The Economic Value of Next-Generation Converged Communications and Broadcasting Services

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This research is to substantially analyze the economic value of portable Internet (WiBro), WCDMA High Speed Downlink Packet Access (HSDPA), WiBro+VoIP, and WiBro+DMB regarded as the next generation of broadcasting. Based on the empirical analysis of economic values, we provide the optimal paths of converged communications and broadcasting services related to WiBro. 1,000 Internet users in the Seoul and Gyeonggi areas were surveyed in their homes. The collected survey was calculated as an accurate economic value distribution for relevant services, and the average and mean were taken using a parametric logit model, semi-parametric Spike model, and nonparametric Turnbull and Kernel estimations in order to analyze the contingent economic value of the amount offered to the subjects of the analysis. The contingent value analysis results varied slightly according to the different methodologies; however, all showed the following common features. The economic value of WiBro, Internet-based WCDMA, VoIP, and DMB with WiBro appeared to be similar. Therefore, if WiBro and WCDMA (HSDPA) form a competitive relationship, the types of bundled services offered as portable Internet service and the supply point of such bundled services are expected to emerge in a strategic plan for stimulating service markets and the prior occupation of the market.

Keywords: Portable Internet (WiBro), WCDMA (HSDPA), bundled service, economic value, CVM, next-generation converged communications and broadcasting services.

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I. Introduction

The convergence between communications services, as well as between communication and broadcasting services, is widely seen as the future path of evolution for both the communications and broadcasting industries. It is likely, in other words, that survival within tomorrow's marketplace requires providers and broadcasters to offer additional economic benefits to users by bundling with various types of services, whether in the form of a combination of communication services or a combination of communications and broadcasting services. Given this development of the market landscape, the important question to be addressed by theoretical and empirical studies in the information, communications, and broadcasting fields, then, is naturally what relationship exists between the service convergence and choice behaviors of potential service users, and how the related economic values are constituted.

In recent times, estimating the economic value of new goods and services has been increasingly used as a tool to assess the impact of their introduction, not only on market prices, but also on the public welfare. A case in point is the study by Goolsbee and Petrin [1] on communications and broadcasting services. This study, noting a price decline in cable TV in the US market, following the introduction of direct broadcast satellite services and a qualitative improvement in competing goods and services, quantitatively estimated the enhancement in the American public welfare at an annual rate of $125 to $190 USD per user.

Korea's communications and broadcasting sectors are fast-moving industry segments exhibiting a unique degree of dynamism compared to other countries around the world. It is a well-acknowledged fact that these sectors of the Korean

industry are on an optimal developmental path, especially in high-speed Internet, mobile Internet, and broadcasting service segments. Along this evolutionary path, it is expected that within the next three years, Korea's information, communications, and broadcasting service industries will achieve new qualitative progress and quantitative expansion by giving new momentum for growth to existing services, as well as by commercializing next-generation services (scheduled for 2006), including portable Internet service (WiBro), VoIP, WCDMA, and DMB services.

Of all the currently-discussed next-generation communications and broadcasting service types, the portable Internet, as has been argued by Sawyer and others [2], appears to be the most critical, as it combines the capacity of broadband transmission with the freedom of portability, and is regarded as the convergence formula most prepared to lead the next-generation market. Furthermore, these bundled service products, between existing services and with new services, are expected to create a new service segment, namely a converged communications and broadcasting service sector. This development elicits two questions. Do these new communications and broadcasting services bring additional economic value to their users? If so, what size would this value be? They constitute the central questions about the new prospective market, relevant to technology developers and carriers preparing to launch the new services, as well as to policymakers.

The portable Internet, scheduled for commercialization in 2006, has been the focus of much attention and debate within Korea's research community, due both to the academic interest it presents and to its high market potential. Services that may be complemented or substituted by WiBro service include WCDMA, DMB, VoIP, high-speed Internet, and wireless Internet. However, due to the current lack in studies on the overlapping of market segments between next-generation communications and broadcasting services, and the purchase capability of users and other various market aspects, complementary or substitutionary relationships between services have been so far discussed only at a technical level. Any next-generation converged service business strategies, whether having to do with portable Internet or other bundled communications-broadcasting services, conceived without considering users, are bound to be critically deficient. Such strategies and policies, lopsidedly centered on technological aspects of service models and grossly neglecting user-end variables, miss out on one of the most fundamental dynamics governing the market and are therefore poorly adapted for market creation and stimulation. Estimating the economic value of portable Internet, next-generation and related services perceived by potential users can precisely enable us to formulate a market strategy incorporating their perspective.

