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Consumer segmentation and switching costs: Evidence from Japan's mobile telecommunication market

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Consumer segmentation and switching costs: Evidence from Japan's mobile telecommunication market*

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Abstract

This study investigates consumers' switching costs in the Japanese mobile telecommunications market by employing a choice-based conjoint experiment that divides consumers into homogenous classes. The results indicate that the change to other carriers is accompanied by low switching costs, whereas the change to carriers with low data transfer rates is accompanied by high switching costs. Consumers have varied switching costs among distinct classes. The Ministry of Internal Affairs and Communications' policies reduced consumers' switching costs but did not encourage competition due to the fixed-assigned frequency bands. However, policies based on homogenous classes can drastically reduce the switching costs.

Keywords: switching costs, telecommunication policy, conjoint analysis, smartphones

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1 Introduction

A meticulous competition policy should be based on the heterogeneity of consumer preferences. Although most consumers use mobile telecommunications with smartphones, the frequency of their use differs widely. In Japan's mobile telecommunication market, mobile telecommunication fees have decreased, and the policies of the Ministry of Internal Affairs and Communications (MIC) has led to a reduction in consumers' switching costs and encouraged competition in the mobile telecommunication market. Some consumers frequently change carriers, whereas others continue to contact with the same carrier for a long time. For the latter, switching costs may remain persistently high.

Employing a choice-based conjoint experiment, I measure consumers' switching costs in Japan's mobile telecommunications market. The results indicate that the change to other carriers is accompanied by low switching costs, whereas the change to carriers with low data transfer rates is accompanied by high switching costs. Furthermore, consumers who frequently use telecommunication services with their smartphones and continue to contact with the same carrier for a long time are divided into anytime users and minimum users and have significantly different switching costs between divided consumers. The MIC's policies reduced consumers' switching costs but did not encourage competition due to the fixed-assigned frequency bands. Policies based on homogenous classes can reduce the switching costs.

This study adds to the literature about measuring switching costs and policies in the mobile telecommunications market and focuses on the Japanese market after several MIC policies to reduce consumers' switching costs. Several studies have used conjoint analysis in various countries, for example, South Korea (Lee, Kim, Lee, & Park, 2006), Germany (Klein & Jakopin, 2014), Poland (Czajkowski & Sobolewski, 2016), and Portugal (Confraria, Ribeiro, & Vasconcelos, 2017). Nakamura (2010) and Ida (2012) investigated Japan's mobile telecommunication market before MIC policies, such as mobile number portability (MNP) and unlocked subscriber identity module (SIM). However, even after several MIC policies to reduce switching costs, some consumers frequently use telecommunication services with their smartphones and continue to contact with the same carrier for a long time. They would have the opportunity to re-adjust service contracts and a high incentive to change contacts with lower prices.

Furthermore, this study uses a latent class logit model to segment consumers and calculate the switching costs for each segmented consumer. Many studies that use conjoint analysis in the mobile telecommunications market assume a random parameter logit model to allow for individual differences in consumers' preferences. However, this model cannot reveal the factors that cause heterogeneity in consumers' preferences. Alternatively, a latent class logit model, which is frequently applied in marketing research, can identify heterogeneity, divide consumers into distinct homogenous classes, and calculate switching costs for each class. Hamka et al. (2014) and Sell et al. (2014) assumed a latent class logit model and segmented mobile consumers but did not calculate switching costs for each segmented consumer.

The remainder of this paper is organized as follows. Section 2 provides a brief overview of Japan's mobile telecommunication market. Section 3 describes the conjoint survey design and the data used in this study. Section 4 explains the model specifications, and Section 5 presents the estimation results. Section 6 discusses the main findings of the study. Section 7 concludes.

2 Japan's mobile telecommunication market and policy

2.1 Japan's mobile telecommunication market perspective

Mobile telecommunication services are an essential part of life in Japan. According to Ministry of internal affairs and communications (2021a), the number of subscriptions to mobile telecommunication services in December 2020 was approximately 192 million, and the smartphone penetration ratio reached 86.8% in 2020. Approximately 90% of people in each age group (20-49) connect to the Internet on their smartphones.

