Chapter 4
Forecasting Video Cord-Cutting: The Bypass of Traditional Pay Television

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4.1 Introduction

Following the substitution of mobile phones for fixed-line phones ("voice cord-cutting"), a similar transition is now occurring for video services. In the United States, traditional pay television service providers are experiencing some revenue losses and slowdowns. Also, consumers are increasingly streaming or downloading long-form video programming (mainly movies and TV shows). This phenomenon—described as "video cord-cutting" or "over-the-top (OTT) bypass"—suggests that the business models of traditional TV service providers are under threat. There is, however, considerable debate about the severity of that threat.

Some observers believe that, by 2014, OTT bypass revenue may reach $5.7 billion globally, driven by streaming services like Netflix Watch Instantly, Hulu Plus, and others. Whether OTT video and traditional pay TV will mostly be consumed jointly or the former will replace the latter remains a matter of conjecture presently. Clearly, as this transformation of the communications-media landscape proceeds, several future developments will need to be forecast. For example, will the traditional pay TV model survive the OTT threat? Will OTT be driven by "free" TV or will the subscription model catch on? How will device manufacturers, content providers, and service providers respond to OTT bypass? How will consumer choices and behaviors drive this transformation?

This chapter reports on efforts to forecast the effect of consumer choices on the future of video cord-cutting. Based on a comprehensive tracking survey of

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J. Alleman et al. (eds.), *Demand for Communications Services - Insights and Perspectives*, The Economics of Information, Communication, and Entertainment,
DOI: 10.1007/978-1-4614-7993-2_4,

households in the United States, the chapter presents evidence on household ownership of OTT-enabling devices and subscription to OTT-enabling services, and forecasts their effects on OTT. It also assesses how consumers' OTT choices are determined by household geo-demographic characteristics, device ownership, and subscription history. Ordered logit regressions are used to analyze and forecast future choices of devices and services, and estimate switching probabilities for OTT substitution by different consumer profiles.

4.2 OTT Bypass or Video Cord-Cutting

Alternatives to traditional pay television services (Pay TV) have been evolving for well over a decade. Starting with subscription-based, mail-delivered services (which made available movies and TV shows on DVDs for a moderate monthly fee), video-viewing alternatives have now "gone online," that is, become internet-based. Both subscription-based and "free" services now offer either streamed or downloaded video content.[1] High-quality (often High Definition) video is now being increasingly streamed as households upgrade to high-bandwidth internet connections, and service/content providers are scrambling to build their video libraries including, in some instances, first-run movies (See Netflix 2012).

The Pay TV model for distributing original and syndicated television programming and movies got a significant boost when new technologies (principally based on cable, satellite, and fiber-based systems) greatly exceeded the reach of over-the-air TV broadcasts, in terms of both content scope and image quality. For at least three decades, the Pay TV model thrived as major improvements occurred in both hardware (TV sets, set-top boxes, and other equipment) and content (with the emergence of a wide range of programming genres). The high penetration rates of Pay TV in the US-enabled resource-rich cable and other companies to also offer reasonably priced and often bundled telephone and internet connection services to their customers. Their entry into telephone markets—following enactment of the Telecommunications Act of 1996—was accompanied by the unexpected popularity of their cable modem-based internet access services.[2] Ironically, the success of the carriers deeply invested in Pay TV also contained the seeds of the technology that would, in time, make OTT alternatives attractive at reasonable cost. It is not hard to imagine that falling costs for internet access and the expansion of

[1] Streamed video content is available in real time and is typically not storable on the consumer's media equipment. Downloaded content can be stored and viewed repeatedly, often an unlimited number of times.

[2] The United States is one of a handful of countries in which cable modems strongly outpace DSL as the preferred delivery vehicle for internet access. The Federal Communications Commission (FCC) reports that two in five residential broadband connections in the United States are through cable modems, followed by about a third through wireless means, and about a quarter via DSL. See Chart 13 in Federal Communications Commission (2011).

internet-capable devices can, through the proliferation of OTT, pose significant challenges to the Pay TV model itself.

The rise of OTT is, however, not as linear and predictable as it might seem at first glance. If it ever happens, large-scale pure substitution of streamed or downloaded video for video content obtained through Pay TV—that is, the complete supplanting of one form of video delivery technology by another (or "video cord-cutting")—is probably several years away. In that respect, the experience with "voice cord-cutting," that is, the substitution of mobile for fixed telecommunications is instructive. Even today, after nearly two decades of relentless expansion by mobile telecommunications, a significant percentage of households in the United States (and other developed countries) use both mobile and fixed-line telephone services. This trend of "co-consumption" may well prove to be true of video content for a considerable number of years.

Another parallel from the voice cord-cutting experience is instructive: the role of "first-timers" or consumers (usually young and newly independent) that opted for mobile telephone service without even first trying out fixed-line telephone service. Strictly speaking, such behavior is not substitution in the truest sense of the term. However, it is a third possibility (besides co-consumption and pure substitution) that must be considered seriously for the manner in which OTT bypass may evolve. For the purposes of this chapter, three possible "OTT use categories" are identified:

Co-consumption: the video content-viewing experience is a mix of Pay TV and OTT alternatives like streaming or downloading. Neither, in and of itself, constitutes the entire viewing experience. Lifestyle factors and convenience may determine when the consumer or the household uses one or the other, and what form of video is viewed using either.[3]

Pure substitution (video cord-cutting): Pay TV is replaced completely by the use of OTT alternatives. The individual consumer or household must make a conscious decision to terminate any form of Pay TV being used to view video content and adopt streaming or downloading methods instead.

First-timer behavior: at the first available opportunity, the individual consumer or household chooses to use only OTT methods to view video content, without ever trying out the Pay TV option.

It follows that any consumer or household that does not choose any one of these three options is an "OTT nonuser." For now, this category also includes

[3] Co-consumption is sometimes characterized as "complementarity." This can be misleading. Complementarity has a specific meaning in economics, namely, the tendency for the consumption of a product Y to increase (decrease) whenever the price of another product X falls (rises). The classic example is that of razors and razor blades. Falling prices for razors may stimulate the demand for razors and, in the process, also drive up the demand for razor blades. This is co-consumption of a particular form, one triggered by price change. In this chapter, we use the term co-consumption more generally, so that the mixing of Pay TV and OTT use does not necessarily mean a common trend in their demands or a phenomenon brought about by demand response to price change.

households that rely exclusively on over-the-air broadcasts for video content and have never tried OTT alternatives, as well as the relatively few households that do not seek out video content from any source.

