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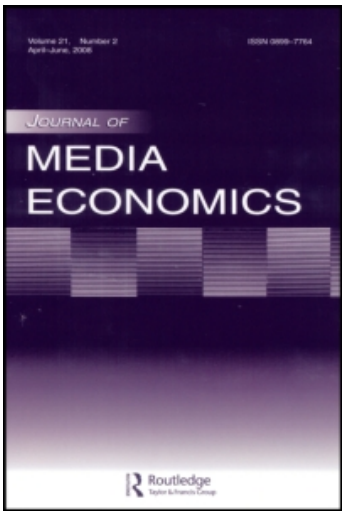

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Some Economic and Social Aspects of Residential Internet Use in Australia

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This study constructs a profile of the representative Australian residential Internet user from data obtained from a web-based survey. Survey data indicate the representative user is male, 20 to 40 years of age, highly educated, uses the Internet 8 hrs per week for e-mail and FTP, and has a monthly bill of AUD32. An ordered-logit model relates Internet use to price, sociodemographic and connection capacity variables. Model estimates show the probability of higher Internet use is greater for middle-income households, but declines with age of the user. Policy may be required to enhance access to lower-income groups, and to inform the elderly of the potential capabilities of the new technology. Further, model estimates suggest that Australian Internet subscribers prefer flat-rate pricing (or a combination of flat-rate and usage-sensitive pricing) over usage-sensitive pricing schemes. This result is consistent with Australian consumer attitudes toward local telephone and mobile cellular pricing.

The number of computers connected to the Internet (hosts) increased from 213 in 1981 to approximately 56 million in 1999 (Network Wizards, 1999). Factors influencing this rapid growth are improvements in computer technology, increased personal computer (PC) penetration, the private provision of network infrastructure, and lower prices (Sarkar, 1997). Internet host growth is also sustained by a network externality effect, whereby the value of the network to existing subscribers is enhanced as other users subscribe to the network. This externality causes a network to grow endogenously, even though nothing may be happening to the objective drivers of the system, such as prices and income (Artle & Averous 1973; Kridel,

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Rappoport, & Taylor, 1998; Rohlfs 1974). Further, the high growth rates of the mid-1990s correspond to a shift away from text-file applications such as e-mail to new bandwidth-intensive applications. In response to these demands Internet capacity has been regularly increased by engineering means and through investment in new technology.[1]

Access to information technology and telecommunications (ITT) in Australia has been traditionally promoted through universal service obligations (USOs), generally interpreted as the provision of the "plain old telephone service" (POTS).[2] A recent government review of telecommunications USOs included an assessment of the POTS definition to reflect new technology and changing community aspirations, and the identification of options to ensure high-speed data transmission over the Internet (Department of Communications and the Arts [DoCA] 1997). The Department of Communications, Information Technology and the Arts (DoCITA, 1999) and Williamson (1999) indicate that the needs of information-disadvantaged groups such as women, remote communities, the elderly, the unemployed and less well-educated persons are the most pressing from a policy perspective. However, the extant debate on USOs and broadband network access and use is characterized by a paucity of data about Australians' usage of information technology, and how this is distributed along key demographic lines.

St. Clair, Muir, and Walker (1996) note that speculation about future demand for access and use for networked services is problematic given the complex and dynamic relationship between supply, demand, and pricing. For instance, while several usage-sensitive pricing schemes have been proposed as longer-term solutions to congestion, little is known about the market reaction to the imposition of usage-sensitive only pricing (Bohn, Braun, Claffy, & Wolf, 1994; MacKie-Mason & Varian 1996; Shenker, Clark, Estrin, & Herzog, 1996).[3] Should network subscribers vote with their feet usage-sensitive pricing may stifle a creative innovation and discourage development of the network (OECD, 1997). Further, given certain user groups are accustomed to untimed local and cellular telephone calls, both business and government, and may find it commercially and politically pru-

[1]Over-provisioning ensures that sufficient network capacity is in place to support peak demands without noticeable service degradation. However, most economists view over-provisioning as costly and inefficient, and argue that expanding the capacity only allows latent demand to be realized (MacKie-Mason & Varian, 1997).

[2]The Australian Telecommunications Act 1991, S288 (1)(a) indicates the objective of the USO is "to ensure that the standard telephone service is reasonably accessible to all people in Australia on an equitable basis, wherever they reside or carry out business."

