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Conference Paper

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26th European Regional Conference of the International Telecommunications Society (ITS): "What Next for European Telecommunications?", Madrid, Spain, 24th-27th June, 2015

Provided in Cooperation with:
International Telecommunications Society (ITS)

Suggested Citation: Kim, Jiin; Nam, Changi; Kim, Seongcheol (2015) : The Economic Value of Personal Information and Policy Implication, 26th European Regional Conference of the International Telecommunications Society (ITS): "What Next for European Telecommunications?", Madrid, Spain, 24th-27th June, 2015, International Telecommunications Society (ITS), Calgary

This Version is available at:
https://hdl.handle.net/10419/127155

The Economic Value of Personal Information and Policy Implication

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Abstract

Personal information is essential in an information-oriented society for societal development and as a valuable business resource. However, because of poor management and a lack of proper protection, leakage of personal information can take place over time, and the standard for compensation is not well established. In order to establish appropriate policies for its protection, we need to know the economic value of personal information. Using conjoint analysis, we analyze the potential value of personal information by calculating the marginal willingness to pay of Korean consumers for each attribute of personal information, which we estimate to be 7501.70 South Korean won (about 6.81 US dollars) per month. After indirectly estimating the economic value of personal information, we provide some political implications regarding the potential market size of any personal information protection service.

Acknowledgement: This research was supported by the MSIP (Ministry of Science, ICT and Future Planning), Korea, under the CPRC (Communication Policy Research Center) support program (IITP-2015-H8201-15-1003) supervised by the IITP (Institute for Information & communications Technology Promotion)

Key words: The value of personal information; Marginal willingness to pay; Conjoint analysis; Multinomial logit model

1. Introduction

Before internet was invented, personal information was collected using written documents (Caudill & Murphy, 2000). However, as digital technology and the Internet became more widely used, firms became able to collect, store, and utilize personal information more easily, and consequently personal information increasingly accumulated within companies. However, while storing personal information online or in computers rather than documents brings convenience, it also brings high risk in terms of confidentiality (Furnell & Warren, 1999).

According to a US Federal Trade Commission survey in 2000, 67% of consumers responded that they were "very concerned" about the personal information they provided online (Federal-Trade-Commission, 2000). Concerns with personal information management have increased, and are now the most common and frequent concern and social issue. For instance, according to Gallup research conducted in October 2014, 69% of Americans were worried about computer hackers stealing the credit card information provided to stores, while 62% were concerned about their computer or smartphone being hacked and the private information therein stolen by unauthorized persons (Riffkin, 2014).

Even though individuals can be careful, the risk of stolen information always exists (Okenyi & Owens, 2007). In fact, others can also frequently view, abuse, and leak personal information (Choe, 2014; Kwak, 2014; Yoon & Armstrong, 2014). For instance, in Korea, government employees have been detected peeking at the personal information of celebrities on more than 1,000 occasions over the past three years (Kwak, 2014). The biggest leakage of personal information in Korea took place in January 2014 with a personal information leakage from the three major Korean credit card companies. More than 100 million pieces of personal information stored by the credit card companies leaked in this incident, representing

some 20 million victims. Considering that the total population of Korea is approximately 50 million persons, this suggests that almost half of all Koreans were victims of this single incident (Choe, 2014). Subsequently, the leakage of personal information for another 9.8 million Koreans took place in KT Corporation, a Korean telecommunications company (Yoon & Armstrong, 2014).

