Factors and Models for Promoting Consumer Use of Electronic Money

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Abstract

Since electronic money (e-money) brings many benefits to consumers, public transportation companies, retailers, and e-money issuers, greater penetration of e-money into everyday life is desirable. The objective of this research is to provide suggestions for promoting the wide use of e-money. As a first step to achieving this objective, a questionnaire on awareness, frequency, and local environments of e-money use was administered to consumers residing in the Tokyo metropolitan area in Japan. By conducting an exploratory factor analysis on the data obtained, seven factors were extracted. Through a confirmatory factor analysis using structural equation modeling with the 7 factors and 14 observed variables, 2 models were constructed: a use model of transport-type e-money and one of retailer-type e-money. The analysis of these two models showed that the factors “transport convenience,” and “non-necessity” significantly affect the use of transport-type e-money, and the factors “shopping convenience” and “non-necessity” significantly affect the use of retailer-type e-money. The findings suggest that improving consumer perception of these factors is the most important for promoting increased use. Schemes for accelerating consumer use of e-money are provided for public transportation companies, retailers, and e-money issuers.

Key words: electronic money, structural equation modeling, consumer survey, diffusion

1. Introduction

Electronic money (e-money) has spread remarkably worldwide, especially in areas of Asia, such as in Singapore and Hong Kong [1]. E-money is primarily used for transportation fare and retail shopping. The e-money infrastructure has provided numerous benefits as described later in detail [2, 3].

E-money users electronically deposit monetary value to a smart card or a smartphone in exchange for cash. They then pay for economic activities, such as transportation fare and shopping goods, with e-money [4]. The Bank of Japan [5] defined e-money as a stored-value, or prepaid electronic payment instrument, that requires users to “load” a certain value before use. In this paper, e-money is defined simply as an instrument used to pay a small amount of money by repeatedly digitizing a monetary value.

E-money is classified into two types: transport-type and retailer-type. The transport-type e-money is used mainly for public transportation, such as trains, subways, buses, and taxis. It is also used for shopping at stores [6]. The retailer-type (or shopping-type) e-money is used primarily for shopping at stores. However, this type cannot be used for paying transportation fare.

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E-money provides consumers, public transportation companies, retailers, and e-money issuers with the following benefits:

(1) Consumers can get on and off public transportation without purchasing tickets. When they arrive at their destinations, the fare is paid with e-money at an automatic ticket gate. Furthermore, consumers do not need to use cumbersome coins for payment. When shopping with e-money, they can earn points.

(2) The benefit for public transportation companies is 1/3 reduced maintenance costs of automatic ticket gates when compared to magnetic-type automatic ticket gates [6].

(3) Retailers can expect an increase in the number of customers due to reduced congestion and waiting times at cash registers, as well as reduced costs of maintaining and replacing cash registers, reduced handling costs of small change, and reduced risk of cash theft, and more.

(4) E-money issuers can earn fees from retailers in accordance with the sale amount paid with e-money.

There are some problems with the use of e-money, related to security, consumer protection, and privacy protection. Schemes must be devised to prevent counterfeiting activities, compensate for losses related to e-money, and protect personal information and personal

purchasing history data. Misra et al.[7] argued strengthening regulations regarding the use of e-money.

2. Previous Research

2.1 E-money experiments in Europe and the USA

In Europe and the USA, e-money experiments, such as Mondex and Visa Cash, were carried out in the late 1990s. In spite of the benefits of e-money (e.g., convenience of payment for consumers and cost reduction for retailers), it was difficult for both consumers and retailers to accept e-money. As a result, it was not extensively utilized [8-11]. Sahut [12] analyzed factors regarding the influence of the electronic purse system “Moneo” in France using a technology acceptance model; findings indicated that key factors for success were security, anonymity of transactions, cost of transactions, and compound functions.

2.2 E-money use in Asia and factors for the spread of e-money

On the other hand, the use of e-money has spread in Asia. Chau [13] analyzed the success factors of the Octopus Card in Hong Kong. Lin & Nguyen [14] analyzed how related factors influenced the adoption of e-payment options in Vietnam and Taiwan. Using the technology acceptance model, they proposed a conceptual model based on four factors: perceived ease of use, perceived usefulness, perceived risk, and information. The survey sample consisted of 676 users of Vietnamese and Taiwanese banking services. The results confirmed the effects of the four factors on customer choice regarding e-payment use.

