Full Length Research Paper

Analysis of consumer attitudes towards integrated circuit (IC) cards

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This paper analyzes the attitudes of consumers towards integrated circuit (IC) cards, which has a big influence on the buying behavior of consumers. For this purpose, we created a questionnaire survey of using IC card on purchasing, and we utilized the text mining method. In reviewing past researches, some related researches were used, but the analyses were based on simple accumulation, though there have been a few investigations on this. The purpose of this survey is to examine the attitudes of consumers to the convenience and need of purchasing with IC card. Additionally, this survey seeks to clarify the general opinions of consumers concerning an IC card system. Moreover, this survey strives to learn about consumers' awareness of the IC card system, their expectations for the IC card system, and the information they need. Some interesting and instructive results were obtained. These were utilized for constructing a much more effective and useful IC card system.

Key words: Integrated circuit (IC), consumers, key graph, electronic money, attitudes.

INTRODUCTION

Electronic money usage is widespread at the present time such as integrated circuit (IC) traffic cards on the railroad. Payment by electronic money has become possible in such places as convenience stores, supermarkets, and restaurants as well as railroads.

There are two types of electronic money and they are categorized by payment method. One type is the prepaid type which is centered on JR East's Suica, private railways' PASMO in the Kanto region (metropolitan area) and bitWallet Edy issues, and the other is the post-paid type. There are some electronic money such as iD, QUICPay and Smartplus which are connected to the credit card mainly in the cell phone wallets and private railways' PiTaPa in the Kansai region.

Use of the traffic system and convenience stores was developed mainly in the prepaid type of IC cards such as

Suica and Edy which were easier to issue from 2001. Afterward, 2 major groups of the retailing business newly issued the group cards such as nanaco and WAON in April 2007. They made the enriched card of the point program to become popular in promoting payment inside the convenience store and supermarket. As a result, nanaco of the "Seven & Eye Holdings" sprang to the top, at the number of the purchase payments within only 2 months after being launched in June, 2007. At the same time, as the rapid popularization of the IC card was promoted, the severity of companies contending for new customers increased greatly.

General summary of the prepaid type of electronic money is shown in Table 1. Number of cards issued by the prepaid type of electronic money has already surpassed 120 million at the time of September 2009. It means that each person has more than 1 card in average.

Reviewing past researches including the following (Arcar and Day, 1980; Osawa, 1992; Ueda et al., 1987), there are some related researches made on this. Oshima

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Table 1. General summary of electronic money of prepaid type (Number of card issue at the time of September 2009).

Electronic money	Main promoting company	Starting period	Number of card issue (Million)	Number of settlement (Million)
Edy	Sony etc.	2001	52.00	25.00
Suica	JR East Japan	2004	27.35	28.37
PASMO	KEIO Railway etc	2007	13.42	12.28
WAON	AEON	2007	11.30	25.30
nanaco	Seven & i Holdings	2007	9.0	35.00

Based on data from Nihon Keizai Shinbun-Sha (6/Nov./2009).

(2005) clarified that electronic money is more superior than IC credit for the settlement of small account. Nakashima (2007) made an overview of current Electronic money status in Japan. Oyama et al. (2006) built made of cash currency and applied to Electronic money. Kurokawa A., et al. (2003) analysed the "FeliCa" technology and its application. There are some related papers such as these, there are few papers concerning consumers' analysis for the need of the purchasing with IC card.

We utilize the Key Graph method for the analysis, which is also a relative new method (Osawa et al., 1999; Osawa, 2003) and we can hardly find researches in these fields using this method. This paper analyzes how electronic money was introduced into the market at present under the rapid popularization of using IC cards, which have a big influence on the buying behavior of consumers and how they will become popular in the future. While considering the advantages and disadvantages of the various kinds of electronic money, a true appearance of the development of electronic money using IC cards is discussed.

The purpose of this survey is to examine the attitudes of consumers to the convenience and need of purchasing with IC card. Additionally, this survey seeks to clarify the general opinions of consumers concerning the IC card system. Moreover, this survey strives to learn about consumers' awareness of the IC card system, their expectations for the IC card system, and the information they need.

Questionnaire research

A questionnaire investigation was carried out using IC card on purchasing. The outline of the questionnaire research is as follows:

1. Scope of investigation: Student, a member of society etc., Japan.
2. Period: October to December 2008.
3. Method: Mail and self writing.
4. Collection: Number of distribution is 500, number of collection is 348 (collection rate 69.6%) and number of valid answers is 346.

The major single variable summary results of the questionnaire investigation are shown in Table 2. Analysis methods were as follows and the questionnaire results are analyzed in five methods. Firstly, summary of single variable is executed in order to examine the pattern of responding to each item. Secondly, analysis by Multi-corresponding analysis is executed in order to visualize the relationship among the items. Thirdly, analysis by Factor analysis is executed so as to clarify the viewpoints of important factors. Fourthly, Quantification Method Ⅱ is executed in order to analyze the contribution of each item to the total index. Fifthly, analysis by Key Graph is executed in order to grasp the total structure of the items, which are summarized in Table 3.

ANALYSIS BY SINGLE VARIABLE

Usage condition of electronic money

We show the usage condition of electronic money concerning the following questions in Figure 1.

Q1. What kind of electronic money do you have?
Q2. What kind of electronic money do you use?
Q3. What kind of electronic money do you use the most?

Electronic monies of high holding rate are IC traffic cards such as Suica, PASMO, ICOCA and PiTaPa. Another genre card is Edy.