Problematically, because we cannot accurately estimate the economic value of personal information, the compensation (or penalties) determined for each piece of leaked personal information is on a case-by-case basis without any accepted standard. According to the Kyunghyang news article (2014), the courts found KT and its executives not guilty. In order to receive compensation, customers need to prove their losses. As it is difficult to prove mental damage or the cause of financial damage, the lawsuits by the customers of three credit card companies are still in progress, and the amount of compensation is not determined. In addition, even though the total penalty for the three credit card companies amounted to some 84 million[1] South Korean won (KRW) or about 76,364 US dollars (USD)[2] (Bae, 2015; Sun, 2015), this represents an average penalty of less than USD 0.001 for each piece of information leaked. Over the last four years in Korea, the average penalty for any piece of leaked information is only KRW 16 (USD 0.015). Moreover, during four years, the average penalty for each information that had been leaked was only KRW 16 (USD 0.01) (Newsis, 2014). Unfortunately, this situation is difficult to correct, because while there are continuous instances of personal information being hacked/leaked, we do not clearly know the economic loss associated with the leakage (or the value of personal information). As the leakage of personal information is more of a social concern, the socioeconomic loss of leakage and the value of personal information should be evaluated (Min & Song, 2008). Therefore, we should establish a method of estimating the value of personal information and use this to analyze the value of personal information.

[1] The penalties for the three credit card companies were KRW 56, 6, and 22 million.

[2] 1 USD = 1,100 KRW.

The purpose of this paper is to estimate the economic value of personal information for consumers and to suggest some related policy implications, particularly regarding the compensation for leaked personal information from the perspective of consumers. Given the difficulty of this task, we do this by estimating the perceived value of a personal information protection service for Korean consumers. More specifically, we use conjoint analysis to analyze the potential value of personal information by estimating the marginal willingness to pay (MWTP) of consumers for each attribute of the personal information protection service.

The remainder of the paper is structured as follows. Section 2 reviews the literature on personal information. In Section 3, we estimate the MWTP of the consumers. Section 4 discusses the research design, including the assumptions, hypothesis, and survey design. Section 5 details the results of the analysis using survey data. In Section 6, we provide our conclusions and some policy implications.

2. Literature Review

2.1 Usage of Personal Information

Personal information is important for firms, especially in marketing. As so-called database marketing has proven increasingly useful, personal information has become a very important asset for most firms. In addition, the ever increasing scale, depth, and degree of personal information offers firms a number of strategic advantages through providing a better understanding of their customers (Bessen, 1993). For example, customer information helps firms to build a competitive advantage and improve their customer service (Dinev & Hart, 2006). In evidence, Choi et al. (2008) studied the importance of customers' personal information to firms and demonstrated the effectiveness of these firms. However, using customer' personal information does not directly affect firm performance. Instead, it influences firm performance indirectly through enhancing financial performance via the effectiveness of internal processes and customer service. As several studies showed, personal information is important asset of

many firms, and therefore, firms collect and store personal information of their customers.

2.2 Personal Information and Consumers' Concerns

Consumers have become more aware of the collection and possible sale of their personal information (Taylor, 2004). Therefore, there has been attempts to identify the factors affecting consumer concerns. To identify the factors arising from personal characteristics, Culnan (1995) examined the characteristics of customers and found that age, race, level of education, and prior experience of shopping via mail differed between the groups of consumers who were more or less concerned with privacy. Jin and Kim (2011) conducted a similar study by investigating the characteristics of Internet users with higher psychological anxiety concerning personal information leakage. They mainly focused on gender, amount of Internet usage, and the frequency of Internet usage.

A number of other studies identified factors other than personal characteristics influencing privacy concerns. This is particularly useful for establishing the policy implications of personal information. For example, Phelps et al. (2000) verified the relationship between the overall level of personal information concerns and four factors, namely the type of personal information requested, the amount of information control offered, the potential consequences and benefits, and consumer characteristics. They also identified the trade-offs consumers are willing to make in handing over their personal information. In other work, Nam et al. (2006) confirmed two factors affecting online privacy concerns: the convenience of the website–user interface and perceptions of the third-party certification of the website. They also identified the relationship between privacy concerns and the willingness to disclose information. Lastly, Dinev and Hart (2006) studied the effects of Internet literacy and social awareness on privacy concerns. They found that Internet literacy tends to lower privacy concerns, while social awareness increases privacy concerns. They also confirmed the effects of Internet literacy and privacy concerns on the intention to transact online, with Internet literacy increasing the intention to transact, whereas privacy concerns lowered the intention to transact.

