The Welfare Effects of Bundling in Multichannel Television Markets *

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Abstract

We measure how the bundling of television channels affects social welfare. We estimate an industry model of viewership, demand, pricing, bundling, and input market bargaining using data on ratings, purchases, prices, bundle composition, and aggregate input costs. We conduct counterfactual simulations of à la carte policies that require distributors to offer individual channels for sale to consumers. We estimate that input costs rise by 145.2% in equilibrium under à la carte. These are passed on as higher prices, offsetting consumer surplus benefits from purchasing individual channels. Before any implementation and marketing costs, mean consumer, producer, and total surplus change by an estimated -1.0%, 13.0%, and 5.3%.

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1 Introduction

Bundling is widespread in multichannel television markets.[1] In theory, bundling can be a profitable form of price discrimination. It makes consumer tastes more homogenous which facilitates surplus extraction, but it has ambiguous effects on total welfare (Stigler (1963), Adams and Yellen (1976), McAfee, McMillan and Whinston (1989)). Regulations mandating *à la carte* pricing would radically alter the choice sets of the roughly 110 million U.S. television households who collectively spend more than $50 billion annually and watch an average of more than seven hours of television per day. This paper predicts the impact of such a regulation on the distribution of consumer and producer welfare.

There are widely differing opinions among policy makers, consumers, and industry participants about the effects of mandating à la carte pricing in the U.S.[2] This lack of consensus is partly because regulations mandating unbundling have not been implemented in enough similar circumstances to provide direct evidence.[3] Experimentation is impractical as unbundling would change not only outcomes at the retail level, but also industry-wide negotiations between content providers and distributors.[4] We develop a model to evaluate à la carte pricing.

We model viewership, demand, pricing, bundling, and input market bargaining of multichannel television services. We estimate the distribution of household preferences for almost fifty cable television channels using ratings and bundle market share data. We estimate the input costs that distributors, such as Comcast and DirecTV, currently pay to content providers, such as ESPN and CNN, using aggregate cost data and observed pricing and bundling decisions. We use the demand and cost estimates to estimate the parameters of a bilateral bargaining with externalities model of the input market. Finally, we hold the estimated demand and bargaining parameters fixed, and force dis-

[1] Cable and satellite television systems are called multichannel video program distributors (MVPDs).

[2] In addition to numerous articles in the popular press (e.g. Reuters (2003), Shatz (2006)), the Federal Communications Commission (FCC) has published two reports analyzing à la carte pricing (FCC (2004), FCC (2006)). The National Cable and Telecommunications Association (NCTA) has a webpage summarizing industry opposition to à la carte at http://www.ncta.com/IssueBrief.aspx?contentId=15. Supporters of à la carte include the Consumers Union http://www.consumersunion.org/pub/core_telecom_and_utilities/000925.html and The Parents Television Council http://www.howcableshouldbe.com/. According to a 2007 poll by Zogby, 52 of cable subscribers sampled support à la carte http://www.zogby.com/news/readnews.cfm?ID=1377.

[3] Internationally, Canada, Hong Kong, and India have introduced various forms of regulations mandating unbundling in multichannel television markets, but idiosyncratic features of these regulations limit generalizations.

[4] Some local experimentation would be useful to gather evidence on how distributors would set prices to consumers.

tributors to unbundle channels, critically allowing for the renegotiation of contracts between channel conglomerates and distributors. In these counterfactual simulations, equilibrium input costs are an estimated 145.2% higher than when distributors sell bundles. These higher costs are passed into prices, offsetting the welfare benefits to consumers from being able to purchase individual channels. We estimate that, accounting for higher equilibrium input costs but before any implementation and marketing costs, consumer, producer, and total welfare change by an estimated -1.0%, 13.0%, and 5.3%.

The model has three types of agents: consumers, downstream distributors, and upstream channels. We estimate consumer preferences using both individual-level and market-level data on viewership, i.e. which channels consumers watch and for how long, and market-level data on bundle purchases, i.e. which bundle of channels consumers purchase and at what price. We assume a functional form for consumer utility which has the property that the more a consumer watches a television channel, the more she is willing to pay for it. The viewership data provides the empirical evidence necessary for flexibly estimating a high dimensional distribution of preferences for television channels. The bundle purchase data provides the empirical evidence necessary to estimate how households value the pleasure they derive from viewing channels relative to income.

On the supply side, downstream distributors compete with each other by choosing both bundles and prices and by negotiating input costs with upstream channels. We assume that observed prices and bundles are a Nash equilibrium given estimated preferences. We estimate input costs as those which make the Nash equilibrium assumption hold. We use the procedure in Pakes, Porter, Ho and Ishii (2006) to incorporate a subset of necessary conditions implied by Nash equilibrium in bundle choice into the estimation. This restricts estimated input costs to reflect that adding or dropping a channel from an observed bundle should reduce profits on average for the firms making the decision.

To model the determination of input costs, we fix an industry bargaining protocol based on the model of Horn and Wolinsky (1988). The bargaining protocol features bilateral meetings between conglomerates of channels and distributors whose outcomes impose externalities on other firms due to downstream competition. We employ the equilibrium concept of contract equilibrium, as in Cremer and Riordan (1987), which requires that no pair of distributor and conglomerate would like to change their agreement given all other agreements. One notable empirical paper that also studies bargaining with externalities due to downstream competition is Ho (2009) which studies hospital-HMO negotiations in the U.S. This paper contributes to this line of research by using a bargaining model that includes Ho's take-it-or-leave-it offers as a special case. We estimate channel conglomerate-distributor specific bargaining parameters that produce the estimated input costs in equilibrium.

The estimated distribution of channel preferences replicates many features of the ratings data. For example, willingness-to-pay (WTP) for Black Entertainment Television (BET) is estimated to be higher on average for black households. Similarly, WTP for Nickelodeon and Disney Channel are estimated to be higher on average for family households than for non-family households. Only about 5% of the dispersion in WTP for channels is attributable to demographics. We find moderate correlations in WTP for most pairs of channels. Estimated own-price elasticities for basic cable, expanded basic cable, and satellite services are on average -2.79, -5.58, and -4.8, respectively.

We estimate that large distributors, such as Comcast, have about 13% lower input costs than small, independent distributors. We also estimate that vertical integration between channels and distributors does not affect input costs for the integrated distributor relative to other distributors.

The estimated bargaining parameters reject take-it-or-leave-it offers as a model of the input market. On average, we estimate that most distributors have higher bargaining parameters than channel conglomerates. For any given distributor, estimated bargaining parameters are higher for satellite providers than for cable firms.

We use these estimates to simulate the welfare effects of an à la carte pricing regulation. In the counterfactual simulation, we consider an economic environment with one large and one small cable market (each served by a single cable system), where the cable system and two "national" satellite distributors compete by charging a fixed fee and separate prices for each of the almost fifty cable television channels in our specification. We also simulate the welfare effects of themed tiers and a bundle-size-pricing regulation as in Chu, Leslie and Sorensen (2010). In all cases, we allow for input market renegotiation between channel conglomerates and distributors.

There are two countervailing forces that largely determine our results. First, for fixed input costs, bundling appears to facilitate surplus extraction by firms: if we do not allow for input market renegotiation, forcing channels to be offered à la carte increases consumer welfare by 16.7% and reduces firm profits by 3.7%. Allowing renegotiation, however, dramatically increases costs (by an estimated 145.2%) as low-value customers are not served under à la carte and equilibrium input costs are roughly proportional to the average valuation per subscriber to the channel. Prices follow suit, eliminating the aforementioned consumer surplus gains and slightly decreasing estimated total surplus from 7.5% to 5.3%. Industry profits are estimated to increase by 13.0%, but this is before any implementation or marketing expenses in an à la carte world. While the specific numbers vary slightly, the qualitative conclusion that consumers would benefit from à la carte at existing input costs but do not due to input cost renegotiation is robust to a variety of alternative assumptions about demand, cost, and bargaining outcomes.

Related Work This paper is related to a number of empirical papers evaluating policy issues in these markets (Crawford (2000), Chipty (2001), Goolsbee and Petrin (2004)) as well as several papers addressing the identical topic. Crawford (2007) tests the implications of bundling in cable markets using reduced-form techniques. While suggestive, he does not identify the structure of channel demand required to estimate the welfare effects of bundling. Byzalov (2008) estimates a model of demand for multichannel television using household-level survey data from a cross-section of four large DMA's in 2004. He finds that forcing cable distributors to offer themed tiers would decrease average consumer welfare at fixed wholesale prices. His household data are advantageous compared to our individual data, but his market data are limited to a small sample of markets in 2004 rather than multiple thousands of systems over ten years as in this study. Furthermore, he does not compute equilibrium input costs in his counterfactual analysis. Rennhoff and Serfes (2009) develop a two-channel, two-distributor model with consumer preferences distributed uniformly on a circle to analytically study bundling and the wholesale market. Rennhoff and Serfes (2008) estimate a logit demand system for channels. In both studies, they conclude that à la carte regulations would likely increase consumer surplus.

2 Intuition for Results

The contribution of this paper can be understood by appreciating the insights of, and interaction between, two theoretical literatures in economics. The first evaluates the welfare consequences of bundling when input costs to the bundling firm are fixed (Stigler (1963), Adams and Yellen (1976), McAfee et al. (1989)). The second models how those input costs are determined in a bilateral bargaining setting under oligopoly (Horn and Wolinsky (1988)). The ultimate welfare effects of à la carte depend on the interaction of the effects analyzed in these literatures, in particular on the magnitude of input cost increases that are likely to arise under à la carte. The three figures we now describe provide intuition for the results of this paper.

Figure 1 demonstrates the price discrimination incentive for bundling by a monopolist. Consider two goods with dispersed valuations and fixed marginal costs of zero given by the dashed lines in the figure. No matter the prices it charges, pricing each good individually requires a seller to miss out on the surplus from high valuation consumers willing to pay more than its price and low valuation consumers willing to pay less than its price but more than its cost. Compare that to the demand curve for the bundle. As long as valuations between the two goods are not perfectly correlated, consumers' valuation of the bundle will be less dispersed than those for the components, allowing the seller to capture more of the combined surplus with a single price. While we choose valuations that are highly negatively correlated in the figure to emphasize this point, it is quite general: à la carte regulations can unlock surplus and improve consumer welfare, for given input costs.

The complication is that marginal costs can change under à la carte. Forgetting bundling for a moment, consider the determination of input costs for a single good in a bilateral monopoly with linear fee contracts, as in the two left-most panels of Figure 2. For a given input cost from the y-axis in the first panel, the downstream distributor in the second panel maximizes profit by choosing price to equate marginal revenue and marginal cost. The area of the upper producer surplus rectangle is the downstream seller's profit; the area of the lower producer surplus rectangle is the upstream producer's profit. The bargaining literature cited above argues equilibrium input costs with linear fee contracts are determined as a function of a weighted geometric average of these two profits called the Nash product. The left panel traces out the Nash product for each possible input cost.[5] The equilibrium input cost maximizes the Nash product.

The third and fourth panels of Figure 2 combines the insights of these two literatures to determine input costs under bundling versus à la carte. It repeats the first two panels for two goods which have the same underlying mean valuations, but different dispersions. One can see that the equilibrium

[5] In this demonstration, we use equal weights. In our results, we estimate ζ_{fK}, the weighting for each pair of distributor and channel conglomerate.

input cost for the more dispersed (à la carte) good is higher than that for the less dispersed (bundled) good. For many distributions of preferences, this drives up costs.[6]

The key to understanding the welfare effects of à la carte is to know how much input costs would rise under mandatory à la carte. If modest, the insights of the bundling literature likely obtain and à la carte could be consumer and total welfare-enhancing. If extreme, prices under à la carte will also be high, making it much more likely to be welfare-reducing. How much input costs rise under à la carte in practice particularly depends on the structure of preferences for individual channels and the relative bargaining power of channels and distributors. These are the focus of our econometric estimation in the sections to follow.

3 The Data

We divide our data into two categories: market data, which measure households' purchasing decisions or firms' production decisions, and viewership data, also called ratings, which measure households' utilization of the cable channels available to them.

Our market data comes from two sources: Warren Communications and SNL Kagan. Warren produces the Television and Cable Factbook Electronic Edition monthly (henceforth Factbook). The Factbook provides data at the local market level on bundle composition, prices, market shares, system ownership, and other system characteristics. SNL Kagan produces the Economics of Basic Cable Networks yearly (henceforth EBCN). EBCN provides data at the level of channels on a variety of revenue, cost, and subscriber quantities.

Cable System (Factbook) and Satellite Data Our Factbook sample spans the time period 1997-2007. The Factbook collects the data by telephone and mail survey of cable systems. The key data in Factbook are the cable system's bundle compositions, the prices of its bundles, the number of monthly subscribers per bundle, the number of homes passed by the cable system, and ownership.

[6]There is an additional, opposite effect on à la carte pricing on input costs. Bundling creates a negative externality in a channel's bargaining problem as a higher input cost weakens demand for the other channels in the bundle. This externality makes input costs higher under bundles; eliminating it pushes input costs *lower* under ALC. On average, we find input costs rise considerably, so in aggregate this externality effect is dominated by the niche pricing effect described in the text. However, for some channels it is the dominant effect.

Table 1 and part of Table 2 provide summary statistics for the Factbook data. An observation is a system-bundle-year, e.g. NY0108's Expanded Basic in 2000. We observe almost 25,000 system-bundle-years, based on almost 19,000 system-years from just over 8,000 systems. Most systems in our data offer a single bundle, while the majority of the rest offer just two bundles. Much of our data comes from early in the sample period when fewer offerings were the norm.

For each of these bundles and by market type, Table 1 reports the average price of the bundle in 2000 dollars, it's market share, and the number of cable channels offered. In markets with two or more bundles, the average Basic service in our data costs about $13.50 and offers about 9 cable channels and the average Expanded Basic bundle costs around $30.00 and offers about 30 cable channels.[7]

There is variation in the composition of bundles across markets and over time. Table 2 presents the share of systems in our sample that offer each of the channels in our specification. The first column indicates whether the channel is carried on any tier of service, while the second column indicates whether the channel is offered on the basic tier. For example, ESPN is carried by almost all systems (96%) in our data. Of these, most (77%) carry it on Basic Service. Smaller channels are frequently offered on Digital Service.

Unlike for cable service, satellite offerings do not vary by geography. We collected satellite menus and prices by hand. We then matched this to aggregate satellite market share data at the DMA level from Nielsen Media Research.[8]

Aggregate Channel (SNL Kagan) Data We use the 2006 edition of the Economics of Basic Cable Networks (EBCN). The 2006 sample covers 120 cable channels with yearly observations dating back to 1994 when applicable. Information collected includes total subscribers, license fee revenue, advertising revenue, and ownership. The data are collected by survey, private communication, consulting information, and some estimation. The exact methods used are not disclosed. The key variables we use are the average input cost (denoted τ_c for a given channel c later in the paper), and the advertising revenue for each channel. The average input cost for a channel is its license fee

[7] Digital basic packages were made possible by cable systems investments in digital infrastructure in the late 1990's and 2000's. This dramatically increased the bandwidth available for delivering television channels. Prior to digital upgrades, most systems offered simply a basic bundle or a basic bundle and an expanded basic bundle. Following the digital upgrades, many systems also offered a higher tier, often called digital basic.

[8] Designated Market Areas, or DMAs, correspond to local broadcast television coverage areas. There are usually several cable systems within a DMA.

revenue divided by the number of subscribers. It measures how much distributors are paying for the channel per subscriber, averaged across distributors. In 2007, this ranged from $3.26 for ESPN to $0.03 for MTV2 for the roughly fifty channels in our model.

