

efforts.

6. Specific state-level economic development programs have received positive benefit-cost evaluations; for example, KTEC in Burress and Oslund (1998). The best benefit-cost discussion I have seen for state and local economic development programs in aggregate is by Bartik (1991, p.182), who concludes: "The range of plausible estimates is wide enough that it is impossible to say whether state and local economic development policies will generally benefit the residents of the targeted metropolitan area."
7. For an example from my own work, see Burress and Oslund (1999).

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## CONSUMER DEMAND FOR DIGITAL VIDEO PRODUCTS

**David Burress  
Joshua Rosenbloom  
Patricia Oslund**

**David Burress, Principal Investigator, is Associate Scientist and Research Economist, Joshua Rosenbloom is Professor of Economics, Patricia Oslund is a Research Economist, all at the University of Kansas.**

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### Overview

This article, which is comprised of the Survey of Consumers, and the Conclusion of the fifth report, is part of a series of reports on the economic impacts of the Digital Video Focused Program Area. The series is being prepared by the Policy Research Institute (PRI) at the University of Kansas. Four previous reports in this series have provided a preliminary analysis of the digital video (DV) market place and its economic impacts:

- Burress *et al.* (1998) establishes an approach for mapping complex marketplaces in terms of the general attributes of goods. The approach is then applied to provide a detailed empirical description of existing and potential DV-related markets.
- Burress *et al.* (1999a) extends this approach to provide a map of technologies needed to implement the identified types of DV goods. It also provides theoretical and empirical maps of the spillovers and other channels through which innovations in digital video technology could potentially affect the US economy and proposes a Computable General Equilibrium (CGE) model of the US to be used as an accounting frame and aggregation method for summarizing

economic impact channels. (A CGE model is one that numerically calculates the effects of all interactions of all markets in the economy, based on moderately to highly aggregated markets.)

- Burress *et al.* (1999b) proposes general methodologies for the entire study, including possible follow-ons and *ex post* economic impact analyses. It also proposes specific methodology for gathering the baseline data (but not the detailed protocols), and proposes a research plan for gathering and analyzing the baseline data needed for the over-all study.
- Burress *et al.* (2000) describes methods and protocols for gathering the baseline data and also analyzes some of the test data so gathered.

It is anticipated that follow-on research will track the Digital Video Focused Program Area over time, and then provide comprehensive *ex post* (i.e., retrospective) measurements of its economic impacts on the US.

### Survey of Consumers

During the spring of 2000, the University of Kansas Policy Research Institute conducted a telephone survey of households to gather information on potential consumer demand for digital video products and services. At the time that the survey was conducted, most of the effects of ATP-supported digital video technologies had not yet been incorporated into products available in the market place. Therefore, our primary approach was to look at consumer valuation of various functions and characteristics of video technology, functions and characteristics that may be actualized in consumer products available in the future. Our concept of valuation involves both the monetary payments that might be made by the consumer and the expenditure of the consumer's time.

Concretely, the survey asked for three categories of information:

- Demographic characteristics;
- Current household consumption of video technologies and entertainment services;
- Preferences for and evaluation of

potential new digital video entertainment goods and services.

This section provides descriptive information on consumer responses to many of the survey questions.

## Characteristics of the survey sample

### Cooperation rate

During April - June, 2000, the Survey Research Center (SRC) at the Policy Research Institute conducted a survey of households throughout the US. The SRC started with a list of randomly-generated telephone numbers drawn from active telephone exchanges across the country. Because the numbers were random, some of them proved to be out of service. Other numbers belonged to businesses rather than households. If a valid telephone number could not be reached on the first try, the SRC called the number back at least four times at various times of the day. The SRC reached 1,052 households. A total of 315 households initially agreed to participate in the survey. Of these, 288 actually completed the telephone interview process - fewer than 6 percent of participants stopped the survey midway. The cooperation rate for the survey is (288/1052) or 27 percent.

We were concerned about the fairly low cooperation rate for the survey (the SRC generally achieves cooperation rates over 50 percent). We spoke with the individual surveyors, who told us that potential respondents seemed to be suspicious of the topic of the survey (use of technology). Potential respondents often commented that they thought we were trying to sell them something (despite our claims to the contrary). Similarly, several potential respondents commented that they were "tired of telemarketers."

Despite the fairly low cooperation rate, a very high percentage of respondents finished the survey once they started it. This indicates to us that the survey is appropriate in length (it takes about 12-15 minutes to complete) and that the subject matter and wording can be understood by the participants.

Most individual survey questions have an item response rate of at least 95 percent (respondents who actually answer question/respondents who are eligible to answer question). This reinforces the idea that the questions are appropriate and understandable.

### Demographics and representativeness

The survey asks a number of demographic and income questions. These questions serve two purposes: a) to test if the resulting survey sample is representative of the population in terms of measurable characteristics, and b) to provide explanatory variables for the regression models estimated in another part of the project. Key demographic and income variables include:

- Respondent age
- Gender
- Employment
- Home ownership
- Household income before taxes
- Household size
- Hours worked

We were able to find up-to-date counterparts from widely-available U.S. data sources for all of the variables except hours worked.

We found that the survey sample is similar to the U.S. population with regards to several measurable criteria (see Tables 2.1-2.4). The sample represents the age distribution of the U.S. population fairly well (note that only people age 18 and older were included in the group of potential survey respondents). The sample does not significantly differ from the U.S. population in gender distribution. The percentage of respondents employed (69%) is close to the employment percentage for the U.S. adult population as a whole (66%). Approximately 70 percent of respondents own their own homes, in comparison to 67 percent nationwide, a difference that is not significant.

The survey does significantly under-represent low income households - those with incomes under \$15,000 per year (see Table 2.5). Fewer than 10 percent of the surveyed households fall into this income

category, in contrast with over 16 percent of households nationwide. Similarly, the survey over-represents middle income households in the \$50,000-\$80,000 per year income category. Under-representation of low income households in the survey sample may be due in part to lack of telephone service. Recent data from the Federal Communications Commission indicates that about 15 percent of households with incomes under \$15,000 lack phone service. In contrast, only about 2 percent of households with incomes over \$60,000 lack service.