2.3 Consumers' Concerns of Personal Information as a Social Issue

As more and more people have become concerned with their online privacy, these concerns have become a major social issue. The roles of firms and governments in addressing these concerns are important. In response, many studies make suggestions about how firms and others can prevent personal information leakage and address consumer privacy concerns using new technologies, policies, and laws.

Some studies have suggested new technologies to prevent information leakage. Gómez-Hidalgo et al. (2010) revealed a technique known as named entity recognition (NER) that could prevent the loss of personal information, while Lucas and Borisov (2008) introduced encryption that can protect personal information in social networking services (SNS).

Elsewhere, Culnan (2011), Xu et al. (2012), and Malin et al. (2010) suggested policies regarding personal information. Culnan (2011) argued the need for improvement of the current privacy regulations given the excessive burden placed on individuals, and suggested a new, more flexible, delegation approach to privacy regulation. Xu et al. (2012) studied the effect of industry self-regulation and government regulation to suggest directions in regulation. Finally, Malin et al. (2010) recommended policies that balance two concepts, data sharing and protection for clinical research, claiming that the balance between information sharing and privacy is important because not sharing data is not the answer to the protection of personal information.

2.4 Value of Personal Information

In order to make effective suggestions regarding the management of personal information, we need to establish the value of personal information, or alternatively, the economic loss through personal information leakage. However, only a few studies illustrate the methodology of estimating the value of personal information and the loss through leakage. In addition, it is difficult to estimate this in monetary terms, as the standard for measuring the value of information or loss through information leakage is not well established.

Grossklags and Acquisti (2007) conducted an experiment on the willingness to sell (willingness to

accept) and the willingness to protect personal information to study the consumer valuation of personal information. Their results showed that respondents are more willing to sell their personal information than to protect it for the same amount of money. This experiment simply asked respondents whether they would like to sell their personal information and receive a given amount of money or protect their personal information by paying the given amount. Therefore, it is difficult to discern the value of personal information using this experiment. The Korea Internet & Security Agency (KISA) undertook a more detailed study of the value of personal information by analyzing the MWTP using the contingent valuation method (CVM) (Kim et al., 2007). The Personal Information Protection Commission (PIPC) in Korea also reported the value of personal information and the social cost of personal information invasion in 2013 using KISA's CVM (Jeong et al., 2013).

There are three reasons supporting another study analyzing the value of personal information in Korea. First, the existing research took place prior to the leakage of personal information from Korea's three major credit card companies discussed earlier. Following this incident, consumer perceptions regarding personal information may have changed. Second, the existing research by KISA used the CVM to estimate the MWTP, but this method can only estimate the MWTP for one attribute at a time. As personal information has more than a single attribute, the CVM cannot capture the MWTP reflecting the interaction between these attributes. Therefore, conjoint analysis is more appropriate. Finally, KISA's report does not include clear criteria governing the selection of the personal information attributes. Therefore, in this analysis, we use conjoint analysis to find the MWTP for a personal information protection service, use this to estimate the value of personal information, and suggest a methodology to measure the value of personal information or the cost of its loss.

Personal information is key element that represent and identify oneself and is regarded as important asset for both individual and firms. As there had been several incidents of personal information leakage and people have become more concerned of their personal information, people will be willing to pay certain amount of money to protect their personal information. In order to make policies that can address

this issue, we should first estimate how much consumers are willing to pay to protect their information to guide the direction of such policy. Therefore, the research question of this paper is how much is the economic value of the personal information, perceived by consumers.

3. Methodology

3.1 Conjoint Analysis

We analyze the potential value of a personal information protection service using conjoint analysis, a very widely used method in this area. Conjoint analysis evaluates consumer preferences for services and products with multiple attributes and derives the willingness to pay for these attributes. The CVM is also a widely used method to estimate consumer preferences for products and services. However, CVM is only useful when the product or service has a single attribute. Given that a protection service for personal information has multiple attributes, we select the conjoint analysis method (Park & Yoo, 2012). In addition, while conjoint analysis is especially useful when products and services have several attributes or levels, by undertaking conjoint analysis, we can also analyze the relative importance and utility consumers place on each attribute and the relationships between attributes (Mackenzie, 1993; Park & Yoo, 2012). Another advantage of conjoint analysis is that it simplifies the evaluation method for respondents (Choi et al., 2007).

