Demand for Number Portability in the Korean Mobile Telecommunications Market: Contingent Valuation Approach

Abstract

The portability of telephone numbers is one of the main regulatory issues in the Korean mobile telecommunications market. The availability of mobile number portability is likely to bring substantial benefits to subscribers such as lower price, greater choice, higher quality and a greater range of services. In this paper, we used willingness to pay (WTP) to elicit demand on number portability in the Korean mobile telecommunication market. In doing so, the study has three goals: i) to introduce the contingent valuation method to the telecommunication field and to obtain WTP estimates for mobile number portability so that we can examine how estimated WTP varies with socio-economic characteristics such as age, gender, income and education etc.; ii) to examine whether a so-called “brand effect problem” exists or not in the Korean mobile telecommunication market, and if so, how it would affect competition in the Korean mobile telecommunication market; iii) to find out a way of facilitating the implementation of number portability in the Korean mobile telecommunication market.

1. Introduction

The portability of mobile telephone numbers is one of several main issues in the Korean mobile telecommunication market. There have been two conflicting opinions regarding this particular issue. The first is a matter of when to introduce, and the second is how to implement number portability. It is well known that number portability reduces switching costs for customers and makes it easier for new service providers who are in competition for customers, by allowing customers to retain their numbers when switching mobile telecommunication service providers. (Reinke, 1998; Gans et al., 2001)

Telecommunications regulators face a number of difficult choices when trying to apply and implement number portability to the telecommunications service. Those choices include such basic concerns as when and how it should be implemented. There have been a variety of studies on number portability. Most of these prior studies have concentrated on not only the benefits that occur with number portability but also how to implement number portability to maximize effectiveness. However, there has been little research specifically focused on customer demand for number portability together as a basis for a cost-benefit analysis. To our knowledge, this is the first attempt to analyze the demand estimation of number portability.

This study seeks to measure demand for number portability in the Korean mobile telecommunication market using willingness to pay (WTP). In doing so, the study has three goals: i) to introduce the contingent valuation method to the telecommunication field and to obtain WTP estimates for mobile number portability so that we can examine how estimated WTP varies with socio-economic characteristics such as age, gender, income and education etc.; ii) to examine whether or not a so-called “brand effect” problem exists in the Korean mobile telecommunication market, and if so, how it affects the competition in the Korean mobile telecommunication market; iii) to find out a way of facilitating the implementation of number portability in the Korean mobile telecommunication market.

2. Prior research on number portability and the contingent valuation method

The availability of mobile number portability is likely to bring substantial benefits to subscribers. These may include lower price, greater choice, higher quality, and a greater range of services. In particular, it would allow subscribers to take full advantage of the choices that will become available in a more competitive telecommunication market. They will also be able to choose the provider that best meets their...
needs without incurring switching costs by changing their phone number.

Gans et al. (2001) argued that by giving consumers ownership of their phone number and a right to number portability, this encourages participants to search for and achieve socially efficient outcomes. Reinke (1998) also insists that even if number portability can increase the competition in the telecommunication market, the means by which number portability is implemented may either insure or threaten competition and universal service. Meanwhile, Aoki et al. (1999) insisted that in well developed telephony markets with high penetration rates, it is possible for consumers as a group to receive less surplus following a reduction in the cost of switching between carriers because of the introduction of number portability.

Many countries have implemented number portability or are rapidly moving towards the implementation of number portability in telecommunication service. Mobile phone number portability between operators is already available in roughly half the EU countries, and most remaining countries have plans to offer it within one year. Even though many countries have implemented number portability or have plans to implement it, number portability has been or is being implemented without any or much research having been done on the cost and benefit of doing so. The cost that will be passed on to subscribers has also not been considered adequately. This paper is one of those efforts.

Various systematic methods have been developed to value non-market goods or services. Among various methods for valuing non-market goods, the contingent valuation method is one of the most well established and widely used methods for estimating the benefits, or costs, associated with non-market goods or services. The theoretic specification of the contingent valuation method for deriving Hicksian compensating and the equivalent surplus is based on a utility theoretic analysis (Hannemann, 1984).

The contingent valuation method is basically aimed at eliciting respondents' WTP in monetary terms directly. CVM uses a survey questionnaire to create a hypothetical market to determine or reveal a respondents' willingness to pay. Although this method of eliciting valuation has mainly been applied and developed within the areas of the environment and public goods, it also can be applied and examined in the context of telecommunications.

3. The Korean Mobile Telecommunication Market and Number portability

The Korean mobile market is now considered to be a closed oligopoly (Park et al. 2002). There are three network operators in the Korean mobile telephony service market. One firm, SKT, holds cellular licenses and two, KTF and LGT, hold PCS licenses. Even though there are three network operators in the Korean mobile market and the mobile telecommunication market seems to be vigorous competition, SKT still holds first place in mobile markets as the dominant player. As of December 2002, the market share of SKT has grown to 53.3%. On the other hand, market shares of KTF and LGT are no more than 31.9% and 14.8%, respectively.

