest is commonly thought to average about 30%."*

Further evidence comes from testimony in merger proceedings. For example, in support of the AT&T acquisition of DirecTV, the merging parties claimed:

> *"This transaction will create a combined entity with a much larger subscriber base than AT&T currently has and thus offer much more value to programmers. That, in turn, should result in lower content costs... No party seriously disputes that the merger will enable the combined company to reduce the cost of acquiring content, which is the largest and most critical variable cost for MVPDs."*

The Federal Communications Commission admitted these marginal cost reductions into its assessment of consumer benefits for the merger. In other words, there was a consensus between the regulator, third parties, and merging firms that increased size would lead to increased bargaining power for distributors vis-à-vis content.

3.3.2 Theoretical Justification for the Existence of Size Effects

Theory does not guarantee size-based increases in bargaining power. Indeed, many basic theories would predict that larger firms pay higher input fees, or that there is no difference at all. Consider a bilateral monopoly with Nash bargaining over a linear input cost. Making the downstream firm larger by increasing its stand-alone utility or stand-alone marginal cost would increase the equilibrium input fee. This is because the linear fee is the instrument to share surplus, and increasing the size of the downstream firm in this manner increases the surplus to be shared. Making the downstream firm larger by doubling the size of its market, in contrast, would have no effect on the equilibrium input fee. This increase in market size raises the stakes for both the upstream and downstream, but does not alter their relative positions. Other theories predict that bigger buyers may pay higher fees (Raskovich, 2003).

[23]Multichannel video programming distributors.

Katz (1987) provides an appealing theoretical foundation for the existence of size effects in the multichannel television industry. Specifically, size advantages derive from economies of scale in seeking alternative supply. Alternative supply can be from backwards integration into content, or from nurturing a new entrant, or from encouraging a content provider who you have a deal with to add content similar to the content under negotiation. To make this concrete, the theory says that Comcast, with its 23 million subscribers, has more bargaining power than Cablevision, three million subscribers, with respect to Food Network, because Comcast has an advantage in using the threat of starting its own content channel of food-related programming than Cablevision. These advantages are natural in this industry. The two revenue sources for a channel are subscription revenues and advertising revenues. Comcast has the ability to make the new channel available to its larger amount of subscribers over night. Cablevision would have to negotiate with other providers, who may have deals with Food Network already, to launch a competitor to Food Network on the same scale as Comcast. Furthermore, Comcast need not ever exercise this outside option in equilibrium to achieve lower content costs.

This formulation also explains why Google, one of the largest firms ever, does not benefit from a size effect, as the relevant measure of size in this theory is the total number of downstream video subscribers. Similarly, the National Cable Television Cooperative, a buyer cooperative which bargains on behalf of smaller cable firms, is not able to achieve as low input costs of a single downstream with the same scale, because that organization is not centralized enough to launch its own content on all its member systems at once.

While the Katz theory of scale in alternative sources of supply is appealing, an empirical verification would require a model of entry into programming which is beyond the scope of this paper. Other theories which predict the existence of buyer size effects in input prices include Snyder (1998), where big buyers affect the degree of collusion that can be supported among suppliers, and Chipty and Snyder (1999) when the bilateral surplus function is concave in the downstream quantity.

4 Model

We use a model which is a slight modification of the model from Crawford and Yurukoglu (2012), and similar to and Crawford et al. (2015). The model consists of several parts: (i) the viewing problem, (ii) the bundle/firm choice problem, (iii) the pricing problem, and (iv) the bargaining problem. The timing of the model is the following:

1. Bargaining and pricing:
   - Channels and distributors negotiate the input fees.
   - Distributors choose the downstream prices at the local level.
2. Household firm choice:
   - Households choose service providers among those available in their markets.
3. Viewing:
   - Households choose how much time to spending watching each channel to which they have access.

4.1 Viewing Problem

Let $\mathcal{C}_{fmt} \subseteq \{1, \ldots, C\}$ be the set of channels available to household i in market m in year t if the household subscribes to firm f (which is present in market m) and $c = 0$ denotes the outside option (not watching any channels). The household solves the following optimization problem

$$\begin{aligned} \max_{\{t_{ict}\colon c=0,1,\ldots,C\}} \quad & \left(\sqrt{t_{i0t}} + \sum_{c=1}^{C} \gamma_{ict} \sqrt{t_{ict}} \right) \\ \text{s.t.} \quad & \sum_{c=1}^{C} t_{ict} \leq T \\ & t_{ict} \geq 0, \quad c \in \mathcal{C}_{fmt} \cup \{0\} \\ & t_{ict} = 0, \quad c \notin \mathcal{C}_{fmt} \cup \{0\}, \end{aligned}$$

where $\{\gamma_{ict}\}_{c=1}^{C}$ are the (random) taste parameters of the household (assumed nonnegative) and T is the total time available to the household.

This problem has a closed form solution. If $c \notin \mathcal{C}_{fmt} \cup \{0\}$ or $\gamma_{ict} = 0$, then $t_{ict} = 0$. Otherwise,

$$\begin{aligned} t_{i0t} &= \frac{T}{1 + \sum_{c' \in \mathcal{C}_{fmt}} \gamma_{ic't}^2} \\ t_{ict} &= \frac{\gamma_{ict}^2 T}{1 + \sum_{c' \in \mathcal{C}_{fmt}} \gamma_{ic't}^2}. \end{aligned}$$

The indirect utility of household i from the viewing problem if it chooses firm f in year t is

$$v^*_{ifmt} = \sqrt{1 + \sum_{c' \in \mathcal{C}_{fmt}} \gamma^2_{ic't}} \cdot \sqrt{T}.$$

The household always has an option not to subscribe to any of the available firms and get the indirect utility

$$v^*_{i0mt} = \sqrt{T}.$$

4.2 Bundle/Firm Choice Problem

Let $\mathcal{F}_{mt}$ be the set of firms present in market m in year t. Then household i in market m in year t chooses firm f that gives the highest utility

$$u_{ifmt} = \beta^v v^*_{ifmt} + x'_{fmt}\beta^x + \chi^{sat}_{if}\beta^{sat}_f + \chi^{telecom}_{if}\beta^{telecom}_f + \alpha p_{fmt} + \xi_{fmt} + \varepsilon_{ifmt},$$

where v^*_{ifmt} is the household's indirect utility from the viewing problem, x_{fmt} are the year effects and the firm-state effects. χ^{sat}_{if} are random coefficients that alters the household's taste for each satellite firm f, $\chi^{telecom}_{if}$ is a random coefficient if firm f if AT&T or Verizon,[24] p_{fmt} is the bundle's price, ξ_{fmt} is an unobserved firm-market-year level shock, and ε_{ifmt} is an idiosyncratic extreme value type-I shock.

Given the assumption about the distribution of ε_{ifmt}, the probability that the household chooses firm f,

$$s_{ifmt} = \frac{\exp\left(u_{ifmt} - u_{i0mt}\right)}{1 + \sum_{g \in \mathcal{F}_{mt}} \exp\left(u_{igmt} - u_{i0mt}\right)},$$

where u_{i0mt} is the household's utility from the outside option,

$$u_{i0mt} = \beta^v \sqrt{T}.$$

The market share of firm f in market m in year t is then equal to

$$s_{fmt} = \int_i s_{ifmt}\, dG_{mt}(i),$$

[24] If f is a cable firm, $\chi^{sat}_{if} = \chi^{telecom}_{if} = \beta_f = 0$.

where G_{mt} is the distribution of random coefficients $(\gamma, \chi^{sat}, \chi^{telecom})$ in market m in year t.

4.3 Downstream Pricing Problem

Each downstream firm f present in market m in year t solves the following profit maximization problem. Following industry practice, we assume the satellite firms set nationwide prices, while wire-based distributors set market-specific prices.

$$\max_{p_{fmt}} \pi^{down}_{fmt} \left(\{\mathcal{C}_{gmt}, p_{gmt}, \tau_{gct},\ g \in \mathcal{F}_{mt}, c = 1, \ldots, C\} \right),$$

where

$$\pi^{down}_{fmt} \left(\{\mathcal{C}_{gmt}, p_{gmt}, \tau_{gct},\ g \in \mathcal{F}_{mt}, c = 1, \ldots, C\} \right) = D_{fmt}(p_{fmt} - mc_{fmt}),$$

$D_{fmt} = s_{fmt} N_{mt}$ is the demand for bundle f where N_{mt} is the total number of households in market m in year t. The marginal costs, mc_{fmt}, are equal to

$$mc_{fmt} = \sum_{c\colon c \in \mathcal{C}_{fmt}} \tau_{fct} + \omega_{fmt}.$$

We denote by τ_{fct} the input fee that firm f pays to channel c in year t per subscriber per month, and by ω_{fmt} the component of the marginal costs that is not related to programming.