In conjoint analysis, respondents are given profile cards, which are combinations of each level in each of the attributes. There are three ways of conducting conjoint analysis for deriving the MWTP, which refers to how the profile cards are given to the respondents. These are the contingent choice method, the contingent ranking method, and the contingent rating method (Park & Yoo, 2012). The contingent choice method involves giving two alternative profile cards and asking the respondents to choose the profile card they prefer. The contingent ranking method relies on asking the respondents to rank all the profile cards. Finally, the contingent rating method requests respondents to rank all the

profile cards and then grade each profile card on a scale of 1 to 10 for more specific and accurate consumer preference information (Park & Yoo, 2012).

3.2 Multinomial logit model

We employ the multinomial logit model developed by McFadden (1974) to estimate the MWTP for the personal information protection service (Cho, 2010; McFadden, 1974; Park & Yoo, 2012).

We do this by entering the results of the conjoint analysis into McFadden's (1974) estimation model. This model explains the choices of respondents among alternatives using a random utility model. In McFadden's model, the indirect utility function is:

$$U_{ij} = V_{ij}(Z_{ij}, S_i) + e_{ij} \quad (1)$$

where U_{ij} is the probability of respondent i choosing alternative j in the choice set. The function consists of a deterministic component, V_{ij}, and a stochastic component, e_{ij}. In equation (1), V_{ij} is a function of the multinomial responses to the attributes, Z_{ij}, and the characteristics of the respondent, S_i.

If $U_{ij} > U_{ik}$ $(k \in choice\ set, k \neq i)$ is satisfied among the choice set C, respondent i will choose alternative j instead of k. We express the probability as:

$$Pr(j|C) = Pr(V_{ij} + e_{ij} > V_{ik} + e_{ik}) = Pr(V_{ij} - V_{ik} > e_{ik} - e_{ij}). \quad (2)$$

To estimate equation (2), we need an assumption for the distribution of e_{ij}. In the multinomial logit model, the error term is independently and identically distributed, which is a Type I extreme value distribution. This implies that the probability of respondent i choosing alternative j is unaffected by the other alternative given with alternative j. In this case, the probability of respondent i choosing alternative j is expressed as:

$$Pr(j|C) = exp(V_{ij}) / \sum_{k \in C} exp(V_{ik}) \quad (3)$$

Each respondent's multinomial responses are then the choices maximizing that respondent's utility. Respondents *i*'s (*i = 1,…,N*) choice is then either 'yes' or 'no' for alternative *j*, expressed as a log-likelihood function. In equation (4), Y_{ij} is a binary variable that has a value of one when respondent *i* selects alternative *j* from among the three alternatives, that is, alternative *j*, alternative *k*, or neither alternative *j* nor alternative *k*. If the respondent does not choose alternative *j*, it is zero.

$$lnL = \sum_{i=1}^{N} \sum_{j=1}^{3} \{Y_{ij} \bullet ln[Pr_i\,(j|C)]\} \tag{4}$$

When we apply maximum likelihood estimation to equation (4), we obtain estimates of the parameters. The deterministic component of the indirect utility function,V_{ij}, is structured as a linear combination function of each attribute vector ($Z_{k,ij}$) and price vector ($Z_{price,ij}$):

$$V_{ij} = \sum_{k=1}^{n} \beta_k Z_{k,ij} + \beta_{price} Z_{price,ij}. \tag{5}$$

In equation (5), β_k and β_{price} are the coefficients of those attributes affecting each respondent's utility. By totally differentiating equation (5), we can obtain the MWTP for each attribute. In equation (6), the $MWTP_{Z_k}$ has a negative sign because price has a negative effect on the respondents' choices and utility.