The average size of households in the survey sample is somewhat larger than for the U.S. as a whole (2.93 persons versus 2.61 persons). The number of employed people per household (1.65) exceeds the national average (1.34), due mainly to the larger than average household size. Although these differences are statistically significant, they are small in size (see Table 2.6).

As mentioned earlier, the demographics and income section of the survey also contains questions on hours worked. We could not find recent U.S. data for these variables, so they do not contribute to the discussion of representativeness. For those respondents who are employed, full time employment (35 to 50 hours per week) is the most common choice. Fully 18 percent of employed respondents work more than full time, that is, more than 50 hours per week. On average, the respondent plus other household members together work about 57 paid hours per week (see Tables 2.7 and 2.8).

To summarize, the survey sample appears to be representative of the U.S. population in age, gender composition, employment, and home ownership. The most important characteristic for which the sample is not representative is income - low income households are significantly under-represented.

### Current household consumption of video technologies and entertainment services

A central hypothesis discussed is the common-sense notion that those

**Table 2.1**  
**Age of Respondent**

age	18-25	26-44	44-64	65+
% of survey respondents	15.4	36.4	32.5	15.7
% of U.S. population age 18+	14.5	39.2	29.2	17.1

N = 286

Source: PRI consumer survey U.S. Bureau of the Census (2000a). Comparison data from 1999.

Significance: A chi-square test of the age distribution of the survey respondents against the age distribution of the general population shows that the survey distribution is not significantly different from the population as a whole (p = .55).

**Table 2.2**  
**Gender**

gender	male	female
% of survey respondents	43.7	56.3
% of U.S. population age 18+	48.1	51.9

N = 286

Source: PRI consumer survey and U.S. Bureau of the Census (2000a). 1999 comparison data.

Significance: A chi-square test of the gender distribution of the survey respondents against the gender distribution of the general population shows that the survey distribution is not significantly different from the population as a whole (p = .14).

**Table 2.3**  
**Employment of Respondent**

employment	employed	not employed
% of survey respondents	68.8	31.2
% of US Population age 20+	66.0	34.0

N = 286

Source: PRI consumer survey and U.S. Bureau of Labor Statistics (2000b). 1999 comparison data. The consumer survey includes respondents age 18 and over, while the BLS data includes persons age 20 and over.

Significance: A chi-square test of the gender distribution of the survey respondents against the employment distribution of the general population shows that the survey distribution is not significantly different from the population as a whole (p = .32).

**Table 2.4**  
**Home Ownership**

ownership	own home	do not own home
% of survey respondents	70.3	29.7
% of U.S. households	66.2	33.8

N = 286

Source: PRI consumer survey and U.S. Bureau of the Census (2000c). 2000 comparison data.

Significance: A chi-square test comparing the home ownership distribution of the survey respondents against the home ownership distribution of the general population shows that the survey distribution is not significantly different from the population as a whole (p = .28).

**Table 2.5**  
**Household Income before Taxes**

income	under \$15,000	\$15,000-29,999	\$30,000-49,999	\$50,000-79,999	\$80,000+
% of survey respondents	09.4	18.5	23.6	26.8	21.7
% of U.S. households	16.5	20.5	22.2	20.6	20.2

N = 253

Source: Consumer survey and U.S. Bureau of the Census (2000d). Interpolation was necessary to make income categories match.

Significance: A chi-square test shows that the income distribution of households participating in the survey differs significantly from the income distribution of households in the U.S. as a whole (p = .01). In particular, the survey under-represents low income households and over-represents households in the upper middle income category (\$50,000-79,999).

**Table 2.6**  
**Household Size and Employment per Household**

household size	mean # people	Standard error of mean	Mean employed people	Standard error of mean
Survey respondents	2.93	.09	1.65	.07
U.S. households, 1998	2.61	-	1.34	-

N = 288

Source: PRI consumer survey; U.S. Bureau of the Census (1998); and U.S. Bureau of Labor Statistics (2000a).

Significance: T tests ( $t = (2.93-2.61)/.09$  and  $t = (1.65-1.34)/.07$ ) show that both the average household size and average employment per household are significantly greater for the survey respondents than that for the US as a whole. But although the differences are statistically significant, they are small (about 1/3 of a person).

**Table 2.7**  
**Hours Worked by Respondents**

	Number of respondents	Percent of employed
15 hours or under	10	05.1%
16 to 34 hours	44	22.3%
35 to 50 hours	107	54.3%
more than 50 hours	36	18.3%
not employed	90	

N=287

Source: PRI consumer survey. Most of the respondents who worked at paid jobs or in their own businesses reported full time employment, working between 35 and 50 hours per week.

**Table 2.8**  
**Total Hours Worked by Household**

	Mean	Standard Error
Total household work hours	56.6	2.0

N = 287

Source: PRI consumer survey. Total hours worked by household members are calculated using the midpoints of reported ranges of hours.

**Table 2.9**  
**Market Penetration of Video Goods and Services**

Good or Service	% owning or receiving	Number of respondents
Color TV	99.0%	288
VCR	97.6%	288
Cable or satellite TV	79.7%	286
Cable TV	67.0%	286
Internet access at home	57.8%	287
Premium channels	33.0%	288
Satellite TV	16.2%	284
DVD player	14.8%	283
HDTV	01.9%	280

Source: PRI consumer survey

consumers who currently are intense of video goods and services will also have the highest willingness to pay for advanced goods and services that are just coming into the market place. In order to test this hypothesis, we asked consumers about their ownership and use of a number of video, electronic, and entertainment goods and services. The survey focuses on television, movies, and video entertainment.

*Market penetration of video goods and services*

Market penetration of color TVs and VCRs is almost universal among the households that we interviewed (see Table 2.9). Cable or satellite service is also very common - fully 80 percent of households receive cable or satellite TV service, and a few households receive both. A majority of the households have Internet access in the home. About one-third of households currently have access to one or more premium channels such as HBO. About 15 percent of households in

the sample currently own DVD players. About 3 percent (8 respondents) report that they already own HDTV. Although the survey questionnaire briefly explained what we meant by HDTV, we found that only 3 of the 8 households reporting HDTV also reported a TV price (>\$2000) consistent with owning HDTV. We adjusted our statistics accordingly.