If $\mathcal{M}_{ft}$ is the set of markets where downstream firm f operates in year t,[25] the total profit of firm f in year t is given by

$$\pi^{down}_{ft} \left(\{\mathcal{C}_{gmt}, p_{gmt}, \tau_{gct},\ m \in \mathcal{M}_{ft}, g \in \mathcal{F}_{mt}, c = 1, \ldots, C\} \right) = \sum_{m \in \mathcal{M}_{ft}} \pi^{down}_{fmt}.$$

4.4 Bargaining Problem

The profit of an upstream firm c in year t is

$$\pi^{up}_{ct} \left(\{\mathcal{C}_{fmt}, \tau_{fct},\ m \in \mathcal{M}_{ct}, f \in \mathcal{F}_{mt}\}, a_{ct} \right) = \sum_{m \in \mathcal{M}_{ct}} \sum_{f\colon c \in \mathcal{C}_{fmt}} D_{fmt} \left(\tau_{fct} + a_{ct} \right),$$

[25] In other words, $\mathcal{M}_{ft} = \{m\colon f \in \mathcal{F}_{mt}\}$.

where a_{ct} is the advertising revenue (per subscriber per month) of channel c in year t and $\mathcal{M}_{ct}$ denotes the set of markets where channel c is carried by at least one bundle.[26]

Channel c and distributor f negotiate their input fee, τ_{fct}, taking all other input fees as given, to solve

$$\max_{\tau} \left(\left[\sum_{m\colon c \in \mathcal{C}_{fmt}} \Delta_{fc} \pi^{down}_{fmt}(\tau) \right]^{\zeta_{fct}} \left[\sum_{m\colon c \in \mathcal{C}_{fmt}} \Delta_{fc} \pi^{up}_{fmt}(\tau) \right]^{1-\zeta_{fct}} \right),$$

where ζ_{fct} is the bargaining power parameter and $\Delta_{fc}\pi^{down}_{fmt}(\tau)$ and $\Delta_{fc}\pi^{up}_{fmt}(\tau)$ are the "gains from trade" of the distributor and the channel respectively. That is,

$$\Delta_{fc}\pi^{down}_{fmt}(\tau) = D_{fmt}(p_{fmt} - mc_{fmt}) - D^{-fc}_{fmt}(p_{fmt} - mc_{fmt} + \tau)$$

and

$$\Delta_{fc}\pi^{up}_{fmt}(\tau) = D_{fmt}(\tau + a_{ct}) + \sum_{g \neq f\colon c \in \mathcal{C}_{gmt}} \left(D_{gmt} - D^{-fc}_{gmt} \right) (\tau_{gct} + a_{ct}),$$

where D^{-fc}_{fmt} denotes the demand for bundle f in market m when channel c is dropped from the bundle.

If firms c and f don't come to an agreement, channel c is dropped in all local markets served by f. Relative to having an agreement, no agreement changes first the demand for f in each market m where it carries c. Second, disagreement decreases the marginal costs of f in those markets as it no longer pays c. The upstream firm likewise loses the input fees from f and all the advertising revenue generated by the subscribers of f. However, the demand increase for other firms that carry c in market m increases which has an offsetting effect on both fee revenues and advertising revenues.

We assume that downstream pricing and bargaining happen simultaneously so that if firms c and f disagree the downstream prices are not revised.[27] Given the assumption of simultaneous pricing and bargaining, finding the optimal input fees $\{\tau_{fct}\}_{f=1}^{F}$ amounts to solving a system of linear equations (one equation for each $f = 1, \ldots, F$).

[26] Namely, $\mathcal{M}_{ct} = \{m\colon \exists f \in \mathcal{F}_{mt}\colon c \in \mathcal{C}_{fmt}\}$.

[27] This assumption, made also in Crawford, Lee, Whinston, and Yurukoglu (2015), could be replaced by a sequential bargaining-then-pricing setup as in Crawford and Yurukoglu (2012). The key advantage of the simultaneous determination of pricing and bargaining is that it lowers the computational burden joint estimation of the bargaining and demand parameters dramatically.

5 Estimation and Identification

5.1 Estimation

To estimate the model, we parameterize G_{mt}, the distribution of random coefficients $(\gamma, \chi^{sat}, \chi^{telecom})$ and the bargaining power parameters $\{\zeta_{fct},\ f = 1, \ldots, F, c = 1, \ldots, C, t = 1, \ldots, T\}$.

We assume that for $c = 1, \ldots, C$ and $t = 1, \ldots, T$

$$\gamma_{ict} = \chi_{ict} \cdot \tilde{\gamma}_{ict},$$

where χ_{ict} is a Bernoulli random variable with parameter ρ_c and $\tilde{\gamma}_{ict}$ is an exponential random variable with parameter $\lambda_{ct} = \lambda_{c0} + \lambda_{c1} t$. This allows each channel's taste distribution to trend linearly over time. Controlling for changing channel quality is important, as we later attribute increases in input fees to increases in bargaining power for channels over time.

We also assume that χ^{sat}_{if} is equal to zero if f is a cable firm and is distributed as an exponential random variable with parameter one if f is a satellite firm. Similarly, $\chi^{telecom}_{if}$ is equal to zero if f is a cable firm and is distributed as an exponential random variable with parameter one if f is AT&T or Verizon. We simulate $N = 150$ households per market-year, and later account for simulation error in the standard errors. For the counterfactuals, we increase the number of simulations to $N = 300$ households per market-year.

For the bargaining power parameter we let for $c = 1, \ldots, C,\ f = 1, \ldots, F$, and $t = 1, \ldots, T$

$$\zeta_{fct} = \zeta_{c0} + \zeta_1 t + \zeta_s \cdot size_{ft},$$

where $size_{ft}$ is the size of firm f in year t measured by the total number of subscribers in that year. This mechanically gives larger downstream firms more bargaining power at a rate which we estimate. Our interpretation is that this parameter substitutes for modeling the backwards integration decision which would generate bargaining leverage for the larger downstream firms as discussed in Section 3.3.2. Avoiding modeling entry into channels is desirable because the dynamic entry process would significantly increase the computational burden of the model. Furthermore, as backwards integration need not happen in equilibrium, the data for estimating the parameters of such a model will be limited. The key question is whether the bargaining power parametrization we employ here can be reasonably held fixed in counterfactual analysis.

A useful analogy can be made between estimated bargaining parameters and productivity residuals in production function estimation. These parameter capture un-modeled effects that generate either more production given inputs in the case of productivity, or different input fees given demand and costs in the case of bargaining. The estimated productivity residuals are thought to capture forces such as management practices, input quality heterogeneity, quality of legal system, among other possible determinants of output. We are effectively adding size as a co-variate into the input fee determination process without going so far as to model the full entry game that would generate such an advantage. This would be analogous to adding a measurement of management practices as a covariate into a production function without modelling how the management practices precisely increases output given measured inputs.

We assume that the downstream firms treat the bargaining power parameters as fixed and do not strategically choose prices to increase their bargaining power (or decrease the bargaining powers of the competitors) through the total number of subscribers.

5.1.1 Moment Conditions

We match the following moments computed from the model with their analogs observed in the data.

1. **Viewership moments.** For each channel $c = 1, \ldots, C$ and year $t = 1, \ldots, T$:
   - The fraction of households that spend nonzero time watching channel c in year t.
   - The average time that households spend watching channel c in year t.
2. **Markup moments.** For a subset of downstream firms $f = 1, \ldots, F$ and years $t = 1, \ldots, T$ such that the data are available in the 10k reports:
   - The (average) markup of firm f in year t.[28]

[28]These data are available for Comcast in 2003–2010, Time Warner Cable in 2004–2010, Charter Communications in 2000–2010, Cox Communication in 2000–2005, DirecTV in 2002–2010, and Dish Network in 2000–2002.

3. **Size effect moments.** For a subset of downstream firms $f = 1, \dots, F$ and years $t = 1, \dots, T$ such that the data are available in the 10k reports:

   - The programming costs of firm f in year t as a fraction of the programming costs of the benchmark firm (Comcast) in year t.[29]
   - We set a moment that Verizon and AT&T aggregate input costs should be 32.5% more than Comcast in 2007 following a data point from SNL Kagan.[30]

4. **Input fee moments.** For each channel $c = 1, \dots, C$ and each year $t = 1, \dots, T$:

   - The average (across distributors) input fee, $\overline{\tau}_{ct}$.
   - For each distributor-year, the average deviation of ω from the year average is zero. That is, we regress the difference in implied marginal costs minus the sum of input fees on year dummy variables. We form moments that the average residuals from this regression for each firm-year should be zero.

5. **Price coefficient.**

   - The unobserved shock, ξ_{fmt}, must be uncorrelated with the price instrument (the state-specific satellite tax). As we include state by firm fixed effects and year effects in the utility function, this moment requires the within-state-firm deviations from mean unobserved quality over time to be uncorrelated with changes in the satellite tax rate.

6. **Indirect utility coefficient.**

   - The average (across all households in market m in year t) indirect utility, $\overline{v}^*_{fmt}$, must be uncorrelated with the unobserved shock, ξ_{fmt}.

We currently adjusted the weights on the moments manually to deal with differences in units across moments. In the next iteration, we will weight the moments optimally by their inverse variance.

[29] Available for Comcast, Time Warner Cable, and Charter Communications in 2006–2010.

[30] "FiOS's programming costs are growing more slowly than their competitors' because the fees started higher — seven years ago, when FiOS launched, it was paying 30%-35% more than other multichannel players." From `http://go.snl.com/rs/snlfinanciallc/images/SNL-Kagan-US-Multichannel-Subscriber-Update-Programming-Cost-Analysis.pdf`

5.2 "Empirical" Identification

In this section we provide some intuition on how the derived moment conditions determine the model parameters in practice. While all parameters affect all moments through the non-linear structure of the model, certain parameters are more sensitive to certain moments which is what we refer to as "empirical identification," rather than the formal identification of the model given the data generating process.

