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The impact of the 1992 Cable Act on household demand and welfare

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I measure the benefit to households of the 1992 Cable Act in light of strategic responses by cable systems to the regulations mandated by the act. A discrete-choice differentiated-product model of household demand for all offered cable television services forms the basis of the analysis. Aggregation over households and service combinations to the level of the data permits estimation on a cross-section of cable markets from before and after the act. The results indicate that while the regulations mandated price reductions of 10–17% for cable services, observed system responses yielded no change in household welfare. Post-act changes in cable prices are responsible for most of the difference.

1. Introduction

■ Between November 1986 and April 1991 cable television prices increased dramatically, rising 56% in nominal and 24% in real terms (GAO, 1991). Concerned that this reflected market power by monopoly cable systems, in October 1992 Congress passed the 1992 Cable Act, the purpose of which was ''to provide increased consumer protection . . . in cable television markets'' (Cable Act, 1992). In April 1993 the Federal Communications Commission (FCC) capped the per-channel prices that systems could charge for most types of cable service. The agency estimated that cable prices would fall by 10% from September 1992 levels, yielding annual savings to U.S. households of over $1 billion (FCC, 1993).

The FCC soon found, however, that not only had these gains failed to materialize, for nearly one-third of cable subscribers the average cable bill had *increased.* Many systems had introduced new, unregulated services and moved popular programming networks to those services; others had reallocated their portfolio of programming across all services (FCC, 1994a; Hazlett and Spitzer, 1997).[1] In February 1994 the FCC therefore imposed an additional 7% rate reduction. Subsequent revisions in FCC policy,

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[1] Most cable television services consist of bundles of individual programming networks.

however, loosened rate controls.[2] The Telecommunications Act of 1996 then phased out regulation on all but the lowest level of cable service after March 1999. Rising cable prices are again prompting lawmakers to consider regulation (FCC, 1997b; Yang, Grover, and Brull, 1998).

The general merit of price regulation in cable television is very much in doubt. Systems choose not only prices, but also the services to offer and the programming to provide on those services. Under price regulation, systems have an incentive to modify these offerings. The theoretical literature suggests that this could include service unbundling to evade the regulations (e.g., Corts, 1995) or changing the program mix to distort the quality of regulated services (e.g., Besanko, Donnenfeld, and White, 1988). The response of systems to the initial rate regulations suggests that both might have occurred.[3]

The purpose of this article is to measure the impact of the 1992 Cable Act on household demand and welfare in cable television markets. I introduce a model of demand for cable services that accommodates changes in cable prices as well as changes in the set of services offered and in the programming offered on those services. This extends models of cable demand estimated by Mayo and Otsuka (1991), Rubinovitz (1993), and Crandall and Furtchgott-Roth (1996). These works focus either on basic cable service or basic and an aggregate of other cable services. As the number of services offered by systems has grown, and as systems have changed the set of services in response to the Cable Act, such aggregation is unsatisfactory. Instead, I estimate demand for each service offered in a market by a cable system.

I specify and estimate a discrete-choice differentiated-product model of demand designed to reflect the nature of household decision making in cable markets. Given the set of services offered, households select one of the available *combinations* of those services. Tastes for each offered service depend on the *particular* programming offered. Demand for any service then depends on tastes for the actual programming provided at the price charged.

As a consequence, my model can measure household benefits from changes in the services, programming, and prices charged by cable systems in response to the Cable Act. As systems introduced new services in response to the act, the set of services—and thus the set of combinations of those services—available to households grew. My model accommodates this growth by extending the household choice set. As systems shifted programming to new services or, more generally, changed the mix of programming on any service, the benefits to households from those services changed, and my model can track that change. By focusing on the actual programming provided on each offered service, my model can differentiate between relatively more and less valuable portfolios of programming.

The principal source of data used in this article is the *Television and Cable Factbook*, a cable industry reference. The *Factbook* conducts detailed annual surveys of the population of U.S. cable systems. I employ information on the price, programming, and subscribers to each service provided by each of these systems at two points in time. The sampling dates chosen, February 1992 and August 1995, predate and follow the September 1993 implementation of the Cable Act. I examine the 344 systems present in both samples.

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[2] In particular, the going-forward rules announced in November 1994 and ''social contracts'' with large operators reached throughout 1995 permitted systems considerable pricing flexibility.

[3] For example, the public affairs network C-SPAN was dropped by systems passing 4.2 million homes as a result of the act, while QVC, the leading home shopping network, was added by 24% of all systems (Ferguson, 1994; Television Digest, 1991; Television Digest, 1996).

I identify household tastes for cable services from aggregate market shares in a cross-section of markets. This requires an assumption on the distribution of unobserved household tastes in each market. In the case of the dataset above, however, further aggregation is required: while households select among all *combinations* of cable services, only the information about each *individual* service is available in the data. Although this is accommodated by adding, for example, the predicted market share for all choices containing HBO to yield an aggregate HBO market share, it restricts the use of general distributions of unobserved tastes. I therefore specify a multinomial logit demand system and assess the robustness of the specification. I also consider the merits of alternative approaches.

Following Berry (1994), I solve for the econometric error implied by the demand system, specify population moment conditions, and estimate by generalized method of moments; cost shifters provide instruments for price. I focus on two outputs of the estimation. First, I look at the expected willingness-to-pay (WTP) of individual program networks. By determining how much more valuable ESPN is compared to MTV, or CBS, or HBO, I can quantify mean household benefits from changes in cable services and programming portfolios. Second, I assess aggregate household benefits from the Cable Act. I evaluate the actual welfare gain to households from the act, measured by the expected equivalent variation of observed changes in cable choice sets, and a benchmark welfare gain had systems implemented the act's mandated price reductions and not modified their services or programming.

The estimation results indicate that many of the most popular programming networks offered by systems are also the most valuable: expected WTP is $5.50 for ESPN and $6.41 for HBO. For all programming types, expected WTP for networks varies widely, underlining the importance of treating each separately in a model of cable demand. With respect to the Cable Act, while regulations mandated price reductions of 10–17% for cable services, observed system responses yielded no change in household welfare. Post-act changes in cable prices are responsible for most of the difference. This suggests that the product and price responses of systems to cable regulation are important.

The article proceeds as follows. Section 2 defines contemporary cable television service, and Section 3 describes the implementation and effects on cable services, programming, and prices of the 1992 Cable Act in the sample of cable systems considered here. Section 4 then introduces the model of demand, followed in Section 5 by a discussion of identification and a description of the estimation procedure. Section 6 presents the empirical specification and results, and Section 7 measures the benefits of the Cable Act. Section 8 concludes.

2. Cable television service: an overview

■ Cable television systems select a portfolio of programming networks, bundle them into one or more services, and offer these services to households in local, geographically separate, monopoly cable markets. This section briefly defines the types of programming and services common to all cable systems and describes the typical allocation of programming to services.

Cable systems offer three principal types of networks. *Broadcast networks* are television signals broadcast in the local cable market and then collected and retransmitted by cable systems. Examples include the major, national broadcast networks—ABC, CBS, NBC, and Fox—as well as public and independent television stations. *Cable networks* are advertising-supported general and special-interest networks distributed nationally to systems via satellite, such as MTV, CNN, and ESPN. *Premium* *networks* are advertising-free entertainment networks, typically offering full-length feature films, such as HBO and Showtime.

Broadcast and cable networks have historically been bundled by cable systems and offered as ‘‘basic service,’’ while premium networks have typically been separated into individual services and sold as ‘‘premium service(s).’’ Some systems, however, elect to split basic service and instead offer some portion of their cable networks as ‘‘expanded basic services.’’

Despite the presence of separate expanded basic and premium services, households are not permitted to buy them directly. They are first required to purchase basic service. This practice is known in the economic literature as a *tying requirement* (e.g., Whinston, 1990). An often-ignored aspect of the cable purchase decision, it is naturally accommodated by the model specified in this article.

3. The 1992 Cable Act: implementation and effects

■ Prior to 1984, cable prices were regulated according to terms reached with the local municipality or regulatory body in a system’s franchise area. The 1984 Cable Act, however, annulled these regulations for 97% of all cable systems (GAO, 1991). As described earlier, prices increased dramatically over the next eight years.