Viewership Data Our viewership data comes from two sources: Nielsen and Mediamark. The Nielsen data is DMA-level tuning (viewing) data. The Mediamark data is individual-level survey data.

Nielsen DMA Tuning Data The Nielsen data comes from the 56 largest DMA's for about 50 of the biggest cable channels over the period 2000-2006 in each of the "sweeps" months of February, May, July, and November. The main variables are the DMA, the program, the channel, and the program's rating.. The rating is the percentage of households with at least one television in the DMA viewing the programming on that channel.

We aggregate the information across programs on each channel within each month of our data. Thus an observation is a channel-DMA-year-month, e.g. the average rating for ESPN in the Boston DMA in February, 2004. We have 1,482 such combinations. The third column in Table 2 presents the average rating for each of the channels in our analysis.

We observe that channels' ratings vary from DMA to DMA and within DMA across months and years. One important type of variation we use is how ratings vary with the demographic composition of a DMA. We focus on six demographic factors: Family status, Income, Race, Education, and Age.[9]

Mediamark Individual level Data The Mediamark data comes from surveying a random sample of consumers in the US about their media usage, consumer behavior, and demographics. They survey roughly 25,000 individuals per year. Our data spans the years 2000 to 2007. Individuals report how many hours they watch each of over 75 cable channels in a given week.

In columns four and five of Table 2, we present the mean and the standard deviation of the fraction of households reporting viewing a certain channel per hour.[10] This is analogous to an average Nielsen rating for that channel and for that reason we call them "ratings" in the table. The final column

[9] We follow U.S. Census definitions for each of these variables.

[10] These are fictional households are created from the real individual data as detailed in the Data Quality section.

reports what fraction of households report positive viewing of each channel. In industry parlance, this is known as the "cume," short for cumulative audience.

Data Quality Issues About two-thirds of the possible observations in the Factbook on market share and price for cable bundles are either missing, not updated from the previous year, or both. We assume this data is missing at random conditional on the observable characteristics of the system. Most systems show up at least once in the time period of the data set.

We only observe the aggregate satellite market share at the DMA level. For the demand estimation, we assume that there is only one satellite firm offering DirecTV's Total Choice package. In reality, both DirecTV and Dish offer three to four tiers of service each.

The Mediamark data is at the individual level while our model is at the household level. To use this data to estimate our model, we create synthetic households by matching individuals to households based on observable characteristics like age, cable or satellite subscription, marital status, household income, and race. For each observation, we randomly draw an individual level observation. We then draw more individuals with similar characteristics to fill in the other members of the reported household size. If several individuals could fit into a given household, we choose at random. If individuals who share the same tastes in television tend to marry, then we will overestimate the number of channels watched by households, while if opposites attract, we will underestimate that number with this procedure.

4 The Industry Model

The industry model predicts household demand for multichannel television services, household viewership of channels, prices and bundles offered by distributors, and distributor-channel specific input costs. This section derives those predictions in terms of a variable set of parameters. The next section, on identification, estimation, and inference, picks a particular set of parameters so that the predictions from the model align with their empirical counterparts.

In **stage 1**, channels and distributors bargain bilaterally to decide input costs; in **stage 2** distributors set prices and bundles; in **stage 3** households make purchases; and in **stage 4**, households view television channels. We start from the last stage and work backwards.

4.1 Household Viewing

Let j index a bundle of programming being offered by cable system n in DMA d in month-year m (e.g. Comcast Digital Basic in Arlington, VA in the Washington, DC DMA in November 2003) and let b_{dnm} be the set of all such bundles.[11,12] We will suppress the market subscripts n, d, and m for the moment. Let c index channels and let C_j be the set of channels offered in bundle j. We assume the utility to household i from spending their time watching television and doing non-television activities has the Cobb-Douglas in logs form:

$$v_{ij}(t_{ij}) = \sum_{c \in C_j} \gamma_{ic} \log(1 + t_{ijc}) \tag{1}$$

where t_{ij} is a vector with components t_{ijc} which denote the number of hours household i watches channel c when the channels in bundle j are available, and γ_{ic} is a parameter representing i's tastes for channel c. We will later estimate the distribution of γ allowing for positive or negative correlations in tastes for pairs of channels. Households may opt to not watch any channel, and we call this state channel 0, $0 \in C_j \ \forall j$, with t_{ij0} the amount of time household i spends on non-television activities and γ_{i0} their preferences for such activities.

Each household i solves:

$$\begin{aligned} \max_{t_{ij}} \quad & \textstyle\sum_c \gamma_{ic} \log(1 + t_{ijc}) \\ \text{subject to} \quad & \textstyle\sum_c t_{ijc} \leq T \end{aligned} \tag{2}$$

with the additional restrictions that the time spent watching any channel must be non-negative, and the time spent on channels not in bundle j is zero.

The solution to this maximization problem yields household i's indirect utility from viewing the channels in bundle j:

$$v^*_{ij}(\gamma_i, C_j) \quad = \textstyle\sum_{c \in C_j} \gamma_{ic} \log(1 + t^*_{ijc}) \tag{3}$$

[11]For convenience, we index month-year combinations (e.g. November, 2003; May, 2004; November, 2004) by the single index, m.

[12]We have two geographic identifiers: cable markets n and Nielsen DMAs d. This is necessary due to the different levels of geographic aggregation in our data.

4.2 Bundle Purchases

A household's choice of cable bundle will depend on v_{ij}^* as well as other characteristics of the bundle and cable system such as the bundle's price. We assume the utility household i derives from subscribing to bundle j in market n in DMA d in month m as:

$$u_{ijndm} \;\; = \;\; v_{ijndm}^* + z_{jndm}'\psi + \alpha_i p_{jndm} + \xi_{jndm} + \epsilon_{ijndm} \tag{4}$$

where, $v_{ijndm}^* = v_{ijndm}^*(\gamma_i, C_{jndm})$, from (3), represents the indirect utility to household i from viewing the channels available on bundle j, p_{jndm} is the monthly subscription fee of bundle j, and z_{jndm} are other observed system and bundle characteristics of bundle j in market n, DMA d, and month m. For convenience, we will sometimes refer to this triple as "market ndm". $\alpha_i = \alpha + \pi_p y_i$, with y_i household i's income, is a taste parameter measuring the marginal utility of income. ψ is a parameter measuring tastes for system and other bundle characteristics. ξ_{jndm} and ϵ_{ijndm} are unobserved portions of household i's utility. We assume that the unobserved term has a component which is common to all households in the market, ξ_{jndm}, and an idiosyncratic term, ϵ_{ijndm}. We further assume that the idiosyncratic term is an i.i.d. draw from a type I Extreme Value distribution whose variance we set to one.

The components of z_{jndm} include by which MSO, if any, the bundle is being offered, the year the bundle is being offered, and bundle name dummies (e.g. "Basic", "Expanded Basic", etc.). ξ_{jndm} represents the deviation of unobserved demand shocks or bundle attributes from the MSO-year-bundle name mean. These unobserved attributes in our data include price and quality of tied Internet service, high definition (HD) service, promotional activity, technical service, and quality of equipment. Theory predicts that these unobservable attributes will be correlated with price. In the estimation section, we will use instrumental variables to disentangle the effect of price from any correlation with unobservable attributes.

Define $\delta_{jdnm} = z_{jndm}'\psi + \alpha p_{jndm} + \xi_{jndm}$ and $\mu_{ijndm} = v_{ijndm}^* + \pi_p y_i p_{jndm}$. Let F^n be the distribution of household preferences and demographics in market n. By the distributional shape assumption on ϵ_{ijndm}, the model's predicted market share for bundle j in market n in DMA d in month m is:

$$s_{jndm} \;\; = \;\; \int \frac{exp((\delta_{jndm} + \mu_{ijndm}))dF^n(i)}{1 + \sum_{k \in ndm} exp((\delta_{kndm} + \mu_{ikndm}))} \tag{5}$$

Our model assumes that the amount of time spent by households watching channels is informative for what they are willing to pay for access to those channels. This would not be good assumption if households valued the option of watching The Weather Channel in case of bad weather, but never watch under normal circumstances. Another problematic case would be if some programming is highly valued but only watched for a short period of time relative to other programming.[13] We also assume that all households have non-negative willingness to pay for channels.[14]

4.3 Supply: Downstream Distributors

Distributors compete by choosing the composition and price of their bundles to maximize profits. We assume that observed prices and bundles form a Nash equilibrium of the price and bundle choice game.

The profit of a distributor before fixed costs is:

$$\Pi_{fndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}}) \;=\; \sum_{j \in \mathbf{b_{fndm}}} (p_{jndm} - \sum_{c \in C_{jndm}} \tau_{fc}) s_{jndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}}) \tag{6}$$

where f denotes distributor, n market, d DMA, m month, and j bundle. $\mathbf{b_{ndm}}$ is a list of offered bundles in market ndm with corresponding prices $\mathbf{p_{ndm}}$ and $\mathbf{b_{fndm}}$ are the bundles offered by firm f. τ_{fc} are distributor-channel specific license fees. Taking a distributor's perspective, we refer to these as "input costs" throughout this paper. Distributor f pays channel c a payment of τ_{fc} for every household which receives channel c from firm f. Following the nature of programming contracts in the industry, these vary by firm and channel, but not across the markets served by firm f.

Separate the bundles offered in market ndm into those offered by distributor f and not: $\mathbf{b_{ndm}} = (\mathbf{b_{fndm}}, \mathbf{b_{-fndm}})$. The same for prices: $\mathbf{p_{ndm}} = (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})$. Nash equilibrium assumes:

Nash Assumption $\forall f$ and $\forall ndm$, $\mathbf{b_{fndm}}$ and $\mathbf{p_{fndm}}$ maximize $\Pi_{fndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}})$ given $\mathbf{b_{-fndm}}$ and $\mathbf{p_{-fndm}}$.

The Nash assumption implies that bundle prices satisfy the downstream firm's first-order necessary conditions for maximizing profit. Furthermore, if an observed bundle is modified by adding or

[13] If this is the case, we will tend to under-estimate WTP for relatively high-value-per-minute programming and over-estimate WTP for relatively low-value-per-minute programming.

[14] Households are free to not watch or block programming they don't like. However, some groups indicate that they might be willing to pay to not receive some channels. For example, evangelical Christian groups support à la carte so that they may block MTV whose content they find distasteful. Some liberal groups have expressed interest in à la carte as a way to protest Fox News Channel, whose content they find slanted towards conservative viewpoints.

removing a channel, then the profit will be less than or equal to the original bundle's profit, no matter the price of the new bundle. Identification and estimation of input costs is partly based on these implications of the Nash assumption.

We do not have a uniqueness result for the Nash equilibria of this pricing and bundling game. The estimation of input costs relies only on the necessary conditions of Nash equilibrium. Therefore, multiple equilibria does not affect the properties of our estimated parameters. Multiple Nash equilibria would negatively affect both the estimation of bargaining parameters and the simulation analysis of unrealized policies. While we can not prove uniqueness, we do numerically search for multiple equilibria by changing the starting values when computing an equilibrium by best-response dynamics, but do not find multiple equilibria.

4.4 Supply: Bargaining Between Distributors and Channel Conglomerates

Input costs are the outcome of bilateral negotiations between upstream channels and downstream distributors. Bilateral negotiations have been studied extensively building on Nash (1950) and Rubinstein (1982), as detailed in Muthoo (1999). Chipty and Snyder (1999) use such models to analyze mergers in the multichannel television industry before the emergence of satellite television. This paper's environment differs from those models because payoffs depend on outcomes of bilateral negotiations that firms are not party to. These cross-negotiation externalities are due to downstream competition. Horn and Wolinsky (1988), Hart and Tirole (1990), McAfee and Schwartz (1994), and Segal and Whinston (2003) study these environments when one side of the market has one or two agents. Raskovich (2003) extends these models to capture the notion of pivotal buyers in the multichannel television industry. de Fontenay and Gans (2007) extend these models to allow for arbitrary numbers of agents on both sides of the market.

We too model this situation as a game involving the upstream channels, or conglomerates of channels, and the downstream distributors. Distributors and conglomerates meet bilaterally. Following industry practice, we assume distributors (MSOs) negotiate on behalf of all their component systems and channel conglomerates bargain on behalf of their component channels. They bargain à la Nash to determine whether to form an agreement, and if so, at what input cost. The ultimate payoffs are determined by downstream competition at the agreed upon input costs.

We assume that the agreements between channel and distributor are simple linear fees: how much must the distributor pay to the channel each month for each subscriber who receives the channel. In reality, payments are linear, but contain other provisions as well: descriptions of the service to be provided by each side, standards for technical service, marketing agreements, most favored nation clauses, division of advertising spots, tiering requirements, and auditing, confidentiality, and severability clauses. However, few contain fixed monetary transfers, and if they do, they are negligible with respect to the contract's total value. We model the contracts as only a linear fee for each distributor and channel.[15]

Let $\Psi = \{\tau_{fc}\}$ be a set of input costs, a scalar for each pair of distributor and channel. In the bargaining stage, each conglomerate of channels and distributor meets separately and simultaneously. We denote a conglomerate by K and a channel by c. Let τ_{fK} be the vector of input costs for conglomerate K. We assume these meetings result in the asymmetric Nash bargaining solution. In each bilateral meeting, τ_{fK} maximizes firm f and conglomerate K's bilateral Nash product:

$$NP_{fK}(\tau_{fK};\Psi_{-fK}) = \Big[\Pi_f(\tau_{fK};\Psi_{-fK}) - \Pi_f(\infty;\Psi_{-fK})\Big]^{\zeta_{fK}}\Big[\Pi_K(\tau_{fK};\Psi_{-fK}) - \Pi_K(\infty;\Psi_{-fK})\Big]^{1-\zeta_{fK}} \quad (7)$$

where Π_f is the sum over markets (ndm) of firm f's profit function in (6) and

$$\Pi_K(\tau_{fK};\Psi_{-fK}) = \sum_{c\in K}\left(\sum_f \tau_{fc}Q_{fc}(\Psi)\right) + r_c^{ad}t_c(\Psi)$$

is conglomerate K's profit function before fixed costs. $Q_{fc}(\Psi)$ is the total number of subscribers of channel c coming from distributor f and r_c^{ad} is the advertising revenue of channel c per household hour watched. The endogenous viewership, $t_c(\Psi)$, is recomputed in every downstream equilibrium using the consumer demand and viewership model. In words, the conglomerate profit function is the sum over distributors of license fee plus advertising revenue. Advertising revenue depends on the advertising rates and endogenous viewership of the conglomerate's channels. If there is no agreement between a distributor and a conglomerate, then the input cost for each channel in the conglomerate is positive infinity.

[15] Linear input costs above the production marginal cost, in this case zero, are often considered unrealistic because with downstream monopoly, the upstream and downstream firms can find fixed transfers that make both better off after changing the input cost to marginal cost. However, when there is downstream competition, committing to linear contracts is one way of avoiding the dissipation of profits due to such competition.

Negotiations are simultaneous and separate, so Ψ_{-fK}, the set of all other input costs, is not known but conjectured. ζ_{fK} is the bargaining parameter of distributor f when meeting conglomerate K. Allowing $\zeta_{fK} \neq 0.5$ distinguishes asymmetric from symmetric Nash bargaining. Setting ζ_{fK} to zero is equivalent to assuming Nash-Bertrand pricing behavior by the upstream firms.

Bargaining Equilibrium $\forall f,\ \forall K,\ \tau_{fK}$ maximizes $NP_{fK}(\tau_{fK}; \Psi_{-fK})$ given Ψ_{-fK}.