Several possible methods exist for estimating the economic value of goods and services not yet existing in the market. One measurement method is based on surveys of potential users, conducted using either discrete choice or multiple choice models [3]. A contingent valuation model (CVM) is another popularly-used technique, notably often adopted for estimating economic values of environmental or public goods. Used to estimate the benefits of goods and services that do not exist in the market, and more particularly non-marketed environmental and public goods, CVM is a hypothetical valuation method in that is based on survey data collected from potential users by directly asking them questions on the hypothetical use value of a good or service [4].

An attempt to measure the economic value of communications and broadcasting services that are as of yet non-existent in the market must reckon with a number of inherent limitations. To begin with, the exercise must make a practically-impossible assumption that potential users accurately understand services that are not yet offered. Hence, the economic value estimates are based on a less-than-perfect understanding on the part of potential users of the communications and broadcasting services evaluated. Secondly, the estimation results can widely vary depending on the method adopted. Finally, to obtain meaningful results, the survey questionnaire on economic values must be appropriately selected and formulated.

To address the above-described limitations in estimating monetary values of hypothetical communications and broadcasting services scheduled to be introduced at a point in time in the future, in this study we used a number of different contingent valuation techniques to measure and compare the economic values of portable Internet and related bundled services, the latter of which may be complementary or competing services relative to the former.

This study distinguishes itself from others on similar subjects in the following aspects: First, we used a contingent valuation, which is a methodology adopted mostly to measure the economic value of environmental and public goods, and to estimate that of communications and broadcasting services to be introduced in the future. Second, in order to overcome the known issue in contingent valuation models of wide discrepancies in results depending on the method used, we resorted to several different contingent valuation methods for more accurate estimation. Last, by estimating the economic value of the portable Internet at the same time as measuring the monetary values of other competing products and services bundled with portable Internet, we have been able to provide more concrete and comprehensive directions towards formulating viable market strategies in communications and broadcasting sectors.

The rest of this paper is organized as follows. We begin with a brief description of contingent valuation methods used in this study. Note that we paid particular attention to our method of exposition so that general readers, even if they fail to completely grasp the concepts in this section, can follow the discussion of results given in section III. In section III, we present the results of our estimation of the economic values of WiBro Internet service, WiBro + Voice service (VoIP), WiBro + DMB, and WCDMA (HSDPA), obtained using three different contingent valuation methods on actual survey data. In the last section, we provide a summary of the results obtained by this study and discuss their implications and directions for future studies.

II. Methodology

1. Theoretical Background

The theoretical underpinning for most estimation models elaborated in recent years, measuring economic values to be expected from the introduction of new goods or qualitative improvement of existing goods, has been provided by economic utility theories [5], [6]. These methods, drawing on utility theories to explain consumer choices of goods and services, are some of today's most authoritative estimation methodologies, and they are, in point of fact, popularly adopted especially for estimating economic values in situations involving economic choices [7], [8].[1)] Among domestic studies, the estimation by Dong-il Kim and others [9] of the economic cost of electromagnetic radiation damage and related R&D cost, using a contingent valuation method, constitutes a good example.

In what follows, we will briefly describe the basic methodological framework for estimating monetary values of goods and services within choice situations, referring to the studies mentioned above. The first choice faced by a communications service user is between adopting a new service or an existing one. The service user, in other words, must make a decision within a communications service choice environment or communication service space expansion environment.[2)] Let us express the change in communications environment resulting from such decision making as $q^0 \rightarrow q^1$, where $q^1 > q^0$ generally. In this case, the indirect utility function of the communications service user will be given by the following:

$$V(q^i, y, z, \varepsilon) \quad i=1, 2, \tag{1}$$

where y is the income of the service user, and z is a variable indicating the characteristics of the communications service, or individual habit or preference of the user. Variable ε is a random variable, indicating the factors in an actual choice of a service user that cannot be explained through observed data. Quantity q_i is the quantity using the service. If the service user judges that the new communications environment is better than the former one before the change, we can formulate the following expression relating to his or her choice:

$$V(q^1, y, z, \varepsilon) \geq V(q^0, y, z, \varepsilon). \tag{2}$$

If the service user is a rational or bounded rational user, the theoretical condition under which in the above choice situation he or she purchases the new service at the price of A won (Korean currency) is as follows:

$$V(q^1, y-A, z, \varepsilon) \geq V(q^0, y, z, \varepsilon). \tag{3}$$

The estimate of change in economic compensation occurring from (3) or C, is computed using the following equation:

$$\Delta V(C, q^1, q^0, y, z, \varepsilon) \equiv V(q^1, y-C, z, \varepsilon) - V(q^0, y, z, \varepsilon) = 0. \tag{4}$$