□ **Implementation of the Act.** The principal purpose of the 1992 Cable Act was to limit cable prices for most types of cable service.[4] In April 1993, the FCC established a price cap for the rates charged by systems for all basic and expanded basic services. Unbundled or à-la-carte programming, including premium services, were specifically excluded from the regulations. Jurisdiction was shared by the local municipal franchise authority and the FCC.

Regulated systems were mandated to compare their September 1992 prices to a benchmark charged by those systems facing ‘‘effective competition.’’[5] This benchmark varied with the subscribers, channels, and cable networks provided. If their prices exceeded the benchmark, systems were required to reduce them to the benchmark or by 10%, whichever required a smaller adjustment. On reconsideration of the rate rules in February 1994, the FCC issued a new rule that reduced all basic cable rates by 17% (FCC, 1994b).

□ **Effects of the Act.** *Data.* To assess the effects of the Cable Act, I compiled a market-level dataset on a panel of U.S. cable systems. The primary source of data for these systems is Warren Publishing’s *Television and Cable Factbook* Directory of Cable Systems database. The data for this article consists of two draws from this database. The first sample was drawn in February 1992, prior to both the September 1993 implementation of the act and the October 1992 passage of the legislation itself. The second sample was drawn in August 1995. To distinguish between these samples, I refer to the sample drawn in 1992 as ‘‘the pre-act sample’’ and to the sample drawn in 1995 as ‘‘the post-act sample.’’

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[4] The 1992 Cable Act also imposed must-carry and retransmission consent regulations. These permitted broadcasters to demand either carriage on local cable systems (i.e., must-carry) or payment for carriage (retransmission consent). Many systems compensated broadcasters under retransmission consent with carriage agreements for broadcaster-affiliated cable networks. Johnson (1994) and Crandall and Furchtgott-Roth (1996) summarize the implementation of these and the other portions of the Cable Act.

[5] ‘‘Effective competition’’ was defined in the statute as satisfying one of (a) local competition, (b) small market share, or (c) municipal ownership (FCC, 1993).

To be included in the analysis, complete and accurate information on all cable services was required. Missing information on prices, quantities, and reporting dates, among other requirements, yielded 1,460 observations from the pre-act sample and 1,105 from the post-act sample. 344 systems were present in both samples and form the basis of the analysis.

Since so many systems were eliminated from the sample, I compared the characteristics of the systems in the sample to their counterparts in the population. While the systems included in the analysis are considerably smaller than their population counterparts, their prices and penetration rates are quite comparable. In general, it appears that large, urban systems have been eliminated from the sample. Controlling for channel capacity, system size is unlikely to affect the demand for cable; differences in tastes across markets might do so, however, and are controlled for in the econometric specification. See the Appendix for a detailed description of the data preparation and further detail on this issue.

Summary statistics. Tables 1 and 2 report summary statistics for the two sample periods. In summarizing the programming provided by systems, it is important to distinguish between more and less popular networks. I therefore disaggregate networks into groups according to the size of their potential audience. The top 20 cable networks and the top 5 premium networks available as of December 1992 are listed in Table 3.

Table 1 shows that cable prices did not fall as mandated by the Cable Act.[6] The price of basic service for the systems in the sample increased 1.5% on average, from $16.82 to $17.07, and the total price of all basic and expanded basic services increased 8.7%.[7] The provision of expanded basic services increased considerably as well: while only 1.7% (6) elected to offer expanded basic services at all in 1992, by 1995 over 17% (60) did. Of these, nearly half (27) offered two expanded basic services.

Of course, the programming provided on cable services also increased. Despite the new must-carry regulations, the average number of broadcast networks carried on cable grew only 4.6%, from 5.52 to 5.77. The average number of cable networks carried increased 18.0%, an increase made possible due to an increase in average channel capacity. Most of these additions were devoted to relatively popular programming: on average, 1.47, or 69%, went to the carriage of previously unavailable top-20 networks.

As the regulations permitted system price adjustments due to expanded program offerings, it is useful to examine prices on a per-channel basis in order to assess price changes. Prices per channel for basic service declined, but only by 2.2% (from $.59 to $.58), while prices per channel for all basic services increased by 6.5%. Despite the aggregate price increases, the average market share of basic service increased slightly, from 63.9% to 66.3%.

The impact of new services. The summary statistics presented in Table 1 mask important differences between systems that did and did not introduce new expanded basic services. Table 2 describes these differences in greater detail. Table 2 suggests that systems that introduced new expanded basic services also raised prices. The price of all basic services increased 4.0%, from $16.79 to $17.47, for systems that did not introduce new services. In contrast, the price increased 30.8% for systems that did.

[6] In all tables, prices have been deflated to September 1992 dollars, as the intent of the regulations was to reduce real cable prices.

[7] The tables report monthly charges for cable programming and, due to data limitations, do not include charges for cable equipment. Furthermore, price increases may reflect increases in programming costs. As the Cable Act reduced equipment charges to subscribers (FCC, 1997a) and permitted cost pass-through, its beneficial effects may be understated.

TABLE 1 Pre-Act and Post-Act Sample Statistics

Variable	Pre-Act	Post-Act
Prices		
P_{Basic}	\$16.82 (2.48)	\$17.07 (3.22)
$P_{Basic} + P_{Exp.Basic1} + P_{Exp.Basic2}$	\$16.95 (1.83)	\$18.42 (3.68)
Services offered		
Any expanded basic services	1.7%	17.4%
One expanded basic service	1.5%	9.6%
Two expanded basic services	.3%	7.8%
Total services	3.19 (1.42)	3.42 (1.78)
Channel capacity	32.66 (8.44)	35.66 (10.91)
Broadcast programming networks		
Available over-the-air	2.54 (1.26)	2.45 (1.28)
Available on cable	5.52 (2.21)	5.77 (2.37)
Cable programming networks		
Top-5 cable programming networks	4.30 (.94)	4.46 (.76)
Top-20 cable programming networks	9.75 (4.04)	11.22 (4.10)
Total cable programming networks	11.82 (5.06)	13.95 (5.65)
Premium programming networks		
Total premium programming networks	2.17	2.17
Prices per channel		
P_{Basic} per channel	\$.59 (.21)	\$.58 (.22)
$P_{Basic} + P_{Exp.Basic1} + P_{Exp.Basic2}$ per channel	\$.59 (.21)	\$.63 (.23)
Market shares		
W_{Basic}	63.9% (.16)	66.3% (.14)

Standard errors in parentheses.

TABLE 2 Pre-Act and Post-Act Sample Statistics by Decision to Add Expanded Basic Services

Variable	Systems Not Adding Expanded Basic Services		Systems Adding Expanded Basic Services	
	Pre-Act	Post-Act	Pre-Act	Post-Act
Prices				
P_{Basic}	\$16.64 (2.43)	\$17.36 (2.90)	\$17.74 (2.53)	\$15.62 (4.27)
$P_{Basic} + P_{Exp. Basic 1} + P_{Exp. Basic 2}$	\$16.79 (2.53)	\$17.47 (2.88)	\$17.74 (2.53)	\$23.21 (3.59)
Cable programming networks				
Basic service				
Top-5 cable programming networks	4.21 (1.02)	4.43 (.75)	4.49 (.94)	1.82 (1.07)
Total cable programming networks	10.64 (4.34)	12.68 (5.08)	16.53 (5.83)	10.39 (4.76)
All basic services				
Top-5 cable programming networks	4.26 (.96)	4.44 (.75)	4.49 (.94)	4.51 (.81)
Total cable programming networks	10.89 (4.35)	12.71 (4.44)	16.53 (5.83)	19.74 (4.44)

Standard errors in parentheses.

Furthermore, this difference cannot be attributed to differences in the quantity or quality of added programming. Systems that introduced new services increased the number of cable networks on any basic service by 19.4%, from 16.53 to 19.74, but systems that did not introduce new services provided a comparable 16.7% increase. Among top-5 networks, systems that did not introduce new services made relative *gains*, increasing these offerings by 4.2% as compared to .2% for systems that did introduce new services.

These results are suggestive of the strategy employed by some systems to respond to the new regulations. Systems creating new services and moving or adding programming to those services were able to lower prices for basic service, from \$17.74 to \$15.62 on average, but also lower the number and quality of programming provided there, from 16.53 to 10.39 cable networks and 4.49 to 1.82 top-5 networks. With many popular programming networks included, market shares for the new services were high.[8] Most households bought all new services offered, and the effect was to increase household cable bills.