1. The channel taste parameters, $\{\rho_c, \lambda_{c0}, \lambda_{c1}\}$, $c = 1, \ldots, C$. These parameters are identified from two sources of variation. First, the variations in the viewing times and fractions of households that spend nonzero time watching a channel (both across channels and over time) identify the taste parameters. Second, as these parameters affect households' willingness to pay for the channels which in turn affects the negotiated input fees through the bargaining problem, the variation in input fees across channels and across time helps identify the parameters.

2. The satellite firm taste parameters, β_f^{sat}, $f = 1, \ldots, F$, are identified from the markup moments. In the absence of random coefficients (or if $\beta_f^{sat} = 0$) the markups would be determined by the satellite market shares (which determine the elasticities). As the market shares of satellite bundles are considerably smaller than those of the cable companies while the markups are comparable, random coefficients (and positive $\beta_f^{sat} = 0$) help fit the markups observed in the data by creating a captive subset of consumers who subscribe to the satellite firm despite a relatively high price.

3. The telecom firm taste parameter, $\beta_f^{telecom}$, is pinned down by the condition that differences in input costs and implied marginal costs are mean zero within firm-year. This implies that the mark-ups earned by telecom providers can not be too high, and thus limits the size of their random effects.

4. The indirect utility coefficient, β^v, is identified from the variation in the market shares of bundles that carry different sets of channels.

5. The price coefficient is identified from the variation in the market shares when the state-specific satellite tax changes.[31] Table 1 reports the states that increased their

[31] As the observed characteristics, x_{fmt}, include state×firm dummies, changes in the state-specific satellite tax are required to identify the price coefficient.

satellite taxes between 2000 and 2010. Table 2 provides a reduced form evidence in favor of using the satellite tax as an instrument.

6. The channel-specific bargaining power parameters, $\{\zeta_{c0}\}$, $c = 1, \ldots, C$ are identified from the levels of each channel's input fees. Advertising revenue and value of viewership create a zone of mutually-agreeable input fees for each pair of channel and distributor. The bargaining parameter for each pair picks out a value in that zone. As ζ_{c0} increases the implied input fee for every distributor for a given channel, it is strongly sensitive to the observed average input fee. Changes in the input fees over time identify ζ_1. Differences in the total programming costs between the distributors of different size identify ζ_s.

Table 1: Satellite Tax Changes in 2000–2010

State	Year	Tax Change
Connecticut	2003	+5%
Florida	2002	+10%
Kentucky	2006	+5%
Massachusetts	2009	+5%
North Carolina	2003	+7%
Ohio	2003	+6%
Utah	2003	+5%

Notes: Each row corresponds to a state which changed its excise tax on satellite during out sample period along with the corresponding change in the rate.

Table 2: Satellite Tax as a Price Instrument

	log(Market Share) − log(Outside Good Market Share)			
	(OLS)		(2SLS)	
Parameter	Estimate	Standard Error	Coefficient	Standard Error
α	-0.0039^{**}	0.0016	-0.0862^{***}	0.0163
Channel Dummies	✓		✓	
Year Dummies	✓		✓	
State×Firm Dummies	✓		✓	
Number of Observations	24,341		24,341	

Notes: * p-value ≤ 0.10, ** p-value ≤ 0.05, *** p-value ≤ 0.01. The 2SLS column corresponds to a specification where we instrument for price with the satellite tax rate. As we are including state x firm dummy variables, the variation in satellite tax rates is due to the states listed in Table 1.

6 Results

Tables 3 and 4 report the estimates of the channel taste parameters and Figure 3 shows the implied monthly willingness to pay for selected channels in 2010. Table 15 in the Appendix reports the average monthly willingness to pay for all of the channels in 2000 and 2010. As λ_{c1} is positive for most of the channels, the implied willingness to pay is generally increasing over time. This is a consequence of the channel ratings rising from 2000 to 2010. As can be seen from Figure 3, the distribution of willingness to pay for ESPN stochastically dominates those of the other channels.

Table 3: Channel Taste Parameters (Part 1)

Channel	$\hat{\rho}_c$	std.err.($\hat{\rho}_c$)	$\hat{\lambda}_{c0}$	std.err.($\hat{\lambda}_{c0}$)	$\hat{\lambda}_{c1}$	std.err.($\hat{\lambda}_{c1}$)
ABC Family Channel	0.3135	0.00009	0.0685	0.00003	0.00169	0.000005
American Movie Classics	0.3132	0.00026	0.0769	0.00003	0.00126	0.000006
Animal Planet	0.3870	0.00012	0.0532	0.00002	0.00260	0.000005
Arts Entertainment	0.4216	0.00017	0.1005	0.00003	0.00011	0.000005
BET	0.1289	0.00015	0.0511	0.00013	0.00118	0.000017
Bravo	0.1742	0.00024	0.0366	0.00010	0.00378	0.000012
Cartoon Network	0.2017	0.00024	0.0934	0.00007	−0.00084	0.000007
CMT	0.1174	0.00004	0.0288	0.00038	0.00158	0.000035
CNBC	0.3308	0.00033	0.0706	0.00005	−0.00005	0.000004
CNN	0.5495	0.00018	0.0921	0.00003	0.00021	0.000004
Comedy Central	0.3116	0.00015	0.0582	0.00004	0.00223	0.000006
Discovery Channel	0.5578	0.00006	0.0937	0.00002	0.00043	0.000004
Disney Channel	0.3632	0.00009	0.0873	0.00004	0.00301	0.000005
E! Entertainment TV	0.2689	0.00013	0.0571	0.00004	0.00110	0.000004
ESPN	0.7048	0.00031	0.1065	0.00004	0.00342	0.000004
ESPN 2	0.2966	0.00017	0.0586	0.00004	0.00202	0.000005
ESPN Classic Sports	0.1373	0.00011	0.0202	0.00066	0.00090	0.000060
Food Network	0.3742	0.00015	0.0469	0.00003	0.00538	0.000008
Fox News Channel	0.5119	0.00020	0.0575	0.00003	0.00693	0.000005

Notes: The standard errors are computed using 1,000 bootstrap simulations. Each time we sample from the set of market×year observations and draw a set of new simulated households.

The estimates of α, β^v, and β_f^{sat} are reported in Table 5. Table 6 reports the own- and cross-price elasticities implied by the estimated parameters. We compute the elasticities separately for the markets with only three and more than three downstream competitors. The estimates suggest that the demand for satellite bundles is more elastic which is consistent with the previous findings in the literature.[32]

Table 7 shows the estimates of the channel-specific bargaining power parameters and

[32]See Crawford, Lee, Whinston, and Yurukoglu (2015).

Table 4: Channel Taste Parameters (Part 2)

Channel	$\hat{\rho}_c$	std.err.($\hat{\rho}_c$)	$\hat{\lambda}_{c0}$	std.err.($\hat{\lambda}_{c0}$)	$\hat{\lambda}_{c1}$	std.err.($\hat{\lambda}_{c1}$)
FX	0.2808	0.00027	0.0536	0.00003	0.00300	0.000007
Golf Channel	0.1079	0.00018	0.0241	0.00040	0.00227	0.000044
Hallmark Channel	0.2140	0.00021	0.0105	0.00011	0.00695	0.000012
HGTV	0.3372	0.00009	0.0575	0.00003	0.00459	0.000006
History Channel	0.4447	0.00018	0.0781	0.00003	0.00279	0.000006
Lifetime	0.3809	0.00033	0.0921	0.00004	0.00097	0.000005
MSNBC	0.3629	0.00014	0.0593	0.00003	0.00220	0.000006
MTV	0.2628	0.00009	0.0764	0.00004	0.00000	0.000005
Nickelodeon	0.2380	0.00024	0.1128	0.00006	−0.00026	0.000006
SyFy	0.2595	0.00012	0.0606	0.00003	0.00205	0.000005
TBS	0.4584	0.00014	0.1008	0.00003	0.00105	0.000004
TLC	0.3289	0.00016	0.0684	0.00003	0.00239	0.000005
truTV	0.2681	0.00010	0.0410	0.00005	0.00263	0.000007
Turner Classic Movies	0.2480	0.00014	0.0418	0.00005	0.00397	0.000006
TNT	0.4732	0.00022	0.0988	0.00003	0.00303	0.000005
USA	0.3767	0.00016	0.0939	0.00003	0.00305	0.000006
VH1	0.2199	0.00005	0.0551	0.00004	0.00034	0.000010
Weather Channel	0.5667	0.00008	0.0648	0.00002	0.00081	0.000004

Notes: The standard errors are computed using 1,000 bootstrap simulations. Each time we sample from the set of market×year observations and draw a set of new simulated households.