[3]To achieve optimal efficiency usage-based charges must be set equal to the marginal cost of usage. Shenker et al. (1996) argue that marginal congestion costs are inherently unmeasurable, as is the consumer loss of utility through service degradation. Further, they consider that although marginal network costs are nontrivial, they are much less than the total facility cost of providing network service, which is essentially the cost of congestion.

dent to promote fixed-price Internet access to encourage widespread use of the Internet.[4]

This study constructs a demand-side profile of Australian residential users with data obtained from a web-based survey conducted during October 13–November 3, 1997. The profile allows investigation of several research questions concerning Internet take-up. First, it identifies the characteristics of early Australian adopters of Internet services. In 1997, Australia ranked ninth in the world in Internet hosts per 100 persons (4) and fifth in PCs per 100 persons (36; International Telecommunications Union [ITU] 1999). Such a profile is useful to Australian government agencies concerned with the development of the information economy, as well as to Internet service providers (ISPs) seeking to retain and attract customers. The study also provides empirical evidence as to the acceptability of usage-sensitive Internet pricing to consumers. In particular, the hypothesis that Australian residential Internet users prefer flat-rate-component over usage-sensitive-only pricing schemes is tested, while the strength of that reaction is analyzed.[5]

The next section describes Australian Internet access, usage, and pricing, relative to developments in OECD-member countries. The survey methodology, and its strengths and weaknesses, are outlined later in this article. A profile of the representative Australian residential Internet user is contained therein. We next introduce an econometric model that explains usage variations across individuals based on sociodemographic characteristics, service application, household technology, and ISP pricing. Estimation results are presented, followed by the study's conclusions.

INTERNET ACCESS, USAGE AND PRICING

Table 1 reports OECD data for Internet access, usage, and pricing in 1996. Countries are ranked GDP per capita from highest to lowest. Average Internet hosts and users per 10,000 persons are 143 and 493, respectively. Host penetration varies from 3 for Mexico and Turkey to 613 for Finland, while user penetration varies from 19 for Turkey to 1,678 for Finland. In absolute terms, the United States has the most Internet hosts and users at 10.1 and 21 million, respectively. Hosts per 10,000 persons are below 50 for all countries with a GDP per capita less than USD $15,000. This suggests a positive relation between domestic Internet network size and national income. Australia's Internet host and user penetration are almost twice the OECD average, however, Australia's growth rates have fallen behind its OECD

[4]Australian residents pay a flat-price monthly charge for telephone access, and a flat-price per local call. Mobile cellular pricing plans typically involve a monthly rental charge, with an additional cost per call for service beyond a given threshold of calls.

[5]Flat-rate-component schemes are defined here as flat-price; and a combination of flat-price plus usage fee beyond a threshold.

TABLE 1
OECD Internet Access and Pricing 1996

Country	Income GDP Per Capita USD[a]	Internet Penetration: Hosts Per 10,000 Persons	Internet Penetration: Users Per 10,000 Persons	Total Price USD	Internet Price: PSTN Share[c]	Internet Price: Affordability (%)
Luxembourg	42,351	85	557	54.27	0.56	1.54
Switzerland	41,632	187	521	64.67	0.71	1.86
Japan	36,575	58	557	49.85	0.67	1.64
Norway	36,028	342	1,138	44.96	0.76	1.50
Denmark	33,125	203	570	61.56	0.77	2.23
Germany	28,720	84	305	65.49	0.74	2.74
USA	28,646	379	788	28.88	0.48	1.21
Sweden	28,308	269	905	43.96	0.73	1.86
Austria	27,602	110	372	89.81	0.78	3.90
Iceland	26,976	428	1,483	30.87	0.43	1.37
Belgium	26,453	64	295	52.02	0.78	2.36
France	26,357	41	86	46.11	0.80	2.10
Netherlands	25,293	174	580	56.59	0.73	2.68
Finland	24,259	613	1,678	32.05	0.74	1.59
Australia	21,383	281	1,092	24.13	0.57	1.35
Italy	21,155	26	102	46.56	0.77	2.64
Canada	20,081	201	667	20.59	0.58	1.23
UK	19,883	124	430	54.47	0.78	3.29
Ireland	18,824	76	227	67.71	0.81	4.32
New Zealand	18,455	237	840	50.80	0.41	3.30
Spain	14,792	24	134	51.01	0.61	4.14
Greece	11,754	16	143	58.28	0.51	5.95
Portugal	10,822	24	232	76.66	0.64	8.50
South Korea	10,645	15	132	*na*	*na*	*na*
Czech Rep.	5,048	40	194	*na*	*na*	*na*
Hungary	3,576	29	98	*na*	*na*	*na*
Mexico	3,466	3	29	94.29	0.32	32.7
Poland	2,747	14	124	*na*	*na*	*na*
Turkey	2,708[a]	3	19	64.53	0.48	28.6
Average	21,299	143	493	53.20	0.65	4.98
Average excluding latest members[b]	23,826	162	550	53.20	0.65	4.98

