# The Welfare Effects of Bundling in Multi-Channel Television Markets *

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**Abstract**

This paper evaluates the welfare effects of bundling in multichannel television markets. We estimate an industry model of viewership, demand, pricing, bundling, and input market bargaining using data on purchases, prices, ratings, bundling decisions, and aggregate input costs. We conduct counterfactual simulations of *à la carte* policies that require cable and satellite television distributors to offer individual channels for sale to consumers. Equilibrium input costs are higher when channels are sold individually. Even so, mean consumer surplus increases by an estimated 8.5%, or $4.4 billion/year. Total industry profits decrease by an estimated 9.0%, with most losses to content providers.

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# 1 Introduction

The proposal of an à la carte pricing regulation in the U.S. multi-channel television industry has polarized policy makers, consumers, and industry participants.[1,2] The arguments for or against usually rest upon a prediction of how prices, quantities, qualities, or costs will change if firms are subject to à la carte pricing regulations. Empirical evidence would be useful because the multi-channel television industry reaches 95 million households in the United States, and the average American household spends around seven hours per day watching television. This impressive fraction of leisure time is increasingly allocated to watching programming from a channel available predominantly through multi-channel television. À la carte pricing proposes to radically alter the choice sets facing the roughly 110 million U.S. television households. It is therefore important to predict the regulation's impact on the distributions of consumer and producer welfare.

Despite the widespread debate, there is no consensus on what an à la carte regulation's effects would be. The lack of consensus is partly because anti-bundling regulations have not been implemented in enough similar circumstances to provide direct evidence. They have not been applied in this industry.[3] Experimentation is not practical due to the costs associated with experimenting on the necessary scale to evaluate the industry wide equilibrium effects.[4] With these options not available, this paper evaluates proposed policy changes using a model as a laboratory.

This paper models viewership, demand, pricing, bundling, and input market bargaining of multi-channel television services. We estimate the distribution of household preferences over about 50 cable television channels using ratings and 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 multilateral bargaining model of the input mar-

[1] By multi-channel television, we mean television services provided by cable and satellite television systems. These are also called multi-channel 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 useful webpage summarizing industry perspectives at http://www.ncta.com/IssueBrief.aspx?contentId=15.

[3] Internationally, Canada, Hong Kong, and India have introduced some anti-bundling regulations in multichannel television.

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

ket. We hold the estimated demand and bargaining parameters fixed, and force distributors to offer consumers more flexibility in choosing channels. In our counterfactual simulations, equilibrium input costs are higher than when distributors sell bundles of channels. These higher costs affect our predicted welfare changes. We estimate that, accounting for higher equilibrium input costs, consumer welfare changes by 8.5%, whereas the change would have been 21.1% holding input costs fixed.

The model has three types of agents: consumers, downstream distributors, and upstream channels. Consumer behavior is determined by their preferences. We estimate those preferences using aggregate data on purchases, i.e. data on which bundle of channels consumers purchase and at what price, and aggregate data on viewership, i.e. which channels consumers watch and for how long. The viewership data provides empirical evidence for estimating a flexible multivariate distribution of preferences for television channels. The purchase data provides empirical evidence about how households value channels relative to income.

On the supply side, downstream firms compete with each other and negotiate input costs with upstream firms. We assume that downstream firms compete by choosing prices and bundles. 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 (2007) 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 similar to the models of Horn and Wolinsky (1988) and de Fontenay and Gans (2007). The bargaining protocol features bilateral meetings between 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 channel 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 (2008) who studies hospital-HMO negotiations in the U.S. This paper contributes to this line of research by using a general bargaining protocol that includes Ho's take-it-or-leave-it offers as a special case. We estimate pair-specific bargaining parameters that produce the estimated input costs in equilibrium.

The estimated distribution of channel demand 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. We find moderate correlations in WTP for most pairs of channels. On average, estimated own-price elasticities for basic cable, expanded basic cable, and satellite services are on average -1.93, -4.81, and -2.98, respectively.

We estimate that large distributors, such as Comcast, face about 10% lower input costs than small and independent operators. We also estimate that vertical integration between channels and distributor does not affect input costs for the integrated distributor relative to other distributors. This is because we focus on established channels. A cursory analysis of the raw data suggests that vertical integration is important for new or small channels, but this is not true for large and established channels. Neither prices nor carriage are systematically different for distributors who are vertically integrated with established channels.

The estimated bargaining parameters reject take-it-or-leave-it offers as a model of the input market for this industry. On average, distributors are estimated to have higher bargaining parameters than channels. Within distributors, estimated bargaining parameters are higher on average for big cable firms than for small cable firms and satellite. Even though small cable's estimated input costs are higher than satellite's, their estimated bargaining parameters are still higher than satellite's.

We use these estimates to simulate the welfare effects of an à la carte pricing regulation. To save computational time, we carry out two simulations. First, we force downstream distributors to offer a combination of a few channels à la carte and the rest at bundle size prices as in Chu, Leslie and Sorensen (2008). We call this our BSP/ALC counterfactual. We compute equilibrium input costs in this case and find that the majority of them rise by between 20% and 100%. We then simulate a regulation where downstream firms must offer all channels à la carte. We call this our Full ALC counterfactual. In this setting, recomputing equilibrium input costs is computationally intensive, because the downstream equilibria are costly to compute. We therefore assume, motivated by the magnitude of increases in input costs in the first simulation, that input costs increase by 75% for all channels.

The intuition for why input costs rise comes from distinguishing between consumers who have high valuations for individual channels and consumers who have high valuations for the bundle. Consumers with high valuations for the bundle may have low valuations for some individual channels included in the bundle. Each channel's equilibrium input cost is roughly proportional to the average valuation per subscriber to that channel. Average valuations for channels are higher when channels are not bundled together, because firms face steeper demand curves for each channel and set high prices.

Bundling in multi-channel television markets appears to facilitate surplus extraction by firms: mean consumer surplus in the Full ALC counterfactual increases by an estimated 8.5% and cable industry profits decrease by an estimated 9.0%. We estimate à la carte regulations decrease total welfare (by 1.4%) even though households not served channels they value under bundling are partially served under à la carte. This is because households served all channels under bundling no longer receive some channels of moderate value.

There are important differences in welfare effects across channels. The change in consumer welfare is higher the fewer channels a household purchases and the less they value high-cost channels like ESPN or The Disney Channel. On the firm side, we estimate distributor profits to increase and aggregate channel advertising revenue to change negligibly. Despite their fee increases, all estimated losses come from reduced revenue to content providers. Our results are sensitive to our assumptions about the percentage increase in programming costs in an à la carte environment (75% in our baseline results). We find, however, that average consumer welfare gains persist even if these input costs increase by 150%.

### 1.1 Other Studies of Bundling in Multichannel Television

This paper is related to empirical policy analysis in these markets (Crawford (2000), Chipty (2001), Goolsbee and Petrin (2004)) as well as a number of papers addressing the identical topic. Crawford (2008) tests the implications of bundling in cable markets using reduced-form techniques. While suggestive, it 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. His household-level data are valuable for describing the distribution of viewing at a more disaggregate level than we can here. Our papers differ on several other dimensions, most prominently in that we model and estimate the input market.[5] In contrast to this paper, he estimates that forcing cable distributors to offer theme tiers would decrease average consumer welfare at fixed wholesale prices. Rennhoff and Serfes (2008a) develop a two channel, two distributor model with consumer preferences distributed uniformly on a circle to analytically study bundling and the wholesale market. In Rennhoff and Serfes (2008b), they estimate a logit demand system for channels. In both studies, they conclude that anti-bundling regulations would likely increase consumer surplus given their assumptions on preferences.

## 2 The Data

This section describes the data underlying this study.[6] We divide the 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. We document many further features of the data and our results in Appendix B.

Market data in the MVPD industry comes from two sources: Warren Communications and Kagan Research. Warren produces the Television and Cable Factbook Electronic Edition monthly (henceforth Factbook). The Factbook provides data at the cable system level on prices, bundle composition, quantity, system ownership and other system characteristics. Kagan produces the Economics of Basic Cable Networks yearly (henceforth EBCN). EBCN provides data at the national channel level on a variety of revenue, cost, and subscriber quantities.

**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, and ownership.

[5] Other differences include his focusing on channel genres and a policy of theme tiers, exempting satellite service from à la carte regulations, focusing on a single year, and data limitations in matching viewership utility to expenditures.

[6] Section A.1 in Appendix A provides a brief overview of the multi-channel television industry.

Tables 1-2 provide summary statistics for the Factbook data. An observation is a system-bundle-year (e.g. NY0108's Expanded Basic in 2000). We observe data on over 20,000 system-bundle-years, based on almost 16,000 system-years from over 6,800 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 2008 dollars, its market share, and the number of cable channels offered. The average Basic service in our data costs $24.14 and offers 17.4 cable channels, the average Digital Basic bundle costs $48.33 and offers 81.2 channels.[7]

There is the variation in composition of bundles across markets and over time. Table 2 presents the share of systems in our sample that offer each of the thirty most widely available channels as of 2006. The first column indicates whether the channel is carried on any tier of service while the second-fourth columns indicate on which tier the channel is offered. For example, ESPN is carried by almost all systems (97%) in our data. Of these, most (77%) carry it on Basic Service. Smaller channels are frequently offered on a 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 penetration data, $\frac{totalsatellitesubscribers}{totaltvhouseholds}$, at the DMA level from Nielsen Media Research.

**Kagan (EBCN) Data** We use the 2006 edition of the 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.

**Viewership Data** Our viewership data comes from Nielsen Media Research. We use tuning data from the 56 largest DMA's for about 50 of the biggest cable channels over the period 2000-2006

[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, called digital basic, and, sometimes, a digital expanded basic bundle.

in each of the "sweeps" months of February, May, July, and November. The main variables are the DMA, the program, the channel, the program's rating, and the channel's cumulative rating. The rating is the percentage of television households in the DMA viewing the program. The channel's cumulative ratings ("cume") indicates what percentage of unduplicated television households with access to the channel tuned to the channel for at least ten minutes in a given week.

We aggregate the information across programs on each channel within each month of our data. Thus an observation is a channel-DMA-year-month. We have 1,482 such combinations. The fifth column in Table 2 presents the average rating for each of the top 30 cable channels in our analysis; the sixth column presents the national average cumulative rating for the third quarter of 2006.[8]

We observe that channels' ratings vary from DMA to DMA and within DMA across months and years. Two important types of variation we use are (1) how ratings vary with the demographic composition of a DMA and (2) how ratings co-vary conditional on demographic differences. We focus on eight demographic factors: Urban/Rural status, Family status, Income, Race, Education, and Age.[9] Table 11 in Appendix B reports the DMA average values for these variables for the DMAs for which we have ratings data. Figure 5 in Appendix B provides an illustrative example of the impact demographic characteristics can have on ratings by comparing average ratings for Black Entertainment Television (BET) across markets. Unsurprisingly given the target audience of BET, the channel has its highest ratings in heavily black populated DMA's such as Memphis and its lowest ratings in sparsely black populated DMA's such as Salt Lake City.

Similar examples demonstrate the importance of ratings co-variation in our data. Table 12 in Appendix B reports correlations in the DMA-month-year ratings across a subset of cable channel pairs. Most of these are consistent with prior beliefs about likely patterns of correlation in viewer tastes. In particular, ratings for children's programming are negatively correlated with ratings for arts programming and old movies (A&E and Turner Classic Movies, TCM). Similarly, ratings for all of ESPN's various sports programming channels are positively correlated.

**Data Quality** We call attention to the nonstandard features of these data sets in Appendix B. We focus on missing market share and price data. About two thirds of the possible observations on

[8]We would prefer to have the cumulative ratings at the DMA-month, but were not able to obtain it.
[9]We follow U.S. Census definitions for each of these variables.

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. We justify this assumption in the appendix.

# 3 The Industry Model

The industry model predicts 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.

The timing of the model is: 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.

## 3.1 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).[10,11] We will suppress the market subscripts $n$, $d$, and $m$ for the moment. Let $C_j$ be the set of channels offered on bundle $j$. Suppose household $i$ has $T_i$ hours per month of leisure time.[12] We assume the utility to household $i$ from spending their leisure time watching television and doing non-television activities has the Cobb-Douglas in logs form:

$$v_{ij}(t_{ij}) = \sum_c \gamma_{ic} \log(1 + t_{ijc}) \tag{1}$$

where $t_{ij}$ is a vector with component $t_{ijc}$, $t_{ijc}$ is the number of hours household $i$ watches channel $c$ when the channels in bundle $j$ are available, and $\gamma_{ic}$ is a parameter representing $i$'s tastes for channel $c$. Households may opt to not watch any channel, and we call this state channel 0, $0 \in$

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

[11] Note 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 two sources of data.

[12] This is without loss of generality. A model where the time a household spends watching television each month depends on bundle $j$ (i.e. $T_{ij} = T_i(C_j)$) yields an identical econometric model. We maintain the chosen specification for analytical convenience.

$C_j \; \forall j$, with $t_{ij0}$ the amount of time household i spends on non-television leisure activities and $\gamma_{i0}$ their preferences for such activities.

Each household $i$ is assumed to allocate its leisure time between watching the channels available and non-television leisure by solving:

$$\max_{t_{ij}} \quad \sum_c \gamma_{ic} \log(1 + t_{ijc}) \qquad (2)$$
$$\text{subject to} \quad \sum_c t_{ijc} \leq T_i$$

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

The solution to this maximization problem yields household $i$'s indirect utility from viewing:

$$v^*_{ij}(\gamma_{ij}, T_i, C_j) \; = \sum_{c \in C_j} \gamma_{ic} \log(1 + t^*_{ijc}) \qquad (3)$$

This utility function implies that the more a household watches a channel, the more it values that channel. Our welfare estimates are based on translating time viewed into utils according to this utility function.

### 3.2 Bundle Purchases

Consider next a household's choice of cable bundle. This will depend on $v^*_{ij}$ as well as other characteristics of the bundle and cable system and the price they have to pay for it. We assume the utility household $i$ derives from subscribing to bundle $j$ in market $n$ in DMA $d$ in month $m$ as:

$$u_{ijndm} \;\; = \;\; v^*_{ijndm} + z'_{jndm}\psi + \alpha_i p_{jndm} + \xi_{jndm} + \sigma_\epsilon \epsilon_{ijndm} \qquad (4)$$

where, $v^*_{ijndm} = v^*_{ijndm}(\gamma_{ij}, t_i, C_j)$, from (3), represents the indirect utility to household $i$ from viewing the channels available on bundle $j$, $p_j$ is the monthly subscription fee of bundle $j$, and $z_j$ are other observed system and bundle characteristics of bundle $j$ in market $n$. $\alpha_i = \alpha + \pi_{ip} y_i$, with $y_i$ household $i$'s income, is a taste parameter measuring the marginal utility of income and $\psi$ is a taste parameter measuring tastes for system and other bundle characteristics. $\xi_j$ and $\epsilon_{ij}$ 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, $\xi_j$, and an idiosyncratic term, $\epsilon_{ij}$. We further assume that the idiosyncratic term is an i.i.d. draw from a type I Extreme Value distribution whose variance we estimate, denoted $\sigma_\epsilon$.[13]

The components of $z_j$ include by which MSO, if any, the bundle is being offered, the year the bundle is being offered, and bundle dummies (e.g. "Tier 1", "Tier 2", etc.). $\xi_{jn}$ is an aggregate term which represents the deviation of unobserved demand shocks or bundle attributes from the MSO-year-bundle mean. These unobserved attributes include Internet, high definition (HD) service, promotional activity, technical service, and quality of equipment. Theory predicts these unobservable attributes will be correlated with price as they affect both valuations and marginal cost. We use the instrumental variables assumption to disentangle the effect of price on utility from the effect of unobservable attributes. Identification is discussed in section 4.

### 3.3 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:

$$\Pi_{fm}(\mathbf{b_m}, \mathbf{p_m}) = \sum_{j \in \mathbf{b_{fm}}} (p_j - \sum_{c \in C_j} \tau_{fc}) D_{jm}(\mathbf{b_m}, \mathbf{p_m}) \tag{5}$$

where $f$ denotes firm, $m$ market, and $j$ bundle. $\mathbf{b_m}$ is a list of offered bundles in market $m$ with corresponding prices $\mathbf{p_m}$. $\tau_{fc}$ are firm-channel specific carriage fees. Firm $f$ pays channel $c$ a fee of $\tau_{fc}$ for every household which receives channel $c$ from firm $f$. The set of bundles offered by firm $f$ is $\mathbf{b_{fm}}$. The set of channels in bundle $j$ is $C_j$.

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

**Nash Assumption** $\forall f$ and $\forall m$, $\mathbf{b_{fm}}$ and $\mathbf{p_{fm}}$ maximize $\Pi_{fm}(\mathbf{b_m}, \mathbf{p_m})$ given $\mathbf{b_{-fm}}$ and $\mathbf{p_{-fm}}$.

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

[13] Typically this variance term is not identified separately, see Berry and Pakes (2007) for detail. Since units of utility are chosen with the ratings data, in our setting this variance term is identified.

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 the estimated cost parameters. Multiple Nash equilibria would hinder 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 initial prices, but do not find multiple equilibria.

### 3.4 Supply: Channel Distributor Negotiations

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 or cable overbuilds. 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 and the downstream distributors. Distributors and channels meet bilaterally. They bargain according to a fixed protocol 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, the contracts are longer. They contain 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 pair[14].

In the bargaining stage, each channel and distributor meets separately and simultaneously. We assume these meetings result in the asymmetric Nash bargaining solution. Let $\Psi = \{\tau_{fc}\}$ be a set of input costs, a scalar for each pair of distributor and channel. If there is no agreement between a distributor and a channel, then the input cost is positive infinity. In each bilateral meeting, $\tau_{fc}$ maximizes firm f and channel c's bilateral Nash product:

$$NP_{fc}(\tau_{fc}; \Psi_{-fc}) = \left[\Pi_f(\tau_{fc}; \Psi_{-fc}) - \Pi_f(\infty; \Psi_{-fc})\right]^{\zeta_{fc}} \left[\Pi_c(\tau_{fc}; \Psi_{-fc}) - \Pi_c(\infty; \Psi_{-fc})\right]^{1-\zeta_{fc}} \quad (6)$$

where

$$\Pi_c(\tau_{fc}; \Psi_{-fc}) = \sum_f (\tau_{fc}) Q_{fc}(\Psi) + r_{ad}(\Psi)$$

is channel $c$'s profit function before fixed costs with $Q_{fc}(\Psi)$ the total number of subscribers of channel $c$ coming from distributor $f$ and $r_c^{ad}(\Psi)$ is the advertising revenue of channel $c$. The profit function is the sum over distributors of the license fee revenue plus advertising revenue which depends on the per ratings advertising rate of the channel and the endogenous viewership rating of the channel.