By analyzing Q3 (What kind of electronic money do you use the most?) for Kansai and Kanto regions, we can obtain Figures 2 and 3. Regional traffic cards occupy more than 70%. In Kansai region, ICOCA and PiTaPa occupy 73% and in Kanto region, Suica and PASMO occupy 88%.
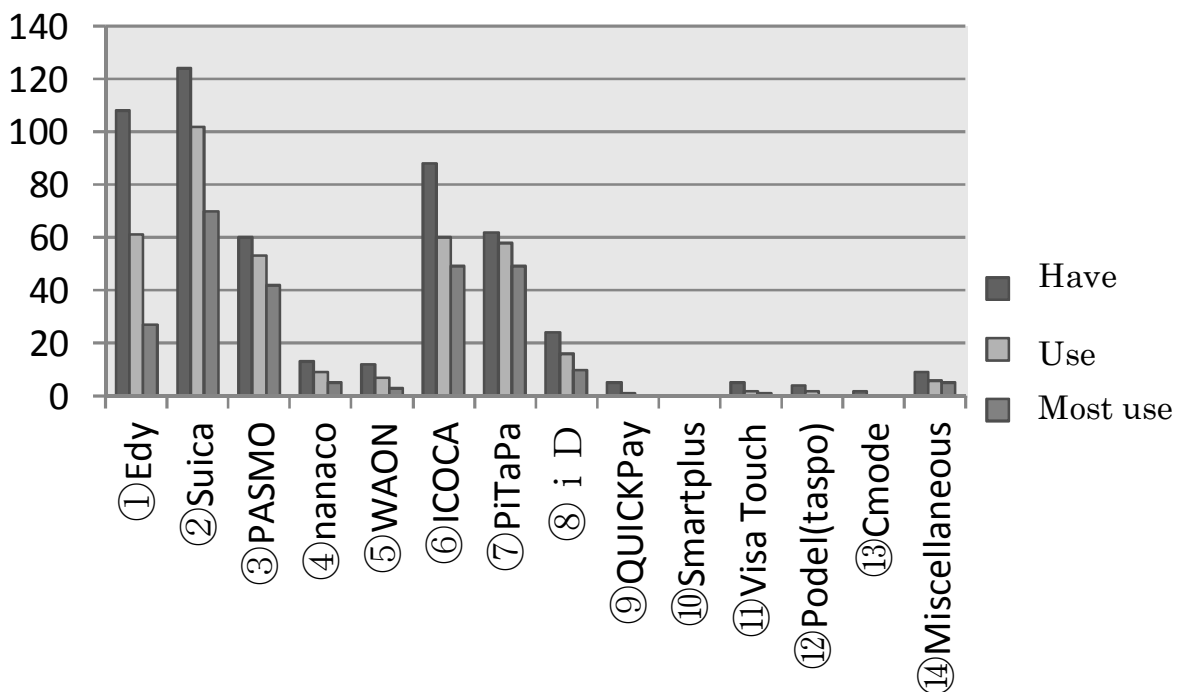
Reason to use electronic money (Q4)

The biggest reason is "▢Able to use as a ticket for a railway and / or bus", then ""▢Able to settle payments without having change", "▢ Able to get additional points"

Table 2. Major single variable summary results.

Question	Answer	Number of answer	Share
Q1. Hold Electronic Money	Hold	265	76.8
	Do not hold	80	23.2
	-20	13	3.8
	-30	137	40.2
Q13. Age	-40	86	25.2
	-50	61	17.9
	-60	42	12.3
	60-	2	0.6
Q14. Sex	Male	255	74.6
	Female	87	25.4
	Kanto Region	118	35.1
Q15. Residence	Kansai Region	194	57.7
	Miscellaneous	24	7.1

Table 3. Analysis method.

Step	Aim of analysis	Used method
1	Examining the pattern of responding to items	Single variable analysis
2	Examine the relationship among questionnaire items about important factors	Multi correspondence analysis : (Positioning)
3	Clarifying the viewpoints and axes for the important factors	Factor analysis : (Extracting)
4	Analyze the contribution of each item to the total index	Quantification method Ⅱ : (Contribution)
5	Visualize the Total structure among questions systematically ⇒ Important factors are extracted	Key graph analysis: (Text mining)

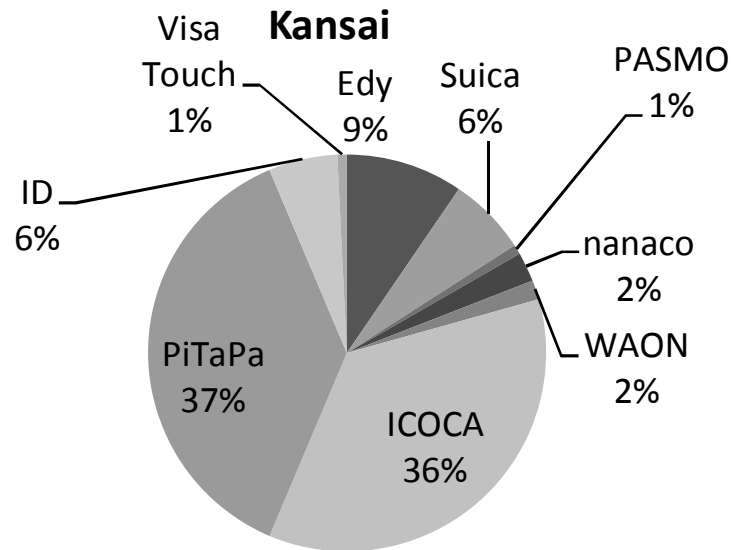**Figure 1.** Usage condition of electronic money (Q1, Q2, Q3).
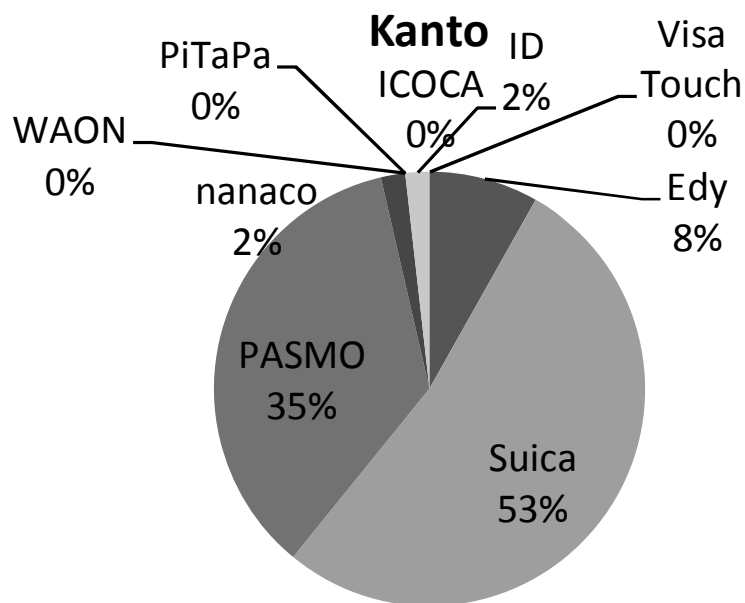
Figure 2. Most used card (Kansai region).

Figure 3. Most used card (Kanto region).

as shown in Figure 4.

shown in Figure 5.

Important points when using electronic money (Q7)

We can observe that ""①Able to use when buying at the shop (usually used)" is the most important point and then "⑪Convenient to settle debts" and "②There are many shops in which electronic money can be used" as

The place electronic money is often used (Q8)

"① Convenience store" is the most often used and then "③Shop in station", "⑪Only railway" and "⑥Vending Machine" as shown in Figure 6.

