Prerequisites for a Network Neutrality Solution : Lessons from an Empirical Analysis of the Japanese Broadband Market

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Prerequisites for a Network Neutrality Solution:

Lessons from an Empirical Analysis of the Japanese Broadband Market

Toshiya Jitsuzumi

Abstract

From an economic viewpoint, the author considers it to be appropriate to interpret the network neutrality problem as a combination of a congestion problem caused by limited network capacity and an anticompetitive problem caused by the dominance of major Internet service providers (ISPs). In Japan, where asymmetric regulation on the incumbent Nippon Telegraph and Telephone Corporation seems to have successfully maintained competitiveness in the retail ISP market, the Ministry of Internal Affairs and Communications (MIC) has focused on fighting network congestion by introducing a "coregulation"-like framework. The validity of this approach is heavily dependent on two prerequisites: (a) effective competition in the broadband ISP market and (b) sufficient user literacy on network quality. As for the first condition, given the Herfindahl-Hirschman Index, the MIC has stated that the current ISP market in Japan has no immediate anticompetitive threat. However, if switching costs for broadband users are very large, the Herfindahl-Hirschman Index cannot reflect the real competitive level. In this study, switching costs based on a model-based estimation as well as a questionnaire-based estimation are calculated. This study concludes that the Japanese broadband ISP market may not be as competitive as it looks, suggesting that the MIC has reasons to reconsider its current policy on network neutrality. Although the discussion in this paper is based on Japanese empirical data, it can apply to other nations that have a similar structure in the broadband ecosystem as that of Japan and where significant market power regulations on incumbent network operators represent the major tool to attain competitiveness in the ISP market.

Keywords: network neutrality, Internet service providers, switching costs, competition, Japanese market

1. Introduction

Despite the large investments made by network operators, traffic congestion is a common phenomenon these days because the growth in the demand for data communication is much larger. This has affected user experiences and has resulted in network neutrality concerns being raised in many developed countries.

From an economic viewpoint, the author considers it appropriate to interpret the "network neutrality problem," even though many issues have been discussed since the term was coined by Wu (2003)[1), as nothing more than a combination of a congestion problem caused by limited network capacity and an anticompetitive problem caused by the dominance of major Internet service providers (ISPs). In Japan, where asymmetric regulation on the incumbent Nippon Telegraph and Telephone Corporation (NTT) seems to have successfully maintained competitiveness in the retail ISP market, the Ministry of Internal Affairs and Communications (MIC) sees no immediate need to act against the anticompetitive behaviors of dominant ISPs. Instead, the MIC has focused on fighting network congestion by introducing a "coregulation"-like framework. As already pointed out in Jitsuzumi (2011a, 2011b), the validity of the MIC's current approach is heavily dependent on two prerequisites: (a) the effectiveness of asymmetric regulation or the degree of competitiveness in the broadband ISP market and (b) sufficient user literacy on network quality. According to MIC (2011), the market share of the top three ISPs has been decreasing over the past five years, and the Herfindahl-Hirschman Index (HHI) was only 1,289 as of the end of March 2011, both of which suggest that the market has no immediate anticompetitive threat. In addition, the MIC's guidelines for consumer protection impose strict disclosure requirements on ISPs. However, these facts may not guarantee that the two prerequisites are met. This is what this paper attempts to clarify.

First, as for checking the competitiveness of the ISP market, this paper focuses on switching costs, which influence the degree of competitiveness from the viewpoint of existing users. The author adopts two approaches: one is model based and the other is questionnaire based. In the former, switching costs are estimated using the MIC's data and each ISP's tariff, relying on the model proposed by Shy (2002). The result shows that smaller ISPs need to incur a cost that is almost as much as their monthly fees when trying to penetrate the major players' turf. In the latter, similar, but much stronger, conclusions are confirmed by using a conjoint approach estimated by a random parameters logit model (RPLM). These results suggest that there is good reason to worry about anticompetitive behaviors in the ISP market, such as "unreasonable" traffic management or insufficient investment into network capacity building.

Second, as for user literacy, the web-based questionnaires conducted in Jitsuzumi (2011a, 2011b, 2011c) suggest a serious deficiency in the broadband quality of service (QoS) literacy of end users. This finding implies that the Japanese "coregulation"-like approach is nothing more than an armchair theory, since uninformed users cannot make any meaningful contributions to setting packet-shaping standards. This paper shows that, in addition to the above, there is insufficient awareness about the contract structure of broadband ISPs and that many users do not fully understand the information that their ISPs provide, inhibiting consumers' proper decision-making in the market.

Overall, these findings suggest that the status quo cannot guarantee the proper functioning of the MIC's network neutrality approach. As a possible solution, the author proposes introducing non-price competition in the ISP market and suggests the necessity of an "ISP sommelier," who could help improve end users' QoS literacy by making ISP's disclosures easy to understand. A similar proposal will be effective in other nations that have a similar structure of the broadband ecosystem[2] to that of Japan, where Internet penetration is almost well saturated, and where network neutrality issues are designed to be solved by ISP competition[3].

The rest of this paper is organized as follows. First, the importance of switching costs in the net neutrality discussion is explained in the second section. The third section presents the results of the two estimation approaches. In the fourth section, based on the conjoint estimates derived from the web-questionnaire data, the author quantitatively evaluates how smaller ISPs can offer better QoS to compete effectively with major ones protected by formidable switching costs, discusses insufficient user literacy, and concludes the paper.

2. The switching cost issue

2.1. Switching costs and network neutrality

In its report on net neutrality (MIC, 2007), in order to alleviate traffic congestion, the MIC evaluated several engineering solutions, including peer-to-peer, IP multicasting, overlay multicasting, content distribution networks, packet shaping, and capacity expansion. The report then concluded that the MIC has been able to allow markets to determine which one(s) should be adopted, since the ISP market in Japan is sufficiently competitive. Based on a similar logic, the report stated that placing a surcharge on content providers cannot be considered a standard treatment and should instead be left to voluntary negotiations among stakeholders. In this way, effective competition is an important prerequisite for the MIC's current approach.