Negotiations are simultaneous and separate, so $\Psi_{-fc}$, the set of all other input costs, is not known but conjectured. $\zeta_{fc}$ is the bargaining parameter of distributor $f$ when meeting channel $c$. Allowing $\zeta_{fc} \neq 0.5$ distinguishes asymmetric Nash bargaining from symmetric.

**Bargaining Equilibrium** $\forall f,\ c,\ \tau_{fc}$ maximizes $NP_{fc}(\tau_{fc}; \Psi_{-fc})$ given $\Psi_{-fc}$.

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 $\tau_{fc}$, and each pair's payoff is its Nash product. The bargaining equilibrium is the Nash equilibrium of that game.

[14]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 downstream competition.

One 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. We solve an alternative case where if a pair disagrees, all other firms re-negotiate conditional on the disagreeing pair dropping out forever. This case is reminiscent of the reasoning in the Shapley value.[15] This paper's conclusions do not depend on which assumption we choose.

We treat each channel as an individual firm even though channels are often part of larger conglomerates. For example, ABC Family, The Disney Channel, ESPN, ESPN2, ESPN Classic, SOAPNet, and several other channels are currently under the ownership of The Walt Disney Company. 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.[16]

One can interpret our bargaining equilibrium as each firm sending a different representative to the meeting, and these representatives do not talk to the other representatives of its own firm. This feature of the bargaining procedure together with passive beliefs means that the model sacrifices capturing incentives due to informational asymmetries,[17] but gains tractability in determining how the threat of unilateral disagreement determines input costs in an bilaterally oligopolistic setting.

## 4 Estimation

We estimate the model in several separate steps. We first parameterize and estimate the distribution of marginal utility derived from each channel using ratings data. We then estimate the marginal utility of income using market share, price, and bundle characteristics data. We then estimate a parameterized cost function which predicts a $\tau_{fc}$ for each pair of distributor and channel. Finally, we choose $\zeta_{fc}$ for each pair so that the bargaining model induces the estimated set of $\tau_{fc}$ in equilibrium. While it would be efficient to estimate all the parameters jointly, we significantly reduce

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

[16] Allowing multi-channel firms introduces both conceptual and computational challenges.

[17] As a separate issue, we also ignore moral hazard issues. 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.

computational time by separating the estimation.

**The First Stage: Using Ratings Data** The indirect utility to household $i$ from viewing the programming on bundle $j$ is given by

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

For each channel, $c$, we define $\beta_{ijc}$ to be the contribution of channel $c$ to bundle $j$'s indirect utility

$$\beta_{ijc} \quad = \quad \gamma_{ic} log(1 + t^*_{ijc}) \tag{7}$$

where $t^*_{ijc}$ is the number of hours of channel $c$ watched by household $i$ subscribing to bundle $j$ in the suppressed market $n$, DMA $d$, month $m$. Given our definition of $\beta_{ijc}$, the indirect utility from viewing can be written as

$$v^*_{ij} \quad = \quad \beta'_{ij} x_j \tag{8}$$

where $\beta_{ij}$ is a vector with components $\beta_{ijc}$ and $x_j$ is a vector of dummy variables whose components $x_{jc}$ indicate whether channel $c$ is on bundle $j$.

A complication arises because of the dependence of a household's tastes for a channel on the bundle on which it is offered (i.e., $\beta_{ij}$ depends on $j$). While a natural consequence of competition among channels for a viewer's time, allowing tastes for each channel to depend on the other channels offered in the bundle would require estimating $2^{N_J}$ distributions,[18] a practical impossibility. Instead, we condition on covariates like the number of channels in the bundle, the sum of average ratings for these channels, and an interaction term.[19] We denote these approximation covariates $a_j$. Table 13 in Appendix B provides sample statistics for these approximation covariates.

We parameterize each component $\beta_{ijc}$, of the vector $\beta_{ij}$ as

$$\beta_{ijc} \quad = \begin{cases} 0 & \text{with prob} \quad 1 - \rho_c \\ \beta_c + \pi_c D_i + v_{ic} + \theta_c a_j & \qquad\qquad \rho_c \end{cases} \tag{9}$$

where $\beta_c$ measures the marginal utility to channel $c$ when offered on the average bundle, $D_i$ measure the demographic characteristics of household $i$, $v_{ic}$ measures household $i$'s unobserved tastes

[18]With $N_J$ given by the number of channels offered on any bundle in our sample.

[19]These capture the logic that the marginal utility of a channel is likely to be lower the more or more popular channels it must compete against.

for channel $c$, $\rho_c$ is the fraction of households that earn positive utility from subscribing to channel $c$, and $a_j$ are our approximation covariates described above.

Our parametrization for marginal utility for channels is intended to reflect existing research on preferences for media products. This research generally finds that preferences exhibit "long tails": many people have low to zero tastes for a given product while a smaller number have strong tastes.[20] We capture this by assuming some fraction of households do not value channel $c$ at all, while the remainder value them according to a distribution that is convex to the origin. In our current specification, $v_i \sim G(v|\lambda, \Sigma)$, with each $v_{ic} \sim$ Exponential$(\lambda_c)$ and the rank correlation matrix of $v_i$ given by $\Sigma$.

Using an indicator function $\chi_{ic}$ for whether household $i$ has positive utility for channel $c$ implies that the vector $\beta_{ij}$ has the form:

$$\beta_{ij} \quad = \quad \overrightarrow{\chi_i}'(\beta + \Pi D_i + v_i + \Theta a_j) \tag{10}$$

Of those households who have positive utility for the channel, we assume that bundle characteristics enter additively separably from household characteristics. We further assume that the additively separate terms are linear in parameters. The utility for channels depends on the other channels in the bundle in an additively separable manner that does not vary across individuals. This assumption restricts the set of possible population distributions of $\gamma_i$.

We use the variation in ratings across DMAs and months to trace out the marginal utility of channels. Getting there requires aggregating across both households and markets within a DMA-month and describing the implications of this aggregation for the econometric model. This is done in Section A.2 in Appendix A.

From Appendix A.2 we obtain our first-stage estimating equation for each channel, $c$:

$$r_{cdm} \log(1 + r_{cdm}T) = \beta_c + \Pi_c D_d + \Theta \bar{a}_{dm} + \eta_{cdm} \tag{11}$$

where $r_{cdm}$ is the vector of ratings for each channel in a given DMA $d$ in month $m$, $T$ is the number of minutes of leisure time available on average, $\bar{a}_{dm}$ are the aggregated approximation covariates, and $\eta_{cdm} \equiv \Upsilon^{dm} v_{ic}$, i.e. the average (across households in DMA $d$ and month $m$) unobserved tastes for channel $c$.

[20]Byzalov (2008) finds such patterns in the number of channels watched by households. Anderson (2006) describes a number of information and media products whose demand has this shape.

The left hand side of this equation, $r_{cdm} \log(1 + r_{cdm}T)$ is data. $D_d$ is demographic data from the Census. We compute DMA-year aggregated bundle characteristics (i.e. $\bar{a}_{dm}$) from the market share data. We can then estimate $\Pi$ and $\Theta$ by ordinary least squares. A byproduct of this estimation are estimated residuals $\hat{\eta}_{dm}$. We then estimate $G(v_i|\lambda, \Sigma)$ as a distribution whose distribution of Nielsen sample averages shares a set of moments with $\hat{\eta}_{dm}$. This says that any variance in ratings net of demographic differences is a result of the distribution of unattributable preferences for channels from which Nielsen is not able to sample perfectly.[21]

A second problem arises due to the selection of households into bundles across markets within a DMA. While Nielsen samples households at random, those households have already chosen what bundle of channels they subscribe to. Our procedure would work perfectly if Nielsen also randomly assigned what channels each household receives. To accommodate this feature of the data, we condition on functions of covariates measuring prices and market shares of channels across markets within that DMA. With enough computing power, we could do this conditioning exactly according to the demand model. That is, the demand model provides the correct function to condition on. However, to reduce computational cost, we condition on a flexible function of the ingredients that would go in the demand model. This is not guaranteed to work, but it does work well on data simulated from the model's estimated parameters.

**First-Stage Identification** The basic identifying assumption in our first-stage estimation is that the amount of time spent by households watching channels is informative for what they are willing to pay for access to those channels. We assume the more a household watches a channel, the more it values that channel. If a household never watches a channel, it values that channel at zero. This would not be good assumption if, for example, households valued the option of watching The Weather Channel in case of bad weather, but never watch under normal circumstances. For our estimates of the impact of demographics on tastes, $\Pi$, identification is clear: we will estimate greater mean marginal utility for a channel $c$ among a demographic group the higher are mean ratings for that channel in a given DMA and month that have more of that group. Thus, mean marginal utility for BET is estimated higher for black households because ratings for BET are higher in markets with greater numbers of black households.

[21] We adjust the estimated variance of unattributable preferences both for the aggregating effects of the Nielsen averaging as well as the effects of a fraction $1 - \rho_c$ of households with zero tastes for the channel.

Identification of $G$ is more subtle. It is the distribution of unobservable marginal utility of channels, assumed to be common across DMAs and months once we control for the channels available and demographic differences across markets. This is identified by variation in the ratings across DMAs and markets due to random variation in the sampling process undertaken by Nielsen across markets and time. The error in our estimation regression, $\eta_{cdm}$, is the average across the Nielsen households in DMA $d$ in month $m$ of the underlying household-specific taste shock, $v_{ic}$, i.e. $\eta_{cdm} = \Upsilon^{dm} v_{ic}$ where $\Upsilon^{dm} = \frac{1}{N_{dm}} \sum_{i \in \text{Nielsen sample of DMA d and month m}}$. If Nielsen were able to sample from a continuum of households within each DMA $d$ in month $m$, this error would be zero. As they cannot, there is variation between our first-stage dependent variable ($r_{cdm} \log(r_{cdm} T)$) and that predicted in the population ($\beta_{cdm} + \Pi D_d + \Upsilon^{dm} v_{ic}$).

**The Shape of the Marginals** While we can identify the variance and covariances of the underlying preferences, $G(v)$, our data do not identify their shape. Within each DMA and month, Nielsen aggregates the viewing choices of a sample of a few hundred households. If preferences are independent across households, and the variance is finite, then Central Limit Theorems tell us that the distribution of average viewing choices will be normally distributed no matter the shape of the distribution underlying that average. If we observe an average rating of 3.0 for a channel in a given DMA-month, we cannot tell if this meant 3% of households were watching that channel 100% of the time or if 30% of households were watching it 10% of the time, or any other equivalent combination. We address this identification problem both by incorporating cumulative ratings data and additional assumptions. Nielsen reports indicate that the typical household does not watch many of the channels included in cable bundles. Our model says that their WTP for these channels is around zero. Therefore, we assume that the distribution of tastes for channels has a mass point at zero, representing the share of the population that does not value the channel enough to view it, and a distribution with support over the positive line. We assume that the positive portion of the mixture distribution is exponential motivated by the view that tastes for media products have "long tails."

**The Second Stage: Estimation on Market Share Data** Given $\hat{\beta}$, $\hat{\Pi}$, $\hat{G}$, and $\hat{\Theta}$, in the second stage we estimate the remaining parameters of the demand model using our market share data in the spirit of Berry, Levinsohn and Pakes (2004). As this is now standard in the empirical demand literature, we develop the formal econometric model in Section A.3 in Appendix A and present an informal discussion here.

Our demand-side instruments follow standard practice in demand estimation on aggregate data. First, we allow observed product characteristics (largely dummy variables for non-channel bundle characteristics such as firm, year, and tier name), $z_{jndm}$, to instrument for themselves. Second, 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 $n$ and with the channel dummy variables. These will be valid instrumental variables if, for bundle $j$ in market $n$, (a) the unobservable demand shock, $\xi_{jndm}$, is uncorrelated and (b) "net" marginal costs are correlated with prices within $n$'s DMA outside market $n$. The former is likely to be true in multichannel television industry because cable systems are physically distinct entities for which local managers have wide authority. The latter will be true, for the average price variable, as labor costs and advertising rates are often correlated within DMAs. Additionally, the channel dummy variables are uncorrelated with the unobservable term as the utility generated by the channels was by construction taken out of $\delta$. They are correlated with price through input costs.

**Cost Estimation** Aggregate input costs, the necessary conditions implied by Nash equilibrium in prices and bundles, and the observed prices and bundles identify input costs. Aggregate input costs are direct evidence. The Nash conditions are indirect evidence; what could input costs have been given the Nash assumption and observed prices and bundles? This section uses the Nash conditions to estimate input costs accounting for factors which are unobservable to the econometrician but known to the distributors at the time of their pricing and bundling decisions.

We parameterize $\tau_{fc}$ as a function of channel characteristics $g(c)$ scaled by a function of firm and channel characteristics:

$$\tau_{fc} \quad = \quad (\eta x_c) exp(\varphi z_{fc})$$

$x_c$ is a function of a constant term and the Kagan average input cost for channel $c$. $z_{fc}$ contains firm $f$'s total number of subscribers and whether channel $c$ and firm $f$ are vertically integrated. While different channels may have different base rates, we assume the functional form of the effect of distributor size and vertical integration on input cost 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 $\tau_{fc}$ over firms predicts an aggregate input cost for each channel $c$. The Kagan EBCN data set's channel input costs are the empirical counterpart of these averages. One set of moment conditions is simply the model's predicted aggregate input costs should equal observed aggregate input costs: $\{\tau_c\}$.

$$E[\tau_{fc}(\eta, \varphi)] - \tau_c \;\; = \;\; 0$$

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

$$\frac{d\Pi_{fm}(\mathbf{b_m}, \mathbf{p_m})}{dp_k} \;\; = \;\; \sum_{j \in B_{fm}} (p_j - \sum_{c \in C_j} \tau_{fc}) \frac{dD_{jm}(\mathbf{b_m}, \mathbf{p_m})}{dp_k} + D_{km}(\mathbf{b_m}, \mathbf{p_m})$$

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 Nash equilibrium for each bundle of each firm, given all other bundles and prices. As demand parameters enter into the mark-up, we use this condition separately to increase efficiency in demand estimation. It plays a more central role in cost estimation, because in its absence the cost parameters are partially identified. In both cases, we directly invert the first order necessary conditions for optimal price choice to back out implied marginal costs per bundle. We then form moments based on a bundle marginal cost function of bundle characteristics, accounting for the endogenous choice of mark-up by instrumenting with an exogenous predicted mark-up. These moments depend on the price sensitivity of consumers, and thus place extra restrictions on this parameter and improve efficiency of demand. Additionally, a by-product of demand estimation are consistent estimates of the marginal cost per bundle.

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. We punish candidate parameter estimates if they imply that altering observed bundles are profitable deviations for the decision making firm. 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 deviation profits 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 deviation profits in the two markets should be negative.

**Channel-Distributor Bargaining Power Estimation** The unobserved parameters of the bargaining game are each channel and distributor's pair-wise bargaining powers $\zeta_{fc}$. We use no additional data in identifying the bargaining powers. They are identified by the estimated cost and demand parameters and the protocol of the bargaining game.

In practice, we choose the values of $\zeta_{fc}$ that 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 channel will most often prefer higher input costs, the distributor will always prefer lower input costs. The bargaining model, for a fixed vector of $\zeta_{\mathbf{c}}$, resolves this disagreement. Part of the resolution is due to the bargaining protocol. The rest is due to the bargaining parameters $\zeta_{\mathbf{c}}$. The estimated input costs are an estimate of the actual resolution point. Therefore, the estimated bargaining powers are the $\zeta_{\mathbf{c}}$ which imply equilibrium input costs from the bargaining model as close as possible to estimated input costs.

Identification of $\zeta_{fc}$ 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. A typical assumption in this case, as in Ho (2008), is to assume take-it-or-leave-it offers. That is, one can fix the bargaining parameters and estimate costs. Likewise, one could fix the costs and estimate the bargaining parameters. In this application, because of those two ingredients, we are able to separately identify the bargaining parameters from cost parameters.

We use a simplified industry structure in estimation of the bargaining parameters. We assume that the country is served by one large cable provider, one small cable provider, and one satellite provider. The large cable and small cable operate in different markets which only differ in number of households. The satellite provider competes with the cable operators in each market, but it must set the same price and package 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. We take the large cable firm to be Comcast, the small to be an unnamed independent firm, and the satellite firm to be DirecTV. 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 the thousands of markets across the country. The simplification allows a connection to the estimated cost parameters by having different sized distributors, but without having so many distributors and markets that computing even one equilibrium would take hours.

## 5 Estimation Results

Table 3 presents estimates of the key parameters in the model, including channel-specific estimates for a selection of channels.[22] Among the non-channel estimates, the table reports the price sensitivity parameter, ($\alpha$), the impact of income on price sensitivity ($\pi_p$), and the approximation covariates. The estimated price sensitivity parameter is $-0.18$.[23] In markets that offer Basic, Expanded Basic, and Digital Basic cable services, this yields an average own price elasticity for Basic of $-1.93$, for Expanded Basic of $-4.81$, for Digital Basic of $-10.70$, and for Satellite of $-2.98$. These are comparable to previous results in the literature.[24]

**Preferences for Channels** Previous demand system estimates for multichannel television either did not define preferences over channels in bundles (Goolsbee and Petrin (2004)) or restricted the preferences for individual channels to be the same for all households (Crawford (2000), Rennhoff and Serfes (2008b)). Our demand system allows for flexible multivariate distributions of preferences for channels.

Table 3 reports features of the distribution of preferences for a subset of channels. We report the distribution shift parameter, $\beta_c$, in column 2, and the exponential parameter $\lambda_c$, in column 4. For convenience, we also report, for each channel, information about the distributions of WTP implied by our estimates. The last three columns of the table report, for a simulated set of 20,000

[22] Results for the full set of channels are available in Tables 14-16 in Appendix B.

[23] Moving from OLS ($\hat{\alpha} = -0.04$) to IV using just the demand-side moments ($\hat{\alpha} = -0.10$) to IV using both demand and pricing equations ($\hat{\alpha} = -0.18$) suggests that our instrumental variables strategy is working as theory would predict and that the optimal pricing assumption has a moderate effect on the price sensitivity estimate.

[24] The FCC (2002) (-2.19), the GAO (2003) (-3.22), 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.

households, the share of households with positive tastes for each channel[25], the overall mean WTP for the channel, and the mean WTP among those households that value the channel positively. Figure 1 presents the estimated distribution of willingness-to-pay for a subset of the channels in our analysis in a sample of 20,000 households.