Some caution, however, is warranted. There is considerable heterogeneity in cable service across markets, and none of the reported differences are statistically significantly different from zero. Furthermore, grouping networks by audience reach only superficially addresses the value of different networks. In any case, such comparisons cannot quantify the benefits to households from these changes. To do so requires a

[8] On average, 94.3% and 91.2% of households buying basic service also bought the one or two available expanded basic services.

TABLE 3 Top Programming Networks Ranked by Total National Subscribers: December 1992

Rank	Network	Subs (millions)
Cable Programming Networks		
1	ESPN	61.4
2	Cable News Network (CNN)	61.2
3	WTBS	60.0
4	USA Network	60.0
5	The Discovery Channel	59.0
6	Nickelodeon/Nick at Nite	58.7
7	The Nashville Network (TNN)	58.5
8	TNT	58.3
9	MTV: Music Television	57.3
10	The Family Channel	57.2
11	C-SPAN-I	56.9
12	Lifetime Television	56.7
13	Arts and Entertainment (A&E)	56.1
14	The Weather Channel	53.3
15	Headline News (HNN)	51.4
16	CNBC	47.7
17	Video Hits One (VH-1)	47.1
18	QVC Network	44.5
19	American Movie Classics (AMC)	43.0
20	WGN	38.1
Premium Programming Networks		
1	Home Box Office (HBO)	17.5
2	Showtime	7.9
3	The Disney Channel	7.1
4	Cinemax	6.3
5	The Movie Channel	2.9

Source: Waterman and Weiss (1993).

model that can measure the benefit of multiple cable services and the programming provided on them. The next section introduces such a model.

4. A model of demand for cable television services

■ My model of cable demand is designed to reflect as closely as possible the nature of household decision making in cable markets. Two institutional characteristics are the focus of the model. The first is accommodating heterogeneity in the number of services offered by systems. The second is accommodating heterogeneity in the programming offered on those services. This is accomplished by specifying a household-level model of demand for combinations of cable services with tastes for each combination depending on the particular programming offered at the price charged. Estimation requires aggregating over both households and service combinations to obtain market shares for each service observed in the data. Each of these components is described in the subsections below. An example of the process matching the model to the data is given in Figure 1.

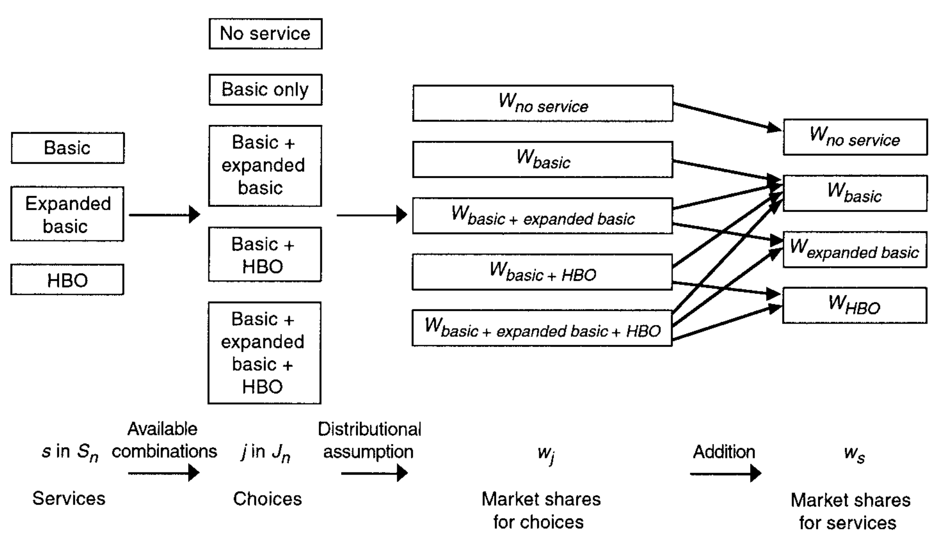
□ **Household-level demand for combinations of cable services.** Let S_n enumerate the set of services offered by the cable system in market *n*. As households must purchase basic service to purchase any other cable services, let J_n, the household choice set, enumerate all possible combinations of the elements of S_n that may be purchased by households, including the option of not purchasing any cable services. The left half of Figure 1 provides an example for a system offering three cable services.

Household demand for combinations of cable services fits in a class of recently developed differentiated-product demand models (Berry, Levinsohn, and Pakes, 1995; Bresnahan, Stern, and Trajtenberg, 1997; Nevo, forthcoming). As such, the underlying theory is only briefly developed here. The interested reader should refer to Berry (1994) for details.

Each choice in J_n is characterized by a vector of attributes, $(X_{jn}, p_{jn}, \xi_{jn})$, where p_{jn} stands for the price and (X_{jn}, ξ_{jn}) stand for observed and unobserved attributes of choice *j* in market *n*. The parameterization of X_{jn} is critical to the accurate characterization of household demand for cable television services. My maintained assumption is that household tastes for cable services depend on the individual networks offered on those services. Thus X_{jn} includes indicators of the networks offered on choice *j*. As the programming provided on any service combination may not exhaust all the relevant dimensions of that choice, unobservable quality, ξ_{jn}, is also incorporated into the demand model. This proxies for any of a host of idiosyncratic features of choice *j* that

FIGURE 1

MODEL-TO-DATA MATCH FOR A CABLE SYSTEM OFFERING THREE SERVICES



may affect demand.[9] While not observed by the econometrician, ξ_{jn} is observed by both households and firms, introducing price endogeneity into the demand specification.

An example helps clarify the household's decision-making process. Suppose as in Figure 1 that a cable system offers three services: basic service, expanded basic service, and HBO. Suppose further that subscription to basic permits reception of the major broadcast networks, ESPN, and CNN; subscription to expanded basic permits reception of MTV, WTBS, and TNT; and subscription to HBO permits reception of only HBO. The set of services offered to households, S_n, is {basic, expanded basic, HBO}. Given this set, households may choose one of five alternatives: {{no service}, {basic only}, {basic + expanded basic}, {basic + HBO}, or {basic + expanded basic + HBO}}. This defines the choice set J_n. Demand for each choice then depends on the programming provided. For the choice {basic + HBO}, demand is driven by preferences for the broadcast networks, ESPN, CNN, and HBO; for the choice {basic + expanded}, demand is driven by preferences for the broadcast networks, ESPN, CNN, MTV, WTBS, and TNT.

This framework provides several advantages in measuring changes in household demand due to changes in the services, programming, and prices charged by cable systems in response to the Cable Act. As systems introduced new services in response to the act, the set of services—and thus the set of combinations of those services—available to households grew. My model accommodates this growth by extending the household choice set. As systems shifted programming to new services or, more generally, changed the mix of programming on any service, the benefits to households from those services changed, and my model can track that change. By focusing on the actual programming provided on each offered service, my model can differentiate between relatively more and less valuable portfolios of programming.

Estimation requires specifying a functional form for household preferences. I assume that household i's utility for each service combination, $j \in J_n$, is given by

$$U_{ijn} = X'_{jn}\beta + \alpha p_{jn} + D'_n\gamma + \xi_{jn} + \epsilon_{ijn} = \delta_{jn}(X_{jn}, D_n, p_{jn}, \xi_{jn} | \theta) + \epsilon_{ijn}, \qquad (1)$$

where $\delta_{jn}(X_{jn}, D_n, p_{jn}, \xi_{jn} | \theta)$ stands for the mean utility to households in market n from the selection of product j and ϵ_{ijn} represents the variation of household i's idiosyncratic tastes for product j around that mean. Since preferences for cable service may also vary across markets, I incorporate a market-specific vector of demographic attributes, D_n, in the demand specification.[10] The vector $\theta = (\alpha, \beta', \gamma')'$ then parameterizes mean household marginal utility of income, marginal utility of programming networks, and differences in tastes across markets arising from different demographic features of the market. Demand by each household is given by the product $j \in J_n$, with the highest utility.

□ **Aggregation across households and service combinations.** I have specified a model of *household* demand for *combinations* of cable services. The data, however, provide *market shares* for each of the *individual* services provided by the system. I must therefore aggregate across both households and service combinations in order to identify the structure of tastes for cable service from the available data.