The interpretation of this equilibrium, due to Horn and Wolinsky (1988), is a Nash equilibrium between Nash bargains. To paraphrase, consider a simultaneous move game where the players are the bargaining pairs, each pair's strategy is τ_{fK}, and each pair's payoff is its Nash product. The bargaining equilibrium is the Nash equilibrium of that game. This setup does not allow for advantages due to informational asymmetries. Each distributor and each conglomerate sends separate representatives to each meeting. Once negotiations start, representatives of the same firm do not coordinate with each other.[16] We view this absence of informational asymmetries as a weakness of the bargaining model. However, in return we gain tractability in determining how the threat of unilateral disagreement determines input costs in a bilaterally oligopolistic setting.

Another issue, also raised in Horn and Wolinsky (1988) and discussed in Raskovich (2003), is how to define the disagreement payoffs. Following the Nash equilibrium reasoning, we assume that agreements are binding in all contingencies. In previous versions of this paper, we have solved alternative cases where if a pair disagrees, all other firms renegotiate conditional on the disagreeing pair dropping out forever. This case is reminiscent of the reasoning in the Shapley value.[17] This alternative model generated different estimates of bargaining parameters, but did not affect our ultimate results. Solving this alternative game is computationally more challenging because one must compute payoffs for every possible configuration of agreement or disagreement. Without more industry specific information on what might happen to other negotiations when a pair disagrees, and given that both models deliver similar ultimate conclusions, we chose the simpler model.

[16] As a separate issue, we also ignore moral hazard. For example, we ignore the imperfectly observable choice of effort exerted by channels into making compelling programming following an agreement. Descriptions of the programming are often written into the agreements, but it is not clear if there is a conflict between the two parties about these terms. Linear fees also may help resolve any more hazard issues upstream.

[17] de Fontenay and Gans (2007) make an explicit connection with a cooperative solution that has the flavor of the Shapley value.

In our baseline specification, we treat each conglomerate as an indivisible block of channels. This implies, for example, that if bargaining breaks down between ABC Disney, which owns ESPN, ESPN 2, Disney Channel, ABC Family, SOAPNet, and other channels, and Comcast, then Comcast will not carry any of the ABC Disney channels. We also have solved a specification where we treat each channel as an individual firm. We assume that the disagreement profits for each of these channels are the profits from only that channel being dropped, rather than from all or a subset of channels from the conglomerate being dropped. Recent details of negotiations which became public provide evidence for both assumptions: Viacom threatened to pull all of its channels, including MTV, Comedy Central, and Nickelodeon, during negotiations with Time Warner Cable in late 2008, whereas Comcast's content division pulled Versus from DirecTV in 2009 following an unsuccessful negotiation, but continued to serve its other channels, such as Golf Channel and E!, through DirecTV. How multi-product firms decide between potentially complex bargaining threats is an open question.

5 Estimation

We first estimate the distribution of preferences for channels, γ_i, using ratings data, jointly with the distribution of marginal utility of income, α_i, and non-price preference parameters, ψ, using market share, price, and bundle characteristics data. We then use these demand estimates to separately estimate a parameterized cost function which predicts an input cost, τ_{fK}, for each pair of distributor f and channel conglomerate K. Finally, given the estimated demand and cost parameters, we choose bargaining parameters, ζ_{fc}, for each pair so that the bargaining model induces the estimated set of input costs in equilibrium. While it would be efficient to estimate all the parameters jointly, we found it simpler to code and estimate the model as this sequence of separate steps.

5.1 Household Preference Parameters

We jointly estimate a parameterized distribution of γ with a parameterized distribution of α_i and non-price preference parameters, ψ. The moments used in estimation are: (1) the fraction of households that watch zero hours by channel for the eight combinations of three demographic groups (black, age, and family), (2) mean hours watched per household per channel by demographic group, (3) the covariance in DMA ratings with DMA mean demographics, (4) mean hours watched per household per channel, (5) the cross channel covariance in household hours watched, (6) the aggregate cable and satellite market share by income level, and (7) the covariance of demand-side instruments, Z_{jndm} with the unobserved demand shock ξ_{jndm}.

Household i's time spent viewing the programming on bundle j, t_{ijndm} depends on their vector of channel preferences, γ_i, and the channels available on bundle j, C_{jndm}. The ratings data are measurements of time spent viewing at the individual and market level. We estimate the distribution of γ by matching moments of the model's predictions of time spent viewing to moments of the ratings data. We parameterize the distribution of γ as:

$$\gamma_i \quad = \quad \chi_i \circ (\Pi o_i + v_i)$$

where χ_i is a vector whose components are indicator random variables

$$\chi_{ic} = \begin{cases} 0, & \text{w. prob } \rho_{o_i c} \\ 1, & \text{w. prob } 1 - \rho_{o_i c} \end{cases}$$

In words, each household's vector of channel preferences consists of individual channel preferences, γ_{ic}, which is zero for a given channel with some probability depending on household demographics. If γ_{ic} is not zero, it is a random variable whose mean depends linearly on household demographics Πo_i, where o_i is a vector of demographic attributes of household i. There is a layer of unobservable heterogeneity in channel preferences due to the vector v_i which we assume is drawn from a multi-dimensional distribution named G with exponential marginal distributions (whose parameters Λ we estimate) and a correlation structure described by a Gaussian copula Σ (which we also estimate). With this parametrization, the household maximization in Equation (2) yields $\hat{t}_{ijcndm}(\Pi, \rho, \Lambda, \Sigma)$, each household's time watched of channel c in bundle j.

One can only observe ratings data for channels which a household has elected to receive. We accommodate the selection into bundles by matching moments of the model's predictions of time spent viewing conditional on bundle choice to ratings data which exhibit the same conditioning. The conditioning on bundle choice requires knowing parameters from the model of bundle choice (stage three of our model, given in equation (4)). We jointly estimate the parameters of the distribution of channel preferences together with bundle choice parameters as in Lee (2010). In our later analysis, household preferences for channels they do not receive will be a key ingredient. We conduct this analysis by extrapolating from the distributions that we estimate.

Te population moments of the model's predicted time spent viewing are sensitive to a limited set of parameters. One may casually think of those moments' observed counterparts as "empirically identifying" these parameters. Using this terminology, $\rho_{d_i c}$ is empirically identified by (1), the fraction of households that watch zero hours by channel by demographic group, Π by (2), the mean hours watched by household by demographic group, and (3), the covariance in DMA ratings with DMA demographics, G's marginal distribution exponential parameters by (4), the mean and variance in hours watched by household, and the correlation structure of G by (5), the cross channel covariance of household hours watched (net of variance attributed to demographics). Identification of the other demand parameters is discussed below.

Positive correlation for a pair of channels could arise if a certain demographic group watches both channels, or even in the absence of demographic patterns, if those who watch one of the channels also watch the other. Negative correlation could arise if exclusive demographic groups watch each channel, for example if rich households watch one of the channels and poor households the other, or even in the absence of demographic patterns, if those who watch one channel don't watch the other.

We parameterize the distribution of α_i as $\alpha_i = \alpha + \pi_p y_i$ where y_i is household i's income. We estimate α, π_p, and ψ as in Berry, Levinsohn and Pakes (2004) and Petrin (2003). This part of the estimation is based on Equation (5). For given values of π_p and the distribution of γ, we find the values of δ_{jndm} which equate observed market shares with predicted market shares using the contraction mapping from Berry, Levinsohn and Pakes (1995). Given δ_{jndm}, we estimate α and ψ by linear instrumental variables regression using instrument vector, $Z_{jndm} = [z_{jndm} \;\; w_{ndm}]$.

We assume observed non-price product characteristics (dummy variables for non-channel bundle characteristics such as firm, year, and tier name), z_{jndm}, are independent of ξ_{jndm}. We accommodate the endogeneity of price by instrumenting for it with w_{ndm}, where w_{ndm} is the average price of other cable systems bundles within the same DMA as cable system n. These will be valid instrumental variables if, for bundle j in market n, (a) the unobservable demand shock, ξ_{jndm}, is uncorrelated and (b) marginal costs are correlated with prices within n's DMA outside market n. Cable systems are physically distinct entities for which local managers have wide authority, so bundle prices should be uncorrelated with non-competing bundles' unobservable characteristics. Labor costs and advertising rates are often correlated within DMAs. Following Hausman (1996), these are often called "Hausman" instruments. π_p is empirically identified by the total cable and satellite market share by income level.

The model's predicted time spent by household i watching channel c when subscribing to bundle j is given by $\hat{t}_{ijcndm}(\delta, \pi_p, \Pi, \rho, \Lambda, \Sigma)$ and depends on the data in addition to the indicated dependence on model parameters. The model's predicted market share for household i for bundle j is $\hat{s}_{ijndm}(\delta, \pi_p, \Pi, \rho, \Lambda, \Sigma)$. Explicitly, the moment conditions used in estimation are:

$$\begin{array}{l} (1) \\ (2) \\ (3) \\ (4) \\ (5) \\ (6) \\ (7) \end{array} \begin{bmatrix} \frac{1}{N_{ndm}} \sum_{ndm} \frac{1}{N_{ondm}} \sum_{i=1}^{N_{ondm}} (\sum_{j \in b_{ndm}} \mathbf{1}_{\{\hat{t}_{ijcndm} > 0\}} \hat{s}_{ijndm}) - r_{co}^{\text{cume}} \\ \frac{1}{N_{ndm}} \sum_{ndm} \frac{1}{N_{ondm}} \sum_{i=1}^{N_{ondm}} (\sum_{j \in b_{ndm}} \hat{t}_{ijcndm} \hat{s}_{ijndm}) - t_{co} \\ \frac{1}{D} \sum_{d=1}^{D} (\hat{t}_{cd} - \bar{t}_c)(o_d - \bar{o}) - \sigma_{r_{cd}, o_d} \\ \frac{1}{D} \sum_{d=1}^{D} \hat{t}_{cd} - r_{cd} \\ \frac{1}{N_{ndm}} \sum_{ndm} \frac{1}{N} \sum_{i=1}^{N} (\sum_{j \in b_{ndm}} (\hat{t}_{ijcndm} \hat{s}_{ijndm} - \bar{t}_c)(\hat{t}_{ijc'ndm} \hat{s}_{ijndm} - \bar{t}_{c'})) - \sigma_{t_c, t_{c'}} \\ \frac{1}{N_{ndm}} \sum_{ndm} \sum_{j \in b_{ndm}} \frac{1}{N_{ondm}} \sum_{i=1}^{N_{ondm}} \hat{s}_{ijndm} - s_o \\ \frac{1}{N_{ndm}} \sum_{ndm} \sum_{j \in b_{ndm}} \xi_{jndm} Z_{rjndm} \end{bmatrix} = 0$$

where $\sum_{ndm}$ is the sum over markets, DMAs, and months in our data, N_{ndm} is the number of such market-DMA-months, $\hat{t}_{cd} = \frac{1}{N_{nm}} \sum_{nm} \sum_{j \in b_{ndm}} \frac{1}{N} \sum_{i=1}^{N} \hat{t}_{ijcndm} \hat{s}_{ijndm}$ is the average time spent watching channel c in DMA d and $o_d = \frac{1}{N_{nm}} \sum_{nm} \sum_{j \in b_{ndm}} \frac{1}{N} \sum_{i=1}^{N} o_{indm}$ is the average of demographic o in DMA d in the third moment (with $\bar{t}_c$ and $\bar{o}$ the across-DMA averages of those), Z_{rjndm} is the r^{th} instrument in Z_{jndm}, and we've suppressed the dependence of predicted time and market shares on the model's parameters and data to economize on space. On the right-hand side of the first six moment conditions are the corresponding moments in our data. r_{co}^{cume} is the share of MRI households of demographic o that have positive viewing to channel c, t_{co} is the average time MRI households of demographic o spend watching channel c, σ_{r_{cd}, o_d} is the across-DMA covariation in Nielsen ratings for channel c and demographic o, r_{cd} is the across-month average Nielsen rating for channel c in DMA d, $\sigma_{t_c, t_{c'}}$ is the covariation in MRI households' time spent watching each pair of channels, c and c', and s_o is the market share for cable (and, separately, satellite) by demographic.

N_{ondm} is the total number of households who have demographic characteristic o in market ndm and D is the total number of DMA's. The set of demographic characteristics we use depends on the set of moments. For the set of moments associated with the first row, we use each of eight combinations of black, family, and whether the head of household is aged over 55. For the set of moments associated with the second and third rows, we use whether the household is a family or not, income level, race, whether the head of household has a bachelor's degree, and the age of the head of household. For the moments associated with the second-to-last row, we use income quartiles only. For convenience, the labeling of the moments to the left of the brackets corresponds to their description on the previous page.

5.2 Cost Estimation

National-average input costs, the necessary conditions implied by Nash equilibrium in prices and bundles, and the observed prices and bundles identify input costs. National-average input costs are direct evidence. The rest is indirect evidence; what could input costs have been given the Nash assumption and observed prices and bundles?

We parameterize τ_{fc} as a function of channel characteristics scaled by a function of firm and channel characteristics:

$$\hat{\tau}_{fc}(\eta, \varphi) = (\eta_1 + \eta_2 x_c) exp(\varphi_1 MSOSIZE_f + \varphi_2 VI_{fc})$$

where x_c is the Kagan average input cost for channel c, $MSOSIZE_f$ is firm f's total number of subscribers, and VI_{fc} is the ownership share firm f has in channel c.[18] While different channels may have different base rates, we assume the functional form of the effect of distributor size and vertical integration on input costs is the same for all channels. If Comcast has a 30% discount on the base rate of ESPN, it also has a 30% discount on the base rate of CNN, and for any other channel that it is not vertically integrated with.

A weighted average of τ_{fc} over firms predicts the national-average input cost for each channel c. The Kagan EBCN data set's channel input costs are the empirical counterpart of these averages. The first set of moment conditions is that the model's predicted aggregate input costs should equal observed aggregate input costs: $\{\tau_c\}$.

$$E_f[\hat{\tau}_{fc}(\eta, \varphi)] - \tau_c = 0$$

[18] This information was collected from a number of different sources, primarily various years of SNL Kagan's EBCN and historical issues of *Multichannel News*.

The first order condition to maximize firm f's profits with respect to the price of bundle k in market ndm is:

$$\frac{d\Pi_{fndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}})}{dp_{kndm}} = \sum_{j \in B_{fndm}} (p_{jndm} - \sum_{c \in C_{jndm}} \tau_{fc}) \frac{ds_{jndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}})}{dp_{kndm}} + s_{kndm}(\mathbf{b_{ndm}}, \mathbf{p_{ndm}})$$

This says that bundle k's optimal price is equal to the input cost of bundle k plus a mark-up that depends on demand conditions and the other bundles in the market. This condition holds in a Nash equilibrium for each firm in each market, given all other bundles and prices. Given the estimated demand parameters and observed prices and bundles, we solve for the implied $\sum_{c \in C_{jndm}} \tau_{fc}$ for each bundle which we call $\hat{mc}_{jndm}$. The second set of moment conditions is that the difference between $\hat{mc}_{jndm}$ and $\sum_{c \in C_{jndm}} \hat{\tau}_{fc}(\eta, \varphi)$ should have zero covariance with the size of bundle j's MSO and the number of own vertically integrated channels included in bundle j.

The Nash assumption also implies the necessary conditions of profit maximizing bundle choice for each firm given the price and bundle choices of its rivals. Our estimation uses a subset of these necessary conditions as moment inequalities. The logic is the same as for the optimal pricing conditions. There are only certain cost parameters which satisfy that adding or dropping channels is less profitable than keeping the observed bundles. We punish candidate parameter estimates if they imply that altering observed bundles are profitable deviations for distributors. Firms may have unobservable information about these decisions which, if left unaddressed, would bias our estimates. We assume that the firm's unobservable information is fixed for a given channel across markets, and sum the profit of changing from observed choices across opposite decisions for a given firm and channel pair. For example, we may see Comcast carry Comedy Central in one market and not in another. Our moment inequality conditions are that the sum of the difference between the observed and deviation profits should be weakly positive.