For years, the Korean Ministry of Information and Communication thought that mobile number portability was necessary in order to increase consumer welfare and to promote competition in the mobile telecommunications market. Recently, MIC decided to set the date of 1 Jan. 2004 for the implementation of mobile number portability. As a result of this number portability decision, all new subscribers will be granted a unified 010 number instead of the existing network identity number such as 011, 016, etc. Also, existing subscribers will be able to change their numbers to the 010 number if they want. In addition, MIC has taken the asymmetric approach among service providers in determining the implementation date for portability requirements. The dominant player will be required to implement number portability from Jan. 1, 2004, before the other two carriers. At six month intervals the other carriers will also be required to comply.

4. Statistical modeling of double bounded dichotomous choice

4.1. Basic model of this study

The double bounded dichotomous choice (DBDC) approach was first proposed by Hanemann (1995) and Carson et al. (1985). A DBDC question presents each respondent with a sequence of two bids and asks for a 'yes' or 'no' vote on whether the respondent's WTP equals or exceeds each bid. The second bid is conditioned on the respondent to the first bid; lower if the first response is no and higher if it is yes.

We adopted the econometric model proposed by Cameron and James (1987). Let the willingness to pay of i respondent be given by \( y_i^* \), where \( y_i^* \) is the \( i_{th} \) respondent of the sample, which is dependent on

\[
y_i^* = \beta_0 + \beta_1 x_i + \epsilon_i
\]
respondent characteristics \( x_i \), \( y_i \) can be written as equation (1)
\[
y_i^* = x_i' B + \varepsilon_i
\]
where \( x_i \) is the vector representing \( i \)'s characteristics, \( B \) is the coefficient to be estimated and \( \varepsilon_i \) is the mean zero error term. Then, we can define the indicator function in the following equation (2).
\[
I_{y_i} = \begin{cases} 
1 & \text{if } y_i^* \geq t_{y_i} \\
0 & \text{if } y_i^* < t_{y_i}
\end{cases}
\]
where \( i = 1, 2, \ldots, N \) be the index of each respondent in the sample and let \( t_{y_i} \) be the initial bid, and \( t_{2i} \) be the higher or lower bid. Respondent \( i \) belongs to one of the following 4 cases;
\( (I_{y_i}, I_{2i}) = (1,1), (1,0), (0,1), (0,0) \).

The log-likelihood function for the sample,
\[
\log L = \sum \left[ I_{y_i} \log \left( 1 - F \left( \frac{t_{y_i}}{\sigma_i} \right) \right) + I_{2i} \log \left( 1 - F \left( \frac{t_{2i}}{\sigma_i} \right) \right) - F \left( \frac{t_{y_i}}{\sigma_i} \right) - F \left( \frac{t_{2i}}{\sigma_i} \right) \right] + (1 - I_{y_i}) \log \left[ F \left( \frac{t_{y_i}}{\sigma_i} \right) \right] + (1 - I_{2i}) \log \left[ F \left( \frac{t_{2i}}{\sigma_i} \right) \right]
\]
Maximum likelihood estimation of the model parameters involves maximizing the above Equation with respect to parameter \( B \) and \( \sigma \). Once the parameters \( B \) and \( \sigma \), estimation of the mean WTP is calculated as following: \( \bar{E}(Y) = \bar{x} B \).

4.2. Major biases concerning DBDC

As mentioned previously, the contingent valuation methodology is most established as a non-market goods valuation method and has been more frequently used to value non-market goods than any other such valuation methods. However, there are several biases concerning CVM such as hypothetical bias, anchoring bias, range bias, compliance bias and strategic bias. The nature of the market created in a contingent valuation method is mainly hypothetical. It may attract a bias called hypothetical bias. (Neil et al., 1994) This bias is defined as the potential divergence between the real and hypothetical payment. (cumings et al., 1986) It is generally known that hypothetical WTP values are found to be greater than the real WTP values (Brown et al., 1996; Neil et al., 1994; Kealy et al., 1990; Bishop and Heberlein, 1979). The results of many CVM studies suggest that the familiarity issue plays a role in minimizing the hypothetical bias in CVM studies. This implies that the WTP values elicited for those public goods, which are traded in the markets or which the individuals are familiar with would be free from hypothetical bias (Whittington et al., 1991).