Any debate over the significance of OTT and the likely extent of the threat to the Pay TV model must first comprehensively define the ways in which OTT bypass can occur. The three OTT use categories defined above for that purpose are proposed. Second that debate must be informed by actual evidence (from either stated or revealed preference data) about the extent to which the four types of behavior (including nonuse of OTT) are occurring. Without such a structured inquiry, no worthwhile inferences can be drawn about OTT.[4]

4.3 Evidence on OTT Use Categories

To answer several questions about the OTT phenomenon, Centris launched a comprehensive research project called "Evolution of Video: Market Demand Tracking Study" in November 2010. For this purpose, Centris surveys approximately 8,000 households from an internet panel every month on their video-viewing habits, ownership of video-viewing devices, subscription to or use of video content services, viewership frequencies, willingness-to-pay for OTT-based services, satisfaction with Pay TV services, etc. Measuring prospective behavior (over the next six months) regarding video consumption is an important component of the survey. Demographic information on respondents (gender, household status, household size, age, household income, employment status, and race or ethnicity) is also collected. All responses are weighted in inverse proportion to the probability with which each surveyed household is selected.

Based on survey data gathered for the first eight months of the research project, the relative sizes of the three OTT use and the OTT nonuse categories are calculated. These calculations pertain to both aggregate households as well as households classified by demographic categories such as age, household income, and race/ethnicity. Specifically, the following proportions are calculated:

- Proportion of households with any form of Pay TV service that also use or subscribe to any free or paid video-streaming or downloading service/website (co-consumption).

[4] In recent months, many research houses have rushed to publish "facts and figures" about OTT that, on their face, seem to contradict each other. A meta-analysis of these publications cannot yield useful insights about the extent of the OTT threat. We believe that different background definitions about what constitutes OTT substitution mainly responsible for the confusion. Service and content providers that have many millions of dollars at stake in this matter cannot extract objective and useful information from these contradictory data.

Table 4.1 Proportion of households in OTT co-consumption category (all households and by demographic category), June 2011 (Three-month moving average)

Percent of households in OTT co-consumption category						
All	By age group		By income range		By race/ethnicity	
43.1	18–34	59.7	$0–$25 K	30.5	White	40.3
	35–44	54.4	$25–$50 K	38.8	African–American	47.0
	45–54	41.4	$50–$75 K	50.1	Asian–American	57.2
	55–64	29.8	$75–$150 K	55.2	Hispanic	54.1
	65+	19.1	$150 K+	59.8		

- Proportion of all households that have terminated their past use of any form of Pay TV and currently use or subscribe to any free or paid video-streaming or downloading service/website (substitution).
- Proportion of all households that never had any past use of any form of Pay TV but currently use or subscribe to one or more free or paid video-streaming or downloading services/websites (first-timers).

By definition, the base for calculating the proportion of households in the co-consumption category must be only the households that currently have any form of Pay TV service. However, it is necessary to also calculate this proportion using all households (with or without Pay TV service) as the base. Doing so makes it possible to calculate the proportion of OTT nonusing households residually as the proportion of all households that fall into none of the three OTT use categories.

Finally, because of monthly fluctuations in the estimated proportions, their three-month moving averages instead are calculated. For eight consecutive months of data, this yields six moving average estimates per OTT use category.

Table 4.1 shows the proportion of all households in June 2011 that comprise the OTT Co-Consumption category, as well as the proportions of households in that category when classified by demographic categories, such as age group, household income range, and race/ethnicity.[5] Similarly, Tables 4.2, 4.3, 4.4 show the proportions of households (aggregate and classified by demographics) that comprise the pure OTT substitution, OTT first-timers, and OTT nonusers categories in June 2011.

The following trends emerge from Tables 4.1, 4.2, 4.3, 4.4:

- OTT bypass in the form of pure substitution or first-timer choice is presently a nascent phenomenon that may not yet represent a significant threat to the Pay TV model. As of mid-2011, pure substitution has occurred in 5 % of households, while slightly more than 5 % of households have made OTT a first-timer choice.

[5] Because of space limitations, only the proportions in the end of the eight-month study period are shown. Full details are available upon request from the principal author.

Table 4.2 Proportion of households in pure OTT substitution category (All households and by demographic category), June 2011 (Three-month moving average)

Percent of households in pure OTT substitution category						
All	By age group		By income range		By race/ethnicity	
5.0	18–34	8.1	$0–$25 K	7.7	White	4.6
	35–44	5.7	$25–$50 K	5.0	African–American	5.5
	45–54	4.4	$50–$75 K	4.5	Asian–American	8.5
	55–64	3.2	$75–$150 K	3.4	Hispanic	6.1
	65+	1.7	$150 K+	2.3		

Table 4.3 Proportion of households in OTT first-timers category (All households and by demographic category), June 2011 (Three-month moving average)

Percent of households in OTT first-timers category						
All	By age group		By income range		By race/ethnicity	
5.4	18–34	8.3	$0–$25 K	8.3	White	4.8
	35–44	5.7	$25–$50 K	5.8	African–American	6.3
	45–54	4.4	$50–$75 K	3.9	Asian–American	13.8
	55–64	4.1	$75–$150 K	3.3	Hispanic	6.3
	65+	2.5	$150 K+	2.5		

Table 4.4 Proportion of households in OTT non-users category (All households and by demographic category), June 2011 (Three-month moving average)

Percent of households in OTT nonusers category						
All	By age group		By income range		By race/ethnicity	
46.5	18–34	23.9	$0–$25 K	53.5	White	50.3
	35–44	34.3	$25–$50 K	50.3	African–American	41.3
	45–54	49.8	$50–$75 K	41.6	Asian-American	20.5
	55–64	62.9	$75–$150 K	38.1	Hispanic	33.4
	65+	76.7	$150 K+	35.4		

- As of mid-2011, just over 43 % of households (or, approximately half of all households with any form of Pay TV service) fall into the OTT co-consumption category. This signifies that most such households interested in OTT options mix the two ways to receive video content as their lifestyle circumstances require. This parallels the situation with telephone service, where a significant proportion of US households utilize both mobile and fixed-line telephones.
- Just under half of all households have, as of mid-2011, made no use of, or are not interested in, OTT options. This statistic alone could mean that a major threat to providers of Pay TV services is not imminent.