*Equipment ages and prices*

We asked consumers about the prices and ages of the video equipment that they owned (see Table 2.10). In the case that the consumers had more than one TV, more than one VCR, or more than one DVD player, they were asked to report on their best piece of equipment. We report median as well as mean values for age and price, because outliers (such as a TV costing \$7500 or a TV 30 years old) have a large effect on means but almost no effect on medians.

To generalize, mean expenditures and mean equipment ages exceed medians of the corresponding variables. Consumers

who have purchased HDTV pull up the average TV expenditure. Similarly, early adopters of DVD players, who paid a high price for their equipment, pull up the DVD expenditure average. For each equipment type, considerably more consumers are able to recall approximately when they acquired their equipment than what the equipment cost.

As mentioned earlier, the overwhelming majority of households report owning TVs and VCRs. The median expenditures on these items are modest (\$400 and \$200 respectively). Half the households purchased their best TV more than four years ago. Only around 15 percent of households have DVD players — the median expenditure on DVD players is \$300, and the majority have been purchased within the last year.

*Equipment quality*

Consumers were asked a few questions assessing the quality of video equipment and services. Most

**Table 2.10  
Equipment Expenditures and Ages**

	mean	median	number of responses
TV expenditure (\$)	642	400	213
TV age (years)	4.7	4.0	271
VCR expenditure (\$)	204	200	202
VCR age (years)	3.8	3.0	263
DVD expenditure (\$)	516	300	26
DVD age (years)	.85	.67	41

Source: PRI consumer survey.

**Table 2.11  
Screen Size of Best Color TV**

	Number of respondents	Percent
21 inches or under	61	21.9
22 to 27 inches	132	47.3
28 to 36 inches	60	21.5
37 to 49 inches	9	3.2
larger than 49 inches	17	6.1
Total	279	100.0

Source: PRI consumer survey.

**Table 2.12**  
**Number of TV Channels with Good Reception**

	Number of respondents	Percent
under 20 channels	73	26.0
20 to 49 channels	72	25.6
50 to 99 channels	91	32.4
100 channels or over	45	16.0
Total	281	100.0

Source: PRI consumer survey

**Table 2.13**  
**Features Wanted in Next Color TV Purchased**

Desired Feature	Number mentioning	Percent mentioning
Bigger screen	79	27.5
Better sound	65	22.6
Sharper-clearer image	56	19.5
Easier controls	52	18.1
Better color	41	14.3
High definition or digital	41	14.3
Cable ready	22	07.7
Picture within picture	10	03.5
Built-in VCR/DVD	8	02.8
Wide-screen/letter-box	6	02.1
Flat screen	6	02.1
More reliability	4	01.4
Better programs	4	01.4
N = 286		

Source: PRI consumer survey.

households have small- or modest-sized TVs. About 31 percent of the households currently own large screen TVs with screen sizes greater than 27 inches (see Table 2.11). Most households receive fewer than 50 TV channels, and about one-fourth of households receive fewer than 20 channels. About 16 percent of households receive more than 100 channels (see Table 2.12).

**Desired characteristics of TV purchases**

Consumers were asked an open-ended question about the TV features that they desired (see Table 2.13). The question was worded as “What features will be important to you in the next color television that you purchase?” The answers were then coded into categories. Over one-fourth of consumers want a

“bigger screen.” This is followed closely by “better sound” and “sharper-clearer image.” “Easier controls” are mentioned by 18 percent of respondents, and “better color” and “high definition” are each mentioned by 14 percent of respondents.

**Intensity of use of video entertainment**

The average consumer spends a considerable amount of time each week watching TV, going to movies, and renting videos (see Tables 2.14-2.16). More than half of consumers spend at least 11 hours per week watching television programs. More than 40 percent of consumers go out to the movies at least once a month. Fully 36 percent of consumers rent a video at least once per week, and another 30 percent rent at least once per month.

It is interesting to ask whether those consumers who watch TV a high number of hours also rent videos and go the movies frequently. To assess this, we divided each type of entertainment into two groups - intense consumers and less-intense consumers. Intense TV consumers are defined as those watching at least 11 hours per week, intense high movie goers are defined as those going to the movies at least once per month, and intense video renters are defined as those renting at least once per month. We created three 2-way tables (movies versus TV; videos versus TV, and videos versus movies) and performed chi-squared tests. We found that:

- Going to the movies is unrelated to hours of TV watched. That is, intense movie goers are just as likely to be intense TV watchers as are less-intense

**Table 2.14**  
**Hours of TV watched per Week by Respondent**

Hours	Number of respondents	Percent
zero	5	1.7
1 to 5	43	15.0
6 to 10	77	26.9
11 to 20	97	33.9
21 to 30	33	11.5
31 to 40	20	7.0
over 40	11	3.8
Total	286	100.0

Source: PRI consumer survey.

**Table 2.15**  
**Frequency of Going to the Movies**

Frequency	Number of respondents	Percent
At least once per week	22	7.7
At least once per month	101	35.2
A few times per year	81	28.2
About once per year	17	05.9
Almost never	66	23.0
Total	287	100.0

Source: PRI consumer survey.

**Table 2.16**  
**Frequency of Renting Videos**

Frequency	Number of respondents	Percent
At least once per week?	103	36.0
At least once per month?	87	30.4
A few times per year?	37	12.9
About once per year?	8	2.8
Almost never?	51	17.8
Total	286	100.0

Source: PRI consumer survey.

**Table 2.17**  
**Intensity of Movie Going Versus Intensity of TV Watching**

Intense TV watcher		Intense movie goer	
		no	yes
no	Count	71	93
	%	43.3	56.7
yes	Count	54	67
	%	44.6	55.4

Source: PRI consumer survey.

**Table 2.18**  
**Intensity of Video Renting Versus Intensity of TV Watching**

Intense TV watcher		Intense video renter	
		no	yes
no	Count	28	67
	%	29.5	70.5
yes	Count	95	94
	%	50.3	49.7

Source: PRI consumer survey.

