# Broadband Economics
## Lessons from Japan

**Takanori Ida**

**First published 2009**

**ISBN: 9780415472562 (hbk)**
**ISBN: 9780415860741 (pbk)**
**ISBN: 9781315889603 (ebk)**

## Chapter 5

**Fixed-line broadband: From ADSL to FTTH**



Routledge
Taylor & Francis Group
LONDON AND NEW YORK

# 5 Fixed-line broadband: From ADSL to FTTH

This chapter will consider the structure of the fixed-line broadband market during the initial period of deployment, including observations based on econometric analysis. Fixed-line broadband began its explosive growth in Japan in 2001 when Softbank BB entered the market. Today, there are clear indications of a full-scale rollout of fiber to the home (FTTH) services, so it is widely believed that ADSL will be superseded by FTTH in the not-too-distant future. In this chapter I will consider fixed-line broadband from the following four points. First, citing data, I will examine the supply-side structure of fixed-line broadband. Taking up ADSL, FTTH, and CATV Internet in turn, I will examine trends in the number of subscribers, market shares, and price levels of each type of service. Second, I will consider the broadband user demand structure, based on a consumer questionnaire. I will examine peoples' objectives in using the Internet, their reasons for selecting a particular service provider, and how and why they migrated from narrowband to broadband and from ADSL to FTTH Internet services. Third, I conduct a discrete choice model analysis based on the consumer questionnaire data. First, I will measure demand substitutability using actual revealed preferences (RP) data, focusing on the degree of price elasticity for the various services. Next, I consider the amount people claim they would be willing to pay for faster throughput using hypothetical choice situations and stated preferences (SP) data. Here, I focus on how the actual availability of FTTH affects consumers' preferences. Fourth, I will address policy-related issues now under discussion including the definition of broadband markets, the state of effective competition in the ADSL market, and the degree of market dominance over the FTTH market.

## Analysis of fixed-line broadband supply

Table 2.4 in Chapter 2 displayed the number of subscribers to different broadband services. This section analyzes broadband supply-side trends for each service. Today, the majority of broadband subscribers receive service over ADSL connections, followed by FTTH, then CATV Internet. When broadband first started to take hold in Japan around the year 2000, CATV

Internet predominated. But then with the widespread popularity and rapid penetration of ADSL in 2002, people quickly came to associate ADSL with broadband. More recently, FTTH has begun to cut into ADSL's market share, and especially in the cities where there is already little difference in price, we can anticipate that FTTH will supersede ADSL over the next few years. Given these extreme changes in the broadband sphere, it is not surprising that supply trend fluctuations have also been striking. Now I take a closer look at ADSL, FTTH, and CATV Internet in turn and examine recent developments involving these services.

### *ADSL supply analysis*

Table 5.1(a) shows the change in the number of ADSL subscribers from 2001 to 2007. ADSL saw a full-scale rollout in 2002 and experienced steady continuous growth until the number of lines exceeded 10 million in 2004. But examining the figures a little closer in half-year increments we see that the greatest growth was achieved in the latter half of 2002 when 2.8 million connections were added, but that the growth rate had slowed to only 880 thousand new lines added by second half of 2004. By then, the ADSL market had matured and was largely saturated. And now that FTTH services are becoming available, we might expect the demand for ADSL to change from a net increase to a net decrease if there is a major shift from ADSL to FTTH. These trends well convey the intensity of ongoing change and dynamism of the broadband market.

Table 5.1(b) shows the changes in market share among Japanese providers of ADSL services from 2002 to 2007. The providers lease lines from NTT East and West in a line-sharing arrangement, and market the ADSL services to end-users. In other words, the services are close to 100% dependent on NTT's infrastructure, but NTT East and West have less than 50% share of the ADSL market between them. NTT did not share in the initial period of rapid ADSL penetration from 2002 to 2003—in fact, the company's share of the market slipped from 40% to 30%—so it is apparent that the explosive growth during this period was driven not by NTT but by the nondominant competing carriers. Eventually, after 2004, NTT's share of the market stabilized around the mid 30% range. Essentially, the ADSL market reached maturity through fierce competition between NTT and the competing providers until the urban areas were largely saturated, and now the battle for market share has shifted from the cities to the countryside. The competing carriers have shown much less interest in the rural areas where the demand density is so low, so by exploiting its ability to provision services nationwide, NTT's market share rebounded somewhat of its own accord.

Now let us consider the competitive situation among providers a little more closely. Table 5.2 shows the number of ADSL subscribers broken down by provider in March 2007. NTT East and West have the largest share of 38%, but Softbank is a close second with 37% share of the ADSL market. The two

*Table 5.1* ADSL market trends

| | *2001.3* | *2001.9* | *2002.3* | *2002.9* | *2003.3* | *2003.9* | *2004.3* | *2004.9* | *2005.3* | *2005.9* | *2006.3* | *2006.9* | *2007.3* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) Change in ADSL subscribers | | | | | | | | | | | | | |
| NTT East | n.a. | n.a. | 0.5 | 0.9 | 1.4 | 1.9 | 2.3 | 2.6 | 2.8 | 2.6 | 3.0 | 2.9 | 2.8 |
| NTT West | n.a. | n.a. | 0.5 | 0.8 | 1.1 | 1.5 | 1.8 | 2.1 | 2.4 | 3.0 | 2.7 | 2.6 | 2.5 |
| Others | n.a. | n.a. | 1.4 | 2.5 | 4.5 | 5.8 | 7.1 | 8.1 | 8.5 | 8.7 | 8.9 | 8.9 | 8.7 |
| Total | 0.1 | 0.7 | 2.4 | 4.2 | 7.0 | 9.2 | 11.2 | 12.8 | 13.7 | 14.3 | 14.5 | 14.4 | 14.0 |
| (b) Changes in market share among ADSL providers | | | | | | | | | | | | | |
| NTT East | | | 24.1% | 22.2% | 20.4% | 20.8% | 20.4% | 20.5% | 20.7% | 20.8% | 20.4% | 20.2% | 19.9% |
| NTT West | | | 21.4% | 18.7% | 16.1% | 16.6% | 16.1% | 16.6% | 17.4% | 18.2% | 18.4% | 18.3% | 18.1% |
| Others | | | 54.5% | 59.1% | 63.5% | 62.6% | 63.5% | 62.9% | 61.9% | 61.0% | 61.2% | 61.5% | 62.0% |
| Total | | | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

*Note:* Figures are millions.

*Source:* MIC (2007).

leaders are followed by eAccess and ACCA Networks, so Japan's ADSL market is essentially an oligopolistic structure dominated by these four companies. A kind of polarized structure has emerged with Softbank and other competing carriers maintaining a competitive advantage in the cities through aggressive price competition, and NTT East and West having a competitive edge in rural areas because the competing carriers have shown only passive interest in these areas. While the market is an oligopoly, there is nevertheless fierce competition for customers among the big four. Competition is clearly working very effectively in this market as the service providers woo consumers with free service promotional campaigns, faster throughput speeds, and other service improvements.

Next, let us take a closer look at the actual substance of the ADSL services. A low-speed version of ADSL was first made available about the year 2000, which supported a download rate of about 1.5 Mbps. This was followed by intermediate-speed services with throughputs of 8 Mbps and 12 Mbps, and it was these offerings that sparked the rapid growth of ADSL in 2002. ADSL speeds have continued to accelerate, most recently from 40 Mbps to 50 Mbps. Note however that the Internet supports best-effort services, so actual speed diminishes the further the user is from the telephone exchange. Table 5.3 shows the number of ADSL subscriber lines broken down by download speed. First, one will observe the relatively small number of users who subscribe to the low-speed ADSL services. These are mostly people who do not use the Internet very much or people who live in rural areas where high-speed ADSL is not available. Second, one can see that the intermediate-speed services are the most popular, constituting 58% of the ADSL market. Many of these users signed up for nominally higher speed services, but because of freezes and congestion and other problems, the actual performance was slower, which moved them into the intermediate-speed category. Third, despite the difficulty of reaching nominal speeds, the number of high-speed ADSL lines has steadily increased. This means that some users will always opt for the highest speed service that is available, migrating from low-speed ADSL to intermediate-, then high-speed ADSL, and finally to FTTH.

Table 5.4 shows a comparison of ADSL rates charged by NTT East and by Softbank. Note that NTT East's line connection and ISP services are not vertically integrated so ISP charges are not included in these figures, while Softbank's line connection and ISP services are vertically integrated so the ISP charges are included in Softbank's figures. In other words, ISP charges of ¥500 to ¥2,000 must be added to NTT East's rates in order to make the figures comparable. When NTT's figures are adjusted, it is apparent that Softbank's charges are substantially less than NTT's. Before Softbank, ADSL service cost about ¥5,000 a month, but then Softbank entered the market offering ADSL services for less than half that amount. Softbank also radically increased consumer awareness of ADSL with a marketing strategy of selling services from local stores, which contrasted sharply with NTT's approach. It is no exaggeration to say that Softbank single-handedly brought

*Table 5.2* Number of ADSL subscribers by provider

| | *Softbank* | *NTT East* | *NTT West* | *a Access* | *ACCA* | *Others* | *Total* |
|---|---|---|---|---|---|---|---|
| No. of contracts | 5.3 | 2.9 | 2.6 | 2.0 | 1.1 | 0.5 | 14.4 |
| Market shares | 36.8% | 19.9% | 18.1% | 13.7% | 7.8% | 3.7% | 100% |

*Note:* Figures are millions, as of March 2007.

*Source:* MIC (2007).