Japan's mobile telecommunications market has three major carriers: NTT docomo, au, and SoftBank mobile. They are mobile network operators (MNOs) that use the 700 MHz to 28 GHz frequency bands to provide telecommunication services through their own base stations on each network. They had a 94.5% market share at the end of FY2010, which was slightly reduced to 85.1% at the end of FY2020, while mobile virtual network operators (MVNOs) borrow part of the lines from MNOs and provide telecommunication services to users increased their market share to 13.4% at the end of FY2020.[1] Rakuten Mobile had a large market share among MVNOs and started telecommunication services as the fourth MNO in April 2020.

Three major carriers sharply reduced prices under government pressure in 2021. In 2017, mobile telecommunication charges in Japan were almost double the Organization for Economic Co-operation and Development average.[2] In 2020, telecommunications service charges were the highest among six cities:

[1] The Ministry of Internal Affairs and Communications "Official Announcement of Quarterly Data on the Number of Telecommunication Service Subscriptions and Market Share."

[2] Organization for Economic Co-operation and Development (2017).

Tokyo, New York, London, Paris, Düsseldorf, and Seoul.[3]. The Japanese government released an action plan in line with the Prime Minister's vocal advocacy of lower mobile telecommunication fees. Three major carriers launched their own discounted large data plans in March 2021.

2.2 Telecommunication policy

In Japan, telecommunications carriers have introduced contracts and practices that involve switching costs. For example, they considerably discounted telecommunication charges on multi-year contracts while imposing heavy penalties if the contract was terminated in the middle of the contract period. They bundled telecommunication services and mobile phone devices and sold them with a SIM lock. Thus, mobile phone devices could only be used with the current carrier.

The policies of the MIC led to reduced switching costs and encouraged competition in the mobile telecommunications market. Kitano et al. (2010), Nakamura (2010), and Ida (2012) pointed out that the switching costs of mobile telecommunication services were high. The MIC introduced a mobile number portability policy in October 2006. While telecommunication services and mobile phone devices have been bundled, the MIC has prohibited bundling since October 2019. The MIC has implemented various policies to increase policy effectiveness. For example, mobile number portability is not charged, and the procedure for mobile number portability can be performed anytime using the internet. The maximum period of the contract is two years, and the maximum penalty is JPY 1,000. The SIM lock can be unlocked on the web free of charge. Mobile phone devices are generally sold without SIM locks.

[3]Ministry of internal affairs and communications (2021b).

3 Conjoint survey

3.1 Experimental design

In this study, a choice-based conjoint experiment is performed. It applies a stated preference approach based on behavioral intentions and responses to hypothetical bundles of attributes related to consumers switching between bundles of telecommunication services.

An overview of the attributes and their corresponding levels used in the choice-based conjoint experiment is presented in Table 1. There are eight attributes: contract carriers, data transfer rate, additional data volume, calling option, customer support, e-mail service provided by the current carrier, and discount on monthly price. The attribute contract period has two different categorical variable levels: whether the contract period is two years and the cancellation charge is1100 JPY or not. The remaining attributes included three categorical variables. The attributes of the contract carriers are current carriers, other MNO carriers, and other MVNO carriers. The attribute levels for the data transfer rate are: higher than for the current contract, the same as for the current contract, and lower than for the current contract. Additional data volume levels are: no additional data volume, 5GB of additional data volume, and 10GB of additional data volume. Calling charges levels are: charges of 22 JPY for every 30 seconds usage time, no charges up to 5 minutes, charges of 22 JPY for every 30 seconds exceeding 5 minutes, and no charges at any time. The customer support service levels are: taken only online, with a handling fee of 3300 JPY at the shop but no fee at the online shop, and with no fee only online. E-mail services provided by current carriers ’ levels are: not available, available but with an additional fee of 300 JPY/month, and available with no additional fees. Finally, the discount in the monthly price level ranges between no discount and 3000 JPY/month.

Table 1: Attributes and levels in the choice-based conjoint experiment

Attributes	Levels
Contract carrier	Current carrier
	Other MNO carriers
	Other MVNO carriers
Data transfer rate	Higher
	Lower
Additional data volume	No
	5GB
	10GB
Calling option:	No
no calling charges	Up to 5 minutes
	Any time
Customer support	Online or no handing fee at the shop
	Online or handing fee 3300JPY at the shop
	Only online
Contract period	2 year (cancellation charge 1100JPY)
	No continuing agreement
E-mail service provided	Available (No additional fee)
by current carrier	Available, but additional fee 300JPY
	Not available
Discount in monthly price	No discount
	1500JPY/month
	3000JPY/month

All possible combinations of attribute levels led to a full-factorial design with 4374 alternatives. To reduce the number of combinations to a manageable size, an orthogonal design was used, reducing the number of alternatives to 18. I divided them into alternatives 1 and 2 and posed them with the status-quo option (alternative 3). Table 2 shows an example of the choice set provided in the questionnaire, which was translated into English. In the questionnaire, respondents were asked to choose their preferred contract from three alternatives. Each respondent was presented with eight choice occasions with two varying alternatives and a fixed-status quo alternative.