By analyzing Q8 (Where do you use electronic money
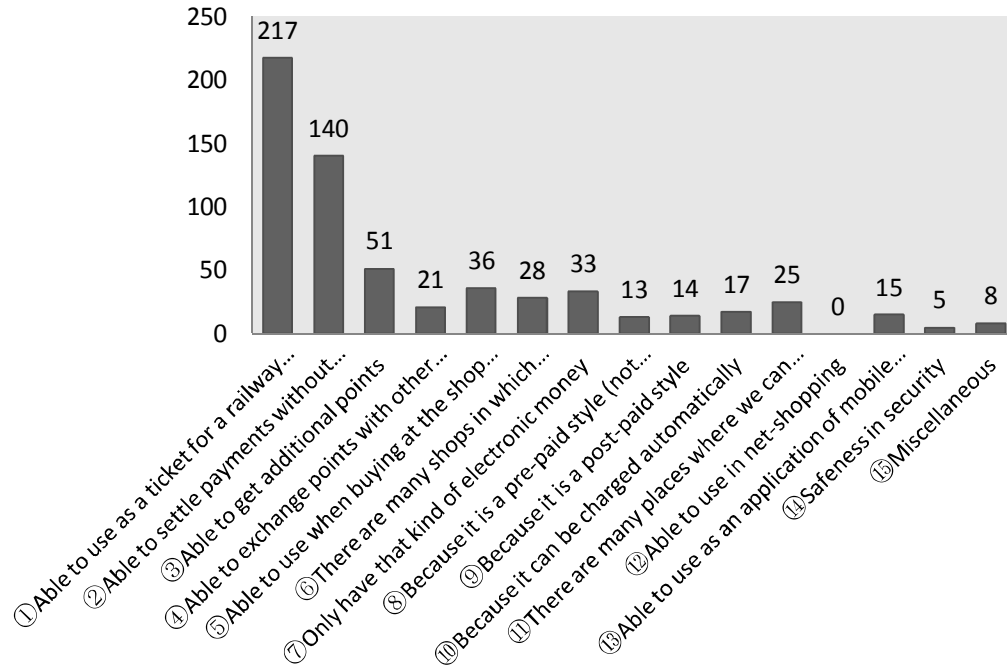
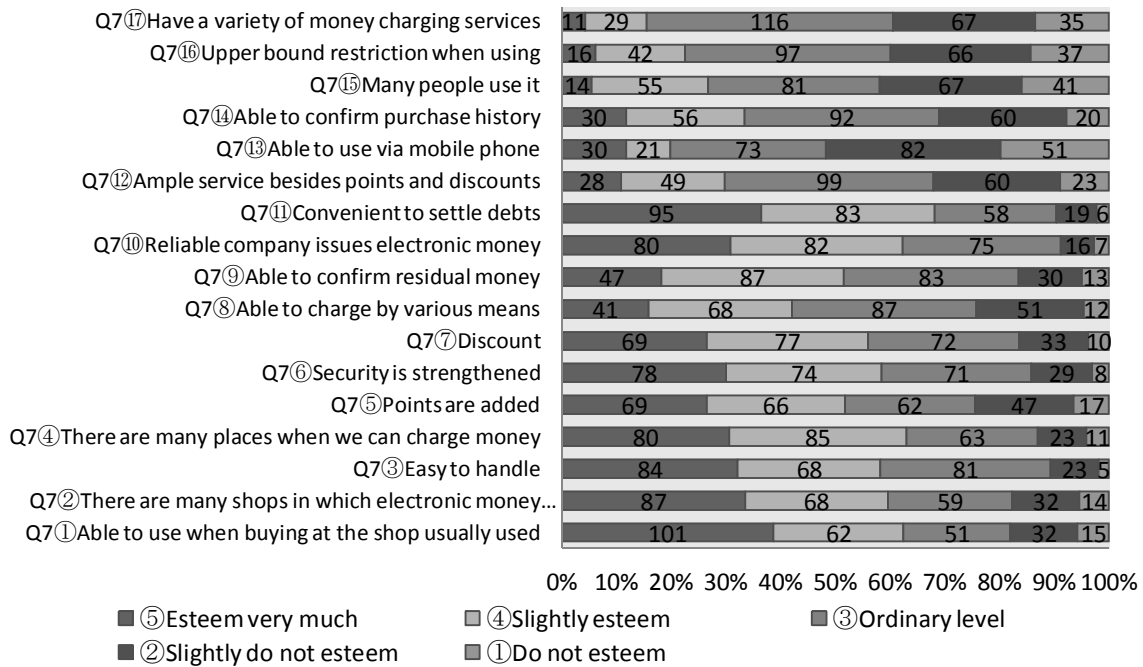**Figure 4.** Reason to use electronic money (Q4).

Figure 5. Important points when using electronic money (Q7).

most often?) for Kansai and Kanto regions, we can obtain Figures 7 and 8. The tendency is the same. Convenience store is the most often used which occupies nearly 1/3, then shopping in station is nearly 20% and Vending Machine is nearly 10% as indicated in the figures.

Average utilization frequency of electronic money (Q9)

From Figure 9, we can observe that nearly 30% of people use electronic money every day and more than half of the
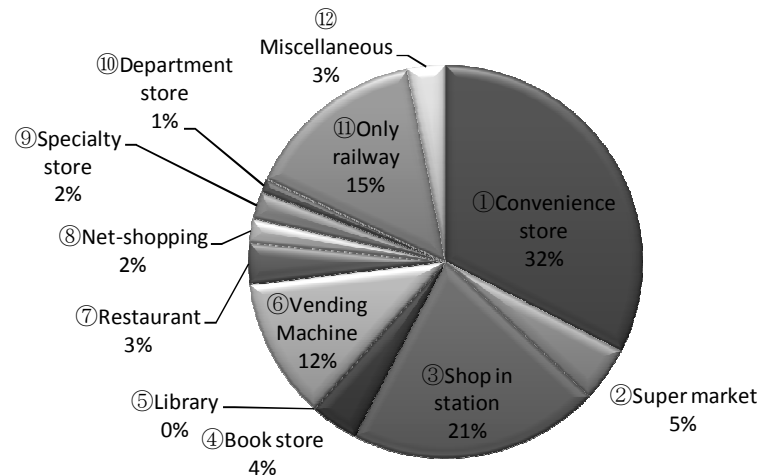
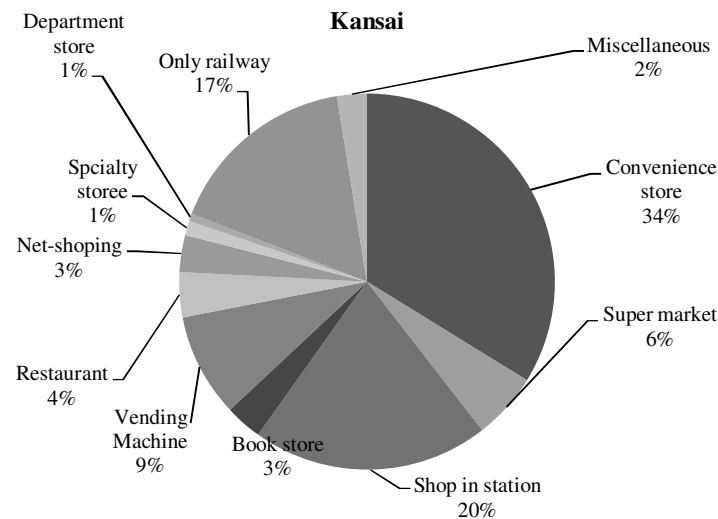**Figure 6.** The place electronic money is often used (Q8).