*Table 5.3* Number of ADSL subscriber lines by download speed

| | *2004.3* | *2004.9* | *2004.12* |
|---|---|---|---|
| Low-speed (Around 1.5Mbps) | 1.7 | 1.9 | 2.0 |
| Medium-speed (Around 8–12Mbps) | 7.7 | 7.8 | 7.8 |
| High-speed (24Mbps and over) | 1.8 | 3.1 | 3.6 |

*Note:* Figures are millions.

*Source:* MIC (2007).

about the explosive growth of ADSL in Japan. Nor must we overlook the fact that it was the Ministry of Internal Affairs and Communications' (MIC) competition policy of permitting new entrants to access NTT lines at relatively low cost that enabled this to happen. Given the substantial difference in price, it is surprising that NTT has been able to hold onto roughly the same share of market as Softbank. Demand analysis distinguishes two very different groups of users: the group gravitating to Softbank is primarily concerned with price, while the group that stayed with NTT is more concerned with brand recognition and stability. We summarize the main points as follows:

**ADSL supply analysis**
ADSL, which accounts for more than half of Japan's broadband lines, spread very rapidly beginning around 2002 as a result of Softbank's aggressive price-slashing strategy. The current ADSL market is an oligopoly dominated by four companies, with NTT and Softbank almost tied for largest market shares. However, there are clear indications that the ADSL market has reached maturity, and it is likely that ADSL will be superseded by FTTH in the not-too-distant future.

### *FTTH supply analysis*

Table 5.5(a) shows the change in number of FTTH subscriber lines from 2002 to 2007. While the uptake of FTTH could not be described as explosive, the number of lines has steadily increased over the period. By 2004, the number of lines had exceeded 2 million, approximately on a par with CATV Internet. Even at this scale, Japan is the only country with such a robust and growing FTTH market. Having all the genuine attributes of true broadband—enormous capacity, ultrahigh speed, symmetrical upload and download throughputs—FTTH is the ultimate fixed-line broadband topology, and will certainly converge with mobile services in the near future.

Table 5.5(b) shows the change in market share among providers of FTTH services from 2002 to 2007. In 2002, when FTTH services first became available in Japan, NTT East and West had a very modest share of the market

*Table 5.4* Comparison of ADSL rates

| | | *2001 1st* | *2001 2nd* | *2002 1st* | *2002 2nd* | *2003 1st* | *2003 2nd* | *2004 1st* | *2004 2nd* |
|---|---|---|---|---|---|---|---|---|---|
| NTT East | Speed | 1.5Mbps | 8Mbps | | 12Mbps | | 24Mbps | 40Mbps | 47Mbps |
| | Price | ¥4,050 | ¥3,100 | | ¥3,200 | | ¥2,750 | ¥2,750 | ¥2,800 |

*Note:* Figures do not include payment for Internet service providers.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Softbank BB | Speed | | 8Mbps | | 12Mbps | | 26Mbps | 45Mbps | 50Mbps |
| | Price | | ¥2,280 | | ¥2,480 | | ¥2,680 | ¥2,780 | ¥2,780 |

*Note:* Figures include ISP charges.

*Source:* MIC (2007).

while the competing carriers had the predominant share. In other words, initially, NTT East and West were not dominant incumbent providers in the FTTH sector. However, subsequently, NTT greatly extended its share, so that by September 2004, NTT East and West had captured 60% of the FTTH market. NTT is thus the central driving force in the recent rapid penetration of FTTH. The competing carriers can be divided into two camps: the power company operators who deliver FTTH services over their own optical fiber facilities, and the other operators who provide FTTH services over fiber lines leased from NTT. The former are referred to as *facilities-based competing operators*, and the latter are called *service-based competing operators*. When the power company operators take customers away from NTT East and West, this creates a class of users that does not use NTT's facilities at all, so NTT loses all income from these customers, including wholesale and retail revenues. It is clear that the power companies, with financial resources and brand recognition on a par with NTT, will emerge as NTT's most formidable rivals in the years ahead. Currently, the power companies have less than 10% share of the market, but this reflects the stalwart efforts of just a handful of utilities including Kansai Electric Power and Kyushu Electric Power. As other utilities enter and capture shares of the market, the power companies will assume a far greater presence in the FTTH market in the future.[1]

Table 5.6 shows a comparison of FTTH rates charged by the main FTTH service providers. Note that the figures for NTT East and West do not include ISP charges, while the figures for K-Opticom and USEN do include the ISP charges. This means that ISP charges of ¥500 to ¥2,000 must be added to NTT's rates to make the figures comparable. One can see that, as a result of competition, FTTH service charges have steadily declined. It is important to note that this price competition does not only involve FTTH, but also directly competes with the price of ADSL services. For example, in cities, subscribers pay a total of ¥4,500 a month for NTT's ADSL service when including a plain basic telephone minimum charge of ¥1,500 to ¥1,700. Meanwhile, single-family residential subscribers pay about that same amount (¥4,500) and condominium residents pay even less for NTT's FTTH service, since they can cancel the fixed-line charges by signing up for Voice over Internet Protocol (VoIP) telephone with 0ABJ number portability. At least in the cities, price is no longer an obstacle to upgrading from ADSL to FTTH service.

So far, we have not distinguished between FTTH services for single-family residences (detached house-type) and businesses on the one hand and FTTH services for multi-dwelling units (Mdialup, or apartment-type) on the other. Table 5.7 shows the change in the number of single-family and business FTTH subscribers, and Table 5.8 shows the change in the number of multi-dwelling unit FTTH subscribers. Comparing Tables 5.7(a) and 5.8(a), one can see that more fiber lines are being deployed to single-family homes and businesses than to multi-dwelling units. The lag in line deployments to Mdialups is attributed to the difficulty of working out arrangements among the different people living in Mdialup complexes (say if some residents want FTTH

*Table 5.5* FTTH market trends

| | *2002.3* | *2002.9* | *2003.3* | 2003.9 | *2004.3* | *2004.9* | 2005.3 | *2005.9* | *2006.3* | *2006.9* | *2007.3* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) Change in number of FTTH subscribers | | | | | | | | | | | |
| NTT East | n.a. | 0.05 | 0.11 | 0.25 | 0.43 | 0.63 | 0.89 | 1.30 | 1.89 | 2.60 | 3.40 |
| NTT West | n.a. | 0.02 | 0.09 | 0.25 | 0.41 | 0.58 | 0.78 | 1.05 | 1.53 | 2.12 | 2.68 |
| Power Company | n.a. | 0.03 | 0.06 | 0.10 | 0.18 | 0.27 | 0.48 | 0.66 | 0.86 | 1.07 | 0.92 |
| USEN | n.a. | 0.02 | 0.06 | 0.10 | 0.14 | 0.19 | 0.28 | 0.38 | 0.47 | 0.52 | 0.55 |
| Others | n.a. | 0.07 | 0.11 | 0.16 | 0.29 | 0.35 | 0.47 | 0.59 | 0.70 | 0.84 | 1.27 |
| Total | 0.07 | 0.19 | 0.42 | 0.86 | 1.45 | 2.03 | 2.90 | 3.98 | 5.46 | 7.16 | 8.80 |
| (b) Change in market share among FTTH providers | | | | | | | | | | | |
| NTT East | | 27.1% | 26.4% | 28.9% | 29.4% | 31.1% | 30.6% | 32.7% | 34.6% | 36.4% | 38.6% |
| NTT West | | 10.1% | 20.9% | 28.8% | 28.5% | 28.7% | 26.9% | 26.5% | 28.0% | 29.6% | 30.4% |
| Power Company | | 15.2% | 13.7% | 12.2% | 12.1% | 13.4% | 16.5% | 16.5% | 15.8% | 15.0% | 10.4% |
| USEN | | 11.7% | 13.1% | 11.3% | 9.9% | 9.5% | 9.7% | 9.5% | 8.7% | 7.3% | 6.2% |
| Others | | 35.9% | 25.9% | 18.9% | 20.1% | 17.3% | 16.4% | 14.8% | 12.9% | 11.7% | 14.4% |
| Total | | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

*Note:* Figures are millions.

*Source:* MIC (2007).

*Table 5.6* Comparison of FTTH rates

| | | *2nd of 2001* | *1st of 2002* | *2nd of 2002* | *1st of 2003* | *2nd of 2003* | *1st of 2004* | *2nd of 2004* | *1st of 2005* |
|---|---|---|---|---|---|---|---|---|---|
| NTT East | Detached house-type | ¥5,000 | | | ¥4,500 | | | | ¥4,100 |
| | Apartment-type | ¥3,800 | ¥3,500 | | | | | ¥2,900 | |

*Note:* Figure do not include ISP charges.

*Source:* MIC (2007).

while others do not), additional problems installing fiber in Mdialups, and other factors. What is most interesting here is the market shares of these sectors held by the different service providers. Table 5.7(b) shows the market shares of the different operators for FTTH services to single-family homes and businesses. As of March 2007, NTT East and West had a 79% share of this market, and the power company providers were trailing far behind with only 13% share of the market. NTT is thus overwhelmingly dominant in the market to provide FTTH services to single-family homes and businesses. Now turning to Table 5.8(b), this shows the market shares of different operators to provide FTTH services to Mdialups. In this market, NTT had less than 60% share as of March 2007, though the figure is rapidly increasing. It will be apparent that, in discussing market dominance in provisioning FTTH services, it is necessary to differentiate the single-family home and business market from the Mdialup market. We summarize the main points as follows:

**FTTH supply analysis**

NTT East and West control a commanding share of the FTTH market. A few of the power company providers have made a good effort to get into the FTTH market, but so far they have not evolved into a truly countervailing force. Interestingly, NTT's share of the market to supply FTTH services to Mdialups is far less than its share of the market to provide FTTH services to single-family homes and businesses. The cost of FTTH services is not markedly higher than other alternative services, so a rapid migration from ADSL to FTTH services is anticipated.

