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Changes in consumers' behavior when a vertically integrated service is separated —The case of Japanese mobile phone services—

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Abstract

In this paper, I empirically examine the consumer behavior change in the case that the current vertically integrated Japanese mobile phone market was separated by employing the stated preference survey. As a hypothetical vertically separated situation, I assumed the introduction of contents compatibility and handsets compatibility among different mobile phone carriers. My analysis also assumed the introduction of mail address portability. My estimation results yield the following implications: (1) handset compatibility, contents compatibility, and mail address portability reduces consumer's switching costs, and (2) current contents incompatibility is offsetting the network quality difference among carriers.

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1. Introduction

In Japan, the number of mobile phone subscribers surpassed 100 million in 2007; this accounts for approximately 76% of Japan's total population. People use mobile phones not just for verbal communication, but also for e-mailing, Internet browsing, and other digital communications. In recent times, mobile phone handsets have also been one of most important items in our life, as the mobile telecommunications network has now become the most important infrastructure for communications. In fact, a mobile phone handset itself can be used as a digital camera, picture viewer, music player, simplified text editor, scheduler, GPS handset, etc. In Japan, there are three major mobile phone carriers: the incumbent NTT docomo, au, and SoftBank mobile. They control 99% of the total market share. New entrants in the mobile phone market are rare because of the limited resource of radio frequency. Aside from the three major carriers, only EMobile started operating a mobile phone service since March 2007. The Japanese mobile phone market is highly oligopolistic and due to this situation, policies to boost competition in the mobile telecom market are being considered.

One of the features in the Japanese mobile phone market, is its high switching cost when consumers change mobile phone carriers (Ohashi et al. 2007, Nakamura 2007). In Japan, when consumers change mobile phone carriers, they must also buy a new handset compatible with the new carrier; this paves the way for a vertically integrated mobile phone business model in Japan. Along with providing telecom services, Japanese mobile phone carriers also supply handsets and provide content services on mobile phones. These content services are certified by the telecom carrier. Although third-party companies can offers content services, the share of official contents is still large. A part of the reason for the large official contents share is that only the official contents can be accessed through each carrier's portal page. As for mobile handsets, they are made by each vendor in accordance with each carrier's standard and are then supplied by the mobile phone carriers.

At present, there is no government policy considered for the vertically integrated market structure in Japan. Introducing the handset and contents compatibility (or portability) would produce benefits to consumers who want to use a combination of various carriers' services, such as contents, handsets, and network. In addition, it might in turn reduce consumers' switching costs when

consumers change mobile phone carriers. As for switching costs, Farrell and Klemperer (2007) reviewed the previous studies on switching costs and covered both the theoretical and empirical approaches. As for the empirical approach to switching costs in the telecom sector[1], Knittel (1997) analyzed the U.S. interstate long-distance market and proved that switching costs have provided long-distance carriers with market power. Lee et al. (2006) empirically estimated switching costs in the Korean mobile phone market with conjoint-type data and proved that the introduced number portability service reduced switching costs. They also include handset portability as an attribute in their conjoint analysis.

However, it must be noted that the compatibility in the complementary services is not always good for consumers. As Matutes and Regibeau (1988) pointed out, if the complementary goods supplied by multiproduct firms became compatible, their prices would become higher than those which are incompatible. This occurs because multiproduct firms can exploit profits from the complementary service market by enclosing consumers in another vertically integrated service market if those two services markets are vertically integrated. Therefore, the competition in vertically integrated markets tends to be more aggressive. In this sense, we need to compare which benefits are greater between the low-price benefits in the vertically integrated market and the benefits from the variety of combinations in the vertically separated market.

In this paper, I empirically examine, by employing a stated preference (SP) questionnaire, consumer behavior change in a case that considers a separation of the current vertically integrated Japanese mobile phone market. This questionnaire was answered by consumers; however, we could not directly observe suppliers' behavior changes, such as a price strategy change. Therefore, this paper's focus lies in the consumer's benefit of vertically separated mobile phone services, such as the availability of combining different carriers' services and reducing switching costs. My estimation results yield the following implications: (1) handset compatibility, contents compatibility, and mail address portability to reduce consumer's switching costs, and (2) current contents incompatibility is offsetting the network quality difference among carriers.