Term C in (4) is the economic value of the new or improved communications service.[3)]

How then can the above-described economic value be measured using actual survey data? In order to do so, one must rewrite (4) into a probability equation as

$$\begin{aligned} P(yes \mid A) &= P(V(q^1, y-A, z, \varepsilon) \geq V(q^0, y, z, \varepsilon)) \\ &= P(C(q^1, q^0, y, z, \varepsilon) \geq A) = P(\Delta V \geq 0). \end{aligned} \tag{5}$$

In other words, if a potential user of a communications service subscribes to a new service by paying A won, the economic value of the corresponding communications service, even after paying for the service, is statistically greater than zero. Accordingly, measuring the value of a communications service using actual data is equivalent to estimating $\Delta V(x, \theta)$. As has been noted above, variable $x = \{A, z, y, \varepsilon\}$ and θ is the parameters of variable x.

Next, to estimate θ, let us introduce the likelihood function for the discrete choice model, expressed as the probability density function of choosing a new communications service and not choosing one, as follows:

1) The study by Petrin [8], estimating consumer benefits following the introduction of new automobiles, is considered to have made a substantial contribution to the research in this field, as it quantitatively measures the importance of micro-data, the effect of early market penetration and the cannibalization effect appreciated by companies. Hausman et al. [7] calculated the losses in consumer welfare at negative environmental changes, using a discrete choice model based on a 2-stage decision process, following a traditional approach.

2) Includes qualitative changes brought to existing communications services.

3) Or the maximum price the user is willing to pay to purchase a new communication service.

$$\ln L(d \mid x,\theta) = \sum_{i}^{N} [d_i \ln(P(\Delta V(x,\theta))) + (1-d_i)\ln(1-P(\Delta V(x,\theta)))]. \quad (6)$$

Here, d_i is the variable of choice. The variable is assigned as 1 when the choice is made and 2 when no choice is made. Probability density functions for parametric estimation of the above-noted likelihood function can be logistic, Weibull, or normal distribution functions. In addition to the above-described parametric estimation of economic values, there are also nonparametric and semi-nonparametric methods of estimation. All these estimation methods, however, derive from the same theoretical background, as discussed in the previous methods.

To sum up, from the perspective of economic theory, the maximum use value or economic value of a new communications service is constrained by the income of a communications service user,[4] and therefore cannot theoretically exceed the income of the user. Accordingly, if a new communications service is chosen, this necessarily entails that the value of the service is greater than zero. In other words, the economic value of a new communications service resides within the following rage:

$$0 \le C(q^1, q^0, y, z, \varepsilon) \le y. \quad (7)$$

Meanwhile, this estimation method is not without certain potential issues. For one, when the distribution of maximum prices users are willing to pay does not assume a normal distribution pattern, the resulting economic value of the communications service can turn out to be a biased estimate. Thus, in order to minimize the risk for biased estimation, it is of paramount importance to formulate survey questions in such a way as to accurately reflect the maximum prices, and to enlarge the sampling size as much as practically possible. In what follows, we will describe the estimation methodologies used by this study in order to measure the economic values of new communications and broadcasting services.

2. Estimation Methodologies

Using contingent valuation techniques, this study estimates the economic value of portable Internet service including services similar to it, and next-generation communications and broadcasting services, scheduled for introduction in coming periods. Contingent valuation is a method for measuring economic values of extra-market goods, such as communications services to be introduced in the future, by proposing a set of prices to potential users in a discrete choice environment. The respondents are made to decide on proposed bid prices by either accepting or rejecting them [10]. Hence, contingent valuation is an empirical estimation method, which was later developed into an estimation model incorporating elements of the random utility maximization theory, drawn from the economic theory proposed by Hanemann, in 1984.