When measured by demographic categories, some interesting insights emerge:

- The youngest age group (18–34) is the vanguard segment for OTT use. This is as expected because this age group was also responsible for leading developments in voice cord-cutting. As of mid-2011, only 24 % of households in this age group fall into the OTT nonuser category, by far the lowest among all age groups. In fact, interest in, and use of, OTT options is nearly monotonic with age, falling with increasing age of the householder.
- When arrayed by household income segments, a more complex picture emerges. The households in the lowest income segments (particularly those with annual income up to $25,000) have the highest propensities for OTT substitution or first-timer choice. With steadily declining costs of broadband access, streaming, and downloading represent lower cost options for accessing video content than the more expensive Pay TV services. OTT options also enable lower income households to target specific forms of video content, thus avoiding the need to subscribe to expensive Pay TV packages within which only a limited number of channels may be of interest. At the same time, co-consumption actually increases steeply with household income. That is to be expected as higher income households are able to afford the luxury of having multiple options for viewing video content. The OTT nonuser category declines monotonically with household income.
- Within racial or ethnic categories, all three forms of OTT use are highest among Asian-Americans, followed by Hispanics and African-Americans. As of mid-2011, Asian-Americans are almost three times as likely as Whites and more than twice as likely as African-Americans and Hispanics to fall into the OTT first-timers category. Also, Asian-Americans are almost twice as likely as Whites, 56 % more likely than African-Americans, and 44 % more likely than Hispanics to belong in the pure OTT substitution category. Curiously, a similar pattern is observed for co-consumption as well. Asian-Americans are significantly more likely than Whites and African-Americans and somewhat more likely than Hispanics to co-consume. The reverse pattern is true among OTT nonusers.

The obvious conclusion from these findings is that the leading edge of OTT substitution (specifically video cord-cutting) and OTT first-timer choice is formed by the combination of young householders in the lowest income segments that are ethnically Asian or Hispanic. These two ethnic groups combined represented less than 15 % of US households in 2010.[6] But, with faster growth projected in both segments compared with the non-Hispanic White segment, steady growth in OTT substitution and first-timer choice may be expected in the future.

[6] See Day (1996).

4.4 Forecasting the Probability of OTT Use by Consumer Profile

The preceding section shows that demographic variations clearly influence patterns of OTT use among US households. In order to forecast the future demand for video content by OTT means, it is important to account for those demographic variations. In addition, we take into account (1) household ownership of internet-enabled media equipment that facilitate OTT use and (2) household use of (or subscribership to) either paid or free streaming or downloading services that provide access to movies, TV shows, and other forms of video content. By doing so, we build a full consumer (household) profile based on demographic, device ownership, and OTT service use characteristics.

Unfortunately, the cross-currents among the three forms of OTT use make it difficult to forecast future demand for any single one of those forms in isolation. To work around this problem, we modeled solely the future probability of pure OTT substitution in terms of consumer profiles constructed in the manner described above. The Centris survey asks responding households about the likelihood of their adopting the pure OTT substitution option "within the next six months." Likelihood is measured on a five-point Likert scale: 1="Not at all likely," 2="Somewhat unlikely," 3="Neither likely nor unlikely," 4="Somewhat likely," and 5="Very likely."

We modeled responses to this question using the ordered logit regression methodology. The dependent variable (likelihood of pure OTT substitution in the next six months) is an ordered categorical variable and is, hence, a prime candidate for this regression methodology.[7]

Let L be an unobservable variable representing the likelihood with which a household would substitute OTT for Pay TV. The household then chooses

"Very likely" if $L > u_1$

"Somewhat likely" if $u_1 > L > u_2$

"Neither likely nor unlikely" if $u_2 > L > u_3$

"Somewhat unlikely" if $u_3 > L > u_4$

"Not at all likely" if $u_4 > L$ where u_1-u_4 are unobserved utility thresholds or "cutoff" points. Let x be a vector of observable household-specific variables that affect the likelihood L, and e be random unobserved effects. Then, consider the following relationship

$$L = \beta' x + \varepsilon. \tag{1}$$

Assuming that ε has a logistic distribution gives rise to an ordered log it regression model that can be estimated by maximum likelihood methods. The probability of each of the five ordered responses can then be recovered as the

[7] See William H. Greene and David A. Hensher, Modeling Ordered Choices: A Primer, New York: Cambridge University Press, 2010.

probability that L falls into the ranges defined by the thresholds above. Maximum likelihood estimation applies jointly to the parameter vector b and the thresholds u_1-u_4. The probabilities are calculated using these estimates.

For independent variables, we selected the following:

1. Demographic variables, including gender, household size, household status, employment status, age, household income, and race/ethnicity. All except household size were treated as categorical variables.[8]
2. Device ownership variables, for high definition TVs, 3D TVs, other types of TV, desktop computers, laptop computers, tablet computers (e.g., the iPad), smartphones, portable video players, Apple TV/ Roku, game consoles, and other video devices. These were all treated as binary categorical variables.
3. Subscription/use variables, including those pertaining to mail-delivered DVD rental services, paid subscription services such as Netflix and Hulu, and "free" streaming services available from various media network websites. These were all treated as binary categorical variables.

We considered two versions of the ordered log it models built from these data, one that includes the device ownership variables and another that excludes them. A household's decision to own certain types of devices intended specifically for streaming can conceivably be made jointly with any decision to receive video content solely through streaming. In econometric terms, modeling the ownership of those devices as independent variables would then introduce an endogeneity bias and require the use of instruments for meaningful model estimation.[9] For the moment, we avoided the possible endogeneity problem by estimating the second version of the model that excluded device ownership variables, and left the use of instrumental variables to a future study.[10]

We estimated separate monthly regression models for five consecutive months (November 2010–March 2011) using the survey data. Maximum likelihood estimation was carried out using STATA-MP® 12.0. Table 1 shows summarized results. [11]

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[8] The levels for these variables are gender (male/female), household status (head/member), employment status (full-time, part-time, neither), age (18-34, 35-44, 45-54, 55-64, 65 and over), household income ($0-$25,000, $25,000-$50,000, $50,000-$75,000, $75,000-$150,000, $150,000 and over, undisclosed), and race/ethnicity (White, African-American, Asian-American, Hispanic, all other).

[9] The endogeneity problem need not arise for all of the devices on the list. For example, the various types of TV sets and computers could be purchased by households primarily for purposes other than streaming video. If so, then the ownership of each device would be considered a "predetermined" variable and, hence, not be endogenous with any decision in favor of pure OTT substitution in the next six months.

[10] This is not an ideal solution because exclusion of a potentially non-endogenous device ownership variable likely creates an omitted variables bias.