We can use the connection between $\beta_{ijc}$ and $\gamma_{ijc}$ to back out the implied $\hat{\gamma_{ijc}}$ from $\hat{\beta_{ijc}}$. Using this connection, we would like to draw attention to an issue in the estimation. First, part of identifying preferences for channels is based on the assumption of free disposal; All households have non-negative willingness to pay for a channel. We force this assumption to hold by shifting the distributions of preferences so that the minimum value is zero. Since the shifting is done to all households, it preserves the estimated variance structure. However, it results in the implied sum of $\hat{\gamma_{ijc}}$ being greater than one for some households which violates the viewership models assumptions. We could use more restrictions imposed by the viewership model to fix this problem in estimation, but we choose not to because the extent of the violations is minor relative to the required additional computational burden.

**Demographic Impacts** We estimate a non-degenerate distribution of taste parameters for a channel if its ratings vary across markets or time periods. The variance of this distribution could be driven by demographic differences, through $\Pi$, or if not by demographic differences, through the variance of $G(v)$. Two channels will have positively correlated tastes if their ratings co-vary in the same direction with the same demographic features or if their portions of ratings unexplainable by demographics co-vary positively.

Demographic results are consistent with intuition. Preferences for BET are higher for Black than Non-Black households; preferences for Disney and Nickelodeon are higher for families, preferences for the American Movie Classics and the Weather Channel are higher for older households; and preferences for Country Music Television are higher for rural households. In most cases, the estimated highest value households match the desired audience of the targeted channel. These patterns are direct consequences of the conditional correlations of a channel's rating in a DMA with that DMA's demographics. Table 18 in Appendix B reports estimated WTP for channels for a subset of household demographic profiles. Similarly, the patterns in the estimated correlations

[25]This is an estimate of $\rho_c$, the share of households with positive tastes for channel $c$, itself equal to 3 times the average weekly "cume" in the last column of Table 2.

tend to follow those in the raw ratings data.

### 5.1 Input Costs

We estimate median marginal costs for bundles to vary from $7.25 for Expanded Basic to $23.31 for Digital Basic packages.

These estimates are combined with the Nash bundling assumption and EBCN average input costs per channel to estimate differences in per-channel input costs across distributors. Doing so, we are able to estimate not only channel specific input costs, but also how those input costs differ for downstream firms based on size or vertical integration.

The estimated input cost parameters, $\eta$ and $\varphi$, in Table 4 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 even large negative values.

The patterns in the data generating these estimates are clear from Tables 19 and 20 in the appendix. Estimated marginal costs and observed prices 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 systematically in a statistically significant way for distributors who offer many of their own vertically integrated channels. One might expect these distributors to at least carry their vertically integrated channels more often than other distributors. This is not true for most of the vertically integrated channels we examine. It is true for some new and small channels that are 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. Table 20 in the Appendix presents statistical evidence to the effect that carriage is not systematically different. 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 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.

### 5.2 Bargaining Parameters

The estimated bargaining parameters are functions of the estimated costs. We find them by searching for the bargaining parameters that produce the estimated input costs as the bargaining game's equilibrium.

The estimates are presented in Table 5. We estimate that bargaining parameters are usually between one-fourth and three-fourths for distributors. In particular, these estimates strongly 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.

We find that the bargaining parameters are higher for cable firms than satellite firms, even though satellite firms have much larger potential markets than some small cable firms. In equilibrium, satellite firms have lower input costs than small cable firms due to market conditions. This discount would be larger if the two firms had equal bargaining parameters. Within cable firms, large cable firms have higher estimated bargaining parameters than small cable firms for most channels.

## 6 The Welfare Effects of À La Carte

### 6.1 Theoretical Predictions

Holding fixed the current set of offered channels, ignoring capacity constraints, and allowing that the social marginal cost of an extra household receiving a channel is zero, 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, 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 enter the market. 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 is one output of the counterfactual exercise.

How the surplus generated by the service of multichannel television 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 ̀la carte pricing in the short run (Adams and Yellen (1976)). The theory under oligopoly is less established and offers still ambiguous predictions about the effects of à la carte on consumer welfare.

In the long run, the conclusions of economic theory on the welfare effects of à la carte depend on even more decisions. 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.

### 6.2 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 (Family and Consumer Choice Act of 2007) to separately priced theme tiers to offering separately priced individual channels.

Here we do two counterfactual simulations that trade off generality with computational time. First, we simulate a partial à la carte policy where distributors are forced to offer a few channels à la carte and offer the rest of the channels in Bundle Size Pricing (BSP/ALC). We compute the full equilibrium of the model at the estimated parameters under this restriction. We allow input prices to be renegotiated under this restriction and analyze the results of the new equilibrium. Second, we use the patterns of increased input costs from the first counterfactual to motivate assumptions on input cost changes in a *full* à la carte equilibrium.

**BSP/ALC** As in the bargaining power estimation, our first simulation has one large and one small cable market. Each is served by a separate cable provider and a common satellite provider. We force the distributors to compete by setting six prices: three for bundle sizes of 5, 20, and 60 channels, and three à la carte prices for Disney, ESPN, and Nickelodeon. We compute equilibrium input costs in this simulation.

The top panel of Table 6 reports welfare effects from the BSP/ALC counterfactual. As the full ALC counterfactual is more policy-relevant, we defer the analysis of welfare effects and instead focus on the input costs changes that result in the BSP/ALC equilibrium.

The bottom panel of Table 6 shows that input costs generally do rise under à la carte. Reported are the distributor-weighted average input costs when all channels are offered in a bundle versus when distributors offer the BSP/ALC package. For some channels, equilibrium input costs double (or more) under BSP/ALC. For others, input cost increases are more modest. The raw average percentage incrase in input costs for the channels reported in Table 6 is 62.9%; across all 60 channels it is roughly 50%. Input cost increases are generally higher when channels are offered ALC than when they are available as part of BSP; as such, we use 75% cost increases when we next analyze the full ALC counterfactual.

Figures 2 and 3 provide intuition for why input costs rise when channels are offered à la carte. Recall a common theme from the bundling literature is that bundling aggregates tastes, making them less disperse (e.g. Adams and Yellen (1976), Crawford (2008)). Figure 2 demonstrates this for an example based on Adams and Yellen (1976). Consider two goods with dispersed valuations and fixed marginal costs of zero. Pricing each good individually would require the seller to choose an intermediate price: the seller would miss out on both the surplus enjoyed by high-valuation consumers and sales to low-valuation (above marginal cost) consumers which it does not serve. As long as valuations between the two goods are not perfectly correlated, the valuation of the bundle will be less dispersed. In Figure 2, we chose underlying valuations that are highly negatively correlated to emphasize this point. Pricing only the bundle allows the seller to capture most of the combined surplus.

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 panels in Figure 3. For a given input cost from the y-axis of the first panel, the seller 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 ($\pi_f$). The area of the lower producer surplus rectangle is the upstream producer's profit ($\pi_c$). The Nash product in the first panel is a weighted geometric average of these two profits.[26] The equilibrium input cost ($\tau^*$) maximizes the Nash product.

The third and fourth panels in Figure 3 examines the determination of input costs in a situation analogous to bundling versus component pricing. It repeats the images from the left panels for two goods which have the same underlying mean valuations, but different dispersions. Associating the demand curve for the more dispersed valuations with demand for a single channel, one can see that the equilibrium input cost for this good is higher than for the good with less-dispersed valuations. Faced with more-dispersed preferences, the downstream firm wishes to raise price and earn a greater share of the total profit. The upstream channel recognizes this and bargains for a higher input cost.[27]

**Full ALC** Our second simulation has one nationwide market served by a "representative" nationwide cable firm and two satellite firms. The distributors compete by setting prices for each channel and a fixed access fee to consumers. We do not compute equilibrium input costs in this simulation. We instead force input costs to rise by 75%. This choice is motivated by the rise in input costs in the first simulation. We make this distinction because re-computing equilibrium input costs in the full ALC setting takes much longer than in the BSP/ALC environment. We evaluate the robustness of our results to this assumption below.

We assume all three firms offer identical products. We allow these products to include all channels for which we were able to estimate non-degenerate distributions of preferences and for whom the 90% percentile of the WTP distribution is greater than the Kagan estimate of their marginal cost. As we are constructing a "nationally representative" cable system, we cannot apply all our estimates directly into the counterfactual. We therefore interpret the logit error as an idiosyncratic disturbance term on the set of channels that deliver the most net utility from each provider. We estimate the variance of this error and the level of the constant term to make predicted market shares and prices match their actual 2007 levels under bundling.[28] To incorporate installation costs

[26] In this case, we use equal weights. In the general model, $\zeta_{fc}$ is the weighting for each pair $fc$.

[27] There is an additional, empirically weaker, opposite effect on input costs changes. Bundling creates an externality in a channel's bargaining problem as a higher input cost weakens demand for the other channels in the bundle. Moving away from bundling eliminates this externality and therefore nudges input costs lower. In our results, this effect is dominated by the niche pricing effect described above.

[28] Formally we estimate these four parameters based on the 6 national average cable and satellite market shares and prices.

we require consumers who would not purchase under bundling to pay an extra $5 monthly fee if they choose to purchase channels à la carte.

Profits for distributors are their revenue from selling to consumers net of the input costs they pay to channels. Profits for the content providers are the affiliate fees plus their advertising revenue. We compute ad revenue as the channel's bundling ad revenue adjusted for the change in viewing in an à la carte world. This is determined in the model by solving for each household the value of $\gamma_{ic}$ corresponding to their WTP for channel $c$, $WTP_{ic}$ (itself a function of their marginal utility for that channel, $\beta_{ic}$). Given the channels household $i$ purchases, viewing follows from solving the household's time allocation problem from stage four of the model. Aggregating across households gives the aggregate ratings effect for channel $c$. We assume advertising prices per ratings point ($p_c$) are constant for each channel, so that $\Delta AdRev_c = p_c \Delta Ratings_c$.

Finally, we make a number of assumptions consistent with a short-run analysis. We assume that preferences are invariant to the policy change. 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 accounting 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.[29] Each of these issues could be addressed in a long-run analysis.

Table 7 presents the results of our baseline full ALC counterfactual. Equilibrium prices for a bundle of all 52 modeled cable channels vary from $35.21 to $49.27 in year 2008 dollars. The total market share across distributors is 88.2%. Industry profits per household per month are an estimated $51.54, with distributors earning less than channels on average. Mean consumer surplus is $39.12 per household per month, although it varies significantly across households, with some households garnering surplus of over $100/month. Total estimated welfare is $90.67 per household per month (roughly $120 billion/year on a national basis).[30]

We turn next to predicted outcomes in an à la carte equilibrium. We report channel prices and market shares for a subset of our channels, as well as the average across all our analyzed channels. We predict fixed fees of $27.08 for cable and $14.51-15.10 for satellite. Marginal prices for channels are fairly low: most are under $1, with the most expensive being ESPN at $6.37 per

[29] The magnitudes of these costs are a matter of disagreement in the ongoing policy debate.

[30] We convert these to aggregate annual figures by multiplying by 110 million U.S. households x 12 months.

subscriber per month. Predicted channel market shares are moderate, with an average share of 39.6%. As a consequence, subscribing households are predicted to purchase an average of 18.2 of the 52 channels. Distributor profits are estimated to increase slightly, channel affiliate fee profits to drop considerably (by 32.7%), and there to be effectively no change in advertising revenue. We predict a total decrease of 9.0% in industry profits. Estimated average consumer expenditure for subscribers is $39.68 per month, a reduction of 14.8%. Mean consumer surplus increases by 8.5%, or approximately $4.4 billion/year. Predicted total welfare decreases by 1.4% to $89.73 per household per month.

Tables 8 and 9 break down these welfare gains by channel for both firms and consumers. On the firm side, the first three columns reports total revenue to each channel in the bundling and à la carte equilibria and the change between them. The next two columns break down this total percentage change into the percentage changes in revenue from affiliate fees versus advertising. The final line in Table 9 aggregates these effects across the 52 channels in the counterfactual.

Some striking effects are evident in the table. First, there is considerable heterogeneity in who wins and loses from à la carte. While the average channel loses 17.6% of its revenue, some channels do substantially worse (ESPN, E!, and most channels outside the top 30) while some are predicted to benefit from an à la carte environment (TBS, TNT, USA). Overall it appears that small and/or high-cost channels suffer most. Changes in affiliate fee revenues and advertising revenues are also heterogeneous, with those channels catering to general-interest tastes doing best.

The dominant predictor of household benefits from à la carte is the number of channels it chooses to purchase: households that purchase fewer channels do much better from à la carte as they aren't forced to pay the full bundle price to obtain access to the few channels they prefer. The last column of Tables 8 and 9 reports, for each channel, the average percentage change in consumer welfare from bundling to à la carte for consumers that purchase that channel in an à la carte environment as a share of the average change in welfare of all consumers. This tries to capture the benefits to those households that like particular channels as compared to the average benefit across all households. To control for the number-of-channels-purchased effect, this calculation is made for only those households among 5,000 simulated households that purchase the median (+/- 1) number of channels. Households that choose not to purchase relatively expensive networks like ESPN or

The Disney Channel do substantially better on average than those that do, indicating that high-cost channels impose a substantial aggregate welfare cost on consumers when they must purchase them in a bundle.

**Robustness of Results to Alternative Assumptions** A key factor in these calculations is our assumption that affiliate fees increase by 75% in an à la carte equilibrium. Table 10 assesses the consequences of relaxing this assumption. The middle three columns of Table 10 (in bold) summarize the previously presented results in Table 7. The first group of columns reports similar results under the assumption that affiliate fees to cable systems do not change under à la carte. The last two columns report results should they double our baseline assumption and increase by 150%. When input costs are unchanged, consumer welfare benefits are substantial. Consumer surplus increases by 21.1% and total industry profits fall by 13.7% (with a greater than 50% decrease in channel's affiliate fee profits). Interestingly, this environment yields a 1.3% *increase* in total surplus. By contrast, if input costs increase by 150%, consumer benefits are moderated. Industry profits fall only 8.5% and consumers surplus is estimated to only increase 4.8% despite a 12.3% decrease in expenditure.

## 7 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 attach to it 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. We compare the distributions of consumer and producer surplus under a simulated à la carte setting with those under bundling and predict that, in the short run, welfare will increase for many consumers under à la carte regulations, while industry profits will decrease, substantially so for content providers. These predictions account for the renegotiation of supply contracts following regulations. A more detailed analysis of the long run effects of à la carte regulations remains an area for further research.

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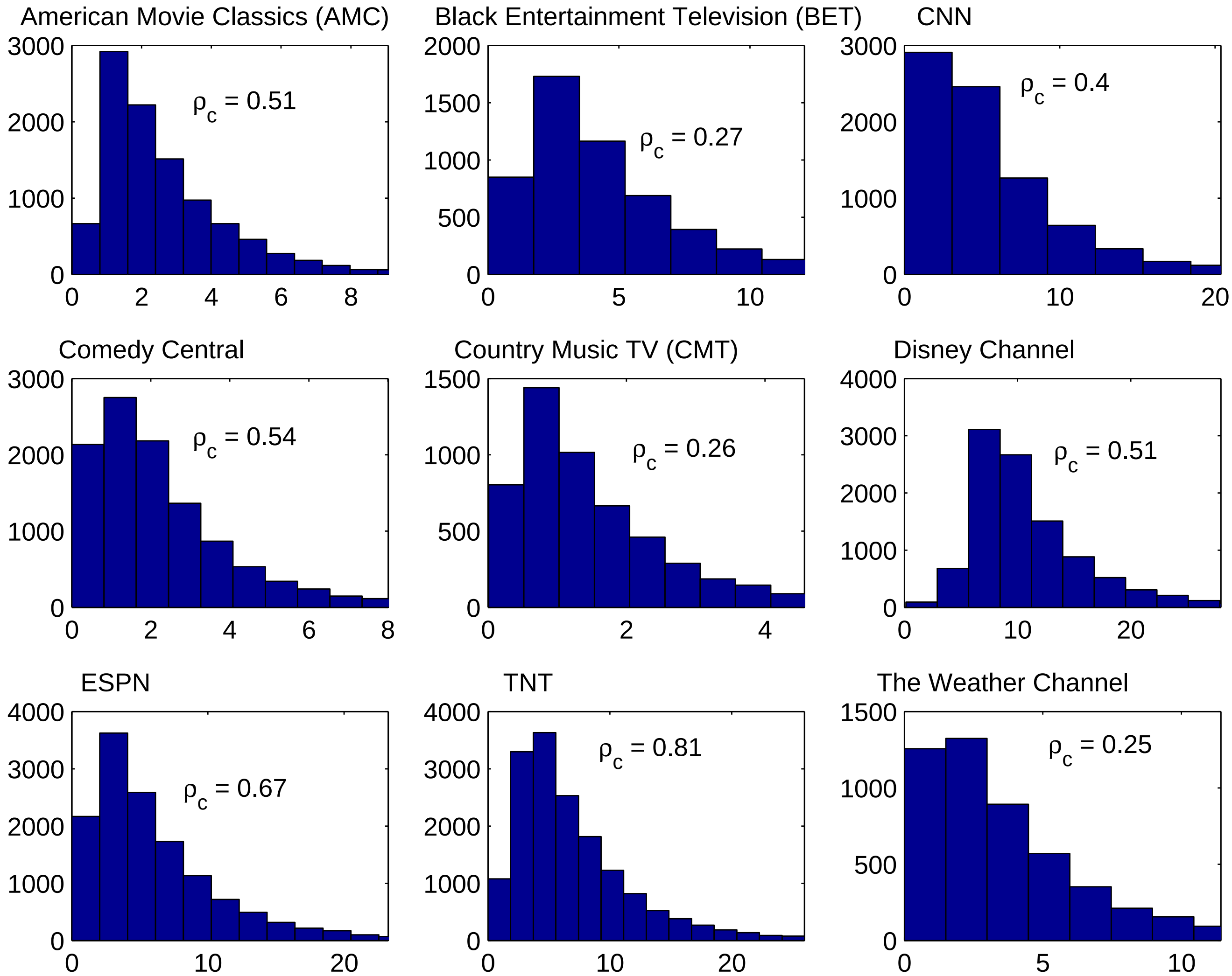
Figure 1: Estimated WTP for a Subset of Channels

Among households with Positive WTP for each Channel, Page 1




*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 a network positively ($\rho_c$) and the distribution of WTP among that subset. In each figure, the y-axis reports households and the x-axis reports WTP in 2008 dollars.