Let us now briefly describe the basic principle of a contingent valuation model. Under a contingent valuation estimator, the response probability is closely related to the assumptions made about the distribution of willingness-to-pay (WTP). This is to say,

$$\pi_i^N = P(A_i > C_i) = G(A_i;\theta). \quad (8)$$

While the value of WTP with regard to a bid price of a service is precisely known to survey subjects, who are the potential users of communications and broadcasting services evaluated, for the observer or researcher, the same value is one of the random variables determined by $G(A_i;\theta)$, the value distribution function of θ. Accordingly, the parameters are determined by variables expressing the characteristics of potential users or a population. For example, if determined by mean and variance, two values descriptive of the distribution characteristics of the population, the mean WTP will be a parameter. In this case, there exist three different methods for estimating the value of WTP, as described below.

A. Parametric Method

Under the parametric method, the most traditional and oldest existing method for measuring WTP, the response variable y can estimate the decision factors, using either a logistic function or a normal distribution function. In this paper, we will limit our explanation to the case using a logistic function, as shown below. If the bid price ω and the social and economic variable z are observed, the dependent variable y, corresponding to the response, will have the following random variable[5]:

$$y = \frac{1}{1+\exp[-(\beta_0 + \beta_1\omega + \gamma z)]}. \quad (9)$$

Equation (9), while it coincides with standard discrete choice models insofar as it expresses the difference in utility value depending on the choice made, fails to satisfy the commonly-imposed constraint that the mean WTP is a value greater than zero. For this reason, studies often use a value converted to a log value as a variable of bid price as shown below.

First, a coefficient estimate is derived using the above

4) We estimate the willingness to pay for using telecommunications service in a residential market. The implications of empirical results, however, are not limited because of a huge residential market.

5) In this study, we used communications spending of individual users.

expression and via a logit or probit choice model. Then, we can calculate the mean WTP, equivalent to the economic value of a service perceived by the user as in the following [4].[6)]

$$WTP_{Mean} = \frac{(\beta_0 + \gamma z)}{|\beta_1|} . \quad (10)$$

The parametric method, when the distribution function determining the assumed parameter precisely corresponds to the distribution pattern of the actual data, can be an effective technique for estimating economic value; as a matter of fact, it is more efficient than the two other methods described below.

B. Nonparametric Method

Estimating WTP using a nonparametric method offers two major advantages: the technique is easier to use than a parametric method, and it eliminates errors resulting from choosing wrong distributions. Turnbull's estimator, a method frequently adopted for estimating WTP, precludes the possibility for occurrences of negative WTP values, often obtained by parametric estimators assuming linearity. Turnbull's estimator divides bid prices into several ranges, and measures the probability density function p_i for each of these ranges. The probability density is the percentage of "No" answers to the bid price c_{j-1}. This percentage must therefore be smaller than the percentage of "No" responses to c_j, the next highest bid price, or at least equal to it. This way, the estimator can determine the probability that the maximum WTP of a user resides between the proposed bid price ranges, which is to say

$$P_i = P(c_{j-1} < WTP < c_j) . \quad (11)$$

In this case, the likelihood function is given as follows:

$$L(p; N, K) = \sum_{j=1}^{M} \left[N_j \ln(\sum_{i=1}^{n} p_i) + K_j \ln(1 - \sum_{i=1}^{j} p_i) \right], \quad (12)$$

where N is the number of "No" responses to the bid price range, K is the number of "Yes" responses, and M corresponds to the number of users surveyed over the total ranges. In addition to Turnbull's nonparametric estimator, this study also uses a Kernel-type estimator, a well-known estimation technique, to measure the WTP of communications and broadcasting services. For the analysis of the response curve, we used the Loess method in appreciation of the simplicity of this procedure.

Nonparametric estimators, although offering the freedom from distributional assumptions required in parametric techniques, are not without elements of potential inefficiency, as the method necessitates large numbers of survey subjects for each of the bid price ranges, and uses only the variable of bid price, not taking into account of any other characteristics of respondents.