Table 2: Example of a choice set (translated to English)

Contract carriers	Other MNO carriers	Current carrier	
Data transfer rate	Lower	Lower	
Additional data volume	10GB	5GB	
Calling option	No	Any time	Current contract
Customer support	Online or handing fee 3300JPY at the shop	Online or no handing fee at the shop	
Contract period	No continuing agreement	No continuing agreement	
E-mail service provided by current carrier	Available (No additional fee)	Not available	
Discount in monthly price	1500JPY/month	1500JPY/month	
	○	○	○

3.2 Data collection and sample

An online questionnaire consisting of two parts was developed. The first part comprised the respondents' actual behavior in the telecommunications market. The second part included a choice-based conjoint experiment to collect stated preference data.

The survey focused on first- and second-year university students. These students frequently use telecommunication services with their smartphones. According to Ministry of internal affairs and communications (2022), telecommunication consumers can be divided into consumers who relatively frequently change carriers and consumers who continue to contact with the same carrier for a long time. The latter includes consumers who frequently use telecommunication services on their smartphones.[4] They have the opportunity to re-adjust service contracts and a high incentive to change contracts with lower prices. If they did not change their contracts at lower prices, their switching costs could be relatively high.

The main survey was conducted in October 2021. A pre-test of the survey

[4]Consumers who hardly use telecommunication services with their smartphones continue to contact with the same carrier for a long time. They would have minimal service contracts and little opportunity to re-adjust service contracts.

was run for some third-year Fukushima University students in September 2021. I revised the survey based on the results of this pretest, conducting the main survey for first- or second-year Fukushima University students. I then collected data from 115 students who completed the questionnaires.

Table 3 summarizes the respondents' characteristics. The majority of respondents (85.5%) were aged between 19 and 20 years. Most of the respondents (45.2%) had been using mobile phones for more than four years and less than six years, while 18.26% had been using mobile phones for more than two years and less than four years, and 31.3% had been using mobile phones for more than six years. While 74.5% of respondents had changed their mobile phone devices in the last four years, 19.1% had experience of carrier change.

4 Model specification

4.1 Random parameter logit model

The consumer behavior model in this study is based on McFadden ' s (1974) random utility framework. The utility of individual i for alternative j is written as $U_{ij} = V_{ij} + \varepsilon_{ij}$, where V_{ij} is the observable utility which depends on attribute levels x of each alternative and unknown parameter to be estimated, and ε_{ij} is the unobserved determinant of the utility. The random parameter logit (RPL) model, known as the mixed logit model, allows for individual differences in consumer tastes. This model can approximate any random utility choice model by appropriately choosing variables and mixing distributions (McFadden & Train, 2000).

The utility specification of the RPL model is given by $U_{ijt} = \beta_i' x_{ijt} + \varepsilon_{ijt}$, where $\beta_i$is a vector of individual-specific coefficients which assume that the density of β_i is $f(\beta|\theta)$ where θ are the vector of parameters of the distribution of

β_i, x_{ijt} is a vector of observed attributes relating to individual i and alternative j on choice occasion t, and ε_{ijt} is a random term which is assumed to be identically and independently extreme value type 1 distributed. For a given vector of coefficients β_i, he probability that individual i chooses alternative j on choice occasion t is

$$p_{ijt}|\beta_i = \frac{\exp(\beta_i' x_{ijt})}{\sum_{j=1}^{J} \exp(\beta_i' x_{ijt})}.$$

For a sequence of alternatives, the choice probability conditional on β is given as

$$L_{ij}(\beta) = \prod_{t=1}^{T} \left(\frac{\exp(\beta_i' x_{ijt})}{\sum_{j=1}^{J} \exp(\beta_i' x_{ijt})} \right).$$

The unconditional probability is the integral of this product overall value of β:

$$p_{ij} = \int L_{ij}(\beta) f(\beta) d\beta.$$

In the RPL model, random parameters are assumed to follow a normal distribution, and the resulting model is fitted through the simulated maximum likelihood.