**Table 2.19**  
**Intensity of Video Renting Versus Intensity of Movie Going**

		no		yes	
		Count	%	Count	%
Intense movie goer	no	66	69.5	29	30.5
	yes	97	51.0	93	49.0
Intense video renter	no	66	69.5	29	30.5
	yes	97	51.0	93	49.0

Source: PRI consumer survey

**Table 2.20**  
**Tradeoffs of Size and Image Quality**

Choice	Number of respondents	Percent
Prefers 49" conventional TV over 27" movie quality	50	17.6
Also prefers 49" conventional over 36 inch movie quality	10	
Also prefers 36 inch conventional over 27 inch movie quality	17	
Prefers 27" movie-quality TV over 49" conventional	234	82.4
Total	284	100.0

Source: PRI consumer survey

**Table 2.21**  
**Activities that Decrease as TV Viewing Increases**

	Number mentioning	Percent mentioning
Active sports and hobbies	30	25.0
Other entertainment	22	18.3
Paid work	20	16.7
Sleep	13	10.8
House and yard work	13	10.8
Computer and Internet use	9	07.5
Reading	8	06.7
Studying	4	03.3

N = 120 = number increasing in TV viewing as result of big package.

Source: PRI consumer survey.

movie goers (Table 2.17).

- Renting videos is *negatively* related to watching TV programs. About half of intense video renters watch TV 11 hours or more per week; in contrast, 70 percent of less intense video renters watch TV 11 hours or more. Differences are significant at the 1 percent level. It appears that video renting is a substitute for watching TV programs (Table 2.18).
- Renting videos is *positively* related to going to movies. About half of the intense video renters are also intense

movie goers. In contrast, only 30 percent of the less-intense video renters are intense movie goers. The results are significant at the 1 percent level. It appears that the underlying preferences that make a person want to go to the movies also influence the person to rent videos (Table 2.19).

**Willingness to pay for advanced video products and services**

The final section of the survey

focuses on consumer preferences for and willingness to pay for advanced video products and services. Some of these products (for example, large screen TV) are already well established in the market place. But many of the products and services are just emerging. Because survey respondents might not be familiar with the goods and services we were trying to evaluate, the survey provides brief descriptions of what the products and services can do in terms that consumers can understand. Among the



goods and services covered by the survey are:

- TVs with movie-quality screens defined as “as crisp, clear, and colorful as what you would see in a movie theater.” Consumers were asked about their trade-offs between screen size and picture quality, and also about their willingness to pay for a movie-quality picture.
- Advanced DVD players that would also allow the consumer to record. Consumers were asked about their willingness to pay to own the device.
- Instant replay devices that would “allow you to stop what you were watching, even if it were a live telecast, and go back and watch part of the telecast again. ...At the same time, the device would record anything you were missing.” Consumers were asked what monthly fee they would be willing to pay to rent such a device.
- Video on demand that would make “a huge library of movies, documentaries, and educational programs” available within 5 minutes for a fixed monthly fee. Consumers were asked about their willingness to pay for monthly service.
- The “big package” providing a large screen TV with movie picture quality, a DVD player and recorder, instant replay, and video on demand services. Consumers were asked about their willingness to pay for monthly rental of the “big package.” They were also asked if, given the big package, they would watch more TV. If so, they were asked what they would do less. The idea here is that the big package (as well as other video services) have a “time use” cost as well as a monetary cost.

*Tradeoff of image quality and screen size*

Consumers were asked explicit questions about their trade-offs

between TV screen size and image quality (see Table 2.20). Consumers initially were given two hypothetical choices: a 49 inch TV with conventional picture quality or a 27 inch TV with a picture quality “as crisp, clear, and colorful as what you would see in a movie theater.” The consumers were asked to imagine that one of the TVs was available to them without cost. The overwhelming majority of consumers - 234 of 284 answering the question - chose the 27 inch movie quality TV. This result is not inconsistent with the previous result that consumers desired “larger size” more than any other feature in a new TV. For the previous question, consumers were talking about TVs of existing quality. For most people, this means conventional TV because they have not even seen HDTV. In this question, consumers are asked to imagine a TV of higher quality than they have actually seen. Consumers are clearly willing to sacrifice size if the image is clear enough and if no price differentials are involved.

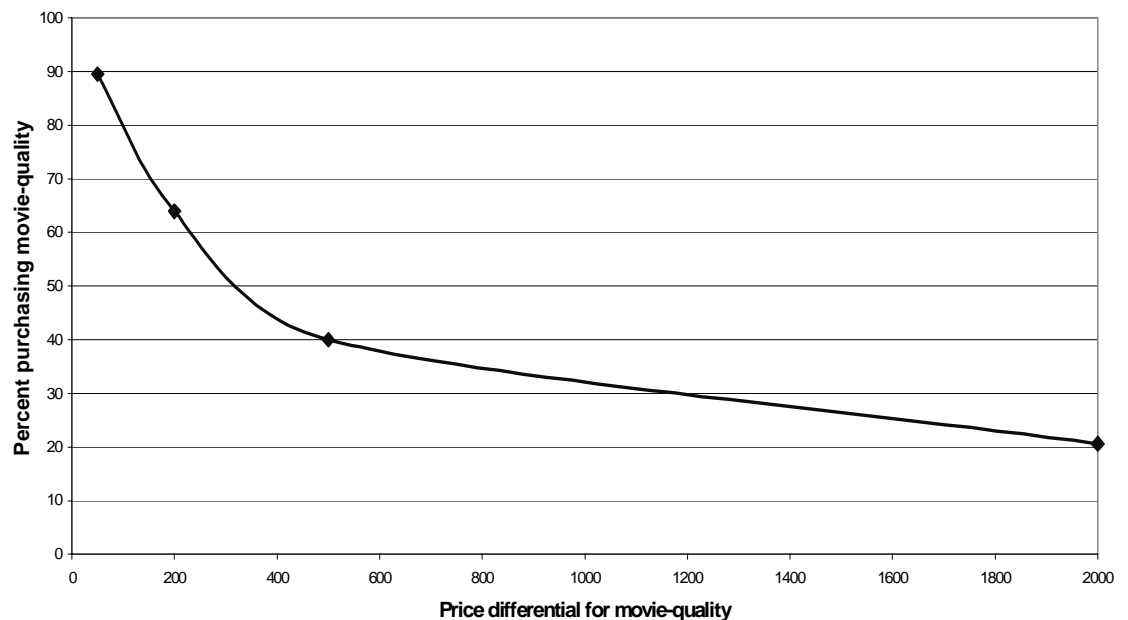
The 50 respondents who chose the 49 inch TV in the initial stage were given one of two other questions: a) choice of a 49 inch TV with conventional quality or

36 inch movie quality (asked to 25 respondents); or b) choice of a 36 inch TV with conventional quality or a 27 inch TV with movie quality (asked to 25 respondents). Ten respondents (40% of those asked) said that they would also choose the 49 inch conventional TV over a 36 inch movie quality TV. Seventeen respondents (68% of those asked) said they would choose a 36 inch conventional TV over the 27 inch movie quality TV.