[11] Because of some significant changes in the survey questionnaire, data for the months April-June 2011 were not used for modeling this issue

Table 4.5 Ordered logit regression models for pure OTT substitution (with and without device ownership variables), summary of results [12]

Independent variables	Effect (in reduced model)	Effect (in full model)
Gender (Male = 1/Female = 0)	+	+
Household size	+	+
Household status (Head = 1/Member = 0)	+	+
Full-time employed (Yes = 1/No = 0)	+	+
Part-time employed (Yes = 1/No = 0)	+	+
Age 18–34 (Yes = 1/No = 0)	+	+
Age 35–44 (Yes = 1/No = 0)	+	+
Age 45–54 (Yes = 1/No = 0)	+	+
Age 55–64 (Yes = 1/No = 0)	+	+
White (Yes = 1/No = 0)	–	–
African–American (Yes = 1/No = 0)	±	±
Asian–American (Yes = 1/No = 0)	+	+
Hispanic (Yes = 1/No = 0)	±	±
Own HD TV (Yes = 1/No = 0)		+
Own laptop computer (Yes = 1/No = 0)		+
Own smartphone (Yes = 1/No = 0)		+
Own apple TV/Google TV/Roku (Yes = 1/No = 0)		+
Own other video device (Yes = 1/No = 0)		+
Subscribe to mail-delivered video rental service (Yes = 1/No = 0)	+	+
Subscribe to Netflix (Yes = 1/No = 0)	+	+
Subscribe to Hulu (Yes = 1/No = 0)	+	+
Use free video-streaming websites (Yes = 1/No = 0)	+	+
Satisfaction with Pay TV (High = 1/Low = 0)	–	–
TV programming available on mobile device (Yes = 1/No = 0)	+	+

Note 1 Only statistically significant effects (positive or negative) are shown. Most are statistically significant at the 5 % level, while the rest are so at the 10 % level
Note 2 The evidence on the four race/ethnicity variables is weaker than for the other variables. Also, the effects of the African–American and Hispanic categories, relative to the "Other Race/Ethnicity" category, have varying signs across the months

The findings in Table 4.5 are a composite of the estimation results from the five monthly regression models. Because almost all of the independent variables in the regression models are categorical, some care is needed to interpret the findings about positive or negative effects. As with all categorical variables, one level is usually set as the default level and is excluded from the list of included independent variables. Then, the direction of the effect of any other level of that variable is interpreted by reference to the default level.

[12] To conserve space, details about estimates, confidence intervals, Wald statistics, and goodness-of-fit statistics for the individual regressions are not reported in this paper. They are available from the contact author upon request.

Some of the demographic variables, such as Age, Household Income, and Race/Ethnicity are multi-level categorical variables. All levels of those variables except for the default level are included among the independent variables. For example, for the Age variable, the default level (held outside the model) is the age group 65 and over while four younger age groups are levels included among the independent variables. As Table 4.5 shows, the effects of all included levels of the Age variable are positive and statistically significant. This implies that, relative to the default age group 65 and over, the effect of every other age group is positive, i.e., increases the likelihood of pure OTT substitution. Although not shown in Table 4.5, the estimated coefficients for the included levels of the Age variable actually decline in magnitude with age, i.e., the age group 18-34 has the largest (and most positive) effect on the dependent variable and the age group 55-64 has the smallest (and least positive). From this it can be inferred that the lower the age group, the greater, and more reinforcing, is the positive effect on the likelihood of pure OTT substitution within the next six months.

All non-demographic variables (device ownership variables, subscription/use variables, satisfaction with Pay TV, and availability of video on mobile devices) are also categorical but strictly binary of the "Yes/No" kind. We set the No level as the default level for these variables. Thus, we find from Table 1 that households that already subscribe to (or use) OTT options presently have a higher likelihood of seeking the pure OTT substitution option within the next six months. Also, households that would like to see TV programming available on mobile devices are more likely to opt for pure OTT substitution within the next six months. Satisfaction with Pay TV service is a binary variable of the "High/Low" kind. We set the "Low" level as the default. Thus, a negative effect means that households highly satisfied with Pay TV service are less likely to opt for pure OTT substitution than households that are not. This result is intuitively plausible and indicates that dissatisfaction with conventional forms of video access may drive households to cut the video cord in favor of streaming and downloading options.

To forecast the probability of pure OTT substitution by consumer profile, we selected the estimated ordered logit regression model (reduced model version) for December 2010, shown in Table 4.5.[13]

We constructed consumer profiles by retaining only the independent variables with statistically significant effects in the regression model shown in Table 4.6. These were the following categorical variables (shown with their levels):

- Gender (Male/Female)
- Full-time employment (Yes/No)
- Part-time employment (Yes/No)
- Age 18-34 (Yes/No)

[13] Probability has a simple interpretation in this context. It is simply the proportion of households that is expected to exhibit a certain behavior, e.g., pure OTT substitution in the next six months.

Table 4.6 Ordered logit regression model for Netflix subscription in next six months, December 2010

Variable	Coeff estimate	Robust std error	z-stat	Prob value
Gender	0.3381	0.0745	4.54	0.000
Household size	0.0291	0.0253	1.15	0.252
Household status	−0.0677	0.1208	−0.56	0.575
Full-time employ	0.2211	0.0843	2.62	0.009
Part-time employ	0.2931	0.1019	2.88	0.004
Age 18–34	0.6845	0.1541	4.44	0.000
Age 35–44	0.5031	0.1504	3.35	0.001
Age 45–54	0.3908	0.1439	2.72	0.007
Age 55–64	0.2632	0.1393	1.89	0.059
Income $0–$25 K	0.0451	0.1880	0.24	0.810
Income $25 K–$50 K	0.1662	0.1717	0.97	0.333
Income $50 K–$75 K	0.1624	0.1737	0.94	0.350
Income $75 K–$150 K	0.2560	0.1718	1.49	0.136
Income over $150 K	0.0892	0.2320	0.38	0.700
White	−0.1479	0.2566	−0.58	0.564
African–American	0.2578	0.2970	0.87	0.385
Asian–American	0.3319	0.3235	1.03	0.305
Hispanic	0.0665	0.3061	0.22	0.828
Subscribe to DVD rental	0.1069	0.0758	1.41	0.158
Subscribe to Netflix	0.2340	0.0766	3.05	0.002
Subscribe to Hulu	0.5695	0.1020	5.58	0.000
Use free video website	0.4761	0.0780	6.10	0.000
Satisfaction with Pay TV	−1.0197	0.0700	−14.58	0.000
TV Prog on mobile device	0.3378	0.0288	11.72	0.000
No of observations = 4,964			Wald $\chi^2(24) = 884.73$	
Log pseudo-likelihood = −4048.88			Prob > $\chi^2 = 0.0000$	
Pseudo $R^2 = 0.1079$				

- Age 35-44 (Yes/No)
- Age 45-54 (Yes/No)
- Age 55-64 (Yes/No)
- Subscribe DVD rental (Yes/No)[14]
- Subscribe to Netflix (Yes/No)
- Subscribe to Hulu (Yes/No)
- Use free video websites (Yes/No)
- Satisfaction with Pay TV (High/Low)
- Want TV programming to be available on mobile devices (Yes/No)

[14] Probability has a simple interpretation in this context. It is simply the proportion of households that is expected to exhibit a certain behavior, e.g., pure OTT substitution in the next six months.