The problem is that the degree of competition for existing users cannot be measured solely by market share, since users may be locked into their current providers. If users are strongly tied to their current ISPs, they are deprived of possibilities of error correction when it turns out that they receive less-than-expected services from their ISPs, and thus they cannot enjoy the benefit of competition. Such locked-in problems occur for various reasons. For example, users receive an e-mail address or a homepage URL as a part of their broadband package, but have to return it when terminating the contract. Since e-commerce sites or fee-based content sites usually do not accept free web-based e-mail addresses, such as Hotmail or Gmail, as an effective ID, e-mail addresses issued by ISPs have been one of the most valued Internet assets for users. When a user transfers to a new ISP, he or she needs to change all the registered e-mail addresses on those sites in addition to notifying all contacts about his or her new address. Alternatively, some users are required to install ISP-specific devices, such as a cable set-top box, and to calibrate in-house networks accordingly; other users may even have to dig a hole and install new access lines to their houses. In such cases, users experience difficulties when moving to alternative service providers. Moreover, when users have subscribed to other bundled services from the same ISP, such as Internet TV or VoIP services, they face even bigger obstacles. In these situations, a user prefers to purchase a series of monthly broadband connections from the same operator in order to enjoy "economies of scope among his purchases" (Farrell and Klemperer, 2007, p.1971). In economics, the costs a consumer incurs if he or she uses a different supplier are called switching costs, the components of which Jones et al. (2002) provide a summary. In general, where there is a switching cost and no product differentiation, firms compete aggressively to attract new users by lowering prices[4)] but aim to maximize their profits by charging monopolistically high prices to existing users who are "locked in"[5)]. Many models have been proposed to evaluate the impact of switching costs on market outcomes (e.g., von Weitzsaecker, 1984; Klemperer, 1987a, 1987b, 1989, 1995). According to Farrell and Klemperer (2007), all models, except the most simplified ones, suggest that switching costs harm optimal resource allocation. In terms of broadband Internet, where more and more new applications are becoming available every month and where an innovative mode of broadband usage is emerging continuously, it is impossible to expect that the fierce competition for new customers can eat up the monopolistic rent that will be captured by ISPs in the later "rip-off" stage. That is, when switching costs are significant in the broadband market, it is probable that users or the market as a whole cannot enjoy the benefit of market competition sufficiently. In other words, high switching costs are likely to make the market less competitive and enable ISPs to exploit their customers.

Therefore, empirically estimating the switching costs that existing users incur in the actual market makes it possible to examine whether the MIC's current policy framework is working properly. When estimated switching costs turn out to be sufficiently large, the MIC may have to formulate a different set of network neutrality policy measures.

2.2. Estimating switching costs

In this paper, two kinds of estimations are examined. The model-based approach proposed by Shy (2002) uses market share data combined with each player's price level. In his estimation, Shy assumes zero marginal cost and the undercut-proof property (UPP). By considering the cost structure of broadband ISPs that offer "unbundled" ISP services and do not offer access network, the first assumption fits well because most of the operating cost of such ISPs is fixed in nature. However, for vertically integrated ISPs that offer Internet connectivity and an access line, the zero marginal cost assumption is oversimplified; thus, researchers need to take extra caution when interpreting the estimated results. The UPP is introduced because a Nash equilibrium cannot exist in Shy's model setting, which is basically a discrete version of Hotelling's location model (Shy, 1996). The UPP assumes a situation where players are in an "exclusive defense" mode: All players set their prices as high as possible as long as this does not motivate the entry of competitors. In Shy's setting, the switching costs of firm i from the viewpoint of firm j, or S_{ij}, can be calculated as Equation (1).

$$S_{ij} \equiv \mathrm{p_j} - \frac{N_i p_i}{N_i + \mathrm{N_j}} \tag{1}$$

where p_x and N_x are, respectively, the price and number of customers of firm x.

Shy's approach is simple and easy to implement, but it is not free of serious drawbacks. One shortcoming is that Shy's model does not distinguish between competition for new customers and for existing customers. Even in the comparatively saturated Japanese broadband market, several million new broadband users are added annually; in addition, five million people change their addresses each year[6)] and may require a new broadband contract at their new homes. Therefore, it is more likely that providers focus not only on exploiting their existing customers but also on attracting new users, leading listed prices to fall lower than the level originally assumed by Shy's model. As a result, this model may underestimate actual switching costs. Another drawback of the model is that it cannot control for the differences in service quality or other features, such as the need to install a new access line, number of free e-mail addresses, or size of free server space for making homepages, leading to bias in switching cost estimation.

To overcome such drawbacks, the author introduces a questionnaire-based approach, even though this needs significant costs to implement and is thus difficult to adopt for actual policymaking. In the questionnaire, a conjoint method is employed where respondents are presented four alternatives, including staying with their current provider. As shown in Table 1, each alternative is described by three attributes: provider's brand[7)], improvement in actual download speed, and discount in monthly fixed fee[8)]. These three attributes and each level are chosen for simplicity as well as for reflecting the author's interest in network congestion. Another reason why an ISP's brand is included is that the NTT brand is said to have powerful marketing power[9)] and thus is expected to significantly influence switching costs. In order to prepare respondents for this situation, before coming to the conjoint questions, they are asked to check the brand of their current ISP and its monthly fee as well as to measure their actual download speed. Thus, these estimates can be considered to reflect the situation where users have a better information on what they pay for compared with general consumers who have no information on their actual download speed. Finally, for reasons of simplicity,

Table 1 Conjoint attributes and attribute levels

Attribute	Level
ISP's brand	NTT group or related companies
	Operated by non-NTT telcos or cablecos
	Operated by ICT venders (vender ISPs)
Improvement in actual download speed	No improvement
	+100%
	+200%
	+300%
Discount in monthly fixed fee	No discount
	Discount of 500 yen
	Discount of 1,000 yen
	Discount of 2,000 yen

Note 1: Telcos refer to telecommunications companies and cablecos refer to cable companies. Vender ISPs are ISPs operated by ICT venders.

Note 2: Since respondents are required to visit the speedtest.net site and measure their actual download speed, "Improvement in actual download speed" will be transformed into "actual Mbps improvement" when estimating model parameters.

"e-mail address portability" is assumed in this conjoint question, and the cost of changing the e-mail address is calculated in a different question instead.

The estimation of conjoint-based switching costs is conducted by following random utility theory, where the utility of user i from choosing alternative j is described as a combination of representative utility, Vij, and an error (Equation (2)), and the probability of choosing alternative k is described as in Equation (3). Here, f is the joint distribution function of the error term and I is an index function that equals one if the inside of the following parenthesis is true and zero otherwise:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{2}$$

$$P_{ik} = \text{prob}\left(U_{ik} > U_{ij}, \forall j \neq k\right) = \int I\left(\varepsilon_{ij} - \varepsilon_{ik} < V_{ik} - V_{ij}, \forall \text{j} \neq \text{k}\right) f(\varepsilon_{\text{i}}) d\varepsilon_{\text{i}} \tag{3}$$

Since the independence from irrelevant alternatives (IIA) assumption cannot be supported at the 5% level of significance in the sample[10)], an RPLM is employed for the parameter estimation, where the normal distribution is assumed for every parameter except one for a price variable. In addition, the means of these parameters may be influenced by the demographic factors of the respondents, such as annual income, Internet experience, length of relationship with current provider, and gender; therefore, based on the following three hypotheses, shift parameters, α, are included in the model. The primary reason for considering these shift parameters and hypotheses is to estimate the switching costs solely derived from a change of ISP by controlling other factors. Using such estimations, the possibility of effective competition among the Japanese ISPs, each of which has unique subscriber features, is evaluated.