In this study, to be free from hypothetical bias as much as possible, a more detailed background on the benefits of number portability as well as a definition of number portability were provided to the respondents before answering the questionnaire. This mechanism can familiarize the individuals with number portability. In addition, even though it seems more natural to measure WTP for number portability as an one time payment instead of monthly fee, we measured WTP for number portability as a monthly fee. The reason is that individuals have been familiar with a monthly fee for additional service (not one time payment) so that hypothetical bias could be minimized. In reality, it is expected that number portability will be implemented as a kind of additional service and the individuals are expected to pay for number portability as a monthly fee.

The double bounded dichotomous choice approach used in this study may inevitably contain some biases induced by a binary question: anchoring bias, nay-saying/yea-saying bias and strategic bias. It is important to construct the scenarios and the measurement instruments so that bias is avoided as far as possible. Nevertheless, even though the scenarios and the measurement instrument were well constructed enough to avoid some biases, it is highly possible that some biases may still exist such as anchoring bias nay-saying/yea-saying bias and strategic bias. Thus, an additional mechanism is needed to examine whether these biases exist or not.

The strategic bias is another problem in CV studies. There are two form of strategic behavior, namely, free riding problem and overpledging (Mitchell and Carson, 1989). In other words, respondents may understate if they think that they will be charged for the good or service (i.e., free riding problem) while they may overstate if they believe that the exercise is only hypothetical. In this study, double a dichotomous choice technique was used and the CV questionnaire was designed such that it would not give any hint to the respondents that would encourage them to behave strategically. Two additional questions were added to the questionnaire lest there be a possibility of existing respondents’ strategic behavior.

The nay-saying or yea-saying bias might be generated when the respondents have a tendency to answer yes or no unconditionally to a specified amount without consideration of the purpose of the survey. McFadden and Leonard (1993) demonstrated that there is a tendency of some respondents to answer yes to a certain amount that is deviated several times of standard deviation from the sample mean. They suggested that if these outliers were removed, the estimation of the mean WTP would be reduced to 46.1 percentage. Mitchell and Carson (1989) argued that
respondents generally think a proposed amount to be an approximate real value of goods so that they tend to anchor their WTP to a proposed amount. This argument was empirically demonstrated by Herriges and Shorgen (1996). In their research they found that the existence of the anchoring bias would be caused by the first bid and that it can affect the estimate. Controlling for the anchoring bias resulted in a significant reduction of the efficiency gains from the second-bid. However, if the anchoring bias could not be controlled by the second bid, the efficiency of a double bounded dichotomous approach would be equal to that of a single bounded approach.

In this study the bivariate model proposed by Cameron and Quggin (1994) is transformed to include the first dichotomous choice response into the WTP model in the second response as following. This was done in order to examine whether the nay/yea-saying bias and anchoring bias exists or not, since there is a high possibility of occurrence when adopting a dichotomous choice approach.

\[ y_1^* = x_i \beta_1 + \epsilon_1, \quad y_2^* = \delta + y_1 \beta_2 + \epsilon_2 \]

If the parameter $\delta$ is estimated to be negative statistically, it can be inferred that an anchoring bias exists. If $\delta$ may be estimated to be positive, it can be inferred that a nay/yea-saying bias occurs. However, if $\delta$ is statistically insignificant, it may be said that neither an anchoring bias nor a nay/yea-saying bias exists.

5. Survey design and variables

In order to develop the methodology for monetary valuation of demand for number portability in the Korean telecommunication market, a web-based online survey questionnaire has been undertaken. The survey data were collected from current subscribers of mobile telecommunications service in Korea from January to February 2003. A hybrid sampling procedure was used for web-based online survey. First, subscribers were divided into three categories by the types of service provider. Then, a different number of questionnaires were collected from each category, according to the following procedure. Through a database of the BestResearch Inc., a list of subscribers included in each service provider were obtained. Then subscribers in the list were randomly selected at the ratio of service providers’ market share. The first e-mail, which encourages subscribers to participate in the web-based online survey together with a description of the survey background, was sent to a selected sample of 15,000 subscribers in January 2003. Table 1 provides a tally of the response rate by service provider and the overall response rate.

<table>
<thead>
<tr>
<th>Table 1. Response rate of online survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable/Provider</td>
</tr>
<tr>
<td>Total inviting e-mailed</td>
</tr>
<tr>
<td>Participated</td>
</tr>
<tr>
<td>Returned mail</td>
</tr>
<tr>
<td>No participated</td>
</tr>
<tr>
<td>Response rate</td>
</tr>
</tbody>
</table>

A total of 1161 responses were obtained. The response rates were not much different between three service providers: 7.89 percent for SKT, 8.76 percent for KTF and 8.21 percent for LGT. This response rate is slightly lower than the typical response rate for a general population survey. So, we provided several adjustments to overcome the non-response bias and to avoid sampling bias when generalizing the sample results to the population. When extrapolating the sample to the population, a critical concern is the ability to generalize the sample value to the population, which is partly dependent on the representativeness of the sample. In this study, to check the representativeness of the sample to the population, the Chi-square ($\chi^2$) test was conducted in terms of service providers’ market share, monthly payment for service, gender, age and living location.