### *CATV Internet supply analysis*

Table 5.9 shows the change in the number of CATV Internet connections from 2002 to 2007. A lot of people signed up for CATV Internet when broadband first became available, but growth has been very modest since ADSL and FTTH services were rolled out. The fact that CATV Internet has played such a modest role in Japan compared with other countries distinguishes Japan's broadband deployment. In Japan there are more than 300 CATV Internet service providers, most of which are local companies. Most of these service providers offer throughputs of around 30 Mbps on a best-effort basis for a basic charge of about ¥5,000 a month, which is relatively expensive compared to the cost of ADSL service. A key issue is how these CATV Internet operators will be able to maintain their unique identity in the face of explosive ADSL growth and full-scale rollout of FTTH services. One radically different approach that deserves close attention is that of Jupiter Telecommunications (J-COM), which is growing very rapidly by taking equity stakes in other cable companies and by providing value-added capabilities to

*Table 5.7* Detached house-type FTTH market trends

| | *2003.9* | *2004.3* | *2004.9* | *2005.3* | *2005.9* | *2006.3* | *2006.9* | *2007.3* |
|---|---|---|---|---|---|---|---|---|
| (a) Change in number of detached house-type FTTH subscribers | | | | | | | | |
| NTT East | 0.19 | 0.32 | 0.46 | 0.61 | 0.85 | 1.19 | 1.57 | 2.03 |
| NTT West | 0.22 | 0.35 | 0.48 | 0.62 | 0.80 | 1.14 | 1.54 | 1.88 |
| Power Company | 0.08 | 0.12 | 0.20 | 0.37 | 0.52 | 0.69 | 0.86 | 0.67 |
| Others | 0.01 | 0.02 | 0.02 | 0.02 | 0.06 | 0.11 | 0.13 | 0.43 |
| Total | 0.50 | 0.83 | 1.18 | 1.64 | 2.26 | 3.13 | 4.09 | 5.01 |
| (b) Change in market share among detached house-type FTTH providers | | | | | | | | |
| NTT East | 39% | 39% | 39% | 37% | 38% | 38% | 38% | 41% |
| NTT West | 43% | 43% | 41% | 38% | 35% | 36% | 38% | 38% |
| Power Company | 16% | 15% | 17% | 22% | 23% | 22% | 21% | 13% |
| Others | 3% | 4% | 3% | 3% | 4% | 4% | 3% | 9% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Note:* Figures are millions.

*Source:* MIC (2007).

*Table 5.8* Apartment-type FTTH market trends

| | *2003.9* | *2004.3* | *2004.9* | *2005.3* | *2005.9* | *2006.3* | *2006.9* | *2007.3* |
|---|---|---|---|---|---|---|---|---|
| (a) Change in number of apartment-type FTTH subscribers | | | | | | | | |
| NTT East | 0.05 | 0.10 | 0.17 | 0.28 | 0.44 | 0.70 | 1.03 | 1.37 |
| NTT West | 0.03 | 0.06 | 0.10 | 0.16 | 0.26 | 0.39 | 0.58 | 0.79 |
| USEN | 0.09 | 0.13 | 0.17 | 0.26 | 0.35 | 0.44 | 0.49 | 0.51 |
| Power Company | 0.03 | 0.06 | 0.08 | 0.10 | 0.13 | 0.17 | 0.21 | 0.20 |
| KDDI | 0.01 | 0.04 | 0.07 | 0.09 | 0.13 | 0.16 | 0.15 | 0.28 |
| Others | 0.15 | 0.24 | 0.29 | 0.37 | 0.4 | 0.46 | 0.59 | 0.64 |
| Total | 0.36 | 0.62 | 0.88 | 1.26 | 1.72 | 2.33 | 3.06 | 3.79 |
| (b) Change in market share among apartment-type FTTH providers | | | | | | | | |
| NTT East | 15.1% | 16.4% | 19.7% | 22.2% | 25.6% | 30.1% | 33.8% | 36.1% |
| NTT West | 8.7% | 9.8% | 11.4% | 12.9% | 15.0% | 16.7% | 18.8% | 20.8% |
| USEN | 23.8% | 20.3% | 19.4% | 20.3% | 20.1% | 19.1% | 16.0% | 13.5% |
| Power Company | 7.6% | 8.8% | 8.5% | 8.1% | 7.8% | 7.3% | 7.0% | 5.4% |
| KDDI | 3.4% | 5.8% | 7.9% | 7.2% | 7.8% | 7.0% | 5.0% | 7.3% |
| Others | 30.0% | 34.4% | 33.0% | 30.1% | 26.1% | 19.8% | 19.4% | 16.9% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

*Note:* Figures are millions.

*Source:* MIC (2007).

existing fixed-line telephony and Internet connection services. We summarize the main points as follows:

**CATV Internet supply analysis**

The relative proportion of CATV Internet compared with other kinds of connections is declining. There are many providers of this kind of service, and most are small-scale. The CATV Internet providers are also mostly local operators, and there is a question as to how they will maintain their unique identity in competition with other services.

## Demand analysis of fixed-line broadband

This section analyzes the demand for access to Internet by using a discrete choice model. The survey was carried out as a Web questionnaire and a representative sample was randomly chosen from households with all five Internet access alternatives. The total number of respondents is 1,013 and the draw of samples reflects national population densities.

### *Basic statistics of survey*

In the following we explain the basic descriptive statistics and the data collected by a series of surveys of Internet access demand for private use conducted according to *The Effective Competition Review of Japan's Telecommunications*, published in June 2004 by the MIC.

Table 5.10 gives the reasons for using the Internet (note: multiple answers are permitted here): (1) Web browsing (44.7%); (2) email (34.9%); (3) online shopping (5.5%); (4) online chat and bulletin boards (4.2%). We observe that the main reasons for using the Internet are still confined to such basic uses as Web and email, and users fail to handle advanced functions. Table 5.11 next shows the reasons for choosing their present Internet access line service provider: (1) low price (44.4%); (2) brand power (23.0%); (3) transmission speed (22.7%); and such miscellaneous reasons as service reliability and using IP telephone, watching cable TV. Therefore, the three important factors for determining providers are price, brand power, and service quality.

Table 5.12(a) shows the selection ratio of the currently using Internet access services. Selection ratios follow: dialup (2%), ISDN (5%), ADSL (67%), FTTH (8%), and CATV Internet (18%). The figure for narrowband Internet access services including dialup and ISDN is low (7.3%), while it is overwhelmingly high (92.7%) for broadband Internet access services composed of ADSL, CATV Internet, and FTTH. As seen in Table 5.12(b), the national ratio of narrowband users is 65%, while it is 35% for broadband users as of September 2003, therefore the overwhelming share of broadband

*Table 5.9* CATV Internet market trends

| | *2002.3* | *2002.9* | *2003.3* | *2003.9* | *2004.3* | *2004.9* | *2005.3* | *2006.3* | *2006.9* | *2007.3* |
|---|---|---|---|---|---|---|---|---|---|---|
| CATV Internet subscribers | 1.5 | 1.8 | 2.1 | 2.3 | 2.6 | 2.8 | 3.0 | 3.3 | 3.5 | 3.6 |
| No. of CATV Internet providers | 252 | 274 | 282 | 304 | 307 | 347 | 372 | 377 | 382 | n.a. |

*Note:* Figures are millions.

*Source:* MIC (2007).

*Table 5.10* Reasons for using the Internet

| *Web browsing* | *Email* | *Online shopping* | *Online chat* | *Online banking* | *Game* |
|---|---|---|---|---|---|
| 44.7% | 34.9% | 5.5% | 4.2% | 3.6% | 3.0% |

*Note:* Multiple answers are permitted.

*Source:* MIC (2004).

*Table 5.11* Reasons for choosing Internet access provider

| *Low price* | *Brand power* | *Transmission speed* | *Service reliability* | *IP telephone* |
|---|---|---|---|---|
| 44.4% | 23.0% | 22.7% | 17.9% | 14.0% |

*Note:* Multiple answers are permitted.

*Source:* MIC (2004).

*Table 5.12* Selection ratio of Internet access services

| | *Dialup* | *ISDN* | *ADSL* | *FTTH* | *CATV* | *Total* |
|---|---|---|---|---|---|---|
| (a) Ratio of this survey | | | | | | |
| No. of samples | 18 | 40 | 534 | 66 | 141 | 799 |
| Selection ratio | 2.3% | 5.0% | 66.8% | 8.3% | 17.6% | 100% |
| (b) Ratio of national average (as of 2003.9) | | | | | | |
| Selection ratio | 61% | 4% | 27% | 2% | 6% | 100% |

*Source:* MIC (2004).

is no doubt due to the bias coming from the Web survey. However, as far as broadband users is concerned, the breakdown of 72%(ADSL) : 9%(CATV) : 19%(FTTH) in our survey corresponds to 77%(ADSL) : 6%(CATV) : 17%(FTTH) very well. Thus, this survey can apply for the broadband demand investigation.