Using this model, the marginal willingness-to-pay (MWTP) was estimated. When the price attribute is assumed to be a fixed parameter, the MWTP is calculated as the ratio of the mean coefficient of a non-price attribute to that of the price attribute.

4.2 Latent class logit model

The random-parameter logit model allows for individual differences in consumer preferences. However, this model cannot reveal the factors that cause heterogeneity in consumers' preferences. The latent class logit (LCL) model can identify heterogeneity, divide consumers into distinct homogenous classes, and calculate switching costs for each class.

While the RPL model specifies random parameters to follow a normal distribution, the LCL model assumes that a discrete number of latent classes is sufficient to account for preference heterogeneity across classes. The utility specification of the LCL model is given by $U_{ijt} = \beta_c' x_{ijt} + \varepsilon_{ijt}$, where β_c is the parameter vector of class c. Then, the choice probability that individual i of class c choses alternative j on choice occasion t is

$$p_{ijt|c} = \frac{\exp(\beta_c' x_{ijt})}{\sum_{j=1}^{J} \exp(\beta_c' x_{ijt})}.$$

For a sequence of alternatives, the choice probability conditional on β_c is given as

$$p_{ij|c} = \prod_{t=1}^{T} p_{ijt|c}.$$

Furthermore, a classification model can be constructed as a function of some individual-specific attributes to explain the heterogeneity across classes. The class probability is determined using the multinomial logit form as follows:

$$H_{ic} = \frac{\exp(\alpha_c' z_i)}{\sum_{c=1}^{C} \exp(\alpha_c' z_i)},$$

where α is a vector of parameters, and z_i denotes a vector of observable characteristics that determine class c. The unconditional probability of choosing alternative j by individual i is given as

$$p_{ij} = \sum_{c=1}^{C} p_{ij|c} H_{ic}.$$

5 Estimation result

5.1 Estimation result: Random parameter logit model

I employ the following utility specification:

$$\begin{aligned}
U_{ijt} = {} & \beta_{i,0}ASC_{ijt} + \beta_{i,1}MNO_{ijt} + \beta_{i,2}MVNO_{ijt} \\
& + \beta_{i,3}Higher_{ijt} + \beta_{i,4}Lower_{ijt} + \beta_{i,5}10GB_{ijt} + \beta_{i,6}5GB_{ijt} \\
& + \beta_{i,7}AnyTime_{ijt} + \beta_{i,8}5min_{ijt} \\
& + \beta_{i,9}PaidOffline_{ijt} + \beta_{i,10}OnlyOnline_{ijt} \\
& + \beta_{i,11}2year_{ijt} + \beta_{i,12}PaidMail_{ijt} + \beta_{i,13}NoMail_{ijt} \\
& + \beta_{14}Price_{ijt} + \varepsilon_{ijt}
\end{aligned} \tag{1}$$

where the definition of variables is given in Table 4 below.

Table 5 presents estimation results of the two RPL models. Model 1 is the equation (1). Some estimated coefficients are similar: MNO and $MVNO$, $AnyTime$ and $5min$, and $PaidOffline$ and $OnlyOnline$. Then, Model 2 replaces MNO and $MVNO$ with $Others$, $AnyTime$ and $5min$ with $TalkOption$, and $PaidOffline$ and $OnlyOnline$ with $Support$, improving the Bayesian information criterion (BIC) in Model 1.2.

The estimation results reveal the following: First, the coefficient of $ASC$is significantly positive, implying that the utility associated with the status quo alternative should be positive. This suggests that respondents experience a status quo bias in telecommunication contract choice. Second, the estimated coefficient of $Others$ was significantly negative. This result indicates that changing to other carriers leads to a decrease in utility. In Model 1.1, the coefficient of MNO is negative at the 5% significance level, and the coefficient of $MVNO$ is negative at the 1% significance level. The absolute value of the estimated coefficient of