Table 1: Sample Statistics, Bundle Purchase Data

| Variable | Nobs | Mean | SDev | Min | Max |
|---|---|---|---|---|---|
| Market Types | | | | | |
| Basic Only | 20,117 | 0.601 | 0.49 | 0.00 | 1.00 |
| Basic + Exp. Basic | 20,117 | 0.319 | 0.47 | 0.00 | 1.00 |
| Basic + Dig. Basic | 20,117 | 0.034 | 0.18 | 0.00 | 1.00 |
| Basic + Exp. Basic + Dig. Basic | 20,117 | 0.045 | 0.21 | 0.00 | 1.00 |
| All Markets | | | | | |
| Price | 20,117 | $29.70 | $11.59 | $2.28 | $146.47 |
| Market Share | 20,117 | 0.461 | 0.259 | 0.010 | 0.990 |
| Total Cable Channels | 20,117 | 20.0 | 15.6 | 0.0 | 176.0 |
| Basic Only Markets | | | | | |
| Basic Service | | | | | |
| Price | 12,105 | $30.19 | $7.59 | $2.43 | $100.62 |
| Market Share | 12,105 | 0.551 | 0.209 | 0.010 | 0.990 |
| Total Cable Channels | 12,105 | 17.4 | 9.3 | 0.0 | 95.0 |
| Basic + Exp. Basic Markets | | | | | |
| Basic Service | | | | | |
| Price | 3,188 | $16.53 | $6.68 | $2.28 | $59.82 |
| Market Share | 3,188 | 0.123 | 0.158 | 0.010 | 0.889 |
| Total Cable Channels | 3,188 | 8.1 | 6.9 | 0.0 | 49.0 |
| Exp. Basic Service | | | | | |
| Price | 3,188 | $34.05 | $9.05 | $6.22 | $89.70 |
| Market Share | 3,188 | 0.559 | 0.193 | 0.010 | 0.969 |
| Total Cable Channels | 3,188 | 26.9 | 9.8 | 3.0 | 84.0 |
| Basic + Dig. Basic Markets | | | | | |
| Basic Service | | | | | |
| Price | 334 | $45.85 | $13.42 | $4.99 | $78.72 |
| Market Share | 334 | 0.517 | 0.183 | 0.029 | 0.924 |
| Total Cable Channels | 334 | 41.4 | 13.2 | 2.0 | 66.0 |
| Dig. Basic Service | | | | | |
| Price | 334 | $57.49 | $18.29 | $10.36 | $141.43 |
| Market Share | 334 | 0.120 | 0.081 | 0.010 | 0.705 |
| Total Cable Channels | 334 | 70.0 | 16.5 | 33.0 | 124.0 |
| Basic + Exp. Basic + Dig. Basic Markets | | | | | |
| Basic Service | | | | | |
| Price | 300 | $16.71 | $6.92 | $6.47 | $48.46 |
| Market Share | 300 | 0.220 | 0.119 | 0.011 | 0.625 |
| Total Cable Channels | 300 | 7.6 | 5.5 | 1.0 | 35.0 |
| Exp. Basic Service | | | | | |
| Price | 300 | $45.32 | $10.93 | $16.69 | $89.70 |
| Market Share | 300 | 0.367 | 0.145 | 0.013 | 0.799 |
| Total Cable Channels | 300 | 47.0 | 10.8 | 19.0 | 89.0 |
| Dig. Basic Service | | | | | |
| Price | 300 | $60.43 | $17.18 | $23.30 | $146.47 |
| Market Share | 300 | 0.124 | 0.077 | 0.010 | 0.474 |
| Total Cable Channels | 300 | 81.2 | 20.5 | 39.0 | 176.0 |

*Notes:* Reported are sample statistics from our bundle purchase data for all markets and by type of bundles they offer. Prices are in 2008 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 defined in Table 2.

Table 2: Sample Statistics, Cable Networks 1-30

| **Network** | **Any Tier** | **Basic** | **Expanded Basic** | **Digital Basic** | **Average Rating** | **Average Cume** |
|---|---|---|---|---|---|---|
| ESPN | 0.97 | 0.77 | 0.19 | 0.00 | 0.91 | 22.2 |
| Discovery Channel | 0.86 | 0.72 | 0.14 | 0.00 | 0.62 | 18.6 |
| TBS | 0.97 | 0.92 | 0.05 | 0.00 | 1.09 | 24.0 |
| TNT | 0.82 | 0.64 | 0.18 | 0.00 | 1.33 | 27.2 |
| USA | 0.87 | 0.67 | 0.19 | 0.00 | 1.17 | 27.2 |
| Nickelodeon | 0.68 | 0.53 | 0.15 | 0.00 | 1.83 | 0.0 |
| CNN | 0.94 | 0.78 | 0.16 | 0.00 | 0.75 | 13.6 |
| Lifetime | 0.56 | 0.42 | 0.14 | 0.00 | 0.90 | 16.7 |
| Spike | 0.86 | 0.70 | 0.16 | 0.00 | 0.52 | 17.7 |
| The Weather Channel | 0.52 | 0.41 | 0.11 | 0.00 | 0.30 | 8.4 |
| HGTV | 0.21 | 0.13 | 0.07 | 0.01 | 0.55 | 14.0 |
| VH1 | 0.33 | 0.23 | 0.10 | 0.00 | 0.36 | 14.0 |
| TLC (The Learning Channel) | 0.40 | 0.30 | 0.10 | 0.00 | 0.54 | 15.1 |
| ESPN 2 | 0.30 | 0.20 | 0.09 | 0.01 | 0.29 | 12.3 |
| Cartoon Network | 0.24 | 0.16 | 0.08 | 0.00 | 1.57 | 10.0 |
| History Channel | 0.26 | 0.18 | 0.08 | 0.01 | 0.55 | 16.7 |
| ABC Family Channel | 0.91 | 0.76 | 0.14 | 0.00 | 0.42 | 15.8 |
| CNBC | 0.29 | 0.20 | 0.10 | 0.00 | 0.20 | 3.9 |
| Animal Planet | 0.18 | 0.12 | 0.06 | 0.00 | 0.34 | 11.8 |
| Food Network | 0.08 | 0.05 | 0.04 | 0.00 | 0.41 | 12.9 |
| Fox News Channel | 0.15 | 0.10 | 0.05 | 0.00 | 0.76 | 12.8 |
| American Movie Classics (AMC) | 0.48 | 0.32 | 0.17 | 0.00 | 0.52 | 17.0 |
| Arts & Entertainment (A&E) | 0.64 | 0.49 | 0.15 | 0.00 | 0.70 | 18.7 |
| Comedy Central | 0.18 | 0.11 | 0.07 | 0.00 | 0.49 | 18.3 |
| Disney Channel | 0.38 | 0.30 | 0.08 | 0.00 | 1.19 | 16.9 |
| TV Land | 0.19 | 0.15 | 0.04 | 0.00 | 0.47 | 10.8 |
| FX | 0.15 | 0.10 | 0.06 | 0.00 | 0.53 | 19.7 |
| MTV | 0.43 | 0.29 | 0.13 | 0.00 | 0.70 | 17.3 |
| E! Entertainment Television | 0.17 | 0.11 | 0.06 | 0.00 | 0.29 | 13.0 |
| Sci-Fi Channel | 0.24 | 0.16 | 0.08 | 0.01 | 0.53 | 14.7 |
| Top30 | 14.27 | 11.00 | 3.23 | 0.04 | | |
| TopNets | 16.89 | 12.32 | 3.78 | 0.78 | | |
| Regional Sports | 0.39 | 0.24 | 0.12 | 0.02 | | |
| Other Channels | 2.71 | 2.15 | 0.63 | 0.32 | | |
| All Nets | 20.55 | 15.12 | 4.65 | 1.20 | | |

*Notes:* Reported are summary statistics from both our bundle purchase and viewership data. The first column reports carriage of each cable channel on *any* offered service (Any Tier). The remaining columns disaggregate carriage by tier. The channels reported are the 30 most widely available cable networks as of 2008 (Kagan World Media (2008)). Regional sports aggregates across regional sports networks (which differ across the country). Also reported are the total number of top-30, top-90, and all networks. only cable channels are included in this table - broadcast, premium, and pay-per-view channels are not. The last two columns report summary statistics from our Nielsen viewership data. The second-to-last column reports the average rating for all programs on that channel for the four Nielsen sweeps months between 2000 and 2006. The last column reports the national average cumulative rating, or "cume", for that channel during the fourth quarter of 2006. The national cumulative rating of a channel in a given week is the Nielsen estimate of the total number of unique television households that tuned into that channel for at least 15 minutes during that week. The average is across the 13 weeks in the quarter.

## Table 3: Demand Estimates, Selected Channels

| | Shift Estimate (StdErr) | Exponential Estimate (StdErr) | Share Positive | Mean | Mean Among Positive |
|---|---|---|---|---|---|
| Non-Channel Estimates | | | | | |
| Price | **-0.18** | —– | | | |
| | (0.00) | | | | |
| Price Income Effect | **0.04** | —– | | | |
| | (0.01) | | | | |
| log(# of channels) | **-0.26** | —– | | | |
| | (0.04) | | | | |
| log(1+sum ratings) | -0.46 | —– | | | |
| | (0.44) | | | | |
| log(# of channels) x log(1+sum ratings) | **-0.83** | —– | | | |
| | (0.09) | | | | |
| Channel Estimates | | | | | |
| ABC Family Channel | 0.03 | **0.170** | 0.472 | $0.95 | $2.01 |
| | (0.03) | (0.007) | | | |
| American Movie Classics (AMC) | 0.06 | **0.204** | 0.507 | $1.17 | $2.30 |
| | (0.05) | (0.008) | | | |
| Black Entertainment Television (BET) | **0.28** | **0.317** | 0.271 | $1.02 | $3.75 |
| | (0.08) | (0.042) | | | |
| Bravo | 0.03 | **0.155** | 0.379 | $0.55 | $1.45 |
| | (0.04) | (0.006) | | | |
| CNN | 0.19 | **0.475** | 0.405 | $1.97 | $4.87 |
| | (0.11) | (0.021) | | | |
| Comedy Central | **0.17** | **0.182** | 0.541 | $1.10 | $2.03 |
| | (0.07) | (0.007) | | | |
| Country Music TV (CMT) | **0.10** | **0.146** | 0.265 | $0.40 | $1.52 |
| | (0.03) | (0.008) | | | |
| Disney Channel | **0.75** | **0.528** | 0.508 | $4.84 | $9.53 |
| | (0.17) | (0.029) | | | |
| ESPN | **0.37** | **0.471** | 0.668 | $3.41 | $5.10 |
| | (0.17) | (0.032) | | | |
| Food Network | 0.11 | **0.195** | 0.383 | $0.74 | $1.94 |
| | (0.07) | (0.009) | | | |
| Lifetime | **0.28** | **0.374** | 0.506 | $2.87 | $5.67 |
| | (0.12) | (0.017) | | | |
| MTV | 0.04 | **0.275** | 0.513 | $1.40 | $2.72 |
| | (0.07) | (0.009) | | | |
| National Geographic Channel | **0.05** | **0.081** | 0.300 | $0.26 | $0.88 |
| | (0.02) | (0.006) | | | |
| Nickelodeon | **0.31** | **0.617** | 0.595 | $6.23 | $10.47 |
| | (0.15) | (0.025) | | | |
| SPEED Channel | 0.00 | **0.125** | 0.170 | $0.19 | $1.15 |
| | (0.02) | (0.013) | | | |
| USA | **0.41** | **0.363** | 0.818 | $4.10 | $5.02 |
| | (0.16) | (0.018) | | | |
| VH1 | **0.15** | **0.162** | 0.420 | $0.76 | $1.80 |
| | (0.05) | (0.006) | | | |
| The Weather Channel | -0.02 | **0.347** | 0.251 | $0.84 | $3.35 |
| | (0.03) | (0.037) | | | |
| Regional Sports | 0.08 | **0.493** | 0.404 | $2.09 | $5.18 |
| | (0.08) | (0.061) | | | |

*Notes:* Reported are combined results from the first two stages of our estimation procedure. Only demand estimates are reported. Shift and exponential estimates are results from our first-stage estimation on aggregate ratings data (cf. Equation 11). For each channel, $c$, the exponential estimate is the value that equates the variance of the residual in the first-stage regression for channel $c$, $V(\eta_{cdm})$, across DMAs and months with the variance of the average of 400 Nielsen households drawn from a mixture distribution with $1-\rho_c$ valuing channel $c$ at zero and $\rho_c$ valuing it according to an exponential distribution. $\rho_c$ is, for channel $c$, equal to 3 times the average cume as reported in Table 2. The shift estimate is the value of $\beta_c$ that ensures no households have negative tastes for networks. Non-channel estimates (top panel) are results from the GMM estimation of aggregate demand and pricing for up to 3 cable services and satellite service. Standard errors allowing arbitrary correlation within system-years and accounting for sampling, first-stage estimation, and simulation error are reported in parentheses. To facilitate interpretation of the channel estimates, also reported are the share positive, average WTP, and average WTP among households with positive WTP among 5,000 simulated households.

Table 4: Estimated Input Cost Parameters

| | *Coef* | *SE* | *t Statistic* |
|---|---|---|---|
| Constant ($\eta_1$) | 0.000 | 0.002 | 0.000 |
| Kagan Scale ($\eta_2$) | 1.100 | 0.023 | 48.889 |
| Distributor Size ($\varphi_1$) | -0.006 | 0.001 | -10.167 |
| Vertical Integration ($\varphi_2$) | 0.020 | 0.056 | 0.358 |

*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 size is measured in millions of households.

Table 5: Estimated Bargaining Parameters, Selected Channels

| | Big Cable | Small Cable | Satellite |
|---|---|---|---|
| ABC Family | 0.5073 | 0.4839 | 0.4569 |
| Animal Planet | 0.493 | 0.4815 | 0.4757 |
| BET | 0.5687 | 0.5716 | 0.5222 |
| CNN | 0.5521 | 0.5533 | 0.4691 |
| Comedy Central | 0.5848 | 0.5922 | 0.5566 |
| Discovery | 0.5044 | 0.5012 | 0.4648 |
| ESPN | 0.0148 | 0.0001 | 0.0002 |
| ESPN 2 | 0.2579 | 0.2209 | 0.2227 |
| Fox News | 0.6138 | 0.6304 | 0.5563 |
| History | 0.5545 | 0.56 | 0.5099 |
| MTV | 0.3452 | 0.3456 | 0.3057 |
| Nickelodeon | 0.73 | 0.7431 | 0.6843 |
| Sci-Fi | 0.5313 | 0.5341 | 0.488 |
| Spike | 0.4507 | 0.4381 | 0.4071 |
| TNT | 0.5471 | 0.5447 | 0.4843 |
| USA | 0.696 | 0.695 | 0.6649 |
| Weather | 0.6094 | 0.6218 | 0.5591 |
| Regional Sports | 0.2401 | 0.2396 | 0.0219 |

*Notes:* Reported are the estimated bargaining parameters for distributor-channel pairs for a subset of channels used in the analysis. Higher values of the bargaining parameters favors distributors compared to channels.

## Table 6: BSP/ALC Counterfactual

| Bundling Equilibrium | | | BSP/ALC Equilibrium | | | Percent Change |
|---|---|---|---|---|---|---|
| **Prices, Shares, and Welfare** | | | **Prices, Shares, and Welfare** | | | |
| Full Bundle | Price | Share | 20-Network Bundle | Price | Share | |
| Big Cable | $50.59 | 0.495 | Big Cable | $36.67 | 0.503 | |
| Small Cable | $51.79 | 0.095 | Small Cable | $37.42 | 0.097 | |
| Satellite | $38.72 | 0.298 | Satellite | $25.13 | 0.320 | |
| Average Price / Total Share | $46.59 | 0.882 | Average Price / Total Share | $32.74 | 0.919 | |
| | | | ALC Channels | | | |
| | | | Disney | $3.88 | 0.472 | |
| | | | ESPN | $3.40 | 0.316 | |
| | | | Nickelodeon | $0.77 | 0.602 | |
| Total Industry Profits | | $59.66 | Total Industry Profits | | $51.02 | -14.5 |
| Consumers Surplus | | $37.79 | Consumers Surplus | | $38.25 | 1.2 |
| Total Welfare | | $97.45 | Total Welfare | | $89.28 | -8.4 |
| **Input Cost Changes** | | | **Input Cost Changes** | | | |
| Channels in the Bundle | | Cost | Channels available in BSP | | Cost | |
| ABC Family | | $0.27 | ABC Family | | $0.62 | 126.2 |
| Animal Planet | | $0.10 | Animal Planet | | $0.34 | 238.9 |
| BET | | $0.17 | BET | | $0.26 | 46.2 |
| CNN | | $0.55 | CNN | | $1.28 | 133.6 |
| Discovery | | $0.34 | Discovery | | $0.56 | 67.3 |
| ESPN2 | | $0.29 | ESPN2 | | $0.73 | 155.0 |
| FX | | $0.35 | FX | | $0.35 | -2.0 |
| Fox News | | $0.31 | Fox News | | $1.05 | 235.4 |
| History | | $0.22 | History | | $0.61 | 172.5 |
| MTV | | $0.35 | MTV | | $0.37 | 6.5 |
| TBS | | $0.36 | TBS | | $0.49 | 35.5 |
| TNT | | $1.07 | TNT | | $1.25 | 16.4 |
| TCM | | $0.35 | TCM | | $0.82 | 133.0 |
| USA | | $0.56 | USA | | $0.75 | 33.6 |
| Regional Sports | | $1.37 | Regional Sports | | $2.48 | 80.6 |
| | | | Channels offered ALC | | | |
| Disney | | $2.12 | Disney | | $3.91 | 84.4 |
| ESPN | | $3.20 | ESPN | | $3.34 | 4.5 |
| Nickelodeon | | $0.50 | Nickelodeon | | $0.74 | 47.8 |
| Total (among these channels) | | $11.99 | Total (among these channels) | | $19.53 | 62.9 |

*Notes:* We simulate economic outcomes under two scenarios. Both scenarios feature competition between a large cable system, a small cable system, and a national satellite system, each offering access to their platform and 60 cable channels. In the bundling equilibrium, each firm competes by pricing a single bundle of channels. In the BSP/ALC equilibrium, each firm competes by setting prices for bundle sizes of 5, 20, and 60 channels and à la carte prices for Disney, ESPN, and Nickelodeon. We compute new equilibrium input costs for the BSP/ALC case and report those here.