Table 5: The Estimates of α, β^v, β^{sat}_f, and β^{tele}

Parameter	Estimate	Standard Error
α	−0.1681	
β^v	44.0496	
$\beta^{sat}_{DirecTV}$	6.0550	
β^{sat}_{Dish}	2.4139	
β^{tele}	7.4582	

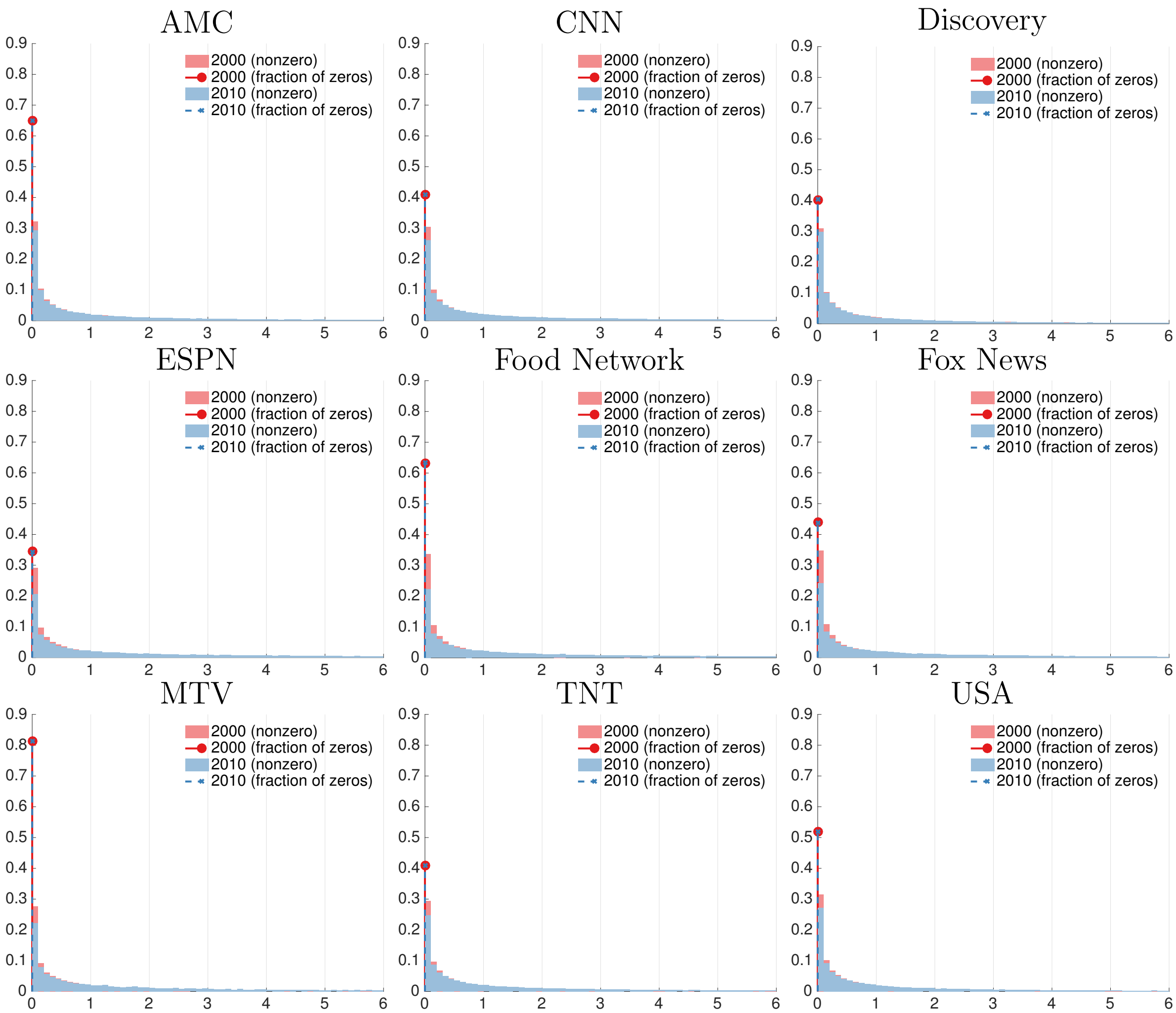
Notes: The standard errors are computed using 1,000 bootstrap simulations. Each time we sample from the set of market×year observations and draw a set of new simulated households.

their standard errors. As $\zeta_{fct} = \zeta_{c0} + \zeta_1 t + \zeta_s \cdot size_{ft}$ determines the bargaining power of distributor f versus channel c, the higher is ζ_{c0} the stronger is the average bargaining power of the distributors against channel c.

The estimate of ζ_1 is 0.0006 with the standard error of XX. The fact that this coefficient so small suggests that the rise in input fees over time can be explained by increasing downstream competition alone.

The estimate of the size effect parameter, ζ_s, is equal to 0.0037 and its standard error is ZZ. As the estimate is positive, the model implies that a merger of two downstream

Figure 3: The Distributions of Willingness to Pay in 2010



Notes: The distribution of willingness to pay (in dollars per month) is truncated at $10.

firms would lead to an improved bargaining position of the merged firm and lower input fees. In concrete terms, Figure 4 displays the model's predictions for differences in input costs for Comcast and Cablevision. The larger Comcast is able to negotiate about 25% lower fees in aggregate in 2010. The figure also displays that the model matches the input fees for the 37 channels we analyze quite well over time despite a bargaining power parameterizations that has a common linear time trend.

The bargaining power parameters vary significantly across channels. The sport channels (ESPN, ESPN 2, ESPN Classic Sports, and Golf Channel) generally have higher bargaining power (lower bargaining power parameters). This is a consequence of the input fees observed in the data (e.g. the input fees paid to ESPN are ten times higher than

Table 6: The Estimates of Own- and Cross-price Elasticities

3 Distributors			
Firm	Cable	DirecTV	Dish
Cable	−1.3986	0.1778	0.2991
DirecTV	1.1120	−1.6506	0.1408
Dish	2.8933	0.2223	−3.9962
> 3 Distributors			
Firm	Cable	DirecTV	Dish
Cable	−2.4783	0.2787	0.5538
DirecTV	0.8592	−2.0785	0.2557
Dish	2.2433	0.3270	−4.3324

Notes: Cell (f_1, f_2) reports the average price elasticity of demand for f_1 with respect to f_2's price.

Table 7: Channel-specific Bargaining Power Parameters

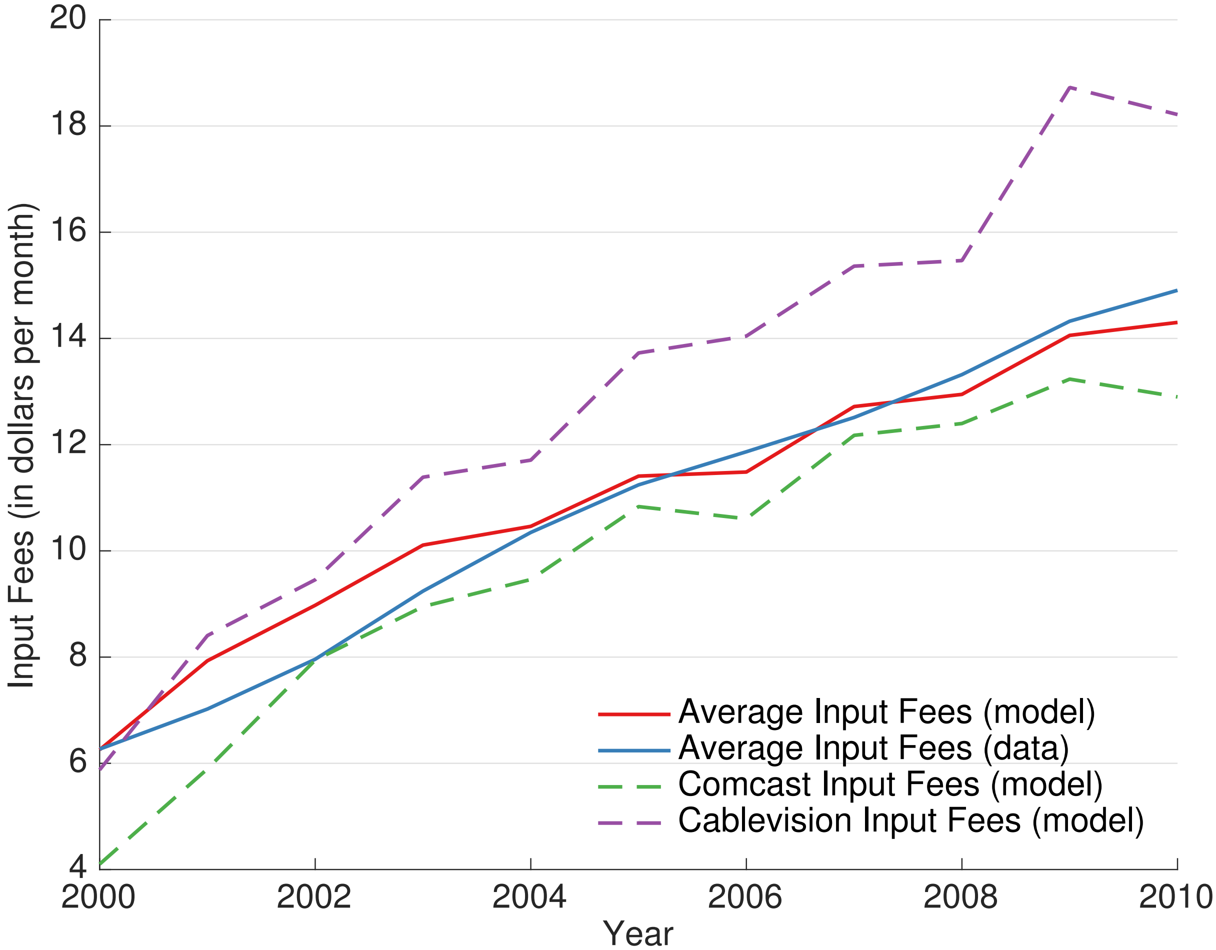
Channel	$\hat{\zeta}_{c0}$	std.err.($\hat{\zeta}_{c0}$)	Channel	$\hat{\zeta}_{c0}$	std.err.($\hat{\zeta}_{c0}$)
ABC Family Channel	0.5433		FX	0.2401	
American Movie Classics	0.4195		Golf Channel	0.0323	
Animal Planet	0.5532		Hallmark Channel	0.5979	
Arts Entertainment	0.6005		HGTV	0.6779	
BET	0.4785		History Channel	0.6297	
Bravo	0.3904		Lifetime	0.6031	
Cartoon Network	0.6750		MSNBC	0.5269	
CMT	0.3963		MTV	0.3776	
CNBC	0.4488		Nickelodeon	0.5386	
CNN	0.5402		SyFy	0.4934	
Comedy Central	0.5955		TBS	0.5261	
Discovery Channel	0.5731		TLC	0.4404	
Disney Channel	0.1909		truTV	0.6252	
E! Entertainment TV	0.4257		Turner Classic Movies	0.3741	
ESPN	0.0000		TNT	0.3628	
ESPN 2	0.0076		USA	0.3860	
ESPN Classic Sports	0.1929		VH1	0.3769	
Food Network	0.7425		Weather Channel	0.6566	
Fox News Channel	0.5919				