Table 5.13 indicates basic statistics. Average monthly expenditures, defined as the sum of connection fees and ISP charges are shown as follows: dialup: ¥3946 ($35.9), ISDN: ¥5207 ($47.3), ADSL: ¥4344 ($39.5), FTTH: ¥5929 ($54.1), and CATV: ¥5200 ($47.3). Narrowband services are not always cheaper than broadband services because their charges are usage sensitive while broadband are flat. Among broadband services, FTTH is the most expensive while ADSL is the cheapest, as obviously expected. Average nominal access speeds are shown as follows: dialup: 52 Kbps, ISDN: 65 Kbps, ADSL: 10 Mbps, FTTH: 82 Mbps, and CATV: 11 Mbps. A huge gap exists between narrowband and broadband services as well as differences among broadband services (ADSL, CATV, and FTTH) concerning nominal access speed. We summarize the main points as follows:

*Table 5.13* Basic statistics

| *Dialup* | *ISDN* | *ADSL* | *FTTH* | *CATV* |
|---|---|---|---|---|
| (a) Average monthly price (Internet access line charge + ISP charge) | | | | |
| ¥3,946 | ¥5,208 | ¥4,344 | ¥5,929 | ¥5,199 |
| (b) Average nominal speed | | | | |
| 52Kbps | 65Kbps | 10Mbps | 82Mbps | 11Mbps |
| (c) Average effective speed | | | | |
| 37Kbps | 58Kbps | 2Mbps | 9Mbps | 3Mbps |

*Source:* MIC(2004)

**Broadband users survey**

Most broadband users are still confined to using basic services including Web browsing and email. Price is the most important factor when choosing an Internet access service, reflecting the fact that the majority of the current broadband users are subscribing to ADSL.

***Demand substitutability of broadband services***

This subsection explores the demand substitutability of broadband services based on the demand survey. Table 5.14 shows the reasons for choosing their present Internet access service: (1) always-on connectivity (55.9%); (2) a flat rate system (41.0%); (3) low prices (31.7%); (4) transmission speed (25.7%); and such miscellaneous reasons as easy introduction, no-charge campaigns, IP telephony, and CATV service. Looking closely at each service, always-on connectivity and flat rate system rank higher for ADSL and CATV, which is a general feature of broadband service compared to narrowband services. For FTTH, transmission speed ranks top, followed by always-on connectivity and flat rate system. Accordingly, we can consider that ADSL and CATV Internet are entry services for broadband and FTTH is an exit to which ADSL and CATV Internet users migrate.

Table 5.15 shows access line services to which they subscribed before moving to the currently using services. It is observed that most users migrated from dialup, ISDN, CATV Internet to ADSL. And ADSL users are gradually moving to FTTH. In this respect, ADSL is an entry to broadband service and FTTH is the exit.

Last, Table 5.16 indicates access line services that they want to use one year later. Users of dialup, ISDN, and ADSL services reply that they will use

*Table 5.14* Reasons for choosing Internet access service

| | *Always-on* | *Flat rate* | *Low prices* | *Transmission speed* | *No-charge campaigns* |
|---|---|---|---|---|---|
| (a) Total | 55.9% | 41.0% | 31.7% | 25.7% | 9.3% |
| (b) ADSL | 64.8% | 40.2% | 29.3% | 7.0% | 30.5% |
| (c) FTTH | 72.4% | 35.2% | 20.0% | 20.0% | 11.4% |
| (d) CATV | 64.7% | 36.6% | 26.8% | 17.0% | 16.3% |

*Note:* Multiple answers permitted.

*Source:* MIC (2004).

*Table 5.15* Previously subscribed access line services

| Before | *After* | | |
|---|---|---|---|
| (a) Dialup (547 cases) | ADSL | CATV | ISDN |
| | 63% | 14% | 13% |
| (b) ISDN (163 cases) | ADSL | FTTH | CATV |
| | 77% | 15% | 6% |
| (c) ADSL (43 cases) | FTTH | CATV | |
| | 79% | 14% | |
| (d) CATV (30 cases) | ADSL | FTTH | |
| | 63% | 37% | |
| (e) FTTH (3cases) | ADSL | Dialup | |
| | 67% | 33% | |

*Source:* MIC (2004).

ADSL, but it is important that FTTH ranks second in ISDN and ADSL and top in CATV Internet. To sum up, most narrowband users will gradually migrate to entry broadband services such as ADSL and CATV Internet and finally to FTTH. We summarize the main points as follows:

*Table 5.16* Access line services to use one year

| *Before* | *After* | | |
|---|---|---|---|
| | ADSL | Dialup | FTTH |
| (a) Dialup | 29% | 25% | 13% |
| | ADSL | FTTH | ISDN |
| (b) ISDN | 30% | 23% | 20% |
| | ADSL | FTTH | CATV |
| (c) ADSL | 37% | 34% | 11% |
| | FTTH | ADSL | |
| (d) CATV | 35% | 29% | |
| | FTTH | | |
| (e) FTTH | 61% | | |

*Source:* MIC (2004).

**Broadband demand substitutability**

ADSL and CATV Internet are entry services for broadband Internet, and their always-on connectivity and flat rate system are evaluated higher. On the other hand, FTTH is the final broadband service, and its ultra-transmission speed is considered important. Therefore, broadband migration will be from narrowband to ADSL and CATV Internet, and then to FTTH.

## Discrete choice model analysis of broadband (revealed preference method)

Much econometrics research has analyzed the demand structure of local telecommunications markets. Taylor's informative survey analyzed customer demand of telecommunications services (2002). One innovation of the demand analysis in the literature of the 1980s and 1990s is the widespread use of discrete choice models, particularly for analyzing access demand under the assumption that consumer choice is qualitative with or without access. Perl (1978, 1983) was one of the first to apply a discrete choice model to the analysis of telecommunications access demand, followed by such discrete choice models as logit and probit (for example, Ben-Akiva and Gershenfeld, 1989; Kridel, 1988; Taylor and Kridel, 1990; Kridel and Taylor, 1993; Bodnar,

Dilworth, and Iacono, 1988; Solvason, 1997). The emergence of a nested logit model, which partially alleviated the independence of irrelevant alternative (IIA) property of a conditional logit model, was also important (see Train et al., 1987, 1989; Train, 2003).

This section analyzes the demand for access to Internet by using a discrete choice model based on Ida and Kuroda (2006), which is the first comprehensive analysis of the demand for broadband services including FTTH. Although analyses of broadband demands are limited, Madden, Savage, and Coble-Neal (1999), Madden and Simpson (1997), Eisner and Waldon (2001), Kridel, Rappoport, and Taylor (2001), and Dufy-Deno (2003) are noteworthy pioneers in the field.

### *RP data*

In the following we explain the basic descriptive statistics and the data collected by a series of surveys of Internet access demand for private use conducted according to *The Competition Review of Japan's Telecommunications for FY 2003*, published in June 2004 by MIC.

The survey was carried out as a Web questionnaire and a representative sample was randomly chosen from households with all five Internet access alternatives: (i) dialup, (ii) always-on ISDN, (iii) ADSL, (iv) FTTH, and (v) CATV Internet. The total number of observations was 1,013; excluding omissions and abnormalities, we obtained 799 observations for nominal speed data and 789 observations for actual speed data.

Table 5.17 summarizes the basic descriptive statistics. Selection ratios follow: (i) dialup: 2%, (ii) ISDN: 5%, (iii) ADSL: 67%, (iv) FTTH: 8%, and (v) CATV: 18%. Since the number of dialup and ISDN users was very limited, it was difficult to consider them as independent alternatives; therefore, we combined dialup and ISDN into one narrowband alternative at this point.[2]

Table 5.18 then examines the differences between NTT users and non-NTT users. As for average monthly expenditures, NTT users pay about ¥1000–1500 more than non-NTT users. Results of the Welch test allow us to reject the null hypothesis that both users pay the same rates at a 1% level of statistical significance (t-value = 7.16 for ADSL and 3.86 for FTTH).[3] NTT dominates the market despite the fact that NTT's Internet access line fees are higher. NTT users still account for 32% of the ADSL market and 65% of the FTTH market. The results of a poll on the choice criteria of current Internet access line providers (allowing for multiple answers) are summarized as follows: (1) low price (44.4%), (2) brand power (23.0%), (3) access speed and functionality (22.7%), (4) stability and reliability (17.9%). The Internet service users can be divided into two groups: non-NTT users who mainly focus on price aspects, and NTT users who emphasize brand power or reliability. We summarize the main points as follows:

*Table 5.17* RP data basic statistics

| | | *Dialup* | *ISDN* | *ADSL* | *FTTH* | *CATV* |
|---|---|---|---|---|---|---|
| (a) Nominal speed | | | | | | |
| No. of samples | | 18 | 40 | 534 | 66 | 141 |
| Price (¥) | mean | 3,946 | 5,207 | 4,344 | 5,929 | 5,200 |
| | s.d. | 3,007 | 2,121 | 1,395 | 1,780 | 1,921 |
| | minimum | 1,030 | 3,500 | 1,580 | 2,625 | 2,100 |
| | maximum | 13,000 | 12,175 | 12,000 | 13,600 | 12,000 |
| Nominal speed | mean | 52 | 65 | 10,044 | 81,909 | 10,589 |
| (Kbps) | s.d. | 9 | 10 | 5,919 | 33,594 | 8,602 |
| | minimum | 32 | 56 | 1,000 | 10,000 | 1,000 |
| | maximum | 56 | 128 | 26,000 | 100,000 | 30,000 |
| (b) Effective speed | | | | | | |
| No. of samples | | 18 | 38 | 511 | 61 | 149 |
| Price (¥) | mean | 3,889 | 5,026 | 4,285 | 5,872 | 5,162 |
| | s.d. | 3,071 | 2,178 | 1,512 | 1,819 | 1,989 |
| | minimum | 1,030 | 3,800 | 1,580 | 2,625 | 2,100 |
| | maximum | 9,650 | 10,547 | 18,000 | 9,600 | 10,600 |
| Effective speed | mean | 37 | 57 | 2,073 | 9,351 | 2,803 |
| (Kbps) | s.d. | 12 | 16 | 2,096 | 9,752 | 2,666 |
| | minimum | 13 | 54 | 13 | 1,000 | 83 |
| | maximum | 41 | 121 | 24,754 | 48,346 | 17,187 |

*Source:* Ida and Kuroda (2006).