Figure 7. Often used place (Kansai region).

users use electronic money several times in a week.

By analyzing Q9 (How often do you spend electronic money in a month?) for under 30 years old and others, we obtain Figures 10 and 11. As for heavy users who use electronic money every day, under 30 years old group occupies 32%, while others occupy 23%. Users who use electronic money for more than two times in a week occupy nearly 60% for both groups.

Average usage amount of electronic money per month (Q10)

Those who spend electronic money less than 3000 Japanese Yen for a month take more than half of the share (Figure 12).

By analyzing Q10 (How much electronic money do you spend in a month?) for Kansai and Kansai regions, we can obtain Figures 13 and 14. Usage amount of less than 3000 Yen occupies nearly 60% for both Kansai and Kanto. As for higher usage amount of more than 10,000 Yen, usage percent is 23% in Kanto and 16% in Kansai. This may be so because IC card holder rate is high in Kanto region.

Usage amount is analyzed by clustering of different ages. The case of persons under 30 years of age and another case of persons that are 30 years old and above are shown in Figures 15 and 16. The usage amount of less than 3000 yen occupies nearly 60% for both cases, but as for the high usage amount of more than 20,000 yen, the case of persons under 30 years of age takes nearly 5% and the other case takes nearly 11%, which
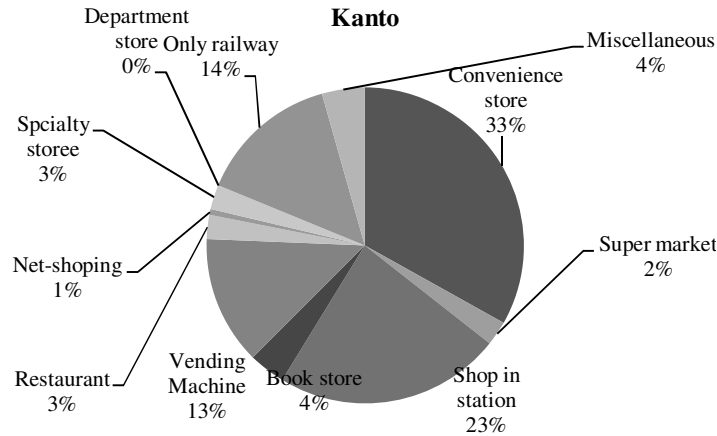
Kanto

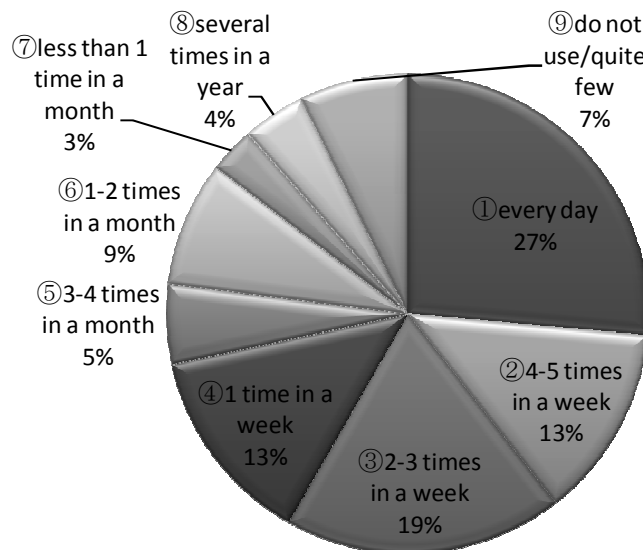**Figure 8.** Often used place (Kanto region).

Figure 9. Average utilization frequency of electronic money (Q9).

suggests that it is influenced by their income.

Reason for not holding electronic money (Q11)

From Figure 17, we can observe that almost 1/4 holders of electronic money think it is troublesome to hold it and almost 1/4 holders of electronic money do not feel merit by using it.

**Expectation to electronic money in the future (Q12)**

From Figure 18, we can observe that "④Increased amount of shops in which electronic money can be used"

is the most expected and then," ①Combine plural electronic money", "②Strengthen security", "③Add additional services such as points, discounts" and "⑤Increased places where users can charge money" follow respectively.
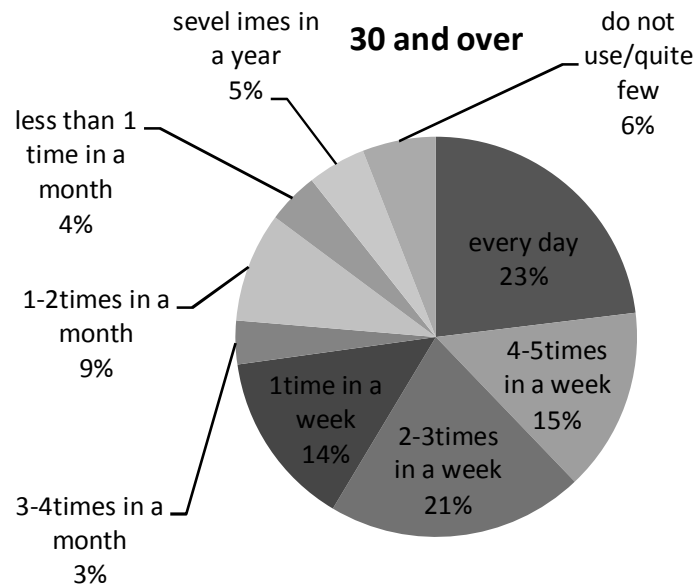
MULTIVARIATE ANALYSIS