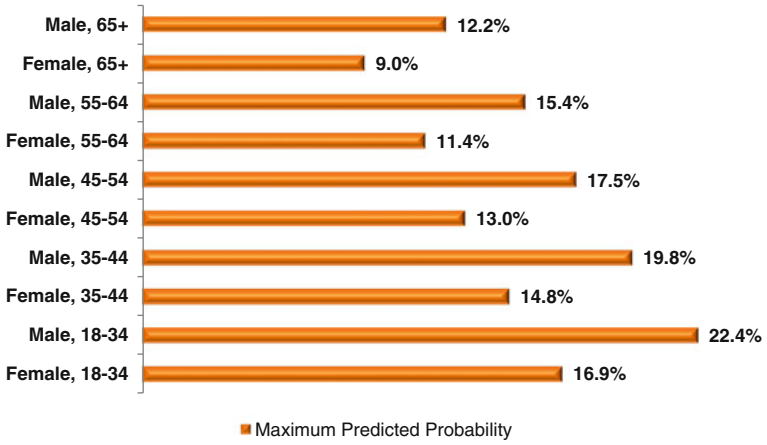

Figure 4.1 Maximum Predicted Probabilities of ("Very likely" + "Somewhat likely") for Different Gender and Age Group Sets, Pure OTT Substitution in Next Six Months, December 2010

Unique combinations of these variables (and their levels) yielded 1,920 consumer profiles. For example, one such profile was:

> Male, full-time employed, age 35-44, subscribes to DVD rental,subscribes to Netflix, does not subscribe to Hulu, uses free video websites, low satisfaction with Pay TV, wants TV programming tobe available on mobile devices

Recall that the dependent variable of interest was the likelihood of pure OTT substitution within the next six months, measured on a five-point scale ("Very likely," "Somewhat likely," Neither Likely nor Unlikely," "Somewhat unlikely," and "Not at all likely"). For every consumer profile,we computed the predicted probability of each of these five levels.[15] Confidence intervals for the predicted probabilities were computed using the delta method.

We then determined the highest, lowest, median, and mean predicted probabilities for all fivelevels and identified the specific consumer profile corresponding to each. In order to makeinference easier, we collapsed the two top likelihood levels ("Very likely" and "Somewhat likely") and added their respective predicted probabilities, and did the same for the two bottom likelihood levels ("Not at all likely" and "Somewhat unlikely"). Again, we identified theconsumer profiles corresponding to the summed predicted probabilities for the top two levels and the bottom two levels.

[15] See Kenneth E. Train, *Discrete Choice Methods with Simulation*, New York: Cambridge University Press, 2003, especially pp. 163-167, for the technical details on predicting these probabilities. We used a routine in STATA to estimate the probabilities and their confidence intervals.

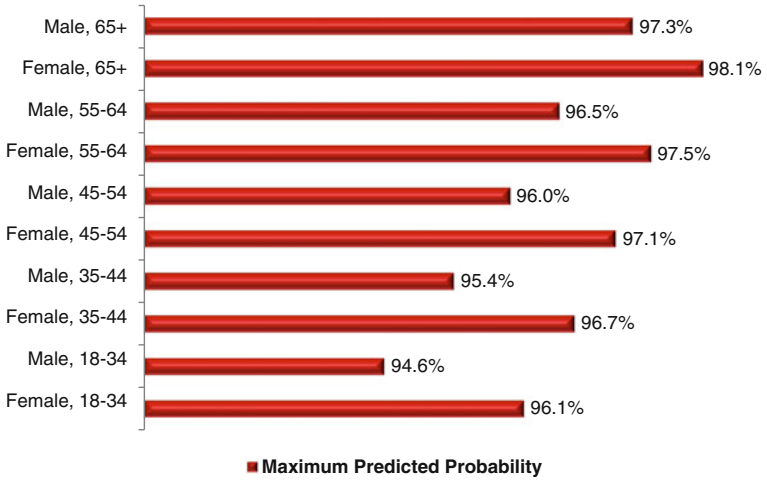

Figure 4.2 Maximum Predicted Probabilities of ("Not at all likely" + "Somewhat unlikely") for Different Gender and Age Group Sets, Pure OTT Substitution in Next Six Months, December 2010

Figures 4.1 and 4.2 provide a convenient way to summarize the highest predicted probabilities ofboth the top two and the bottom two levels of the dependent variable.

As Table 4.6 shows, males are more likely than females, and younger age groups are more likelythan older age groups to consider pure OTT substitution in the next six months. Figures 4.1 and4.2 confirm this in terms of the predicted probabilities. In Figure 4.1, the highest probability of being "Very likely" or "Somewhat likely" to consider pure OTT substitution in the next monthsis 22.4% for a consumer profile within the (male, age 18-34) set. That is, more than one in fivemale consumers in the 18-34 age group with this profile is leaning towards such substitution inthe near future.

Figure 4.2 shows that the highest probability of being "Not at all likely" or "Somewhat unlikely"to consider pure OTT substitution in the next six months is 98.1% for a consumer profile in the (female, age 65+) set. Very few consumers with this profile are even thinking of OTT substitution in the near future.

Figures 4.1 and 4.2 also show the converses. In Figure 4.1, the lowest probability of being "Very likely" or "Somewhat likely" to consider pure OTT substitution in the next six months is 9.0%for a consumer profile in the (female, age 65+) set. Similarly, in Figure 4.2, the lowest probability of being "Not at all likely" or "Somewhat unlikely" to consider pure OTTsubstitution in the next months is 94.6% for a consumer profile in the (male, age 18-34) set.

The specific consumer profile corresponding to the maximum predicted probability of being"Very likely" or "Somewhat likely" (or, simply "Very likely") to consider pure OTT substitutionin the next months is shown in Table 3.

Whether for the combined likelihoods (e.g., "Very likely" + "Somewhat likely") or the individual likelihoods, we computed predicted probabilities for all 1,920 consumer profiles. [16]Therefore, for any specific consumer profile, a predicted probability is available for all fivelevels of the "likelihood of pure OTT substitution within next six months" variable. From these,we also identified the consumer profiles most closely associated with the median levels of thosepredicted probabilities. Table 4 shows the consumer profiles associated with the median

predicted probability of pure OTT substitution in the next six months.

The median predicted probability of a household being very or somewhat likely to drop Pay TV service altogether in favor of OTT options in the next months is quite a bit lower than the maximum predicted probability. The findings that (1) only about 5% of households have substituted OTT for Pay TV already and (2) the median predicted probability of substitution in the next six month is very small together imply that, on average, the present OTT threat to Pay TV in the US is nascent at best.