Because adding or dropping channels is a discrete choice, the implied restrictions are inequalities. We follow the set-up in Pakes et al. (2006). From the Nash assumption, the profits to firm f in market n are higher for its chosen and observed bundles and prices than for alternate bundles:

$$\Pi_{fndm}((\mathbf{b_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})) \geq \Pi_{fndm}((\mathbf{b'_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p'_{fndm}}, \mathbf{p_{-fndm}}))$$

We approximate Π_{fndm} using the profits predicted from the model, r_{fndm}, which of course depend on input costs.

$$\Pi_{fndm}((\mathbf{b_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})) \approx r_{fndm}((\mathbf{b_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})) + \nu_{fndmb,1} + \nu_{fndmb,2}$$

$\nu_{fndmb,1}$ is the error in the approximation that is unknown to the firms when making their bundling decision. $\nu_{fndmb,1}$ contains measurement error and firm uncertainty. $\nu_{fndmb,2}$ is the error in the approximation known to firms at that time. $\nu_{fndmb,2}$ contains, for example, the loss a vertically integrated channel would suffer if its integrated distributor carried a competing channel.

Following Pakes et al. (2006), we define

$$\Delta\Pi_{fndm}(b, b') \equiv \Pi_{fndm}((\mathbf{b_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})) - \Pi_{fndm}((\mathbf{b'_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p'_{fndm}}, \mathbf{p_{-fndm}}))$$

and

$$\begin{aligned}
\Delta r_{fndm}(b, b') &\equiv r_{fndm}((\mathbf{b_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p_{fndm}}, \mathbf{p_{-fndm}})) - r_{fndm}((\mathbf{b'_{fndm}}, \mathbf{b_{-fndm}}), (\mathbf{p'_{fndm}}, \mathbf{p_{-fndm}})) \\
\nu_{fndm,b,b',1} &\equiv \nu_{fndmb,2} - \nu_{fndmb',2} \\
\nu_{fndm,b,b',2} &\equiv \nu_{fndmb,2} - \nu_{fndmb',2}
\end{aligned}$$

We assume that for two markets ndm and ndm' and the same firm, $\nu_{fndm,b,b',2} = \nu_{fndm',b,b',2} = \nu_{f,b,b',2}$.

Therefore, any unobservable error in the approximation of profits for adding or dropping channels is common to all markets for a given firm. For example, the benefit of adding Turner Classic Movies, a channel vertically integrated with Time Warner Cable, that is not accounted for in the function Δr is the same in any Time Warner Cable market.

This assumption and the Nash condition imply the optimal bundling moment conditions:

$$E[\Delta r_{fndm}(b, b') + \Delta r_{fndm'}(b', b)] \geq 0$$

The estimation routine punishes input cost parameters whose implied r functions violate this condition.

The optimal pricing condition identifies the cost parameters on its own. Furthermore, in its absence the cost parameters are partially identified. Stacking the three sets of moment conditions together:

$$\begin{array}{l} \text{Agg. Input Costs} \\ \text{Nash Pricing} \\ \text{Nash Pricing} \\ \text{Nash Bundling} \end{array} \begin{bmatrix} E_f[\hat{\tau}_{fc}(\eta,\varphi)] - \tau_c \\ \frac{1}{J}\sum_j SZ_{jndm}(\hat{mc}_{jndm} - \sum_{c \in C_{jndm}} \hat{\tau}_{fc}(\eta,\varphi)) \\ \frac{1}{J}\sum_j VI_{jndm}(\hat{mc}_{jndm} - \sum_{c \in C_{jndm}} \hat{\tau}_{fc}(\eta,\varphi)) \\ min(0, \frac{1}{J}\sum_j \Delta r_{fndm}(b_{jndm}, b'; \eta, \varphi) + \Delta r_{fndm'}(b', b_{jndm}; \eta, \varphi)) \end{bmatrix} = 0$$

We estimate η and φ by minimizing the empirical analog of these moment conditions.

5.3 Channel-Distributor Bargaining Parameter Estimation

The unobserved parameters of the bargaining game are each conglomerate and distributor's pair-wise bargaining parameters ζ_{fK}. We use no additional data in identifying the bargaining parameters. They are functions of the estimated cost and demand parameters and the protocol of the bargaining game.

In practice, we choose the values of ζ_{fK} to minimize the distance of the bargaining model's equilibrium input costs and estimated input costs. The demand and pricing model implies a set of input costs which deliver higher profits for both channel and distributor than no agreement. If this set is non-empty, it will usually be an uncountable set. In this case, the two firms will disagree over what point in the set should be chosen. The conglomerate will most often prefer higher input costs, the distributor will always prefer lower input costs. The bargaining model, for a fixed vector of $\zeta_{\mathbf{K}}$, resolves this disagreement. Part of the resolution is due to the bargaining protocol and the respective parties' outside options. The rest is due to the bargaining parameters $\zeta_{\mathbf{K}}$. The estimated input costs are an estimate of the actual resolution point. Therefore, the estimated bargaining powers are the $\zeta_{\mathbf{K}}$ which imply equilibrium input costs from the bargaining model as close as possible to estimated input costs.

Identification of ζ_{fK} relies on two key ingredients. First, we are able to estimate pair-specific input costs. Second, the marginal cost of upstream production is commonly known to be zero. When costs are not observed nor separately estimated, they are not separately identified from the bargaining parameters. The analyst would not know if the input costs are high because marginal cost is high or because the upstream firm's bargaining parameter is high. In this application, because of these two ingredients, we are able to separately identify the bargaining parameters from cost parameters.

The ultimate payoffs for each of the parties involved in bargaining is determined after downstream competition has taken place. When solving for equilibrium input costs, we re-compute, for each potential input cost, the viewership, subscription, and pricing decisions at each stage of the model. These equilibrium quantities determine how much advertising revenue is sold and how much revenue the conglomerate receives from each distributor. We model the advertising revenue as a linear function of household hours watched. We estimate a channel-specific advertising price using Kagan advertising revenue data and Nielsen ratings data. Each channel's estimated advertising price is simply its advertising revenue divided by its average national household rating.

Computing equilibrium input costs is computationally demanding. For both the estimation of the bargaining parameters and the counterfactual, we simplify the computational burden by assuming there is one large market and one small market. We further assume there is one cable distributor for the large market and a separate cable distributor for the small market. There are two "national" satellite providers that compete with the cable operators in each market, but must set the same prices and packages in both markets. The simplified industry structure reduces the number of players in the bargaining game, which in turn reduces the computational burden of estimation. The downstream local market structure is the same as in the estimation, and in reality during the time period of the sample: one cable and two satellite options per market. Without a simplification, it would be necessary to solve the bargaining game with many simultaneous negotiations, and to have the downstream competition take place in thousands of markets. The simplification allows a connection to the estimated cost parameters by having different sized distributors while economizing on computational time.

6 Estimation Results

Demand Estimates Table 3 presents estimates of the price sensitivity parameter (α), the impact of income on price sensitivity (π_p), and differences across demographics in tastes for the outside good. The estimated price sensitivity parameter is -0.44.[19] In markets that offer Basic, Expanded Basic, and Digital Basic cable services, this yields an average own price elasticity for Basic of -2.79, for

[19]Moving from OLS ($\hat{\alpha} = -0.27$) to IV ($\hat{\alpha} = -0.44$) suggests that our instrumental variables strategy is working as theory would predict.

Expanded Basic of -5.58, for Digital Basic of -12.31, and for Satellite of -4.81. These are on par with most previous estimates in the literature.[20]

Table 4 reports, for each channel, information about the distributions of WTP implied by our estimates. The first three columns of the table report, for a simulated set of 20,000 households, the mean and standard deviation in WTP for the channel among those that value it positively and the share of households that value it positively. Figure 4 presents estimates of the full marginal distribution of WTP for a subset of these channels.

The WTP estimates mimic the patterns in the Nielsen ratings and Mediamark consumer survey data. The mean and standard deviation of WTP for ESPN ($2.75, $4.08) are higher than for Bravo ($0.59, $0.68) because the mean and variance of ESPN's ratings are higher than Bravo's. The estimated share of households with positive tastes for TNT (0.72) is higher than for the Golf Channel (0.08) because more consumers report watching TNT than the Golf Channel.

The dispersion in WTP for any given channel can be decomposed into the dispersion which can be attributed to demographics and that which cannot. Dispersion due to demographics comes through the impact of demographics on tastes (i.e., Π or $\rho_{d_i c}$) while further dispersion comes through the distribution of unobserved tastes for channels, G. On average across channels, 5% of the dispersion in WTP can be attributed to demographics, although this can be much higher for individual channels.[21] Columns three and four provide an example of demographic effects by reporting mean WTP for family and black households, respectively. Family households are estimated to prefer channels offering family-oriented programming like the Disney Channel and Nickelodeon. Black households are estimated to generally value channels more highly, with a strong effect for BET ($4.13 versus $1.14 among all households).

Correlations in WTP between pairs of channels can arise through demographic groups sharing tastes for those channels, or through the correlations estimated in G. Most pairwise correlations are between -0.1 and 0.1, although some pairs of channels have stronger correlations. We estimate that

[20] The FCC (2002) (-2.19), the GAO (2003) (-3.22), Beard, Ford, Hill and Saba (2005) (-2.5), Chipty (2001) (-5.9), and Goolsbee and Petrin (2004) (-1.5 for EB, -3.2 for DB, -2.4 for Satellite), have all separately estimated the average own price elasticity of cable services, using market share regressions, diverse data sets, and instrumental variables techniques.

[21] We calculate this by regressing, for each channel, WTP for the channel among 20,000 simulated households on their demographics and then constructing a weighted average of the R^2 from those regressions using the mean WTP for the channel as a weight.

ESPN and ESPN2 have a correlation in household WTP of 0.45, ESPN and Fox Sports of 0.29, MTV and SoapNet of -0.16, and CNBC and Comedy Central of -0.17. The last column in Table 4 shows that the channel estimated to have the highest correlation in tastes for each channel accords with intuition in who is likely to be the target audience of the programming on both channels.

Input Cost Estimates We estimate median marginal costs for bundles to vary from $7.96 for Basic to $47.31 for Digital Basic packages. For Basic and Expanded Basic, these imply margins for cable systems consistent with that reported in FCC (2008); for Digital Basic, they imply slightly negative margins.[22]

The demand estimates are combined with Nash pricing and bundling assumptions and EBCN average input costs per channel to estimate differences in per-channel input costs across distributors. We attempted to project the estimated bundle marginal costs onto the channels in the bundle, but did not find enough variation in the bundles to do so with any statistical power. By bringing the extra information contained in EBCN's average costs and the Nash in bundling assumptions, we are able to estimate not only channel specific input costs, but also how those input costs differ for downstream firms based on size and vertical integration.

The estimated input cost parameters, η and φ, in Table 5 imply that Comcast, a distributor with roughly 23 million subscribers, faces input costs 13% below those of a small distributor. The estimated effect of vertical integration is slightly positive, contrary to economic theory, but not statistically significantly different from zero. Of the three moment conditions, the EBCN average costs help pin down the overall level of input costs while the Nash in pricing and bundling assumptions help pin down how those input costs vary across distributors of different size and/or integration status. For robustness, the second set of columns of Table 5 report the same estimates excluding the Nash in bundle moments conditions. There are few differences.

The patterns in the data generating these estimates are clear from Table 6. It shows that observed prices and estimated marginal costs are lower on average for large distributors, conditional on the characteristics of the bundle. Consequently, we estimate large distributors to have lower per-channel input costs. Similarly, prices and estimated marginal costs for bundles don't vary in a statistically significant way for distributors who offer many of their own vertically integrated channels. One

[22]We conjecture this is due to introductory pricing of new digital services.

might expect these distributors to at least carry their vertically integrated channels more often than other distributors, but this is not true for most of the vertically integrated channels we examine.[23]

Bargaining Parameter Estimates We report our estimates of channel conglomerates' bargaining parameters relative to distributors in Table 7. Smaller values indicate relatively more bargaining power for channels. We estimate that bargaining parameters are usually between 0.25 and 0.75. These estimates discourage assuming take-it-or-leave-it offers as the estimated bargaining parameters are neither zero, which would imply channels take all the marginal surplus, nor one, which would imply distributors do. ABC Disney, Time Warner, News Corporation and Lifetime (jointly owned by Disney, Hearst, and NBC) are estimated to have the greatest bargaining power among channel conglomerates.

We find that the bargaining parameters are higher for satellite firms than cable firms. In equilibrium, big cable firms have lower input costs than satellite firms due to primitives like market size and preferences for cable versus satellite. This discount would be larger if the two firms had equal bargaining parameters. Within cable firms, big cable firms and small cable firms have roughly equal estimated bargaining parameters.

7 The Welfare Effects of À La Carte

7.1 Theoretical Predictions

For a fixed set of channels and ignoring capacity constraints, the socially optimal allocation would deliver every channel in existence to each household that has a positive willingness to pay for that channel. Bundling excludes households that have positive willingness to pay for some channels,

[23] It is true for some new and small channels that are too small to be included in either the TMS or Nielsen viewing data and are therefore not part of the analysis. For example, both CNN, a large and highly watched news channel, and CNN International, a smaller channel targeted towards an international audience, were vertically integrated with Time Warner Cable during the sample period. Pricing and carriage decisions for bundles with CNN do not differ systematically for Time Warner Cable compared to other distributors. CNN International, on the other hand, is carried much more often by Time Warner Cable than by other distributors. More analysis would be necessary to determine whether Time Warner Cable's specific markets have higher tastes for international news, but the pattern holds conditional on market characteristics. Chipty (2001) focuses on a small and specific group of vertically integrated channels to find that integration does affect costs and carriage. Here, we show that this is indeed true if one looks at certain less-established channels, but not for the established channels.

but do not derive a value from the full bundle that justifies its price. À la carte pricing of channels allows for those excluded under bundling to purchase some channels. However, à la carte partially excludes households who have positive valuations for channels that do not exceed the prices at which the channels are being sold. Which of these two effects dominates determines the total welfare effect of à la carte, and is one output of the counterfactual exercise.

How the surplus generated by multichannel television service is split between and within consumers and firms is also of importance to policy makers. Bundling theory under monopoly suggests that consumers with highly variant preferences, as we estimate television households to be, are better off under l̀a carte pricing in the short run (Adams and Yellen (1976)). The theory under oligopoly is less established and offers ambiguous predictions about the effects of à la carte on consumer welfare. Furthermore, neither of these literatures consider the welfare effects allowing for renegotiation of linear contracts between upstream and downstream firms.

In the long run, the conclusions of economic theory on the welfare effects of à la carte are even less clear. Many opponents of à la carte claim smaller channels appealing to niche tastes will become unprofitable and exit in an à la carte environment. Others claim they may invest less in program quality. We do not model the impact of à la carte on these long-run outcomes. Further research of their evolution in an equilibrium setting is necessary to assess these effects of à la carte regulations.

7.2 Counterfactual Simulations

Supporters have suggested various implementations of à la carte policies. These range from requiring firms which bundle to allow consumers to opt out of programming and receive a rebate (as in the Family and Consumer Choice Act of 2007) to separately priced themed tiers to offering separately priced individual channels. We simulate three outcomes: full à la carte (ALC), themed tiers (TT), and bundle-sized pricing (BSP).

In all our simulations, we make a number of assumptions consistent with a short-run analysis. We assume that preferences are invariant to the policy change. As discussed above, we assume that channels do not alter their programming following the policy change, nor do new channels enter or existing channels exit. We assume the technical, administration, billing, and marketing costs of firms are the same when firms are allowed to bundle as when firms are forced to sell channels à la carte. Finally, we assume that households don't incur any extra cognitive costs from choosing from the larger choice set.