H1: The higher the income, the more respondents value an improvement in download speed.

If income is higher, the value of time is higher. An improvement in actual download speed saves time when users download large files or applications. Therefore, a person with higher income is expected to value speed improvement more than one with lower income.

H2: The longer the Internet experience, the less respondents value the benefit of changing ISPs.

As a person accumulates Internet experience, he or she also adds peripheral equipment, software, experience of particular applications, and other tacit expertise. Those not transferrable to a new ISP service will be a cause of switching costs, which will force the respondent to devalue the new ISP's offer.

H3: The longer the relationship with a particular ISP, the less benefit respondents attach to changing ISPs.

As the duration of the relationship with a particular ISP increases, the user accumulates hardware, software, and expertise that are useful only in this ISP's setting. Those not transferrable to a new ISP service will be a cause of switching costs, which will force the respondent to devalue the new ISP's offer.

The resulting probability function where user i chooses alternative k and the utility function for the parameter estimation is indicated in Equations (4) and (5), respectively, where x represents an attribute vector for the chosen alternatives, g represents a distribution function of parameter β, and θ is its parameter[11].

$$P_{ik} = \int \frac{\exp(\beta_i{}'X)}{\sum_j \exp(\beta_i{}'X)} g(\beta|\theta)d\beta \tag{4}$$

$$\begin{aligned} U_{ij} &= \beta_{NTT}D_{NTT} + \beta_{nonNTT}D_{nonNTT} + \beta_{vender}D_{vender} + \beta_{same}D_{same} + \beta_j speed_j + \beta_{price}price_j + \varepsilon_{ij} \\ &= \sum_l \left(\alpha_{inc}^l inc_i + \alpha_{net}^l netEX_i + \alpha_{isp}^l ispEX_i + \alpha_{male}^l D_{male_i} + \alpha_l + \sigma_l v_l\right)D_l \\ &\quad + \left(\alpha_{inc}^{speed} inc_i + \alpha_{net}^{speed} netEX_i + \alpha_{isp}^{speed} ispEX_i + \alpha_{male}^{speed} D_{male_i} + \alpha_{speed} + \sigma_{speed}v_{speed}\right)speed_j \\ &\quad + \beta_{price}price_j + \varepsilon_{ij} \end{aligned} \tag{5}$$

where l = {NTT, nonNTT, vender, same}; D_{NTT} = 1 if the respondent chooses an NTT-group ISP, and 0 otherwise; D_{nonNTT} = 1 if the respondent chooses a non-NTT ISP, and 0 otherwise; D_{vender} = 1 if the respondent chooses a vender ISP, and 0 otherwise; D_{same} = 1 if the respondent chooses the same pre-switching category of ISP that his or her current ISP belong to, and 0 otherwise; inc = annual family income (0,000 yen); $netEX$ = Internet experience (years); $ispEX$ = duration of the relationship with the current ISP (months); D_{male} = 1 if the respondent is male, and 0 otherwise; $speed$ = improvement in actual download speed (Mbps); and $price$ = discount in monthly fee (yen, negative value). v is the individual specific heterogeneity with mean zero and standard deviation one, and ε_{ij} is an error term. The element "non-NTT" includes ISPs that are not in the NTT group, cable Internet, and other independent ISPs.

In Equation (5), β_{NTT}, β_{nonNTT}, and β_{vender} reflect the size of incremental utility that is derived from switching to the respective group of ISPs, and β_{same} measures the utility level of staying with the same brand provider. Divided by β_{price}, these can be transformed into monetary values, or willingness-to-pay (WTP) figures, which are equivalent to the switching costs for moving to an alternative ISP brand category[12]. In particular, the switching costs in various cases are estimated as shown in Table 2.

In order to reject the null hypothesis to the above-mentioned three hypotheses, H1, H2, and H3, the author checked the sign and statistical significance of the parameters presented in Table 3.

Table 2 Switching cost calculations

Pre-switching ISP brand	Post-switching ISP brand	Switching cost
NTT group ISP	NTT group ISP	$-\beta_{NTT}/\beta_{price}$
	non-NTT ISP	$(-\beta_{nonNTT}+\beta_{same})/\beta_{price}$
	vender ISP	$(-\beta_{vender}+\beta_{same})/\beta_{price}$
non-NTT ISP	NTT group ISP	$(-\beta_{NTT}+\beta_{same})/\beta_{price}$
	non-NTT ISP	$-\beta_{nonNTT}/\beta_{price}$
	vender ISP	$(-\beta_{vender}+\beta_{same})/\beta_{price}$
vender ISP	NTT group ISP	$(-\beta_{NTT}+\beta_{same})/\beta_{price}$
	non-NTT ISP	$(-\beta_{nonNTT}+\beta_{same})/\beta_{price}$
	vender ISP	$-\beta_{vender}/\beta_{price}$

Table 3 Criterion for hypothesis testing

		Criterion for judgment
H1	The higher the income, the more the respondents value an improvement in download speed.	α_{inc}^{speed} is significantly greater than zero.
H2	The longer the Internet experience, the less the respondents value the benefit of changing ISPs.	α_{net}^{NTT}, α_{net}^{nonNTT}, and/or α_{net}^{vender} are significantly smaller than zero.
H3	The longer the relationship with a particular ISP, the less the benefit that the respondents attach to changing ISPs.	α_{isp}^{NTT}, α_{isp}^{nonNTT}, and/or α_{isp}^{vender} are significantly smaller than zero.

3. Estimation of switching costs

3.1. Model-based approach

To calculate switching costs using Shy's approach, price data and the number of users of each ISP need to be compiled. Price data can be accessed from the providers' homepages, where each ISP offers a wide range of broadband services. For the calculation, this paper collates price data for the most basic, or cheapest, service that has a maximum download speed of 100 Mbps (or the minimum, if above 100 Mbps) (Table 4). In general, the monthly fixed fee for 100 Mbps-class best-effort Internet access is around 1,000 to 2,000 yen if not bundled with access line service, and 2,500 to 6,000 yen if bundled. In the former case, users have to pay 2,500 to 5,000 yen monthly for fiber-to-the-home (FTTH) services.