Takao et al. [1] analyzed the factors for promoting the diffusion of e-money in Japan by focusing on inter-firm networks. As a result, they identified that collective actions of a hub leader firm enabled rapid dissemination. Ishii et al. [15] analyzed consumer views about IC (Integrated Circuit) cards with a questionnaire focused on the use of the cards for purchases. Results were utilized to construct a more effective and useful IC card system. Watabe & Iwasaki [16] used a questionnaire to survey consumer awareness of e-money and its intended use in two regions. Subsequently, they developed a use intention model using structural equation modeling (SEM). They identified transportation convenience and shopping convenience as factors associated with the spread of e-money. Further, the lack of opportunities for use and anxiety over use were factors inhibiting widespread dissemination.

Few research findings quantitatively show the relationship between consumer awareness of e-money and its use. One purpose of our research was to identify a set of factors, including consumer awareness of e-money, and transportation and shopping environments. We developed models showing the cause-and-effect relationships of these factors by quantitative modeling, and then applied the models to promoting the use of e-money.

3. Research Purposes and Research Procedure

The diffusion rates of transport-type e-money and retailer-type e-money are around 50% and 44%, respectively, in the Tokyo metropolitan area [17]. According to Rogers’ adopter categorization on the basis of innovativeness [18], the diffusion rate of transport-type e-money is in the boundary of the “early majority” and “late majority” stages, while retailer-type is still in the “early majority” stage. This means that there are many potential margins for promoting the use of e-money, even in the Tokyo metropolitan area, which is considered the most advanced area in Japan.

To increase use of e-money, we focus on consumer intentions and frequency of use. Our research purposes are as follows:
1. To determine the factors affecting the use of e-money.
2. To determine the cause-and-effect relationships among the factors and the use of e-money.
3. To suggest schemes for promoting consumer use of e-money to public transportation companies, retailers, and e-money issuers.

Our research procedure is as follows:
1. We develop a survey questionnaire on consumer awareness, intention, frequency of e-money usage, and current opportunities in the situations of transportation networks and shops in order to introduce e-money in corresponding regions.
2. We extract factors of consumer awareness of e-money from survey data through an exploratory factor analysis.
3. We develop two models that show the relationship between e-money use and the factors extracted in step 2 using SEM. We call these two models the “use model of transport-type e-money” and the “use model of retailer-type e-money.”
4. By analyzing these models, we suggest e-money-use schemes to improve consumer use of e-money for public transportation companies, retailers, and e-money issuers.

4. Questionnaire Survey

To accomplish our research aims described in the previous section, we developed a questionnaire for consumers residing in the Tokyo metropolitan area, one of the areas e-money is actively used in the world.

Subjects were selected to ensure equitable participation by gender and age (i.e., 20-29, 30-39, 40-49, 50-59, 60 or older). Through a research company, the questionnaire was distributed to a part of their consumer panels via e-mail. Respondents answered by accessing the research company’s website. The survey was conducted in May 2013. 8,574 consumers were sent questionnaires by mail.
and 1,470 (17.1%) sent us effective answers. Table 1 shows the summary of survey results.

In accordance with the previous research mentioned in Section 2, Watabe & Iwasaki [17] and their last three consumer surveys since 2008, the authors asked consumers about e-money and related matters. We classified 18 observed variables into four categories in the following list. The actual statements made are shown in Table 2.

1. Statements about the use of e-money for public transportation:
   - The perceived extent of railway development or bus networks in a respondent’s residential area
   - The perceived convenience of e-money when using public transportation

2. Statements about the use of e-money for shopping:
   - The perceived extent of supermarket or convenience store development in a respondent’s residential area
   - The perceived convenience of e-money while shopping

3. Statements about anxiety over the use of e-money:
   - Causes of anxiety regarding the use of e-money

4. Information sources:
   - Consumer information sources, such as TV, radio, and the Internet

Table 1 Summary of survey results

| Valid Answers | 1,470 |
|---------------|-------|
| Respondents’ Gender |       |
| Male | 736 | 50.1% |
| Female | 734 | 49.9% |
| Respondents’ Age Category |       |
| 20-29 | 294 | 20.0% |
| 30-39 | 294 | 20.0% |
| 40-49 | 300 | 20.4% |
| 50-59 | 303 | 20.6% |
| 60 or older | 279 | 19.0% |
| E-money User/Non-user |       |
| User | 1,053 | 71.6% |
| Non-user | 417 | 28.4% |
| Type of E-money Used |       |
| Transport-type | 858 | 58.4% |
| Retailer-type | 596 | 40.5% |
| E-money Used |       |
| Suica | 690 | 46.9% |
| PASMO | 320 | 21.8% |
| Edy | 411 | 28.0% |
| nanaco | 409 | 27.8% |
| WAON | 352 | 23.9% |
| iD | 210 | 14.3% |
| QUICPay | 167 | 11.4% |