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[9] Examples include idiosyncratic features of the local geography that inhibit the reception of broadcast signals, channel position, or utility of networks not included in X_{jn}.

[10] A more general specification would permit preferences to vary with *household* demographics, D_{in}, as in Davis (2000). I assume that all households have demographic characteristics equal to the mean in market n; deviations from this mean are captured in ϵ_{ijn}.

Aggregation across households requires an assumption about the distribution of idiosyncratic tastes, ϵ_{ijn}, in each market. The market share of each product w_n, is then determined by the set of tastes in the population such that product, is preferred to all others (Berry, Levinsohn, and Pakes, 1995). Aggregation across service combinations requires no distributional assumptions; the market share of each service, w_{sn}, is simply the sum of the market shares of each combination of services, w_{jn}, that contain service s. The right side of Figure 1 demonstrates this process for the cable system offering three services.

I assume that ϵ_{ijn} is continuously distributed within markets according to a type I extreme value distribution, yielding familiar multinomial logit market shares:

$$w_{0n}(X_n, D_n, p_n, \xi_n | \theta) = \frac{1}{\sum_{k \in J_n} e^{\delta_{kn}}} \qquad w_{jn}(X_n, D_n, p_n, \xi_n | \theta) = \frac{e^{\delta_{jn}}}{\sum_{k \in J_n} e^{\delta_{kn}}},$$

where 0 indexes the purchase of no cable service, j indexes the elements of J_n, and the utility of the outside good has been normalized to zero. Market shares for service s are then

$$w_{sn}(X_n, D_n, p_n, \xi_n | \theta) = \sum_{j\ cont.s} w_{jn} = \sum_{j\ cont.s} \frac{e^{\delta_{jn}}}{\sum_{k \in J_n} e^{\delta_{kn}}}, \tag{2}$$

where $j\ cont.s$ is defined to be those choices $j \in J_n$, containing each service, $s \in S_n$, and w_s is the market share for service s.

Alternative specifications. Recent research has demonstrated that it is desirable to permit a general distribution of unobserved household tastes when estimating a differentiated-product demand system on aggregate data (e.g., Berry, Levinsohn, and Pakes, 1998; Petrin, 1999). Berry (1994) outlines a procedure applicable to a wide variety of distributional assumptions on ϵ_{ijn}. This procedure has been used to estimate more general models of differentiated product demand than that considered here (e.g., Berry, Levinsohn, and Pakes, 1995; Bresnahan, Stern, and Trajtenberg, 1997; Nevo, forthcoming).

I do not specify a more general model, as this procedure fails in the case of the aggregation over choices described above. The sufficient condition for the contraction mapping underpinning the Berry algorithm exploits the weak substitutability of market share functions for mutually exclusive and exhaustive choice sets. Market share functions for choice aggregates, however, may actually be complements.[11] I must therefore employ alternative solution techniques for the system of nonlinear equations defined by the market share functions; this is a topic of ongoing research (Coppejans and Crawford, 1999). I therefore pursue the specification outlined above and consider the implications of this assumption when discussing the results.

5. Estimation

■ This section briefly describes my estimation strategy. Following Berry (1994), estimation requires inverting the market share system defined in (2) to obtain ξ as a

[11] For example, the market share for one service (e.g., HBO) contains choices containing other services (e.g., expanded basic).

function of observables and parameters. I assume that a set of moment conditions involving ξ are satisfied at the true population parameter values. The sample analogs to these moment conditions are obtained by multiplying ξ by a set of exogenous instruments in each market and aggregating across markets; parameter estimates are obtained via the generalized method of moments. An informal discussion of identification concludes.

□ **Model solution.** The framework above ensures that the number of demand equations in each market is equal to the number of services offered by the system in that market. I also assume that the utility to any combination of services equals the sum of the utilities to each service in the combination, ensuring that ξ is the same dimension as well.[12] Together, these assumptions permit treating each service, s, as the unit of analysis in the model of demand.

The independence of ϵ_{ijn} across alternatives implies that incremental household utility from any service *except basic* is independent of the other services they choose to purchase. The estimating equation for the service therefore has the familiar logit log-ratio form

$$\log(w_{sn}/w_{\bar{s}n}) = X'_{sn}\beta + \alpha p_{sn} + \xi_{sn} \qquad s \neq b, \tag{3}$$

where $s \neq b$ indexes the services, s, offered in the market excluding basic service, b, w_{sn} is the market share for cable service s, and $w_{\bar{s}n} = w_{bn} - w_{sn}$.

The requirement tying the purchase of basic to other cable services induces a slightly modified estimating equation for basic service:

$$\log(w_{bn}/w_{0n}) - \sum_{s \neq b} [1 + \log(w_{sn}/w_{\bar{s}n})] = X'_{bn}\beta + D'_n\gamma + \alpha p_{bn} + \xi_{bn}, \tag{4}$$

where b indexes basic service and 0 indexes no cable service. The additional term on the left-hand side equals the option value of purchasing the other services, $s \neq b$, given the purchase of basic service. Subtracting this option value yields the utility from basic service alone.

□ **Moment conditions and estimation.** The maintained assumption in this article is that at the population parameter value, θ_0, the unobserved demand errors, ξ_{sn}, have zero means conditional on observed product characteristics, X_{sn}, demographic variables, D_n, and cost shifters, W_n, or

$$E[\xi_{sn}(\theta_0) | X_{sn}, D_n, W_n] = 0.$$

Note that this assumes variables that shift marginal cost across markets, W_n, provide instruments for price in the demand equations while the programming provided on each service, X_{sn}, and demand shifters, D_n, serve as their own instruments.[13]

[12] This obtains with additive separability of utility across services. Thus it excludes complementarity or substitutability of networks across bundles independent of that induced by assumptions on ϵ_{ijn}. The validity of this assumption is a topic of ongoing research.

[13] Although common, the exogeneity assumption is most problematic for X_{sn}. Instrumenting for every element of X_{sn} is infeasible, however, due to a lack of instruments for the number of networks considered in the model. Developing techniques to relax such assumptions is an important area of future research.

The sample analogs to the population moment conditions above are given as follows. Let $\xi_s(\theta)$ be the vector of demand errors and $Z_s \equiv (X_s, D, W)$ the matrix of instruments for services. Then $Z_s'\xi_s(\theta)$ are the moment conditions for equations. Let $Z'\xi(\theta)$ be the stacked vector of moment conditions for the whole system. The GMM estimator solves for the θ that sets these moments as close to zero as possible. The optimal weighting matrix is given by the inverse of the expected variance-covariance matrix of the orthogonality conditions, denoted $\Sigma = \text{var}(Z'\xi)$. Then the estimated parameters solve

$$\theta = \underset{\theta}{\text{argmin}}\ \xi(\theta)'Z\,\Sigma^{-1}Z'\xi(\theta).$$

Under the assumptions above, minimizing this objective function with respect to the parameters θ yields consistent, asymptotically normal estimates of all the parameters in the model. The reported standard errors allow for both possible heteroskedasticity as well as arbitrary correlation in the demand errors across services.

□ **Identification.** Variation in market shares for services corresponding to variation in the observed characteristics of those services identifies the parameter vector, θ. Two types of parameters merit additional discussion, however. First, as most networks on cable are offered in bundles, the identification of the marginal utility of networks, β, is discussed. Second, as prices are endogenous, the identification of the marginal utility of income, α, is discussed.

The identification of tastes for bundled products is complicated by the commingling of their distinct effects in each bundle. Identification therefore comes from two sources. First, systems differ in the portfolio of programming they offer to households. As a result, variation in market shares for services corresponding to variation in network carriage on those services identifies the marginal utility to networks, albeit more weakly than in the absence of bundling. In the extreme case that all systems carry a given network, however, it could not be identified in this way. Identification also arises from variation in the allocation of programming to different services. If some systems offer a given network on expanded basic service, while others offer it on basic service, its presence in the former markets permits price-portfolio comparisons of expanded basic services across markets, which identifies its effect.

Table 4 presents evidence of carriage patterns from the post-act sample to address this issue. The first column suggests that carriage does vary across networks, but few systems do not carry the most popular networks. The remaining columns indicate that there is variation in the allocation of these networks among offered services. This provides the information needed to accurately identify their effects.