This paper is organized as follows: In the next section, the design of my SP experiment is described. My econometric model framework and the estimation procedure are presented in Section 3. The estimation results and

[1] There are many empirical analysis of switching costs in other sectors: Kim et al. (2003) study bank loan services, Elzinga and Mills (1998) study the wholesale distribution of cigarettes, and Stango (2002) analyzes credit cards markets.

discussion based on the estimation results are presented in Section 4. Section 5 concludes this paper by providing a brief summary of our findings. Issues pertaining to the limitations of this paper will also be discussed in this section.

2. Choice Experiments

In this section, I briefly explain the data used in this study. My data is obtained from an SP survey I conducted in collaboration with the Information Communications Research Institute of Japan in December 2008.

I employed an SP survey that uses a conjoint questionnaire to capture consumers' preferences, because currently each carrier's contents and handsets are incompatible. By designing the SP experiment, a researcher can ensure the variability of the attribute levels and avoid collinearity among the attributes. A conjoint analysis is one of the SP experiment techniques that have been applied to a wide array of study areas. Hensher (2001, 2004) applied this method to automobile travel evaluation, Layton (2000) conducted environmental research using this technique, and Kim (2005) analyzed 3G mobile phone demand by applying this method to the Korean mobile phone market. Marketing is one of the most popular research areas that use conjoint analysis (Huber and Train, 2001). In a conjoint analysis, researchers make hypothetical bundles using several attributes that describe a product or service and ask respondents to state their preferences from among hypothetical alternatives. Their responses are analyzed using statistical techniques.

The range of attributes and the levels that comprised each of the alternatives in my conjoint experiment are presented in Table 1. The example of my choice experiment questionnaire is presented as Figure 1.

Hypothetical Compatibility/Portability Situation			Please Choose One of the following Carriers		
Mail Address is Portable.	Contents are compatible across carriers. Therefore, all the contents are available.	Handsets are compatible across carriers. Therefore, all the handsets are usable.	NTT docomo	au by KDDI	Soft Bank
Available	NOT available	Available	2,000JPY	4,000JPY	3,000JPY
			( )	( )	(√)

*: Question "Currently you cannot use other carriers' handsets or contents. In addition, you need to change your mail address when you change mobile phone carriers. The following table shows that these situations have been hypothetically changed. The presented fee is a monthly fixed service fee. Under the assumption that you need not pay any more, how would you choose the carrier under the following hypothetical situations? Note that you need to pay approximately 5,000JPY (2,000JPY as a number portability commission and 3,000JPY as a new contract commission) when you change to a carrier that permits number portability."

**: As of December 2008, 100JPY is equal to 1.1USD.

Figure 1: An Example of Conjoint Cards[*,**]

Table 1: Design of Conjoint Analysis

Attribute	Description	Levels
MAIL	Mail addresses are portable when consumers change their current mobile phone carriers	1 if portability is available 0 otherwise
CONTENTS (*CT*)	All the contents are compatible, therefore consumers can also use all the content supplied by carriers with which they do not have a contract.	1 if compatible 0 otherwise (remaining incompatible)
HANDSETS (*HS*)	All the handsets are compatible, therefore consumers can also use all the handsets supplied by carriers with which they do not have a contract.	1 if compatible 0 otherwise (remaining incompatible)
PRICE	Fixed monthly fee (divided by 1000 yen for normalization)	2, 3, 4, 5

In this analysis, each alternative is bundled according to the brand names of mobile phone carriers, the hypothetical monthly fixed fee, and the hypothetical mobile phone service structures. As for hypothetical service structures, I assumed contents compatibility, handsets compatibility, and mail address portability. As mentioned above, Japanese mobile phone carriers also supply handsets and provide contents services. Currently, each carrier's handsets and contents are incompatible across carriers. By employing these compatibility attributes, we can examine consumers' behavior changes if a vertical separation policy had been introduced in the Japanese mobile phone market. As for a mail address portability attribute, this is not a compatibility issue. However, I thought this is one of the biggest switching costs in mobile phone markets. In Japan, the mobile number portability policy started in October 2006. However, mail address portability was not decided on because each carrier's mail address domain is the carrier's name. Nakamura (2007) evaluates switching cost changes by introducing various hypothetical portability services to the Japanese mobile phone market with SP data, and shows that the consumer's evaluation of mail address portability is equal to that of number portability. Therefore, because of the lack of the mail address portability attribute, it could be that only a few consumers change carriers even if the compatibility attributes change. In that case, we cannot observe potential consumer behavior changes. Therefore, I employ mail address portability as an attribute in my choice experiment. In addition, in my choice experiment, the mobile number portability service is considered another big factor in switching

costs. However, customers need to pay a fee to retain their mobile number, which amounts to 5000 JPY and is equal to the actual costs.