Most of the observed variables were measured on a 5-point scale (5: “I think so” to 1: “I do not think so”). A statement about the frequency of e-money use was measured with a 6-point scale (5: “I use e-money more than four times a week” to 0: “I do not use e-money at all”). The consumers’ intentions for use were also measured by a 6-point scale (5: “I’d like to use e-money more than four times a week” to 0: “I do not want to use e-money at all”).

5. Extraction and Selection of Factors

5.1 Exploratory factor analysis

To extract further information on factors associated with consumer awareness of e-money, shopping and information sources, an exploratory factor analysis was conducted. Results are shown in Table 2. Seven factors (from A to G) were extracted from the 18 observed variables. As shown in Table 2, all Cronbach’s alpha values were more than 0.8, indicating good internal consistency of the observed variables.

Table 2 Results of exploratory factor analysis

| Factors / Statements | A | B | C | D | E | F | G |
|----------------------|---|---|---|---|---|---|---|
| Local private railway development | .941 |     |     |     |     |     |     |
| Local public railway development | .881 | .941 |     |     |     |     |     |
| Local bus network development | .740 | .887 | .740 |     |     |     |     |
| Local franchise store development | .780 | .930 | .740 | .780 |     |     |     |
| Local convenience store development | .780 | .930 | .740 | .780 | .780 |     |     |
| Local service development | .881 | .930 | .740 | .780 | .780 | .780 |     |
| Local information gathering | .740 | .930 | .740 | .780 | .780 | .780 | .780 |

Notes: 1) Principal Factor Method and Promax Rotation were used. 2) Factor loading values under 0.1 are omitted to display.
We named the seven factors according to the respective relationships between each factor and the factor loading values of the corresponding observed variables. For example, the first factor was named “local transport network development,” because the factor loading values on the statements about railway and bus network development are high. The third factor was named “uneasiness” because it is closely related with worries about a leak of personal information, and loss or damage to the e-money IC card. The extracted and named factors are:

A. Local transport network development
B. Transport convenience
C. Uneasiness
D. Shopping convenience
E. Non-necessity
F. Local store network development
G. Information gathering

5.2 Selecting factors related to e-money use

From the factors extracted from the exploratory factor analysis, we selected factors related to the frequency of and intention for e-money use. Correlations of factors and responses about the use of transport-type and retailer-type e-money are shown in Table 3. All seven factors show significant correlations with the use frequencies and use intentions of transport-type e-money or retailer-type e-money in at least two out of four items. The findings suggest that all seven factors are effective for modeling.

Table 3  Correlations between the seven factors and e-money use

| Objective variables / Factors | 1. Use Frequency of Transport-type e-money | 2. Use Intention of Transport-type e-money | 3. Use Frequency of Retailer-type e-money | 4. Use Intention of Retailer-type e-money |
|------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| A. Local transport network development | .428** | .396** | .064* | .054* |
| B. Transport convenience | .325** | .364** | .110** | .173** |
| C. Uneasiness | -.193** | -.153** | -.046 | -.032 |
| D. Shopping convenience | .056* | .117** | .195** | .245** |
| E. Non-necessity | -.521** | -.499** | -.288** | -.293** |
| F. Local store network development | .201** | .223** | .092** | .113** |
| G. Information gathering | .101** | .113** | .049 | .075** |

Notes: 1) **: Significant at the 1%, *: significant at the 5%. 2) Pearson’s product-moment correlation coefficient is used.

6. Confirmatory Factor Analysis

We selected the observed variables related to the seven factors using a confirmatory factor analysis based on the exploratory factor analysis.

As a result, the model fitness measures such as GFI and CFI were the highest, and RMSEA was the lowest in the case using the 14 observed variables out of the 18 observed variables shown in rectangles in Figure 1. We used AMOS (Ver. 20) for SEM.

The Cronbach’s alpha values of the observed variables for each factor were between 0.81 and 0.90. Therefore, we adopted these 14 observed variables.

![Figure 1 Result of the confirmatory factor analysis](image)

Note: 1) Observed variables are shown in rectangles. Latent variables are shown in ovals. e1-e14 are error terms. 2) Curved lines with a two directional arrow show factor covariances.

