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The Economic Value of Location Data: Conditions for Big Data Secondary Markets

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1. Background and purpose of the analysis

In recent years, thanks to the rapid advancement of ICT accompanied by innovative software development, the use of a new class of huge data sets has become increasingly popular, especially in developed nations. These data sets, which are characterized by their inherent difficulty in handling with on-hand database management tools or with traditional data processing applications because of their sheer size, complexity, diversity, and/or magnitude of the real-time flow of information, are called “big data.”

The term “big data” is sometimes still treated as an IT buzzword, and not many people understand its meaning; however, it has come to attract serious attention from managers in IT sectors as well as from people in non-IT related industries. It has even attracted the interest of policymakers in various fields. For example, it is widely known that many online retailers, such as Amazon and Rakuten, have increased their efforts in “big data” mining in order to customize their ad messages to match the needs of individual customers, and even traditional “off-line” supermarkets and convenience stores have started to use big data to reallocate shelf space to increase sales. In addition, some game developers now utilize players’ location data as an integral part of their applications. Pharmaceutical firms have begun to produce innovative drugs that match the genetic type of each patient, and hospitals and nursing homes are streamlining their operations by using medical/biological big data. Moreover, big data is expected to contribute significantly to overall production and national welfare. For example, the Ministry of Internal Affairs and Communications (MIC) indicated that the growth of the in-house usage of big data has a significant positive correlation with the labor productivity improvement within each firm surveyed and that related investment and the creation of new businesses and job opportunities further improve overall economic efficiency (MIC 2013). Similar analyses are found in Manyila et al. (2011) and SAS (2012).

However, the majority of use cases—as well as the MIC’s analysis—are based on in-house usage of big data; that is, the firm that creates, collects, and/or accumulates the big data is the sole user of the data set. This is partly due to the lack of a secondary market in which data-generating firms can sell/share their data sets to/with third parties for a fee. In order to realize its full potential to the overall economy, big data should be utilized not only by data-generating firms but also by “user firms,” which cannot generate such data sets by themselves but have opportunities to utilize them, or even by consumers themselves. The authors believe that given the number of potential “user firms” and their purchasing power, policymakers should establish big data secondary B2B markets that can make

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significant economic contributions. It should also be pointed out that providing the opportunity to make profits in secondary markets will incentivize data-generating firms to be more aggressive in related investments, leading to greater contributions to the overall economy.

Based on the above consideration, the purpose of this paper is to empirically estimate the size of big data secondary markets in Japan and determine the parameters that influence them by focusing on the GPS location data collected via smartphone applications. In the estimation, using a questionnaire survey that targets firms with a high possibility of utilizing such secondary markets, the authors apply the conjoint method to estimate the willingness-to-pay for location data. In the estimation, applying a random-utility-theory (RUT) framework on firms' procurement decision making, the authors employ a random parameters logit model (RPLM) for parameter estimation.

From the theoretical viewpoint, this paper attempts to construct a model of firms' procurement decisions under uncertainty following the RUT methodology. The authors believe this new approach will lead to rich possibilities for RPLM applications in empirical studies.

2. Analysis framework

In this paper, we conducted a conjoint analysis using a questionnaire to the mobile industry firms. A questionnaire was conducted on a sample of 84 (21 firms, 4 conjoint questionnaire to each firms) in December 2013.

In the conjoint analysis, we selected GPS data as a big data, and set some options as attributes in conjoint analysis. The data scenario is presented in Table 1, and the attributes is presented in Table 2.

Table 1 Data scenario

Factor	Outline
data	A year's one millions of GPS data without unobservable ID
Frequency	Every 5 minutes
Area	Throughout Japan
Options	Sex information, Age information, The size of mesh unit

Table 2 Attributes and levels

Attributes	Levels			
Sex	Yes=1	No=0		
Age	Yes=1	No=0		
Mesh unit	100m ²	500m ²	3km ²	5km ²
Price	1,000,000 yen	2,000,000 yen	4,000,000 yen	8,000,000 yen

In the analysis, we identified the probability function where firm i chooses alternative k and the supplier utility function as in Expressions 1 (probability function), respectively where x represents an attribute vector for the chosen alternatives, g represents a distribution function of parameter β , and θ is

its parameter. And, we conducted an estimation using the random parameter logit model and conditional logit model as a referential analysis. We regarded the WTA calculated based on the estimation results.

$$P_{ik} = \int \frac{\exp(\beta_i' X)}{\sum_j \exp(\beta_j' X)} g(\beta|\theta) d\beta \quad (\text{Expressions 1})$$

3. Estimation results (tentative)

The estimation results are shown in Table 3. And, the WTA for each variable was determined based on the price coefficient shown in Table 4.

Table 3 Estimation results

Random Parameter Logit Model			
Variable	Coefficient	Standard Error	p-value
Sex	0.970	0.519	0.061
Age	1.175	0.673	0.081
Mesh unit	-0.079	0.083	0.342
Price	-0.007	0.001	0.000

(reference)Conditional Logit Model			
Variable	Coefficient	Standard Error	p-value
Sex	0.951	0.498	0.056
Age	0.964	0.511	0.059
Mesh unit	-0.034	0.019	0.078
Price	-0.007	0.001	0.000

Table 4 WTA for each variable

Variable	WTA (Yen)
Sex	¥1,365,954
Age	¥1,654,005
Mesh unit	(Insignificant)

This analysis revealed as follows;

- For the GPS data, information about sex and age is significant factor to the valuable data set.
- About mesh unit as the factor of GPS data, we warrant further discussion.
- Based on the scenario of this paper, GPS data with sex and age information as a big data is worth about 6,000,000 yen.

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