$$\begin{aligned}
MWTP_1 &= -(dV/dZ_1)/\left(dV/dZ_{price}\right) = -dZ_{price}/dZ_1 = -\beta_1/\beta_{price} \\
MWTP_2 &= -(dV/dZ_2)/\left(dV/dZ_{price}\right) = -dZ_{price}/dZ_2 = -\beta_2/\beta_{price} \\
MWTP_3 &= -(dV/dZ_3)/\left(dV/dZ_{price}\right) = -dZ_{price}/dZ_3 = -\beta_3/\beta_{price} \\
MWTP_4 &= -(dV/dZ_4)/\left(dV/dZ_{price}\right) = -dZ_{price}/dZ_4 = -\beta_4/\beta_{price}
\end{aligned} \tag{6}$$

4. Research Design

4.1 Categorization of Personal Information

In Korean privacy law, personal information is information that can distinguish between individuals directly or indirectly by combining several pieces of information (Son, 2014). According to the annual report of Personal Information Protection Commission, there are more than 15 types of personal information including personal general information, education information, family information, financial information, location information, health records, legal records, and communication information (Personal-Information-Protection-Commission, 2012). Among these various types of personal information, we focus on information that is directly related to an individual's social and economic activities because this information, once leaked, has a high probability of use by others for illegal or undesirable purposes. As personal information closely relates to social activity, we select personal general information and communication information, because both are required for individual social activities. Moreover, to reflect the personal information directly related to economic activities, we select financial information. According to KISA's report on personal information value, Koreans tend to be most sensitive in relation to financial information, because they regard the leakage of financial information as critical (Kim et al., 2007). Therefore, we divide financial information into two different kinds of information: direct financial information, needed for transaction purposes such as credit card information, and complementary financial information, such as account numbers for credit card payments.

Thus, we use four categories of personal information in our analysis. First, personal general information, also called indigenous information, relates to the characteristics and identification of individuals, such as their name, social security number, marital status, employment status, and ownership of a car and house. Second, communication information relates to the means of communication or contact point information, including cell and home phone numbers and e-mail and home addresses. Third, direct financial information needed for transaction purposes relates to the financial information required for payments by credit card, including the credit card number, expiry date, CVC number, and password. Finally, complementary financial information relates to consumer credit information resulting from individual economic activity and other financial information.

For subordinate of each of the four categories of personal information, we used the personal information of credit card companies and telecommunications companies as subordinate information for two reasons. The first relates to the fact that credit card companies are representative of those institutions collecting financial information that people are sensitive to, such as bank account or transaction history information. The second is that in Korea, credit cards are widely used, and the cell phone penetration ratio is very high. According to CNN, credit card usage is one of the ten things that South Korea does better than anywhere else in the world (Cha, 2014). In addition, Korea is one of the top countries for cell phone usage. Consequently, Koreans might be concerned about disclosure of their financial activities, even indirectly, by way of credit card and cell phone companies. Table 1 shows the subordinate information for each personal information category.

Table 1 shows the subordinate information for each categories of personal information.

Table 1 Personal Information Categorization

Personal Information Taxonomy	Personal Information
Personal Indigenous Information	Name
	Social Security Number
	Marital Status
	Employment status
	Possession of Car
	Possession of House
Communication Information	Cell Phone Number
	E-mail Address
	Home Address and Phone Number
	Home Address and Phone Number
	Cell Phone Fee Settlement Method

	Cell Phone Applicant Information
Required Financial Information To Pay by Credit Card (Direct financial information needed for transaction purposes)	Credit Card Number
	Credit Card Expiration Date
	Credit Card CVC Number
	Credit Card Password
Consumer Credit and Other Financial Information (Complementary financial information)	Credit Rating
	Credit Limit
	Credit Card Transaction Performance
	Account Number for Credit Card Payment
	Credit Card Payment Date
	Transactional Information of Credit Card
	Possession Status of Credit Cards
	Account Number for Telecommunication Fee Payment

4.2 Attributes for the Protection Service for Personal Information

Just as there are four categories of personal information, there are also four kinds of personal information protection services. Therefore, there are five attributes of the personal information protection service; the four protection services for personal information and the amount of consumers' willingness to pay for the service. Table 2 shows the attributes of the personal information protection service and the levels of each attribute.