Figure 2: Dispersion in WTP for components is higher than dispersion in WTP for a bundle

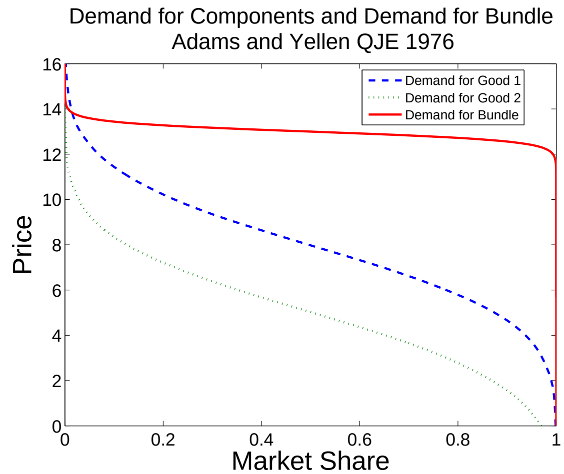
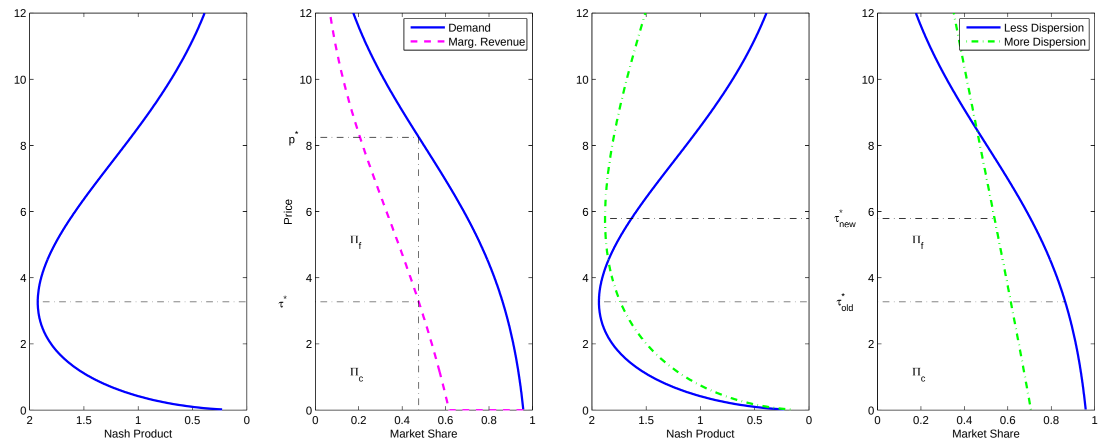



Figure 3: Nash Bargaining for Input Costs




*Notes:* These figures provide the intuition for the determination of input costs under Nash Bargaining. The left figure (encompassing two panels) shows the value for the input cost that maximizes the Nash Product under bilateral monopoly with linear fee contracts and symmetric bargaining parameters. The 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 ($\pi_f$) and the upstream content providers ($\pi_c$) according to an input cost ($\tau$). 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 (6)) for different values of $\tau$. 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 earn 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 7: Full ALC Counterfactual

| Bundling Equilibrium | | | | Full À La Carte Equilibrium | | | | | Percent Change |
|---|---|---|---|---|---|---|---|---|---|
| Bundle Price | | | | Channel Prices and Market Shares | | | | | |
| | | | | | | Channel Prices | | Shares | |
| | Cable | Satellite 1 | Satellite 2 | | Cable | Satellite 1 | Satellite 2 | All Platforms | |
| Full Bundle | $49.27 | $35.21 | $34.67 | Fixed Fee | $27.08 | $15.10 | $14.51 | $20.72 | |
| | | | | ABC Family | $0.52 | $0.52 | $0.54 | 0.523 | |
| | | | | AMC | $0.54 | $0.53 | $0.54 | 0.535 | |
| | | | | BET | $0.54 | $0.38 | $0.37 | 0.305 | |
| | | | | Bravo | $0.33 | $0.33 | $0.34 | 0.388 | |
| | | | | CNN | $1.23 | $1.10 | $1.10 | 0.403 | |
| | | | | Comedy | $0.24 | $0.21 | $0.21 | 0.594 | |
| | | | | CMT | $0.11 | $0.10 | $0.09 | 0.306 | |
| | | | | Disney | $4.35 | $4.08 | $4.09 | 0.548 | |
| | | | | ESPN | $6.37 | $6.37 | $6.37 | 0.189 | |
| | | | | Food | $0.29 | $0.19 | $0.17 | 0.425 | |
| | | | | Lifetime | $0.98 | $0.60 | $0.55 | 0.576 | |
| | | | | MTV | $0.68 | $0.67 | $0.67 | 0.543 | |
| | | | | Natl. Geog. | $0.44 | $0.46 | $0.46 | 0.218 | |
| | | | | Nickelodeon | $2.21 | $1.31 | $1.24 | 0.692 | |
| | | | | SPEED | $0.39 | $0.39 | $0.39 | 0.148 | |
| | | | | USA | $1.54 | $1.21 | $1.20 | 0.902 | |
| | | | | VH1 | $0.00 | $0.12 | $0.13 | 0.479 | |
| | | | | Weather | $0.27 | $0.26 | $0.26 | 0.281 | |
| | | | | Avg P or Share | $0.76 | $0.68 | $0.68 | 0.396 | |
| Platform Market Shares | | | | Platform Market Shares | | | | | |
| Cable | Satellite 1 | Satellite 2 | Total | | Cable | Satellite 1 | Satellite 2 | Total | |
| 0.569 | 0.181 | 0.133 | 0.882 | | 0.587 | 0.187 | 0.138 | 0.912 | 3.4 |
| Distributor Profits | | | | Distributor Profits | | | | | |
| Cable | Satellite 1 | Satellite 2 | Total | | Cable | Satellite 1 | Satellite 2 | Total | |
| $17.49 | $2.86 | $1.97 | $22.32 | | $18.01 | $3.01 | $2.10 | $23.12 | 3.6 |
| Channel Affiliate Fee Profit | | | | Channel Affiliate Fee Profit | | | | | |
| Cable | Satellite 1 | Satellite 2 | Total | | Cable | Satellite 1 | Satellite 2 | Total | |
| $10.53 | $3.51 | $2.62 | $16.66 | | $7.05 | $2.38 | $1.78 | $11.21 | -32.7 |
| Channel Advertising Profit | | | | Channel Advertising Profit | | | | | |
| | | | $12.56 | | | | | $12.58 | 0.1 |
| Total Industry Profits | | | | Total Industry Profits | | | | | |
| | | | Total | | Cable | Satellite 1 | Satellite 2 | Total | |
| | | | $51.54 | | | | | $46.91 | -9.0 |
| Channels Purchased | | | | Channels Purchased | | | | | |
| | | | 55.0 | | | | | 18.2 | -66.9 |
| Average Consumer Expenditure | | | | Average Consumer Expenditure | | | | | |
| | | | $44.21 | | | | | $37.68 | -14.8 |
| Consumers Surplus | | | | Consumers Surplus | | | | | |
| 25th Perc | Median | 75th perc | Mean | | 25th Perc | Median | 75th perc | Mean | |
| $22.67 | $33.80 | $49.10 | $39.12 | | $26.77 | $37.22 | $51.63 | $42.46 | 8.5 |
| Total Welfare | | | | Total Welfare | | | | | |
| | | | $90.67 | | | | | $89.37 | -1.4 |

*Notes:* Reported are results from our baseline Full ALC counterfactual. In it, we simulate economic outcomes under two scenarios. Both scenarios feature competition between a "nationally-representative" cable system and two national satellite systems, each offering access to their platform and 52 cable channels. In the bundling equilibrium, each firm competes by pricing a single bundle of channels. In the full à la carte equilibrium, each firm competes by setting a fixed fee and individual prices for each channel. Marginal costs to each firm for each channel are assumed to be equal to the national average for that channel for 2008 (from Kagan World Media (2008)) times (1.03/1.08/1.11) for the (cable/satellite1/satellite2) distributor. Reflecting likely changes in the wholesale programming market under the à la carte counterfactual, marginal costs in the à la carte equilibrium are 75% higher than in the bundling equilibrium. Table 10 assess the robustness of our conclusions to variation in that assumption. The last column reports estimated changes in various outcomes between the bundling and à la carte equilibria.

Table 8: Welfare Effects by Channel, Channels 1-30

| | Firm Effects | | | | | Consumer Effects |
|---|---|---|---|---|---|---|
| | Total Revenue | | | Component Revenues | | |
| **Network** | **Bundle** | **À La Carte** | **Percent Change** | **% Change Affiliate Fee Revenue** | **% Change Advertising Revenue** | **Welfare Discount if Purchase Channel** |
| ESPN | $3.99 | $1.42 | -64.5% | -70.0% | -47.5% | -162.4% |
| Discovery Channel | $0.61 | $0.59 | -2.8% | -8.4% | 3.2% | -7.6% |
| TBS | $0.91 | $1.03 | 12.8% | 26.8% | 4.6% | -0.5% |
| TNT | $1.63 | $1.94 | 19.2% | 30.7% | 1.0% | -13.7% |
| USA | $1.18 | $1.45 | 22.4% | 43.2% | 6.0% | -5.3% |
| Nickelodeon | $1.41 | $1.51 | 6.8% | 9.7% | 5.4% | -17.1% |
| CNN | $0.89 | $0.71 | -19.7% | -36.0% | 2.4% | -15.6% |
| Lifetime | $0.76 | $0.77 | 1.2% | -8.8% | 6.2% | -11.1% |
| Spike | $0.51 | $0.49 | -3.1% | -13.8% | 4.4% | 6.6% |
| The Weather Channel | $0.26 | $0.20 | -22.0% | -55.9% | 5.8% | 22.5% |
| HGTV | $0.54 | $0.53 | -3.2% | -27.5% | 6.1% | 14.3% |
| VH1 | $0.51 | $0.50 | -2.5% | -24.3% | 5.6% | 18.9% |
| TLC (The Learning Channel) | $0.37 | $0.33 | -10.7% | -26.4% | 5.0% | 12.4% |
| ESPN 2 | $0.44 | $0.32 | -27.6% | -45.5% | 0.0% | 3.4% |
| Cartoon Network | $0.49 | $0.48 | -2.1% | -15.8% | 5.5% | -16.1% |
| History Channel | $0.48 | $0.46 | -4.6% | -16.8% | 4.7% | 0.2% |
| ABC Family Channel | $0.44 | $0.41 | -8.0% | -17.2% | 4.4% | -0.1% |
| Animal Planet | $0.17 | $0.14 | -18.2% | -39.2% | 6.1% | 5.5% |
| Food Network | $0.38 | $0.38 | -0.2% | -32.6% | 5.6% | 3.6% |
| Fox News Channel | $0.66 | $0.59 | -10.4% | -30.2% | 5.1% | -6.8% |
| American Movie Classics (AMC) | $0.38 | $0.35 | -8.3% | -15.2% | 5.8% | 12.9% |
| Arts & Entertainment (A&E) | $0.55 | $0.56 | 1.4% | -2.6% | 4.6% | -6.8% |
| Comedy Central | $0.54 | $0.55 | 1.7% | -5.9% | 4.0% | 7.2% |
| Disney Channel | $1.97 | $1.71 | -13.0% | -13.0% | — | -87.0% |
| TV Land | $0.26 | $0.23 | -13.3% | -42.2% | 5.4% | 0.2% |
| FX | $0.62 | $0.63 | 1.6% | 0.4% | 2.8% | -2.3% |
| MTV | $1.13 | $1.12 | -1.2% | -13.5% | 3.8% | -3.5% |
| E! Entertainment Television | $0.37 | $0.25 | -32.8% | -50.0% | -6.8% | 2.3% |
| Sci-Fi Channel | $0.50 | $0.48 | -5.6% | -24.3% | 5.3% | 0.0% |

*Notes:* This table reports welfare effects by channel for both firms (content providers) and consumers. The first three columns report the predicted change in total revenue (equal to affiliate fee + advertising revenue) to content providers for each of the 52 channels in our counterfactual simulation. Units are 2008 dollars per subscriber per month. Affiliate fee revenue equals affiliate fee times 110 million US households times market share by distributor aggregated across distributor. Advertising revenue under bundling is from Kagan World Media (2008); advertising revenue under à la carte is the same times the percent change in ratings predicted by the model. The next two columns document the relative importance of changes in affiliate fee and advertising revenue to a channel's total revenue change. The last column reports, for each channel, the average change in consumer welfare (from bundling to à la carte) for consumers that purchase that channel as a share of the average change in welfare of all consumers. This calculation is made for only those households among 5,000 simulated households that purchase the median (+/- 1) number of channels.

Table 9: Welfare Effects by Channel, Channels 31+

| | Firm Effects | | | | | Consumer Effects |
|---|---|---|---|---|---|---|
| | Total Revenue | | | Component Revenues | | |
| **Network** | **Bundle** | **À La Carte** | **Percent Change** | **% Change Affiliate Fee Revenue** | **% Change Advertising Revenue** | **Welfare Discount if Purchase Channel** |
| Court TV | $0.27 | $0.24 | -11.4% | -34.4% | 5.8% | 9.6% |
| MSNBC | $0.27 | $0.19 | -32.2% | -57.7% | 5.3% | 5.2% |
| Bravo | $0.33 | $0.27 | -19.0% | -38.5% | 0.0% | 19.2% |
| Black Entertainment Television | $0.49 | $0.43 | -12.7% | -51.5% | 6.7% | 0.8% |
| Travel Channel | $0.18 | $0.13 | -24.2% | -51.4% | 5.3% | 7.7% |
| Country Music TV (CMT) | $0.16 | $0.14 | -12.3% | -52.2% | 9.3% | 26.8% |
| TV Guide Channel | $0.16 | $0.14 | -12.9% | -50.0% | 8.8% | 23.9% |
| Turner Classic Movies | $0.32 | $0.15 | -54.8% | -54.8% | — | 4.5% |
| SPEED Channel | $0.26 | $0.11 | -57.4% | -76.4% | -10.6% | 19.0% |
| Hallmark Channel | $0.23 | $0.23 | -3.3% | -33.9% | 9.8% | 1.7% |
| Versus | $0.18 | $0.07 | -62.6% | -82.9% | 0.0% | 22.0% |
| Game Show network | $0.12 | $0.09 | -26.6% | -67.4% | 9.4% | 17.7% |
| MTV2 | $0.08 | $0.06 | -31.2% | -71.4% | 0.0% | 30.6% |
| Oxygen | $0.31 | $0.17 | -46.3% | -63.6% | -3.4% | 3.9% |
| WE: Womens Entertainment | $0.17 | $0.10 | -40.7% | -65.1% | -1.3% | 25.0% |
| National Geographic Channel | $0.30 | $0.15 | -52.2% | -65.3% | -18.1% | 21.5% |
| SoapNet | $0.16 | $0.07 | -53.2% | -74.2% | 4.8% | 22.0% |
| Toon Disney | $0.14 | $0.08 | -42.2% | -75.4% | 5.1% | 14.8% |
| Noggin / The N | $0.16 | $0.05 | -71.2% | -82.9% | 0.0% | -20.2% |
| Lifetime Movie Network | $0.16 | $0.10 | -35.1% | -55.4% | 5.9% | 7.0% |
| The Science Channel | $0.08 | $0.03 | -62.1% | -78.3% | -16.7% | 4.1% |
| NickToons TV | $0.07 | $0.03 | -64.7% | -82.6% | -0.2% | 4.0% |
| Regional Sports | $1.27 | $0.66 | -48.0% | -48.0% | — | -54.9% |
| Total (Among These Channels) | $28.86 | $23.78 | -17.6% | -31.3% | 0.1% | — |

*Notes:* See notes for Table 8 above.

Table 10: Counterfactual Robustness

| | Baseline | Lower Costs: Constant Costs À La Carte | | **Baseline: 75% Higher Costs À La Carte** | | Higher Costs: 150% Higher Costs À La Carte | |
|---|---|---|---|---|---|---|---|
| | Bundle | Level | Change | **Level** | **Change** | Level | Change |
| Results | | | | | | | |
| Fixed Fee | | $21.06 | | **$20.72** | | $20.53 | |
| Weighted Average Price | $44.20 | $0.48 | | **$0.73** | | $0.82 | |
| Average Channel Share | | 0.341 | | **0.317** | | 0.307 | |
| Platform Share | 0.882 | 0.935 | 6.0 | **0.912** | **3.4** | 0.904 | 2.5 |
| Distributor Profits | $22.32 | $23.95 | 7.3 | **$23.12** | **3.6** | $19.77 | -11.4 |
| Channel Aff. Fee Profits | $16.66 | $7.54 | -54.8 | **$11.21** | **-32.7** | $15.24 | -8.6 |
| Channel Advertising Profits | $12.56 | $12.99 | 3.4 | **$12.58** | **0.1** | $12.16 | -3.2 |
| Industry Profits | $51.54 | $44.48 | -13.7 | **$46.91** | **-9.0** | $47.17 | -8.5 |
| Channels Purchased | 55.0 | 19.2 | -65.0 | **18.2** | **-66.9** | 17.8 | -67.7 |
| Average Consumer Expenditure | $44.21 | $33.72 | -23.7 | **$37.68** | **-14.8** | $38.76 | -12.3 |
| Mean Consumers Surplus | $39.12 | $47.37 | 21.1 | **$42.46** | **8.5** | $40.98 | 4.8 |
| Mean Total Surplus | $90.67 | $91.85 | 1.3 | **$89.37** | **-1.4** | $88.15 | -2.8 |
| Assumptions | | | | | | | |
| Marginal Costs | Kagan | Kagan | | **Kagan x 1.75** | | Kagan x 2.5 | |
| Channels | All | All | | **All** | | All | |
| Fixed Fee | None | Comp. | | **Comp.** | | Comp. | |

*Notes:* This table reports the sensitivity of our welfare conclusions to our assumptions about the increase in affiliate fees under à la carte. Our baseline assumption in Tables 7-10 are that they increase by 75%. In the second and third groups of columns we report the same economic outcomes as in Table 7 under the assumption that costs do not increase (constant costs) or go up twice as much as in the baseline (150% higher costs).

## This Appendix Not for Publication

# A Institutional and Econometric Details

## A.1 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 4 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.[31] 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.

[31] 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.

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*.[32] Distributors 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.[33] 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.

## A.2 First-Stage Estimation

### A.2.1 Model Aggregation Details

Let $\Upsilon^{dm}$ be the operator that takes a dataset whose units of observation are households within a DMA into the mean of the sample of television household Nielsen takes in DMA $d$ and month $m$.[34] Since Nielsen strives to match its sample of television households to the actual demographic distribution, $\Upsilon^{dm}$ has the property that the samples it generates are consistent estimates of the demographic profile of the population of the DMA.[35] For example, $\Upsilon^{dm}(\{T_i\}_{i\in d})$, in a DMA where Nielsen samples 400 television households, would produce the sample average of 400 observations of leisure time devoted to watching television in DMA $d$ where the demographic distribution of the sample is equal (as close as possible for 400 draws) to the DMA population demographic distribution. Applying $\Upsilon^{dm}$ to the dataset of any demographic variable would produce a sample estimate of the population average of that demographic. For variables involving some choice by the households, applying the Nielsen operator produces a sample estimate of the selected distribution.