Note. Source: Some data adapted from the following sources: International Monetary Fund (IMF, 1998), ITU (1997, 1998), OECD (1997).

[a]Denotes 1995 GDP per capita. [b]Latest OECD members are the Czech Rep. (December 21 1995), Hungary (May 7 1996), Poland (Nov 22 1996) and South Korea (December 12 1996). [c]Total public switched telephone network (PSTN) price is the average of peak and off-peak charges. Internet pricing information is for 20 hours of online service per month. Total Internet price is the sum of ISP and PSTN charges. PSTN share is the ratio of PSTN charges to total Internet price. Affordability is the ratio of total annual price divided by GDP per capita.

counterparts in recent years. Between 1993–1996 Australia's growth in Internet hosts was 77% per annum compared to average OECD growth of 84.8% per annum (ITU, 1997).

Table 1 also reports OECD Internet pricing information for 20 hrs of online service per month in 1996. Many of the countries with high penetration levels, Australia, Canada, Finland, Iceland, Sweden, and the United States, have a total Internet price below the OECD average of USD $53.20. However, when examining all countries no clear relationship is apparent. Public switched telephone network (PSTN) charges typically account for over half the total cost of accessing the Internet. In these markets high local-exchange and leased-line prices charged by the public telecommunications operator represent a major barrier to Internet take-up. For instance, Internet prices in Austria, Ireland, and Switzerland are substantially above the OECD average and their levels of Internet penetration are below average.

In 1996 Australian leased-lines, local-exchange, long-distance, and international services were provided by C&W Optus and Telstra. Open competition prevailed in the ISP market. Increased competition within both the PSTN and ISP markets has driven prices steadily down but they have yet to reach the low levels of flat-rate plans offered in Canada and the United States. At the end of July 1998 there were over 300 ISPs operating in Australia, typically offering flat-rate service plans and plans that combined monthly access and usage fees. For example, on August 5, 1998, Ozemail offered to high-volume users a flat-rate unlimited usage plan for 295 Australian dollars (AUD) per month.[6] Low-volume, frequent users can subscribe to the OzSaver 2 plan that offers 20 hrs of access time for AUD39 per month and AUD5 (AUD2.50) per additional hr during the peak (off-peak) period. Australia's average Internet price of AUD30.82 (USD $24.13) for 20 hrs access (as reported in Table 1) is less than half the sample average and the second lowest of all OECD countries. Australian annual Internet affordability is also relatively low at 1.35% of annual GDP per capita.

SURVEY METHODOLOGY AND INTERNET USER PROFILE

A profile of Australian residential Internet users is obtained from a survey posted on the Communications Economics Research Program's (CERP) Web site. Because no national census or central registry of Internet users exists in Australia, sampling is necessarily nonprobabilistic. As such, it is difficult to ensure that certain portions of the Internet-subscriber population are either not excluded or otherwise disproportionately represented. This can create a problem of applying the re-

[6]The 1997 average annual exchange rate for AUD: USD is 1: 0.7829 (IMF, 1998).

sults to the entire population when the nonparticipating group is different in some manner from the participating group. Because there is no web-based broadcast mechanism that would enable participants to be selected or notified at random it was decided to advertise the survey nationally through print media and by hyperlinks attached to selected ISP home pages. This procedure gave the survey exposure at sites that capture a substantial portion of all Internet-user activity.[7]

An incentive to satisfactorily complete the questionnaire was offered through a draw in a lottery to respondents. Further, the questionnaire is layered in its design so that the "observed" information requests vary with respondents revealed Internet use and demographic profile. Focus-group feed-back, prior to posting the survey, showed the layered design substantially improved response accuracy and questionnaire completion. The document was posted to the Web page from October 13 through November 3, 1997. To activate the survey questionnaire respondents were required to click on a hyperlink. During the period of the survey 1,257 persons activated the questionnaire. Of those, 34 persons responded more than once. These actions led to the exclusion of 121 completed questionnaires from the sample, leaving 1,136 independently completed questionnaires. Most respondents found the survey while browsing (40%) or from hyperlinks attached to the home page of their ISP (33%). Identification of survey location by other media is relatively unimportant. The questionnaire was successfully completed by 591 of the 1,136 respondents (52%). A logit model failed to detect any significant relation between survey completion and the sociodemographic background of respondents.