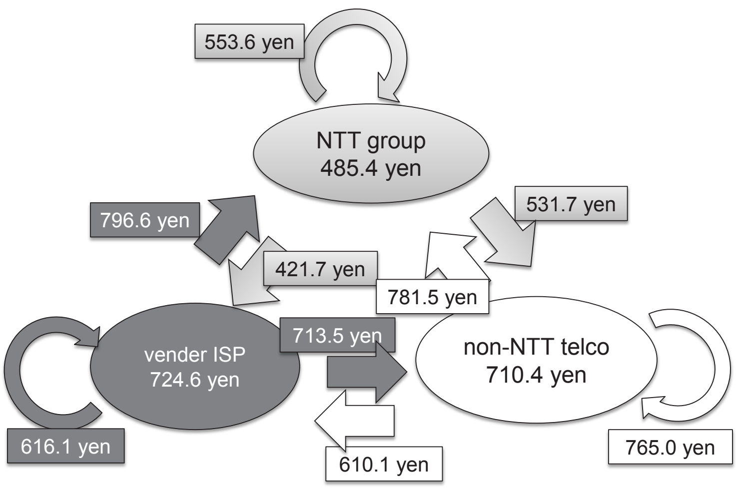
Data on the number of users were obtained with the help of the MIC. These data comprise the number of subscribers of 48 ISPs as of September 2011, originally collected for the MIC's (2011) annual telecom competition review. Since price data for individual ISPs are available, the Shy-based switching cost calculation is possible for each ISP; however, for reasons of the confidentiality of subscriber data, only an average estimation for each ISP category is presented in the following analysis.

Figures 1 and 2 show the estimated switching costs for "unbundled ISP services" and "ISP + access line services," respectively. These estimates represent the discounts required to infiltrate other ISPs' customer

Table 4 Monthly fees for 100 Mbps-class best-effort Internet access

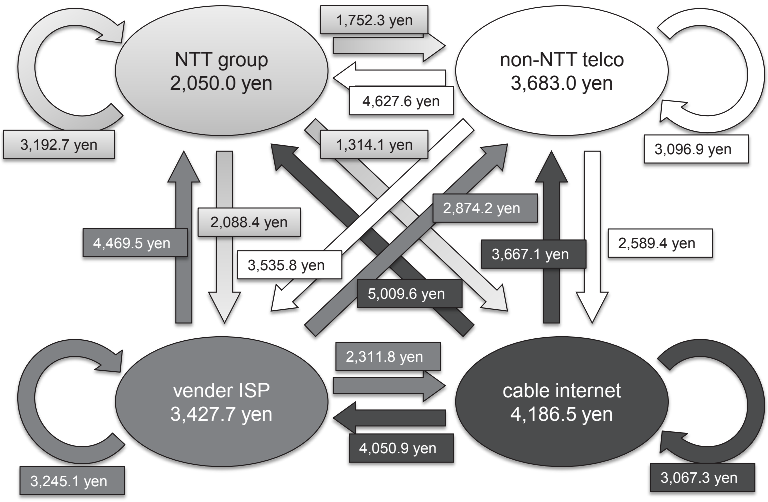
ISP catgegory	Name of ISP	Monthly fee		Max download speed	# of free addresses	Size of free homepage
NTT group	NTT Communications, Inc.	1,260		100 Mbps	1	10MB
	NTT DATA SANYO SYSTEM CORP.	1,260		1,000 Mbps	1	100 MB
	NTT-ME CORP.	997		200 Mbps	2	
	NTT Media Supply, Inc.	2,394	*	100 Mbps	1	50 MB
	NTT Plala, Inc.	1,050		200 Mbps	1	
Non-NTT telco	COMMUNITY NETWORK CENTER Inc.	2,100		100 Mbps	1	100 MB
	F Bit Communications Corp.	2,980	*	100 Mbps	5	
	Hi-Bit Co., Ltd.	1,890		100 Mbps	3	100 MB
	KDDI CORP.	6,615	*	1,000 Mbps	5	100 MB
	K-Opticom Corp.	4,900	*	100 Mbps	1	20 MB
	NDS Corp.	1,050		200 Mbps	1	20 MB
	SOFTBANK BB Corp.	1,260		100 Mbps	11	300 MB
	SOFTBANK TELECOM Corp.	1,260		100 Mbps	1	
	TOKAI Corp.	1,470		200 Mbps	1	20 MB
	The Career Community Partners, Inc.	1,890		100 Mbps	1	100 MB
	UCOM Corp.	5,040	*	100 Mbps	1	20 MB
Vendor ISP	ASAHI Net, Inc.	1,050		100 Mbps	1	100 MB
	DREAM TRAIN INTERNET INC.	998		100 Mbps	1	50 MB
	edion WEST Corp.	2,646	*	1,000 Mbps	1	10 MB
	GMO Internet, Inc.	798		100 Mbps	15	350 MB
	hi-ho Inc.	1,260		200 Mbps	1	100 MB
	Internet Initiative Japan Inc.	2,100		200 Mbps	1	5 MB
	NEC BIGLOBE, Ltd.	1,260		100 Mbps	1	100 MB
	NIFTY Corp.	1,260		100 Mbps	3	100 MB
	So-net Entertainment Corp.	1,260		200 Mbps	4	10 MB
Cable Internet	Bay communications Inc.	5,300	*	120 Mbps	5	100 MB
	Chubu Cable Network Co., Inc.	5,500	*	120 Mbps	1	100 MB
	Himawari Network	5,250	*	160 Mbps	1	150 MB
	its communications Inc.	6,300	*	160 Mbps	5	100 MB
	JAPAN CABLENET Ltd.	6,090	*	160 Mbps	5	50 MB
	KATCH NETWORK INC.	5,250	*	120 Mbps	1	150 MB
	Kintetsu Cable Network	4,725	*	100 Mbps	1	50 MB
	Oita Cable Telecom Co.,Ltd.	5,250	*	160 Mbps	5	50 MB
	Technology Networks Inc.	6,300	*	160 Mbps	5	100 MB
	VIC TOKAI	7,434	*	200 Mbps	3	100 MB
	ZTV Co., Ltd.	5,040	*	160 Mbps	3	100 MB

Note 1: "*" shows the monthly fee includes access line charge.
Note 2: All figures are as of March 2012.



Note: Numbers in rectangular boxes indicate the switching cost that an ISP atthe tail needs to overcome in order to win a customer from an ISP at the arrowhead. Numbers in the oval-shaped circles show the weighted average of such switching costs for ISPs of that category.

Figure 1 Switching costs for "unbundled ISP services"



Note: Numbers in rectangular boxes indicate the switching cost that an ISP at the tail needs to overcome in order to win a customer from an ISP at the arrowhead. Numbers in the oval-shaped circles show the weighted average of such switching costs for ISPs of that category.