*Willingness to pay for image quality*

We then asked consumers how much they would be willing to pay to get a movie-quality TV. Consumers were asked to compare two TVs of the same size (49 inch), one with conventional quality picture and one with a movie quality picture. Consumers were given one of four price differentials (\$50, \$200, \$500, and \$2000) and asked which TV they would buy. At a price differential of \$50, about 90 percent of consumers would choose movie-quality TV. For a price differential of \$200, that percentage falls to 64 percent. About 40 percent of consumers say they are willing to pay a

**Willingness to Pay for Movie-Quality TV**



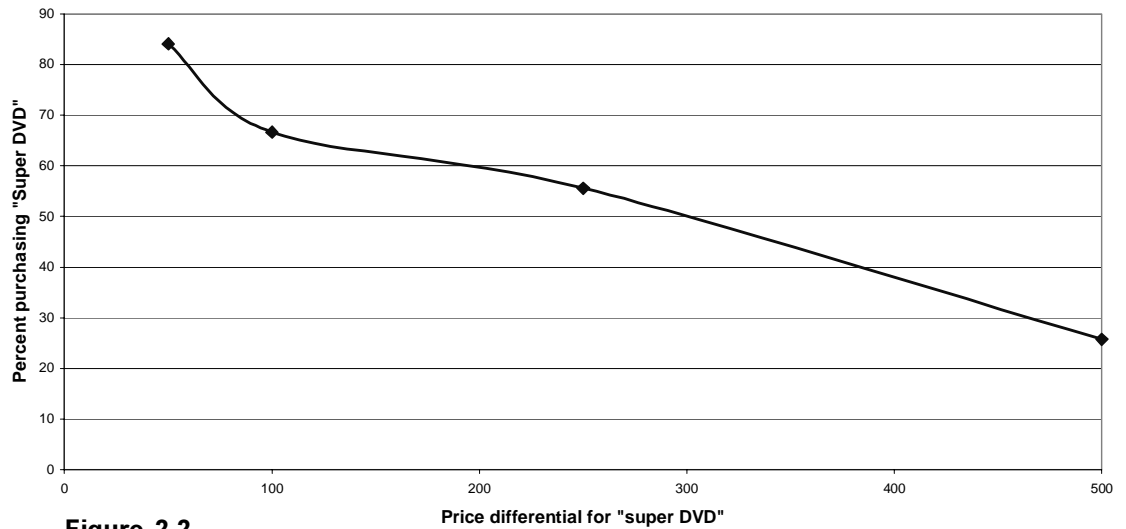
**Figure 2.1**

price differential of \$500 and about 20 percent say they are to pay \$2000. The graph below (Figure 2.1) shows the tradeoff between the price differential for movie quality and the percentage of consumers who say they are willing to pay that price.

*Willingness to pay for advanced DVD device*

Consumers were asked to place themselves in a situation where they were going to buy a new video recorder and player. They were asked to choose between an advanced DVD player that allowed recording and a conventional VCR. Consumers were told that the advanced DVD player would cost more than the VCR - consumers were presented with one of four price differentials (\$50, \$100, \$250, and \$500). They were asked whether they would buy the more expensive "super DVD" player or the conventional VCR. A large majority of consumers (84 percent) were willing to pay a price differential of \$50 for the super

**Willingness to Pay for "Super DVD" Player**



**Figure 2.2**

VCR. Slightly more than 25 percent of consumers were willing to pay a \$500 price differential (see Figure 2.2).

*Willingness to pay for instant replay*

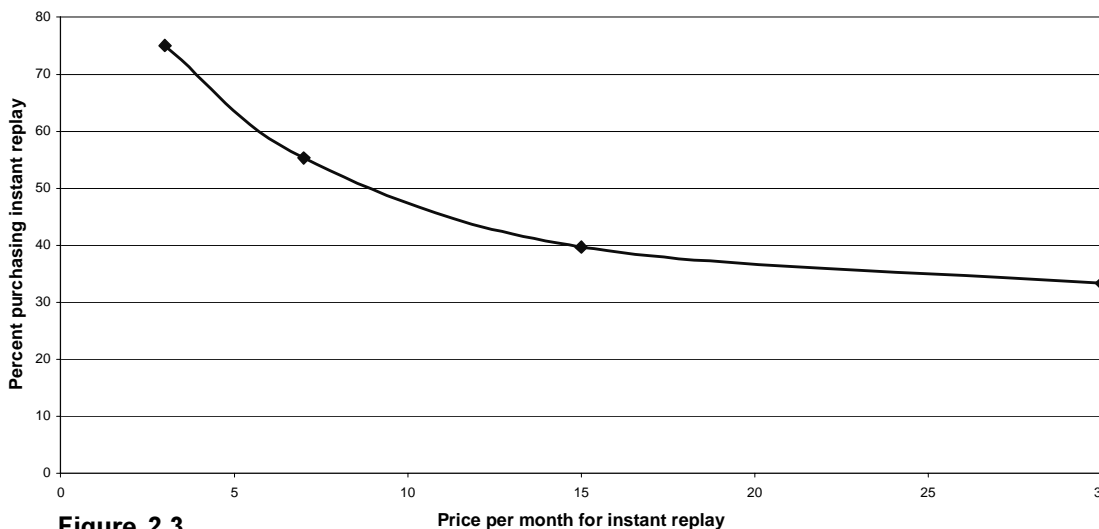
Consumers were asked to place themselves in a situation where they could rent an instant replay device without installation charges or long term commitments. Consumers were told that the monthly rental fee would be one of four dollar amounts (\$3, \$7, \$15, and \$30).

They were asked whether they would rent the device. About 75 percent of consumers said they are willing to pay \$3 per month. Willingness to pay drops off slowly, with 33 percent of consumers saying that they would pay \$30 per month (see Figure 2.3).