Time and Size Effects

Effect	$\hat{\zeta}$	std.err.($\hat{\zeta}$)
Time Trend (per year)	0.0006	
Size Effect (per million subscribers)	0.0037	

Notes: The standard errors are computed using 1,000 bootstrap simulations. Each time we sample from the set of market×year observations and draw a set of new simulated households.

Figure 4: Estimated Input Costs



Notes: These lines correspond to the weighted (by subscribers) sums of input costs for the 37 cable channels as predicted by the model at the estimated parameters.

those paid to some other channels). Our viewing model implies a direct link between the watching time (ratings) and the willingness to pay for the channel. A more flexible model that allows different consumer values from a unit of time spent watching different channels would reduce the variation in the bargaining power parameters across channels as in Crawford et al. (2015).

7 Counterfactuals

In this section, we show how accounting for size-based bargaining leverage is important for merger analysis and for the analysis of entry. For merger analysis, size-based bargaining leverage provides a natural efficiency in lower input costs that a regulator can weigh against any market power effects. For new entrants, size-based bargaining leverage creates a disadvantage that can materially affect profits.

7.1 Merger Analysis

We simulate several proposed or consummated mergers using the year 2010 which is the most recent year for our data. To simulate these mergers, we join the merging parties into a new firm. In markets where both firms were present, we maintain the two products of each party, but their prices are now jointly set by a common owner. We compute counterfactual input fees, downstream prices, and market shares. We then compute the implied consumer surplus, upstream profits (decomposed into advertising and fee revenue), and downstream profits.

The two main effects in these simulations are: (i) if the merging firms compete at the local level, the merger will reduce downstream competition– the classic horizontal market power effect, and (ii) the merged firm will have a stronger bargaining position against the channels and will be able to negotiate lower input fees due to its size– the size-based bargaining effect. The first effect will tend to increase industry profits and decrease consumer surplus. The second effect will tend to lower upstream profits, increase downstream profits, and increase consumer surplus. The net effect of these mergers on industry profits and consumer surplus is ambiguous in theory. As a caveat, there are several other non-modeled considerations that regulators analyzed in the review of these mergers. These include vertical considerations as some of the merging parties own content or Internet video platforms, and the effects of the mergers on incentives to invest both upstream in channel quality and downstream in distribution and broadband network quality. As described in Hill et al. (2015), the Department of Justice concluded that Comcast's acquisition of Time Warner Cable would increase their leverage in the programming market, and interpreted this as bad for welfare because of interactions with other vertical considerations, however the details of this logic are not public. The model we employ could be embedded into a larger model that captures these effects, but these are outside the scope of the analysis in this paper.

7.1.1 Comcast - Time Warner Cable

Comcast and Time Warner Cable are the two largest wire-based distributors in the United States. In 2013, they together served video programming to more than 32 million cus-

Table 8: Counterfactual Merger Outcomes

	(1) Status Quo	(2) Comcast - TWC		(3) Charter-TWC		(4) AT&T-DirecTV	
	Level	Level	%Δ	Level	%Δ	Level	%Δ
Prices and Market Shares							
Total Market Share	0.82	0.83	0.86	0.83	0.22	0.82	-0.01
Cable Market Share	0.57	0.58	2.27	0.57	0.58	0.55	-3.16
Satellite Market Share	0.26	0.25	-2.22	0.26	-0.57	0.28	7.00
Average Cable Price	57.96	57.20	-1.32	57.76	-0.34	58.00	0.07
Average Satellite Price	67.53	67.39	-0.20	67.49	-0.06	67.01	-0.77
Average Household Expenditure	50.30	50.18	-0.23	50.29	-0.01	50.29	-0.01
Merging Parties Market Share (in market)							
Comcast + TWC	0.49	0.51	4.83				
TWC + Charter	0.43			0.44	2.52		
AT&T + DirecTV	0.17					0.17	-0.05
Average Marginal Cost for Merging Parties							
Comcast + TWC	30.45	27.54	-9.57				
TWC + Charter	35.13			33.82	-3.73		
AT&T + DirecTV	36.77					36.18	-1.59
Average Price for Merging Parties							
Comcast + TWC	56.96	55.57	-2.45				
TWC + Charter	59.38			58.73	-1.10		
AT&T + DirecTV	69.65					69.67	0.02
Components of Welfare							
Consumer Welfare	34.75	35.21	1.33	34.86	0.31	34.74	-0.01
Downstream Profits	24.09	24.73	2.64	24.23	0.58	24.21	0.50
Comcast + TWC	8.67	9.51	9.61				
TWC + Charter	3.83			4.02	4.94		
AT&T + DirecTV	5.17					5.29	2.29
Upstream Fee Revenue	11.75	10.95	-6.80	11.59	-1.39	11.63	-1.03
Upstream Advertising Revenue	10.26	10.35	0.82	10.28	0.22	10.26	-0.01
Upstream Profits	22.02	21.30	-3.25	21.87	-0.64	21.89	-0.55
Total Welfare	80.85	81.24	0.47	80.96	0.13	80.85	-0.01

Notes: This table reports predictions of counterfactual mergers in the year 2010. Column (1) corresponds to the model's predictions for the status quo at the estimated parameters. (2), (3), and (4) correspond to counterfactual simulations under mergers between the identified parties.

tomers. The proposed merger was announced in February 2014 and was reviewed by the Federal Communication Commission since April 2014. At the time of the announcement the value of the deal was estimated as $45.2 billion. On April 24, 2015 Comcast announced that the deal was terminated.

There is no market power effect in the case of Comcast and Time Warner Cable merger because these distributors do not compete at the local level. This has implications for the direction of the overall effect of the merger. The larger firm will negotiate lower input fees which will lead to lower downstream prices. Our model implies that in the short-run the consumers as well as the merged downstream firm will definitely be better off and the profits of the upstream firms will be lower.

To compute the new input fees and downstream prices we re-solve the bargaining problem and iterate the best-response prices of the downstream firms until convergence.[33]

Our estimates imply that the programming costs of the merged firm will be 9.6% lower than the average programming costs of Comcast and Time Warner Cable before the merger.[34] This will allow the firm to optimally reduce the average downstream price by 2.45% (as compared to the average of Comcast and Time Warner Cable prices before the merger). The model predicts consumer surplus would increase by 1.33%, which is about $176 million per year in the short-run. Upstream profits decrease due to decreases in fee revenue. However, about 10% of these losses are recouped from increased advertising revenue as more subscribers enter the market. Total welfare increases by 0.47%.

While the merger analysis in this case turned on additional issues, such as broadband price discrimination and set top box integration, the short-run efficiencies created by scale are an important component of the analysis.

7.1.2 Charter - Time Warner Cable

After Comcast abandoned its merger with TWC, Charter made a bid for Time Warner Cable. Here, we do the same simulation as above but for Charter and Time Warner Cable. The overall scale of the combined firm is less than Comcast, so the results mirror Comcast in direction, but are scaled down. Again, there is no direct horizontal effect of this merger.

[33] We do not change the bundle compositions.

[34] The programming costs are obtained by adding up the input fees paid to all channels.

7.1.3 AT&T - DirecTV

The AT&T acquisition of DirecTV was approved and consummated. Given AT&T's modest size in 2010, the model's predictions for this merger are also modest quantitatively. In this case, there is a direct horizontal competition effect which must be traded off against scale efficiencies. We find that the profits of the merged entity increase by 2.29%, upstream fee revenue decreases by 1.03%, and total welfare is effectively unchanged. In terms of total welfare, the benefits of scale in bargaining with content are off-set by the increased market power of the combined firm.

7.2 Contracts and Entry

Another significant implication of size-based bargaining power is that the equilibrium contracts create a barrier to entry in the industry.[35] An entrant needs low input costs to scale up, but needs scale to achieve low input costs. In Table 9, we calculate counterfactual outcomes when size does not effect bargaining power, that is we set ζ_S to zero. We then calibrate the overall level of bargaining power through ζ_{c0} so that upstream revenues are unchanged. This allows direct comparisons with the status quo that aren't contaminated by a shift in the overall level of bargaining power for downstream firms.