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[16] These are too numerous to reproduce here, but may be requested from the contact author, subject to appropriate data disclosure agreements.

[17] Founded in 1997, Netflix Inc. is a Los Gatos, California, based provider of streamed and mail-delivered video services (including movies and TV shows). Launched in late 2010, "Netflix Watch Instantly" is a streaming service that can play videos on a variety of media devices, including standard and high definition TVs, computers (desktop, laptop, and tablet), smartphones, portable video players, Blu-ray players, game consoles, and specialized direct feed devices like Apple TV and Roku. Until recently, the monthly subscription charge presently was $7.99 and, for $2 a month more, consumers had the additional option of receiving DVDs from Netflix by mail. As of September 1, 2011, all Netflix customers must pay $15.98 to bundle the streaming and mail offerings, although the price of the streaming subscription only remains at $7.99. Hulu is a joint venture of several major media companies and studios, and began website-based and advertising-supported streaming service in 2008. Under the label "Hulu Plus," it now offers a commercial-free streaming video service that competes with Netflix Watch Instantly and is also priced at $7.99 a month. Hulu Plus can also be received on several media platforms.

[18] In early September 2011, news broke that Starz (a content provider and supplier to Netflix of over 2,500 movie titles from two major studios, Sony Pictures and Disney) was terminating its contract with Netflix in February 2012. The loss of Starz content can be difficult for Netflix's prospects unless it is able to find an equal or better content provider, particularly for premium content. Coming on the heels of the substantial price increase for its bundled streaming and mail-delivered subscription service, the outlook for Netflix does not look as promising presently as it did before either of these events occurred.

Table 4.7 Maximum Predicted Probabilities of ("Very likely" + "Somewhat likely") for Different Age Groups, Netflix Subscription in Next Six Months, December 2010

Maximum predicted probability	
Age	
18–34	58.1 %
35–44	70.9 %
45–54	70.1 %
55–64	70.9 %
65+	58.1 %

4.5 Forecasting the Probability of OTT Use: Case of Paid Streamed Video Services

In the United States, there is rising excitement about the recent forays made by Netflix (and, to a lesser extent, by Hulu) into the paid subscription-based video-streaming business.[17] Both Netflix and Hulu have large video libraries, including first-run movies and current TV shows.[18] In this environment, is supply creating its own demand? To test this proposition, we modeled the Centris survey data for household interest in Netflix's paid subscription streaming service.[19]

The Centris survey asks responding households about the likelihood of their subscribing to a Netflix OTT service within the next six months. For this too, likelihood is measured on a five-point Likert scale, ranging from "Very likely" to "Not at all likely." As with the likelihood of pure OTT substitution in the next six

[17] Founded in 1997, Netflix Inc. is a Los Gatos, California, based provider of streamed and mail-delivered video services (including movies and TV shows). Launched in late 2010, "Netflix Watch Instantly" is a streaming service that can play videos on a variety of media devices, including standard and high definition TVs, computers (desktop, laptop, and tablet), smartphones, portable video players, Blu-ray players, game consoles, and specialized direct feed devices like Apple TV and Roku. Until recently, the monthly subscription charge presently was $7.99 and, for $2 a month more, consumers had the additional option of receiving DVDs from Netflix by mail. As of September 1, 2011, all Netflix customers must pay $15.98 to bundle the streaming and mail offerings, although the price of the streaming subscription only remains at $7.99. Hulu is a joint venture of several major media companies and studios, and began website-based and advertising-supported streaming service in 2008. Under the label "Hulu Plus," it now offers a commercial-free streaming video service that competes with Netflix Watch Instantly and is also priced at $7.99 a month. Hulu Plus can also be received on several media platforms.

[18] In early September 2011, news broke that Starz (a content provider and supplier to Netflix of over 2,500 movie titles from two major studios, Sony Pictures and Disney) was terminating its contract with Netflix in February 2012. The loss of Starz content can be difficult for Netflix's prospects unless it is able to find an equal or better content provider, particularly for premium content. Coming on the heels of the substantial price increase for its bundled streaming and mail-delivered subscription service, the outlook for Netflix does not look as promising presently as it did before either of these events occurred.

[19] The results in this section pertain to the period before Netflix initiated a major price increase and saw Starz terminate its contract for content provision. Significant changes in these results may be expected in the aftermath of these events.

Table 4.8 Consumer profiles associated with the median predicted probability of the combined top two levels of the likelihood of Netflix subscription in next six months

Likelihood of pure OTT substitution: very likely + somewhat likely	Median predicted probability = 3.8 %	
	Consumer profile	
Gender	Female	Male
Age group	18–34	18–34
Full-time employed	No	No
Part-time employed	No	No
Subscribes to DVD rental service	Yes	No
Subscribes to Netflix	Yes	No
Subscribes to Hulu	Yes	Yes
Uses free video websites	Yes	Yes
Satisfaction with Pay TV	High	High
Wants TV programming on mobile devices	No	No

months, responses to the question about Netflix subscription using the ordered logit regression methodology was modeled. The dependent variable (likelihood of Netflix subscription in the next six months) is also an ordered categorical variable with the same five levels. The same cohort of independent variables was retained as before.

Using STATA, separate monthly regression models for each of the five months (November 2010—March 2011) for which survey data are available were estimated. Table 4.5 shows summarized results.

Not surprisingly, the independent variables with statistically significant effects—and the directions of those effects—were largely similar to those in the models for pure OTT substitution (in Table 4.5). However, the role of one independent variable in particular—Subscribe to Netflix currently—raised several questions. Not only was it dominant enough to swamp the effects of other independent variables, it also obscured the real appeal of Netflix's streaming service in particular. It is hardly surprising that households currently subscribing to Netflix remain strongly inclined to continue doing so "in the next six months." A more interesting question to us was whether households that are *not* current Netflix subscribers would consider becoming subscribers in the near future, perhaps attracted by the streamed offering Netflix Watch Instantly. To answer this question, we extracted the sub-sample consisting only of non-Netflix subscribing households, dropped the Subscribe to Netflix currently variable, and re-estimated the ordered logit regression models.

To forecast the probability of future Netflix subscription by consumer profile for this sub-sample, we selected the estimated ordered logit regression model for December 2010 in Table 4.6.

[20] A subscription to Netflix could be purely for the streaming service Netflix Watch Instantly or, for a small additional monthly charge, also include mail-delivered DVDs.

Profiles of 640 consumer profiles are constructed from the levels of these independent variables. As before, the predicted probabilities of "Very likely" + "Somewhat likely" and "Not at all likely" + "Somewhat unlikely" responses and their associated confidence intervals (using the delta method) were computed.

The highest, lowest, median, and mean predicted probabilities for these responses and identified the specific consumer profile corresponding to each is determined. Table 4.7 summarizes the highest predicted probabilities by age group.