Identification of the marginal utility of income requires instrumenting for price in the estimating equations. Instruments come from the supply side of the market. The cost of providing cable services is assumed to consist of a (large) fixed cost and a (small) marginal cost (Mayo and Otsuka, 1991; Rubinovitz, 1993). The primary inputs into marginal costs are administrative (billing) and programming costs (Rubinovitz, 1993). Variables that shift *markups*, successful instruments in studies of differentiated-product demand in oligopoly markets (e.g., Nevo, forthcoming), are unavailable in monopoly cable markets.

Instrumental variables for price come from three variables thought to affect the marginal cost of providing cable television service(s). The first two, homes passed and the number of subscribers served by the system's corporate parent, or multiple system

TABLE 4 Carriage of Top-20 Program Networks: Post-Act Sample

	Any Basic	Basic	Exp.Basic1	Exp.Basic2
Network				
ESPN	99%	94%	5%	0%
Cable News Network (CNN)	93%	81%	10%	2%
WTBS	95%	87%	4%	4%
USA Network	86%	76%	10%	0%
The Discovery Channel	73%	63%	8%	3%
Top-5	4.46	3.99	.38	.09
Nickelodeon/Nick at Nite	58%	53%	5%	0%
The Nashville Network (TNN)	91%	80%	10%	1%
TNT	73%	62%	9%	2%
MTV: Music Television	35%	31%	4%	0%
The Family Channel	93%	83%	8%	2%
Top-10	7.30	6.51	.65	.13
C-SPAN-I	25%	23%	2%	0%
Lifetime Television	37%	30%	6%	0%
Arts and Entertainment (A&E)	39%	35%	4%	0%
The Weather Channel	34%	27%	6%	1%
Headline News (HNN)	28%	19%	9%	1%
CNBC	12%	10%	2%	0%
Video Hits One (VH-1)	22%	19%	2%	0%
QVC Network	31%	31%	1%	0%
American Movie Classics (AMC)	19%	15%	3%	1%
WGN	81%	73%	4%	3%
Top-20	11.22	9.89	1.12	.21
Observations	344	344	60	27

operator (MSO), proxy for system size at the local and national level. They capture differences in marginal programming costs due to differences in bargaining power in the programming market (Noam, 1985; Chipty, 1995) and are plausibly unrelated to unobserved elements of cable demand. I also include a dummy variable if a system's MSO has vertical ties to programming networks. Both Chipty (1993) and Waterman and Weiss (1996) find that systems tend to favor affiliated networks, at least in part because they can purchase programming from their affiliates at its true (very low) marginal cost. Reduced-form regressions generally support the use of these variables as instruments.[14]

[14] Among the instruments, affiliation has the greatest explanatory power, followed by homes passed and total MSO subscribers. The latter two were occasionally not significantly different from zero.

6. Empirical specification and results

■ Empirical specification. The estimating equations are given by equations (3) and (4). I model the demand for eight cable services: basic service, two expanded basic services, and five premium services: HBO, Showtime, the Disney Channel, Cinemax, and the Movie Channel.[15]

The dependent variable in each of the eight equations is a function of the market share for each service. This is defined as the number of subscribers to that service divided by the number of homes passed by the cable system, where homes passed is the number of households accessible by a cable system's distribution network. This is a reliable measure of market size, as it defines the set of households available to purchase cable services from each system.

Because of the sheer number of broadcast, cable, and premium networks offered by cable systems, permitting a separate effect for each network is impractical. Instead, for each type of programming, I split networks into those permitted a separate effect and those permitted a common effect. This unequal treatment reflects the heterogeneity in value to households of different networks; I tried to permit separate effects where that heterogeneity was greatest. For broadcast networks, distinctions were made between the first and duplicate networks, both over-the-air and on cable. For cable networks, the top-10 or top-20, depending on the specification, were permitted a separate impact, as were all premium networks considered. See the Appendix for variable definitions and further details.

Demographic variables included in the model are the designated market area (DMA) rank, measuring the strength of the local television market, median income, the percentage of the population aged 5 to 18, and the percentage of the population with any college experience. The DMA rank affects demand by proxying for alternative sources of entertainment in the local system area. Region and year dummies were also included, as were expanded service dummies in the basic demand equation.[16]

Table 5 presents sample statistics for the pre- and post-act samples.

□ **Results.** *Alternative specifications.* Table 6 presents the results of the demand model estimated on the post-act sample for two specifications of X_s. Each column presents GMM estimates of the system of eight demand equations using cost shifters as instruments for price in each equation.[17]

The columns differ in the number of cable network dummies in demand. This was the primary dimension over which specification decisions affected the estimation results. The first column, specification A, presents results where only the top-10 cable networks separately affect tastes; remaining cable programming networks provide a common impact. The second column, specification B, expands the choice to 20 networks.

The qualitative effects of expanding the specification from 10 to 20 networks are significant. Tastes for common options generally fall, resulting in negative tastes for 8 of the 20 cable networks and all but one of the premium networks. While negative

[15] Only 1.5% of systems in the sample offered a premium service other than the ones included in the model. Including these offerings did not affect the results.

[16] This controls for differences in the mean utility of basic service across systems that do and do not offer expanded services. It captures the degrading of basic service when expanded services are offered.

[17] Not reported here are least-squares regression estimates of the same system. Instrumenting had the expected effect of increasing (in absolute value) the coefficient on price. Also not reported are alternative specifications that varied the demographic, control, and broadcast programming variables included in the model.

TABLE 5 Sample Statistics: Pre- and Post-Act Samples

Variable	Pre-Act Observations	Pre-Act Mean	Pre-Act Standard Deviations	Post-Act Observations	Post-Act Mean	Post-Act Standard Deviations
Dependent variables						
$\log(w_b/w_b) + SUM_r\{1 + \log(w_r/w_r)\}$	344	.13	1.01	344	−.52	2.32
$\log(w_e/w_e)$	6	.11	1.70	60	3.47	1.38
$\log(w_f/w_f)$	1	−1.28	.00	27	2.62	1.48
$\log(w_h/w_h)$	267	−1.03	.73	267	−1.15	.65
$\log(w_s/w_s)$	150	−1.63	.96	150	−1.63	.77
$\log(w_d/w_d)$	145	−2.41	.68	145	−2.42	.79
$\log(w_c/w_c)$	114	−1.82	1.04	114	−2.01	.72
$\log(w_t/w_t)$	63	−2.19	.90	63	−2.50	.76
Independent variables						
Broadcast programming						
First over-the-air-networks	344	2.38	1.06	344	2.31	1.08
Duplicate over-the-air networks	344	.15	.48	344	.14	.46
First networks not available over-the-air	344	2.15	.99	344	2.38	.98
Duplicate networks not available over-the-air	344	.84	1.32	344	.94	1.48
Cable programming						
Individual networks		—			See Table 4	
Other than top-5	344	7.52	4.58	344	9.49	5.26
Other than top-10	344	5.32	3.37	344	6.65	4.17
Other than top-20	344	2.06	1.39	344	2.73	1.96
Other channels	344	13.15	8.44	344	13.77	10.34
Prices						
P_{Basic}	344	$16.82	$2.48	344	$17.07	$3.22
$P_{Expanded\,Basic\,I}$	6	$6.98	$2.52	60	$5.69	$4.74
$P_{Expanded\,Basic\,II}$	1	$5.79	$0.00	27	$4.51	$1.17
P_{HBO}	267	$11.02	$1.05	267	$10.52	$.99
$P_{Showtime}$	150	$11.12	$1.03	150	$10.49	$.91
P_{Disney}	145	$9.28	$1.50	145	$8.53	$1.55
$P_{Cinemax}$	114	$10.67	$1.06	114	$9.95	$1.05
P_{TMC}	63	$11.06	$1.16	63	$10.05	$.87
Demographics						
DMA rank	344	62.24	31.49	344	55.17	34.92
Median income (thousands)	344	$29.35	$5.76	344	$29.32	$5.70
% Population aged 5–18	344	21.5%	2.5%	344	21.5%	2.5%
% Population college	344	23.4%	6.2%	344	23.3%	6.1%

Note: b = basic; e = expanded basic I; f = expanded basic II; h = HBO; s = Showtime; c = Cinemax; d = Disney; t = TMC.