Multi correspondence analysis

We carried out multi correspondence analysis based on the selection of answers made concerning Q7 (What is the important point you note when you use electronic money?) and Q12 (What do you expect for electronic
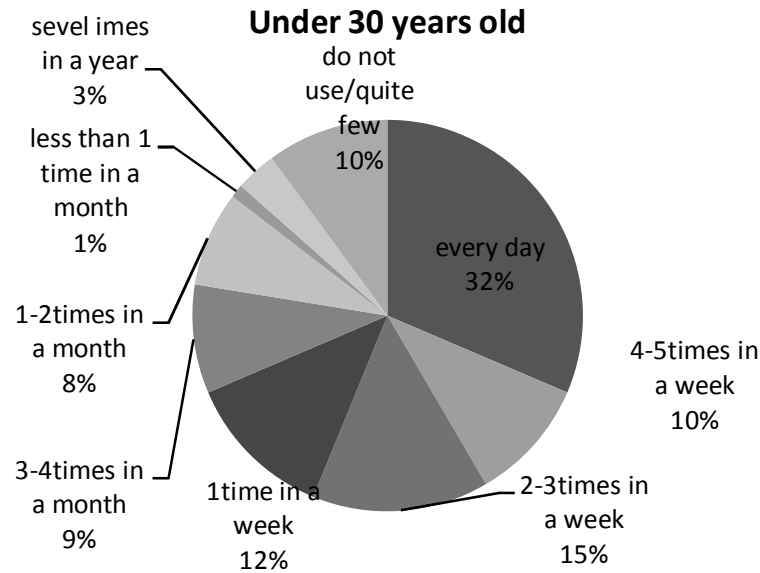
Figure 10. Utilization frequency (Under 30).

Figure 11. Utilization frequency (30 and over).

money in the future?) and analyzed the intimacy among items from the scattering figure of discrimination measure.

Important points when using electronic money (Q7)

We can observe four clusters from Figure 19. The first one is the group which indicates the easiness in confirming usage data and the reliability of card such as

"⑨Able to confirm residual money", "⑭Able to confirm purchase history", and "⑯Upper bound restriction when using." The second one is items concerning safety of card settlement such as "⑥Security is strengthened", "⑩Reliable company issues electronic money", and "⑪Convenient to settle debts." The third one is items concerning additional services such as "①Able to use when buying at the shop (usually used)", "②There are many shops in which electronic money can be used",
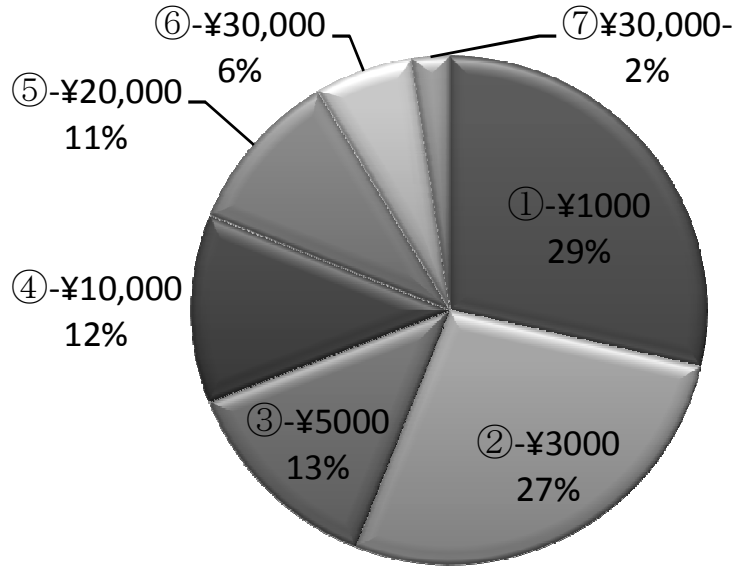
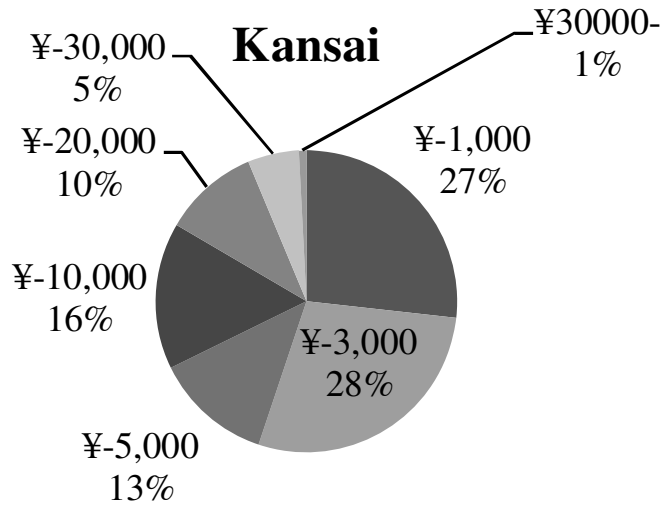**Figure 12.** Average usage amount of electronic money per month (Q10).

Figure 13. Average usage (Kansai region).

"⑤Points are added", "⑦Discount", "⑧Able to charge by various means", "⑫Ample service besides points and discount", and "⑮Many people use it." The fourth one is the group which indicates convenience for its usage such as "③Easy to handle", "④There are many places where we can charge money", and "⑬Able to use via mobile phone."

Expectation to electronic money in the future (Q12)

We can observe four clusters from Figure 20. The first one is the group which indicates items of the expansion of usage channel and restriction of usage such as "⑨Increased kinds of mobile phone by which users can use electronic money", "⑫Age certification by electronic money card when the user enters into a bar or an adult movie theater", and "⑯Upper bound restriction when using."

The second one is the items concerning convenience of settlement and safety such as "⑬Able to use by mobile phone", and "⑰Have a variety of money charging services."

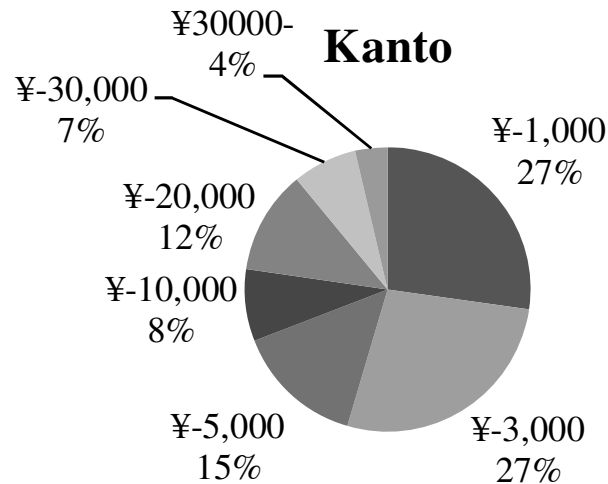The third one is the group which indicates convenience

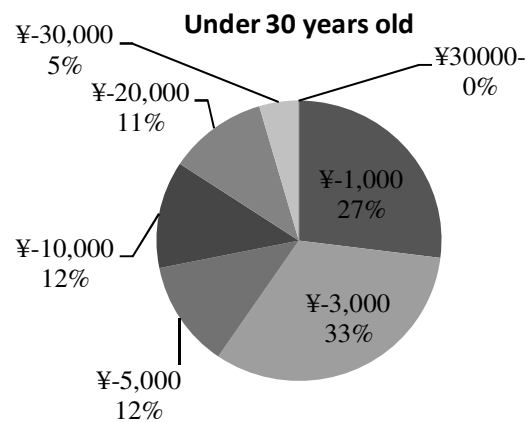**Figure 14.** Average usage (Kanto region).