*Table 5.18* Average expenditures of NTT and non-NTT users

| | *ADSL* | | *FTTH* | |
|---|---|---|---|---|
| | *NTT users* | *Non-NTT users* | *NTT users* | *Non-NTT users* |
| No. of samples | 173 | 361 | 43 | 23 |
| Average expenditures (¥) | 5,000 | 4,028 | 6,439 | 4,974 |
| Variance | 1,590 | 1,169 | 1,826 | 1,236 |
| Welch – t value | 7.16 | | 3.86 | |

*Source:* Ida and Kuroda (2006).

**RP data**

Looking at the RP data derived from the broadband demand survey, although NTT users pay about ¥1000–1500 more than non-NTT users, the market shares of NTT East and West are still higher. The reason for this may be that broadband users are divided into the price-oriented and the quality-oriented.

***Four alternative models and the criteria of model selection***

Here we analyze Internet access demand using a representative discrete choice model. Dependent variables are the four Internet access services: (i) narrowband (dialup/ISDN), (ii) ADSL, (iii) CATV Internet, and (iv) FTTH. The independent variables are: (i) the fixed term of each alternative, (ii) average monthly expenditure (price), (iii) nominal or effective access speed, and (iv) the NTT users dummy variable.

Here is a problem. What proxies should be used for the prices and speeds of non-chosen alternatives? We do not know them for the non-chosen alternatives. However, we do have detailed information on individual characteristics including Internet access line provider, Internet service provider, and income class for each customer. Therefore, we classify all customers according to the above individual characteristics (such as IAP, ISP, and income class) and calculate the price and speed averages for respective groups. Then, we use them as proxies for all alternatives, including the chosen one.[4]

Note, furthermore, that we first investigate nominal access speed and later discuss effective access speed; since such individual characteristics as age, gender, and income are not statistically significant, we did not directly address them in this analysis.

We consider the following kinds of logit models: one conditional logit (CL) model and four two-level nested logit (NL) models:

- CL: [narrowband, ADSL, CATV, FTTH],
- 2-NL (i): [narrowband] v. [ADSL, CATV, FTTH],
- 2-NL (ii): [narrowband] v. [ADSL] v. [CATV, FTTH],
- 2-NL (iii): [narrowband] v. [FTTH] v. [ADSL, CATV],
- 2-NL (iv): [narrowband] v. [CATV] v. [ADSL, FTTH],

  Note: [ ] denotes a choice set, and v. means a partition of choice sets.

Since a CL model requires that the IIA property must hold, we conduct the Hausman test based on this assumption. If we adopt the NL model, determining the nested choice structure becomes problematic (Greene, 2003). So we establish the following model selection criteria.[5] First, we examine whether the coefficient signs of such important variables as price and speed meet our expectations: the sign of price parameter is expected to be negative, and the

speed parameter is expected to be positive. Second, we investigate whether, at the 1% or 5% level, the t-values of such important parameters as price and speed are statistically significant. Third, we compare the goodness of fit of the models and determine the best model with the highest value. We consider a McFadden $R^2$ to be the goodness of fit measure.

### *Estimation results of four alternative models*

Table 5.19 compares the estimation results of the four alternative models. Beginning with the CL model, the sign conditions of price/nominal-speed parameters and the statistical significance at a 1% level of price parameter are satisfied, but, on the other hand, the statistical significance of the nominal speed parameter is satisfied only at a 10% level. When we execute the Hausman test and exclude ADSL and CATV alternatives from the choice set, we obtain $\chi^2(2)=17.7677$, which means that the IIA assumption of the CL model can be rejected at a 1% level of statistical significance. Consequently, the CL model is not appropriate.

Second, turning to the four kinds of two-level NL models, the sign conditions and the statistical significance at the 1% level of price/nominal-speed are all satisfied. Comparing their figures of McFadden $R^2$, we see that the 2-NL (i) model has the highest McFadden $R^2$; therefore, it is appropriate to divide the four alternatives into two categories: a narrowband category that

*Table 5.19* Comparison of four alternative models

| *Sign conditions* | | *Statistical significances* | | *McFadden $R^2$* |
|---|---|---|---|---|
| (a) The CL model [NB, ADSL, CATV, FTTH] | | | | |
| price | nominal speed | price | nominal speed | 0.38399 |
| (–) | (+) | 1% significant | 10% significant | |
| (b) NL models | | | | |
| (i) [NB] v. [ADSL, CATV, FTTH] | | | | |
| price | nominal speed | price | nominal speed | 0.50130 |
| (–) | (+) | 1% significant | 1% significant | |
| (ii) [NB] v. [ADSL] v. [CATV, FTTH] | | | | |
| price | nominal speed | price | nominal speed | 0.33823 |
| (–) | (+) | 1% significant | 1% significant | |
| (iii) [NB] v. [ADSL, CATV] v. [FTTH] | | | | |
| price | nominal speed | price | nominal speed | 0.49365 |
| (–) | (+) | 1% significant | 1% significant | |
| (iv) [NB] v. [ADSL, FTTH] v. [CATV] | | | | |
| price | nominal speed | price | nominal speed | 0.47265 |
| (–) | (+) | 1% significant | 1% significant | |

*Note:* Hausman test $X^2(2)=17.7677$ p-value=0.00014.

*Source:* Ida and Kuroda (2006).

includes dialup and ISDN, and a broadband category that includes ADSL, CATV Internet, and FTTH.[6]

We conclude from the above that we should adopt the 2-NL (i) model with estimation results shown in Table 5.20. Since a value of 0.3 of McFadden $R^2$ generally corresponds to around 0.6 of OLS $R^2$, we conclude that 0.5 of McFadden $R^2$ represents a high goodness of fit. Constant terms, price, nominal speed, and IV parameters are statistically significant. Furthermore, although we include the NTT dummy variable in the model because NTT users pay significantly more than non-NTT users, this statistical significance is very low.

Let us next consider the own-*price* elasticities of access demand.[7] This figure of ADSL is about 0.8, and thus the ADSL service is inelastic. An increase in ADSL price does not significantly decrease the demand for ADSL. The ADSL market itself is so gigantic that ADSL users are switching from low-speed (1.5 Mbps) to medium-speed (8–12 Mbps) and finally to high-speed band (more than 24 Mbps) within the ADSL market. We later scrutinize the ADSL market and divide it into three submarkets.

On the other hand, own-price elasticities of access demand are about 3.2

*Table 5.20* Estimation results of the 2-NL (i) model

| | | | |
|---|---|---|---|
| No. of samples | 799 | | |
| LL(1234) | –682.175 | | |
| LL(0) | –1367.896 | | |
| ρ | 0.50130 | | |
| *Parameters* | *Coefficients* | *Standard errors* | *t-values* |
| price | –0.00074 | 0.00010 | –7.37000 |
| nominal speed | 0.000022 | 0.000006 | 3.69100 |
| constant term (NB) | –1.03264 | 0.25091 | –4.11600 |
| constant term (FTTH) | –2.43898 | 0.58094 | –4.19800 |
| constant term (CATV) | –0.49144 | 0.21204 | –2.31800 |
| NTT dummy | 34.08949 | 271145.0 | 0.00000 |
| IV parameter | 0.77620 | 0.14203 | 5.46500 |
| Price own-elasticities of demand | | | |
| NB | –3.325 | | |
| ADSL | –0.846 | | |
| FTTH | –3.150 | | |
| CATV | –2.500 | | |
| Nominal speed own-elasticities of demand | | | |
| NB | 0.001 | | |
| ADSL | 0.058 | | |
| FTTH | 1.261 | | |
| CATV | 0.147 | | |

*Note:* The model structure is [NB] v. [ADSL, CATV, FTTH].

*Source:* Ida and Kuroda (2006).

for FTTH and 2.5 for CATV, which are elastic. This means that a 1% increase in price decreases the demand for FTTH or CATV significantly. Consequently, ADSL service is less elastic to price than FTTH and CATV.[8] We summarize the main points as follows:

**Estimation results of four alternatives model**

The best model for explaining the demand for broadband services is the nested logit model in which a decision-maker first chooses narrowband or broadband nest and then chooses ADSL, CATV Internet, or FTTH after choosing the broadband nest. Investigating the own-elasticity of demand with respect to price, ADSL is inelastic, while CATV Internet and FTTH are elastic.

*(*) Nominal speed or effective speed?*

There are two kinds of Internet transmission speed: nominal and effective. We cannot intuitively determine to which speed consumers attach more importance when choosing services or providers. Having dealt with nominal speed, we also estimate models with effective speed being assumed to be an explanatory variable. We consequently see that neither sign condition nor statistical significance was satisfied; using effective speed is less advantageous than nominal speed as an explanatory variable for two reasons. First, the variance of effective speed is so large that it is not suited for econometric analysis; second, since the Internet is a so-called "best-effort" type of service, we cannot know the true quality of service (eg effective speed) before actual use.[9] However, consumer preferences may eventually rely on effective speed rather than nominal speed as broadband services become more popular.

***Analysis of ADSL submarkets***

We have shown that the own-price elasticity of ADSL demand is much lower than FTTH and CATV Internet. However, since the ADSL market itself is so huge, occupying around 70% of the whole broadband market, it is informative to examine the submarkets of ADSL. At this point, we divide the ADSL market into three submarkets: low-speed (around 1.5 Mbps), medium-speed (around 8–12 Mbps), and high-speed (more than 24 Mbps). Table 5.21 shows the basic descriptive statistics of the ADSL market. Note that medium-speed ADSL users account for 74% of the ADSL market.