Taking for granted the probability sampling procedure, the obtained sample is considered to be representative of the population in the view of the service provider’s, monthly payment for service, gender, age and living location’s distribution of the population. As the result of the chi-square test, a statistical analysis of representativeness of the sample showed no statistical difference between the sample and the population in all variables. – Chi-Square Test statistics: Service provider(0.192), Gender(0.124), Age(0.160), Monthly payment(0.160), and Living location(0.510). The questionnaire was pre-tested. Results of the pre-test were used to adjust the final questionnaire form to assure comprehension and clarity. The guideline provided by the National Oceanic and Atmospheric Administration (NOAA) panel (1993) was used in applying the questionnaire.

There have been heated arguments as to which measures should be used for determining the estimation of value on goods. Hicks (1946) classified the consumer surplus into two different categories – the compensating variation and the equivalent variation. For a proposed welfare gain due to provision of public goods, the compensating variation refers to WTP that is the amount of monetary income that has to
be given up by the consumer to attain an increased level of utility. Whereas, the equivalent variation refers to WTA (Willingness To Accept) that is the amount of compensation required to be provided to the individual to attain an improved utility level in case the provision of the public good does not take place. It is known that there exists a disparity between WTP and WTA and this disparity is influenced by many different factors such as income effect, substitution effect, transaction costs, broad based preferences, etc (Shrogen et al., 1994; Mitchell and Carson, 1989; Horowitz and McConnell, 2002). It has been demonstrated empirically that the WTA value is always greater than the WTP value if used for the same issue. However, recently a consensus has emerged that the WTA value is not a proper measure of consumer surplus. Moreover, if an improvement is to be valued, the natural question is that for respondents’ WTP, while for a damage assessment after deterioration WTA compensation for the resulting decrease in utility is adequate measure of consumer surplus.

From the above discussion, it would seem more logical to ask the respondents how much they would be willing to pay for number portability. Thus, the measure used in this study is WTP.

This study was designed so as to adhere, as closely as possible, to the recommendations made by National Oceanic and Atmospheric Administration (NOAA). A few were left out because of time and budget constraints, the most notable being the use of a web-based online survey instead of in-person interviews. For validity of web-based online survey questionnaire, this survey has been designed and implemented considering that it was very easy for the respondents to answer the questions and easy to process the data. The questionnaire was organized into four parts. The first part comprised questions regarding the respondent’s perceptions of number portability. The second part determined the socio-economic issues of age, monthly income, gender and education etc. of the respondents. The third part was composed to determine experience of the operator, i.e. years of using, monthly using time of the respondents. Two additional questions were added to examine whether a strategic bias would exist or not. The fourth part addressed the WTP questions. There were, then, a total of 19 variables addressed in this survey, including the two variables used to test for strategic bias.

At the start of the questionnaire a detailed description and the benefits of number portability were explained to the respondents. Respondents also received information regarding substitute good (change their numbers to the unified 010 number if they want) and reminded the income constraints (call their attention to their budget and monthly payment). The budget constraint was presented with the first and second dichotomous question. The reason of providing the detailed description of number portability to respondents and reminding of the budget constraint and substitute goods was to prevent hypothetical market error that occurs in using the contingent valuation method and to minimize the information effect. One of six monetary bidding values (based on the results of pre-test) was suggested randomly at the first bid. Half or twice the value of the first bid was suggested at the second bid.

The WTP questions for number portability were designed assuming number portability would certainly increase utility for the respondent. Rather than asking people to value number portability directly, valuation questions were framed in terms of an allotted charge for number portability. Asking valuation questions in this way allows us to elicit the views of those who do not currently need the number portability in question. An example of the wording of the questions is as follows:

“Let us assume that number portability will benefit you by allowing you to keep your current mobile phone even if you were to switch providers, and also decrease the price you pay for service by increasing competition. Taking into consideration how much you can afford, are you willing to pay Bf won per month for an allotted charge of number portability? If Yes (or no), are you willing to pay 2* Bf (1/2 * Bf) won per month?”

6. Results and discussion

The analysis was conducted in two stages. In the first stage, factor analysis was run to determine the explanatory factor. Secondly, the maximum likelihood estimation was performed to determine the contribution of the various factors to a subscriber’s WTP for number portability and to calculate their willingness to pay for number portability.