Respondents were asked to supply information on their ISP, Internet use, expenditure, pricing plan, home technology, and sociodemographic background. The questionnaire consisted of 42 questions as follows:

(a) Two questions to indicate the main location from where the Internet is accessed and principal purpose of Internet use.
(b) Four questions concerning the timing and duration of Internet access.
(c) Three questions to identify the purpose for using the Internet.
(d) Three questions relating the mode, frequency, and amount of recent ISP billings.
(e) Four questions regarding future use.
(f) Five questions to identify the most frequently used applications.
(g) Three questions identifying details of home-technology stocks.
(h) Seven questions regarding ISP choice, satisfaction, and possible retention.
(i) Ten demographic and economic questions to identify gender, age, occupational status, income group, and household size and composition.
(j) A final question asking how the respondent located the survey.

[7]These procedures mimic those employed by the Graphic, Visualisation, and Usability Center (GVU, 1999) in conducting their WWW User Survey.

Nonprice data was used to construct a sociodemographic profile of respondent's Internet use. Men accounted for 80% of the respondents. This figure is slightly higher than that observed by the GVU (1999) survey. Australian residential Internet users are highly educated with 64% having a degree or diploma compared to 20% for the entire population. Further, more than three-quarters of the respondents were employed as professionals. Approximately 55% of Internet connections have multiple users, however, usage does not increase proportionately with the number of users. Households with two or three users sharing an Internet subscriber account have substantially lower usage than households with one, or more than three, Internet users.

About 80% of the respondents access the Internet via modems with at least 28.8 Kbps capacity, and more than 90% of Internet users regularly use e-mail. File transfer is also used widely, but Internet telephony and video-conferencing are yet to be adopted by a substantial proportion of users. The weekly household income for Internet users of AUD1,080 is more than twice that of the average Australian household (as reported by ABS, 1996). Internet take-up is concentrated around the 20 to 40 years age group, and has a similar age distribution to that reported by the ABS (1998), Kridel, Rappoport, and Taylor (1998), and GVU (1999). Although the Internet is commonly used by younger persons, a larger proportion of users in the 30–50 age group adopted the Internet six months prior to the survey.

Average weekly Internet use is 8 hrs.[8] Recent Internet adopters (first accessed within the last 6 months) have an average weekly use of 7 hrs, whereas more experienced users (more than 3 years) spend 11 hrs online. One half of the respondents are online for more than 5 hrs each week, and 10% of the respondents are connected for more than 20 hrs. Approximately 80% of the respondents make monthly ISP payments of between AUD10 and AUD60. The average monthly payment, excluding those receiving free access, is AUD32.[9] The most common pricing plan reported is a monthly access fee, with an additional usage-based fee for service beyond a given hours threshold. This plan accounts for one-third of all Internet accounts, and flat-rate and usage-sensitive plans account for 18% and 11%, respectively. Table 2 provides a profile of the representative respondent Internet user.

MODEL SPECIFICATION

The econometric model seeks to identify determinants of Australian residential Internet use. This study reports information concerning the time span within which

[8]This calculation assumes a uniform distribution within time bands, with 25 hrs the weekly average for hosts connected more than 20 hrs.

[9]Average monthly payments calculations use the price mid-point, with AUD100 as the upper limit.

TABLE 2
Representative Respondent Internet User Profile

Characteristic	
Gender	Male
Age	20–40 years
Education	Degree/Diploma
Occupation	Professional
Income	AUD 1,080 per week
Internet usage	Eight hours per week
Type of use	Email, FTP
Mode of access	Modem
Internet bill	AUD32 per month

the host is online, hours of use are not observed. A categorical dependent variable, HOURS, was created to stratify the sample into four mutually exclusive and exhaustive hours of use groups: low usage (< 4 hrs per week); medium usage (4 hrs per week); high usage (5 hrs per week); and very high usage (> 5 hrs per week).