[32] 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.).

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

[34] $\Upsilon^{dm} = \frac{1}{N_{dm}} \sum_{i\in \text{Nielsen sample of DMA d and month m}}$ where $N_{dm}$ is the number of households in the Nielsen sample of DMA $d$ and month $m$. $\Upsilon^{dm}$ satisfies $\Upsilon^{dm}\{kx_{id}\} = k\Upsilon^{dm}\{x_{id}\}$ for k constant and data x. We call $\Upsilon^{dm}$ the Nielsen operator.

[35] Any sampling error here is going to be attributed to unattributable variation in preferences.

In our case, applying the Nielsen operator to time spent watching a channel produces the sample mean time spent watching a channel conditional on the bundle selected by each household.

Applying $\Upsilon^{dm}$ to the right-hand side of Equation (10) produces

$$\begin{aligned}\Upsilon^{dm}\beta_{ij} &= \rho'\Upsilon^{dm}(\beta + \Pi D_i + v_i + \Theta a_j) \\ &= \rho'(\beta + \Pi D_d + \eta_{cdm} + \Theta \bar{a}_{dm}) \end{aligned} \tag{12}$$

where we assume $D_d = \Upsilon^{dm} D_i$ doesn't vary with $m$ (as the demographic data is taken from the year 2000 Census), $\eta_{cdm} = \Upsilon^{dm} v_i$, and $\bar{a}_{dm} = \Upsilon^{dm} a_j$ are population averages of our approximation covariates for each market and time period.

Before applying $\Upsilon^{dm}$ to the right-hand side of Equation (7), we will manipulate it to overcome difficulties due to its nonlinearity in $\gamma_{ic}$. Let $t_{cdm}$ be the average amount of leisure time allocated to watching channel $c$ in DMA $d$ in month $m$ in the bundles chosen by the respective households ($t_{cdm} = \Upsilon^{dm}\{t_{ijc}\}$). Similarly, let $\gamma_{cdm}$ be the demographic weighted average of the fraction of leisure time households would allocate to channel $c$ if they had all channels available ($\gamma_{cdm} = \Upsilon^{dm}\{\gamma_{ic}\}$).

A first-order Taylor Series expansion of $\gamma^{ic}\log(1 + t_{ijc})$ around $(\gamma_{cdm}, t_{cdm})$ yields

$$\gamma_{ic}\log(1 + t_{ijc}) \approx \gamma_{cdm}\log(1 + t_{cdm}) + log(1 + t_{cdm})(\gamma_{ic} - \gamma_{cdm}) + \frac{\gamma_{cdm}}{1 + t_{cdm}}(t_{ijc} - t_{cdm})$$

Applying $\Upsilon^{dm}$ to this approximation of the right hand side of Equation (7) produces:

$$\Upsilon^{dm}\gamma_{ic}\log(1 + t_{ic}) \approx \gamma_{cdm}\log(t_{1+cdm}) \tag{13}$$

where the second and third terms in the approximation are 0 by the definition of $\Upsilon^{dm}$.[36]

[36] A second-order approximation would yield, after application of $\Upsilon_{dm}$:

$$\begin{aligned}\Upsilon^{dm}\gamma_{ic}\log(1 + t_{ijc}) &\approx \gamma_{cdm}\log(1 + t_{cdm}) + \frac{1}{2}[\Upsilon^{dm}(\frac{1}{1 + t_{cdm}}(\gamma_{ic} - \gamma_{cdm})(t_{ijc} - t_{cdm}))' \\ &\quad - \Upsilon^{dm}(\frac{\gamma_{cdm}}{(1 + t_{cdm})^2}(t_{ijc} - t_{cdm})^2)] \end{aligned} \tag{14}$$

The credibility of our first order approximation depends on the variance of the aggregated second order terms. As we

Equating Equations (12) and (13) yields our approximation of the population relationship in the data. For channel $c$,

$$\gamma_{cdm}\log(1+t_{cdm}) = \beta_c + \Pi_c D_d + \Theta\bar{a}_{dm} + \eta_{cdm} \tag{15}$$

To estimate this relationship, we replace the population values, $t_{cdm}$ and $\gamma_{cdm}$ with their sample analogs. For $t_{cdm}$, this is a direct substitution. Recall the Nielsen rating, $r_{cdm}$, is measured as:

$$r_{cdm} = \frac{1}{T}\sum_{h=1}^{T}\Upsilon^{dm}\{\chi_{\text{household i watches c in hour h}}\} \tag{16}$$

and $t_{cdm}$ by definition is:

$$\begin{aligned} t_{cdm} &= \Upsilon^{dm}\{t_{ic}\} \\ &= \Upsilon^{dm}\{\sum_{h=1}^{T}\chi_{\text{household i watches c in hour h}}\} \end{aligned}$$

which implies that $r_{cdm}T = t_{cdm}$ because $\Upsilon^{dm}$ is a linear operator.

Determining a sample analog for $\gamma_{cdm}$ presents more difficulties. Recall that $\gamma_{cdm}$ is closely related to the average fraction of leisure time Nielsen households would allocate to channel $c$ *if they had all channels available.* The Nielsen rating, on the other hand, is the average fraction of leisure time Nielsen households actually devote to the channel. Because some households do not have access to all channels, $\gamma_{cdm}$ will generally be less than the Nielsen rating, $r_{cdm}$.

To account for this difference, we approximate $\gamma_{cdm}$ with a first-order Taylor Series expansion around $r_{cdm}$. In particular,

$$\begin{aligned} \gamma_{cdm}\log(1+r_{cdm}T) &\approx r_{cdm}\log(1+r_{cdm}T) + \log(1+r_{cdm}T)(\gamma_{cdm} - r_{cdm}) \\ &\approx r_{cdm}\log(1+r_{cdm}T) + \zeta_{cdm} \end{aligned} \tag{17}$$

Again, we note that $\zeta_{cdm}$ will be smaller the closer the average bundle in DMA $d$ and market $m$ comes to including all potential offered channels and the smaller the total viewing of the bundles (due to the dependence of $\zeta_{cdm}$ on $\log(1 + r_{cdm}T)$). These, however, are the same as our

do not have information about the variance of $t_{ijc}$ or the covariance between $\gamma_{ic}$ and $t_{ijc}$ within DMA $d$ and month $m$, we cannot estimate these additional terms. Our assumption is that the variation in $\Upsilon^{dm}\gamma_{ic}\log(1+t_{ic})$ is driven by the 0th-order term, $\gamma_{cdm}\log(t_{cdm})$, rather than the second-order terms in the more general approximation.

approximation-error covariates, $\bar{a}_{cdm}$. Thus $\Theta$ should pick up the effects both of the reduction in utility to a channel due to competition from other channels as well as the difference between measured ratings for a channel and the share of time devoted to it in the presence of all channels.

Inserting our sample estimates of the population values in Equation (15) yields our first-stage estimating equation:

$$r_{cdm} \log(1 + r_{cdm}T) = \beta_c + \Pi_c D_d + \Theta \bar{a}_{dm} + \eta_{cdm} \tag{18}$$

where $r_{cdm}$ is the vector of ratings for each channel in a given DMA $d$ in month $m$, $T$ is the number of minutes of television viewing measured by Nielsen, $\bar{a}_{dm}$ are the aggregated approximation covariates, and $\eta_{cdm} \equiv \Upsilon^{dm} v_{icm}$.

### A.2.2 Summary of Procedure

To summarize, first-stage estimation proceeds in four steps. First, for each channel $c$, we estimate the share of household with positive tastes for that channel, $\rho_c$. We start with the Nielsen "cume" for each channel, from Table 2, defined as the average share of unduplicated households tuned into that channel in each week of the third quarter of 2006. $\rho_c$, on the other hand, measures the share of households with positive tastes for a channel in a given *month*. This is likely to be greater than the Nielsen "cume" both because households must watch weakly more channels in a given month than a given week within that month and because there may be an option value to having access to a channel even if a household doesn't watch it in a given week. We therefore scale the Nielsen cume by a common factor to match the average number of channels watched by U.S. households under the assumption that tastes for channels are independent across channels within a household, a number we take to be 21.[37,38] Doing so yields a scale factor of 3.0. The resulting values for $\rho_c$ are given in the "Share Positive" column of Table 3.

[37]There is significant discretion in selecting this value. Nielsen Media Research (2008) finds that the average U.S. household watches 16 channels in a given week in 2007. This must be adjusted (upwards) for monthly viewing, (downwards) for broadcast channel viewing, and (upwards) for option value. On balance, we thought a value slightly larger than 16 appropriate. Because the more channels a household prefers, the more likely it is to like the bundle, if this assumption is in error, any bias in our results would likely favor bundling. As such, we treat this as a conservative assumption.

[38]The assumption of independent viewing across channels within a household is strong, but introducing within-household correlation necessarily breaks the construction of the multivariate distribution of tastes as further described below.

Second, we estimate the regression in (11), yielding estimates $\hat{\Pi}$, $\hat{\Theta}$, and $\hat{\eta}_{dm}$. $\hat{\eta}_{dm}$ is the average of unobserved tastes for channel $c$, $G(v|\lambda, \Sigma)$. We can therefore infer features of the distribution of those unobserved tastes by analyzing estimates of the variance and covariance of $\hat{\eta}_{dm}$. The set of moments of $\hat{\eta}_{dm}$ we choose G to match are Kendall's $\tau$ [39] and the variance of the marginal distributions. Still, G is not identified by these moments. We further assume that the marginal distributions for each channel, among those households with positive tastes, follow an Exponential distribution with parameter $\lambda_c$.[40]

Third, given $\hat{\eta}_{dm}$, we compute Kendall's $\tau$ of $\hat{\eta}_{dm}$ and create a t-copula based on $\hat{\tau}$. We then choose the Exponential distribution parameter, $\lambda_c$, whose sample averages distribution has the variance of the observed marginal distributions (accounting for the $1 - \rho_c$ fraction of households that value that channel at zero). We can sample from this distribution by drawing multivariate uniformly distributed random variables from the estimated t-copula (preserving the rank correlation of the $\hat{\eta}_{dm}$), applying the inverse cdf of the exponential distribution, and setting $1 - \rho_c$ of those to zero. The multivariate distribution of sample averages of these draws will preserve $\hat{\tau}$ and the chosen mixture of zeros and an Exponential distribution will have sample average variances equal to those of $\hat{\eta}_{dm}$.

Fourth, we select $\beta_c$ for each channel so that no household has negative willingness to pay.[41]

### A.3 Aggregation and Estimation on Market Share Data

This appendix describes our second-stage model and estimation on market share data. As this is standard in the literature, we present an abbreviated version here.

#### A.3.1 Aggregating to Market Shares

Recall the utility model (from Equation 4) is given by

[39] Kendall's $\tau$ is a measure of ordinal correlation. It can be calculated for two data series as $\frac{4P}{n(n-1)} - 1$ where P sum, over all the items, of items ranked after the given item by both rankings. Explicitly, $P = \sum_{i=1}^{N} \sum_{j=1}^{N} \chi_{\{x_j > x_i \bigwedge y_j > y_i\}}$. $\tau$ is equal to 1 if the orderings of the two data series are perfectly harmonious and $-1$ if the orderings are completely discordant. $\tau$ is invariant under CDF and inverse CDF operations.

[40] We discuss this important decision in greater detail in the next sub-section.

[41] These estimates are very highly correlated ($\rho \approx 0.80$) with the values of $\hat{\beta}_c$ estimated, but not used, in the second step. We are using the assumption of free disposal for the consumption of television channels.

$$u_{ijndm} \quad = \quad v^*_{ijndm} + z'_{jndm}\psi - \alpha_i p_{jndm} + \xi_{jndm} + \sigma_\epsilon \epsilon_{ijndm} \tag{19}$$

where $v^*_{ijndm} = v^*_{ijndm}(\gamma_{ij}, t_i, C_j)$, from (3), represents the indirect utility to household $i$ from viewing the channels available on bundle $j$ in market $n$, DMA $d$, and month $m$.

We normalize the mean utility of not subscribing to any bundle to zero and assume that each household subscribes to the bundle which delivers the highest positive utility, or to no bundle at all. We derive market shares by aggregating households' choices.

Let the portion of utility of bundle $j$ that is common to all households in market $n$ in DMA $d$ in month $m$ be given by

$$\delta_{jndm} = z_{jndm}\psi - \alpha p_{jndm} + \xi_{jndm} \tag{20}$$

and let the household specific utility derived from viewing programming in the bundle and price be denoted as

$$\mu_{ijndm} = v^*_{ijndm} + (\alpha_i - \alpha)p_{jndm} \tag{21}$$

Substituting these into Equation (4) yields the following formulation for the indirect utility to household $i$ from bundle $j$ in market $n$ in DMA $d$:

$$u_{ijndm} \quad = \quad \delta_{jndm} + \mu_{ijndm} + \sigma_\epsilon \epsilon_{ij} \tag{22}$$

Let $A_{jndm}$ be the set of households whose individual-specific characteristics induce bundle $j$ having the highest positive utility from the set of bundles available, including the empty bundle outside good $k = 0$, in market $n$, DMA $d$, and month $m$.[42] Thus

$$A_{jndm} = (i|\delta_{jndm} + \mu_{ijndm} \geq \delta_{kndm} + \mu_{ikndm} \ \ \forall k \in J_{ndm}) \tag{23}$$

Under the assumption that $\epsilon_{ij} \sim$ Type I Extreme Value, the model's predicted market share for bundle $j$ in market $n$ in DMA $d$ in month $t$ is given by

$$s_{jndm} \quad = \quad \int_{A_{jndm}} \frac{\exp((\delta_{jndm} + \mu_{ijndm})\sigma_\epsilon^{-1})dF(i)}{\sum_{k=0}^{J_{ndm}} \exp((\delta_{kndm} + \mu_{ikndm})\sigma_\epsilon^{-1})} \tag{24}$$

[42] In the next section, we describe out parameterization of the individual-specific characteristics of $v^*_{ijndm}$ as a function of household $i$'s demographic characteristics, $D_i$, and unobserved tastes for channels, $v_i$.

where $J_{ndm} \equiv \{J^c_{ndm}, J^s_{ndm}, 0\}$ are the set of bundles on offer in market $n$ in DMA $d$ in month $m$. These consist of all offered cable bundles ($J^c_{ndm}$), satellite bundles ($J^s_{ndm}$), and the outside good.

Estimation will partly be based on setting these predicted market shares equal to their empirical counterparts.

### A.3.2 Pricing

In our estimation, we focus on the demand and pricing of cable services and not satellite services. We do this for two reasons: satellite systems price on a national basis and our satellite market share data is limited. The combination of these features limit the information provided by satellite data and increase the costs of using it.[43]

We assume that each cable system chooses the price of its offered bundles to maximize profits. Due to satellite systems' nationwide-pricing strategy, we assume that individual cable system's take satellite prices as given.

Due to the two-sided nature of television markets, cable system profits consist of both advertising and subscription profits. A sophisticated model of advertising profits would account for the differentiated "audiences" produced by each of its offered bundles, the resulting demand for those audiences by advertisers, and competition between cable systems and other producers of audiences (e.g. satellite and broadcast television providers as well as other media). We unfortunately do not have the data for such a specification. Instead we model the advertising revenue (profits) from bundle $j$ to depend only on the quantity (share) of subscribers that purchase that bundle, denoted $r_j(s_{jndm})$.[44]

Each system's problem is then

$$\max_{\{p\}_{j=1}^{J_n dm}} \sum_{j=1}^{J_{ndm}} (p_{jndm} - mc_{jndm}) s_{jndm}(p_{ndm}) + r_j(s_{jndm}(p_{ndm}))$$

where $mc_{jndm}$ are the marginal costs of providing bundle $j$ in market $n$ in DMA $d$ and month $m$.[45]

[43] We do, of course, account for the price and characteristics of satellite bundles when measuring cable demand.

[44] For convenience in estimation, we further assume the marginal advertising revenue of a subscriber is the same across all bundles offered by the cable system, i.e. $r_j(s_{jndm}) = r(s_{jndm}) \; \forall j \in J^c_{ndm}$.

[45] The assumption of constant marginal costs within a cable market is appropriate given that contracts between cable systems and content providers uniformly specify affiliate fees that are linear in subscribers.

The first-order conditions for this problem are:

$$s_{jndm} + \sum_{j=1}^{J_n dm} (p_{jndm} - mc_{jndm}) \frac{\partial s_{jndm}}{\partial p_{jndm}} + r'_j(s_{jndm}) \frac{\partial s_{jndm}}{\partial p_{jndm}} \;\; = \;\; 0 \tag{25}$$

As marginal cost and marginal advertising revenue are not observed, we assume a functional form for the relationship between the sum of these two terms and other variables in the data:

$$mc_{jndm} - r'_j(s_{jndm}) \;\; = \;\; w'_{jndm}\theta + \omega_{jndm}$$

where $w_{jndm}$ is a vector of cost shifters (channel, year, and MSO dummies) and market share. $\omega_{jndm}$ is an unobservable stochastic term containing factors which affect marginal cost not accounted for in $w$. These include the deviation from the MSO year means of discounts available to systems of large systems on programming input costs and the quality of the system's local advertising opportunities.

#### A.3.3 Estimation on Market Share Data

Recall we estimate $\hat{\beta}$, $\hat{\Pi}$, $\hat{G}$, and $\hat{\Theta}$ in our first-stage estimation. In the second stage we estimate the remaining parameters of the model using moments from both the bundle demand and pricing equations.

**The Demand Side** The demand-side moments are:

$$\begin{aligned} E[\xi_{jndm} z^d_{jndm}] &= 0 \\ \xi_{jndm} &= \delta_{jndm}(s_{ndm}, x_{ndm}, p_{ndm}; \hat{\beta}, \hat{\Pi}, \hat{G}, \hat{\Theta}, \sigma_\epsilon, \pi_{ip}, \cdot) - z'_{jndm}\psi + \alpha p_{jndm} \\ Z^d_{jndm} &= [z_{jndm} w_{ndm}] \end{aligned}$$

where $\delta_{jndm}(s_{ndm}, x_{ndm}, p_{ndm}; \hat{\beta}, \hat{\Pi}, \hat{G}, \hat{\Theta}, \sigma_\epsilon, \pi_{ip}, \cdot)$ equates predicted and observed market shares for bundle $j$ in market $n$ and month $m$, given the set of model parameters listed after the semi-colon. It can be computed quickly using the contraction mapping in Berry, Levinsohn and Pakes (1995). In practice, computing these values requires computing a multidimensional integral with no known analytic solution. We use simulation techniques to approximate the true integral, accounting for this approximation in the standard errors.