Table 9: Size Effects and Barriers to Entry Counterfactual Outcomes

	Status Quo	No Size Effects	
	Level	Level	%Δ
Prices and Market Shares			
Verizon + AT&T Market Share	0.14	0.15	4.52
Verizon + AT&T Price	55.02	53.42	-2.92
Verizon + AT&T Marginal Cost	20.86	19.09	-8.48
Verizon + AT&T Profits	1.50	1.57	4.79
Components of Welfare			
Consumer Welfare	34.75	34.68	-0.21
Downstream Profits	24.09	24.20	0.45
Upstream Fee Revenue	11.75	11.75	-0.01
Upstream Advertising Revenue	10.26	10.26	-0.01
Upstream Profits	22.02	22.01	-0.01
Total Welfare	80.85	80.89	0.04

Notes: This table reports predictions of counterfactual outcomes in the year 2010. The first column of results corresponds to the model's predictions for the status quo at the estimated parameters. The next two columns correspond to the model's predictions for eliminating size-based differences in bargaining.

[35] Aghion and Bolton (1987) model the use of contracts between a supplier and incumbent to foreclose entry, however the mechanism here is different in that the barrier is created purely from the size effect.

We find that video profits for Verizon and AT&T would increase by 4.79% if they did not face a disadvantage due to size based bargaining parameters. This increase in profits is coming from a combination of a decrease in content costs of 8.48%, a decrease in price of 2.92%, and an increase in market share of 4.52%. Unfortunately, we do not know the exact cost of capital and the planned revenue stream associated with building out Verizon's and AT&T's wire-based networks, so we can not say which markets would be rendered profitable to build out by this change in profits.

8 Conclusion

This paper estimates, models, and analyzes the cost advantages large downstream distribution firms enjoy in procuring content. In this context, we analyze the short-run effects of potential mergers between Comcast and Time Warner Cable, Charter and Time Warner Cable, and AT&T and DirecTV. Wed conclude that in the absence of downstream competition between the two firms, these mergers will result in the lower downstream prices and the consumers will be better off. The merger between AT&T and DirecTV is not as clear cut as it also involves a loss of horizontal competition. Here we estimate that consumer welfare and total welfare are unchanged. Finally, we considered the degree to which size-based price discrimination lowers the profits of new entrants who have not achieved scale. We find that eliminating size-based bargaining power would increase the video profits of AT&T and Verizon by about 5%.

In terms of future research, the current model does not take into account that some of the distributors and channels are vertically integrated. It also ignores the long-run consequences of mergers such as the effect on investment, both in programming quality and in network quality. Long run changes due to changes in investment or entry could potentially change the predictions of these models for merger effects dramatically.

References

Aghion, P. and P. Bolton (1987). Contracts as a barrier to entry. *The American economic review*, 388–401.

Bhattacharyya, S. and A. Nain (2011). Horizontal acquisitions and buying power: A product market analysis. *Journal of Financial Economics 99*(1), 97–115.

Chipty, T. (1995). Horizontal integration for bargaining power: Evidence from the cable television industry. *Journal of Economics & Management Strategy 4*(2), 375–397.

Chipty, T. and C. M. Snyder (1999). The role of firm size in bilateral bargaining: A study of the cable television industry. *Review of Economics and Statistics 81*(2), 326–340.

Crawford, G. S., R. S. Lee, M. D. Whinston, and A. Yurukoglu (2015). The welfare effects of vertical integration in multichannel television markets.

Crawford, G. S. and A. Yurukoglu (2012). The welfare effects of bundling in multichannel television markets. *The American Economic Review 102*(2), 643–685.

Draganska, M., D. Klapper, and S. B. Villas-Boas (2010). A larger slice or a larger pie? an empirical investigation of bargaining power in the distribution channel. *Marketing Science 29*(1), 57–74.

Ellison, S. F. and C. M. Snyder (2010). Countervailing power in wholesale pharmaceuticals. *The Journal of Industrial Economics 58*(1), 32–53.

Fee, C. E. and S. Thomas (2004). Sources of gains in horizontal mergers: evidence from customer, supplier, and rival firms. *Journal of Financial Economics 74*(3), 423–460.

Galbraith, J. K. (1952). American capitalism: The concept of countervailing power.

Gandhi, A., Z. Lu, and X. Shi (2013). Estimating demand for differentiated products with error in market shares. Technical report, Cemmap Working Paper, Centre for Microdata Methods and Practice.

Gowrisankaran, G., A. Nevo, and R. Town (2015). Mergers when prices are negotiated: Evidence from the hospital industry. *The American Economic Review 105*(1), 172–203.

Grennan, M. (2013). Price discrimination and bargaining: Empirical evidence from medical devices. *The American Economic Review 103*(1), 145–177.

Hart, O. and J. Tirole (1990). Vertical integration and market foreclosure. *Brookings papers on economic activity. Microeconomics*, 205–286.

Hill, N., N. L. Rose, and T. Winston (2015). Economics at the antitrust division 2014–2015: Comcast/time warner cable and applied materials/tokyo electron. *Review of Industrial Organization 47*(4), 425–435.

Ho, K. and R. S. Lee (2015). Insurer competition in health care markets. *NBER Working Paper* (19401).

Horn, H. and A. Wolinsky (1988). Bilateral monopolies and incentives for merger. *The RAND Journal of Economics*, 408–419.

Inderst, R. and T. Valletti (2009). Price discrimination in input markets. *The RAND Journal of Economics 40*(1), 1–19.

Katz, M. L. (1987). The welfare effects of third-degree price discrimination in intermediate good markets. *The American Economic Review*, 154–167.

McAfee, R. P. and M. Schwartz (1994). Opportunism in multilateral vertical contracting: Nondiscrimination, exclusivity, and uniformity. *The American Economic Review*, 210–230.

Raskovich, A. (2003). Pivotal buyers and bargaining position. *The Journal of Industrial Economics 51*(4), 405–426.

Shahrur, H. (2005). Industry structure and horizontal takeovers: Analysis of wealth effects on rivals, suppliers, and corporate customers. *Journal of Financial Economics 76*(1), 61–98.

Snyder, C. M. (1998). Why do larger buyers pay lower prices? intense supplier competition. *Economics Letters 58*(2), 205–209.

Sorensen, A. T. (2003). Insurer-hospital bargaining: negotiated discounts in post-deregulation connecticut. *The Journal of Industrial Economics 51*(4), 469–490.

A Appendix: Tables

Table 10: Descriptive Statistics of the Downstream Market: Distributors

	Price				Market Share				Number of Channels			
Distributor	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Comcast	47.6	10.3	10.0	101.7	0.59	0.17	0.02	0.96	34.0	4.3	9	37
TWC	45.7	10.3	16.0	122.9	0.56	0.17	0.07	0.96	34.8	3.5	12	37
Charter	45.9	12.5	11.3	94.7	0.59	0.17	0.03	0.93	33.1	5.2	11	37
Cablevision	49.2	9.9	10.4	76.0	0.69	0.15	0.16	0.96	34.2	3.6	20	37
Cox	39.9	7.9	16.8	72.6	0.65	0.15	0.03	0.91	32.3	4.6	11	37
RCN	52.4	12.4	30.8	68.9	0.17	0.19	0.01	0.92	34.9	3.0	16	37
Verizon	51.8	4.4	40.9	55.4	0.18	0.11	0.01	0.73	36.2	0.6	34	37
AT&T	54.5	10.1	26.0	98.6	0.14	0.13	0.00	0.82	36.2	1.8	20	37
DirecTV	50.2	11.2	37.8	76.7	0.11	0.07	0.00	0.53	36.8	0.4	36	37
Dish	49.5	8.2	35.0	68.3	0.08	0.07	0.00	0.62	36.7	0.5	36	37
Other	41.8	11.0	11.4	95.9	0.60	0.19	0.01	0.96	31.3	5.7	9	37

Notes: The statistics are computed for the full set of bundles (24,341 observations) for each distributor (across years 2000–2010).

Table 11: Descriptive Statistics of the Downstream Market: Viewership (Part 1)

	Rating				Fraction of Households that Watch			
Channel	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
ABC Family Channel	0.0046	0.0007	0.0038	0.0056	0.2504	0.0480	0.1642	0.3316
American Movie Classics	0.0053	0.0005	0.0047	0.0062	0.2353	0.0303	0.1640	0.2698
Animal Planet	0.0040	0.0006	0.0026	0.0051	0.2858	0.0589	0.1928	0.3700
Arts Entertainment	0.0070	0.0009	0.0057	0.0088	0.3453	0.0446	0.2510	0.4004
BET	0.0032	0.0005	0.0022	0.0038	0.0927	0.0216	0.0614	0.1178
Bravo	0.0028	0.0010	0.0014	0.0047	0.1502	0.0404	0.0804	0.1970
Cartoon Network	0.0070	0.0013	0.0052	0.0087	0.1507	0.0333	0.0892	0.1892
CMT	0.0014	0.0003	0.0009	0.0018	0.0801	0.0161	0.0592	0.1138
CNBC	0.0037	0.0004	0.0029	0.0041	0.2597	0.0545	0.1614	0.3382
CNN	0.0085	0.0011	0.0067	0.0102	0.4493	0.0888	0.2732	0.5452
Comedy Central	0.0045	0.0009	0.0029	0.0054	0.2352	0.0538	0.1592	0.3038
Discovery Channel	0.0077	0.0004	0.0069	0.0082	0.4546	0.0778	0.2986	0.5466
Disney Channel	0.0078	0.0015	0.0055	0.0097	0.1606	0.0358	0.1088	0.2120
E! Entertainment TV	0.0032	0.0003	0.0027	0.0036	0.2115	0.0477	0.1264	0.2668
ESPN	0.0094	0.0014	0.0080	0.0125	0.3619	0.0522	0.2438	0.4194
ESPN 2	0.0037	0.0007	0.0030	0.0049	0.2144	0.0335	0.1596	0.2674
ESPN Classic Sports	0.0007	0.0002	0.0004	0.0010	0.0687	0.0193	0.0414	0.0946
Food Network	0.0055	0.0020	0.0023	0.0087	0.2698	0.0611	0.1600	0.3514
Fox News Channel	0.0095	0.0031	0.0034	0.0136	0.3665	0.0846	0.2122	0.4588

Notes: The statistics are computed for each channel (across years 2000–2010).