C. Semi-nonparametric Distribution-Free Method

Semi-nonparametric distribution-free methods (SNDF) offer the advantage over parametric techniques of reducing the excessive sensitivity of parameter estimates to assumptions about distribution.[7)] Furthermore, this methodology can introduce a significant degree of flexibility to the distribution pattern assumed under a parametric approach. Hence, semi-nonparametric techniques may be said to combine the strengths of both nonparametric and parametric methods. The simplest form of the semi-nonparametric estimator assumes the distribution of WTP to be a logistic distribution, and the random response variable in the following form:

$$P(x, \omega) = F_{\varepsilon}(\Delta V) . \quad (13)$$

Here, let us define the cumulative probability density function as logistic function $\Lambda(\eta) = [1 + e(-\eta)]^{-1}$, as has been commonly done by previous empirical studies. One of the key strengths of an SNDF estimator being the flexibility of estimation equation, let us assume the following form for the logistic function, $h(x, \omega) = \Lambda^{-1}[F_{\varepsilon}(\Delta V)]$. Then, the relationship with (13) is given by $P(x, \omega) = \Lambda(h) = F_{\omega}(\Delta V)$.

The next important step in parameter estimation using the SNDF technique is obtaining the approximate value corresponding to the logistic function to be used through a Fourier function. In other words, under an SNDF estimator, the difference in linear utility function is estimated by converting to a Fourier flexible form as

$$h_k(x, \theta_K) = x\beta + \sum_{\alpha=1}^{A} \sum_{j=1}^{J} (\mu_{j\alpha} \cos[jK'_{\alpha} s(x)] - \nu_{j\alpha} \sin[jK'_{\alpha} s(x)]), \quad (14)$$

where K is the variable indicating the dimension of θ_K to be estimated by the above model.[8)]

The simplified SNDF estimator used in this study is $x = \{\omega, \xi\}$, corresponding to the bid price and communications service spending, respectively. Equation (14) can be now rewritten as

6) Some of the recent CVM-related studies use median WTP values as the main measures of economic values. In this study, we used median WTP values as a complementary indicator.

7) We found that the results of estimation using the SNDF technique were as accurate as those obtained using the parametric technique (refer to Cooper, [6], p.278).

8) K, determining the number of parameters to be estimated, is generally defined as $K = n^{1/2}$.

Table 1. General concepts of portable Internet and other similar next-generation services.

Service	Portable Internet [WiBro]	Wired high-speed Internet	Mobile phone wireless Internet [HSDPA]	Wireless LAN	Digital multimedia broadcasting [DMB]
Service content	Mobile Internet access and voice services	Internet access from fixed locations	Internet access through mobile phone	Wireless high-speed Internet	Mobile reception of broadcast content (TV, music, streamed videos)
Service range	Indoors/outdoors	Indoors	Nationwide	Indoors (hot spot)	Nationwide
Data transmission speed	High speed (1 Mbps)	Super-high speed (8 - 20 Mbps)	Medium to low speed (384 kbps)	Super-high speed (11 Mbps)	High speed (1.7 Mbps)
Mobility	High	None	Very high	Low	High
Price	Cheap	Cheap	Costly	Cheap	Cheap
Device	Notebook computer, PDA, other portable devices	PC	Portable phone, PDA	Notebook computer, PDA	Notebook computer, PDA, other portable devices

$$\Delta V_F = \sum_{\alpha \in x} \beta_\alpha \ln(\alpha) + \sum_{\alpha \in x} \mu_\alpha \cos s_\alpha (\ln(\alpha)) + \sum_{\alpha \in x} \nu_\alpha \sin s_\alpha (\ln(\alpha)). \quad (15)$$

In this study, to calculate WTP, we adopted the Spike model proposed by Kristrom [11]. Notably, this Spike model allows for zero WTP. Since the probability for WTP being zero is greater than zero, a Spike is caused in the WTP distribution when the bid price is zero. Spike models are frequently used in economic value estimations, combined with parametric maximum likelihood methods or other various estimation techniques.[9)]

To sum up, this study resorts to all of the above-described methods in spite of the fact that, for instance, the SNDF methodology is a highly difficult technique to implement in practical terms. The reason why this study chooses to adopt all of these estimation techniques is that, since our estimation exercise has to reckon with a situation in which exact data about the parameters are generally lacking, and the form of utility function determining economic values is unknown, we judged our best course of action to be to use several of the previous estimation models and compare the resulting estimates.