Table 2 Attributes of the Protection Service for Personal Information

Attributes	Levels	(Meanings of Each Levels)
Protection Service for	1	Current level

Personal Indigenous Information	2	Blocks illegal use of name and prevent additional leakages of personal indigenous information
Protection Service for Communication Information	1	Current level
	2	Blocks illegal spam, and phishing and prevent additional leakages of communication information
Protection Service for Required Financial Information to Pay by Credit Card	1	Current level
	2	Prevents financial damage that can occur by stealing the information that is required for payment. Also prevents additional leakages of required financial information to pay by credit card
Protection Service for Consumer Credit and Other Financial Information	1	Current level
	2	Blocks secondary damages that can occur by stealing credibility or other financial information. Also prevents additional leakages of consumer credit and other financial information
Amount of Willingness To Pay for the Protection Service for Personal Information (monthly)	1	Do not wish to pay
	2	KRW 2,000 (USD 1.82) per month
	3	KRW 4,000 (USD 3.64) per month
	4	KRW 6,000 (USD 5.45) per month

4.3 Survey Design

Of the three possible methods (contingent choice, ranking, and rating) for conducting conjoint analysis, we use the contingent choice method, which involves providing two profile cards for each question for comparison. In our study, we provided three alternatives to the respondents for each comparison. Two alternatives were profile cards and the remaining alternative was neither of the two profile cards. The Appendix includes an example of the survey comparison.

The respondents chose one card for each comparison. In our survey, there are four attributes with two levels and one attribute with four levels, i.e., 64 profile cards = $(2^4 \times 4)$. However, it would be impractical for respondents to compare all 64 profile cards. Therefore, subfactorial design focused on orthogonal main effects design is used. When using subfactorial design, we need to know how many attributes have the same number of levels. In our study, four attributes have the same number of levels, so for subfactorial design we need at least 16 cards $((2^4 \times 4) \div 4)$ for conjoint analysis.

However, among these 16 cards, four cards contained levels that were inconsistent with each other, such as all attributes of the protection service for personal information at the current level, but willing to pay KRW 4,000. After removing these four cards, 12 cards were available for use in the conjoint analysis. With 12 cards, combining two cards randomly results in 66 comparisons for each respondent. However, after drawing out impractical comparisons, we obtained 50 comparisons. Lastly, because 50 comparisons are typically too many and could lower the respondent's concentration on the survey, we split the survey into eight smaller surveys. For each smaller survey, the respondents were required to make only six or seven comparisons.

4.4 Survey Assumption

Because customer distrust might affect the credibility of the survey, we assume that the personal information protection service is completely reliable. In other words, the protection service can fully prevent any secondary damage and additional information leakage. However, given that such a service

was actually available, we surveyed the perceived reliability of the protection service for personal information for each of the attributes. We use the reliability for each of the attributes to draw policy implications in developing a new market for such a protection service.

4.5 Survey Sample

We administered the survey and collected the data online. The survey target was people aged in their twenties to sixties in Korea. In the samples, gender was evenly distributed and we considered the population distribution in distributing the samples by region. The total number of survey samples is 919. In each survey, we added two in-between comparisons to verify valid samples. Among the 919 samples, 652 samples were valid. The average income of the respondents was KRW 4 million (USD 3,690) per month.

4.6 Interpretation of the Result

We estimate the MWTP for each attribute, which indicate the marginal rate of substitution between each attribute and the price. By adding up all MWTPs, we can estimate the consumer's total MWTP for the personal information protection service. Using the MWTP result, we can then analyze the potential value of the personal information. In addition, as with the reliability, we can estimate the potential market size of the personal information protection service.

5. Results & Discussion

We use a multinomial logit model to estimate the betas in equation (5) using the XLSTAT program. Table 3 provides information concerning the statistical significance of the results.

Table 3 Statistical Significance of the Model

Statistic	Result

Number of observations	8150
Log-likelihood	681.83
Wald-statistic (p-value)	626.08

As shown, the Wald statistic for the estimation is 626.08, indicating that we reject the null hypothesis that all coefficients are jointly zero. This supports our research hypothesis and method of estimating the coefficients. Table 4 shows the coefficient estimation results.