Here we scrutinize the ADSL submarkets. Table 5.22 indicates the results of model selection. Beginning with the CL model, the sign conditions and the

*Table 5.21* Basic statistics of the ADSL market

| | *No. of samples* | *NTT users* | *Price* | | *Nominal speed* | |
|---|---|---|---|---|---|---|
| | | | *average (¥)* | *s.d.* | *average (Kbps)* | *s.d.* |
| L-ADSL | 87 | 32 | 4,248 | 1,712 | 1,397 | 204 |
| M-ADSL | 396 | 118 | 4,329 | 1,294 | 10,090 | 1,995 |
| H-ADSL | 51 | 23 | 4,615 | 1,543 | 24,431 | 831 |

*Source:* Ida and Kuroda (2006).

statistical significance at a 1% level of price/nominal-speed are satisfied. However, when we carried out the Hausman test, excluding the L-ADSL alternative from the choice set, we obtained $\chi^2(2)=289.3$, allowing us to reject the IIA assumption at a 1% level. Then, we compared the three two-level NL models:

- 2-NL(i): [L-ADSL] v. [M-ADSL, H-ADSL],
- 2-NL(ii): [M-ADSL] v. [L-ADSL, H-ADSL],
- 2-NL(iii): [H-ADSL] v. [L-ADSL, M-ADSL].
  Note: [ ] denotes a choice set, and v. means a partition of choice sets.

Obviously, the 2-NL (ii) model is best because the sign conditions and statistical (1% level) significance of the price and speed parameters are all satisfied; furthermore, its McFadden $R^2$ is the highest. Table 5.23 indicates the

*Table 5.22* Comparison of ADSL submarkets

| *Sign conditions* | | *Statistical significances* | | *McFadden $R^2$* |
|---|---|---|---|---|
| (a) The CL model [L-ADSL, M-ADSL, H-ADSL] | | | | |
| price | nominal speed | price | nominal speed | 0.48124 |
| (–) | (+) | 1% significant | 1% significant | |
| (b) NL model | | | | |
| (i) [L-ADSL] v. [M-ADSL, H-ADSL] | | | | |
| price | nominal speed | price | nominal speed | 0.50955 |
| (–) | (+) | insignificant | 5% significant | |
| (ii) [M-ADSL] v. [L-ADSL, H-ADSL] | | | | |
| price | nominal speed | price | nominal speed | 0.51341 |
| (–) | (+) | 1% significant | 1% significant | |
| (iii) [H-ADSL] v. [L-ADSL, M-ADSL] | | | | |
| price | nominal speed | price | nominal speed | 0.49374 |
| (–) | (+) | 1% significant | 5% significant | |

Note: Hausman test $X^2(2)=289.3$ P-value=0.00000.

*Source:* Ida and Kuroda (2006).

*Table 5.23* Estimation result of ADSL submarkets

| | | | |
|---|---|---|---|
| No. of samples | 534 | | |
| LL(1234) | –200.498 | | |
| LL(0) | –704.9307 | | |
| ρ | 0.71558 | | |
| *Parameters* | *Coefficients* | *Standard errors* | *t-values* |
| price | –0.00120 | 0.00027 | –4.34700 |
| nominal speed | 0.00019 | 0.00007 | 2.62800 |
| constant term (L-ADSL) | 2.28583 | 1.18310 | 1.93200 |
| constant term (H-ADSL) | –2.08902 | 0.98504 | –2.12100 |
| NTT dummy | 36.27031 | 665519.0 | 0.00000 |
| IV parameter (L-ADSL) | 0.51638 | 0.21706 | 2.37900 |
| IV parameter (M-ADSL) | 0.27175 | 0.07070 | 3.84400 |
| Price own-elasticities of demand | | | |
| L-ADSL | –10.595 | | |
| M-ADSL | –2.585 | | |
| H-ADSL | –9.067 | | |
| Nominal speed own-elasticities of demand | | | |
| L-ADSL | 0.543 | | |
| M-ADSL | 0.934 | | |
| H-ADSL | 7.453 | | |

*Note:* The model structure is [M-ADSL] v. [L-ADSL, H-ADSL].

*Source:* Ida and Kuroda (2006).

estimation results of the 2-NL (ii) model. Looking at the own-*price* elasticities of access demand, the medium-speed ADSL figure is 2.6. On the other hand, since the figures are 10.6 for low-speed ADSL and 9.1 for high-speed ADSL, they are very elastic. In conclusion, ADSL users can be divided into two groups: those who are normally sensitive to price changes, the medium-speed ADSL users, and those who are extremely sensitive to price changes, the low-speed and high-speed ADSL users. We summarize the main points as follows:

**Estimation results of four alternatives model**

Looking closely at the ADSL demand structure, users can be divided into two categories: first, the low-speed and high-speed ADSL users and, second, the medium-speed ADSL users. The estimation results conclude that the former are very elastic, while the latter are inelastic.

## Discrete choice model analysis of broadband (stated preference method)

This section investigates the stated preference (SP) of broadband markets based on Ida and Sato (2007). We first explain the SP data used in the analysis. We next discuss the estimation results. Consequently, we found that the actual availability of FTTH has an effect on the stated preferences of consumers and also that stated preference and revealed preference may vary for certain populations.

### *SP data*

The key approach adopted here is *conjoint analysis*, or the stated preference method (SPM). It aims to measure consumers' preferences based not on the actual data observed in the market but instead on answers to a virtual questionnaire, which highlights a remarkable difference from revealed preference methods (RPM). Compared with RPM, one advantage of SPM is that it is virtual by nature and scrutinizes consumers' preferences that are generally ignored or overlooked. For instance, even when we cannot collect actual product data prior to its market launch, we can quantitatively evaluate such products with SPM.

Particular analysis purposes shape the contours and amount of the attributes that should be introduced into a profile. If we include too many attributes, the respondents will have difficulty answering the questions.[10] On the other hand, if we adopt too few attributes, the description of alternative will become inadequate. In our research, the pretests were prudently carried out three times, and then we determined the attributes and levels. The attributes of profiles used in this research are presented as follows:

- Alternatives: ADSL, CATV Internet, FTTH,
- Prices of each service:
  - ADSL price: ¥2,500, ¥3,000, ¥3,500, or ¥4,000,
  - CATV Internet price: ¥4,500, ¥5,000, ¥5,500, or ¥6,000,
  - FTTH Price: ¥6,000, ¥6,500, ¥7,000, or ¥7,500.
- Access speeds of each service:
  - ADSL speed: 1Mbps, 10Mbps, or 20Mbps,
  - CATV Internet speed: 20Mbps or 30Mbps,
  - FTTH speed: 30Mbps or 100Mbps.
- IP telephony: available or unavailable for all services,
- TV programs: always unavailable for ADSL; always available for CATV Internet; available, partially available, or unavailable for FTTH,
- Provider's type: NTT or non-NTT for ADSL and FTTH; always non-NTT for CATV Internet,
- Transmission speed symmetry: always asymmetric for ADSL and CATV Internet; always symmetric for FTTH.

Since the number of profiles becomes too large if we consider all possible combinations of the attributes, we adopt an orthogonal planning method to avoid this problem. At this point, there are five alternatives in this multiple-choice question: alternatives 1 and 2 are ADSL, alternative 3 is CATV Internet, and alternatives 4 and 5 are FTTH. There may be strong similarities between alternatives 1 and 2 and between alternatives 4 and 5. Figure 5.1 indicates a representative questionnaire.

Next we explain the data and the basic descriptive statistics collected by the same survey based on *The Effective Competition Review* as explained above. We surveyed a random sample of two groups to investigate how actual FTTH availability influences SP, or how the SP and RP of identical populations are different. Group A, derived from a population having access to FTTH, is 105. Group N, derived from the population without access to FTTH, is 104. We conduct a conjoint analysis for these respondents, asking them the seven questions. Thus, the numbers of observations are 105*7=735 for group A and 104*7=728 for group N. The results of the questionnaire are summarized in Table 5.24.

Comparing groups A and N, the ratio of choosing ADSL is higher in group N (60.1%) than in group A (52.5%); on the other hand, choosing FTTH is lower in group N (27.6%) than in group A (32.5%). Accordingly, we suppose that the actual availability of FTTH would influence preferences and cause different choice behaviors in this conjoint analysis. We summarize the main points as follows:

**SP data**

SPM is effective for analyzing broadband services whose innovation is rapid and demand is quickly changing. By conjoint analysis, we scrutinize the influence of the availability of FTTH on consumers' preferences.

***Estimation results of SP models***

Conjoint analysis studies consumer preferences based on their hypothetical choices. It is then interesting to consider whether respondents' choices are influenced by the actual availability of alternatives. As stated, the respondents were divided into two sub-samples: group A with access to FTTH and group N without, a division merely based on the difference of living environments of respondents; otherwise the questionnaire was identical for the two groups. If this difference in the actual availability of FTTH systematically influences the consumers' SP, the estimated coefficients will be different between the two groups.

To test the null hypothesis that the estimated coefficients are the same between the two groups A and N, we used a likelihood ratio (LR) test

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|---|---|---|---|---|---|
| Service | **ADSL** | **ADSL** | **CATV** | **FTTH** | **FTTH** |
| Price | ¥2,500 | ¥4,000 | ¥5,500 | ¥7,000 | ¥6,000 |
| Access speed | 10Mbps | 20Mbps | 30Mbps | 100Mbps | 30Mbps |
| Symmetry | Asymmetric | Asymmetric | Asymmetric | Symmetric | Symmetric |
| IP telephony | Available | Unavailable | Available | Available | Unavailable |
| TV programs | Unavailable | Unavailable | Available | Partially available | Unavailable |
| Provider | Non-NTT | NTT | Non-NTT | Non-NTT | NTT |

*Figure 5.1* Representative questionnaire.

*Source:* Ida and Sato (2007).