In what follows, we describe in some detail our preferred results. They represent our best estimates of what outcomes would be under various counterfactual policy environments. We recognize, however, that there are many assumptions underlying the specific numbers we present below. In Appendix B, we assess the robustness of our conclusions to alternative assumptions underlying our analysis.

Full ALC Our baseline simulation has one large and one small cable market as in the bargaining power estimation. Each is served by its own cable provider and two "national" satellite providers. The demographic distribution for each market is that of the whole United States.

Table 8 summarizes our baseline results. We report economic outcomes implied by our estimates under three scenarios. The first scenario is a bundling equilibrium where each distributor competes by setting a single fixed fee for a bundle of all the 49 channels in our analysis. Table 9 lists the included channels. The second scenario is a Full ALC equilibrium without renegotiation. In this counterfactual, each distributor competes by setting a fixed fee and separate à la carte prices for each channel in the specification. The input costs they face do not allow for renegotiation, however. That is, the input costs are the same as those we estimate. While unrealistic in television markets, this is the maintained assumption in most of the theory literature analyzing this issue. The last scenario is again Full ALC, but allows for the renegotiation of input costs.[24]

We also simulate the effects of ALC on channels' advertising revenue. For each channel, we assume that the price per minute of advertising they receive under bundling will also be what they receive under ALC. The change in their advertising revenue is then simply given by their current adver-

[24] In this equilibrium, we made the simplifying assumption that distributors set ALC prices equal to their agreed-upon input costs and earned profits only on fixed fees for access to their platforms. We did so primarily for computational reasons. Solving for renegotiated input costs in the full ALC equilibrium requires repeatedly solving for downstream prices at candidate input costs. Numerical errors in those pricing equilibria appear to propagate into the bargaining equilibria at tractable convergence tolerances, making that optimization non-smooth. It also makes it extremely time-consuming as the pricing equilibria must be repeated at each iteration in the solution of the input costs for each distributor-conglomerate pair and these in turn must be iterated to obtain the bargaining equilibrium. We feel comfortable with this assumption for two reasons. First, before imposing it we were finding downstream markups of between -5 and 10% for input costs close to but not quite reaching equilibrium values. Second, it is consistent with the predictions of Armstrong and Vickers (2001) and Rochet and Stole (2002) who find cost-based two-part tariffs characterize the equilibria in some settings analyzing competition among price-discriminating firms. In Appendix B, we allow for downstream margins to be 10% rather than 0 and obtain qualitatively similar results.

tising revenue times the percentage change in their viewing implied by the counterfactual. This is converted to a per-household basis when calculating total revenue in Tables 8 and 9.

The top panels in Table 8 present general features of the various equilibria. We see that while most households purchase some cable or satellite service in the bundling equilibrium, this is even greater under à la carte as households unwilling to pay the full cost of the bundle opt to purchase a smaller number of channels. As expected, households under ALC purchase fewer than the full complement of channels.

The bottom panels in Table 8 summarize the welfare effects of ALC. Comparing first the bundling and Full ALC *without* renegotiation, we see that channel profits drop significantly (despite an increase in advertising revenue), distributor profits increase slightly, and overall industry profits fall (by 3.7%). Consistent with the theory literature, consumer surplus rises by 16.7%, driven both by reduced expenditure among those that previously purchased the bundle and the addition of households that were previously excluded from the market. The increase in consumer surplus outweighs the fall in profits, meaning total surplus rises by 7.5%.

Allowing for renegotiation in the last set of columns changes these conclusions. Most input costs increase, some dramatically so. The total for the channels in our analysis increases an estimated 145.2%, increasing prices paid by households. Mean consumer expenditure increases an estimated 14.2%.

These input cost increases also have important effects on welfare. Instead of reducing channel profits, all of channel, distributor and industry profits are estimated to increase, the latter by 13.0%.[25] Instead of modestly increasing consumer surplus, estimated consumer surplus is effectively unchanged (-1.0%). The predicted change in total welfare is still positive, but lower than before renegotiation as some households no longer purchase some channels of moderate value whose input costs and thus prices rise.

Table 9 breaks down the input cost and profit effects by the channels included in our analysis. The first three columns report the estimated monthly license fee per subscriber under bundling for the

[25] This need not be surprising. There is tremendous uncertainty in the industry about outcomes in an ALC world. Neither channel nor distributors may know the structure of demand for channels and/or bargaining outcomes under ALC. Our results suggest ALC would be profitable for the industry. Of course, any equipment, administration, billing, or marketing costs arising under ALC would reduce these profits, possibly further reducing consumer surplus and even causing total surplus to fall.

large cable operator, the license fee under ALC with renegotiation, and the percentage change (with similar effects for other distributors). There is considerable heterogeneity across channels in the effects of ALC. Some channels are estimated to increase their license fees by 500% or more (Cartoon Network, Food Network, Toon Disney), while others are estimated to cut their fees (Hallmark, Oxygen, TV Guide).[26]

There are similarly heterogeneous effects on channel revenues. The remaining columns in Table 9 report total (license fee plus advertising) per-household revenue to each channel under bundling and ALC with renegotiation, the change between them, and the percentage change in the component (license fee, advertising) revenues. Total channel affiliate fee revenue increases by an estimated 26.0% and advertising revenue by 10.3%, the latter driven by increased viewership by households that did not purchase under bundling. There is significant estimated heterogeneity across channels, with some predicted to lose 40% or more of their revenue (AMC, Oxygen, Versus) while others are predicted to increase revenue by 100% or more (Animal Planet, CNN, TV Land).

Themed Tiers and Bundle Sized Pricing We also simulated two alternative regulatory scenarios. In the Bundle-Sized Pricing (BSP) scenario (Chu et al. (2010)), we assume downstream firms continue to offer a bundle of all the channels, but add to this a package of fifteen channels assembled by each household according to their tastes. In the Themed-Tier (TT) scenario, we assume downstream firms offer five tiers (Sports, News, Family and Education, Music and Lifestyle, and General) from which a household can choose any combination.[27] In this scenario, distributors also charge a fixed fee. In both scenarios, distributors and channel conglomerates renegotiate input costs. Table 10 reports the results.

Outcomes under BSP are quite similar to our baseline Full ALC results. Opt-in increases considerably as many consumers not willing to purchase the full bundle select instead the 15-channel alternative. Consumer surplus increases relative to Full ALC, but just enough to make consumers effectively indifferent (-0.1%) relative to the baseline bundle. Firms are slightly worse off, industry profits increasing by 5.3% instead of 13.0%, and total surplus is slightly lower (2.3%) but still positive. Outcomes under themed tiers are more dramatic. Mean consumer expenditure increases

[26] We predict Oxygen should in fact pay distributors for carriage. Negative payments to one side of a two-sided market can be optimal given that one can recoup those payments in advertising revenue.

[27] See the notes to Table 10 to see the identities of the channels included in each tier.

considerably despite a fall in channels watched. Estimated consumer surplus therefore falls considerably (-20.7%). Channel profits soar, yielding an aggregate predicted industry profit increase of 31.1%. Total surplus remains weakly positive.

Results Summary Our findings confirm the intuition regarding the likely effects of ALC described in Section 2. When we do not allow for renegotiation (Table 8, Columns 2-3), we turn off the input-cost-raising bargaining effect and find consumer surplus increases considerably (+16.7%) and industry profits fall (-3.7%). As suggested by much of the bundling literature, for fixed input costs, we find bundling transfers surplus from consumers to firms. When we allow for renegotiation (Table 8, Columns 4-5), costs rise (+145.2%), prices follow suit, and these consumer surplus gains are eliminated (-1.0%). Things are even worse for consumers under themed tiers (Table 10, Columns 4 & 7). The bundling of channels within the tiers eliminates much of the consumer surplus benefits accruing under Full ALC and *still* yields (67%) higher input costs. This worst-of-both-worlds outcome significantly lowers consumer surplus (-20.7%). Our qualitative conclusion is that consumers could in principle benefit from mandatory à la carte at existing input costs, but would not in practice benefit due to input cost renegotiation in an à la carte world.

Robustness Our goal is to accurately measure the welfare effects of à la carte pricing in multichannel television markets. As such, it is important to have confidence that this fundamental conclusion is robust and not sensitive to particular assumptions underlying the model, estimation, or counterfactual simulations. In Appendix B, we consider the robustness of our results to alternative assumptions on demand, cost, and bargaining, including allowing for positive channel margins for distributors in the counterfactual, different distributional assumptions for preferences, turning off unobserved correlation in tastes, and allowing renegotiated input costs to be half or double what we estimate. Of these, only the last has a material effect on our welfare estimates and the most likely direction for these (input cost doubling) merely reinforces our qualitative conclusions that à la carte is unlikely to benefit consumers.

8 Conclusion

This paper has combined a model of the multichannel television industry with market and viewership data in order to evaluate the welfare effects of proposed à la carte pricing regulations. We extend a standard demand model to a setting of joint purchasing and viewership decisions and combine it with a model of distributor pricing and bundling, and channel-distributor bargaining. We estimate the model using demand, pricing, viewership, and cost data from the industry. We use the estimated model to simulate an unrealized regulatory environment: à la carte pricing regulations. Critically, we allow for the renegotiation of supply contracts under à la carte and find that total input costs for the 49 channels in our analysis would rise by 145.2%. We compare the distributions of consumer and producer surplus under a simulated bundling setting with those under à la carte allowing for these cost increases and predict that, in the short run, consumer welfare would decrease approximately 1.0% under à la carte regulations, while industry profits and total surplus would increase by 13.0% and 5.3%, respectively. Any implementation or marketing costs of à la carte could make it worse for all.

One could improve our analysis of bundling in this industry in future work by either improving upon the specifics of the model and estimation we propose, or by adding more levels of strategic behavior. Regarding the former, we employed a model of bargaining which can be improved upon in several dimensions. An extensive form game which accounts for the information asymmetries about secret contracts would be a major improvement. Regarding the latter, the long-run effects of à la carte regulations on entry, exit, content, and quality of channels are often raised as concerns by policy makers.

Figure 1: Dispersion in WTP for components is higher than dispersion in WTP for a bundle

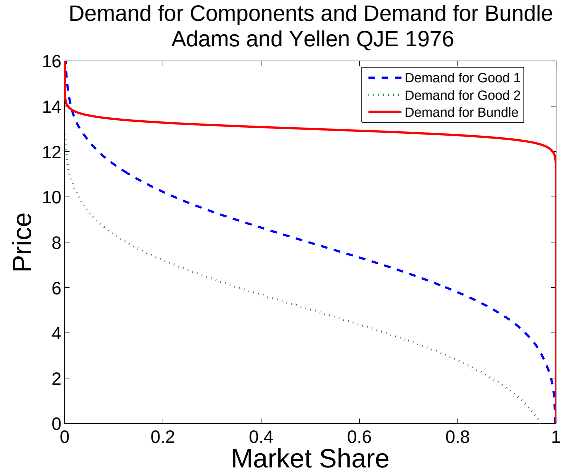
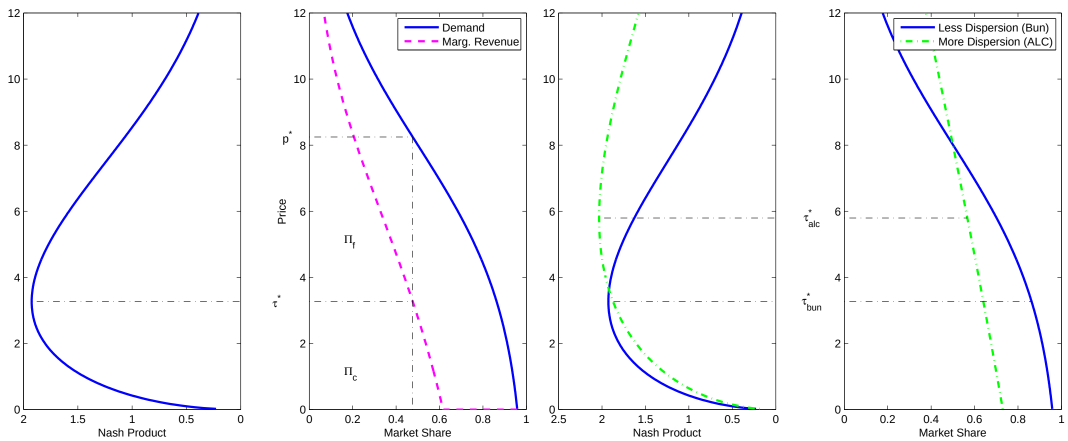


Figure 2: Nash Bargaining for Input Costs



Notes: These figures provide the intuition for the determination of input costs under Nash Bargaining. The left figure shows the value for the input cost that maximizes the Nash Product under bilateral monopoly with linear fee contracts and symmetric bargaining parameters. The solid lines in the right panel of the left figure show the demand and marginal revenue for the product faced by the downstream firm. Total (gross) profit is divided between the downstream distributor (π_f) and the upstream content providers (π_c) according to an input cost (τ). The marginal cost to the content provider is assumed to be zero. The left panel of the left figure reports the value of Nash Product (as in Equation (7) for different values of τ. The reported input cost maximizes the Nash Product.

The right figure demonstrates the consequences to input costs of the firm facing a product with more dispersion in tastes (as typically happens under à la carte pricing). At the optimal input price in the left figure, the downstream firm wishes to raise price and earns a greater share of the total profit. The upstream content provider recognizes this and bargains for a higher input cost. These dynamics are evident in the shape of the Nash Product for the more dispersed tastes.

Table 1: Factbook Summary Statistics

	N	Mean	SD	Min	Max
All Bundles					
Price	24,576	23.33	9.00	0.00	87.06
Market Share	24,576	0.45	0.26	0.00	0.99
Total Cable Channels	24,576	19.8	15.2	0	176
Basic Only Markets					
Basic Service					
Price	14,486	23.73	6.38	0.00	80.25
Share	14,486	0.54	0.22	0.00	0.99
Total Cable Channels	14,486	17.3	9.4	0	95
Basic and Exp. Basic Markets					
Basic Service					
Price	4,073	13.51	5.70	0.00	47.67
Share	4,073	0.11	0.15	0.00	0.89
Total Cable Channels	4,073	8.90	7.65	0	56
Expanded Basic Service					
Price	4,073	27.29	7.83	0.00	87.06
Share	4,073	0.56	0.19	0.00	0.97
Total Cable Channels	4,073	26.4	10.0	0	77
Basic, Exp. Basic, and Dig. Basic Markets					
Basic Service					
Price	377	13.54	5.76	0.00	38.68
Share	377	0.20	0.11	0.01	0.68
Total Cable Channels	377	8.1	6.7	1	67
Expanded Basic Service					
Price	377	34.40	7.35	0.00	61.51
Share	377	0.39	0.15	0.01	0.80
Total Cable Channels	377	46.2	11.1	18	89
Digital Basic Service					
Price	377	44.65	9.91	0.00	70.27
Share	377	0.12	0.08	0.00	0.47
Total Cable Channels	377	77.2	19.4	37	176

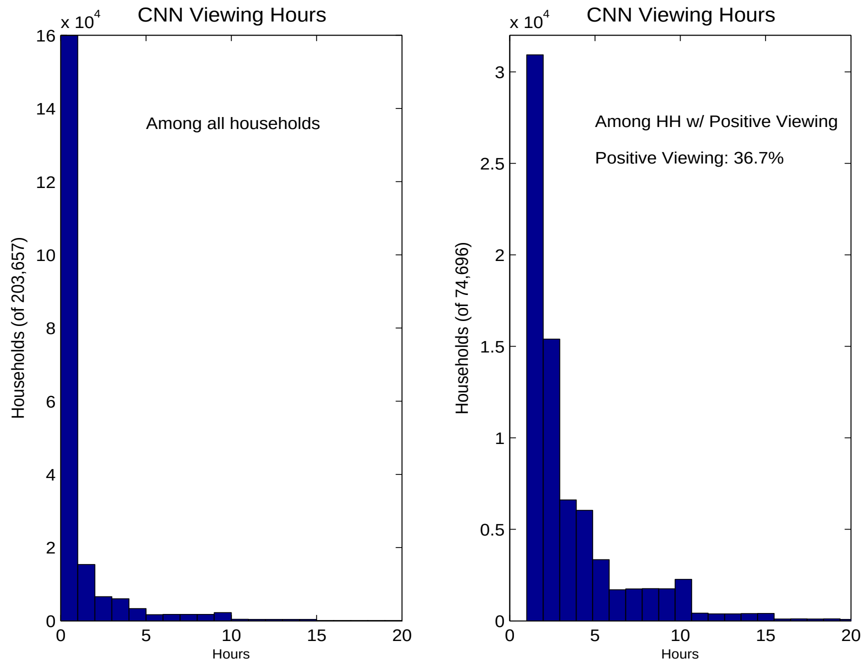
Notes: This table reports sample statistics from our individual cable system (Factbook) data for all markets and by type of bundles they offer. An observation is a system-bundle-year. Prices are in 2000 dollars. Market shares are defined as subscribers divided by homes passed, with homes passed defined as the set of households able to purchase cable service from each system. Both are in the data. Total cable channels xxx.