Figure 15. Average usage (Under 30).

for its usage such as "⑤Increased places where users can charge money", and "⑥Easy explanation on how to use."

The fourth one is the group which indicates additional services such as "②Strengthen security", "③Add additional services such as points, discounts", "④Increased amount of shops in which electronic money can be used, "⑦Combination of credit card function and cash card function", and "⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines."

Analysis by factor analysis

Factor analysis is used to analyze Q7 "What is the important point you note when you use electronic money?" and Q12 "What do you expect for electronic money in the future?"

Factor analysis is executed so as to extract viewpoints or axes for the users' appraisal. As for the extraction method of the factor, "the principal axis factoring" is adopted, and as for the rolling-method, "the varimax rotation which is accompanied by the normalization of Kaiser as orthogonal rotation" is adopted. Also, we confirmed the validity of the KMO (Kaiser-Meyer-Olkin) specimen validity measure.

Important points when using electronic money (Q7)

KMO is 0.877 and we can confirm an appropriate common factor. From the factor matrix, after rotation, we can extract 5 meaningful axes. The accumulated sum of the square of factor loading is 54.941%.

We can see in Table 4 that the 1st axis is the factor concerning relief in the use of card based on such items
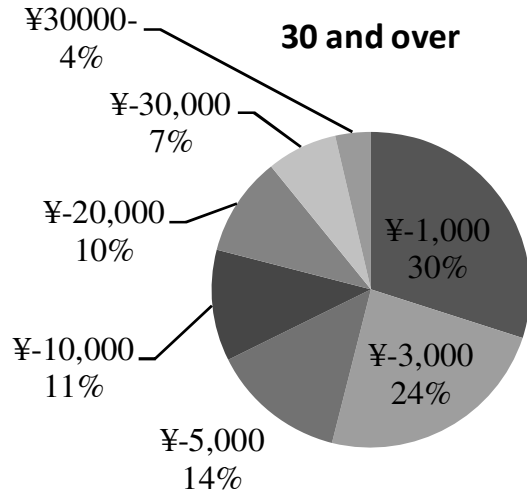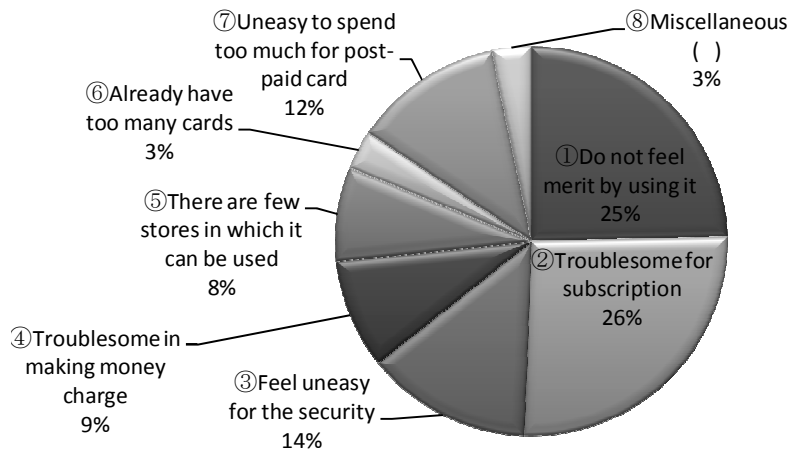
Figure 16. Average usage (30 and over).

Figure 17. The reason for not holding electronic money (Q11).

as "⑬Able to use via mobile phone", "⑭Able to confirm purchase history", and "⑮Many people use it."

The 2nd axis is the axis concerning reliability in the use of card based on such items as "⑯Upper bound restriction when using", and "⑰Have a variety of money charging services."

The 3rd axis is the factor which indicates additional value when using card based on such items as "⑤Points are added", "⑦Discount", and "⑫Ample service besides points and discounts."

The 4th axis is the factor which indicates convenience in the use of card based on such items as "①Able to use when buying at the shop (usually used)", and "②There are many shops in which electronic money can be used."

The 5th axis is the axis concerning safety in the use of

card based on such items as "⑥Security is strengthened", and "⑩Reliable company issues electronic money."

Expectation to electronic money in the future (Q12)

As regards this question, KMO is 0.936 and we can confirm an appropriate common factor. From the factor matrix, after rotation in Table 5, we can extract 2 meaningful axes. Accumulated sum of the square of Factor loading is 56.651%. We can see that the 1st axis is the factor concerning improvement of service quality based on such items as "①Combine plural electronic money", "②Strengthen security", "③Add additional services such as points, discounts", "④Increased amount

| | 5 Expect very much | 4 Slightly Expect | 3 Ordinary level |
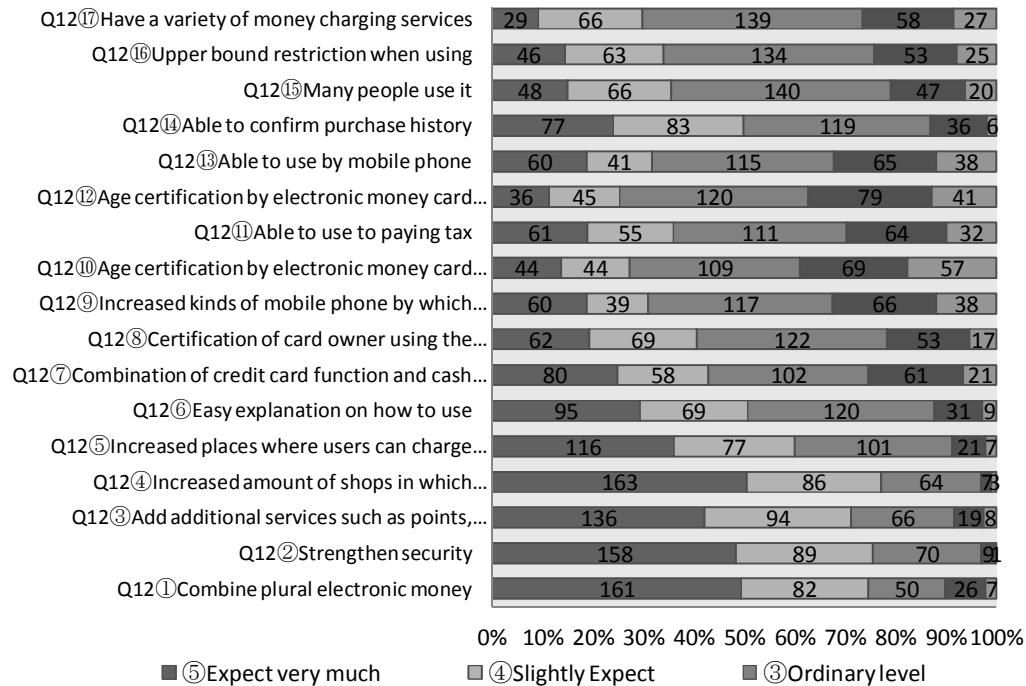
Figure 18. Expectation to electronic money in the future (Q12).