Table 12: Descriptive Statistics of the Downstream Market: Viewership (Part 2)

	Rating				Fraction of Households that Watch			
Channel	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
FX	0.0042	0.0010	0.0027	0.0056	0.1947	0.0452	0.1428	0.2682
Golf Channel	0.0009	0.0004	0.0006	0.0018	0.0562	0.0092	0.0396	0.0696
Hallmark Channel	0.0031	0.0022	0.0003	0.0060	0.1101	0.0767	0.0000	0.1986
HGTV	0.0058	0.0020	0.0032	0.0094	0.2389	0.0373	0.1604	0.2852
History Channel	0.0069	0.0015	0.0052	0.0097	0.3622	0.0469	0.3110	0.4342
Lifetime	0.0078	0.0007	0.0071	0.0091	0.2967	0.0198	0.2594	0.3242
MSNBC	0.0044	0.0008	0.0031	0.0059	0.2730	0.0605	0.1760	0.3366
MTV	0.0047	0.0006	0.0040	0.0057	0.1905	0.0353	0.1278	0.2360
Nickelodeon	0.0095	0.0011	0.0079	0.0109	0.1418	0.0205	0.1028	0.1616
SyFy	0.0043	0.0009	0.0032	0.0062	0.1792	0.0307	0.1366	0.2140
TBS	0.0084	0.0004	0.0077	0.0092	0.3432	0.0469	0.2648	0.4248
TLC	0.0048	0.0012	0.0035	0.0071	0.2549	0.0200	0.2150	0.2944
truTV	0.0037	0.0010	0.0016	0.0049	0.1399	0.0398	0.0906	0.2014
Turner Classic Movies	0.0036	0.0012	0.0018	0.0057	0.1519	0.0310	0.1008	0.1838
TNT	0.0108	0.0017	0.0084	0.0133	0.3698	0.0542	0.2980	0.4466
USA	0.0091	0.0020	0.0069	0.0128	0.3264	0.0367	0.2610	0.3688
VH1	0.0030	0.0004	0.0025	0.0035	0.1628	0.0366	0.0820	0.1942
Weather Channel	0.0041	0.0003	0.0036	0.0046	0.4515	0.0606	0.3262	0.5120

Notes: The statistics are computed for each channel (across years 2000–2010).

Table 13: Descriptive Statistics of the Upstream Market: Input Fees and Advertising Revenues (Part 1)

	Input Fee				Advertising Revenue			
Channel	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
ABC Family Channel	0.1918	0.0223	0.1600	0.2200	0.2111	0.0550	0.1424	0.2941
American Movie Classics	0.2200	0.0155	0.2000	0.2500	0.1092	0.0694	0.0138	0.2123
Animal Planet	0.0718	0.0125	0.0600	0.0900	0.0921	0.0205	0.0659	0.1233
Arts Entertainment	0.2100	0.0332	0.1600	0.2600	0.3050	0.0407	0.2520	0.3815
BET	0.1364	0.0201	0.1100	0.1700	0.2436	0.0567	0.1576	0.3204
Bravo	0.1473	0.0297	0.1100	0.2000	0.1623	0.0817	0.0627	0.2850
Cartoon Network	0.1400	0.0303	0.0800	0.1800	0.2502	0.0721	0.1525	0.3246
CMT	0.0573	0.0224	0.0300	0.0900	0.0970	0.0176	0.0646	0.1156
CNBC	0.2436	0.0434	0.1600	0.3000	0.2254	0.0897	0.1333	0.4090
CNN	0.4327	0.0546	0.3500	0.5200	0.3873	0.0496	0.2979	0.4716
Comedy Central	0.1064	0.0225	0.0800	0.1400	0.3245	0.0684	0.2210	0.3988
Discovery Channel	0.2691	0.0435	0.2200	0.3500	0.3437	0.0540	0.2623	0.4250
Disney Channel	0.8055	0.0572	0.7500	0.9100	0.0000	0.0000	0.0000	0.0000
E! Entertainment TV	0.1855	0.0186	0.1500	0.2100	0.1487	0.0204	0.1238	0.1867
ESPN	2.8082	1.1211	1.1400	4.3400	0.9970	0.2047	0.6524	1.2452
ESPN 2	0.3682	0.1398	0.1700	0.5800	0.1782	0.0430	0.1088	0.2315
ESPN Classic Sports	0.1409	0.0291	0.1000	0.1800	0.0658	0.0152	0.0388	0.0833
Food Network	0.0609	0.0318	0.0300	0.1400	0.2506	0.1025	0.1101	0.4048
Fox News Channel	0.3182	0.1793	0.1700	0.7000	0.3016	0.1730	0.0647	0.5243

Notes: The statistics are computed for each channel (across years 2000–2010) per subscriber per month.

Table 14: Descriptive Statistics of the Upstream Market: Input Fees and Advertising Revenues (Part 2)

	Input Fee				Advertising Revenue			
Channel	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
FX	0.3409	0.0587	0.2700	0.4300	0.2458	0.0965	0.1015	0.3800
Golf Channel	0.2018	0.0483	0.1300	0.2600	0.1096	0.0169	0.0882	0.1327
Hallmark Channel	0.0336	0.0220	0.0000	0.0600	0.1393	0.0711	0.0000	0.2111
HGTV	0.0782	0.0382	0.0300	0.1400	0.3209	0.0840	0.2069	0.4283
History Channel	0.1773	0.0361	0.1300	0.2300	0.2208	0.0592	0.1219	0.2997
Lifetime	0.2127	0.0553	0.1300	0.2900	0.5200	0.0363	0.4418	0.5564
MSNBC	0.1418	0.0160	0.1200	0.1700	0.1358	0.0295	0.1042	0.1884
MTV	0.2673	0.0473	0.2000	0.3500	0.6704	0.0927	0.5446	0.7959
Nickelodeon	0.3700	0.0544	0.2900	0.4700	0.7820	0.1380	0.5618	0.9217
SyFy	0.1655	0.0350	0.1200	0.2200	0.2898	0.0463	0.1835	0.3288
TBS	0.3673	0.1152	0.1900	0.5400	0.5553	0.0502	0.4906	0.6352
TLC	0.1555	0.0093	0.1400	0.1700	0.2307	0.0281	0.1957	0.2875
truTV	0.0882	0.0087	0.0800	0.1000	0.1452	0.0565	0.0600	0.2108
Turner Classic Movies	0.2182	0.0340	0.1600	0.2700	0.0000	0.0000	0.0000	0.0000
TNT	0.8318	0.1612	0.5500	1.1000	0.5711	0.0870	0.4449	0.7058
USA	0.4600	0.0717	0.3600	0.5700	0.5767	0.1286	0.4397	0.7959
VH1	0.1218	0.0218	0.0900	0.1600	0.2821	0.0520	0.1949	0.3485
Weather Channel	0.0982	0.0117	0.0800	0.1200	0.1291	0.0129	0.1082	0.1537

Notes: The statistics are computed for each channel (across years 2000–2010) per subscriber per month.

Table 15: Average Monthly Willingness to Pay in 2000 and 2010

Channel	2000	2010	Channel	2000	2010
ABC Family Channel	0.4104	0.6583	FX	0.2544	0.5832
American Movie Classics	0.5135	0.6784	Golf Channel	0.0231	0.0719
Animal Planet	0.3354	0.7020	Hallmark Channel	0.0000	0.4468
Arts Entertainment	1.1893	1.1645	HGTV	0.3961	1.0409
BET	0.1037	0.1494	History Channel	0.8098	1.5255
Bravo	0.0819	0.2788	Lifetime	0.9154	1.0583
Cartoon Network	0.4869	0.3970	MSNBC	0.3919	0.6918
CMT	0.0333	0.0751	MTV	0.4262	0.4383
CNBC	0.4587	0.4446	Nickelodeon	0.8484	0.7779
CNN	1.2532	1.2455	SyFy	0.2714	0.4713
Comedy Central	0.3325	0.5787	TBS	1.2675	1.5845
Discovery Channel	1.4027	1.4731	TLC	0.4468	0.8053
Disney Channel	0.8682	1.3498	truTV	0.1534	0.3617
E! Entertainment TV	0.2517	0.3430	Turner Classic Movies	0.1466	0.4962
ESPN	2.3553	3.8411	TNT	1.3634	2.1759
ESPN 2	0.2955	0.5526	USA	1.0077	1.6371
ESPN Classic Sports	0.0174	0.0352	VH1	0.1917	0.2072
Food Network	0.2897	1.1124	Weather Channel	0.7039	0.8051
Fox News Channel	0.6070	2.5057			

Notes: The averages are computed across all simulated households.