My conjoint experiment exercise was pretested several times, where respondents were queried about their understanding of terminology, i.e., whether they felt they could meaningfully evaluate the hypothetical vertical separated situations, and their attitudes relating to the number and presentation of the experiments. A few revisions were made in the wording of the survey after the first pretest. I test various combinations of price attributes levels to capture consumers' preferences.

The participants of my survey were members of a survey panel for an Internet survey company, goo research Inc. The respondents were asked a series of twelve multiple-choice questions. The respondent was asked to choose one carrier according to his/her preference. The sample size in this survey was 1,457; this number is limited to the subscribers of the three major Japanese mobile phone carriers, namely, NTT DoCoMo, au by KDDI, and SoftBank Mobile. I distribute survey forms to monitors corresponding to the socio demographic composition of Japanese mobile phone subscribers[2].

It must be noted that the number of profiles becomes unwieldy if I consider all possible combinations of attributes. Therefore, I narrowed down conjoint profiles in our survey to 48 patterns using orthogonal design methods, considering each main effect and the possible interaction effects (see Louviere et al. 2000; Kuehl 1999; or Hensher et al. 2005 for details).

3. Econometric Approach

3.1 Model Specification

My consumer behavior model is based on the random utility framework proposed by McFadden (1974). My model specification follows the random parameter logit (RPL) model. The RPL model is also known as the mixed logit model. McFadden and Train (2000) show that the mixed logit model can approximate any random utility choice model by appropriately choosing variables and mixing distributions. Assuming that an individual i faces a choice among J alternatives in each of T choice sets, my utility functional form in case the

[2] The socio demographic composition is calculated based on the information and communications survey (households) by Ministry of Internal affairs and Communications (MIC), Japan. The information and communications survey (households) is an annual mail survey conducted by MIC, Japan every February (or January). The survey was held in 2008, and contacted 3,640 households and 12,574 persons as effective samples.

individual i chooses alternative j in a choice set t is as follows:

$$U_{ijt} = \beta_i' x_{ijt} + \varepsilon_{ijt}$$

The distribution of random disturbance ε_{ijt} is assumed to be an independent and identical extreme value. β_i is the unknown coefficients vector, each element of which is given by $\beta_{i,x}$. More concretely, my assumed utility function is as follows:

$$\begin{aligned} U_{ijt} = {} & \beta_{i,au} au_{ijt} + \beta_{i,SB} SB_{ijt} \\ & + \left(\beta_{i,SW} + \beta_{SWML} MAIL_{ijt} + \beta_{SWHS} HS_{ijt} + \beta_{SWCT} CT_{ijt}\right) SW_{ijt} \\ & + \left(\beta_{PR} + \beta_{PRML} MAIL_{ijt} + \beta_{PRHS} HS_{ijt} + \beta_{PRCT} CT_{ijt}\right) PRICE_{ijt} \\ & + \varepsilon_{ijt} \end{aligned}$$

Except for brand dummy variables (*au* and *SB* [SoftBank] based on NTT docomo = 0) and switching cost dummy variables (*SW*), the independent variables correspond to the attributes in the experiment. SW_{ij} is 1 if alternative j involves a change in the carrier, and 0 if alternative j is a current carrier. This definition is the same as in Lee et al (2006). *HS* and *CT* are compatibility dummy variables. *HS* takes 1 when the handset compatibility was assumed and 0 otherwise. *CT* takes 1 if all the contents were compatible and 0 otherwise. *MAIL* is 1 when a mail address is portable and 0 otherwise. The definition of each attribute/variable is provided in detail in Table 1 in the last section. As for the distributions of coefficients, the coefficients of each brand dummy variable and the switching cost variable ($\beta_{i,au}$, $\beta_{i,SB}$, $\beta_{i,SW}$) are assumed to be distributed normally across the population. Other coefficients are assumed as fixed across the population.