III. Empirical Results

1. Data

The survey data used in this study are from the survey conducted by Core Research & Consulting, a Korean market research firm we contracted for the purpose of this study in November 2004. The survey was conducted at the homes or workplaces of subjects sampled from active Internet users living in the Seoul and Gyeonggi areas, and the questionnaire consisted of questions on economic values of portable Internet service, next-generation communications, and broadcasting services. The questions were closed questions[10)].

Table 1 lists brief descriptions provided to survey respondents to help them understand future bundled products. The descriptions are on currently-marketed services that are similar to future ones, portable Internet service, portable Internet bundled with DMB, and portable Internet bundled with voice services.

Table 2 gives the general value distributions corresponding to portable Internet service and next-generation communications and broadcasting services, bid price ranges and numbers of respondents answering "Yes" to respective price ranges. We planned the distribution of survey subjects so that the largest segment of respondents is assigned to the bid price range of 20,000 to 40,000 won monthly.[11)]

These arithmetically-computed results indicated that, of the four next-generation communication and broadcasting services, the service bundle consisting of WiBro and DMB has the highest economic value, and portable Internet service, the lowest value. These estimates of economic value do not consider statistical factors indicating the probability of actual occurrences, and therefore may not be considered as valid predictions. Another notable pattern was that the greatest number of surveyed potential service users preferred the bundle of WiBro + DMB (46%) of all four service products.

9) Other techniques for measuring WTP, which assume a truncated distribution, do not significantly differ in resulting WTP estimates from the spike model, Cooper [6], p. 275.

10) An example of a closed survey question is as follows: Do you want to subscribe to portable Internet services for the monthly fee of _____?

11) We pre-adjusted the distribution of survey subjects in this way because the monthly subscription fees for portable Internet service and related bundled services are currently expected to be within the range of 30,000 won.

Table 2. Distribution of user desire with regard to next-generation communications and broadcasting services.

Survey services	Overall (Bid)	10 (1,000 won)	15 (1,000 won)	20 (1,000 won)	25 (1,000 won)	30 (1,000 won)	35 (1,000 won)	40 (1,000 won)	45 (1,000 won)	50 (1,000 won)	55 (1,000 won)	Arithmetic mean economic value (unit: won)
Survey subjects	1000	51	53	105	99	201	148	150	95	47	51	-
WiBro	417	42	38	75	60	88	54	34	18	1	7	26,680
WiBro +VoIP	443	41	38	80	61	102	54	39	19	3	6	26,980
WiBro +DMB	464	42	42	77	61	102	59	50	19	5	7	27,440
WCDMA (HSDPA)	450	45	37	76	58	95	62	48	17	5	7	27,370

Note: Won is Korean currency; approximately 1,100 Won is equivalent to $ 1 (US).

However, this result does not constitute any conclusive evidence, as we were unable to test the statistical significance of the preference levels. Lastly, all in all, no single service or service bundle clearly stood out from the rest, both in terms of economic value perceived and preference. This pattern may be explained by the fact that the level of understanding among the respondents of the services and service bundles asked about in survey questions was not elevated enough to produce distinctively discriminating responses. This further indicates that no single service or service bundle has yet emerged as a leading product in user perception.

2. Results of Economic Value Analysis

Using the measurement techniques described earlier, in this subsection we present the results of estimating economic values of next-generation converged communications and broadcasting services scheduled to be introduced to the market in coming periods. To begin with, the means of economic values exhibited slight discrepancies from one measuring technique to another. Under the parametric approach, the service scoring the highest economic value, 31,000 won, was the WiBro + DMB service bundle. WiBro service scored the lowest, 29,000 won. The difference in perceived economic value between the two service products therefore is about 2,000 won. Accordingly, the increase in economic value felt by a user from bundling WiBro with DMB amounts to 2,000 won, approximately. The reason for such little value difference is that first, the subject can not distinguish the value difference from new bundled services. Second, the utility gained from using a new service is not big enough for a user to recognize the difference value. Finally, using the methodologies is not fitted to valuing a telecommunications service.

Next, when using the SNPSPIKE estimator, the economic value of the WiBro + VoIP bundle was the highest (33,000 won). According to this estimation method, the value generated from bundling WiBro service with VoIP is measured at over 2,700 won. Finally, concerning the general characteristics of the measurement methodologies, economic value estimates were higher with the SNPSPIKE technique than with the nonparametric estimator. The discrepancies noted between measuring models cast significant doubts as to the objectivity of those estimates of extra-market goods and services such as communications and broadcasting services, obtained using a single methodology.