*Table 5.24* Answers to conjoint analysis

| | *ADSL* | | *CATV* | *FTTH* | |
|---|---|---|---|---|---|
| (a) Answers from group A (FTTH available) | | | | | |
| Alternatives | 1 | 2 | 3 | 4 | 5 |
| No. of choice | 276 | 110 | 110 | 146 | 93 |
| Subtotal | 386 | | 110 | 239 | |
| | | | Prices (¥) | | |
| Mean | 2916.7 | 3513.6 | 5100.0 | 6213.6 | 6639.8 |
| S.D. | 465.5 | 588.3 | 528.1 | 603.7 | 586.8 |
| | | | Speeds (Mbps) | | |
| Mean | 12.3 | 11.5 | 24.7 | 80.3 | 87.2 |
| S.D. | 5.8 | 6.0 | 7.3 | 31.6 | 27.2 |
| *Note:* No. of choice=7 questions × 105 samples=735. | | | | | |
| (b) Answers from group N (FTTH unavailable) | | | | | |
| No. of choice | 294 | 150 | 83 | 107 | 94 |
| Subtotal | 444 | | 83 | 201 | |
| | | | Prices (¥) | | |
| Mean | 2960.9 | 3550.3 | 5066.3 | 6120.4 | 6585.1 |
| S.D. | 479.3 | 547.6 | 516.6 | 599.3 | 561.5 |
| | | | Speeds (Mbps) | | |
| Mean | 12.6 | 12.3 | 27.1 | 79.3 | 84.4 |
| S.D. | 5.8 | 5.7 | 5.1 | 32.1 | 29.3 |

*Note:* No. of choice=7 questions × 104 samples=728.

*Source:* Ida and Sato (2007).

(Ben-Akiva and Lerman 1985). Concretely, we calculated the quantity of LR=–2[LL(A+N)–{LL(A)+LL(N)}] that is asymptotically $\chi^2$ distributed, where LL(x) represents the log-likelihood of group x∈ {*A*, *N*}. At this point, we obtain LR=21.919. Consequently, we reject the null hypothesis at the 1% level of statistical significance. The actual availability of FTTH significantly changes the consumers' SP.

Table 5.25 indicates the estimation results of groups A and N, and Table 5.26 summarizes the values of willingness to pay (WTP). The WTP for 1 Mbps is about ¥32 ($0.29) for group A individuals who can avail of FTTH, while it is about ¥45 ($0.41) for group N who cannot. People without access to FTTH have a higher preference for an increase in access speed than those to whom FTTH is available.

This slightly surprising result can be explained as follows. FTTH is mostly available in urban areas such as Tokyo, Osaka, and Nagoya, while areas without access to FTTH are mainly rural or sparsely populated. In urban areas, the competition between firms who provide ADSL and FTTH is very fierce; therefore, people living in the urban areas can easily switch services or

*Table 5.25* SP data estimation results

| | *(a) Group A (FTTH available)* | | | *(b) Group N (FTTH unavailable)* | | |
|---|---|---|---|---|---|---|
| No. of samples | 735 | *S.E.* | *t-value* | 728 | | |
| LL(b) | –1093.8830 | *S.E.* | *t-value* | –1067.324 | | |
| LL(0) | –1182.9369 | *S.E.* | *t-value* | –1171.6708 | | |
| ρ | 0.0753 | *S.E.* | *t-value* | 0.0891 | | |
| *Parameters* | *Coefficients* | *S.E.* | *t-value* | *Coefficients* | *S.E.* | *t-value* |
| Price | –0.00059 | 0.00011 | –5.45518 | –0.00038 | 0.00009 | –4.19554 |
| Speed | 0.01887 | 0.00254 | 7.43680 | 0.01708 | 0.00256 | 6.66874 |
| IP telephony | 0.52844 | 0.10561 | 5.00364 | 0.29988 | 0.08646 | 3.46847 |
| Partial TV program | –0.10494 | 0.17823 | –0.58880 | 0.15618 | 0.18659 | 0.83701 |
| Full TV program | 0.81555 | 0.50075 | 1.62864 | –0.47293 | 0.31972 | –1.47921 |
| NTT dummy | –0.38844 | 0.15894 | –2.44401 | –0.16697 | 0.16209 | –1.03015 |
| Symmetry dummy | –0.28544 | 1.20197 | –0.23748 | –0.98611 | 0.67430 | –1.46242 |
| IV parameter ((ADSL) | 0.21930 | 0.25615 | 0.85614 | 0.73095 | 0.55741 | 1.31134 |
| IV parameter (CATV) | 1.00000 | – | – | 1.00000 | – | – |
| IV parameter (FTTH) | 0.36153 | 0.19013 | 1.90150 | 0.77015 | 0.37258 | 2.06705 |

*Source:* Ida and Sato (2007).

*Table 5.26* WTP measurements

| | *(a) Group A (FTTH available)* | | | *(b) Group N (FTTH unavailable)* | | |
|---|---|---|---|---|---|---|
| *Attributes* | *Coefficients* | *WTP* | *Significance* | *Coefficients* | *WTP* | *Significance* |
| Price | –0.0006 | – | *** | –0.0004 | – | *** |
| Speed | 0.0189 | ¥32 | *** | 0.0171 | ¥45 | *** |
| IP telephony | 0.5284 | ¥899 | *** | 0.2999 | ¥783 | *** |
| Partial TV program | –0.1049 | ¥–178 | | 0.1562 | ¥408 | |
| Full TV program | 0.8156 | ¥1,387 | | –0.4729 | ¥–1,235 | |
| NTT dummy | –0.3884 | ¥–661 | ** | –0.1670 | ¥–436 | |
| Symmetry dummy | –0.2854 | ¥–486 | | –0.9861 | ¥–2,576 | |

*Note:* *** 1% level significance, ** 5% level significance, * 10% level significance.

*Source:* Ida and Sato (2007).

providers. On the other hand, there is little or no competition in rural areas where a single, or at worst, no firm is providing broadband services. Therefore, since it is important for group A to seek better, cheaper broadband services, they are more aware of price; group N is less concerned because they are primarily concerned with securing access to broadband services, rather than price levels. This result is also interesting from a psychological point of view. Schwarz and Vaughn (2002) have stated that individuals are likely to rely on ease of recall when the judgement task is of low personal relevance, but draw on recalled content when the task is of high personal relevance. Therefore, it makes sense that the availability of an alternative leads consumers to severer evaluations.

This conclusion provides interesting implications for the digital divide problem for further diffusion of broadband services. Since people with limited access to broadband services have a higher WTP for high-speed Internet access, they represent potentially high preferences for them, especially in rural areas where the demand has not yet been actualized.[11] We summarize the main points as follows:

**Analysis results of SPM**

Availability of FTTH influences consumers' preference. Interestingly, people without access to FTTH have higher preferences for an increase in access speed than those to whom FTTH is available. This conclusion implies that potential demands exist even in rural areas.

## Policy issues for fixed-line broadband

In this section I will discuss the primary policy issues relating to fixed-line broadband based on the analysis presented.

### *Defining Internet access markets*

In this section I will discuss market definition of the Internet access market. Fixed-line Internet services can be divided into narrowband services and broadband services. Broadband services can then be further divided into ADSL, CATV Internet, and FTTH services. The question is whether these services constitute a single market or whether they can be regarded as separate markets.

Market definition is a critically important issue for antimonopoly policy and competition reviews, and the *SSNIP test* (or *hypothetical monopolist test*) has been widely accepted as an important tool for this purpose. However, to apply the SSNIP test requires own-price elasticity of demand and the price-cost mark-up. The demand elasticity can be estimated using discrete choice model analysis, but the price-cost markup for a single service is generally

unobtainable, which makes it difficult to apply the SSNIP test with rigor. Here, I will present an outline of market definition, while referring to the estimated results shown earlier in Table 5.3. First, we consider narrowband and broadband services, but it is apparent from the NL model comparative results that the two categories are different. Narrowband and broadband can therefore justifiably be defined as different markets.

Second, focusing attention on the own-price elasticity of demand for broadband services, we find that ADSL is inelastic while CATV Internet and FTTH are elastic. From an antimonopoly policy standpoint, a problematic critical price elasticity normally is in the range of approximately 1 to 2, so it is thought that ADSL does comprise an independently demarcated market (Werden, 1998, p. 390). ADSL comprises a large market and could be divided into several submarkets, but because slow-, intermediate-, and high-speed ADSL are all elastic, ADSL can be regarded as a single market.[12]

Third, both CATV Internet and FTTH require their own new infrastructure facilities to be deployed before services can be provided, so there are no operators that provide both CATV Internet and FTTH services. It other words, it would be quite difficult for a cable provider to enter the FTTH market or for an FTTH provider to enter the cable market, so it is assumed that supply substitutability does not exist between the two (MIC, 2004, p. 90). Based on these considerations, we first define narrowband and broadband as separate markets, then define ADSL, CATV Internet, and FTTH as distinct markets. We summarize the main points as follows:

**Defining Internet access markets**

Applying the SSNIP test to the definition of Internet access markets, it is apparent that, first, narrowband and broadband can be differentiated. Second, within broadband, ADSL constitutes an independent market based on demand substitutability considerations. And third, there are market boundaries differentiating the FTTH and CATV Internet markets based on supply substitutability.