*Willingness to pay for video on demand*

Video on demand (VOD) services were described to consumers. Consumers were asked to imagine that VOD services were available for a monthly fee, without installation charges or long term commitments. Consumers were told that the monthly fee would be one of four dollar amounts (\$8, \$16, \$40, and \$80). They were asked whether they would subscribe to the VOD services. About 71 percent of consumers say they are willing to pay a monthly subscription fee of \$8. Willingness to pay drops off rapidly, with 28 percent of consumers willing to pay \$40 per

**Willingness to Pay for Instant Replay**



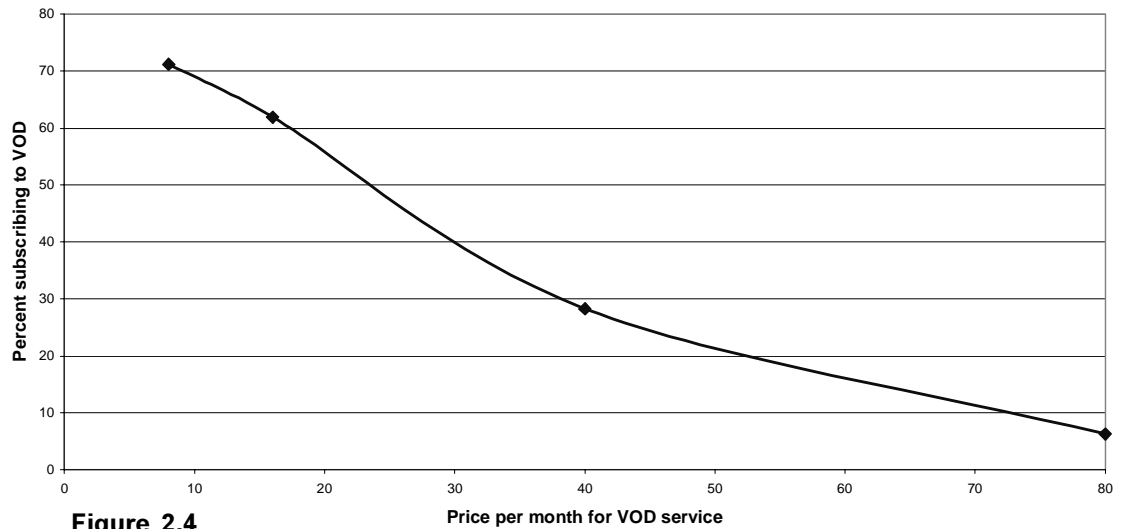
**Figure 2.3**

month and only 6 percent of consumers willing to pay \$80 per month (see Figure 2.4).

*Willingness to pay for the "big package"*

Finally, consumers were asked about their willingness to pay for a package of video goods and services. Consumers were asked to imagine that all of their video goods and services could be provided by a subscription service, again without installation fees or long term commitments. The subscription service would provide a large screen TV with a movie quality picture, a recordable DVD, instant replay, video on demand, and at least 100 cable channels. Consumers were asked about their willingness to pay for such a subscription service. They were presented with one of four possible monthly subscription fees (\$16, \$40, \$80, and \$160). Over three-fourths of consumers are willing to pay \$40 for the all-inclusive package. About 40 percent are willing to pay \$80 per month, and 13

**Willingness to Pay for Video on Demand Service**



**Figure 2.4**

percent are willing to pay \$200 (see Figure 2.5). Valuations for the big package appear to be on the low side, given that the great majority of households are already paying \$20 to \$30 per month for cable or satellite TV.

The willingness to pay assessment for the "big package" also included a second round of pricing. If a consumer answered "no" to a given price, she or he was then presented with a price half as much; if the consumer answered "yes," she or he was

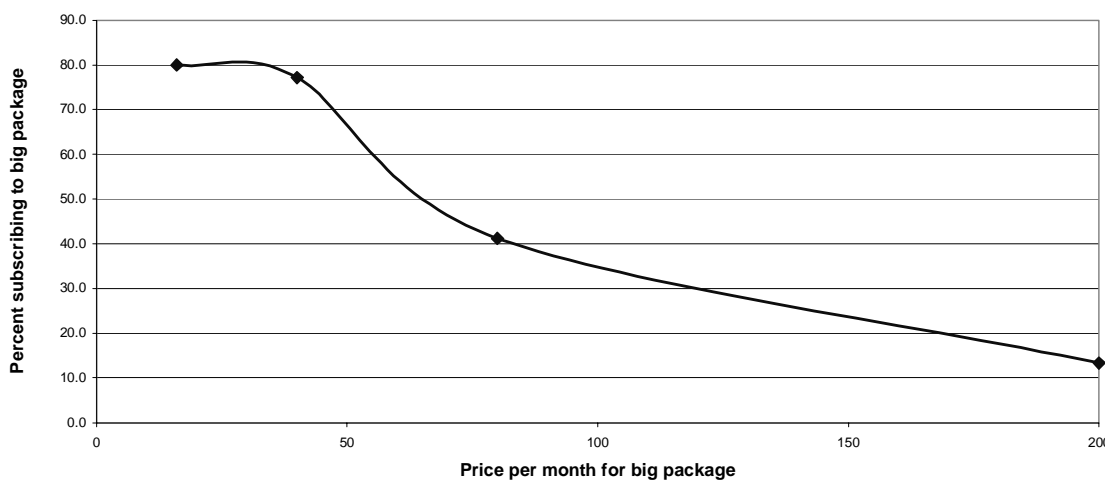
presented with a price twice as much. The results were generally consistent with the relationships shown in Figure 2.5. However, there are a few anomalies: for example, 77 percent of consumers are willing to pay \$40 for the package, but only 63 percent are willing to pay \$32. In the second-round pricing, some consumers were asked if they would pay \$400 per month - no one said "yes."

*Increased time spent watching TV*

Consumers were asked whether they thought they would spend more time watching TV if they had the "big package" available. Only 44 percent of those responding (120 respondents) anticipate that their viewing time will increase. Among those who will spend more time viewing, the average anticipated increase is 8.5 hours.