Table 3. Means of distributions of economic values perceived by potential users (unit: won).

Estimation method	WiBro	WiBro+VoIP	WiBro+DMB	WCDMA (HSDPA)
Parametric logit	29,104	30,429	31,580	30,856
SNPSPIKE	30,774	33,559	32,176	30,108
Turnbull	25,332	26,168	27,366	27,081
Kernel	18,843	20,047	20,896	20,033

Notes: (1) 1,000 users of high-speed Internet from the Seoul and Gyeonggi areas.
(2) Monthly communications spending was constrained by imposing a maximum constraint.

Now, when estimating the economic values of these services through the median values in the respective distributions, the highest-valued service proved also in this case to be the WiBro + DMB service bundle (approx. 29,000 won). The result, similar to that obtained using the means of distributions, once again confirmed the pattern observed in the general results.[12)]

12) We interpret the main results using a parametric logit model because it is a popular model in this research field.

The results of the empirical analysis of the economic values of next-generation communications and broadcasting services, presented thus far, in spite of slight differences exhibited depending on the measurement technique used, shared the following common characteristics: First, the economic value of portable Internet service was roughly equivalent to that of WCDMA; and second, VoIP and DMB services, as portable Internet bundle services, were also nearly equivalent to each other in economic value.[13] Accordingly, if portable Internet service comes to form a competing relationship with WCDMA, the crucial questions for portable Internet service providers, seeking early market penetration, will naturally be what bundled services to offer and when to offer them. Concerning the accuracy and reliability of these estimates obtained through contingent valuation, the contingent economic values in this study are the most conservative possible estimates. As has been demonstrated by Bishop and Heberlein [10], contingent valuation results show a common tendency for downward bias concerning the economic value users are willing to pay, and upward bias concerning the economic values users expect to receive. Accordingly, the willingness-to-pay estimates provided by this study are also in the lowest possible economic value range.[14]

Table 4. Estimates of median value in distributions of economic values perceived by potential users (unit: won)

Estimation method	WiBro	WiBro+VoIP	WiBro+DMB	WCDMA (HSDPA)
Parametric logit	27,027	28,528	29,529	28,528
SNPSPIKE	29,029	31,531	31,031	29,029
Turnbull	24,924	25,055	26,754	25,822
Kernel	10,000	10,000	10,000	10,000

Notes: (1) 1,000 users of high-speed Internet from the Seoul and Gyeonggi areas.
(2) Monthly communications spending was constrained by imposing a maximum constraint.

IV. Conclusions and Implications

This study was conducted as a complementary study to an earlier work by us [13], which was an analysis performed from a similar perspective, starting out from similar premises.[15] In addition to the difference in measured services and methodologies used, this study reached outcomes distinct from the conclusions arrived at by the earlier study concerning the implications derived from the estimation results. Whereas our previous study found that the economic value of the WiBro + VoIP service bundle was superior to that of the WiBro + DMB service bundle, the results of the present study indicated that the gap between the two estimates was significantly narrower. Hence, it may be more recommendable, considering the current market situation where the overriding determinant is customer-perceived values, that the evolution path for WiBro be determined by market strategies of individual service providers themselves, rather than by following the evolution path according to the economic value perceived and formed during initial stages.[16]

The implications of the findings of this study are as follows: First, there is no significant difference in user-perceived economic value among the next-generation communications and broadcasting services. Accordingly, it may be wise for service providers seeking early market penetration to turn to more traditional market strategies such as a pricing policy. Secondly, such equivalency in economic value among next-generation services suggests that the competition relationship among similar services may be primarily determined by individual service providers' market decisions concerning the types of services a next-generation service is bundled with, and the point in time when the service is introduced in the market. Lastly, the shapes assumed by user-response function curves vis-à-vis projected bid prices indicate that service providers, prior to deciding on a pricing structure, must conduct user response surveys within prospective markets in a more thorough fashion for WiBro services than for WCDMA services. Overall, given the rapid growth of mobile and data telecommunications, the early and rapid estimates of economic values perceived by potential consumers are to help service providers and policy makers develop new services and institutions that better satisfy consumers.