Figure 2 Switching costs for "ISP + access line services"

bases. Since these are almost as large as ISPs' service charges, it is possible to conclude that ISPs need to offer services almost free-of-charge, even though this represents a one-time discount when a user changes his or her ISP, in order to motivate existing users of rival ISPs to change their ISP subscriptions[13]. This shows there is a margin, as wide as the ISP's monthly fee, where price competition is meaningless. Additionally, it shows that NTT-group ISPs face much lower switching costs than other ISPs, indicating they enjoy a more "secure" position in terms of price competition for the markets of both "unbundled" (Figure 1) and "integrated" ISP services (Figure 2).

3.2. Questionnaire-based approach

The questionnaire-based survey was conducted between March 30, 2012, and April 25, 2012[14], for registered monitors of goo Research who live in the Kanto area. In the Kanto area, there exists no serious difference in broadband availability or in the competitive situation among ISPs. Completed questionnaires were received from 1,024 respondents in their 20s, 30s, 40s, and 50s, almost evenly distributed[15]. Valid responses were received from 704 individuals, who constituted the sample for the present study. The features of the sample are shown in Table 5.

The questionnaire assumed that the features not mentioned in Table 1 are identical, except for the need to install a new line, which is necessary when a user transfers to the NTT group (except for transfers within the group) or to a non-NTT group. However, this is assumed to be free of charge because its current market price is usually zero as a result of rigorous marketing campaigns to attract new users[16]. In addition, e-mail

Table 5 Descriptive statistics of the sample

	Whole sample	Access lines			
		FTTH for SDU	FTTH for MDU	ADSL	Cable Internet
N	704	250	190	195	69
Average household income (0,000yen)	622.5	681.2	605.5	560.8	631.2
Average Internet experience (years)	14.1	14.5	14.2	13.5	13.7
Average duration of relationship with current ISP (months)	71.3	73.8	57.0	83.0	69.0
Average monthly charge for Internet use (yen)	5,251.1	6,756.8	4,696.5	3,679.6	5,753.9
Percentage of male respondents	74.7%	76.8%	77.9%	69.7%	72.5%
In-house network					
Fixed line only (no WiFi)	571	190	152	167	62
PC via WiFi	128	58	37	26	7
Tablet via WiFi	5	2	1	2	0

Note: SDU stands for Single Dwelling Unit, and MDU stands for Multi Dwelling Unit.

address portability, by which users can continue using the address provided by their previous ISPs, was assumed[17].

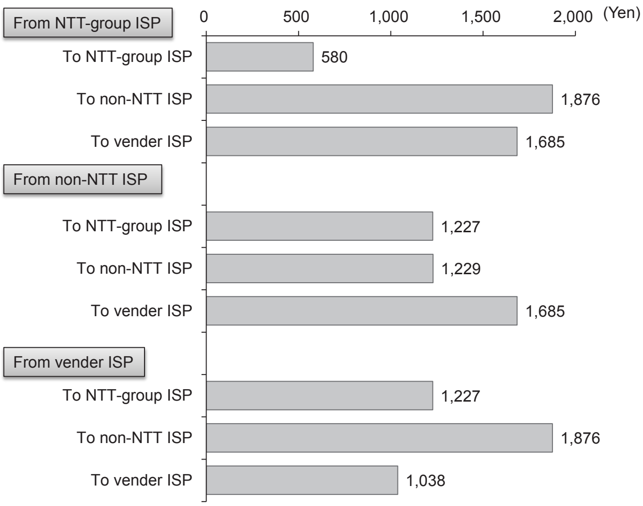
Table 6 shows the results of the parameter estimation. According to the McFadden Pseudo R^2, the overall fitness of the model is sufficiently good[18,19]. The signs and p-values of all related parameters, except α_{net}^{vender}, confirm all three of the hypotheses stated in Section 2.2. Since the price variable is a negative value, the minus sign of parameter β_{price} represents that the utility level becomes smaller when the size of discount is decreased. Estimated switching costs (or more precisely the monthly fee equivalences), following the formulae presented in Table 2, are summarized in Figure 3[20].

Overall, the results confirm the finding derived using Shy's approach; that is, NTT brand providers face far smaller switching costs than other brand providers. It is also shown that staying within the same brand category has as much influence on the level of switching costs as that of the powerful NTT brand, although the sign is opposite; this result is not made clear in Shy's model. Moreover, considering the one-time nature of Shy's estimates in Figure 1 and the monthly fee nature of the questionnaire-based estimates[21], it turns out that the degree of possible underestimation in Shy's results is significant. The WTP to improve actual broadband speed is also obtained; the estimation suggests that users will pay up to 6.74 yen per month for an additional 1 Mbps. This finding indicates that if an ISP can offer a higher-quality service than its competitors, the switching cost it must overcome will be lower, as shown in Figure 4.

Table 6 Estimated parameters of Equations (4) and (5)

				coefficient	standard error	p-value	β_k / β_{price} *
N				2372			
Log likelihood				-2594.070			
Restricted log likelihood				-3288.290			
McFadden Pseudo R^2				0.211			
D_{NTT}			α_{NTT}	0.0819	0.3489	0.815	580.11
	Shift parameters	*income*	α_{inc}^{NTT}	8.62.E-04	2.15.E-04	0.000	
		netEx	α_{net}^{NTT}	-0.0537	0.0242	0.027	
		ispEx	α_{isp}^{NTT}	-0.0064	0.0017	0.000	
		D_{male}	α_{male}^{NTT}	-0.2686	0.1917	0.161	
		v_{NTT}	σ_{NTT}	0.0038	0.3195	0.991	
D_{nonNTT}			α_{nonNTT}	-0.7399	0.3496	0.034	1,229.02
	Shift parameters	*income*	α_{inc}^{nonNTT}	4.14.E-04	2.14.E-04	0.053	
		netEx	α_{net}^{nonNTT}	-0.0533	0.0239	0.026	
		ispEx	α_{isp}^{nonNTT}	-0.0048	0.0017	0.004	
		D_{male}	α_{male}^{nonNTT}	-0.1475	0.1877	0.432	
		v_{nonNTT}	σ_{onNTT}	0.0545	0.3875	0.888	
D_{vender}			α_{vender}	-0.7936	0.3709	0.032	1,037.70
	Shift parameters	*income*	α_{inc}^{vender}	-0.0003	0.0002	0.202	
		netEx	α_{net}^{vender}	0.0184	0.0249	0.460	
		ispEx	α_{isp}^{vender}	-0.0099	0.0017	0.000	
		D_{male}	α_{male}^{vender}	-0.0117	0.1984	0.953	
		v_{vender}	σ_{vender}	0.0385	0.3232	0.905	
D_{same}			α_{same}	0.9124	0.2885	0.002	-647.04
	Shift parameters	*income*	α_{inc}^{same}	4.40.E-04	1.77.E-04	0.013	
		netEx	α_{net}^{same}	0.0014	0.0196	0.945	
		ispEx	α_{isp}^{same}	-5.37.E-04	0.0014	0.701	
		D_{male}	α_{male}^{same}	-0.3714	0.1603	0.021	
		v_{same}	σ_{same}	0.8453	0.2913	0.004	
speed			α_{speed}	0.0126	0.0066	0.059	-6.74
	Shift parameters	*income*	α_{inc}^{speed}	7.61.E-06	3.49.E-06	0.029	
		netEx	α_{net}^{speed}	-1.83.E-04	4.37.E-04	0.675	
		ispEx	α_{isp}^{speed}	7.85.E-07	2.71.E-05	0.977	
		D_{male}	α_{male}^{speed}	-0.0073	0.0037	0.046	
		v_{speed}	σ_{speed}	0.0251	0.0039	0.000	
price			β_{price}	-0.0014	0.0001	0.000	