$MVNO$ was larger than that of MNO. This result indicates that changing to other MVNO results in a larger decrease in utility than changing to other MNO. Third, the coefficient of $Higher$ is significantly positive, while the coefficient of $Lower$ is significantly negative, meaning that a higher data transfer rate leads to an increase in utility, whereas a lower data transfer rate leads to a decrease in utility. Fourth, the coefficient of $10GB$ is positive at the 1% significance level and the coefficient of $5GB$ is positive at the 10% significance level.[5] This result indicates that additional data volume increases the utility. Fifth, the coefficient of $NoMail$ is negative at the 5% significance level, while the coefficient of $PaidMail$ is negative at the 10% significance level, meaning that an additional fee for e-mail services provided by the current carrier could cause a decrease in the utility due to no fee for this e-mail service. The e-mail service provided by the current carrier should increase utility. Finally, the coefficient of $Price$ is negative and significant at the 1% level. Since a contract with a high monthly price could not be chosen, the expected sign of the coefficient of $Price$ could be negative. In both Model 1.1 and 1.2, the coefficient of $Price$ is approximately -0.6, as expected.

The MWTP values calculated using the estimated RPL model are presented in Table 6. The results show that respondents have a positive MWTP of 1800 JPY on a monthly bias for a new telecommunication contract. The monthly bias for a new telecommunication contract might have decreased over the last 18 years. Zeng and Tsuge (2005) show that university students in 2003 had a positive MWTP of 2840 JPY on a monthly bias for a new telecommunication contract. Similarly, they had a negative MWTP of -1792 JPY for a new contract with other carriers.[6] The MWTP is less than half of the average monthly

[5]In Model 1.1, the coefficient of 5GB is positive but not significant.

[6]In Model 1.1, although the absolute value of the estimated coefficient of $MVNO$ is larger than that of MNO, the MWTP for a new contract from other MNO carriers is a little more than that from other MVNO carriers.

payment. In the no-MNP situation, the switching cost of changing to other carriers was 4107 JPY (Zeng & Tsuge, 2005). Most SIM locked mobile phone users evaluate a highly compatible platform with SIM unlocked (Nakamura, 2010). The estimated low switching costs could be caused by MIC policies that reduce consumers' switching costs and encourage competition in the mobile telecommunication market.

Furthermore, respondents had a strictly negative MWTP for weak connections to the internet. Respondents were willing to pay -5184 JPY for a lower data transfer rate, while they were willing to pay 1090 JPY for a higher data transfer rate. About half of all respondents had their smartphones with an occasional slow connection to the Internet. Many university students frequently use their smartphones to connect to the internet. The results suggest that a weak connection to the Internet would make their lives less convenient.

5.2 Estimation result: Latent class logit model

The LCL model can be used to estimate different numbers of classes. The number of classes was defined based on the Akaike information criterion (AIC) or Bayesian information criterion (BIC). As shown in Table 7, AIC was the lowest in four classes, while BIC was the lowest in two classes. Of the four classes, one class had fewer than 5% class shares. This study adopted the two latent classes.

Table 8 presents the estimation results of the two LCL models. Explanatory variables in two specifications correspond to those in Table 5. Model 2.2 improves the BIC in Model 2.1. Then, I focus on Model 2.2. Estimation results in Class 1 are nearly similar to those in Table 5, although ASC, $PaidMail$, and $NoMail$ are not significant. In Class 2, $Others$, $PaidMail$, and $NoMail$ are significant. Members in Class 2 have positive utility due to the no fee for e-mail service provided by their current carrier.

In the class membership model, individual-specific attributes to explain the heterogeneity across classes are as follows: *Android* is a dummy variable that takes the value of 1 if the device OS is Android, and 0 otherwise. *HighSpeed* is a dummy variable that takes the value of 1 if the respondent can quickly access the Internet and 0 otherwise. *Less4years* is a dummy variable that takes 1 if the respondent has been using mobile phones for less than four years and 0 otherwise. *Less4pay* is a dummy variable that takes the value of 1 if the respondent paid less than 4000 JPY for mobile telecommunication and 0 otherwise. Student discount, Family discount, Bundle discount, Credit card discount, and Contract period Discount are dummy variables if the respondent paid mobile telecommunication fees with each discount and 0 otherwise.

The two latent classes may be interpreted as anytime or minimum users. Table 9 presents the estimation results for the class membership models. Models 2.1 and 2.2 correspond to those in Table 8. From the results of Class 1 in Model 2.2, anytime users ' class represents 61% of the sample size, and class members are likely to pay more than 4000 JPY for mobile telecommunication. They sometimes access the Internet slowly. They may frequently use mobile telecommunications to watch videos or play games.