6.1. Factor analysis

Factor analysis was performed for reducing the number of variables and avoiding multi-collinearity. Factor scores of each derived factor were used as the input data for explaining the WTP of the respondents. Among 19 variables, total 11 variables were included in factor analysis, 6 variables were used as moderating variables to measure the moderating effect on WTP and the other 2 variables were used to examine whether a strategic bias would exist or not.
Demographic variables included in this study are qualitative (e.g., gender, job, a type of service provider and living location) and quantitative (e.g., age and income). However, by including demographic values in factor analysis, it is very difficult to analyze the results. We performed the factor analysis after removing such variables, since we use them as moderating variables. Those variables provide information as to the conditions in which we would expect a relationship between dependent and predictor variables to exist.

A principal components method with a varimax rotation of the 11 variables reveals 5 underlying factors with eigenvalue of greater than one. These 5 factors explained 75.9% of the variability in the eleven variables. A description of each factor and its corresponding variables are provided in Table 3; (1) the perceived degree of number portability (PD-Awareness), (2) experience of changing number and service provider (Experience), (3) the perceived necessity degree of number portability (PD-Necessity), (4) monthly using time and monthly payment (Using Pattern), (5) intention of switching service provider and the degree of satisfaction for current service provider (Intention).

6.2. Willingness to pay value for number portability

With the data obtained from 1161 respondents, the parameters of the suggested model in equation (1) were estimated. The maximum likelihood estimates of the parameters were obtained using TSP 4.5 applying the Newton-Raphson optimization method. Table 3 provides the coefficients and standard errors for the WTP equation. It is noted that PD-Awareness, PD-Necessity and Intention affect WTP for number portability. It means that for the number portability WTP increases as PD-Awareness, PD-Necessity and Intention increase. Meanwhile, WTP for number portability is not influenced by Experience and Using Pattern factor. The first relationship of interest is that between individuality and WTP. This result can be explained as follows.

In Korea, mobile telecommunication service is regarded as consumer goods and as many as 32.3 million people are using mobile telephony service. Therefore, respondents’ demand for number portability is mainly dependent on the degree of perception and the necessity of number portability. It is not based on individuality such as age, gender, job and living location etc. It means that respondents who know more about number portability and its benefits would pay more. Also, of course, those who urgently need the introduction of number portability would pay more. “Experience of a signature-collecting campaign” and “Job relation”, which were used as examining a strategic bias in this study, do not affect WTP, as shown in Table 3. It indicates that a strategic bias does not occur in estimating model parameters with respect to parameter B and \( \sigma \). It will be discussed in next section in detail.

As previously mentioned, the mean WTP from the dichotomous choice WTP questions is calculated as \( E(Y) = \pi' \beta \). The mean WTP was 1182.837 won/month for number portability. Table 4 summarizes estimation results of mean WTP.

<table>
<thead>
<tr>
<th>Variables/Factor</th>
<th>Factor1</th>
<th>Factor2</th>
<th>Factor3</th>
<th>Factor4</th>
<th>Factor5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit recognition of number portability</td>
<td>.908</td>
<td>-.04463</td>
<td>-.176</td>
<td>.09652</td>
<td>-.03604</td>
</tr>
<tr>
<td>Awareness of number portability</td>
<td>.905</td>
<td>-.01182</td>
<td>-.186</td>
<td>.09543</td>
<td>-.01288</td>
</tr>
<tr>
<td>Experience of service provider change</td>
<td>-.02467</td>
<td>.898</td>
<td>.008013</td>
<td>-.116</td>
<td>.04284</td>
</tr>
<tr>
<td>Experience of number change</td>
<td>-.03409</td>
<td>.887</td>
<td>.03282</td>
<td>-.155</td>
<td>.006091</td>
</tr>
<tr>
<td>Urgency</td>
<td>-.110</td>
<td>-.005772</td>
<td>.887</td>
<td>-.05425</td>
<td>.104</td>
</tr>
<tr>
<td>The degree of necessity</td>
<td>-.249</td>
<td>.03748</td>
<td>.857</td>
<td>-.05740</td>
<td>.07017</td>
</tr>
<tr>
<td>Monthly using time</td>
<td>-.158</td>
<td>-.01609</td>
<td>-.09364</td>
<td>.874</td>
<td>.000285</td>
</tr>
<tr>
<td>Monthly payment</td>
<td>.385</td>
<td>-.147</td>
<td>-.139</td>
<td>.661</td>
<td>-.07503</td>
</tr>
<tr>
<td>Years of subscription</td>
<td>-.202</td>
<td>.234</td>
<td>-.07032</td>
<td>-.521</td>
<td>.06253</td>
</tr>
<tr>
<td>Satisfaction of existing service provider</td>
<td>.02745</td>
<td>.03047</td>
<td>-.03897</td>
<td>-.105</td>
<td>.888</td>
</tr>
<tr>
<td>Intention of changing service provider</td>
<td>.08405</td>
<td>-.02156</td>
<td>-.228</td>
<td>-.01101</td>
<td>-.836</td>
</tr>
</tbody>
</table>

Table 2. Description of derived factors and its corresponding variables
As suggested to the respondents in the questionnaire, the average monthly payment of the respondents in this survey was 36,400 won per month. The mean WTP (1182.837 won/month) is 3.24% of average monthly payments for using mobile telecommunication service. Since there are 32.3 million users in the Korean mobile telecommunication market, the total mean demand for number portability is also calculated as 32.3 (million) × 1182.837 = 38.2 billion won per month. This is equivalent to approximately 32 million US dollars.