Discrimination measures

Figure 19. Important points when using electronic money (Q7).

of shops in which electronic money can be used", "⑤Increased places where users can charge money",

"⑥Easy explanation on how to use", "⑦Combination of credit card function and cash card function,

Discrimination measures

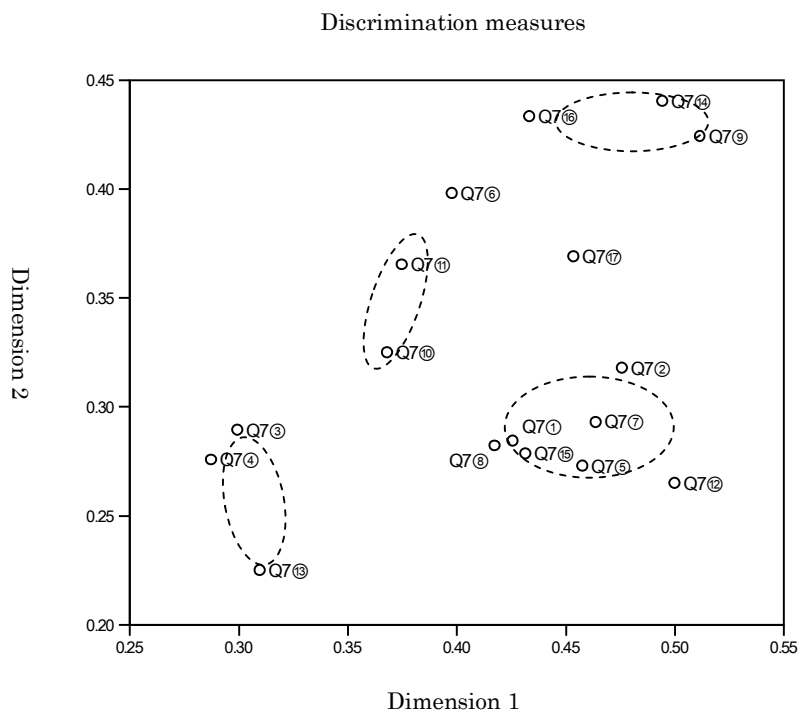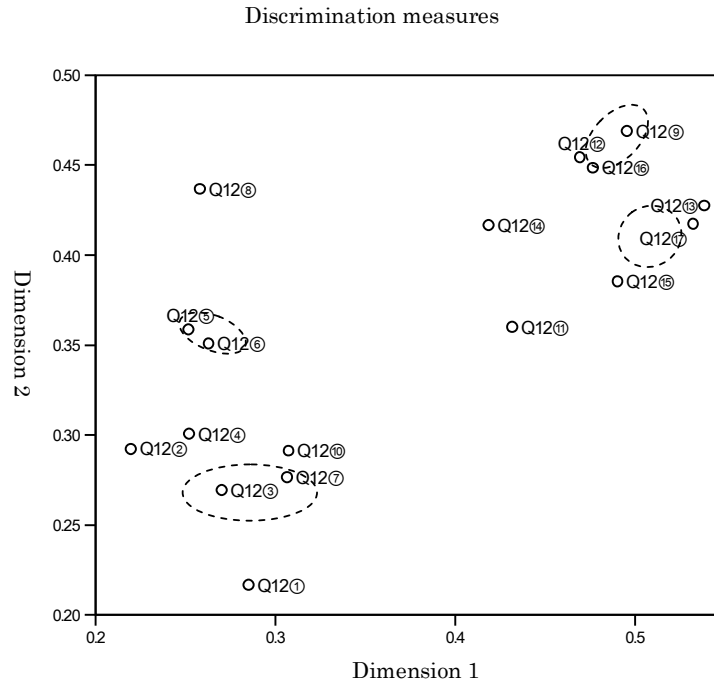**Figure 20.** Expectation to electronic money in the future (Q12).

Table 4. Important points when using electronic money (Factor matrix after rotation).

Q7 : What is an important point when you use electronic money?	Factor				
	1	2	3	4	5
①Able to use when buying at the shop usually used	0.173	0.057	0.265	0.658	0.212
②There are many shops in which electronic money can be used	0.241	0.146	0.151	0.934	0.096
③Easy to handle	0.075	0.252	0.228	0.310	0.458
④There are many places when we can charge money	0.122	0.246	0.246	0.321	0.227
⑤Points are added	0.124	-0.010	0.788	0.225	0.175
⑥Security is strengthened	0.205	0.328	0.300	0.204	0.542
⑦Discount	0.144	0.176	0.676	0.153	0.272
⑧Able to charge by various means	0.322	0.293	0.353	0.175	0.207
⑨Able to confirm residual money	0.419	0.231	0.182	0.154	0.416
⑩Reliable company issues electronic money	0.291	0.267	0.132	0.142	0.750
⑪Convenient to settle debts	0.307	0.116	0.229	0.280	0.377
⑫Ample service besides points and discounts	0.456	0.286	0.504	0.201	0.107
⑬Able to use via mobile phone	0.627	0.123	0.146	0.173	-0.058
⑭Able to confirm purchase history	0.699	0.206	0.149	0.123	0.330
⑮Many people use it	0.611	0.332	0.071	0.137	0.171
⑯Upper bound restriction when using	0.269	0.706	0.135	0.089	0.115
⑰Have a variety of money charging services	0.268	0.830	0.086	0.132	0.032
⑱Miscellaneous ( )	0.013	0.062	-0.042	-0.012	-0.224

"⑧Certification of card owner using the electronic money card when the user uses net banking", "⑭Able to confirm purchase history", "⑮Many people use it", "⑯Upper bound restriction when using", and "⑰Have a variety of money charging services."

The 2nd axis is the axis concerning convenience by the

Table 5. Expectation to electronic money in the future (Factor matrix after rotation).