Anytime users and minimum users have quite different switching costs. The MWTP of anytime users is similar to that based on the estimated RPL model. The MWTP values calculated using the estimated LCL model are presented in Table 10. In Model 2.2, members in Class 1 have a negative MWTP of -1293JPY for a new contract with other carriers and -3024 JPY for a lower data-transfer rate.

In the result of Class 2 in Model 2.2, the minimum user class represents 39% of the sample size, and class members are likely to pay less than 4000

JPY for mobile telecommunications. They almost always access the internet quickly. They have been using mobile phones for a long time and might have used e-mail services provided by the contract carrier. Members in Class 2 have a negative and indispensable MWTP when the e-mail service provided by the contract carrier is unavailable or there is an additional fee. For minimum users, e-mail services provided by the contract carrier could cause high switching costs. The results suggest that policies based on distinct homogenous classes should drastically reduce switching costs.

6 Discussion

Using the RPL estimation result of Model 1.2, I investigate how the probability of choosing an alternative change under three counterfactual situations. First, if the contract carrier is some other carrier than the current carrier, the probability of choosing an alternative increases by 9.5%. Second, if the data transfer rate decreases, the probability of choosing an alternative increases by 18.6%, suggesting that the respondent should change the carrier with a low data transfer rate to another carrier. Third, as long as the contact carrier is another carrier with additional services, the probability of choosing an alternative increases. The relative importance between the change in other carriers and attribute that bring positive utility is calculated as the ratio of those coefficients. The absolute value of the estimated coefficient of $Others$ is higher than that of the attributes that bring about positive utility. Respondents would not change their carriers to other carriers with additional services unless their carriers decreased the data transfer rate.

The results suggest that when frequency bands are fixed, many respondents do not change their carriers unless carriers with a high data transfer rate occasionally experience communication failures or accidents. The data transfer rate depends on the frequency bands. Useful frequency bands were assigned to the three major carriers. The fourth MNO, Rakuten Mobile, was not assigned low bands (700 MHz to 900 MHz). Once respondents recognize a carrier as one with a low data transfer rate, it is difficult to change the perception. Few respondents would choose a new carrier with a low data transfer rate.

7 Conclusions

Employing a choice-based conjoint experiment to measure consumers' switching costs in Japan's mobile telecommunication market, this study divided university students into anytime users and minimum users, and have shown that they have significantly different switching costs, and the change to other carriers is accompanied with low switching costs, while the change to carriers with low data transfer rates is accompanied with high switching costs. Anytime users have a negative MWTP of approximately -1293 JPY for changing to other carriers. The MWTP is less than half the average monthly payment. They have a negative MWTP of approximately -3024 JPY for the change to carriers with a low data transfer rate and rarely choose a new carrier with a low data transfer rate. These results suggest that the MIC's policies reduced consumers' switching costs but did not encourage competition due to fixed frequency bands. Policies based on homogenous classes would drastically reduce the switching costs.

This study has several limitations. These results are based on a data analysis of stated preferences, considering the switching behavior of university students. Although this study focuses on consumers who continue to contract with the same carrier for a long time and frequently use telecommunication services with their smartphones, telecommunication consumers include consumers who frequently change carriers and infrequently use telecommunication services. Furthermore, my survey was cross-sectional. Respondents may have low switching costs, regardless of several of the MIC's policies. This consideration would require me to use panel data of not only university students but also several consumers.

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Table 3: Respondents' characteristics

		Num. of respondents	Ratio (%)
Age	19	55	47.83
	20	39	33.91
	21	14	12.17
	22 or more	7	6.09
Device OS	Android	24	20.87
	iOS	91	79.13
Current carrier	Docomo	49	42.61
	au	27	23.48
	SoftBank	25	21.74
	others	14	12.17
Period of mobile phone usage	less than 2 years	6	5.22
	2 to 4 years	21	18.26
	4 to 6 years	52	45.22
	more than 6 years	36	31.30
Last device change	before Oct. 2017	4	3.48
	after Oct. 2017	86	74.78
	No change	25	21.74
Experience of carrier change	Yes	22	19.13
Average monthly income (thousand JPY)	<10	6	5.22
	10-29	9	7.83
	30-49	22	19.13
	50-69	20	17.39
	70-89	18	15.65
	90-109	20	17.39
	110-129	8	6.96
	130-149	3	2.61
	150 <	4	3.48
	unknown	5	4.35