There are two important issues that arise with this specification. First, while there are two large satellite providers, we observe only the aggregate satellite market share within each DMA. We therefore assume that there is just a single satellite product with characteristics given by the DirecTV Total Choice package.[46] Second, we are assuming product characteristics, $x_{jndm}$, are uncorrelated with the unobservable term, $\xi_{jndm}$. We don't believe the likely bias induced by violations of this assumption will be quantitatively important, in related work, we have worked on relaxing that assumption (Ackerberg and Crawford (2007)). We note that $\xi_{jndm}$ measures the deviation from the MSO-year-bundle mean of extra options such as Internet or high definition (HD) service, promotional activity, technical service, and quality of equipment.

**The Supply Side** The supply-side moments are of the form

$$\begin{aligned} E[\omega_{jndm} z^p_{jndm}] &= 0 \\ \omega_{jndm} &= p_{jndm} - (mc_j + r'(s_{jndm}) - \Omega^{-1} s_{ndm}(p_n dm) \\ &= p_{jndm} - \Omega^{-1} s_{ndm}(p_n dm) - w'_{jndm}\theta \\ &= p_{jndm} - markup_{jn} - w'_{jndm}\theta \\ z^p_{jndm} &= [w_{jndm}\, mar\hat{k}up_{jndm}] \end{aligned}$$

where $S_{jr,n} = -\partial s_{rn}/\partial p_{jn}$, $j, r = 1, \ldots, J_n$,

$$\Theta_{jr,n} = \begin{cases} 1, & \text{if in market } n \text{ there exists } f : \{r, j\} \subset F_f; \\ 0, & \text{otherwise} \end{cases} \tag{26}$$

and $\Omega_{jr,n} = \Theta_{jr,n} * S_{jr,n}$.

Estimation proceeds by GMM using a consistent estimate of the optimal weighting matrix. We discuss our choice of instruments in the body of the text.

To estimate input costs, one could simply project estimated marginal cost per bundle onto the channels included. We do this, but add the aggregate cost moments, the bundling moments, and use the cost parametrization. Explicitly, here are the moments conditions implied by assuming distributors are at a Nash equilibrium in prices:

[46] Less restrictive assumptions are possible. We could predict all satellite shares and aggregate the predicted shares to the level of the data.

$$\begin{aligned}\epsilon_j &= \hat{mc}_j(\mathbf{p_m}, \mathbf{b_m}, \hat{\beta}, \hat{\Pi}, \hat{G}, \hat{\Theta}, \sigma_\epsilon, \pi_{ip}) - \hat{mc}_j(\eta, \varphi) \\ E[Z'\epsilon] &= 0\end{aligned}$$

where the first $\hat{mc}$ are the implied marginal costs per bundle from inverting the price first order necessary condition, and the second $\hat{mc}$ are the aggregate predicted costs per channel. Z is a set of instruments, which contains, in particular, firm size and the extent of vertical integration in that bundle.

We now derive the restrictions from optimal bundling used in estimation. The logic is the same as the use of 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. However, since adding or dropping channels is a discrete choice, the implied restrictions are inequalities. We follow the set-up in Pakes et al. (2007).

From the Nash assumption,

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

We approximate $\Pi_{fm}$ using the profits predicted from the model, $r_{fm}$, which of course depend on input costs.

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

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

Following Pakes et al. (2007), we define

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

and

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

We make the following assumption about $\nu_{fm,b,b',2}$.

For two markets m and m' and the same firm, $\nu_{fm,b,b',2} = \nu_{fm',b,b',2} = \nu_{f,b,b',2}$.

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 $\Delta r$ is the same in any Time Warner Cable market.

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

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

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

### A.3.4 Standard Errors

In the first-stage estimation, we calculate block-bootstrap standard errors allowing for correlation within DMA. In the second-stage estimation, there are three sources of error: Sampling Error, Simulation Error, and 1st-Stage Estimation Error. We calculate standard errors using the usual GMM formulas modified to account for the additional sources of error as in Berry et al. (2004). We first compute the expectation of the derivative of the moment conditions at the estimated values. We then compute the variance in the moments generated by sampling error at the estimated values of the parameters. Simulation error arises from simulating the values of the model's predicted market shares in order to compute the set of $\delta$. We fix $\beta$, $\Pi$, $G$, and $\Theta$ at their estimated values and re-calculating the variance in moment conditions repeatedly using different sets of simulation draws. 1st-Stage estimation error arises from using our estimates, $\hat{\beta}$, $\hat{\Pi}$, $\hat{G}$, and $\hat{\Theta}$ when calculating market shares. We fix the simulation draws and re-calculate the variance in the moment conditions by repeatedly using draws from the estimated asymptotic distributions of $\beta$, $\Pi$, $G$, and $\Theta$. As these three sources of error are independent, we can simply add the three variance-covariance matrices of the sample moments from each type of error to calculate total standard errors using these aggregates.

# This Appendix Not for Publication

## B Data Quality and Appendix Tables

### B.1 Data Quality

**Warren Factbook Data** The Factbook data suffers from two weaknesses: persistent non-updating of entries and incomplete observations. When comparing yearly entries on an individual cable system in the Factbook, it is common to see that data does not change between two (and sometimes several) years. Given industry subscriber churn rates, channel introduction during the relevant time periods, and pricing behavior, we are certain that a lack of updating is the cause. Another common occurrence when analyzing the Factbook is that a cable system will have a bundle on offer, but no price and/or quantity is listed. Similarly, some observations are missing the number of homes the cable system passes. We try to estimate this figure when possible using census data on number of households. Sometimes this estimation is obviously unsuccessful, producing market shares well over one, for example. A third dimension of incomplete data in the Factbook deals with geographical market definition. In a few geographical markets, particularly dense metropolitan areas, there is more than one cable system. However, the Factbook does not specify on what portions of the market the cable systems overlap. We drop any observation for which there is a common community served with a distinct cable system, or if Factbook designates the system an overbuild. We present statistics on the extent of these two data quality issues below in Table 21. As can be seen there, the share of observations in a given year that are full and complete varies from 2% (in 2005) to 41% (in 1997).

While we worry in general about the quality of the Factbook data and its suitability for extrapolation to cable systems as a whole, we don't think it poses a serious econometric issue. In particular, we don't think unobservable characteristics of cable systems that impact whether an entry in the Factbook is up-to-date are likely to be correlated with the demand they face and/or their pricing behavior.

**Satellite Data** As noted in the text, we only observe market shares for the aggregate of bundles offered by both satellite providers at the DMA level. To accommodate this data limitation, we make the following two assumptions in our modeling approach. First, we assume the only satellite bundle in the DMA is the DirecTV total choice bundle (the most popular satellite bundle offered by either provider). Second, within a DMA, we assume the unobservable quality measure of this bundle does not vary across systems.

**Ratings Data** Nielsen is the dominant provider of television ratings. It has a large staff dedicated to data quality, statistical integrity, and metering technology. Our data comes from Set Meters which measure electronically to what channel the television is tuned throughout the day. This data is then linked with which programs aired on the relevant channels. We therefore have considerable confidence in the quality of the ratings data.[47]

[47] That being said, it is not without its critics. Nielsen data has been criticized both for not accurately capturing the whole television universe, for example out-of-home viewing, and for sample sizes too small to accurately measure the viewing of niche programming.

Figure 4: Television Programming Industry

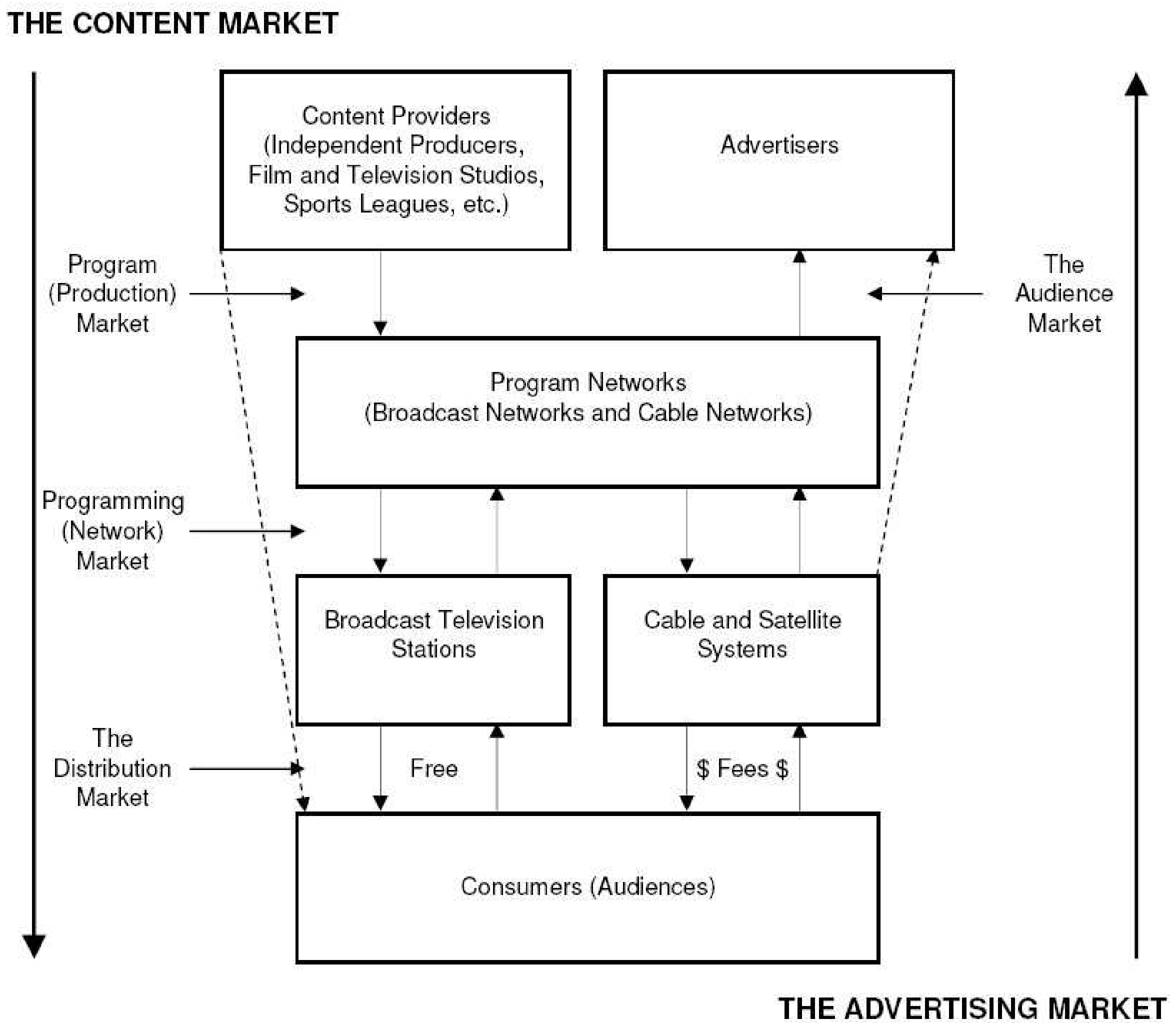


Figure 5: High and Low Rating DMA's for Black Entertainment Television

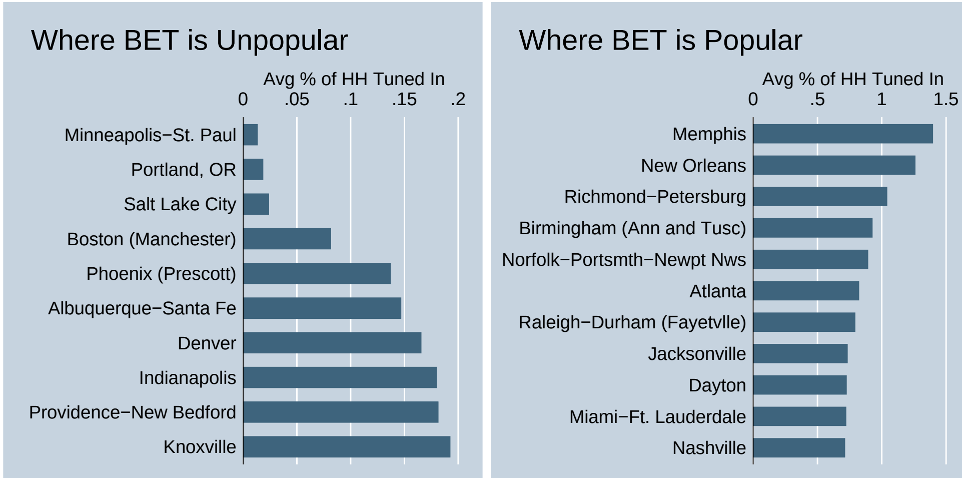


Table 11: Sample Statistics, Ratings Data, Selected Networks

| Network | Nobs | Mean | SDev | Min | Max |
|---|---|---|---|---|---|
| ABC Family | 1,482 | 0.42 | 0.13 | 0.05 | 0.94 |
| AMC | 1,482 | 0.52 | 0.16 | 0.12 | 1.31 |
| BET | 1,477 | 0.43 | 0.32 | 0.01 | 2.38 |
| Bravo | 1,472 | 0.25 | 0.16 | 0.01 | 0.86 |
| CNN | 1,481 | 0.75 | 0.32 | 0.21 | 2.82 |
| Comedy | 1,482 | 0.49 | 0.18 | 0.09 | 1.41 |
| CMT | 1,467 | 0.19 | 0.13 | 0.01 | 0.90 |
| Disney | 1,482 | 1.19 | 0.42 | 0.13 | 2.99 |
| ESPN | 1,482 | 0.91 | 0.45 | 0.17 | 3.68 |
| Food | 1,481 | 0.41 | 0.20 | 0.01 | 1.12 |
| Lifetime | 1,563 | 0.90 | 0.37 | 0.01 | 2.19 |
| MTV | 1,482 | 0.70 | 0.23 | 0.10 | 1.79 |
| Natl. Geog. | 1,109 | 0.10 | 0.08 | 0.00 | 0.53 |
| SoapNet | 1,210 | 0.11 | 0.11 | 0.00 | 0.70 |
| SPEED | 1,037 | 0.12 | 0.09 | 0.00 | 0.62 |
| USA | 1,481 | 1.17 | 0.36 | 0.17 | 2.57 |
| VH1 | 1,480 | 0.36 | 0.13 | 0.03 | 0.96 |
| Weather | 1,478 | 0.30 | 0.21 | 0.01 | 2.69 |

Table 12: Correlation in the Ratings Data

| **Network** | Cartoon Network | A&E | Turner Classic Movies | Discovery Channel | ESPN | ESPN2 | ESPN Classic | ESPN News |
|---|---|---|---|---|---|---|---|---|
| Cartoon Network | 1 | | | | | | | |
| A&E | -0.14 | 1 | | | | | | |
| TCM | -0.29 | 0.09 | 1 | | | | | |
| Discovery | 0.18 | 0.28 | -0.33 | 1 | | | | |
| ESPN | 0.14 | 0.01 | 0.07 | -0.08 | 1 | | | |
| ESPN2 | 0.11 | 0.16 | 0.10 | 0.08 | 0.54 | 1 | | |
| ESPN Classic | 0.30 | -0.10 | 0.16 | -0.17 | 0.16 | 0.15 | 1 | |
| ESPNews | 0.35 | -0.16 | 0.06 | -0.09 | 0.26 | 0.20 | 0.39 | 1 |

Table 13: Sample Statistics, Other Estimation Data

| Variable | NObs | Mean | SDev | Min | Max |
|---|---|---|---|---|---|
| First-Stage Estimation Covariates | | | | | |
| Channel Dummies | | | See Tables in Paper | | |
| Demographics | | | | | |
| Urban | 56 | 0.61 | 0.22 | 0.14 | 0.99 |
| Family | 56 | 0.68 | 0.03 | 0.59 | 0.77 |
| Household Income | 56 | $0.48 | $0.07 | $0.38 | $0.75 |
| Black | 56 | 0.10 | 0.09 | 0.00 | 0.34 |
| Hispanic | 56 | 0.12 | 0.11 | 0.02 | 0.54 |
| Asian | 56 | 0.02 | 0.03 | 0.00 | 0.19 |
| College Degree or Greater | 56 | 0.18 | 0.06 | 0.09 | 0.36 |
| Age | 56 | 0.37 | 0.02 | 0.33 | 0.42 |
| Second-Stage Estimation Covariates | | | | | |
| Channel Dummies | | | See Tables in Paper | | |
| Approximation Error Covariates | | | | | |
| Log(1 + Sum of Channels) | 20,117 | 2.39 | 0.95 | 0.00 | 4.33 |
| Log(1 + Sum of Ratings) | 20,117 | -0.07 | 0.06 | -0.41 | 0.00 |
| Instruments | | | | | |
| Within-DMA Price of Other Systems | 20,117 | $23.75 | $2.60 | $7.12 | $44.04 |