### Table 3. The results of maximum likelihood estimate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>S.E.</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant ($\beta_0$)</td>
<td>97.25706</td>
<td>891.6622</td>
<td>.1090739</td>
<td>.913</td>
</tr>
<tr>
<td>PD-Awareness ($\beta_1$)</td>
<td>267.7782</td>
<td>82.27875</td>
<td>3.254524(0.001) ***</td>
<td></td>
</tr>
<tr>
<td>Experience ($\beta_2$)</td>
<td>-9.055220</td>
<td>78.83419</td>
<td>-1148641(0.909)</td>
<td></td>
</tr>
<tr>
<td>PD-Necessity ($\beta_3$)</td>
<td>14934833</td>
<td>78.18397</td>
<td>1.911943(0.056)</td>
<td>*</td>
</tr>
<tr>
<td>Using Pattern ($\beta_4$)</td>
<td>64.68364</td>
<td>84.16001</td>
<td>.7685972(0.442)</td>
<td></td>
</tr>
<tr>
<td>Intention ($\beta_5$)</td>
<td>-246.8578</td>
<td>80.96962</td>
<td>-3.048771(0.002) ***</td>
<td></td>
</tr>
<tr>
<td>Experience of a signature-collecting campaign ($\beta_6$)</td>
<td>22.12135</td>
<td>171.7007</td>
<td>.1288367(0.897)</td>
<td></td>
</tr>
<tr>
<td>Job relation ($\beta_7$)</td>
<td>-13.31630</td>
<td>362.1671</td>
<td>-0.0367684(0.971)</td>
<td></td>
</tr>
<tr>
<td>Monthly income ($\beta_8$)</td>
<td>180.4461</td>
<td>57.96293</td>
<td>3.113129(0.002) ***</td>
<td></td>
</tr>
<tr>
<td>Job ($\beta_9$)</td>
<td>46.63156</td>
<td>35.43480</td>
<td>1.315982(0.188)</td>
<td></td>
</tr>
<tr>
<td>Living location ($\beta_{10}$)</td>
<td>-42.36836</td>
<td>25.81514</td>
<td>-1.641158(0.101)</td>
<td></td>
</tr>
<tr>
<td>A type of service provider ($\beta_{11}$)</td>
<td>434.1454</td>
<td>112.0322</td>
<td>3.875185(0.002) ***</td>
<td></td>
</tr>
<tr>
<td>Gender ($\beta_{12}$)</td>
<td>13.05631</td>
<td>164.8034</td>
<td>.0792236(0.937)</td>
<td></td>
</tr>
<tr>
<td>Age ($\beta_{13}$)</td>
<td>-66.70220</td>
<td>68.91375</td>
<td>-.9679084(0.333)</td>
<td></td>
</tr>
<tr>
<td>Sigma ($\sigma$)</td>
<td>2303.579</td>
<td>78.62407</td>
<td>29.29865(0.000) ***</td>
<td></td>
</tr>
<tr>
<td>Number of observation</td>
<td>1161</td>
<td>Log likelihood</td>
<td>-1902.594</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. The demand for number portability in Korean Telecommunications market

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>S.E.</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean WTP</td>
<td>1182.837 won/month</td>
<td>78.0411</td>
<td>15.15601(0.000) ***</td>
<td></td>
</tr>
<tr>
<td>Confidence Interval (95% C.I - using \pm 1.96 \times S.E.)</td>
<td>Lower</td>
<td>1029.87</td>
<td>Upper</td>
<td>1335.79</td>
</tr>
<tr>
<td>Chi-squared(p-value)</td>
<td>229.70467(0.000) ***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As we mentioned previously, there are many possible biases in CVM. It is important to construct the scenarios and the measurement instruments so that bias is avoided as far as possible. Nevertheless, it holds true that there continues to be some possibility of bias occurring. In order to calculate the WTP for number portability, three major biases concerning double bounded dichotomous choice approach were examined: Nay/yea-saying bias, anchoring bias, and strategic bias, were examined in this study.