Table 2: Channel Summary Statistics

	Cable System Carriage		Household Viewership			
Data Source	Factbook		Nielsen	Mediamark		
Channel	Any Tier (Pcntge)	Basic Tier (Pcntge)	Mean Rating	Mean Rating	StdDev Rating	Cume
ABC Family Channel	89.9	76.1	0.4	0.6	1.5	31.6
AMC	47.1	30.7	0.5	0.6	1.4	27.2
Animal Planet	17.9	11.9	0.3	0.6	1.5	34.8
Arts & Entertainment	63.3	48.7	0.7	0.8	1.7	37.8
BET Networks	16.3	11.0	0.4	0.3	1.5	10.6
Bravo	7.7	3.3	0.2	0.2	0.7	14.4
Cartoon Network	23.4	15.6	1.6	0.5	1.8	20.9
CNBC	29.5	19.8	0.2	0.5	1.4	29.5
CNN	93.5	78.0	0.7	1.8	3.0	53.8
Comedy Central	18.3	11.0	0.5	0.5	1.3	27.6
Country Music TV	46.1	37.3	0.2	0.2	1.0	13.5
Court TV	10.7	4.5	0.4	0.4	1.4	18.1
Discovery Channel	85.6	71.9	0.6	1.1	1.9	50.9
Disney Channel	37.8	29.3	1.2	0.5	1.4	21.2
E! Entertainment Television	17.1	10.8	0.3	0.3	0.9	24.4
ESPN	96.0	77.0	0.9	1.1	2.2	40.7
ESPN 2	30.8	21.2	0.3	0.5	1.4	25.2
Food Network	8.3	4.4	0.4	0.5	1.5	26.7
Fox News Channel	14.9	9.8	0.8	1.0	2.2	40.0
Fox Sports Net	27.7	18.3	0.3	0.4	1.2	20.2
FX	15.1	9.6	0.5	0.4	1.2	23.3
GSN	4.0	0.7	0.2	0.2	0.9	7.4
Golf Channel	5.6	1.8	0.0	0.1	0.6	6.9
Hallmark Channel	4.7	3.1	0.3	0.2	1.0	10.8
HGTV	20.2	13.0	0.6	0.6	1.6	27.5
History Channel	26.3	18.2	0.6	0.8	1.7	37.9
Lifetime	55.5	41.8	0.9	1.0	2.2	34.4
MSNBC	9.3	5.0	0.3	0.5	1.3	30.2
MTV	43.3	30.2	0.7	0.4	1.4	21.8
MTV2	0.7	0.1	0.0	0.1	0.7	7.8
National Geographic Channel	3.3	1.1	0.1	0.2	0.8	13.2
Nickelodeon	67.9	52.8	1.8	0.4	1.3	17.7
Oxygen	1.1	0.3	0.1	0.1	0.5	7.2
Syfy	27.2	18.4	0.5	0.4	1.4	20.9
SoapNet	1.8	0.4	0.1	0.1	0.6	2.5
Speed Channel	7.0	3.1	0.1	0.1	0.7	7.8
Spike TV	18.8	14.3	0.5	0.4	1.1	18.9
TBS Superstation	96.3	91.2	1.1	0.9	1.7	39.8
The Weather Channel	57.2	46.0	0.3	0.7	1.3	50.3
TLC	39.6	29.8	0.5	0.5	1.3	29.0
TNT	82.2	63.8	1.3	0.9	1.8	41.3
Toon Disney	4.8	2.0	0.2	0.1	0.7	6.1
Travel Channel	12.4	8.2	0.2	0.2	0.7	18.7
TV Guide Channel	13.4	11.2	0.2	0.2	0.6	17.5
TV Land	19.5	14.9	0.8	0.6	1.8	23.9
USA Network	86.1	66.7	1.2	0.8	1.6	37.4
Versus	4.7	1.4	0.1	0.1	0.5	4.8
VH1	32.6	22.6	0.4	0.3	0.9	18.2
WE: Women's Entertainment	3.2	0.8	0.1	0.1	0.5	5.9

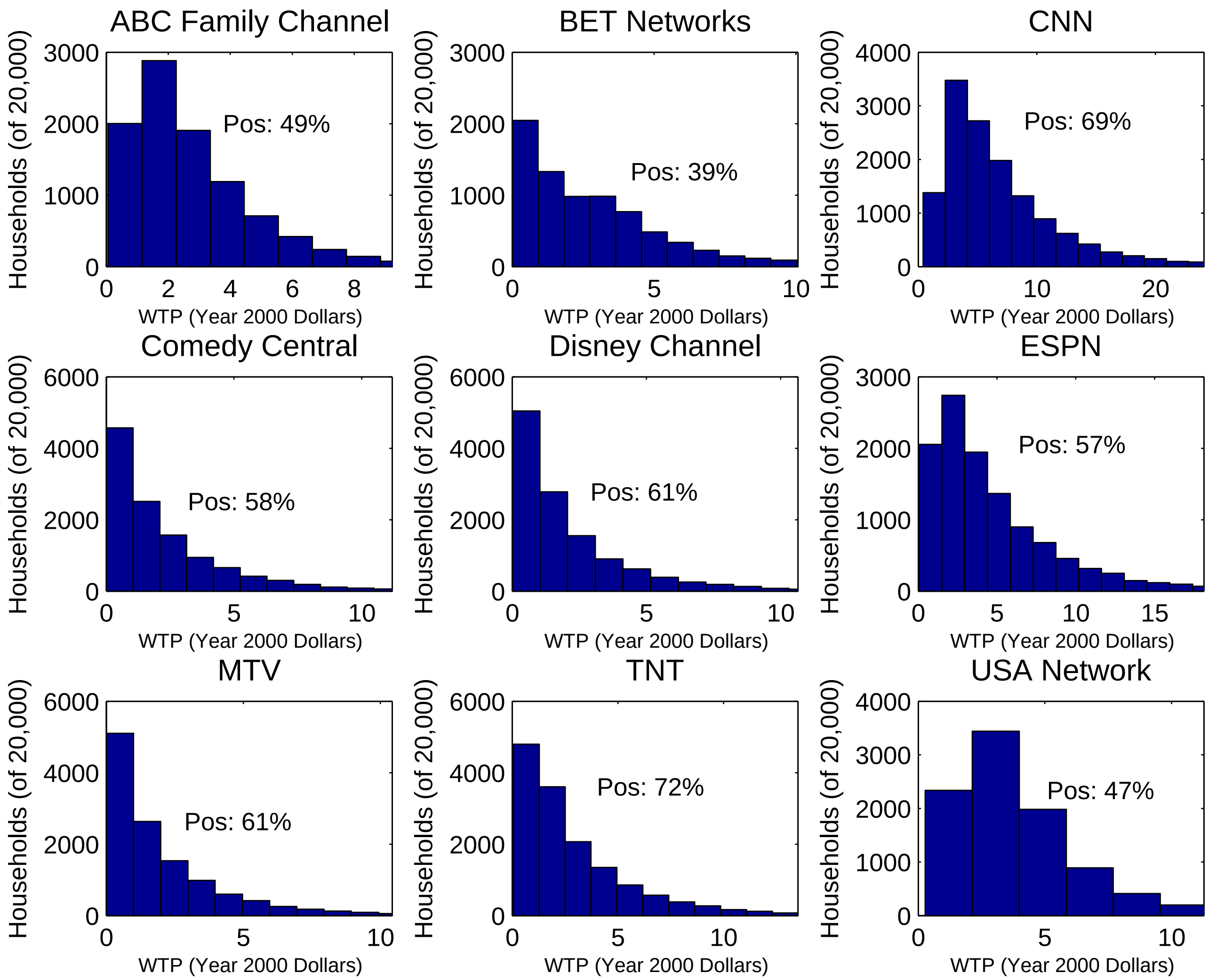
Notes: This table reports summary statistics for channels from both our cable system (Factbook) and viewership (Nielsen, Mediamark) data. The channels reported are those cable channels for which we could get complete data from all three channel data sources used in our analysis. The first column reports the average carriage of each cable channel on any offered tier of service across our system-years. The second column reports average channel carriage on just the Basic tier. The last four columns report summary statistics about household viewing patterns across channels from our Nielsen and Mediamark data. The third column reports the average rating for all programs on that channel for the four Nielsen sweeps months (Feb, May, Aug, Nov) between 2000 and 2006. The fourth and fifth columns report the mean and standard deviation of the fraction of households reporting viewing each channel per hour for our sample of Mediamark households from 2000 to 2007. This is analogous to an average Nielsen rating for that channel and we therefore call them "ratings" above. The last column reports the fraction of Mediamark households reporting positive viewing for each channel. This is known as the channel's "cume," short for cumulative audience.

Figure 3: Distribution of Viewing for CNN, Mediamark (MRI) Data



Notes: This figure reports the distribution of viewing hours reported by our 200,000+ MRI households for CNN. The left panel shows the distribution of viewing for all MRI households, including the 63.3% that report no viewing. The right panel shows the distribution of viewing among the 36.7% of households that report positive amounts of viewing. Note the positive skewness in the distribution; similar patterns arise for all channels. This motivates our assumption that the marginal distributions of unobserved tastes for channels follows a mixture distribution with a mass point at zero and an exponential distribution among those with positive values.

Figure 4: Estimated WTP for a Subset of Channels



Notes: This figure documents the estimated willingness-to-pay for a subset of cable channels among 20,000 simulated households. Reported is the share of those households that value each network positively and the distribution of WTP among that subset. In each figure, the y-axis reports households and the x-axis reports WTP in 2000 dollars.

Table 3: Price Sensitivity and Non-Television Preference Parameters

Parameter	*Estimate*	*Standard Error*
Price Sensitivity (IV) α	-0.44	0.03
Price Sensitivity (OLS)	*-0.27*	*0.00*
Price Income Interaction	0.10	0.01
Family x Outside Good	0.18	0.13
Income x Outside Good	0.52	0.38
Black x Outside Good	0.16	0.46
Hispanic x Outside Good	1.01	2.03
Asian x Outside Good	0.98	0.18
Bachelors x Outside Good	1.18	0.58
Age x Outside Good	1.92	0.30

Notes: This table reports our GMM results for a subset of demand parameters, including the estimated mean marginal utility of income, α, the impact of income on marginal utility, π_{yp}, and differences across demographics in tastes for the outside good. Also reported is the estimated mean marginal utility from the same estimation procedure without price instruments, which we denote OLS.

Table 4: Estimated WTP

Channel	Mean WTP	StdDev WTP	Share Positive	Mean WTP Family HH	Mean WTP Black HH	Highest Correlated Channel
ABC Family Channel	1.39	2.13	0.49	1.44	1.48	TV Land
AMC	1.25	1.44	0.51	1.06	1.54	MSNBC
Animal Planet	1.96	3.06	0.54	1.97	1.78	National Geographic Channel
Arts & Entertainment	1.84	2.28	0.58	1.67	1.82	VH1
BET Networks	1.14	2.26	0.39	1.11	4.13	MTV2
Bravo	0.59	0.68	0.58	0.58	0.67	ESPN
Cartoon Network	1.89	3.76	0.48	2.07	2.27	Disney Channel
CNBC	1.92	2.77	0.54	1.74	1.88	CNN
CNN	4.82	5.44	0.69	4.51	7.37	CNBC
Comedy Central	1.38	2.35	0.58	1.38	1.32	VH1
Country Music TV	0.78	1.35	0.56	0.78	0.67	Food Network
Court TV	1.65	2.88	0.51	1.70	2.10	Animal Planet
Discovery Channel	2.53	2.89	0.63	2.36	2.59	Animal Planet
Disney Channel	1.35	2.27	0.61	1.45	1.63	Nickelodeon
E! Entertainment Television	1.00	1.56	0.62	1.00	0.91	WE: Womens Entertainment
ESPN	2.75	4.08	0.57	2.55	3.33	ESPN 2
ESPN 2	1.70	2.92	0.55	1.64	1.83	ESPN
Food Network	1.86	2.95	0.69	1.87	2.15	TV Guide Channel
Fox News Channel	3.74	5.85	0.58	3.89	4.20	CNN
Fox Sports Net	1.58	2.78	0.56	1.54	1.37	ESPN 2
FX	1.30	2.41	0.48	1.33	1.35	USA Network
GSN	0.73	3.34	0.07	0.78	1.37	ESPN 2
Golf Channel	0.68	2.62	0.09	0.56	0.84	HGTV
Hallmark Channel	1.26	4.00	0.13	1.21	1.84	Versus
HGTV	2.55	4.75	0.41	2.58	3.14	Food Network
History Channel	2.48	3.96	0.37	2.40	2.67	Arts & Entertainment
Lifetime	2.11	3.84	0.27	2.28	5.14	AMC
MSNBC	1.75	3.58	0.25	1.60	2.71	AMC
MTV	1.30	2.20	0.61	1.29	1.37	VH1
MTV2	0.65	1.32	0.46	0.66	0.64	VH1
National Geographic Channel	0.94	1.48	0.63	0.94	0.85	Animal Planet
Nickelodeon	1.20	2.53	0.45	1.29	1.30	Disney Channel
Oxygen	0.33	0.37	0.59	0.42	0.49	Speed Channel
Syfy	1.66	2.94	0.53	1.66	1.68	USA Network
SoapNet	0.39	0.84	0.40	0.41	0.51	TBS Superstation
Speed Channel	0.24	0.30	0.56	0.29	0.17	Versus
Spike TV	1.16	1.97	0.54	1.15	1.05	The Weather Channel
TBS Superstation	1.94	2.72	0.67	1.89	2.05	TNT
The Weather Channel	1.53	1.66	0.65	1.44	1.59	Spike TV
TLC	1.76	2.72	0.58	1.80	1.55	Discovery Channel
TNT	2.19	2.92	0.72	2.17	2.15	TBS Superstation
Toon Disney	0.37	1.50	0.12	0.48	0.89	Lifetime
Travel Channel	0.75	2.52	0.11	0.77	0.85	Nickelodeon
TV Guide Channel	0.47	0.74	0.56	0.50	0.63	Food Network
TV Land	2.08	3.56	0.53	2.12	2.46	ABC Family Channel
USA Network	1.89	2.71	0.47	2.03	2.54	TNT
Versus	0.20	0.28	0.50	0.24	0.20	Speed Channel
VH1	0.74	1.27	0.55	0.75	0.84	MTV2
WE: Womens Entertainment	0.37	0.59	0.49	0.40	0.38	National Geographic Channel

Notes: This table reports information of the distribution of WTP for channels implied by our estimates. The first two columns report the mean and standard deviation in WTP for each channel among those that value it positively. The third column reports the estimate share of households that do so. The fourth and fifth columns report estimated WTP among family and black households. The last column reports the channel estimated to have the highest correlation in WTP for each channel. WTP is measured in year 2000 dollars per month per household.