As expected, the two youngest presently non-subscribing household cohorts (age 18–44) have the highest predicted probability of Netflix subscription in the near future, while non-subscribing households in the oldest age group (65 and over) have the highest predicted probability of *not* subscribing to Netflix in the near future.

The consumer profiles most closely associated with the median level of the predicted probability of Netflix subscription in the next six months (among presently non-subscribing households) are shown in Table 4.8.

The profiles of households with the median probability of starting Netflix subscriptions in the near future are somewhat similar in some ways and profoundly different in others. Neither set of households falls into the extreme age ranges, high or low. They also both own some of the facilitating devices for video viewing and streaming, such as Apple TV/Roku etc., DVD players, and Blu-ray players.[20] Finally, they both make considerable use of mail-delivered or pickup DVD rentals. However, they differ in other important respects, such as with respect to the use of free websites that stream video and how satisfied they are with traditional Pay TV. The 45–54 age group has high satisfaction with Pay TV but also would like to see TV programming (such as that from Netflix) made available on mobile devices. In contrast, the 55–64 age group appears to favor streaming by Netflix because it is not satisfied with Pay TV, rather than because of any compelling desire to receive TV programming on other screens such as mobile devices.

The 15.2 % median probability of presently nonsubscribing households considering subscribing in the next six months is considerably higher than the 3.8 % median probability (see Table 4.4) of households considering pure OTT substitution in the next six months. However, even then, the urge to switch to, or add on,

[21] It is important to remember that the median probability of future Netflix subscription pertains only to the profiles of households that presently do not subscribe. In December 2010, just under three in four (72.7 %) households were Netflix nonsubscribers. Of these households, only 6.3 % indicated seriously considering subscribing to Netflix in the next six months. In contrast, of the slightly more than a quarter of households that were already Netflix subscribers, an astonishing 75.4 % indicated a willingness to continue subscribing in the next months. The story is similar for subscribers and nonsubscribers for Hulu or free video websites as well. Conceivably, the high rates of co-consumption of Pay TV and OTT observed in Table 4.1 are largely driven by households that subscribe to Netflix or Hulu or use free video-streaming websites.

[22] Also, from April 2011 onward, we can track WTP only for the Netflix paid streaming subscription service because of changes in the wording of those questions.

Table 4.9 Summary Statistics from WTP Distributions for Netflix and Hulu Plus, Monthly from November 2010 to March 2011

	Netflix				Hulu			
	Obs	Median	Mean	Std Dev	Obs	Median	Mean	Std Dev
Nov 2010	1,346	$10	$11.15	$6.74	1,570	$4	$5.30	$7.46
Dec 2010	1,847	$10	$11.62	$6.39	1,389	$1	$4.66	$7.20
Jan 2011	2,445	$10	$10.90	$6.06	2,688	$5	$5.48	$6.91
Feb 2011	1,228	$10	$11.04	$6.14	1,405	$5	$5.22	$7.04
Mar 2011	2,171	$10	$10.97	$5.92	2,511	$5	$5.39	$7.01
Apr 2011	244	$10	$11.64	$7.80				
May 2011	323	$10	$11.64	$7.11				
Jun 2011	313	$10	$12.41	$7.53				

Netflix as a source of video programming is still tepid at this time. Much of the demand for Netflix in the near future will come from households that co-consume Pay TV and streamed video, rather than from those interested in cutting the video cord.[21]

4.6 Willingness-to-Pay for Netflix and Hulu: Do Present Prices Maximize Revenues?

What households are willing to pay for specific services is often a powerful indicator of the popularity of and, more concretely, demand for that service. For example, in many willingness-to-pay (WTP) surveys, a nontrivial fraction of respondents indicate an unwillingness-to-pay anything at all for the product or service in question. Others indicate amounts greater than zero, with a few outliers proposing to pay unrealistically large amounts. Service providers frequently rely on WTP surveys to get a fair indication of sustainable price points for their services and the revenues that may be expected at those prices.

The Centris survey included questions about household WTP for Netflix and Hulu Plus (the paid subscription service offered by Hulu). From November 2010 to March 2011, these were asked of both present subscribers and nonsubscribers. From April 2011 onward, the question has been asked solely of nonsubscribers.[22] We analyzed the WTP data at two levels: (1) constructing summary statistics of the WTP distribution and (2) estimating underlying pseudo-demand curves from which price elasticities can be calculated at various price points.[23]

[23] See the qualification in fn. 10 supra.

[24] Histograms of the WTP distributions revealed that non-trivial proportions of households had WTPs that were at least five times the median value.

[25] The WTP data were mildly left-censored. Tobit (or censored) regression is explained in a number of econometrics texts. See, e.g., Greene (2003), especially pp. 761–768.

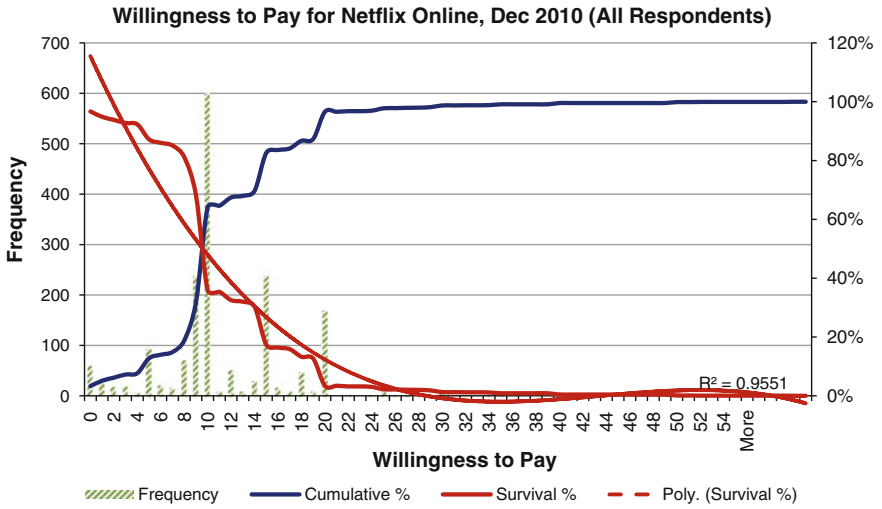

Figure 4.3 Constructing a Pseudo-Demand Curve for Netflix from Willingness-to-Pay Data (AllRespondents), December 2010

Table 4.10 Estimated Third-Order Polynomial Relationship Between Survival Function and WTP for Netflix Using Robust OLS and Tobit Regression Methods, December 2010

Maximum predicted probability	
Age	(%)
18–34	94.4
35–44	94.3
45–54	95.9
55–64	95.8
65+	97.6

Summary statistics (after omitting outliers in the right tail) for all eight months of survey data are shown in Table 4.9.