Examination of the results with respect to an anchoring bias shows that the $\delta$ is estimated to be positive statistically ($\delta = 3933.904$, t-statistic: 5.354289); $y_2^* = \delta \hat{y}_1 + x_2 \beta_2 + \epsilon_2$. This suggests that an anchoring bias does not exist but it is possible that nay/yea-saying bias would exist. It also suggests that the mean WTP, which is estimated in this study, could be underestimated or overestimated. However, after excluding the cases of the two highest bid prices (3,000 won and 5,000) from the sample, we can see that a nay/yea-saying bias does not exist (t-statistic: 1.85026). From this result, we can infer that a nay/yea-saying bias may be caused not because of a survey error, but, rather, it might be caused by the structure of the six monetary bids. Thus, we can conclude that the fact that...
nay/yea saying bias would exist does not distort the result of the estimation for the mean WTP.

In an attempt to avoid strategic bias the respondents were asked if they are involved to the work related with mobile telecommunication service and if they have experience in participating in signature collecting campaign such as mobile service price reduction campaign. Five percent of the respondents said yes to the former question, while to the latter question thirty two percent said yes. This provides us with the opportunity to run a test for strategic bias. The estimate of the variable 6 and 7 parameters confirm both statistically insignificant ($p=0.897$, $p=0.971$), which means that $\beta_6, \beta_7$ are not zero statistically, thus strategic bias does not exit.

6.4. Evidence for existence of brand effect

The “Brand Effect” can be defined as an intangible value of a product, advertisement, logo or other entity that supports the argument in the prospect’s buying decision process. That is to say, a certain brand has a loyal segment of subscribers who buy their favorite brand even though the competing brand is offered at a much lower price.

In this section, we examine whether the phenomenon known as brand effect exists or not in the Korean telecommunication industry and if so, how it would affect the competition of Korean mobile telecommunication market when the number portability is introduced. Of course, number portability is not necessarily the sole determinant of customer switching when there are price differences, and presumably, quality differences as well. Thus it is hard to say that difference in WTP for number portability among service providers can explain the existence of brand effect directly. But if it is assumed that there are no price differences and quality differences, the difference in WTP for number portability among service providers can be an indirect evidence of existence of brand effect.

Prior to calculating the WTP for number portability of each service provider, price difference and quality difference were examined. According to the recent survey results of mobile telecommunication service quality, all three service providers have an excellence grade (Aa) in 95% of nationwide region and an excellence grade (A) in 99% of nationwide region in terms of access success ratio and interrupting ratio. It was concluded that there was no quality difference among service providers. In the view of price level, average rate for 200 minutes usage of each service provider is similar to each other (i.e., SKT:32,900 won, KTF:32,200 won, LGT:31,400 won). This fact implies that there is no quite price difference among service providers. Accordingly, we can conclude that price and quality level is not significantly different across the service providers. As a result, we can assume that it is possible for a brand effect to exist in the Korean mobile market if there is a difference in WTP for number portability among service providers.

As previously analyzed, a total of 1161 sample data was obtained. 598 of them were SKT’s subscribers and KTF and LGT subscribers are 395 and 168 respectively. Maximum likelihood estimates of the parameters were also obtained using TSP 4.5 applying the Newton optimization method as previously analyzed. According to the results of the analysis as shown in Table 5, the mean willingness to pay for number portability of SKT subscriber was 992.153 won/month, 1185.391 for KTF subscriber and 2049.961 won/month for LGT subscriber respectively. Indeed, many of the zero WTP responses come from the SKT subscribers. Of the total 598 SKT included in the analysis, 13.9% refused to pay anything for number portability and 11.2% of KTF subscribers were unwilling to pay anything for number portability. In contrast, only 8% of LGT subscribers were unwilling to pay for number portability.

<table>
<thead>
<tr>
<th>Service Provider</th>
<th>WTP Estimate</th>
<th>t-statistic</th>
<th>Confidence Interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKT</td>
<td>992.1527</td>
<td>10.2810***</td>
<td>815.1669 - 1169.1385</td>
</tr>
<tr>
<td>KTF</td>
<td>1185.391</td>
<td>8.8147***</td>
<td>916.4354 - 1454.3466</td>
</tr>
<tr>
<td>LGT</td>
<td>2049.961</td>
<td>7.1968***</td>
<td>1478.1204 - 2621.8016</td>
</tr>
</tbody>
</table>

***: p<0.01 **: p<0.05 * : p<0.1

Based on the results of this test, we can draw conclusions as follow:

- As shown in Table 5, we can empirically show that there is a difference of WTP for number portability among service providers at the 0.05 significance level. It means that there is a difference in the tendency to change among subscribers of service providers.