This paper's central focus is to investigate contents and handsets compatibility impacts. Introducing these compatibilities might affect consumers' switching costs. Currently, consumers cannot continue to use their favorite contents or handsets when they change mobile phone carriers. Moreover, as recent handsets are expensive, the expense of purchasing a new handset is considered a part of switching cost. Therefore, I insert the compatibility/incompatibility dummy variables to capture the switching costs parameters changes. The portability of mail addresses is also considered to change switching costs, so I insert this dummy variable into the switching costs parameter.

In addition, switching costs could include uncertainties inherent in the next carriers' services, which are unfamiliar to the user. In fact, my sample data suggests that over 60% of mobile phone users have not changed their carriers. If compatibilities in the complementary service layers were introduced, consumers

would not need to care about the uncertainties in those service layers. The switching cost parameters in my estimation model will capture the cost when a consumer switches from their current carrier to another carrier. However, this cannot capture the reduction of switching costs incurred by leaving the next carrier. The latter would appear as price sensitivity changes in my model, since declining uncertainty would persuade consumers to switch carriers even for a small difference in service fee.

There would be another aspect to the price sensitivity changes. We can also understand the price sensitivity changes as the changes of the consumer's evaluation basis for each carrier. For example, in the case that contents are incompatible across carriers, consumers would evaluate each carrier based on the total quality difference of its network service and contents services (to simplify the explanation, I neglected differences in handset quality). However, if contents became compatible across carriers and all the contents became usable for any mobile phone users, users would evaluate each carrier based only on its network service and not on its contents service values. In other words, consumers would choose a contracting carrier based on its service fee and its network quality, if other layer services were separated from its network. Therefore, consumers' price sensitivity would be changed by introducing compatibility in the complementary service of network services.

My estimation model is structured o capture the above changes of switching costs and price sensitivity when portability and compatibility is introduced.

3.2 Estimation Procedure

The RPL model captures the preference variation by introducing stochastic terms into the coefficients created through deviations from the mean preferences and by allowing these terms to be correlated with each other. Even under logit specifications, these stochastically correlated terms relaxed the independent from irrelevant alternatives property. Both the classical and Bayesian procedures can be used for estimating RPL models.

In recent studies, due to the developments in computer technology, the classical approach to estimating RPL models is generally based on simulation methods. Integrations of the multivariate densities are usually required for estimating RPL models. The understanding of simulation methods has allowed us to calculate multivariate integrations. The estimation of the maximum simulated

likelihood (MSL) is the most popular method employed to estimate RPL models. There are various studies that apply these techniques, such as Calfee et al. (2001).

As an alternative to classical estimation, the parameters of the RPL models can be estimated using the Bayesian procedure. As Train (2003) has pointed out, Bayesian procedures have certain advantages over the classical approach. Since Bayesian procedures do not require the maximization of any function, the related difficulty of the numerical maximization of likelihood functions can be avoided. In practice, the choice of starting values often results in the algorithm failing to converge in maximizing the simulated likelihood functions. The results of the Bayesian procedures can be interpreted simultaneously from both the Bayesian and classical perspectives. However, as Train (2003) also points out, in comparison to the classical approach, the Bayesian approach takes more computer run time to estimate the model including both fixed and distributed parameters.

Since my model includes the fixed coefficients, the classical approach is convenient in terms of run time. In practice, reducing run time is one of the most important factors to try and estimate the various alternative model specifications for attaining the robust results; therefore, in this paper, I employ the classical approach, MSL, in order to estimate the RPL models.

4. Estimated Parameters and Discussion

As mentioned in the last section, I assumed that the coefficients of brand dummy variables and the switching costs variable follow a normal distribution. I proceeded with the MSL method for estimation by setting 500 Halton draws (see Train 2000 for details). Furthermore, since a respondent repeatedly completes 12 multiple-choice questions, I considered the data to be a type of panel data (see Allenby and Rossi 1999 for details). Thus, I applied a standard random effect method in which random draws were repeatedly reused for the same respondent.