Table 4: Definition of variables

Variable	Definition
ASC	Alternative specific constant regarded as information about the utility associated by respondents with the status-quo alternative
MNO	Dummy variable that equals 1 if the contract carrier of the alternative j is another MNO carrier than the current contract and 0 otherwise
$MVNO$	Dummy variable that equals 1 if the contract carrier of the alternative j is another MVNO carrier than the current contract and 0 otherwise
$Higher$	Dummy variable that equals 1 if the data transfer rate of the alternative j is higher than that of the current contract and 0 otherwise
$Lower$	Dummy variable that equals 1 if the data transfer rate of the alternative j is lower than that of the current contract and 0 otherwise
$10GB$	Dummy variable that equals 1 if the additional data volume of the alternative j is 10GB higher than that of the current contract and 0 otherwise
$5GB$	Dummy variable that equals 1 if the additional data volume of the alternative j is 5GB higher than that of the current contract and 0 otherwise
$AnyTime$	Dummy variable that equals 1 if the calling option of the alternative j has no charge at any time and 0 otherwise
$5min$	Dummy variable that equals 1 if the calling option of the alternative j has no charge up to 5 minutes and 0 otherwise
$PaidOffline$	Dummy variable that equals 1 if the customer support service of the alternative j charges handing fee 3300 JPY at the shop but no fee at online shop and 0 otherwise
$OnlyOnline$	Dummy variable that equals 1 if the customer support service of the alternative j charges no fee at online shop and is available only online and 0 otherwise
$2year$	Dummy variable that equals 1 if the contract period of the alternative j is 2 years but cancellation charges are 1100 JPY and 0 otherwise
$PaidMail$	Dummy variable that equals 1 if e-mail service provided by the contract carrier of the alternative j is available but additional fee 300 JPY is charged and 0 otherwise
$NoMail$	Dummy variable that equals 1 if e-mail service provided by the contract carrier of the alternative j is not available and 0 otherwise
$Price$	monthly price discount

Table 5: Estimation results: RPL models

	Model 1.1		Model 1.2	
Price	-0.6260^{***}	(0.1160)	-0.5683^{***}	(0.0886)
ASC	1.1047^{**}	(0.4880)	1.0227^{**}	(0.4442)
MNO	-1.0206^{***}	(0.3448)		
MVNO	-1.0559^{***}	(0.2761)		
Others			-1.0183^{***}	(0.2531)
Higher	0.7221^{***}	(0.2260)	0.6194^{***}	(0.2021)
Lower	-3.4009^{***}	(0.6991)	-2.9464^{***}	(0.5571)
10*GB*	0.8513^{***}	(0.2930)	0.6373^{***}	(0.2455)
5*GB*	0.4123	(0.2716)	0.4203*	(0.2482)
AnyTime	0.4970^{*}	(0.2941)		
5*min*	0.4624	(0.2817)		
TalkOption			0.4342^{*}	(0.2228)
PaidOffline	-0.3093	(0.2674)		
OnlyOnline	-0.3598	(0.2884)		
Support			-0.2863	(0.2262)
2*year*	-0.4348^{*}	(0.2479)	-0.3457	(0.2143)
PaidMail	-0.6338^{**}	(0.3158)	-0.4778*	(0.2640)
NoMail	-0.6133^{**}	(0.2899)	-0.5441^{**}	(0.2567)
AIC	1406.4009		1403.3153	
BIC	1578.1674		1539.5439	
Obs.	2760		2760	

Notes: ***, **, and * denote significance at 0.01, 0.05, and 0.10, respectively. Standard errors are shown in parentheses.

Table 6: Marginal willingness-to-pay based on the estimated RPL model

	Model 1.1	Model 1.2
ASC	1765	1800
MNO	-1630	
$MVNO$	-1687	
$Others$		-1792
$Higher$	1154	1090
$Lower$	-5433	-5184
$10GB$	1360	1121
$5GB$	659	740
$AnyTime$	794	
$5min$	739	
$TalkOption$		764
$PaidOffline$	-494	
$OnlyOnline$	-575	
$Support$		-504
$2year$	-695	-608
$PaidMail$	-1012	-841
$NoMail$	-980	-957

Table 7: Latent classes selection criteria

No. classes	AIC	BIC
2	1488.454	1683.913
3	1433.268	1753.109
4	1424.466	1868.69
5	1429.33	1997.937