TABLE 6 Parameter Estimates: Post-Act Sample

Parameter	Specification: A Top-10 Cable Networks Estimate	Specification: B Top-20 Cable Networks Estimate
Constant terms		
Basic	5.43	3.53
	(1.30)	(1.18)
Expanded basic I	4.30	3.94
	(.16)	(.14)
Expanded basic II	3.69	3.18
	(.17)	(.16)
Basic dummies		
Expanded basic I	−3.11	−3.89
	(.43)	(.38)
Expanded basic II	−2.69	−2.29
	(.66)	(.55)
Broadcast programming		
First over-the-air	−.28	−.19
	(.09)	(.09)
Duplicate over-the-air	.05	.10
	(.15)	(.14)
First on basic not available over-the-air	−.06	−.05
	(.09)	(.08)
Duplicate on basic not available over-the-air	.15	.09
	(.05)	(.05)
Other programming on basic	−.01	−.01
	(.01)	(.01)
Premium programming		
HBO	1.74	.18
	(.36)	(.31)
Showtime	1.23	−.33
	(.36)	(.31)
The Disney Channel	−.06	−1.32
	(.30)	(.26)
Cinemax	.76	−.71
	(.34)	(.30)
The Movie Channel	.25	−1.24
	(.35)	(.30)
Demographics		
DMA rank	.01	.01
	(.00)	(.00)
% Population aged 5–18	−.89	−.87
	(2.84)	(2.68)
% Population some college	1.20	99
	(1.47)	(1.40)
Median income (thousands)	−.05	−.03
	(.02)	(.02)
Control variables		
Dummy—1994	.12	−.08
	(.87)	(.78)
Dummy—1995	−.43	−.42
	(.87)	(.78)
Northeast region	1.10	.79
	(.56)	(.52)
South region	−1.67	−1.05
	(.35)	(.32)
North central region	−.68	−.34
	(.26)	(.25)

TABLE 6 ***Continued***

Parameter	Specification A Top-10 Cable Networks Estimate	Specification B Top-20 Cable Networks Estimate
Price		
Price	−.35 (.04)	−.16 (.04)
Cable programming		
ESPN	1.49 (.30)	.49 (.25)
CNN	−.11 (.11)	−.22 (.11)
WTBS	.25 (.16)	.05 (.18)
USA	.25 (.15)	.52 (.13)
Discovery Channel	.12 (.10)	.22 (.09)
Nickelodeon	.43 (.15)	.41 (.14)
Nashville	−.14 (.15)	−.37 (.13)
TNT	−.10 (.12)	−.26 (.10)
MTV	.05 (.16)	−.04 (.14)
Family Channel	−.33 (.15)	−.42 (.14)
C-SPAN-I	—	.36 (.18)
Lifetime Television	—	−.54 (.14)
Arts & Entertainment	—	.26 (.14)
The Weather Channel	—	.40 (.10)
Headline News (HNN)	—	.41 (.13)
CNBC	—	.48 (.21)
Video Hits One (VH-1)	—	−.91 (.16)
QVC Network	—	.20 (.15)
AMC	—	−.37 (.15)
WGN	—	.11 (.15)
Other cable networks	.06 (.02)	.05 (.04)
Objective function value	1.25	1.95
Test statistic: null excluding additional parameters	18.88	130.65
χ^2 critical value, size = .05	11.07	18.31
Degrees of freedom	5	10
J-test of overidentifying restrictions	447.97	672.47
Degrees of freedom	42	56
Number of observations	344	344

Standard errors are in parentheses.

tastes for a network is not inconsistent with economic theory and might be expected for less popular networks, the results suggest that the model with separate effects for 20 networks may be misspecified. Further, the estimated marginal utility of income, α, falls considerably (in absolute value), casting doubt on the assumption of exogeneity for the additional networks.[18] The balance of this section therefore analyzes demand using specification A.

To facilitate comparison with previous models of cable demand, I report estimated own- and cross-price elasticities for a subset of the services offered by cable systems. The estimated own-price elasticity for basic service is –1.67 and for expanded services are –.66 and –.49. Own-price elasticities for premium services range from –2.18 for the Disney Channel to –2.59 for the Movie Channel. Estimated cross-price elasticities indicate the importance of the tying requirement in cable demand: while the cross-price elasticity of basic service with respect to other services averages –.23, the cross-price elasticity of other services with respect to basic service averages –1.61. This is an intuitive result: as the price of basic service increases, the effective price of each additional service increases as well. The welfare implications of this restriction on choice in cable television, and of bundling in general, is a topic of ongoing research (Crawford, 1999; Coppejans and Crawford, 1999).

To assess the robustness of the results, I consider several specification tests of the model. First is the J-test of the overidentifying restrictions implied by the moment conditions. The test statistic and implied degrees of freedom for each GMM specification are included at the bottom of Table 6. All are rejected at reasonable confidence values.[19]

To specifically address the logit assumption, I also conduct several Hausman-McFadden tests (Hausman and McFadden, 1984). These compare the parameter estimates from the unrestricted model and a restricted model that eliminates elements from households' choice sets. If tastes are independent across products, this should not affect the estimates for the remaining choices. Estimating the model on just the basic and expanded basic service equations yields quite comparable estimates of the remaining parameters: the Hausman-McFadden test statistic of 36.64 is lower than the critical value for a χ^2 distribution with 31 degrees of freedom of 47.73. This suggests that the heterogeneity assumption embodied in logit demand may not be inaccurate in cable markets.[20]

Measuring tastes for cable networks. Table 7 presents expected willingness-to-pay (WTP) estimates for the networks implied by the specification A estimates. These are computed by dividing the estimated marginal utility of the network, β, by the marginal utility of income, α. While not precise, the estimates governing tastes for broadcast networks are of consistent sign and magnitudes. The addition of an otherwise unavailable over-the-air broadcast network reduces expected WTP for cable services by an estimated \$1.04. A comparable network available on cable and *not* available over the

[18] This is perhaps not surprising. For the most popular networks, identification is driven by the allocation of networks across services. For less popular networks, identification is also driven by differences in network carriage decisions. Exogeneity is a more palatable assumption in the first instance than in the second.

[19] The overidentifying test is an omnibus specification test; as such, there are many reasons why it may be rejected, and it doesn't provide a direction to proceed in generalizing the specification. Furthermore, it is fairly common to reject this test in models of differentiated-product demand on aggregate data (e.g., Nevo, forthcoming).

[20] Excluding expanded basic services yields slightly weaker conclusions. Excluding the second expanded basic service yields a test statistic of 56.20 (χ^2 critical value (.05) = 43.77). Excluding both expanded basic services yields a statistic of 13.38 (χ^2 critical value (.05) = 42.56). The rejection in the former case is perhaps not surprising, given that identification is driven by the allocation of networks across these services.

TABLE 7 Expected Willingness-to-Pay: Broadcast and Premium Programming Networks, Specification A

Parameter	Estimate
Broadcast programming	
First over-the-air	−$1.04
	(.36)
Duplicate over-the-air	$.20
	(.56)
First on basic not available over-the-air	−$.22
	(.33)
Duplicate on basic not available over-the-air	$.54
	(.21)
Other programming on basic	−$.04
	(.03)
Premium programming	
HBO	$6.41
	(.53)
Showtime	$4.52
	(.77)
The Disney Channel	−$.21
	(1.11)
Cinemax	$2.81
	(.91)
The Movie Channel	$.91
	(1.16)
Cable programming	
ESPN	$5.50
	(.80)
CNN	−$.39
	(.40)
WTBS	$.93
	(.62)
USA	$.91
	(.56)
The Discovery Channel	$.42
	(.37)
Nickelodeon	$1.59
	(.57)
Nashville	−$.53
	(.57)
TNT	−$.38
	(.45)
MTV	$.19
	(.57)
The Family Channel	−$1.22
	(.64)
Other cable networks	$.10
	(.07)

Note: Standard errors are calculated via the delta method and are shown in parentheses.

air has a slight negative effect.[21] Duplicate broadcast networks increase expected WTP for cable services by \$.54 if not available over-the-air.