- It is confirmed empirically that brand effect may exist in the Korean mobile market. It is highly probable that introduction of number portability to the market in which brand effect of dominant player exists would have an adverse effect on competition of mobile telecommunication market. In other words, if the market structure is asymmetric with a strong dominant player and number portability is mandated to all service providers without any additional regulatory mechanism, number portability may threaten...
competition of the market and even may aggravate asymmetric market situation.

6.5. Suggestions for facilitating the implementation of number portability

With the aid of economic theory we demonstrated that in the Korean telecommunication market structure, it is highly probable that brand effect exists, and the effect is further likely to be a source of an adverse effect on the competitive climates in the Korean telecommunications industry. As we described in Section 3, even though there are three network operators in the Korean mobile market, the mobile telecommunication market seems to provide vigorous competition. SK Telecom still holds the first place in mobile markets as the dominant player. So, if the mobile number portability were mandated to all service providers simultaneously, it would be highly probable that the asymmetric market situation would be more aggravated. In this section, we propose two possible suggestions to effectively introduce mobile number portability into the Korean telecommunication market. The first one is the introduction of number portability into the Korean mobile telephony market together with asymmetric regulation of access charge. The other is to introduce number portability in serial order as a demand of number portability not as market share. Both suggestions are asymmetric regulation. The rationale for asymmetric regulation is the infant industry policy and competition argument. In other words, it is necessary that a new market entrant should be protected temporarily from the full forces of competition in order to be able to reach a critical mass in market penetration.

First, the asymmetric approach among service providers in determining the implementation date for portability requirements is a less direct solution than an asymmetric access charge regulation in alleviating an adverse effect occurring with the implementation of mobile number portability. It allows a non-dominant firm not only to be protected from losing their subscribers but can also attract other subscribers temporarily. As a result, this suggestion allows a non-dominant firm to be able to reach a critical mass in market penetration and it may contribute to shaping competition in an asymmetric mobile market situation. Although an asymmetric approach in determining the implementation date for portability requirements helps to stimulate competition, it cannot be a fundamental remedy when brand royalty of the dominant firm is so high that a number portability requirement affects insignificant changes of demand.

Secondly, Petiz (2002) argued that asymmetric access price regulation that gives a positive access markup to the entrant and is cost-based for the incumbent is an effective instrument that can be used to increase consumer surplus and the entrant’s profit by stimulating competition in the market. Thus, asymmetric access charge regulation gives the dominant carrier incentives to increase its mobile-to-mobile call price and an incentive to decrease the price level to the non-dominant for profit maximization. In other words, access markup to the non-dominant carrier allows the non-dominant carrier to increase its market share in the mobile call market. An increase (decrease, respectively) in the retail price implies a decrease (an increase, respectively) in the market share of the mobile telecommunication market. Accordingly, introduction of asymmetric regulation of access charge is one way of alleviating the adverse effect occurring with introduction of number portability.

Although it is an effective instrument for the facilitation and the implementation of number portability and for reducing the side effect of number portability, we should stress that it is highly probable that the asymmetric access charge regulation could lead to a decrease in consumer and social welfare. It follows that once an asymmetric market situation becomes more or less symmetric, asymmetric regulation should be replaced by a symmetric regulation for maximizing total social welfare.

7. Conclusions and Further study

This paper was undertaken with the primary purpose of measuring the demand for number portability in the Korean mobile telecommunication market using a contingent valuation method. This approach provides a direct estimate of the demand for number portability of Korean mobile subscribers. This paper also shows that there is a difference in demand for number portability among service providers’ subscribers. The findings of this study have several policy implications. The most important finding from a policy perspective is that the demand for number portability is relatively higher than is generally thought when considering a subscriber’s average monthly payment of 36,400 won. However, it should be stressed that the results of this paper are not a complete economic analysis of number portability. The cost of introducing and providing number portability should be taken into consideration, as well as the economic impacts on the mobile service market. Thus, cost study and economic impact studies should be conducted and analyzed to give perfect policy implications to regulators. The second implication is that there is a
difference in demand for number portability among the service providers’ subscribers. This paper has shown clearly that brand effect most likely exists and explains the difference in demand among the service providers. Thus, regulators should consider thoughtfully how to implement number portability when there is an asymmetric demand in number portability among the service providers.

To counter this brand effect, we propose two alternative solutions. The first one is the introduction of number portability in the Korean mobile telephony market together with asymmetric regulation of access charge. The other is to introduce number portability in serial order as a demand in number portability not as a market share. Although number portability is likely to bring us substantial benefits, implementing number portability is not a simple issue. To implement it, some other economic as well as non-economic effects induced by number portability, which were not considered in this paper, should be comprehensively analyzed. There are some questions for the future study. One interesting question is how number portability may affect the market share of each service provider after the implementation of number portability. Another one is that whether or not the number portability should be provided, as it will increase welfare from an economic point of view.

8. References