B Appendix: Data Collection

We take individual level bank and card transaction data from Yodlee in 2011–2013 and estimate household cable usage by zip code. We consider "debit" transactions only. The set of criteria that an individual needs to satisfy to be considered "the head of a domestic household" and counted towards the number of subscribers to a service provider is the following:

1. Has more than $500.0 in utility payments in the current year.[36,37]

2. Has both bank and card transactions present in the dataset.

3. The aggregate amount of US dollar transactions exceeds the aggregate amount of foreign currency transactions (measured in the US dollars).

Yodlee files do not contain user level geographic information. Consequently, zip codes in which Yodlee users[38] live are estimated. We treat the zip code of the grocery store most often visited by the member in a given year as the zip code of his or her living address. Zip codes of the grocery stores are taken from the 2012–2015 Yodlee files that contain merchant locations.

We estimate zip code level market shares for the following cable and satellite service providers: AT&T U-Verse, Bright House Networks, Cablevision, Charter, Comcast, Cox, DirecTV, Dish Network, RCN, Time Warner Cable, and Verizon FiOS. The rest of the providers are pooled into category "Other."

The cable/satellite service provider that a user subscribes to is taken from either the merchant name field (first choice) or the description field (second choice) of the "Cable/Satellite Services" transactions. We parse the descriptions searching for firm names listed in Table 16. The most popular firm in a given year is treated as the main service provider if

- Either there are 3 or more payments to that firm in the current year.

- Or at least one payment in the current year exceeds $100.0.

[36]Utility payments are taken from the transactions of type "Utilities."

[37]The date of the transaction is comes from "Post date" field.

[38]Henceforth, a (Yodlee) "user" or "member" refers to an account that satisfies the criteria for being considered the head of a domestic household.

If this does not lead to an estimate of the service provider in the current year we do a few other adjustments to ensure that we capture as many multichannel television subscribers as possible.

First, we try to fill in the gaps. We find the first preceding and succeeding years such that the service provider estimates are available. If these two estimates are the same as well as the zip code estimates for all three years, we conclude that the user subscribed to the same service provider in the current year.

Second, we try to capture those members that subscribe to AT&T U-Verse or Verizon FiOS and may be paying for the cable services together with the telephone/cell phone services. To do this we start by estimating the user's telephone service provider. Table 17 lists all the keywords we are searching for in the merchant names and descriptions of the "Telephone Services" transactions. Keywords "u-verse", "uverse", or "fios" clearly indicate that the member subscribes to AT&T or Verizon cable services. Otherwise, we count the user as a subscriber to a new (temporary) service provider, "Telco," if

- Either there are 3 or more payments to AT&T or Verizon in the current year.
- Or the aggregate amount paid to AT&T or Verizon divided by the number of payments to that firm exceeds \$100.0.

We also require that the aggregate payments to AT&T and Verizon combined exceed \$2,000.0 in the current year.

We fill in the gaps using the same procedure as the one described above.

Finally, if we are still unable to estimate the service provider, but the user has recurrent (at least 5 in the current year) check payments of the same amount between \$100.0 and \$150.0, we record the user as a cable subscriber to firm "Other."

We assume that the remaining Yodlee members do not subscribe to multichannel television (they are attributed to category "None").

Table 16: Cable / Satellite Service Providers

Firm	Spelling	Firm	Spelling	Firm	Spelling
Adelphia	adelphia				
Advanced Cable	advancedcable				
Allegiance	allegiance				
Armstrong	armstrong				
Atlantic	atlantic				
Comcast	alameda				
	cmcast				
	cmcst				
	comcast				
	comcst				
	xfinity				
DirecTV	directv				
	DTV				
Time Warner Cable	timewarner				
	twarner				
	twc				
Dish Network	dish				
	echostar				
Verizon FiOS	fios				
	verizon				
Mediatti Broadband	mediatti				
AT&T U-verse	att				
	at&t				
	at&t				
	uverse				
	u-verse				
Wave	astound				
	wave				
Other					

Notes: We search for all the alternative firm name spellings in the "Merchant Name" and "Description" fields of the transaction lines. The fields are transformed into lowercase and trimmed off whitespaces.

Table 17: Telephone / Cell Phone Service Providers

Firm	Spelling
AT&T	at&twire
MetroPCS	
Sprint	
T-Mobile	
US Cellular	
Verizon	

Notes: We search for all the alternative firm name spellings in the "Merchant Name" and "Description" fields of the transaction lines. The fields are transformed into lowercase and trimmed off whitespaces.

Appendix: Interpolation

We want to estimate zip level downstream market shares for years 2006–2010. However, Yodlee data is only available from 2011.[39] We rely on an interpolation technique described in this section.

First, we classify every service provider except AT&T U-Verse, Bright House Networks, Cablevision, Charter, Comcast, Cox, DirecTV, Dish Network, RCN, Time Warner Cable, Verizon FiOS, and special categories "Telco" and "None" as "Other."

Second, we take all AT&T and Verizon subscribers that (according to our estimation procedure) live in zip codes not served by the corresponding provider according to the Nielsen data. We divide these subscribers evenly between all zip codes that share the first three digits with their estimated zip code and that are served by AT&T or Verizon.[40]

Third, we split the "Telco" category into AT&T and Verizon depending on the provider availability in the current zip code. For example, if Verizon in present in the current zip code and AT&T is not, all "Telco" subscribers in the current zip code are attributed to Verizon. When both providers are present the "Telco" subscribers are divided evenly between them.

Fourth, if neither AT&T nor Verizon are present in the current zip code we divide the "Telco" subscribers between AT&T and Verizon in the zip codes that share the same first three digits with the current zip code.

We attribute to "Other" all AT&T subscribers in years before 2007 and all Verizon subscribers in years before 2006.

Fifth, we perform the interpolation. We estimate separate for each of the providers[41] the following numbers:

- The number of subscribers, $S_{i,1}$, in each of the zip codes in the first year when the firm enters that zip code, i (in time period 2006–2010).
- The growth rates, r_t, $t = 1, \ldots, T$ (depending on the provider we estimate at most $T = 6$ different numbers). Growth rate r_t determines the growth in the number of

[39] It is also available for the second half of 2010, but the data are limited and we ignore it.

[40] E.g. if a Verizon subscriber lives in a zip code not served by Verizon according to Nielsen, he/she is added to each of the zip codes within the same area with equal probability.

[41] AT&T U-Verse, Bright House Networks, Cablevision, Charter, Comcast, Cox, DirecTV, Dish Network, RCN, Time Warner Cable, Verizon FiOS, Other, None.

subscribers from year t to $t+1$. In other words, $S_{i,t+1} = S_{i,t}(1+r_t)$. These growth rates are assumed to be the same across zip codes, but different across providers.

These parameters are estimated by matching zip code level subscriber numbers in 2012 and national level subscriber numbers in 2006–2011 (the exact time periods differ depending on the provider).[42]

These estimates allow us to compute the number of subscribers to each of the listed provider in 2006–2010 and, consequently, the market shares.

Finally, as the zip code level number of subscribers in 2012 estimated from Yodlee data can be small, we shrink the obtained market shares towards the state level market shares using a procedure similar to that in Gandhi, Lu, and Shi (2013) to decrease the variance of our estimates. Let n_i^{2012} be the aggregate number of subscribers to all providers (including "Other" and "None") in zip code i in 2012 based on Yodlee data. For provider $f \in \mathcal{F}_{it}$ (where $\mathcal{F}_{it}$ is the set of all providers that serve zip code i in year t including "None") let s_{fit} be the market share obtained using the interpolation procedure described above. Let $st(i)$ denote the state that zip code i belongs to, and let $s_{fit}^{st(i)}$ the state level estimate of market share in zip code i computed using the following formula

$$s_{fit}^{st(i)} = \frac{n_{ft}^{st(i)}}{\sum_{g \in \mathcal{F}_{it}} n_{gt}^{st(i)}},$$

where $n_{ft}^{st(i)}$ is the state level number of subscribers to firm f in state $st(i)$ in year t.

We adjust the estimates of the market shares using the following expression

$$\tilde{s}_{fit} = \frac{n_i^{2012} s_{fit}}{n_i^{2012} + 1/s_{fit}^{st(i)}} = s_{fit} \frac{n_i^{2012} s_{fit}^{st(i)}}{n_i^{2012} s_{fit}^{st(i)} + 1} + s_{fit}^{st(i)} \frac{1}{n_i^{2012} s_{fit}^{st(i)} + 1}.$$

Hence, the closer is n_i^{2012} to zero, the more $\tilde{s}_{fit}$ will be based on the state level estimate, $s_{fit}^{st(i)}$. When n_i^{2012} goes to infinity, $\tilde{s}_{fit}$ approaches s_{fit}.

[42] We adjust the national level numbers so that the number of subscribers in 2012 in our dataset coincides with the total number of subscribers taken from the firm's financial report.