Table 4 Estimation of coefficients and its p-value

Attributes	Estimated beta	Wald	p-value
Protection Service for Personal Indigenous Information	0.508	93.460	.000
Protection Service for Communication Information	0.305	33.478	.000
Protection Service for Required Financial Information to Pay by Credit Card	0.659	154.393	.000
Protection Service for Consumer Credit and Other Financial Information	0.684	169.302	.000
Amount of Willingness To Pay for Protection Service for Personal Information (monthly)	-0.00029	339.964	.000

As the p-values for each of the estimated betas are very small, all coefficient estimates are significant at the 1% level. Moreover, the attribute coefficients are all positive except for price. This suggests that each type of protection service yields positive utility to consumers. Therefore, the higher the attribute level, the greater the consumer utility.

By substituting the estimated betas into equation (6), we can estimate the MWTP by consumers for

each attribute of the personal information protection service. Table 5 shows the results.

Table 5 MWTP for Each Attributes of the Protection Service for Personal Information

Attributes	MWTP (KRW) per Month
Protection Service for Personal Indigenous Information	1767.54
Protection Service for Communication Information	1062.55
Protection Service for Required Financial Information to Pay by Credit Card	2292.55
Protection Service for Consumer Credit and Other Financial Information	2379.05
Total	7501.70

As shown, the MWTP of consumers for a personal information protection service is highest for consumer credit and other financial information, being some KRW 2,379 (USD 2.16) per month. The second highest MWTP is for a protection service for required financial information to pay by credit card, KRW 2,293 (USD 2.08) per month. Consumer MWTP for a personal indigenous information protection service is KRW 1,768 (USD 1.61) per month, while that for communication information is KRW 1,063 (USD 0.97) per month. Summing the MWTP of each of the attributes yields the MWTP of the full personal information protection service, i.e., KRW 7,502 (USD 6.82) per month.

From these results, in addition to the economic value of the personal information protection service for each attribute, we can also analyze the potential market size of the information protection service in Korea. For example, if the 20 million Koreans who were victims of the abovementioned personal information leakage from the three credit card companies become customers of the protection service, the potential market size could be about KRW 150 billion (USD 136 million) per month (20 million people × KRW 7,502) or KRW 1.8 trillion (USD 1.6 billion) per year (Choe, 2014). One assumption of the survey was that the personal information protection service was 100% reliable and safe. However,

when consumers in the surveys estimated the reliability of such a protection service, the reliability was only estimated to be between 50.9% and 55.4%, as shown in Table 6.

Table 6 Consumers' Reliability on

Each Attributes of the Protection Service for Personal Information

Attributes	Reliability
Protection Service for Personal Indigenous Information	52.8%
Protection Service for Communication Information	50.9%
Protection Service for Required Financial Information to Pay by Credit Card	55.4%
Protection Service for Consumer Credit and Other Financial Information	55.0%

According to Statistics Korea, there were approximately 33 million people in Korea aged in their twenties to sixties in 2010 (Kosis, 2010). All of these people possess personal indigenous information. In addition, about 88.7% of Koreans have credit cards, which according to the Bank of Korea is the highest rate in the world, and 100% of Koreans use cell phones because according to IT Statistics of Korea the cell phone penetration rate exceeds 100% (ITSTAT, 2014; Kim & Lee, 2015). If we use these figures, the maximum potential market size is about KRW 124 billion (USD 113 million), as shown in Table 7. On the other hand, according to the Bank of Korea, 34.2% of Koreans actually use credit cards to make payments, and 43.4% use Internet banking and payments via personal computers (Kim & Lee, 2015). Therefore, if we conservatively estimate the potential market size by applying these figures, the potential market size is about KRW 76 billion (USD 69 million).