Note 1: β_k (k = NTT, nonNTT, vender, same, speed) are calculated at the sample mean.
Note 2: Considering the statistical significance/insignificance of σs, the author tried another specification where the β_k for NTT, nonNTT, and vender are nonstochastic. This specification generates almost the same switching cost estimates as those in Table 6, and are as follows: 582.69 for D_{NTT}, 1,227.32 for D_{nonNTT}, 1,037.98 for D_{vender}, -642.61 for D_{same}, and -6.90 for speed. Detailed results are available upon request.



Note: "non-NTT ISP" includes telecom ISPs that are not in NTT group, cable internet firms, and other independent ISPs.

Figure 3 Switching costs estimated using the questionnaire data

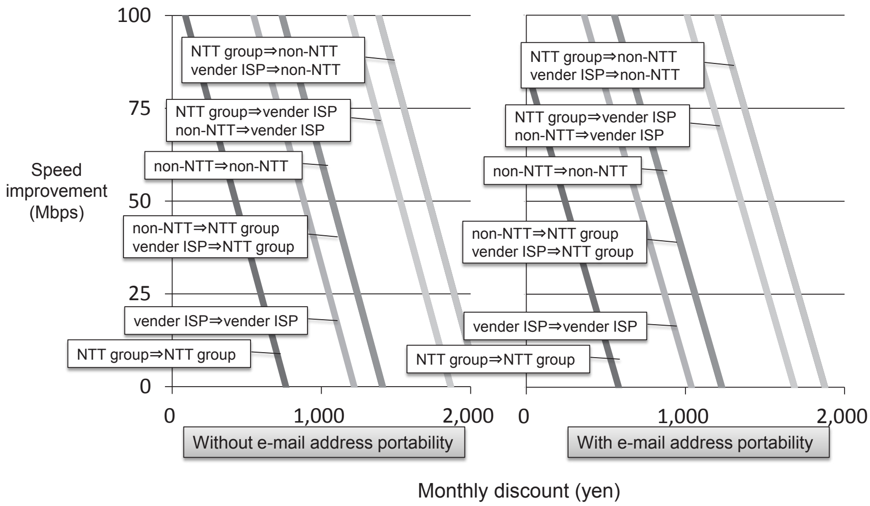


Figure 4 Trade-off between speed improvement and monthly discount

4. Discussion and Conclusion

In a matured broadband market, what matters most for a network neutrality solution is not competition for new users but competition for existing users. As long as the choice of alternative service providers is sufficiently guaranteed for a user whose current Internet experience is not exactly what he or she pays for, the MIC's approach can work as expected. In this paper, the author employs two methods: Shy's model, which is easy to use but tends to underestimate values, and a difficult-to-implement but more reliable questionnaire-based method. Using these methods, this paper empirically estimates the switching costs in the Japanese broadband ISP market and demonstrates that the Japanese broadband Internet market may not be as competitive as the MIC expected. Considering the size of the switching costs, or more precisely the monthly fee equivalence, estimated by the latter method, it is almost impossible for unbundled ISPs to compete for existing customers, because these providers have to provide a one-time discount that may require as much cost as to offer a free or a negatively priced service[22]. Since the number of integrated ISPs that offer bundled access lines and thus can make such a discount is small compared with those that provide unbundled deals, competition in the Japanese broadband market might actually be an oligopoly, where end users cannot enjoy the full benefit of a competitive ISP market. In fact, in Japan, the number of competitors that can challenge an incumbent ISP is around three in the metropolitan market: one non-NTT telco ISP, one cable Internet company, and one power company (powerco) ISP. This number decreases to two (possibly, one powerco ISP and one cable Internet company) in suburban areas and to as few as one (perhaps, one cable Internet company) in rural areas. In this situation, the degree of market competition could be much lower than that required for the MIC to practice its net neutrality policy. Introducing quality competition in actual download speed can result in scaling down the required discount and ultimately enabling other ISPs to compete with an incumbent ISP. However, as shown in Figure 4, they would still need to improve their effective speeds substantially to stay competitive.

Even though an ISP could find a way to overcome switching costs and make broadband competition in the retail market effective, the market equilibrium still cannot attain the social optimum unless end users fully understand what they are paying for. Moreover, poor QoS literacy will inhibit the “coregulatory” approach sought by the MIC, which requires the active engagement of well-informed end users. First, end users’ awareness of the actual quality of broadband services should be improved. Currently, users regard price level as the most important criterion when selecting an ISP and pay little attention to service quality (Figure 5).

According to a web-based survey conducted in Jitsuzumi (2011c), 49% of the respondents gave positive responses to the question of whether QoS affects the satisfactory level of Internet experience, and such “QoS-conscious users” are more likely to change ISPs than “QoS-unconscious users” if provided with better QoS. Jitsuzumi (2011c) also empirically argued that the current pro-FTTH initiative in Japan could positively contribute to increasing the number of QoS-conscious users, who have more reasons to seek a better quality ISP than QoS-unconscious users and, in addition, as bit-intensive applications make traffic congestion more frequent, more people will become conscious of QoS. Therefore, it can be expected that the trade-off between the required discount and quality improvement will shift towards the latter as time goes by, leading to greater quality competition in the Japanese broadband market, which will ultimately help the MIC attain its original target (Figure 6).