7. Common Hypotheses and the Structure of E-money Use Models

The e-money use models are of two types: the transport-type and the retailer-type. Initially, based on the references [1,12-15], our observations, and experience with e-money, we developed nine common hypotheses about the seven factors and examined the relationship between the use of e-money and the structure of the two models (Figure 2).

(1) In the information age, consumer attitudes toward information gathering using mass media and the Internet will affect consumer awareness of the environment and convenience of using e-money. Thus, the factor “information gathering” will affect other factors: “local transport network development,” “transport convenience,” “local store network development,” and “shopping convenience.”

(2) In the areas where public transportation networks such as trains and buses are developed, consumers will experience many opportunities to see and learn how e-money is used: passing through train ticket gates, riding buses, and taking taxis. The consumers may use e-money.
themselves and recognize its convenience (especially transport-type). Therefore, “local transport network development” will increase consumer awareness of “transport convenience,” and may directly affect the “use of transport-type e-money.”

(3) The more consumers understand the convenience of transport-type e-money for public transportation use, the more they use transport-type e-money. Therefore, the factor “transport convenience” will affect the “use of transport-type e-money.”

(4) If the network of local stores is developed, consumers will have many opportunities to use e-money for shopping. If they perceive “shopping convenience” more favorably, they will use the retailer-type e-money more often. Thus, “local store network development” may influence “shopping convenience” and “use of retailer-type e-money.”

(5) If consumers understand that retailer-type e-money is convenient for shopping, they use the retailer-type e-money more often. Thus, the factor “shopping convenience” will affect the use of retailer-type e-money.

(6) Because transport-type e-money, which is more popular than retailer-type e-money as shown in Table 1, is also used for shopping, consumer awareness of the environment and convenience of use may influence one another. Therefore, “local store network development” and “local transport network development” may influence one another. Further, “shopping convenience” and “transport convenience” may influence one another.

(7) If consumers feel uneasy about using e-money, they may view e-money as not necessary. The factor “uneasiness” will then affect the “non-necessity” factor.

(8) If consumers perceive the local environment of using e-money positively and e-money as useful, they may think e-money is necessary. This leads to the notion that “local transport (shopping) network development” and “transport (shopping) convenience” will negatively affect “non-necessity.”

(9) If consumers view e-money as not necessary, they will not use e-money. Thus, the factor “non-necessity” will negatively affect the “use of transport-type e-money” and the “use of retailer-type e-money.”

8. Use Model of Transport-type E-money and Suggestions for Promoting Its Use

To consider the extracted factors shown in the previous section and Figure 2, we developed a use model of transport-type e-money as shown in Figure 3. The objective variables include two observed variables: consumer use frequency of transport-type e-money and consumer intention for use of transport-type e-money. The GFI and CFI values are more than 0.9 and RMSEA is less than 0.05, indicating a good model fit.
directly and strongly (.31**) and indirectly through “transport convenience” (.17**, .18**).

(3) An increase in the perceived value of “transport convenience” leads to greater “use of transport-type e-money” (.18**).

(4) The factor “non-necessity” is increased by “uneasiness” (.29**). The factor is decreased by “local transport network development” (-.26**), “transport convenience” (-.25**), and “shopping convenience” (-.10**). The factor considerably diminishes the “use of transport-type e-money” (-.43**).

(5) The “local store network development” significantly influences “local transport network development” (.57**), and “shopping convenience” influences “transport convenience” (.28**).

8.2 For promoting the use of transport-type e-money

Based on Section 8.1, we consider schemes for promoting the use of transport-type e-money.

Public transportation companies, including railway, bus, and taxi companies, should enhance consumer perception of “local transport network development” so that consumers understand the public transportation networks, including the local bus networks. Further, they should improve “transport convenience” by introducing automatic ticket gates so that passengers can use transport-type e-money. Passengers can then get on and off public transportation and settle the fare automatically and instantly at the gate.

The issuers of transport-type e-money should petition public transportation companies to accept e-money for their services. Furthermore, the e-money issuers can improve the convenience of transport-type e-money by collaborating with many public transportation companies to ensure that passengers are able to settle their fares with other public transportation companies at once using e-money.

Since we found that “local transport network development” is influenced by “local store network development,” public transportation companies and e-money issuers should ensure that stores in or near railway stations accept transport-type e-money and augment shopping opportunities for customers with transport-type e-money.