## Table 14: Demand Estimates, All Channels, Page 1

| | Shift Estimate (StdErr) | Exponential Estimate (StdErr) | Share Positive | Mean | Mean Among Positive |
|---|---|---|---|---|---|
| Non-Channel Estimates | | | | | |
| Price | **-0.18** | —— | | | |
| | (0.00) | | | | |
| Logit Standard Deviation | **0.33** | —— | | | |
| | (0.08) | | | | |
| Price Income Effect | **0.04** | —— | | | |
| | (0.01) | | | | |
| log(# of channels) | **-0.26** | —— | | | |
| | (0.04) | | | | |
| log(1+sum ratings) | -0.46 | —— | | | |
| | (0.44) | | | | |
| log(# of channels) x log(1+sum ratings) | **-0.83** | —— | | | |
| | (0.09) | | | | |
| Channel Estimates | | | | | |
| ABC Family Channel | 0.03 | **0.170** | 0.472 | $0.95 | $2.01 |
| | (0.03) | (0.007) | | | |
| American Movie Classics (AMC) | 0.06 | **0.204** | 0.507 | $1.17 | $2.30 |
| | (0.05) | (0.008) | | | |
| Animal Planet | 0.01 | **0.158** | 0.350 | $0.51 | $1.46 |
| | (0.03) | (0.006) | | | |
| Arts & Entertainment (A&E) | **0.24** | **0.244** | 0.562 | $1.60 | $2.85 |
| | (0.10) | (0.012) | | | |
| BBC America | 0.00 | **0.063** | —— | —— | —— |
| | (0.00) | (0.004) | | | |
| Black Entertainment Television (BET) | **0.28** | **0.317** | 0.271 | $1.02 | $3.75 |
| | (0.08) | (0.042) | | | |
| BET Jazz | 0.12 | —— | —— | —— | —— |
| | (0.16) | | | | |
| Biography | 0.00 | **0.034** | —— | —— | —— |
| | (0.00) | (0.002) | | | |
| Black Family Channel | 0.03 | —— | —— | —— | —— |
| | (0.27) | | | | |
| Bravo | 0.03 | **0.155** | 0.379 | $0.55 | $1.45 |
| | (0.04) | (0.006) | | | |
| CNBC | **0.09** | **0.193** | —— | —— | —— |
| | (0.03) | (0.012) | | | |
| CNN | 0.19 | **0.475** | 0.405 | $1.97 | $4.87 |
| | (0.11) | (0.021) | | | |
| Cartoon Network | **0.62** | **0.992** | 0.450 | $5.25 | $11.67 |
| | (0.26) | (0.031) | | | |
| Comedy Central | **0.17** | **0.182** | 0.541 | $1.10 | $2.03 |
| | (0.07) | (0.007) | | | |
| Country Music TV (CMT) | **0.10** | **0.146** | 0.265 | $0.40 | $1.52 |
| | (0.03) | (0.008) | | | |
| Court TV | **0.20** | **0.254** | 0.368 | $1.14 | $3.10 |
| | (0.06) | (0.013) | | | |
| Discovery Channel | **0.23** | **0.217** | 0.558 | $1.38 | $2.47 |
| | (0.09) | (0.013) | | | |
| Discovery Health Channel | 0.02 | —— | —— | —— | —— |
| | (0.02) | | | | |
| Discovery Home Channel | **1.25** | —— | —— | —— | —— |
| | (0.34) | | | | |
| Discovery Times | 0.00 | **0.018** | —— | —— | —— |
| | (0.00) | (0.001) | | | |
| Disney Channel | **0.75** | **0.528** | 0.508 | $4.84 | $9.53 |
| | (0.17) | (0.029) | | | |
| Do-It-Yourself | **0.00** | —— | —— | —— | —— |
| | (0.00) | | | | |
| E! Entertainment Television | 0.05 | **0.114** | 0.387 | $0.46 | $1.20 |
| | (0.04) | (0.004) | | | |
| ESPN | **0.37** | **0.471** | 0.668 | $3.41 | $5.10 |
| | (0.17) | (0.032) | | | |
| ESPN 2 | **0.10** | **0.181** | 0.371 | $0.69 | $1.85 |
| | (0.04) | (0.014) | | | |
| ESPN Classic Sports | 0.00 | **0.055** | —— | —— | —— |
| | (0.01) | (0.004) | | | |
| ESPNews | 0.00 | —— | —— | —— | —— |
| | (0.00) | | | | |

*Notes:* See Notes to Table 3.

Table 15: Demand Estimates, All Channels, Page 2

| | **Shift Estimate (StdErr)** | **Exponential Estimate (StdErr)** | **Share Positive** | **Mean** | **Mean Among Positive** |
|---|---|---|---|---|---|
| Channel Estimates, cont. | | | | | |
| FX | **0.20** | **0.251** | 0.589 | $1.61 | $2.73 |
| | (0.10) | (0.015) | | | |
| Fine Living | **0.00** | — | — | — | — |
| | (0.00) | | | | |
| FitTV | 0.00 | **0.017** | — | — | — |
| | (0.00) | (0.003) | | | |
| Food Network | 0.11 | **0.195** | 0.383 | $0.74 | $1.94 |
| | (0.07) | (0.009) | | | |
| Fox Movie Channel | 0.20 | — | — | — | — |
| | (0.11) | | | | |
| Fox News Channel | 0.10 | **0.519** | 0.384 | $1.91 | $4.97 |
| | (0.14) | (0.032) | | | |
| Fox Soccer Channel | **-0.53** | — | — | — | — |
| | (0.17) | | | | |
| Fuel | **1.02** | — | — | — | — |
| | (0.35) | | | | |
| Fuse | 0.00 | **0.068** | — | — | — |
| | (0.00) | (0.014) | | | |
| G4 | **-0.01** | **0.055** | — | — | — |
| | (0.00) | (0.005) | | | |
| Game Show network | -0.02 | **0.229** | 0.183 | $0.46 | $2.50 |
| | (0.02) | (0.019) | | | |
| GalaVision | **0.07** | — | — | — | — |
| | (0.02) | | | | |
| Golf Channel | 0.00 | **0.073** | — | — | — |
| | (0.00) | (0.006) | | | |
| Great American Country | 0.00 | **0.055** | — | — | — |
| | (0.00) | (0.005) | | | |
| HGTV | 0.06 | **0.222** | 0.421 | $0.86 | $2.05 |
| | (0.06) | (0.009) | | | |
| Hallmark Channel | **0.19** | **0.274** | 0.356 | $1.03 | $2.88 |
| | (0.07) | (0.014) | | | |
| Hallmark Movie Channel | **1.88** | — | — | — | — |
| | (0.28) | | | | |
| History Channel | **0.20** | **0.203** | 0.504 | $1.16 | $2.29 |
| | (0.07) | (0.009) | | | |
| History Channel International | 0.00 | **0.020** | — | — | — |
| | (0.00) | (0.001) | | | |
| Independent Film Channel (IFC) | **0.00** | — | — | — | — |
| | (0.00) | | | | |
| Lifetime | **0.28** | **0.374** | 0.506 | $2.87 | $5.67 |
| | (0.12) | (0.017) | | | |
| Lifetime Movie Network | 0.36 | **0.284** | 0.245 | $0.87 | $3.55 |
| | (0.20) | (0.023) | | | |
| MSNBC | **0.13** | **0.267** | 0.256 | $0.65 | $2.55 |
| | (0.05) | (0.015) | | | |
| MTV | 0.04 | **0.275** | 0.513 | $1.40 | $2.72 |
| | (0.07) | (0.009) | | | |
| MTV2 | **0.02** | **0.068** | 0.171 | $0.11 | $0.64 |
| | (0.01) | (0.006) | | | |
| Military Channel | **0.00** | **0.032** | — | — | — |
| | (0.00) | (0.003) | | | |
| NFL Network | **0.00** | — | — | — | — |
| | (0.00) | | | | |
| National Geographic Channel | **0.05** | **0.081** | 0.300 | $0.26 | $0.88 |
| | (0.02) | (0.006) | | | |
| Games and Sports (GAS) | 0.00 | — | — | — | — |
| | (0.00) | | | | |

*Notes:* See Notes to Table 3.

## Table 16: Demand Estimates, All Channels, Page 3

| | **Shift Estimate (StdErr)** | **Exponential Estimate (StdErr)** | **Share Positive** | **Mean** | **Mean Among Positive** |
|---|---|---|---|---|---|
| Channel Estimates, cont. | | | | | |
| NickToons TV | 0.00 | **0.051** | 0.129 | $0.06 | $0.43 |
| | (0.00) | (0.003) | | | |
| Nickelodeon | **0.31** | **0.617** | 0.595 | $6.23 | $10.47 |
| | (0.15) | (0.025) | | | |
| Noggin / The N | -0.01 | **0.105** | — | — | — |
| | (0.01) | (0.006) | | | |
| Outdoor Channel | **0.28** | — | — | — | — |
| | (0.05) | | | | |
| Ovation | -0.01 | — | — | — | — |
| | (0.22) | | | | |
| Oxygen | **0.13** | **0.103** | 0.238 | $0.30 | $1.24 |
| | (0.02) | (0.006) | | | |
| Sci-Fi Channel | **0.22** | **0.259** | 0.437 | $1.27 | $2.90 |
| | (0.09) | (0.011) | | | |
| The Science Channel | **0.01** | **0.039** | 0.151 | $0.06 | $0.36 |
| | (0.00) | (0.002) | | | |
| Si TV | 0.10 | — | — | — | — |
| | (0.10) | | | | |
| SoapNet | **0.11** | **0.162** | 0.157 | $0.26 | $1.67 |
| | (0.03) | (0.015) | | | |
| SPEED Channel | 0.00 | **0.125** | 0.170 | $0.19 | $1.15 |
| | (0.02) | (0.013) | | | |
| Spike | 0.04 | **0.181** | 0.521 | $0.95 | $1.83 |
| | (0.04) | (0.008) | | | |
| Style Network | **-0.01** | **0.052** | — | — | — |
| | (0.00) | (0.005) | | | |
| Sundance Channel | 0.01 | — | — | — | — |
| | (0.20) | | | | |
| TBS | **0.34** | **0.435** | 0.721 | $3.60 | $5.00 |
| | (0.17) | (0.043) | | | |
| TNT | **0.44** | **0.461** | 0.810 | $4.63 | $5.71 |
| | (0.20) | (0.018) | | | |
| TV Guide Channel | 0.06 | **0.152** | 0.286 | $0.47 | $1.63 |
| | (0.04) | (0.010) | | | |
| TV Land | **0.19** | **0.291** | 0.323 | $1.07 | $3.31 |
| | (0.09) | (0.015) | | | |
| TLC (The Learning Channel) | **0.18** | **0.174** | 0.452 | $0.89 | $1.96 |
| | (0.07) | (0.005) | | | |
| Toon Disney | **0.30** | **0.257** | 0.138 | $0.46 | $3.31 |
| | (0.13) | (0.033) | | | |
| Travel Channel | **0.18** | **0.099** | 0.310 | $0.41 | $1.33 |
| | (0.03) | (0.003) | | | |
| Turner Classic Movies | **0.15** | **0.167** | 0.299 | $0.61 | $2.03 |
| | (0.04) | (0.007) | | | |
| USA | **0.41** | **0.363** | 0.818 | $4.10 | $5.02 |
| | (0.16) | (0.018) | | | |
| Versus | 0.02 | **0.144** | — | — | — |
| | (0.01) | (0.013) | | | |
| VH1 | **0.15** | **0.162** | 0.420 | $0.76 | $1.80 |
| | (0.05) | (0.006) | | | |
| WE: Womens Entertainment | 0.03 | **0.097** | 0.223 | $0.20 | $0.90 |
| | (0.02) | (0.006) | | | |
| The Weather Channel | -0.02 | **0.347** | 0.251 | $0.84 | $3.35 |
| | (0.03) | (0.037) | | | |
| Regional Sports | 0.08 | **0.493** | 0.404 | $2.09 | $5.18 |
| | (0.08) | (0.061) | | | |
| Cable Audio | 0.01 | — | — | — | — |
| | (0.13) | | | | |

*Notes:* See Notes to Table 3.

Table 17: Estimated Price Elasticities, B+EB+DB Markets

| Price Elasticity of | wrt | Mean | Std. Dev. |
|---|---|---|---|
| Basic | Outside Good | 0.203 | 0.397 |
| | Basic | -2.056 | 1.489 |
| | Expanded Basic | 2.082 | 1.433 |
| | Digital Basic | 0.593 | 0.599 |
| | Satellite | 0.321 | 0.496 |
| Expanded Basic | Outside Good | 0.186 | 1.928 |
| | Basic | 0.410 | 0.830 |
| | Expanded Basic | -4.899 | 2.293 |
| | Digital Basic | 1.993 | 2.122 |
| | Satellite | 0.710 | 0.956 |
| Digital Basic | Outside Good | 0.042 | 0.098 |
| | Basic | 0.308 | 0.831 |
| | Expanded Basic | 5.812 | 2.788 |
| | Digital Basic | -11.681 | 4.237 |
| | Satellite | 1.242 | 1.468 |
| Satellite | Outside Good | 0.028 | 0.181 |
| | Basic | 0.107 | 0.449 |
| | Expanded Basic | 1.122 | 1.101 |
| | Digital Basic | 0.755 | 1.192 |
| | Satellite | -2.656 | 1.532 |

*Notes:* B+EB+DB Markets are those offering Basic, Expanded Basic, and Digital Basic cable service.

Table 18: Estimated Mean WTP for Channels by a Subset of Household Demographic Profiles

| | Household Type | | | | |
|---|---|---|---|---|---|
| Channel | White Rural Family | Black Urban Family | Rich College Grad | Nonfamily Under-30 College Grad | Over 60 |
| ABC Family Channel | $0.73 | $0.84 | $0.91 | $0.56 | $0.79 |
| American Movie Classics (AMC) | $0.84 | $1.06 | $0.88 | $0.58 | $0.98 |
| Animal Planet | $0.37 | $0.41 | $0.29 | $0.31 | $0.42 |
| Arts & Entertainment (A&E) | $1.18 | $1.15 | $0.96 | $1.08 | $1.07 |
| Black Entertainment Television (BET) | $0.68 | $1.03 | $0.72 | $0.96 | $0.70 |
| Bravo | $0.42 | $0.36 | $0.57 | $0.47 | $0.44 |
| CNN | $1.47 | $1.63 | $1.45 | $1.92 | $1.57 |
| Cartoon Network | $3.87 | $4.22 | $4.00 | $4.11 | $3.77 |
| Country Music TV (CMT) | $0.31 | $0.31 | $0.26 | $0.25 | $0.34 |
| Disney Channel | $3.35 | $3.68 | $3.00 | $3.38 | $3.52 |
| ESPN | $2.88 | $3.22 | $2.96 | $3.49 | $2.79 |
| ESPN 2 | $0.49 | $0.67 | $0.42 | $0.55 | $0.44 |
| FX | $1.19 | $1.30 | $1.11 | $1.27 | $1.16 |
| Food Network | $0.57 | $0.62 | $0.55 | $0.57 | $0.48 |
| Fox News Channel | $1.64 | $1.72 | $1.59 | $1.67 | $2.16 |
| Lifetime | $2.10 | $2.65 | $1.65 | $1.82 | $2.34 |
| MTV | $1.00 | $1.11 | $1.09 | $1.05 | $1.14 |
| National Geographic Channel | $0.18 | $0.17 | $0.19 | $0.22 | $0.16 |
| SoapNet | $0.17 | $0.20 | $0.21 | $0.19 | $0.17 |
| SPEED Channel | $0.16 | $0.16 | $0.20 | $0.11 | $0.15 |
| TNT | $3.36 | $4.06 | $3.58 | $3.39 | $3.20 |
| USA | $2.96 | $3.36 | $2.80 | $2.93 | $3.04 |
| VH1 | $0.56 | $0.61 | $0.57 | $0.66 | $0.51 |
| Regional Sports | $1.44 | $1.70 | $1.69 | $1.13 | $1.69 |

*Notes:* Reported are the estimated mean willingness-to-pay for a selection of channels by demographic characteristics.

They demonstrate the impact household demographics have on average tastes in our estimates.

Table 19: 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 | -0.059 | 0.014 | -4.070 | -0.185 | 0.030 | -6.130 |
| Vertical Integration | -0.073 | 0.092 | -0.790 | -0.010 | 0.194 | -0.050 |
| *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 | 20117 | | | 20117 | | |
| R-squared | 0.564 | | | 0.632 | | |
| F(160, 19956) | 159.41 | | | 211.17 | | |

*Notes:* Reported are the results of reduced-form regressions of prices (left columns) and estimated bundle marginal costs (right columns) on bundle and distributor characteristics.

Table 20: Carriage of Time Warner Channels by Distributor 2004-2007.

| | *N* | *CNN* | *CNNi* | *Cartoon Network* | *Boomerang* |
|---|---|---|---|---|---|
| Charter | 1652 | 0.980 | 0.078 | 0.648 | 0.137 |
| Comcast | 2045 | 0.996 | 0.007 | 0.871 | 0.004 |
| Cox | 257 | 0.988 | 0.058 | 0.922 | 0.144 |
| Time Warner Cable | 589 | 0.988 | **0.204** | 0.902 | **0.447** |
| Other | 6926 | 0.980 | 0.008 | 0.663 | 0.074 |

*Notes:* CNN and Cartoon Network are each over 15 years old. Boomerang and CNN International are digital channels that began distribution in the 2000's. Carriage for the established channels is not systematically different for the vertically integrated operator Time Warner Cable.

Table 21: Data Quality of Factbook

| *Year* | *Variable* | *Number of Bundles* | *Fraction of Bundles* |
|---|---|---|---|
| 1997 | Total Bundles | 15205 | 1.00 |
| | Full Information | 10740 | 0.71 |
| | Updated | 9264 | 0.61 |
| | Full Information and Updated | 6165 | 0.41 |
| 1998 | Total Bundles | 15743 | 1.00 |
| | Full Information | 10872 | 0.69 |
| | Updated | 4714 | 0.30 |
| | Full Information and Updated | 3461 | 0.22 |
| 1999 | Total Bundles | 15497 | 1.00 |
| | Full Information | 10444 | 0.67 |
| | Updated | 5663 | 0.37 |
| | Full Information and Updated | 3595 | 0.23 |
| 2000 | Total Bundles | 15453 | 1.00 |
| | Full Information | 10312 | 0.67 |
| | Updated | 3358 | 0.22 |
| | Full Information and Updated | 2478 | 0.16 |
| 2001 | Total Bundles | 15391 | 1.00 |
| | Full Information | 9793 | 0.64 |
| | Updated | 4173 | 0.27 |
| | Full Information and Updated | 2663 | 0.17 |
| 2002 | Total Bundles | 15287 | 1.00 |
| | Full Information | 7776 | 0.51 |
| | Updated | 5086 | 0.33 |
| | Full Information and Updated | 1484 | 0.10 |
| 2003 | Total Bundles | 15365 | 1.00 |
| | Full Information | 8370 | 0.54 |
| | Updated | 9744 | 0.63 |
| | Full Information and Updated | 4750 | 0.31 |
| 2004 | Total Bundles | 15145 | 1.00 |
| | Full Information | 7137 | 0.47 |
| | Updated | 8175 | 0.54 |
| | Full Information and Updated | 3556 | 0.23 |
| 2005 | Total Bundles | 15001 | 1.00 |
| | Full Information | 7009 | 0.47 |
| | Updated | 846 | 0.06 |
| | Full Information and Updated | 327 | 0.02 |
| 2006 | Total Bundles | 14653 | 1.00 |
| | Full Information | 4577 | 0.31 |
| | Updated | 8141 | 0.56 |
| | Full Information and Updated | 2303 | 0.16 |
| 2007 | Total Bundles | 13879 | 1.00 |
| | Full Information | 4070 | 0.29 |
| | Updated | 3135 | 0.23 |
| | Full Information and Updated | 711 | 0.05 |
| 1997-2007 | Total Bundles | 166619 | 1.00 |
| | Full Information | 91100 | 0.55 |
| | Updated | 62299 | 0.37 |
| | Full Information and Updated | 31493 | 0.19 |