With this information an ordered probability model was employed to explain variations in Internet usage based on pricing scheme, household technology, and respondent's sociodemographic characteristics. For the purpose of estimation discrete = variable models are often cast in the form of an index-function model. The discrete outcome, *y*, is specified as reflecting an underlying regression:

$$y^* = \beta' x + \varepsilon \tag{1}$$

where y^* is an index variable of actual Internet hours of use, β is a vector of parameters, x is a vector of measurable factors that influence these respondent's intensity of Internet use, and ε is a unique component to the individual not reflected in the data. The dependent variable, y^*, is not actually observed. What is observed is the categorical variable y (HOURS). The model assumes that distinct cut-off points, relate y^* with y in the following manner:[10]

$$\begin{aligned} y &= 0 \text{ if } y^* \le \mu_0 \\ y &= 1 \text{ if } \mu_0 < y^* \le \mu_1 \\ y &= 2 \text{ if } \mu_1 < y^* \le \mu_2 \\ y &= 3 \text{ if } y^* > \mu_2 \end{aligned} \tag{2}$$

[10]Alternatively, Greene (1997) shows that the optimal intensity of use can be described as the outcome of a sequential binary choice from an ordered set of discrete alternatives.

where the μ's are unknown partition parameters to be estimated. Theory and previous studies of ITT networks are used to guide selection of the explanatory variables contained in x (see Bodnar, Dilworth, & Iacono, 1988; Rappoport, Taylor, Kridel, & Serad, 1998; Train, McFadden, & Ben-Akiva, 1987). Independent variable descriptions and expected signs are provided in Table 3.

TABLE 3
Independent Variables

Variable	*Description*	*Expected sign*
Price		
FLAT RATE	= 1, if ISP payment is a flat-rate monthly fee, or a combination of a flat-rate monthly fee and a usage fee beyond a certain threshold of hours; 0 otherwise	≥ 0
TIMED USE	= 1, if ISP payment is a usage-sensitive only fee; 0 otherwise	≤ 0
ISP BILL	= average monthly expenditure on Internet host access	≥ 0
Socio-demographic		
INCOME1	= 1, if gross weekly household income < AUD160; 0 otherwise	≥ 0
INCOME2	= 1, if AUD160 ≤ gross weekly household income < AUD700; 0 otherwise	≥ 0
INCOME3	= 1, if AUD700 ≤ gross weekly household income < AUD1200; 0 otherwise	≥ 0
INCOME4	= 1, if gross weekly household income ≥ AUD1200; 0 otherwise	≥ 0
AGE	= respondent age in years	≤ 0
MALE	= 1, if respondent is male; 0 otherwise	?
MULTIPLE USERS	= 1, should more than one person use the Internet account; 0 otherwise	≥ 0
MONTHS	= length of Internet subscription in months	≥ 0
BROWSE	= 1, if Internet is accessed mainly for browsing; 0 otherwise	≥ 0
CHAT	= 1, if Internet is accessed mainly for chat lines; 0 otherwise	≥ 0
EMAIL	= 1, if Internet is accessed mainly for e-mail; 0 otherwise	≥ 0
FTP	= 1, if Internet is accessed mainly for file transfer; 0 otherwise	≥ 0
GAMES	= 1, if Internet is accessed mainly to play games; 0 otherwise	≥ 0
Modem capacity		
CABLE	= 1, if Internet is accessed by cable modem; 0 otherwise	≤ 0
LESS288	= 1, if Internet is accessed by dial-up modem with capacity less than 28.8 kbps; 0 otherwise	≥ 0

Note. Education and occupation variables were excluded from the analysis due to their close correlations with INCOME.

ESTIMATION RESULTS

The ordered-logit model results from Equation 1 when the cumulative density of ε is assumed logistic. Model estimates are obtained by maximum likelihood estimation using the algorithm proposed by Fletcher (1980). Table 4 reports coefficient estimates for hours of Internet use. Marginal effects, calculated using the separate procedures for continuous and discrete variables outlined in Greene (1997), are reported in Table 5.