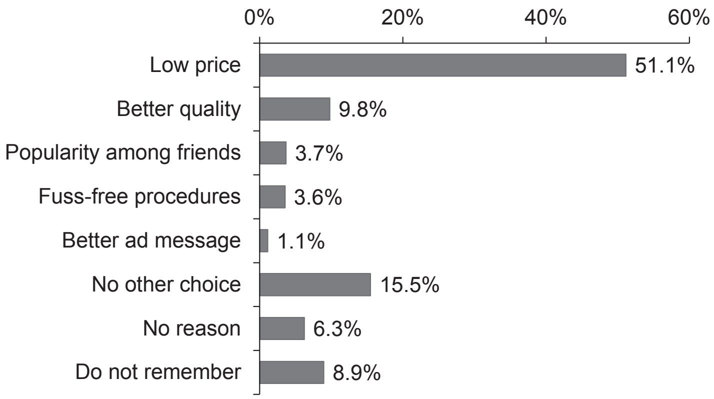


Figure 5 The most important reason for selecting the current ISP

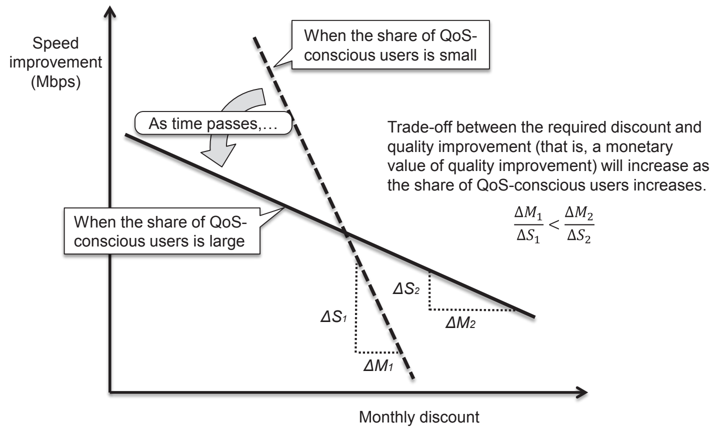


Figure 6 Changes in the trade-off

Second, even QoS-conscious users cannot react properly without an accurate and timely understanding of the actual QoS they are experiencing and the alternative ISP options available to them. As for providing actual QoS data, some initiatives already exist, such as those created by the Federal Communications Commission in the US and Ofcom in the UK. However, the information provided by these parties is not always easily understandable to residential users that lack the relevant technical background. In addition, their disclosures relate only to the performance of individual ISPs, and thus may not fully cover the end-to-end (E2E) QoS that matters most to users. Therefore, the author proposes introducing a specialist, an "ISP sommelier," who could translate the technical information and provide proper suggestions to people who lack sufficient technical knowledge[23]. It is true that, even for a highly knowledgeable ISP sommelier, it would be a formidable challenge to come up with the "right" suggestion because E2E QoS is significantly influenced by various reasons, such as the clients' PC performance, software installed, and quality of in-house wiring.

For this, conducting a client interview or performing a statistical analysis would help improve the accuracy of their suggestions.

As for users' awareness of the available options, four questions were included in the above-mentioned web survey: two to examine the awareness of the ISP's contract structure and two to determine to what extent users understand the ISP's features. Figures 7 and 8 summarize the results, implying that a proper understanding of the actual situation, which is a prerequisite for efficient ISP competition, is lacking among a significant number of broadband users; this is another area where ISP sommeliers could help general con-

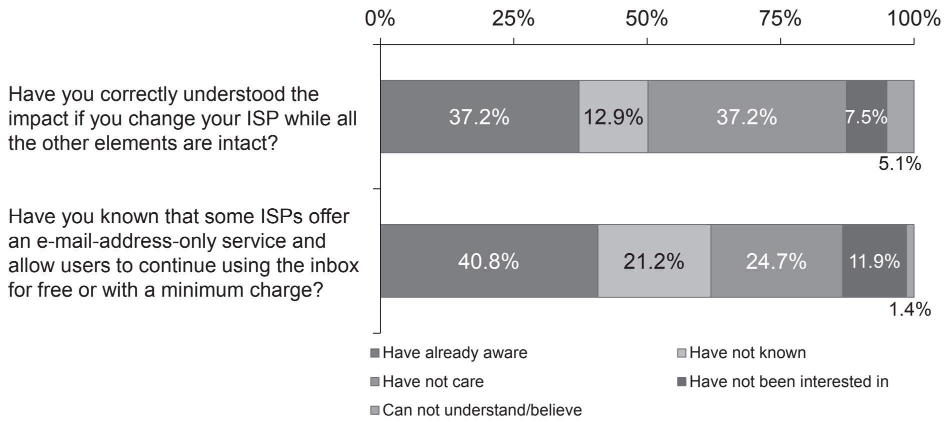


Figure 7 Summary of questions on users' contract structure literacy

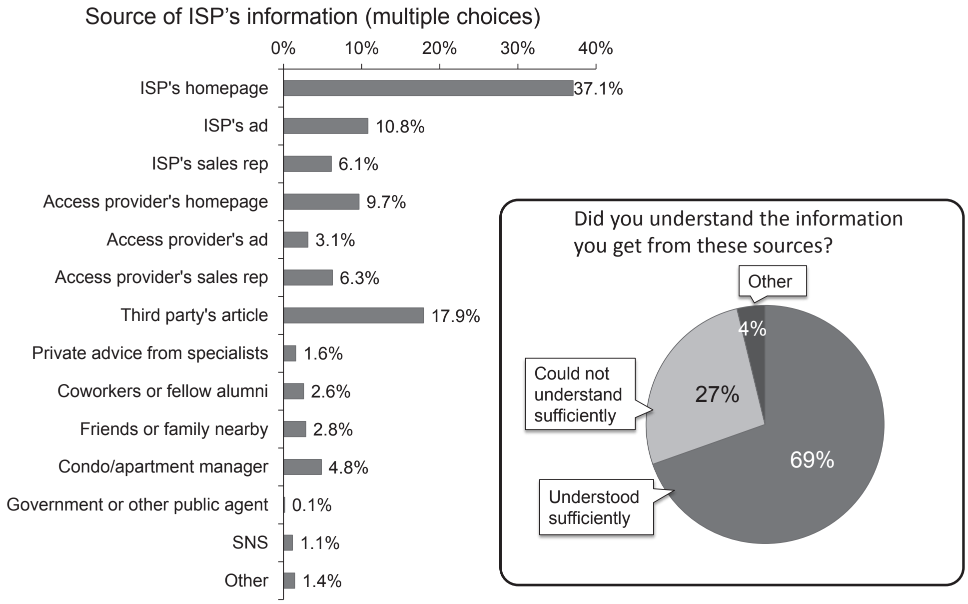


Figure 8 Summary of questions on users' ISP information literacy

sumers. According to the survey, 37% of the respondents have a positive attitude to the use of such a sommelier service; however, only 1.6% of them are ready to pay for such a service.