Additional time spent watching TV must come from somewhere. Those consumers who reported they will spend more time watching TV

**Willingness to Pay for the "Big Package"**



**Figure 2.5**

were asked an open-ended question about what they would spend less time doing (Table 2.21). The most frequent response is active sports and hobbies, followed by other entertainment and paid work.

## Summary

The consumer survey described in this chapter was successful in gathering information about:

- Respondent and household demographic and income characteristics;
- Current ownership and use of video goods and services;
- Consumer valuations of new and emerging video goods and services.

Key findings include:

- Market penetration of color TV and VCRs is almost universal.
- The great majority (80 percent) of households currently get satellite or cable TV services.
- Most consumers spend at least 11 hours per week watching television.
- People who rent videos frequently spend less time watching TV programs. On the other hand, people who rent videos frequently also spend more time going to the movies.
- Most consumers currently make only modest expenditures for video equipment and their equipment is fairly old (median age of TVs is 4 years).
- Over three-fourths of consumers claim that they are willing to pay \$40 for an all-inclusive package including cable, rental of a "movie quality" TV and DVD, and advanced services such as video on demand. About 40 percent are willing to pay \$80 per month, and 13 percent are willing to pay \$200. Valuations for the big package appear to be on the low side, given that the great majority of households are already paying \$20 to \$30 per month for cable or satellite TV.

## CONCLUSION (To the Fifth Report)

This report focuses on a single question: how can we measure the *ex post* (or retrospective) economic impacts of the ATP Digital Video program, either now or

in the future? Within that question, it addresses four topics that employ relatively discrete research methods:

- survey and analysis of consumer demands for video-related goods;
- an event study of the effects of digital video patents on market values of firms;
- a survey and analysis of the activities of client firms assisted by the ATP DV program;
- a computable general equilibrium (CGE) model, showing how activities of client firms have effects that trickle through the US economy, together with a Monte Carlo model that shows the interaction of various measurement errors.

Within each topic, this report provides baseline data, gives concrete examples of the empirical successes that can be achieved using that methodology, analyzes empirical problems in the methodology, and makes suggestions for further research. Performing a complete *ex post* evaluation of the DV program was *not* a major goal of this report, because insufficient time has passed for much meaningful impact to have occurred (many of the projects are still in the R&D stage). However we did arrive at a number of substantive findings. These findings are based either on *ex post* data, or on reasonably well founded short run expectations for three DV innovations that have actually reached the market.

## The consumer survey

Data from a telephone survey of US consumers show a coherent pattern in which video-related market goods act like necessities. That is, even the poorest household purchases them to some extent and the budget share declines with income. Expenditure amounts probably increase rather than declining when prices increase. Purchases increase with number of family members, though often at a low rate which suggests there are economies of scale in consumption. (More technically, estimated income elasticities are around .1 to .5; price elasticities are around -.5 to -.9; family size elasticities vary more widely, between .1 and .9.) The coherency of this pattern suggests that it can be extrapolated to demands for new

DV-related goods.

When measured in terms of economic value, households make a vastly larger commitment of time than of dollars to the consumption of video goods. It follows that efforts to evaluate new video goods are likely to be seriously mis-specified if they ignore time usage. However, relatively subtle modeling of time seems to be needed. We found for example that video time use falls with factors that make time more scarce, such as work and family commitments, while expenditures on DV goods tend to rise with these same factors, even after controlling for income. Evidently, people whose time is scarce tend to substitute quality of viewing for quantity.

We constructed an aggregate video goods consumption index, which takes into account qualitative as well as quantitative characteristics. Its demand properties are entirely similar to those of disaggregated goods. We have estimated a utility system that incorporates both time usage and the consumption index. This or a similar construct could be used in evaluations of consumer goods influenced by ATP's DV programs.

We had originally planned to use the consumer survey data in the CGE model described below. As it turned out, none of the ATP-supported DV innovations have reached the stage of actually affecting consumer goods or consumer benefits provided in the marketplace. Accordingly, simulations of the CGE model could not be influenced by the consumer survey data. Therefore we left these results out of our CGE model.

## The event study of patent announcements

There is some evidence from the event study that digital video patenting has a positive effect on market value of the patenting firm and a negative effect on the value of competing firms. This evidence is important because it is the *only* method we are aware of that attempts to measure the aggregate impact of *all* spillovers from an innovation. (However it does so only with respect to selected competitors, and does not evaluate effects on other actors.) It does so in an *ex ante* (predictive) sense, but

according to rational market theories accepted by many economists, those implicit market predictions are based on efficient use of knowledge about historic market relationships that is widely distributed among market actors. Consequently, with a sufficiently large sample those *ex ante* measurements would (arguably) provide an unbiased and reasonably accurate measurement of average spillover effects.

To make the evidence more persuasive, a larger sample that includes a longer time series of relatively small DV-related firms will need to be constructed. Also, a citation study of patents was used to select out "important" patents for the event study, and to select an appropriate set of competing firms. This citation study needs to be sharpened.

Most importantly, the event study needs to be respecified to focus on the actual dollar value rather than on the percentage for changes in market value induced by DV innovations. With such a measurement, we may be able to estimate an average ratio between direct effects on the innovating firm (which is relatively easy to measure), and aggregate spillover effects (which is otherwise very hard to measure).

### Interviews with client firms

A partial equilibrium approach is developed in Chapters 5 and 6. Baseline data for the approach was gathered through interviews with research staff members at ATP client firms. The interview process was designed to gather information about spillover effects and other project outcomes.

ATP intervention has stimulated the development of a number of potentially beneficial technologies. These technologies will directly affect all aspects of the creation, storage, distribution, and use of DV data. Three technologies have already resulted in marketable products.

We constructed partial equilibrium estimates of the economic impacts of the innovations arising from these projects that have been realized to date, and we made projections about their potential future impacts over a limited horizon. The combined present value of past and

anticipated benefits of these projects is estimated between \$175M and \$120M (for base year 2000), depending on the discount rate. This substantially exceeds the government's investment in the program, and is approximately equal to the combined public and private costs to date. If even a few additional projects result in substantial pay-offs the program's net social benefit will be strongly positive.

In the approach of our interview method we were especially careful to distinguish between impacts of an *innovation* and impacts of an *intervention* such as ATP funding. For the most part, we found that research staff had a clear idea of what would likely have happened in the absence of ATP funding. They were able to formulate impacts in terms of how much their research programs were accelerated. We also found that the researchers were able to identify potential network and knowledge spillovers, although they were not, for the most part, able either to quantify them, or to identify spillovers that had already occurred.