Cable and premium networks have stronger demand effects. Expected WTP for the top-10 individual cable networks vary from a high of \$5.50 for ESPN to a low of –\$1.22 for the Family Channel. Tastes for networks outside these ten are comparable, with an expected WTP of \$.10 per network. Expected WTP for premium networks vary from a high of \$6.41 for HBO to a low of –\$.21 for the Disney Channel.

These results demonstrate that households have different tastes for different networks. Further, much of the greatest value is concentrated in the most popular networks. This has two implications. First, from a modelling perspective, aggregating over tastes for distinct networks may seriously bias demand estimates both for cable networks in general and for the services that are bundles of those networks. MTV is decidedly *not* ESPN. Second, as systems that introduced new services disproportionately offered the most popular networks on these services, the portfolio reallocation by systems in response to the Cable Act may have had significant consequences for household welfare. I measure the effects of these changes in the next section.

7. Measuring the benefits of the 1992 Cable Act

■ The principal application of the estimates above is to measure household benefits from the 1992 Cable Act and the impact on those benefits of portfolio changes made by cable systems in response to the act.[22] This section describes the calculation of the benefit measure used in this article. I also discuss the robustness of the welfare measures to the assumptions underlying the estimated model of demand.

□ **Expected equivalent variation.** Following Small and Rosen (1981), the welfare effect of changes in the price, programming, and services offered by cable systems in response to the Cable Act is measured by the expected equivalent variation of the changes. This is defined as the amount of money required to make households in a market indifferent, in expectation, between facing the choice set available to them before the change and facing the choice set available after the change. If changes in cable choice sets increase household welfare, the expected equivalent variation is positive. It is calculated as the difference in households' expected surplus in market *n* evaluated at the choice sets offered after and before the change.

For my model, a consistent estimate of the household's expected surplus in market *n* is given by

$$S(X_n, D_n, p_n, J_n \,|\, \hat{\theta}) = \log\left(\sum_{j}^{J_n} \exp[\hat{\delta}_{jn}(X_{jn}, D_n, p_{jn} \,|\, \hat{\theta})]\right),$$

where $\hat{\delta}_{jn}$ is the estimated conditional indirect utility for each offered combination of services in market *n* evaluated at the parameter vector, $\hat{\theta}$. $\hat{\delta}_{jn}$ is a function of the prices, p_{jn}, and programming, X_{jn}, of each of the J_n combination of services offered in market

[21] The first effect is expected, as over-the-air broadcast networks are a competitive alternative to cable. The second is somewhat surprising given cable's traditional role of providing broadcast networks in areas where they are not otherwise available.

[22] I focus on household (consumer) welfare, as the goal of the act was to protect consumers from cable system market power. The act surely affected producer welfare (profits) as well. The calculations presented here do not capture these effects.

n, as well as demographic features, D_n, of the market and control variables. The expected equivalent variation is then just

$$EV = S(X_n^1, D_n^1, p_n^1, J_n^1 | \hat{\theta}) - S(X_n^0, D_n^0, p_n^0, J_n^0 | \hat{\theta}), \tag{5}$$

where 0 and 1 index the initial and final vectors of prices, programming, services, and demographic and system characteristics.[23]

To aid interpretation of the expected welfare effects, I also consider the reduction in the price of pre-act basic service that would yield the equivalent welfare change. The principle is the same as for income changes: I measure the hypothetical change in the initial price of basic service that would be required for households to be indifferent, in expectation, between two cable choice sets. This calculation permits a comparison of the benefit associated with the Cable Act to an equivalent reduction in the price of cable service, holding constant the service and programming offered before the act. Following Trajtenberg (1990), this price change is implicitly defined by Δ in the following equation:

$$EV = S(X_n^0, D_n^0, p_n^0\,(1 + \Delta), J_n^0 | \hat{\theta}) - S(X_n^0, D_n^0, p_n^0, J_n^0 | \hat{\theta}),$$

where each of these variables is defined above, EV is calculated from the equation above, and Δ implicitly measures only changes in the price of basic service.

To consider the benefits of the 1992 Cable Act, I conduct several simulations. I first establish a benchmark measure of the potential benefit to households from the Cable Act. I do so by fixing the services offered, the programming offered on those services, and the prices for all but basic and expanded basic cable service at their pre-act values. I then evaluate the expected equivalent variation associated with both a 10% and a 17% reduction in the price of all basic and expanded basic cable services. Since these were the price reductions mandated by the FCC, they provide an estimate of the *potential* gain to households from the act if systems had been prohibited from changing the nature of any offered cable services in response to the act, save to reduce their prices.

Given these benchmark measures, I next evaluate the expected equivalent variation from the actual price and portfolio changes implemented by systems in response to the act. This is computed by calculating the change in expected households' surplus using for comparison the actual choice sets facing households after and before the act. This provides an estimate of the expected *realized* gain to households given the new services, new programming, and new prices offered by systems.

□ **Results.** Table 8 indicates that the difference in the benchmark and realized measures is substantial. While a 10% (17%) price reduction would have yielded, in expectation, a welfare gain of \$1.18 (\$2.22) per household per month, in practice I estimate a welfare gain of at most \$.03 per household per month.[24] Equivalently, while house-

[23] The surplus calculations must be done with respect to some measure of household tastes. These are represented by θ. I use tastes for contemporary, post–Cable Act cable service in all calculations. Fisher and Shell (1972) argue that this is the appropriate choice for policy analysis.

[24] There is significant variation in this value due to imprecision in the parameter estimates. The reported standard errors were calculated via a bootstrap procedure using 10,000 simulations. For each simulation, a sample vector of parameters was drawn from the asymptotic distribution given in specification A and the average expected equivalent variation calculated. Reported are the mean and standard error of that average across the simulations.

TABLE 8 Expected Household Welfare Gain and Equivalent Price Change

Change in Choice Set		Component Welfare Gain	Component Change in P_b		Total Welfare Gain	Total Change in P_b
Benchmark changes						
10% reduction in price of pre-act basic and expanded basic services					\$1.18 (.25)	−14.2%
17% reduction in price of pre-act basic and expanded basic services					\$2.22 (.40)	−17.2%
Realized changes						
Attributable to system responses to the cable act:						
Changes in prices		−\$.97 (.02)	8.6%			
Introduction of new services		\$.67 (.10)	−5.6%			
Addition of programming to new and existing services		\$.36 (.22)	−2.1%			
Reallocation of programming across services	+	−\$.01 (.08)	−.9%	=	\$.03 (.17)	.0%
Other changes						
Changes in demographic and control variables	+	−\$.70 (2.15)	4.9%	=	−\$.69 (2.16)	4.9%

Note: Reported standard errors are bootstrap estimates based on 10,000 simulations.

holds could have expected benefits equal to a basic service price decrease of 14.2% (17.2%), in fact expected benefits yielded at best no change in cable prices.

What was the source of these differences? Was it the introduction of new, unregulated services? Or the reallocation of programming across services? Or was it a pure price effect? To address these questions, I decompose the expected equivalent variation associated with the observed changes in cable choice sets into several components: those due to (1) changes in prices, (2) the introduction of new services, (3) the addition of programming to new and existing services, (4) the reallocation of existing programming across services, and (5) demographic and control variables (primarily year effects). In each case, I calculate the expected equivalent variation from the change in that component of the vector, (X_n, D_n, p_n, J_n), via equation (5). The balance of Table 8 presents the findings.

The results indicate that several factors were responsible for the loss in household welfare from the Cable Act. The largest effect was due to the increase in cable prices documented earlier. Controlling for changes in system programming and services, the simple fact that prices did not fall considerably limited household benefits of the act. By contrast, system service introductions actually *increased* household welfare over the period, as did increases in programming offerings on new and existing services. The reallocation of programming was of negligible aggregate importance. Aggregating these four components yields the reported conclusion: there was little if any increase in household welfare from the Cable Act.[25]

The final row in Table 8 reports the change in household welfare from changes in demographic and control variables, dominated by the year fixed effects estimated in Table 6. Controlling for the other characteristics of offered cable services, the basic service demand curve shifted inward in 1994 and 1995. It is an open question whether to attribute these effects to the Cable Act. One possible explanation of the shift is unobserved growth in subscribers to direct broadcast satellite (DBS) systems. This would increase the utility of the outside good at the expense of all cable services and should not be attributed to the Cable Act. As DBS became viable late in the sample period, however, it is unlikely to be driving the results.[26] Instead, the shift plausibly reflects widespread dissatisfaction with systems' responses to the act (e.g., wholesale changes in programming lineups, lack of price decreases, etc.)[27] As these explanations are outside the model, however, I do not explicitly attribute them to the Cable Act. Instead, I conclude that estimated household benefits were *no greater* than that reported above.