Table 7 Estimation of Potential market Size of the Protection Service of Personal Information

Attributes	Conservative Estimation of Potential Market Size	Maximum Estimation of Potential Market Size
Protection Service of Personal Indigenous Information	KRW 31 billion (1767.54×52.8%×100%×33m)	KRW 31 billion (1767.54×52.8%×100%×33m)
Protection Service of Communication Information	KRW 13 billion (1062.55×50.9%×70.4%×33m)	KRW 18 billion (1062.55×50.9%×100%×33m)
Protection Service of Required Financial Information to Pay by Credit Card	KRW 14 billion (2292.55×55.4%×34.2%×33m)	KRW 37 billion (2292.55×55.4%×88.7%×33m)
Protection Service of Consumer Credit and Other Financial Information	KRW 19 billion (2379.05×55.0%×43.4%×33m)	KRW 38 billion (2379.05×55.0%×88.7%×33m)
Total	KRW 76 billion (USD 69 million)	KRW 124 billion (USD 113 million)

MWTP (KRW) per Month×reliability×penetration rate×target population

6. Policy Implications and Conclusion

This paper analyzes the potential economic value of personal information by estimating the MWTP of consumers for a personal information protection service using conjoint analysis. We estimate that the MWTP for the protection service in Korea is about KRW 7,502 (USD 6.82) per month. In addition, we suggest that the maximum potential market size based on the reliability of the service by consumers in the market is about KRW 124 billion (USD 113 million).

Therefore, this research provides some important policy implications for government and firms. For governments, first, this paper provides a guide for developing the standard of countermeasures for personal information leakage. Until now, the standard of deciding the compensation or penalty for personal information leakage were not arranged and were decided case by case with different criterion. Also since, the penalty of personal information leakage in Korea is very low compared to the perceived economic value of consumers, standard of deciding penalty should also be improved. With the calculated economic value of personal information and the method used in this paper, government can roughly develop the standard of compensation or penalties. Second, this paper supports the need of

legal system or policies that can assure individuals' rights of personal information by suggesting the amount of economic value of personal information perceived by consumers. Especially, government should guide the firms to manage and protect the information, since firms collect, store, and commercialize large amount of consumers' personal information. Third, since the MWTPs for each attributes of personal information protection service differ, government should apply discriminative regulations or laws to firms by the categories of personal information the firm collects.

Fourth to Sixth implication refers to both governments and firms. Fourth, as we provide price information for a personal information protection service through the MWTP of consumers and range of market size estimation, any protection service providers could utilize this price information and the potential market size in designing their services and in investment planning for such services. Fifth, our study would be helpful in designing a personal information protection scheme such as the priority in protecting personal information among the various taxonomies of personal information, because we ascertain the relative importance of personal information as perceived by customers. For example, since the consumers value consumer credit and other financial information, firms or government should invest more on providing protection service of consumer credit and other financial information of consumers. Sixth, although people are willing to pay certain price if they can protect their personal information, they trust the service only about 50%. Therefore, protection service that consumers can trust should be developed.

However, this analysis also has several limitations. One limitation is that we use a survey to estimate economic value. As the survey includes estimation errors, the economic value we suggest may also contain errors. Second, we conducted our analysis only in Korea, and the utility rankings or MWTPs of attributes may differ by country. Therefore, as future research, it would be worthwhile studying the economic value of personal information for consumers in other countries.

Appendix: Survey Question Sample

Comparison	Alternative A	Alternative B	Alternative C
Protection Service for Personal Indigenous Information	Current level	Blocks illegal use of name and prevent additional leakages of personal indigenous information	Neither alternative A nor B
Protection Service for Communication Information	Blocks illegal spam, and phishing and prevent additional leakages of communication information	Blocks illegal spam, and phishing and prevent additional leakages of communication information	
Protection Service for Required Financial Information To Pay by Credit Card	Current level	Prevents financial damage that can occur by stealing the information that is required for payment. Also prevents additional leakages of required financial information to pay by credit card	
Protection Service for Consumer Credit and Other Financial Information	Current level	Current level	
Amount of Willingness To Pay for Protection Service for Personal Information	KRW 2,000	KRW 4,000	

(monthly)			
	□ Choose Alternative A	□ Choose Alternative B	□ Neither A nor B

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