Furthermore, companies should work to mitigate customers’ feelings of uneasiness and the non-necessity of e-money. They must convince consumers that e-money is useful for paying small amounts of money, and that there are useful services involved in e-money, including automatic charge service, shopping points, and compensation for loss.

They also ought to provide information about transport-type e-money through mass media and the Internet to promote consumer perception of “transport convenience” and “local store network development.”

As transport-type e-money is also used for shopping, the schemes to be mentioned in Section 9.2 are also important for public transportation companies and e-money issuers since “shopping convenience” influences “transport convenience.”

9. Use Model of Retailer-type E-money and Suggestions for Increasing Its Use

9.1 Use model of retailer-type e-money

Using the hypotheses shown in Section 7 and Figure 2, we developed a use model for retailer-type e-money as shown in Figure 4. As retailer-type e-money is primarily used for shopping, the factors concerning transportation (Factors A and B) are omitted. Consequently, the model becomes simpler than shown in Figure 3. The objective variable consists of two observed variables: consumer use frequency and use intention of retailer-type e-money. The measurements of this model (GFI, CFI, RMSEA) show a good fit, too.

Figure 4 Use model of retailer-type e-money

(n=1,470, GFI = .980, CFI = .980, RMSEA = .044)

Notes: The same as the notes of Figure 3.

In Figure 4, we find the following effects:

(1) The perceived extent of “information gathering” increases the factors of “local store network development” (.13**) and “shopping convenience” (.07)*.

(2) The perceived extent of “local store network development” increases “shopping convenience” (.16**).

(3) An increase in the perceived value of “shopping convenience” leads to greater “use of retailer-type e-money” (.20**).

(4) The “non-necessity” factor is considerably increased by “uneasiness” (.34**). The factor is decreased by “shopping convenience” (-.21**). The factor considerably diminishes the “use of retailer-type e-money” (-.32**).
9.2 For promoting the use of retailer-type e-money

Based on section 9.1, we consider schemes for promoting the use of retailer-type e-money.

To make consumers recognize “shopping convenience,” e-money issuers must work to increase the number of stores that accept retailer-type e-money; that leads to improved “local store network development.” Then, information on which stores accept e-money should be disseminated to consumers through mass media and the Internet, leading to improved “information gathering.”

Further, e-money-related companies should improve “shopping convenience” by making it nearly unnecessary to bring cash or small change for retail shopping. Expanding consumer understanding of the benefits of retailer-type e-money should moderate the impression that e-money is not needed in their daily lives. The benefits include earning shopping points, and experiencing rapid checkout and paperless transactions at stores.

Consumer uneasiness about using e-money for shopping relates to compensation for loss or damage, and the protection system against personal information leaks. E-money issuers must address and avoid these problems.

10. Conclusions, Limitations, and Future Work

E-money has many benefits for consumers, public transportation companies, retailers, and e-money issuers. To identify factors related to promoting e-money use, we administered a questionnaire and analyzed the results by constructing use models of transport-type and retailer-type e-money using SEM.

We found that the factor “transport convenience” directly influences the use of transport-type e-money. For similar improvements associated with retailer-type e-money, we found shopping convenience to be important. For promoting e-money use, public transportation companies, retailers, and e-money issuers must improve these two factors.

We also found that the “uneasiness” and “non-necessity” factors reduce e-money use considerably. To reduce consumer perception of “uneasiness” and “non-necessity,” the e-money-related companies mentioned above must convince consumers with these perceptions that e-money offers many benefits and conveniences.

The constructed models also show that consumer perception of types of infrastructure, such as local transport network development and local store network development, enhances the perception of transport convenience and shopping convenience. The use model of transport-type e-money shows that factors related to shopping affect those related to transportation because transport-type e-money is used for shopping too.

The models also suggest that information gathering by consumers increases the perception of the infrastructure and convenience of e-money.

We expect that the extracted factors and the e-money use models will help public transportation companies, retailers, and e-money issuers draw up effective strategies for promoting the use of e-money.

As shown in Table 2, the correlation between “local transport network development” and “local store network development” is high (.592). By finding other strong relationships between factors and by integrating the use models of Figures 3 and 4, we might be able to find another model with a better fit.

In this research, we focused on consumers residing in the Tokyo metropolitan area in Japan because this area is thought to be one of the largest markets where e-money is used considerably. We found that more than 70% of the respondents use e-money in this area. In further research, we will apply the factors and the structure of the e-money use models to other areas.

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