Even after omitting the most egregious outliers, the WTP distributions are still clearly right-skewed—modestly for Netflix but more pronouncedly for Hulu Plus.[24] Moreover, the proportions of households with zero WTP vary dramatically between Netflix (3.9–4.5 %) and Hulu Plus (38–47 %). The higher median WTP and lower proportion of zero WTP for Netflix makes it, at least presently, a more desirable or popular video-streaming service than Hulu Plus.

A more formal analysis on the WTP data is conducted as follows. First, the cumulative distribution function (CDF) of the WTP data is constructed, from which its complement is recovered, the survival function (SF). The SF of the WTP shows the proportion of households that are willing to pay at least a designated level of the price. The mirror image of this interpretation is that it measures the

[26] Details are available from the principal author.

Table 4.11 Price Elasticity at Median WTP and Revenue-Maximizing Price Point for Netflix and Hulu Plus, Monthly November 2010 – March 2011

	Netflix				Hulu Plus			
	Price Elasticity at Median WTP		Price at Unitary Price Elasticity		Price Elasticity at Median WTP		Price at Unitary Price Elasticity	
	Robust OLS	Tobit	Robust OLS	Tobit	Robust OLS	Tobit	Robust OLS	Tobit
Nov 2010	-1.98	-2.02	$6.95	$6.90	-0.70	-0.72	$6.23	$6.18
Dec 2010	-1.82	-1.85	$7.25	$7.20	-0.71	-0.73	$6.20	$6.12
Jan 2011	-1.99	-2.02	$6.95	$6.90	-0.72	-0.73	$6.12	$6.08
Feb 2011	-1.97	-2.00	$7.00	$6.90	-0.72	-0.73	$6.15	$6.07
Mar 2011	-2.01	-2.00	$6.90	$6.90	-0.67	-0.69	$6.45	$6.40
Apr 2011	-1.94	-1.97	$7.02	$6.97				
May 2011	-1.88	-1.91	$7.11	$7.05				
Jun 2011	-1.78	-1.81	$7.30	$7.22				

Median WTP for Hulu service is less than $5 in November and December 2010 samples, while it is $5 in the following three months. For comparability, we calculate the price elasticity at the $5 price point in November and December 2010

most number of subscribers ("demand") at that level of the price. Hence, an SF of the WTP can be imagined as reflecting a pseudo-demand curve. This pseudo-demand curve can be estimated by fitting a polynomial function of the appropriate order in WTP to the survival function. "Price elasticities" can then be calculated as the ratio of the percentage change in the fitted SF to the percentage change in (first-order) WTP.

For each monthly household sample, regression techniques to estimate the SF as a function of WTP are used. Two techniques were used: ordinary least squares with robust standard errors and Tobit regression appropriate for censored data.[25] A polynomial of the third order was appropriate in all instances.

Figure 4.3 shows an example of how monthly pseudo-demand curves for Netflix were constructed, in this instance from WTP data for December 2010. The WTP histogram is shown by green columns and the CDF of the WTP data is depicted by the yellow curve. The SF (shown in red) is calculated as 100 %—CDF. A third-order polynomial in WTP fitted to the SF is depicted by the dashed red line. Table 4.10 presents the estimated relationship using the two estimation techniques. Censoring of the WTP data does not appear to be a major factor as the coefficient estimates vary little between the two techniques.

This fitted line was interpreted as the pseudo-demand curve and elasticities were calculated at different "price" (or WTP) points. These estimated price elasticities were robust, with little variation over either months or estimation techniques.[26] Table 4.10 provides information on price elasticity in two ways. First, it reports the price elasticity at the median WTP level. Second, it shows the price point at which price elasticity is unitary (in absolute value). This price point is also known as the revenue-maximizing price since revenue neither increases nor decreases for small departures from that price.

These results have the following interesting implications:

- If Netflix were to set its price at the median of $10, demand would be quite elastic. A lower price would, in fact, increase revenue. In contrast, if Hulu were to set the Hulu Plus price at the median of around $5, demand would be inelastic. A higher price would, in fact, increase revenue.
- Netflix currently charges $7.99 a month for its pure streaming Netflix Watch Instantly service and $7.99 more to bundle that with its traditional mail-delivered DVD rental service. Table 4.11 suggests that Netflix may still have overpriced its service somewhat, that is, if maximizing revenue is its goal. A price in the neighborhood of $7 would be closer to optimal.
- Hulu currently charges $7.99 a month for its pure streaming Hulu Plus service. This price matches that set by Netflix and is, perhaps, a competitive response. However, as noted earlier, consumer interest and their WTP for Hulu Plus content are not at the same level as those for Netflix. From Table 4.11, it appears that pricing at the median of $5 would not be revenue-maximizing. Rather, the price should be somewhat more than $6. It appears that Hulu may have overpriced its Hulu Plus service to a greater degree than has Netflix.

- A revenue-maximizing price does not necessarily maximize profits as well. However, in the absence of publicly available cost information, the WTP survey data best provide a tool for selecting the revenue-maximizing price. Pricing "too high" or "too low" leaves unexploited revenue opportunities on the table.

4.7 Conclusion

Centris' survey research provides useful insights into the burgeoning OTT phenomenon and, in particular, the move to streamed video (either by itself or in combination with traditional Pay TV). This research indicates that the onset of OTT is still at a nascent stage and does not yet represent a substantial threat to Pay TV service providers in the United States. However, the proliferation of platforms and devices through which video programming can be streamed or downloaded may mean that it is only a matter of time before OTT becomes a serious competitor to Pay TV. Much will depend on how content is created and distributed in the future—the rise of hybrid entities that both create and distribute content over low-cost, high-bandwidth broadband connections can mark an important turning point.

Apart from these prognostications, this chapter also attempts to rigorously define and measure the various forms of OTT, not all of which represent a replacement of traditional Pay TV. Any failure to make these distinctions can lead to seemingly contradictory and confusing forecasts of the future of OTT video. The term "video cord-cutting" is now coming into vogue, following by a decade or so the form of "voice cord-cutting" that emerged from the rapid diffusion of mobile telecommunications in the United States and other developed countries. The nature—and implications—of video cord-cutting are more complex. For video cord-cutting to advance, a significant variety of devices and platforms must be available, as must more powerful and versatile internet connections. In the United States, some of the largest providers of video service are also those of internet service. Therefore, the extent to which those service providers will resist OTT in order to protect their Pay TV business or embrace OTT in order to fortify their internet connections business will determine the evolution of OTT in a major way. For now, the threat to the core Pay TV business looks manageably small.

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