Moreover, since such a sommelier service would generate a positive externality and require fairness, transparency, and independency, there would be less than the optimal number of such specialists if only private initiatives were relied on. The author believes this is an area in which regulators can help by using their legitimate authority.

Although the discussion in this paper is based on Japanese empirical data and reflects the current Japanese policy framework, it can apply to other nations that have a similar structure in the broadband ecosystem as that of Japan and where significant market power regulations on incumbent network operators represent the major tool to attain competitiveness in the ISP market. The author's findings do suggest the necessity for such nations to empirically check the degree of competitiveness in their ISP markets. If this turns out to be insufficient from the viewpoint of attaining network neutrality, the introduction of QoS competition through a mandatory disclosure requirement to ISPs, appropriate end-user education, and support for ISP sommelier businesses will become important policy options for consideration.

The apparent shortcoming of this paper is that it covers only a fixed broadband service due to the technological difficulties in data collection. Considering the current market situation of people starting to use fixed broadband and mobile broadband seamlessly via Wi-Fi-enabled PCs, smartphones, and tablets, more relevant switching cost estimates would be obtained if mobile broadband were covered as well. Since the mobile service is much more personal in nature than its fixed counterpart, switching costs are expected to be larger than those estimated in this paper. The author believes that this area is a clear direction for future research, with the expectation that the basic conclusion of this paper will be strengthened.

Acknowledgments

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Footnotes

1) Some issues and viewpoints so far found in network neutrality arguments were summarized in Cherry (2007) and Jitsuzumi (2010).

2) In this paper, a "broadband ecosystem" is defined as an economic arena where network operators, ISPs, platform providers, content/application providers, and users exist and interact with each other.

3) Some EU nations can satisfy these conditions.

4) Competing service providers need to quote a price lower than that of the existing player to at least com-

pensate the user for the switching costs involved.

5) This practice is called "hold-up" or "bargain-then-rip-off" pricing.

6) According to an MIC survey, 2.7 million people changed their addresses within the same prefecture and 2.3 million beyond the prefectural border in 2011. For more details, please refer to http://www.stat.go.jp/data/idou/2011np/kihon/zuhyou/hyo01.xls.

7) There are far more than three ISP brands in the Japanese ISP market. However, owing to the difficulty in questionnaire design, they are grouped into the three "brand groups" shown in Table 1.

8) This setting is hypothetical for analytical purposes only and does not accurately reflect how users currently choose their ISPs, which is shown in Figure 5.

9) This is why the MIC did not allow NTT data (NTT's data-service subsidiary) to share the same logo when it was split off from NTT.

10) Details of the IIA test results are available upon request to the author.

11) In this specification, the income level of each respondent affects utility level only through the shift of coefficients, which apply Ds and/or a speed parameter. Table 6 shows that the estimated parameters on income level are either significantly positive or not significant from zero, suggesting that, ceteris paribus, utility level will increase when income increases.

12) Switching costs arise when consumers change suppliers, and are usually calculated as a lump sum cost. However, in order to make the question easily understandable and familiar to respondents and thereby generate realistic answers, the author measures them in terms of the equivalent monthly fee that yields the same amount of utility change on subscribers. In order to obtain a lump-sum switching cost or the size of a one-time discount required to attract subscribers of other ISPs, we need to calculate the net present value of the estimated monthly fee stream, which requires us to estimate the discount rate of consumers and expected length of use. However, that is beyond the scope of this paper. Moreover, because potential customers react not only to such one-time discounts but also to monthly discounts, we believe that a monthly fee-based discussion is also meaningful for ISP managers when designing a competitive tariff structure. Because of this treatment, these estimations cannot be compared directly with those of Shy's model.

13) If ISPs can mandate a fixed-term contract, "bargain-then-rip-off" pricing allows them to cover such costs by charging a monthly surcharge over those periods.

14) This period includes a break of almost three and a half weeks due to a fault with the speedtest.net site.

15) It is true that the Japanese population is significantly skewed towards older age groups. However, considering that the selection of a broadband ISP is a family decision not an individual one and that the younger generation is more influential in high-tech-related decisions than elderly people, the author adopted the even distribution as a plausible assumption when estimating average switching costs in Japan.

16) This is also for simplicity purposes.

17) Based on the responses to a separate question, the average WTP for e-mail address portability was estimated to be 184.5 yen per month. The details of this estimation are available upon request to the author.

18) The McFadden Pseudo R^2, or ρ, cannot be directly comparable to the standard R^2, and it is known to present lower values. The relationship between ρ and R^2 is summarized in Domencich and McFadden (1975). According to Ida (2007), $\rho = 0.2$ is a sign of sufficiently high fitness.

19) For comparison purposes, a model that does not include shift parameters is also estimated. The result is presented in Table A, showing an inferior fitness of the model.

Table A Estimated parameters without shift parameters

N		2372			
Log likelihood		-2654.482			
Restricted log likelihood		-3288.290			
McFadden Pseudo R^2		0.193			
		coefficient		σ	
D_{NTT}	β_{NTT}	-0.7603	***	0.1606	
D_{nonNTT}	β_{nonNTT}	-1.6098	***	0.0091	
D_{vender}	β_{vender}	-1.3410	***	0.1633	
D_{same}	β_{same}	0.8670	***	0.5841	
speed	β_{speed}	0.0090	***	0.0260	***
price	β_{price}	-0.0013	***		

Note: *, **, and *** mean p<0.10, p<0.05, and p<0.01, respectively.

20) From the viewpoint of simplicity, we assume that the only "brand" factor that influences the switching cost is whether the pre-switching ISP brand is the same as the post-switching brand, and that the pre-switching individual brand category does not influence the switching cost. For reference, Table B shows the estimated switching cost that addresses the individual ISP brand. Although it is not statistically appropriate to compare figures with those in Figure 3 because the estimation in Table B employs different functional specifications from those of Table 6 (and Figure 3), their sizes approximate each other. The estimated parameters used in Table B are available upon request with the author.

Table B Estimated switching cost considering the pre-switching ISP brand

Pre-switching brand	Post-switching brand	Estimated Switching cost
NTT group ISP	NTT group ISP	461
	non-NTT ISP	1,678
	vender ISP	1,565
non-NTT ISP	NTT group ISP	1,576
	non-NTT ISP	1,535
	vender ISP	1,739
vender ISP	NTT group ISP	1,199
	non-NTT ISP	1,765
	vender ISP	1,073

21) See Footnote 12.

22) See Footnote 12.

23) This kind of situation reminds me of when we order wine at dinner. It is not easy to choose the best wine

for the dish even if there is a good amount of information on the wine list.

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