Table 2: Estimation Results

	Conditional Logit			*Mixed Logit*		
	Coef.	*S.D.*	*P-value*	*Coef.*	*S.D.*	*P-value*
au	-0.2169	0.0241	(0.000)	-0.3765	0.0901	(0.000)
standard deviation of au				1.7085	0.0945	(0.000)
SB	-0.4819	0.0256	(0.000)	-0.9215	0.0994	(0.000)
standard deviation of SB				1.9547	0.1071	(0.000)
SW	-2.2041	0.0494	(0.000)	-4.0907	0.1059	(0.000)
standard deviation of SW				2.7904	0.1182	(0.000)
SWML	0.1646	0.0483	(0.001)	0.3101	0.0549	(0.000)
SWHS	0.1422	0.0482	(0.003)	0.3202	0.0597	(0.000)
SWCT	0.0535	0.0483	(0.269)	0.1132	0.0687	(0.100)
PRICE	-0.9068	0.0293	(0.000)	-1.5691	0.0401	(0.000)
PRML	-0.0528	0.0285	(0.064)	-0.1606	0.0387	(0.000)
PRHS	-0.0620	0.0284	(0.029)	0.0227	0.0367	(0.537)
PRCT	0.0964	0.0285	(0.001)	0.1532	0.0426	(0.000)
McFadden R2	0.40			0.57		

Prior to estimating the RPL model, I also estimated the standard conditional logit model. Table 2 presents the estimation results; the result shows that the signs of switching costs and price coefficients are appropriately negative and statistically significant. In terms of consumer taste variations, the RPL model estimation result indicates a large variation in consumer tastes. McFadden quasi R-square indexes also indicate that the RPL model has more power to explain consumers' preferences.

As for switching costs parameters changes, the above estimation results show that both, handsets compatibility and contents compatibility reduces switching costs. We can also see that introducing mail address portability reduces consumer's switching costs. As for price sensitivity changes, introducing contents compatibility declines price sensitivity, and introducing mail address portability increases price sensitivity. Concerning handsets compatibility, from the standard conditional logit model estimation results it increases price sensitivity, although this effect is not statistically significant based on the RPL model estimation results.

As mentioned in the model specification section, price sensitivity parameters in my model would capture the change of the switching cost incurred by leaving the next carrier carrier, since declining uncertainty by introducing compatibilities persuades consumers to switch even for smaller service fee differences. For the estimation results of price sensitivity parameters, we observe that introduction of mail address portability would decrease the switching cost incurred leaving the next carrier for the next next carrier. Another aspect of price sensitivity parameters change is the basis of evaluation changes for each carrier. In my estimation results, introduction of contents compatibility decreases price sensitivity. Considering that it reduces switching costs incurred leaving the next

carrier, which should appear as the price sensitivity parameter increases, it strongly decreases price sensitivity in terms of carrier evaluation basis changes. Under the situation that all the contents and handsets were compatible, consumers choose their contracting carrier based only on each carrier's network quality. In this sense, if the introduction of contents compatibility decreases price sensitivity, it increases the quality difference among carriers. In other words, my estimation result reveals that current contents incompatibility offsets the network quality difference among carriers.

In terms of handset compatibility, my standard conditional logit model estimation result indicates that it increases price sensitivity. On the contrary, it is not observed as a statistically significant change in the RPL model estimation result. We cannot divide price sensitivity change effects into switching costs reductions and carrier evaluation basis changes. In addition, the reduction of uncertainty by introducing compatibility in complementary service layers, if any, is considered to appear as price sensitivity increases. We can confirm carrier evaluation basis changes only in the price sensitivity reduction case, since, in this case, the direction of switching cost reduction and the direction of carrier evaluation basis change are opposite in price sensitivity parameters. In this sense, carrier evaluation basis changes could not be observed in terms of handsets compatibility in my estimation result.

5. Concluding Remarks

In this paper, I empirically examine the consumer behavior change in the case that the current vertically integrated Japanese mobile phone market was separated by employing the stated preference survey. As a hypothetical compatibility situation, I assumed the introduction of contents compatibility and handsets compatibility among different mobile phone carriers. My analysis also assumed the introduction of mail address portability. My estimation results yield the following implications: (1) handset compatibility, contents compatibility, and mail address portability reduces consumer's switching costs, and (2) current contents incompatibility is offsetting the network quality difference among carriers.

Although I empirically examine consumers' evaluations in the case of a hypothetical vertically separated mobile phone market, supply side behaviors change is also important when discussing consumer benefits from introducing

compatibilities. In general, competition in vertically integrated markets is considered to be more aggressive. In this sense, we need to compare which benefits are greater between the low-price benefits in the vertically integrated market and the benefits from the variety of combinations in the vertically separated market. Empirical analysis of supply side behavior is left for future research; however, I believe that my empirical analysis will help the concerned policy-makers determine potential competition policies.

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