*SSNIP test*

A market is essentially a relevant area of competition between firms and that provides some criteria for determining whether anticompetitive effects have arisen. Here, market definition will be examined from the two perspectives of *demand substitutability* and *supply substitutability*. Demand substitutability determines whether there are other products that could be substituted for the relevant product from the perspective of the buyer, and supply substitutability determines whether there are goods or services that could be easily substituted or interchanged with the relevant goods or services from the

perspective of suppliers. Debates regarding market definition criteria have generally developed around demand substitutability.[13]

The U.S. Department of Justice issued Merger Guidelines in 1968, which provide a formula for defining markets. The Guidelines were thoroughly overhauled in 1982, and the market definition procedure was also substantially revised. Basically, the procedure in the 1982 Guidelines tries to gauge how buyers would respond if, at prevailing prices, a hypothetical monopolist seeking to maximize profits imposed a "small but significant and nontransitory increase in price" (SSNIP) for the relevant product or service. If a price increase of 5% would cause enough buyers to switch to another product over a one-year period that the price increase would be unprofitable, then the next best substitute for the product is added to the product group. The SSNIP test is repeated and the product group enlarged until the hypothetical monopolist could impose the price increase on the group of products. The relevant product market is the smallest group of products that satisfies this test. Supply substitutability defines any firm capable of producing and selling the relevant product within six months in response to an SSNIP as a participant in the market.

In using the SSNIP test to define an actual market, it is necessary to calculate the critical elasticity of demand. If the critical elasticity of demand exceeds the demand elasticity measured at prevailing prices, then the maximum price increase that is profitable will exceed the SSNIP. Because this hypothetical monopolist is able to increase profits with an SSNIP, this kind of product is defined as a market. Conversely, if the critical elasticity of demand is less than the demand elasticity measured at prevailing prices, then the type of product or service is not defined as a market.

### *(*) Critical elasticity*

Here I will elaborate on critical elasticity in the case of linear demand. Let $p = a - bq$ represent a linear demand curve, where $p$ is price, $q$ is demand, and $a$, $b$ are parameters. The prevailing price is $p^0$. So calculating the elasticity of demand at the prevailing price, we obtain $\varepsilon_{ii}(p^0) = (p^0) / (a - p^0)$. Next, calculating the hypothetical monopolist's profit maximizing price where the profit maximizing price is $p^m$ and the critical cost is $c$, we obtain $p^m = (a + c) / 2$. If a hypothetical monopolist who obtains price-cost margin of $m$ imposes a price increase (SSNIP) of $t$, calculating the critical elasticity that maximizes profits, we obtain $\bar{e}_{ii}(p^0) = (p^0) / (2p^m - c - p^0) = 1 / (m + 2t)$ from $a = 2p^m - c$. Here the prevailing price-cost margin is $m = (p^0 - c) / p^0$, and the SSNIP is $t = (p^m - p^0) / p^0$.

## *Effective competition in the ADSL market*

Key attributes of the ADSL market, accounting for more than half the current broadband connections, can be summarized as follow. The ADSL market has now evolved from a period of rapid growth to one of maturity. The

number of net new subscribers is now being overtaken by FTTH, so it likely that before too long ADSL will enter into a period of decline.

Globally, ADSL is the least expensive broadband service option that is available. Japan's ADSL market is an oligopoly dominated by four providers—NTT, Softbank, eAccess, and ACCA Networks—but none of the four has a conspicuously dominant position, so competition is working effectively in this market.

Featuring always-on connectivity and flat-rate pricing, ADSL has played a major role in moving people from narrowband to broadband service, a role that ADSL continues to play up to the present day.

The service areas where ADSL is available are now extended out from cities into rural areas, and NTT East and West have been particularly active in pursuing this rural development.

The nondominant competing carriers have greatly extended the availability of ADSL services through access to NTT's dark fiber and by line-sharing. This intense competition that has evolved in the ADSL market can be largely attributed to the MIC's successful access regulations. Currently, competition is working very effectively in the ADSL market, and has been a major factor in the rapid spread of broadband in Japan. Softbank's contribution based on one innovative marketing strategy after another—unprecedented low rates, selling services from local stores, offering 050 IP telephony services, and so on—has been especially noteworthy in furthering the penetration of ADSL.

But now a shadow has appeared that will likely diminish the prospects of further ADSL growth, as heavy users of the Internet living in cities have already begun to shift to FTTH. Note that this migration from ADSL to FTTH primarily involves users who have generated the most profits for the ADSL providers, and particularly when you factor in the loss of sales for higher functions, content, and the like, this loss of users is a major blow to the profitability of the ADSL providers.

NTT East and West support both ADSL and FTTH, but the competing operators are wholly invested in ADSL and have very little presence in the FTTH market. This means that subscribers to NTT's ADSL service can transit smoothly from ADSL to FTTH without having to change email addresses or other annoyances, while subscribers to the other service providers are burdened with a range of monetary and nonmonetary switching costs when they move to FTTH. These asymmetrical switching costs will have a serious adverse impact on the profitability of competing ADSL providers that will become increasingly apparent as ADSL evolves from its mature phase to one of decline (discussed in Chapter 8). A key policy issue is how to assist those ADSL users who find it difficult to make the transition to FTTH, due to the switching costs and whose continued use of ADSL is threatened by scaled-back services as the service providers cope with worsening profitability. We summarize the main points as follows:

**Effective competition in the ADSL market**

Although Japan's ADSL market is an oligopoly dominated by four companies, the market is highly competitive. However, there are now indications that the ADSL market is evolving from a mature phase to one of decline, and competition between ADSL and FTTH in the cities will likely intensify in the years ahead. As this develops, close attention must be paid to the competitive asymmetry between operators providing both ADSL and FTTH, and operators that only provide ADSL services.

### *Effective competition in the FTTH market*

Key attributes of the FTTH market, much anticipated as the final broadband access solution, can be summarized as follows.

The FTTH market was launched and became firmly established after 2004. We can anticipate very rapid penetration of FTTH considering the aggressive efforts of service providers: NTT's stated goal of extending fiber to 30 million households in line with its Mid-Term Management Strategy, the aggressive rate reductions by K-Opticom Corporation, and the agreement between Tokyo Electric Power Company and KDDI Corporation to integrate their FTTH operations.

Demand is emerging for Triple Play service, provisioning of three services over a single optical broadband connection: high-speed Internet, IP telephony with 0ABJ number portability that is equivalent in quality and features with fixed-line telephony, and multi-channel television equivalent to satellite broadcasting. Triple Play is coming to be perceived not as a luxury but as an ordinary service offering. Note however that, from a supply-side perspective, Triple Play services must be made available as an integrated moderately priced package and not marketed as separate services as in the past, so this development will not do anything to improve the profitability of the operators.

Areas where FTTH service is available have rapidly expanded, but there are many rural areas where fiber has not yet been extended to the remote terminal (RT). Thus, the problem of the digital divide separating districts with broadband access from those without remains a serious social issue.

In provisioning FTTH services, there is facilities-based competition among NTT and power company providers who deliver services over their own fiber-optic infrastructure, and there is service-based competition among competing operators who deliver services over fiber lines leased from NTT. Facilities-based competition has focused mainly on providing services to single-family homes, and NTT East and West have a predominant share of this market. However, the service-based competition has focused more on the

multi-dwelling unit market, and NTT's share of this market is far more modest. Thus, a critical factor in the emergence of effective competition in the future FTTH market is whether the competing operators will make significant investments in optical facilities. The real issue is that, aside from NTT, no one is in a position to shoulder the heavy investment required to deploy optical fiber except the power companies, so trends among the power companies become highly important in the FTTH market. Meanwhile, the NTT Group also feels threatened that, in competition with power companies who are just as familiar to people as NTT, they may not emerge as the winner.

Currently, only NTT East and West are obligated to provide open access to their optical lines, a burden that is not imposed on the power company operators. There have thus been strong appeals that this obligation on NTT should be lifted, and some have contended that this obligation to provide open access to its fiber lines acts as a deterrent or a disincentive for NTT to invest in fiber deployment to rural areas. But the current competition between NTT and the power company operators is only being played out in the cities, and there is no guarantee that NTT would invest in fiber deployment to sparsely populated rural areas if the open access obligation was lifted. NTT might instead choose to focus on winning the competition for the more lucrative urban areas. Thus, the two issues of NTT's open access obligation and investment incentives for rural fiber deployment should be clearly distinguished, the former as a competition policy issue and the latter as an industrial policy issue. Aside from the fact that a number of new competing operators are already providing services over lines leased from NTT, if the open access regulations were removed, we would have to scrap the current competition policy guidelines that have worked so well up to now, and start over at the beginning. The important thing is to set charges for leasing NTT's dark fiber at a reasonable level, and take care to ensure that arrangements are not biased in such a way that only NTT East and West incur losses. Here as elsewhere, balance is critically important. We summarize the main points as follows:

**Effective competition in the FTTH market**

The FTTH market has gotten off to a good start. Yet there is an enormous gulf between availability of FTTH in the cities and in rural areas. In the cities, facilities-based competition is making rapid progress, but in rural areas there are many places where no services are available at all. We are thus now confronted with a difficult policy dilemma of competition policy and industrial policy working at cross-purposes.

## Conclusions

In this chapter, we have discussed the fixed-line broadband services in Japan. Particularly, we carried out two empirical investigations based on RP data and SP data. First, we have analyzed the demand substitutability of four alternatives in Japan's broadband services with NL models. The nested choice structure with two categories of narrowband and broadband has the highest goodness of fit. In addition, ADSL is less sensitive to price changes than FTTH and CATV. We analyze ADSL submarkets and conclude that medium-speed ADSL is different from low-speed and high-speed ADSL: low-speed and high-speed ADSL are very elastic, based on the own-price elasticities of access demand. Thus, we conclude that in Japan's broadband services, ADSL is independent of other services but is actively competing with narrowband (dialup, ISDN) and broadband (FTTH, CATV) services on both ends of the spectrum. Second, using conjoint analysis this chapter has analyzed consumers' preferences with respect to Japan's broadband services. On analyzing whether the actual availability of FTTH influences SP, we found that SP differs depending on the actual availability of FTTH: the WTP for 1 Mbps is ¥32 ($0.29) in areas with access to FTTH and ¥45 ($0.41) in areas without access to FTTH.