Table 5: Input Cost Parameters

	All Moments		No Bundling Moments	
Parameter	*Estimate*	*Standard Error*	*Estimate*	*Standard Error*
Constant	-0.03	0.00	0.00	0.00
Kagan Scale	1.04	0.01	1.07	0.01
MSO Size	-0.04	0.01	-0.05	0.01
Vertical Integration	0.00	0.07	0.07	0.08

Notes: This table reports the impact of various factors on our estimated input costs. Kagan scale refers to the input cost for that channel as estimated by Kagan World Media (2008). Distributor (MSO) size is measured in tens of millions of households. Vertical integration is the share of the channel owned by that distributor (between 0 and 1).

Table 6: Regression Analysis of Distributor Size on Price and Estimated Marginal Cost

	Price Regression			Estimated Marginal Cost Regression		
	Coef	*SE*	*t Statistic*	*Coef*	*SE*	*t Statistic*
Distributor Size	-0.057	0.010	-5.720	-0.100	0.038	-2.632
Number of Integrated Channels	-0.005	0.058	-0.086	-0.251	0.216	-1.160
Dummy Variables						
Channels	Yes			Yes		
Year	Yes			Yes		
Tier	Yes			Yes		
Number of Bundles	Yes			Yes		
Year x Tier	Yes			Yes		
Number of Bundles x Tier	Yes			Yes		
N	24576			24576		
R-squared	0.547			0.211		
F(262, 24313)	111.92			24.82		

Notes: This table reports the results of regressions designed to highlight the identification of our input cost estimates. The first set of columns reports the results of a regression of bundle prices on the size of the distributor offering the bundle and a sum of the number of vertically integrated channels in the distributor's bundle. We condition on various variables that might affect marginal costs. The second set of columns reports the results of a regression of our estimated bundle marginal costs on the same covariates.

Table 7: Conglomerate Bargaining Parameters

Conglomerate	Big Cable	Small Cable	DirecTV	Dish Network
ABC Disney	0.352	0.359	0.306	0.319
Viacom	0.582	0.588	0.678	0.696
NBC Universal	0.518	0.528	0.581	0.594
Comcast Content Division	0.559	0.575	0.623	0.638
Scripps	0.550	0.568	0.613	0.625
News Corporation	0.450	0.450	0.456	0.469
Rainbow Media	0.756	0.759	0.784	0.791
Discovery Networks	0.522	0.535	0.586	0.604
Time Warner	0.421	0.431	0.450	0.463
Hallmark	0.736	0.752	0.793	0.803
Lifetime	0.450	0.459	0.497	0.509
Oxygen	0.761	0.770	0.786	0.794
Weather Channel	0.556	0.569	0.619	0.628
TV Guide	0.785	0.795	0.832	0.836

Notes: This table reports our estimated bargaining parameters for channel conglomerates versus distributors of various types. Smaller values of the bargaining parameters indicate relatively more bargaining power for channels. Channel conglomerates are ABC Disney (ABC Family Channel, Disney Channel, ESPN, ESPN2, Soap Net, Toon Disney), Viacom (BET Networks, Comedy Central, Country Music TV, GSN, MTV, MTV2, Nickelodeon, Spike TV, TV Land, VH1), NBC Universal (Arts & Entertainment, Bravo, CNBC, MSNBC, Syfy, USA Network), Comcast (E! Entertainment Television, Golf Channel, Versus), Scripps (Food Network, HGTV), News Corporation (Fox News Channel, Fox Sports Net, FX, National Geographic Channel, Speed Channel), Rainbow Media (AMC, WE: Women's Entertainment), Discovery Networks (Animal Planet, Discovery Channel, History Channel, TLC, Travel Channel), Time Warner (Cartoon Network, CNN, Court TV, TBS Superstation, TNT). Hallmark, Lifetime, Oxygen, Weather Channel, and TV Guide are single-channel "conglomerates." See the end of Section 5 for descriptions of the distributor types.

Table 8: Baseline Counterfactual Results: Full À La Carte

	Bundling	ALC No Reneg	% Change	ALC With Reneg	% Change
Non-welfare Outcomes					
Cable & Sat Penetration	0.873	0.988	13.2%	0.976	11.8%
Total Input Costs	$12.61	$12.61	0.0%	$32.69	145.2%
Mean Consumer Expn	$27.27	$24.38	-10.6%	$31.15	14.2%
Number Channels Received	42.8	22.6	-47.3%	20.8	-51.4%
Number Channels Watched	20.9	22.6	7.7%	20.8	-0.7%
Welfare Outcomes					
Channel Profits					
Total License Fee Rev	$10.77	$5.33	-50.5%	$13.04	21.1%
Total Advertising Rev	$12.65	$14.07	11.2%	$13.95	10.3%
Total Channel Revenue	$23.42	$19.40	-17.1%	$26.99	15.2%
Distributor Profits	$16.50	$19.04	15.4%	$18.11	9.8%
Total Industry Profits	$39.92	$38.45	-3.7%	$45.10	13.0%
Mean Consumers Surplus	$48.27	$56.34	16.7%	$47.79	-1.0%
Total Surplus	$88.18	$94.78	7.5%	$92.89	5.3%

Notes: This table reports the results of our baseline counterfactual simulations of full à la carte (ALC) pricing policies on prices and welfare. The economic environment consists of one large and one small cable market (served by one large and one small cable operator) and two "national" satellite providers, each offering access to their platform and approximately 50 cable channels. In the bundling equilibria reported in column one, each firm competes by pricing a single bundle of channels. In both ALC equilibria, each firm competes by setting a fixed fee and then separate prices for each offered channel. Columns two and three report results for ALC *without* allowing input market renegotiation (i.e. with input costs at their values in the bundling equilibrium); columns four and five allow renegotiation. In the renegotiation equilibrium, we impose that downstream prices equal the renegotiated input costs. See footnote 24 in the text for details. Dollar values are 2000 dollars per U.S. television household per month.

Table 9: Input Cost and Welfare Effects by Channel

	Input Cost Effects			Profit Effects				
Channel	Bundling Input Cost	ALC Input Cost	% Change	Total Bundling Revenue	Total ALC Revenue	% Change	% Change License Fee Rev	% Change Advert Rev
ABC Family Channel	$0.22	$1.28	495.2%	$0.37	$0.66	78.2%	148.7%	6.1%
AMC	$0.21	$0.08	-60.2%	$0.30	$0.18	-41.4%	-77.4%	16.0%
Animal Planet	$0.08	$0.62	724.9%	$0.14	$0.40	190.5%	381.5%	14.9%
Arts & Entertainment	$0.20	$0.84	323.4%	$0.46	$0.79	72.2%	167.8%	14.7%
BET Networks	$0.14	$0.50	268.3%	$0.41	$0.50	20.5%	36.5%	14.0%
Bravo	$0.15	$0.44	199.5%	$0.28	$0.39	36.6%	70.4%	8.8%
Cartoon Network	$0.14	$0.97	579.1%	$0.42	$0.66	55.8%	165.4%	9.8%
CNBC	$0.24	$0.76	219.5%	$0.44	$0.65	48.8%	86.6%	14.4%
CNN	$0.41	$3.07	651.0%	$0.72	$2.07	187.6%	372.2%	6.1%
Comedy Central	$0.11	$0.54	408.7%	$0.47	$0.67	41.9%	166.3%	11.5%
Country Music TV	$0.05	$0.49	927.7%	$0.14	$0.31	116.9%	375.3%	7.8%
Court TV	$0.10	$1.03	934.1%	$0.23	$0.55	138.2%	355.2%	9.4%
Discovery Channel	$0.23	$1.01	341.0%	$0.48	$0.92	91.8%	200.8%	13.1%
Disney Channel	$0.74	$1.23	66.2%	$0.64	$0.40	-37.9%	-37.9%	0.0%
E! Entertainment Television	$0.19	$0.15	-20.1%	$0.30	$0.22	-26.3%	-55.5%	8.3%
ESPN	$1.96	$1.41	-28.1%	$3.16	$2.24	-29.0%	-58.7%	6.1%
ESPN 2	$0.23	$1.25	450.9%	$0.37	$0.63	71.4%	128.2%	4.2%
Food Network	$0.05	$0.74	1261.3%	$0.36	$0.71	96.0%	673.0%	8.6%
Fox News Channel	$0.26	$1.81	607.6%	$0.57	$1.19	109.3%	264.4%	8.7%
Fox Sports Net	$1.67	$0.93	-44.6%	$1.59	$0.50	-68.7%	-75.5%	7.5%
FX	$0.26	$0.75	190.8%	$0.51	$0.58	14.3%	18.2%	11.1%
GSN	$0.05	$0.37	595.0%	$0.10	$0.09	-13.6%	-51.0%	15.8%
Golf Channel	$0.21	$0.00	-101.7%	$0.28	$0.11	-61.7%	-102.0%	15.8%
Hallmark Channel	$0.03	$0.01	-73.5%	$0.18	$0.18	-2.9%	-96.1%	15.5%
HGTV	$0.13	$0.69	421.6%	$0.49	$0.71	46.3%	146.2%	15.2%
History Channel	$0.17	$0.50	189.1%	$0.41	$0.49	19.5%	26.2%	15.6%
Lifetime	$0.21	$0.99	366.0%	$0.66	$0.81	23.2%	41.0%	16.3%
MSNBC	$0.14	$0.54	302.3%	$0.22	$0.26	19.4%	22.6%	15.8%
MTV	$0.27	$0.43	58.7%	$1.01	$1.05	4.0%	-15.2%	9.8%
MTV2	$0.03	$0.01	-79.5%	$0.07	$0.05	-23.5%	-89.5%	17.3%
National Geographic Channel	$0.18	$0.74	307.2%	$0.24	$0.36	54.2%	80.3%	1.2%
Nickelodeon	$0.40	$0.35	-12.6%	$1.22	$1.10	-9.8%	-64.7%	12.3%
Oxygen	$0.12	-$0.05	-140.0%	$0.19	$0.05	-74.1%	-144.7%	15.0%
Syfy	$0.15	$0.63	307.2%	$0.43	$0.60	41.0%	104.2%	12.3%
SoapNet	$0.10	$0.74	661.0%	$0.12	$0.16	33.3%	53.2%	-11.8%
Speed Channel	$0.15	$0.46	201.1%	$0.20	$0.15	-24.4%	-19.5%	-33.9%
Spike TV	$0.18	$0.54	202.9%	$0.44	$0.55	24.9%	49.3%	11.9%
TBS Superstation	$0.28	$1.03	265.3%	$0.77	$1.07	38.0%	105.3%	6.6%
The Weather Channel	$0.09	$0.13	46.9%	$0.21	$0.24	12.1%	7.8%	14.7%
TLC	$0.15	$0.56	264.6%	$0.30	$0.48	57.3%	113.0%	13.6%
TNT	$0.82	$1.11	34.9%	$1.30	$1.18	-9.5%	-21.6%	5.4%
Toon Disney	$0.08	$0.72	819.4%	$0.12	$0.12	-4.1%	-19.0%	14.2%
Travel Channel	$0.14	$0.29	103.1%	$0.21	$0.13	-35.7%	-67.4%	14.5%
TV Guide Channel	$0.03	$0.00	-95.4%	$0.12	$0.11	-8.4%	-97.1%	15.0%
TV Land	$0.09	$0.74	744.7%	$0.23	$0.52	121.9%	347.7%	12.8%
USA Network	$0.43	$0.72	66.5%	$0.98	$1.03	4.7%	-12.2%	15.3%
Versus	$0.13	$0.04	-70.8%	$0.15	$0.05	-66.5%	-88.2%	0.0%
VH1	$0.12	$0.38	217.2%	$0.47	$0.56	18.2%	50.5%	9.1%
WE: Women's Entertainment	$0.09	$0.12	26.1%	$0.14	$0.12	-14.0%	-35.0%	13.9%
Total	$12.61	$32.69	145.2%	$23.66	$27.83	17.6%	26.0%	10.3%

Notes: This table reports the results by channel of the input cost and profit consequences from our baseline, Full À La Carte (ALC), counterfactual with input cost renegotiation. As in Table 8, downstream prices are set at the renegotiated input costs; see footnote 24 for details. The first three columns are our estimated per-subscriber input costs for a large cable operator under bundling and ALC equilibria (and their associated change). They are measured in 2000 dollars per subscriber per month. Distributors must pay the bundle input cost for all their subscribers in the bundling counterfactual, but pay the ALC input cost only for those that choose to subscribe under the ALC counterfactual. The remaining columns summarize the profit effects by channel. The fourth through seventh columns report the total (license fee plus advertising) profit effects, while the last two columns break out the percentage change for each of these components. Profits are measured in 2000 dollars per household per month.

Table 10: Alternative Counterfactual: Full ALC, Bundle-Sized Pricing, and Themed Tiers

		Levels			Percent Change		
	Bundling	Full ALC	Bundle Sized Pricing	Theme Tiers	Full ALC	Bundle Sized Pricing	Theme Tiers
Non-welfare Outcomes							
Cable & Sat Penetration	0.873	0.976	0.977	0.953	11.8%	11.9%	9.2%
Total Input Costs	$12.61	$30.91	$21.09	$27.83	145.2%	67.3%	120.8%
Mean Consumer Expn	$27.27	$31.15	$29.26	$38.78	14.2%	7.3%	42.2%
Number Channels Received	42.8	20.8	23.1	37.5	-51.4%	-46.0%	-12.5%
Number Channels Watched	20.9	20.8	17.8	19.5	-0.7%	-14.9%	-6.9%
Welfare Outcomes							
Channel Profits							
Total License Fee Rev	$10.77	$13.04	$12.65	$22.24	21.1%	17.5%	106.5%
Total Advertising Rev	$12.65	$13.95	$12.77	$13.56	10.3%	0.9%	7.2%
Total Channel Revenue	$23.42	$26.99	$25.42	$35.80	15.2%	8.5%	52.9%
Distributor Profits	$16.50	$18.11	$16.61	$16.53	9.8%	0.7%	0.2%
Total Industry Profits	$39.92	$45.10	$42.03	$52.34	13.0%	5.3%	31.1%
Mean Consumers Surplus	$48.27	$47.79	$48.21	$38.29	-1.0%	-0.1%	-20.7%
Total Surplus	$88.18	$92.89	$90.25	$90.63	5.3%	2.3%	2.8%

Notes: This table reports the results of alternative counterfactual simulations of various policy interventions on prices and welfare. The economic environment is as in Table 8. Columns one, two, and five report the counterfactual outcomes in bundling and full à la carte (ALC) environments as in Table 8. The remaining columns report counterfactual outcomes under Bundle-Sized Pricing and Themed Tiers. In the Bundle-Sized Pricing counterfactual, each downstream distributor competes by offering a full bundle of all the channels and a second bundle of fifteen channels, the identities of which may be chosen by each household. In the Themed Tier counterfactual, each downstream distributor competes by setting a fixed fee and offering 5 themed tiers from which the household can choose any combination. The themed tiers are Sports (ESPN, ESPN 2, Fox Sports Net, Golf Channel, Speed Channel, Versus), News (CNBC, CNN, Fox News Channel, MSNBC), Family and Education (ABC Family Channel, Animal Planet, Discovery Channel, Disney Channel, History Channel, National Geographic Channel, Nickelodeon, TLC, Toon Disney), Music and Lifestyle (Bravo, Country Music TV, E! Entertainment Television, Food Network, HGTV, Lifetime, MTV, MTV2, Oxygen, SoapNet, TV Guide Channel, VH1, WE: Women's Entertainment), and General (AMC, Arts & Entertainment, BET Networks, Cartoon Network, Comedy Central, Court TV, FX, GSN, Hallmark Channel, Syfy, Spike TV, TBS Superstation, The Weather Channel, TNT, Travel Channel, TV Land, USA Network). All counterfactuals allow for input-market renegotiation. Dollar values are 2000 dollars per U.S. television household per month.