□ **Discussion.** Recent research in modelling differentiated-product demand has called into question the robustness of welfare estimates from models of logit demand (Pakes, Berry, and Levinsohn, 1993; Petrin, 1999). Moreover, the sample selection required to estimate the model casts doubt about the generality of these results. I address these and related concerns in this subsection.

A primary concern discussed in the welfare measurement literature is the measurement of the benefits of new goods. Since market shares for new goods are often small at introduction, the model explains purchases by large values of ϵ_{ij}, unobserved tastes for the good by household i idiosyncratic to product j. These tastes imply very high and inelastic demand at low quantities and can lead to implausibly high welfare benefits of the new good.[28] Another concern is implausibility of substitution patterns induced by the independence of ϵ across alternatives.

In practice, these concerns are moderated in the case of cable. First, the market share of new goods introduced by systems (expanded basic services) were high, implying that the set of valuations required for purchase are drawn from a larger region of the ϵ distribution. Furthermore, while logit welfare measures of new goods can be troublesome, their use in measuring the benefits of changes in characteristics of existing goods can provide reasonable results. Of course, substitutability patterns must be adequately described by logit demand, something weakly supported by the data. Most important, however, the welfare benefits of new services are only one part of the change in household welfare from the Cable Act. An upward bias in this measure only strengthens the conclusion that consumers benefited little if at all from the act.

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[25] One can reject the null hypothesis that the benchmark (10%) and actual equivalent variation from these changes have equal means (test statistic = 9.41, χ^2 critical value (.05) = 3.84).

[26] DBS debuted in 1990 with PrimeStar, a wholly-owned subsidiary of cable companies. A more competitive alternative did not arise until DirecTV entered in June 1994. While demand for DirecTV grew quickly, subscriptions reached only 1 million by the end of the sample period considered here, less than 1% of total U.S. households.

[27] Aggregate subscription declines in 1994 and 1995 are a frequently cited example of the Cable Act's lack of success in achieving consumers' interests (e.g., Hazlett and Spitzer, 1997).

[28] For example, Petrin (1999) finds that if one estimates a logit demand system for passenger automobiles, purchasers of minivans need to be compensated $7,400 on average for their loss of the option to purchase an $8,700 vehicle.

Related research by Nevo (2000) focuses on the role of unobservable demand factors in welfare measurement.[29] Implicit in the welfare calculations above is the assumption that ξ is constant across observed changes in choice sets. If it varies with such changes, as for instance with the introduction of new services and programming, conditioning on this higher (unobserved) utility will tend to underestimate the benefits of the Cable Act. This is why I permit distinct effects for the most popular programming networks; these were the networks most likely to be added by systems. Among other time-varying unobservables, most have plausibly negative effects (e.g., the consumer dissatisfaction previously discussed, unobserved must-carry effects, etc.) and would lower the reported benefits.

Finally, extrapolating the findings for the sample of cable systems considered here to the population at large requires some caution. To the extent that my dataset undersamples relatively large, urban cable systems, my results may underestimate overall household benefits from the act. To estimate the magnitude of this effect, I regressed the expected equivalent variation on exogenous characteristics of the system and the market. Increasing the size of the systems in the sample by 4,000 to the population average could increase expected household benefits by $.16.[30] An increase by 30 in a system's television market ranking could have a comparable effect. It is therefore unlikely that sample selection accounts for the estimated difference between the benchmark and realized gains.

8. Conclusion

■ My purpose has been to assess the benefits to households from the 1992 Cable Act. I introduced a model of demand for each of the services offered by cable systems built from tastes for the particular programming networks offered on those services. The model accommodates changes in services, programming, and prices of the type implemented by systems in response to the act.

The estimation results indicate that many of the most popular programming networks offered by systems are also the most valuable. For all types of programming, expected WTP for different networks varies widely, underlining the importance of treating each separately in a model of cable demand. With respect to the Cable Act, while regulations mandated price reductions of 10–17% for cable services, observed system responses yielded at best no change in household welfare. Post-act changes in cable prices are responsible for most of the difference.

These results have several implications for regulation in cable television markets. First, despite the considerable costs associated with regulation, I find no evidence of benefits to households from the 1992 Cable Act. Of greater importance, however, are the implications for further cable regulation. Cable systems control many aspects of their services: what programming to offer, how to bundle that programming into services, and how to price those services. The results suggest that one should carefully consider the product and price responses of systems to further regulations, and that alternative policies promoting competition in multichannel video programming markets may prove more effective at increasing household welfare in cable markets.

Appendix

■ This Appendix describes the data preparation and variable definitions used in the article. As described in Section 3, most of the data come from a database maintained by Warren Publishing for use in its annual *Television and Cable Factbook* (Television Digest, 1991; Television Digest, 1996).

[29] I am grateful to the Editor and an anonymous referee for highlighting this issue for me.

[30] Caution is required, as such a regression is most useful as a descriptive device. Out-of-sample forecasting could be inaccurate.

The *Factbook* data were supplemented with information from three additional sources. First, to account for data of different vintages, I deflated all reported *Factbook* prices by the Consumer Price Index for nondurable consumption for the month corresponding to the reporting date. I chose this index because cable service constitutes a discretionary purchase whose real price should reflect the growth in prices of similar goods. The reference date chosen was September 1992, the benchmark date implemented by the Cable Act.

Second, I constructed a measure of over-the-air broadcast network availability from the American Research Bureau's listing of ''significantly viewed'' television stations from December 1986 (Television Digest, 1987). This listing provides the identities of broadcast signals available to all households in a county. While somewhat dated, growth in broadcast signals was moderate in the late 1980s and early 1990s, and this measure is superior to the alternative of omitting the impact of over-the-air broadcast signals on cable demand.

In the econometric specification, I separated stations by the six principal types of broadcast networks available in local markets: ABC, NBC, CBS, Fox, independent stations, and public stations. For networks of each type, both over-the-air and on cable, I noted the *first* network in the market and the number of *duplicative* networks. The incremental service provided by cable was then defined as the cable magnitude less the over-the-air counterpart. Other specifications were considered but yielded qualitatively similar results.

Finally, to avoid confounding heterogeneity in tastes and costs across markets, system characteristics reported in the *Factbook* were supplemented with demographic features of the system's county of service. These were obtained for 1990 from the County and City Compendium (Slater Hall Information Products, 1993). Selected for inclusion were variables thought to impact the demand and cost of providing cable service that have been used in previous studies of the industry.

The four data sources were merged at the county level. This was the most detailed level of geographic aggregation available for all the systems in the sample.

Table A1 compares some summary statistics for systems in the sample versus the population of U.S. cable systems (NCTA, 1993). The systems in this analysis are smaller than the average cable system and are more likely to offer premium services. Market share of basic service tends to be higher than the national average, but premium subscriptions tend to be lower. Prices for basic and premium services are comparable. The share of revenue earned by basic services is overestimated, due largely to the absence of equipment and pay-per-view information for the systems in the sample. These findings imply that relatively large, urban cable systems were disproportionately dropped in the data preparation. I assess the implications of this conclusion in the discussion of the results.

TABLE A1 Comparability of Sample Data with Population of Cable Systems: Post-Act Sample

Variable	Sample Data	Population Data
Homes passed	3,915	~8,195
Market share, basic service	65.7%	61.0%
Incidence of premium services	100.0%	~75.6%
Pay units per basic subscription	.45	.79
Price, basic services	$17.08	$18.85
Average price, premium services	$10.27	$10.17
Revenue shares:		
Basic revenue	70.8%	57.0%
Other revenue	11.3%	19.0%
Premium revenue	17.9%	24.0%

Population Source: NCTA (1993). Pay units are defined as the total of all subscriptions to premium services in each market. Other revenue is defined as revenue from expanded basic services, pay-per-view services, equipment sales, etc. In the sample data, only the revenue from expanded basic services is available.

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