Diagnostic testing reveals the model performs well. A likelihood ratio test rejects the hypothesis that all slope parameters are equal to zero ($\chi^2 = 224.93$). An anticipated problem is heteroskedasticity as the variations in Internet use may in-

TABLE 4
Estimated Internet Use Equation

Variable	*Estimate*	*Standard Error*	*t Ratio*
Price			
FLAT RATE	0.5911	0.1035	5.7105
TIMED USE	–0.3973	0.1463	–2.7152
ISP BILL	0.0224	0.0025	8.7985
Socio-demographic			
INCOME1	0.1137	0.2429	0.4679
INCOME2	0.4506	0.1719	2.6215
INCOME3	0.2713	0.1304	2.0799
INCOME4	0.0205	0.1138	0.1798
AGE	–0.0111	0.0034	–3.2207
MALE	0.1740	0.1272	1.3674
MULTIPLE USERS	0.0353	0.0956	0.3696
MONTHS	0.0089	0.0046	1.9195
BROWSE	0.1201	0.1279	0.9390
CHAT	0.4623	0.1111	4.1625
E-MAIL	0.0534	0.1747	0.3056
FTP	0.2577	0.1017	2.5345
GAMES	–0.0399	0.1212	–0.3293
Connection capacity			
CABLE	–1.0682	0.3766	–2.8368
LESS288	0.2355	0.1966	1.1983
Partition parameters for index function			
μ_1	1.2952	0.0800	16.1899
μ_2	2.2434	0.0958	23.4278
Sample size	591		
Log likelihood	–681.47		
Restricted log likelihood	–793.94		

Note. μ_0 is normalized to 0.

TABLE 5
Marginal Effects

Variable	*Prob (y = 0) Low Use*	*Prob (y = 1) Medium Use*	*Prob (y = 2) High Use*	*Prob (y = 3) Very High Use*
Price				
FLAT RATE	–0.1019	–0.1368	0.0847	0.1540
TIMED USE	0.0648	0.0870	–0.0539	–0.0979
ISP BILL	–0.0039	–0.0053	0.0033	0.0059
Socio-demographic				
INCOME1	–0.0228	–0.0307	0.0190	0.0345
INCOME2	–0.0789	–0.1059	0.0656	0.1192
INCOME3	–0.0478	–0.0642	0.0398	0.0722
INCOME4	–0.0051	–0.0068	0.0042	0.0077
AGE	0.0016	0.0022	–0.0014	–0.0025
MALE	–0.0336	–0.0452	0.0280	0.0508
MULTIPLE USERS	–0.0085	–0.0114	0.0071	0.0128
MONTHS	–0.0016	–0.0022	0.0014	0.0025
BROWSE	–0.0242	–0.0325	0.0201	0.0365
CHAT	–0.0799	–0.1073	0.0665	0.1207
EMAIL	–0.0310	–0.0416	0.0258	0.0468
FTP	–0.0454	–0.0610	0.0378	0.0687
GAMES	0.0051	0.0069	–0.0043	–0.0077
Modem capacity				
LESS288	–0.0414	–0.0556	0.0345	0.0626
CABLE	0.1765	0.2370	–0.1468	–0.2667

crease with hours of Internet use. However, homoskedasticity of the error process is supported by a likelihood ratio test ($\chi^2 = 11.95$).[11] Given the normalization of μ_0 to zero, the estimated partition boundaries satisfy the condition for positive probabilities ($\mu_2 > \mu_1$). Finally, the model correctly predicts 46.5% of the sample observations, while a naive model, that always places Internet users in the lowest USE category correctly predicts 14.9%.

Marginal effects are of interest because they provide a measure of the impact in the changes of an *x* variable on the likelihood of an Internet host having a usage in the *i*th HOURS band, all other *x* constant.[12] However, the marginal effects must be interpreted with caution. For continuous variables, increasing one of the *x*s while holding β (>0) and μ constant is equivalent to shifting the probability distribution slightly to the right. The effect of this shift is unambiguously to shift some mass out of the leftmost cell and Prob ($y = 0$) must decline. Clearly, some probability is

[11]The likelihood ratio test of the hypothesis of homoskedasticity is based on $\lambda = n \ln s^2 - \Sigma_g n_g \ln s_g 2$, where $n = \Sigma_g n_g$, s^2 is the pooled least-squares residual variance.

[12]The marginal effects for continuous variables sum to zero across rows, which follows from the requirement that probabilities add to one.

shifted into the rightmost cell and Prob ($y = 4$) must increase. What happens in the middle cells is ambiguous. At best, it can be stated that a higher value for x implies a higher predicted probability that the respondent will be observed in the extreme (very high) HOURS band. The interpretation for discrete independent variables is slightly different. For instance, a positive value for β on INCOME3 implies that respondents with AUD700 ≤ income < AUD1200 have an increased probability of being very high users of the Internet.