We would like to conclude this paper by drawing the reader's attention to a number of interpretative issues regarding the results of this study. First, there may be a degree of bias in the composition of survey questions. As can be seen in the preceding, bid prices of a number of different services were presented to the same survey subjects, and this may have resulted in questions proposing similar service values. Secondly, the fact that the economic values obtained in this study are in the lowest possible range may have been induced by psychological factors on the side of responding potential

13) An anonymous referee pointed out that the arithmetic mean for WCDMA is nearly identical to that of WiBro+DMB and is quite a bit higher than WiBro or WiBro+VoIP. Tables 3 and 4 show that the more sophisticated estimation methods are able to reveal much more subtlety.

14) Cooper [12] suggests the confidence interval method for DC CVM, similar to our paper's methodology.

15) Cho, et al. [14] conducted simulation tests to find out similarity of Wibro and WCDMA. The paper showed the possibility of bias from the probit method under the existing correlation of two telecommunication services.

16) Recently, there have been a lot of interactions between micro-level and macro-level telecommunications researches. Refer to Rim et al. [15].

users. Lastly, it may be possible that the survey responses were not based on adequate levels of value perception, due to the lack of familiarity and experience of respondents with regard to services they were surveyed about (being non-existent services in the market). In spite of these potential or actual limitations, we believe that this study, as an attempt to assess the economic values of next-generation communications and broadcasting services, has made meaningful contributions to the research in this field.

References

[1] Austan Goolsbee and Amil Petrin, "The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable TV," *Econometrica*, vol. 7, no. 2, 2004, pp. 351-381.

[2] Sawyer Steve, J. Allen, and Heejin Lee , "Broadband and Mobile Opportunities: A Socio-technical Perspective," *J. Information Technology*, vol. 18, 2003, pp. 121-136.

[3] Kenneth Train, *Discrete Choice Methods with Simulation*, Cambridge University Press, 2003.

[4] Michael Hanemann and Barbara Kanninen, "The Statistical Analysis of Discrete Response CV Data," *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EC, and Developing Countries*, Ian Bateman and Ken Willis, eds, Oxford University Press, 1998.

[5] Michael Hanemann, "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses," *American J. Agricultural Economics*, vol. 66, 1984, pp. 332-341.

[6] Joseph Cooper, "Flexible Form Estimation of Willingness to Pay Using Dichotomous Choice Data," *J. Environmental Economics and Management*, vol. 43, 2002, pp. 267-279.

[7] Jerry Hausman, Gregory Leonard, and Daniel McFadden, "A Utility-Consistent, Combined Discrete Choice and Count Data Model: Assessing Recreational Use Losses due to Natural Resource Damage," *J. Public Economics*, vol. 56, 1995, pp. 1-30.

[8] A. Petrin, "Quantifying the Benefits of New Products: The Case of the Minivan," *J. Political Economy*, vol. 110, 2002, pp. 705-729.

[9] Dongil Kim and Jongho Hong, "The Economic Cost of the Electromagnetic Radiation Damage from Cellular Phone: Application of Contingent Valuation Method," *Econometric Studies*, vol. 14, 2003, pp.71-94.

[10] Richard Bishop and Heberlein Thomas, "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" *American J. Agricultural Economics*, vol. 66, 1979, pp. 926-930.

[11] Bengt Kristrom, "Spike Models in Contingent Valuation," *American J. Agricultural Economics*, vol. 79, 1997, pp. 1013-1023.

[12] Joseph C. Cooper, " A Comparison of Approaches to Calculating Confidence Intervals for Benefit Measures from Dichotomous Choice Contingent Valuation Surveys," *Land Economics*, vol. 70, 1994, pp.111-122.

[13] Sang-Sup Cho and Shin-Won Kang, "An Economic Value Analysis on the Evolution Path of Portable Internet Service: Is Voice Better than Broadcast as Integrated Service?" *Korea Association for Telecommunications Policies Conf.*, 2004, pp.235-255.

[14] Sang-Sup Cho and Sun-Young Park, "The Comparative Economic Value Analysis for Data Based Internet Service Using Simulation Method under Complex Market Environment," *Korean Telecommunications Policy Review*, vol. 12, 2005, pp.101-121.

[15] Myung-Hwan Rim, Sang-Sup Cho, and Choon-Geol Moon, "Measuring Economic Externalities of IT and R&D," *ETRI J.*, vol. 27, no. 2, Feb. 2005, pp.206-218.

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