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A The Multi-Channel Television Industry

The multi-channel television market is a two-sided market. Cable and satellite systems provide a platform connecting households with both program producers and advertisers. Figure 5 provides a graphical representation of the supply chain by which programming is produced and sold to households and audiences are created and sold to advertisers. Downward arrows represent the flow of programming from content providers to households.[28] Upward arrows represent the creation and sale of audiences to advertisers. The various sub-markets that characterize the purchase and sale of content or audiences are indicated at each step in the chain. In this paper, we focus on the for-pay distribution and advertising markets.

Cable television systems choose a portfolio of television channels, bundle them into services, and offer these services to consumers in local, geographically separate, markets. Satellite television systems similarly choose and bundle channels into services, but offer them to consumers on a national basis.

All cable and satellite systems offer four main types of channels. *Broadcast channels* are advertising-supported television signals broadcast over the air in the local cable market by television stations and then collected and retransmitted by cable systems. Examples include the major, national broadcast channels – ABC, CBS, NBC, and FOX – as well as public and independent television stations. *Cable programming channels* are advertising- and fee-supported general and special-interest channels distributed nationally to systems via satellite. Examples include MTV, CNN, and ESPN. *Premium programming channels* are advertising-free entertainment channels. Examples include HBO and Showtime. *Pay-Per-View* are specialty channels devoted to on-demand viewing of the most recent theatrical releases and specialty sporting events.

Broadcast channels and cable channels are typically bundled and offered as *Basic Service* while premium programming channels are typically unbundled and sold as *Premium Services*.[29] Distributors

[28]The distribution rights to content (e.g. a television program like "Crocodile Hunter") is purchased by a television channel (e.g. CBS or The Discovery Channel) and placed in its programming lineup. These channels are then distributed to consumers in one of two ways. Broadcast networks, like ABC, CBS, and NBC, distribute their programming over the air via local broadcast television stations at no cost to households. Cable channels like The Discovery Channel, MTV, and ESPN distribute their programming via cable or satellite television systems that charge fees to consumers. The dashed arrow between content providers and consumers represents the small but growing trend to distribute some content directly to households via the Internet.

[29]In the last 5 years, premium channels have begun "multiplexing" their programming, i.e. offering multiple channels under a single brand (e.g. HBO, HBO 2, HBO Family, etc.).

now offer cable channels on multiple services, called *Expanded Basic* and *Digital Services*.

Most advertising space is sold by channels, but also for a few minutes per hour by the local cable system.[30] Advertising revenues account for nearly one half of total channel revenues. Advertising revenues depend on the total number and demographics of viewers. These figures, called ratings, are measured by Nielsen Media Research (hereafter Nielsen). Ratings are measured at the Designated Metropolitan Area (DMA) level, of which there are 210 in the United States. In urban areas, the DMA corresponds to the greater metropolitan area. DMA's usually include multiple cable systems with different owners.

B Counterfactual Robustness

Our goal is to accurately measure the welfare effects of à la carte pricing in multichannel television markets. As such, it is important to have confidence that our qualitative results are robust and not sensitive to particular assumptions underlying the counterfactual exercises. In this sub-section we consider the robustness of our results to alternative assumptions on downstream markups, demand, and bargaining in our counterfactual exercises.

Due to the computational cost of estimating the full model, all of these robustness exercises are undertaken for the counterfactual analysis only.[31] The method used to appropriately conduct the counterfactual under each alternative assumption varied; the specifics for each are described below.

We evaluated the robustness of our results in the following dimensions:

Downstream Markups As described in footnote 24 in the text, for computational reasons we assume that downstream channel markups are zero in our counterfactual analysis and that distributors instead earn profit on the fixed fees that they charge. In this robustness exercise, we allow downstream margins to be 10% instead of zero. This is at the upper end of the range we were finding when we tried to flexibly solve for them in the counterfactual equilibrium.

[30] Local advertising revenue to cable systems for 2006 accounted for approximately 5% of total cable system revenue.

[31] For example, estimating the full demand model under alternative assumptions for marginal distributions would take several weeks for each assumption considered.

Demand: Marginal Distributions One of the critical assumptions underlying our demand model is the shape of households' distribution of preferences (WTP) for the individual channels that constitute existing service bundles. As discussed in Section 5 and motivated by our individual-level data as shown in Figure 3, we assume that the marginal distribution of unobserved tastes for each channel is a mixture of a mass point at zero and an exponential distribution whose (single) mean and variance parameter we estimate for each channel. To evaluate the robustness of this assumption, we conducted our counterfactual analysis under two alternative families of marginal distributions: the Rayleigh Distribution and the Log-Normal Distribution. The Rayleigh distribution is also a single-parameter family, but, relative to the exponential, it has a slightly smaller coefficient of variation (COV), a non-zero mode, and smaller skewness and kurtosis. It looks a bit like a log-normal, but with a thinner right tail than both it and the exponential. The Log-Normal distribution is a two-parameter family which, for mean and variance comparable to those we find for individual channels using our exponential distribution, also has a non-zero mode and larger skewness and kurtosis. With these choices, we are effectively allowing tastes to (1) have more mass nearer the center of the distribution and (2) relatively thinner or thicker tails than an exponential.

To evaluate the robustness of our distributional assumption on the marginals, we maintain the assumption of the zero mass point,[32] but calibrate the parameters of the Rayleigh or Log-Normal for each channel to match as closely as possible the implied mean and variance of the estimated WTP for that channel.[33] We then re-estimated our Full ALC counterfactual using these implied marginal distributions and the input costs implied by renegotiation under the exponential distribution.[34]

Demand: Correlations One of the primary motivations for bundling identified in the theoretical literature is the degree of correlation in tastes for bundle components. We allow for correlation from both demographic differences in tastes as well as correlation in unobserved tastes. We evaluate the robustness of our findings to these correlations by conducting our Full ALC counterfactual

[32]It is an important factor allowing us to accurately predict the number of channels watched by households when offered a bundle of channels.

[33]In doing this calibration, we tried to match the mean and variance for the marginal distribution of G for each channel using a weight of one for the mean and ten for the variance.

[34]Using the renegotiation input costs under our exponential assumption was also necessary due to the high computational costs of calculating renegotiation equilibria. Overall mean WTP for the bundle under the alternative distributions differed slightly from that coming out of the exponential. To ensure comparability across the counterfactuals, we allocated this mean WTP difference to CS and/or Profit at the same proportion as that implied by the counterfactual for that distributional family.

eliminating unobserved correlations.[35] To do so, we set all off-diagonal elements of the copula generating our estimated $G()$ distribution to zero. For the same reasons as for the marginal distribution calculations above, we do so at the renegotiated input costs implied by the full (with correlation) model.

Bargaining: Halve/Double Input Costs A key element of this paper is our ability to estimate bargaining parameters and predict renegotiated input costs in an ALC environment. It is possible, however, that true bargaining outcomes would differ from our predictions. To get a sense of how important this might be, we evaluate our Full ALC counterfactual under two different assumptions: that estimated input costs are either half or double our estimated renegotiated values.

Table 11 at the end of this Appendix reports the results of these robustness exercises. For each different assumption considered, we report the percent change in consumer surplus, industry profit, and total surplus. The first row replicates these values for our baseline, Full À La Carte counterfactual.

Assuming the larger 10% markup downstream actually improves consumer outcomes and reduces industry profits relative to our Full ALC baseline. This is due to changes in the bargaining equilibrium: distributors earn slightly more but channels substantially less (+11.9% instead of +15.2% in the baseline). Prices fall and consumers are better off. All the predicted changes are quite small, however, and do not change our qualitative conclusions that estimated consumer welfare gains from ALC would be negligible.

Changes in demand assumptions have slightly larger effects, at least on estimated industry profits. Using a distribution with a thinner (fatter) tail as in the Rayleigh (Log-Normal) distribution yielded greater (lesser) industry profits under ALC. This is intuitive as firms have trouble capturing surplus the more dispersed are preferences for channels. Consumer surplus effects are opposite the profit effects with very minor changes in total surplus. Eliminating correlation in unobserved tastes, nominally an important profit motivation for bundling, had (surprisingly) little effect on any of the outcomes.

Alternative bargaining assumptions had substantial effects on our estimated welfare effects. Recall the total increase in input costs under our baseline counterfactual was an estimated 145.2%. If

[35]It is more complicated to eliminate correlations due to demographics as they influence both the mean and variance-covariance matrix of tastes for channels. Because demographics explained only 5% of the variation in mean tastes, we decided to simply eliminate correlation due to the unobserved component.

we halve those, we find a substantially different picture: consumer welfare increases considerably (+14.3%), industry profits increase only modestly (+2.0%, before any implementation or marketing costs), and total surplus increases. These effects are qualitatively similar to that which we found when evaluating the welfare effects while keeping input costs at their level in a bundling equilibrium: it is the sharp rise in input costs (and prices) that prevents a significant increase in consumer welfare under ALC.

Doubling our estimated renegotiation input costs would, not surprisingly, be even worse for consumers, reducing consumer surplus by an estimated 21.3%. Industry profits rise in this setting, with more than all of those gains accruing to channels. Distributors are worse off (+3.4% instead of +9.8%), the reason we don't see this outcome in equilibrium.

Only the changes in bargaining outcomes have a meaningful impact on the magnitude of our estimated welfare effects. How then should one interpret them? *If* our assumptions on renegotiated input costs under à la carte are incorrect, we conclude that because a doubling of input costs increases industry profits, that makes that it the more likely of the two deviations. If so, prospects are even worse for consumer and total welfare than in our baseline results presented in the body of the text. Like our baseline, these results also do not take into account any additional implementation or marketing costs that might arise in an à la carte environment. We therefore conclude that our qualitative conclusions about à la carte are robust: in the absence of input costs changes, it would likely improve consumer welfare, but in their presence, consumers are likely better off with existing bundles.

Figure 5: Television Programming Industry

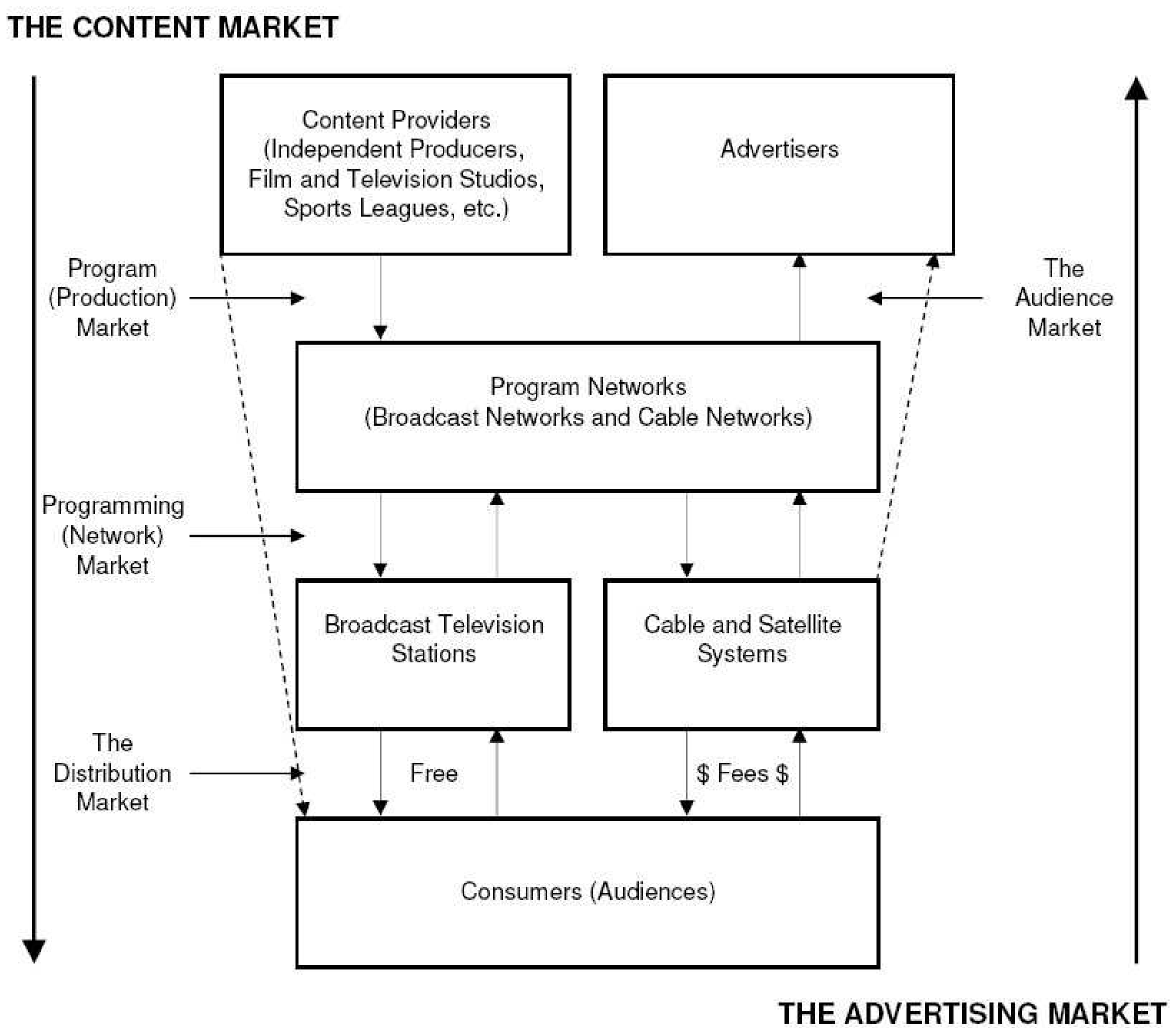

Table 11: Robustness of Counterfactual Results

	% Change Consumer Surplus	% Change Industry Profit	% Change Total Surplus
Baseline Counterfactual			
Full À La Carte	-1.0%	13.0%	5.3%
Alternative Distributor Markup			
10% Distributor Markup	1.7%	11.4%	6.1%
Alternative Demand Assumptions			
Marginal Distributions: Rayleigh	-4.8%	19.2%	5.2%
Marginal Distributions: Log-Normal	-0.8%	9.4%	3.8%
Joint Distribution: No Correlation in Unobserved Tastes	-3.8%	13.2%	4.3%
Alternative Bargaining Assumptions			
Halve Renegotiated Input Costs	14.3%	2.0%	8.7%
Double Renegotiated Input Costs	-21.3%	21.9%	-1.8%

Notes: This table reports the percentage change in consumer surplus, industry profits, and total surplus estimated under our baseline Full À La Carte counterfactual and under alternative assumptions about demand, bargaining conditions, downstream distributor markups, and/or exit in the counterfactual. All counterfactuals rely on parameter estimates from the baseline specification suitably adapted for the specific robustness test - see text for details. Alternative demand assumptions are evaluated at the renegotiated input costs from the baseline demand specification. The baseline counterfactual is as described in Table 10. See Appendix B for a description of the specific alternative assumptions considered in the table.