Table 8: Estimation results: LCL models

	Model 2.1		Model 2.2	
Price	-0.4507^{***}		-0.4399^{***}	
	(0.0649)		(0.0610)	
	Class 1	Class 2	Class 1	Class 2
ASC	-0.8022	0.0374	0.0670	0.7963
	(1.5364)	(0.2881)	(0.2779)	(1.0941)
MNO	-1.2805^{**}	-0.3313^{*}		
	(0.5848)	(0.1835)		
MVNO	-1.3732	-0.7607^{***}		
	(0.9688)	(0.1794)		
Others			-0.5687^{***}	-1.3921^{*}
			(0.1516)	(0.7545)
Higher	-0.9269	0.5291^{***}	0.4617^{***}	0.4396
	(0.8595)	(0.1678)	(0.1584)	(0.4585)
Lower	-2.8689^{**}	-1.2185^{***}	-1.3337^{***}	-1.2407
	(1.1837)	(0.2020)	(0.1936)	(0.8542)
10*GB*	-0.2562	0.4270^{**}	0.5136^{***}	-0.0830
	(0.6617)	(0.1831)	(0.1804)	(0.5260)
5*GB*	-0.1725	0.2735	0.3470^{*}	-0.3610
	(0.6165)	(0.1817)	(0.1772)	(0.7437)
AnyTime	0.9816	0.1452		
	(0.6189)	(0.1901)		
5*min*	-1.4073	0.2159		
	(1.0950)	(0.1882)		
TalkOption			0.2800^{*}	-0.1431
			(0.1658)	(0.7656)
PaidOffline	0.0076	-0.1170		
	(0.5581)	(0.1845)		
OnlyOnline	-2.2379^{*}	0.0555		
	(1.3057)	(0.1808)		
Support			-0.0665	-1.0997
			(0.1517)	(0.7543)
2*year*	-2.0161^{***}	0.0051	-0.0655	-0.8814
	(0.7656)	(0.1445)	(0.1405)	(0.5386)
PaidMail	-1.2167^{*}	-0.2052	-0.2129	-0.9849^{*}
	(0.6835)	(0.1742)	(0.1780)	(0.9680)
NoMail	-2.4964^{***}	-0.0423	-0.1509	-1.7114^{**}
	(0.8579)	(0.1765)	(0.1752)	(0.7437)
AIC	1487.6189		1488.4542	
BIC	1718.6153		1683.9127	
Obs.	2760		2760	

Notes: ***, **, and * denote significance at 0.01, 0.05, and 0.10, respectively. Standard errors are shown in parentheses.

Table 9: Estimation results: class membership models

Class 1	Model 2.1	Model 2.2
Share	0.416	0.610
Constant	-1.2981^{**}	1.4115^{**}
	(0.6505)	(0.7092)
Android	-0.9697	0.8701
	(0.5924)	(0.5876)
HighSpeed	0.8997^{**}	-0.9481^{**}
	(0.4481)	(0.4724)
Less4years	-0.8212^{*}	0.8608^{*}
	(0.4932)	(0.4976)
Less4pay	0.9904^{**}	-0.8267^{*}
	(0.4869)	(0.4949)
Student discount	0.8212^{*}	-0.9331^{**}
	(0.4629)	(0.4722)
Family discount	-0.0025	0.0718
	(0.4830)	(0.4936)
Bundle discount	0.2435	-0.3076
	(0.5756)	(0.5851)
Credit card discount	-0.1609	0.0630
	(1.1339)	(1.1264)
Contract period Discount	-0.3496	0.3042
	(0.6473)	(0.6497)

Notes: ***, **, and * denote significance at 0.01, 0.05, and 0.10, respectively. Standard errors are shown in parentheses.

Table 10: Marginal willingness-to-pay based on the estimated LCL model

	Model 2.1		Model 2.2	
	Class 1	Class 2	Class 1	Class 2
ASC	−1780	83	152	1810
MNO	−2841	−735		
$MVNO$	−3047	−1688		
$Others$			−1293	−3164
$Higher$	−2056	1174	1050	999
$Lower$	−6365	−2703	−3032	−2820
$10GB$	−568	947	1168	−189
$5GB$	−383	607	789	−821
$AnyTime$	2178	322		
$5min$	−3122	479		
$TalkOption$			636	−325
$PaidOffline$	17	−260		
$OnlyOnline$	−4965	123		
$Support$			−151	−2500
$2year$	−4473	11	−149	−2004
$PaidMail$	−2699	−455	−484	−2239
$NoMail$	−5538	−94	−343	−3890