The significance of INCOME2 and INCOME3 indicates that household income is a driver of residential Internet use. The insignificance of the extreme income measure, INCOME4, is not unexpected given that previous studies of ITT networks suggest high income groups may be income rich but leisure-time poor (Williamson, 1999). Internet use is inversely related to age, with higher values for age implying a higher predicted probability that the respondent will be observed in the low HOURS band. A learning effect is apparent with MONTHS. The marginal effects indicate an increase in the number of months respondents are subscribed to the Internet increases the likelihood that they will use the Internet for a higher number of hours per week. The significance of the FTP variable suggests respondents who use the Internet mainly for file transfers are likely to have higher hourly levels of Internet use. By contrast, the insignificance of EMAIL reflects the fact that e-mail uses minimal network capacity and is unlikely to increase the number of hours a user spends on the Internet. The positive sign on CHAT is intuitive. Respondents who use the Internet mainly to participate in chat lines and forums will spend more time on the network. Finally, cable modems provide greater capacity between the user and ISP, and increased transmission speeds are likely to mean lower hours of Internet use per week.

All price variables are significantly different from zero and conform to a priori expectations. The marginal effects suggest that Internet users on flat-rate-component pricing plans are more likely to be in the very high Internet-use band relative to respondents without flat-rate plans. Similarly, respondents on usage-sensitive-only pricing plans are more likely to be located in the low Internet-use band. Essentially, the coefficient estimates and marginal effects for FLAT RATE and TIMED USE imply that residential Internet users may be unwilling to accept usage-sensitive-only pricing as the basis of their ISP connection arrangements. The probability of increased Internet usage increases with ISP BILL.

CONCLUSIONS

Recently, the Australian government has provided a framework to make digital data and Internet capability comparable to an ISDN channel available to all people in Australia by January 2000. Charges for services supplied under the USO

can be regulated to safeguard the continuing affordability of such services. Although regulation can maintain an affordable price and extend Internet accessibility and use, consumer response to lower Internet prices has yet to be carefully quantified. Speculation about future Internet demand can be problematic given the complex relationship between supply, demand, and pricing.

This study constructs a profile of the representative Australian residential Internet user from data obtained from a web-based survey. Internet user characteristics should prove useful to governments concerned with Internet acceptance and universal service in the information economy, as well as to ISPs when developing marketing strategies. Survey data indicate that the representative respondent Internet user is male, 20 to 40 years of age, highly educated, uses the Internet 8 hrs per week for e-mail and FTP, and has a monthly bill of AUD32. Logit-model results identify several important sociodemographic predictors of Internet use. The probability of greater usage increases with income, but declines with age of the user. These relations suggest that policies that guarantee Internet access may not be sufficient to promote Internet use. Policy may be required to enhance access to lower-income groups, ensuring that they are not further disadvantaged relative to the information rich. Education programs may also be needed to inform the elderly of the potential capabilities of the new technology.

Economists advocate demand-side solutions to alleviate congestion through better demand management and the efficient pricing of Internet services. Although usage-sensitive pricing takes into account the social cost of congestion, it ignores network externalities and the social benefits from widespread Internet access and use. Other than the standard network externality, positive spillovers arise from innovation in related technology, increased access to information and knowledge, and the development of new markets such as electronic commerce. Several attempts have been made to develop pricing mechanisms to reflect the true social cost of Internet use. Setting aside the practical difficulties of determining what the appropriate prices should be, little attention has been given to the consumer acceptance of usage-sensitive-only pricing as opposed to the dominant flat-rate-component schemes that are currently in operation.

The study provides empirical evidence as to acceptability of usage-sensitive-only pricing to consumers. Survey data suggest that Australian Internet subscribers prefer flat-rate pricing (or a combination of flat-rate and usage-sensitive pricing) over usage-sensitive-only pricing schemes. This result is consistent with Australian consumer attitudes toward local telephone service and mobile cellular pricing plans. Ordered logit-model estimates confirm this preference. Respondents on flat-rate-component pricing plans are likely to use the Internet for a greater number of hours per week than respondents on usage-sensitive pricing plans. Thus, usage-sensitive pricing appears a very blunt instrument whose use is not costless, especially when attempting to ensure USOs are met.

Although the model results represent an important first step in understanding determinants of residential Internet use, many questions still remain to be addressed. Among these, from a policy perspective, is the applicability of model results to populations outside Australia, and beyond the current Internet user population. Second, the analysis of business demand, in particular small to medium enterprise, is outside the range of this study.

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