These data gathering and analysis methods would be directly applicable to estimating impacts of ATP programs in later years. Data would need to be updated through further interviews to establish a) whether and what new products have come on line; and b) whether the anticipated impacts of the products already in the market place have been borne out. In addition, network and knowledge spillovers can be verified and perhaps quantified by interviewing researchers at firms in related industries.

### The CGE and Monte Carlo models

Technology impact studies are supposed to tell stories about changes in the economy that follow from innovation. Partial equilibrium studies tell only the first part of the story -- what the innovation does to the immediate industry in which it is embedded. To complete the picture, we built a Computable General Equilibrium (CGE) intersectoral model of the US economy and simulated the overall effects of the three successful DV innovations.

Our model described a static, slack-

economy version of the US, based on 1996 data broken out into some 15 sectors. We solved the model separately for each year during 1996-2005, and separately for the actual world (including ATP interventions) and the counterfactual world (without ATP). Impacts of ATP are defined as differences between the two worlds. Different states of the world have differing R&D commitments and differing amounts of production cost savings induced by ATP-backed innovations.

We found that solutions of the model are highly sensitive to certain parameters, especially the amount of imported goods used by various industries. Import data of this kind are not measured directly in the US, so we had to infer them from import data by type of commodity demanded, aggregated across user industries. Moreover, the source data are themselves known to be relatively inaccurate. In consequence, the model is most sensitive to the parameters that are least well known. Therefore we were able to draw only qualitative conclusions from the model, not quantitative ones. These conclusions are discussed further below.

We believe that this problem is not specific to our particular specification, but rather general to intersectoral Keynesian models. All such models are sensitive to import data. Until better data become available, it will be hard to make predictions about slack economy multipliers.

We also built up a Monte Carlo model that made detailed but conservative assumptions about measurement uncertainties in the direct effects, and then aggregated them to determine overall effects on the portfolio of three established innovations. We found a surprisingly high rate of uncertainty. According to the model, the undiscounted net present value (NPV) of effects on real income has a 95% confidence interval ranging from \$50M to some \$600M. (Of course, the relative size of the confidence interval would tend to be reduced if the portfolio of successful innovations grew to include more innovations.)

## Implications for ATP's Digital Video Program

The basis of evaluation of government programs is usually restricted to partial equilibrium data - that is, to data on the relatively direct and easily measured effects of the program. Applying that standard, we believe the probabilities are substantially greater than 50% that the ATP program on net will produce a positive social profit. In other words, the real income of Americans will be greater (in a net present value sense) with the program than it would have been without it. This conclusion holds for a reasonably wide range of social discount rates.

We based this conclusion on conservative data. We asked our interviewees to give lower bound estimates of benefits. We included social gains only from three innovations that have actually reached the market, omitting many R&D projects still in the pipeline. We projected no more than 5 years into the future. We omitted any profits received by the innovators, since that might be offset by unmeasured losses to competitors. We omitted any gains that households may eventually derive from, for example, greater access to high definition TV. And we made conservative assumptions about the accuracy of our interview data.

This finding does *not* by itself imply that the ATP DV program is socially justified (or even that it is justified with a probability of 50%). First, merely having a positive social net present value (NPV) does not pass a high enough hurdle to justify a government program. In a perfect world with lump sum taxes and with fully rational trade-offs being made in all choices between public and private consumption and investment, then it is true that every program with a positive NPV should and would be implemented. But in our world, the taxes used to finance programs always induce distortions and external costs on the economy, and these costs need to be covered by the social profits of the program. (These costs conventionally are not included in NPV calculations.) Also, there exist political limitations on the size of the government budget. This raises the hurdle by putting

each government program into direct competition with other programs that also have high NPVs.

Second, much of this report is concerned with overcoming the limitations of the partial equilibrium approach. In a complex and interconnected economy, many things happen which can either augment or reduce the measured direct effects of an innovation. Our event study produced at least limited evidence that innovations do in fact reduce the profits of competing firms (but measuring the amount of lost profits will have to await further research). And our CGE model produced strong evidence that the unmeasured indirect effects of an innovation can be quite large, and can be of either sign.

What then can we say about the reliability of our partial equilibrium result when it is extended into a general equilibrium world? This report addresses only a limited situation, namely that of an economy in disequilibrium leading to a period of recession or slow growth. We assumed that the economy responds in a Keynesian fashion (there being no other coherent and operational approach to modeling disequilibrium). Under those conditions we found that indirect effects of a cost reduction are quite likely to be negative-- that is, the total effect of an innovation on the economy is less than would be predicted from partial equilibrium data. The indirect effects from diverting consumption dollars into R&D are indeterminate - that is, the lost consumption may on net be either greater or lesser than the amount of income that is diverted to R&D. Because of innate uncertainties in the CGE model, we are unable to quantify these various indirect effects with any precision. The uncertainties result from ill-measured data on imported goods by sector of use, and are unlikely to be resolved until better data can be gathered at the national level.

In future work it would be desirable to address CGE effects under conditions of full employment of factor resources. In the particular case of cost reductions, we anticipate that indirect effects will be positive rather than negative, for reasons explained in Chapter 8. We also anticipate that multipliers will be much less sensitive to import data, hopefully leading to an

acceptable level of precision. And, while the sign of the indirect effect of a transfer from consumption to R&D cannot be predicted in advance, we anticipate that it will be relatively small.

Based on these initial findings, we will propose a tentative and limited general equilibrium interpretation of our partial equilibrium results. The ATP DV program started in 1996. During 1996-2000 the US economy has experienced a period of generally full employment, while the DV program was mainly engaged in R&D. We anticipate that indirect general equilibrium effects for that period of time will be found to be small.

At the time of this writing, there are signs that the US economy may be entering a period of slow growth or recession. If so, then the indirect effects of cost reductions are likely to be negative, though they would probably not completely reverse the positive direct effects. In consequence, conservative data would no longer be able to predict whether or not the DV program will turn a social profit. That is, a full general equilibrium justification of the DV program will have to await future research that can document strong *ex post* gains.

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