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Q12: What do you expect for electronic money in the future?	Factor	
	1	2
①Combine plural electronic money	0.691	0.207
②Strengthen security	0.772	0.185
③Add additional services such as points, discounts	0.745	0.204
④Increased amount of shops in which electronic money can be used	0.791	0.248
⑤Increased places where users can charge money	0.792	0.252
⑥Easy explanation on how to use	0.722	0.290
⑦Combination of credit card function and cash card function	0.532	0.406
⑧Certification of card owner using the electronic money card when the user uses net banking	0.600	0.449
⑨Increased kinds of mobile phone by which user can use electronic money	0.420	0.673
⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines	0.311	0.663
⑪Able to use to paying tax	0.447	0.561
⑫Age certification by electronic money card when the user enters into a bar or an adult movie theater	0.343	0.787
⑬Able to use by mobile phone	0.379	0.704
⑭Able to confirm purchase history	0.660	0.403
⑮Many people use it	0.613	0.461
⑯Upper bound restriction when using	0.585	0.452
⑰Have a variety of money charging services	0.558	0.536
⑱Miscellaneous ( )	-0.006	0.264

expansion of utilization channel based on such items as "⑨Increased kinds of mobile phone by which users can use electronic money", "⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines", "⑪Able to use to pay tax", "⑫Age certification by electronic money card when the user enters into a bar or an adult movie theater", and "⑬Able to use by mobile phone."

Analysis by quantification method II

Considering the volume of data and the characteristics of the analysis, which is a kind of purchase behavior theme, an analysis was carried out by converting the 5 answer level division into a 3 level division, that is, 5, 4 to 3, 3 to 2, 2, and 1 to 1.

Case 1

Outer criterion is tagged "Hold or does not hold IC card". Explanations for the variables are given for each question in Q7. Through the result of the coefficient of canonical discrimination function, the discrimination equation of the outer criteria can be stated as follows:

$$Z = -6.484 + 0.43Q701 - 0.032Q702 + 0.082Q703 + 0.087Q704 + 0.099Q705$$
$$- 0.052Q706 + 0.013Q707 - 0.031Q708 + 0.059Q709 - 0.026Q710 + 0.145Q711$$
$$+ 0.060Q712 + 0.073Q713 - 0.030Q714 + 0.154Q715 + 0.095Q716 + 0.194Q717$$

(1)

where question number is added to Q7**. For example, Q712 means that the question number is 12 in Q7.

The discriminate hitting ratio is 99.7%. It is quite good in this case. We can make good forecasting of "Hold or does not hold IC card" in utilizing this equation and we can see the contribution of each item in Q7 by its parameter weight (Equation 1).

Case 2

The outer criterion is tagged in the same way as Case 1.

Explanations for the variables are given for each question in Q12. Through the result of the coefficient of canonical discrimination function, the discrimination of the outer criteria can be stated as follows:

$$Z = -1.484 - 0.366Q1201 + 0.377Q1202 + 0.179Q1203 - 0.250Q1204 + 0.075Q1205$$

$$- 0.007Q1206 - 0.276Q1207 - 0.214Q1208 + 0.144Q1209 - 0.177Q1210 - 0.107Q1211$$

$$+ 0.288Q1212 + 0.111Q1213 + 0.500Q1214 - 0.036Q1215 + 0.194Q1216 + 0.060Q1217$$

(2)

where question number is added to Q12**. For example, Q1205 means that question number is 5 in Q12.

The discriminate hitting ratio is 68.7%, which is rather good in this case. We can make rather good forecasting of "Hold or does not hold IC card" in utilizing this equation and we can see the contribution of each item in Q12 by its parameter weight (Equation 2).

ANALYSIS USING KEY GRAPH

Key graph is a method used to visualize the data structure using key words. Data occurrences at the same period of time are exhibited by the link of Key graph. Jaccard coefficient is utilized for the analysis of co-appearance rate.

Kind of electronic money and reason for its usage (Q1~Q4)

We analyzed four items altogether by utilizing Key graph: Q1 - "What kind of electronic money do you have?", Q2 - "What kind of electronic money do you use?", Q3 - "What kind of electronic money do you use the most?", and Q4 - "Why?"

As shown in Figure 21, we can observe high co-occurrence rate among "PiTaPa", "ICOCA", "Suica", "Pasmo" and "Edy". Items concerning convenience are derived, for example, "①Able to use as a ticket for a railway and/or bus", "②Able to settle payments without having change", "③Able to get additional points." However, "PiTaPa", "Post-paid" and "Auto-charge" have also rather high co-occurrence rate.

Most often used cards and its reasons (Q3-4 and Q13-15)

As shown in Figure 22, we can observe that co-occurrence rate is high with ICOCA and PiTaPa in Kansai region, and Suica and PASMO in Kanto region, though PiTaPa has high co-occurrence rate with Post-Paid style. "Able to use as a ticket" and "Able to settle payments without having charge" have high co-occurrence rate with "Suica", "30-40", "Male", "Kansai" and "Kanto".

"60-" has high co-occurrence rate with "Safeness in Security" and "There are many places where we can charge money". "Able to settle payments without having charge" has high co-occurrence rate with "Able to get additional point", which also has high co-occurrence rate with "Able to exchange points" linking "WAON".

Attributes of answerers and usage condition of electronic money (Q13-15, Q8-10)

Overall, we analyzed six items: Q8 - "Where do you use electronic money most often?", Q9 - "How often do you spend electronic money?", Q10 - "How much electronic money do you spend in a month?", Q13 - "How old are you?", Q14 - "Sex", and Q15 - "Residence". From Figure 23, we can observe one "island". Items of high co-occurrence rate are "Kanto", "Kansai", "Male", "20-30 years old", and "convenience store". The highest co-occurrence rate of used money within one month is "less than ¥1000", followed by "¥1000～¥2000". The former one has high co-occurrence rate with "several times in a year" and "less than 1 time in a month", while "¥10,000～¥20,000" has high co-occurrence rate with "Every day".

Analysis of electronic money's non holders (Q1, Q11, Q13-15)

The analysis of 80 people that did not hold electronic money is shown in Figure 24. The co-occurrence rate is high among items "Do not feel merit by using it", "Feel uneasy for the security", "Troublesome for subscription", "Uneasy to spend too much for post-paid card", and "Troublesome in making money charge". The former four items have high co-occurrence rate with "Kansai region", where "Troublesome for subscription" and "Uneasy to spend too much for post-paid card" may depend on the characteristics of PiTaPa in Kansai region.

Those who do not hold electronic money have high co-occurrence rate with "20-30 years old", "Do not feel merit by using it", "Feel uneasy for the security", "Troublesome for subscription", and "Uneasy to spend too much for post-paid card".

The main results obtained by Key Graph are as follows:

i) In Figure 21, high co-occurrence rate was observed between the IC card often used and its reason for usage.
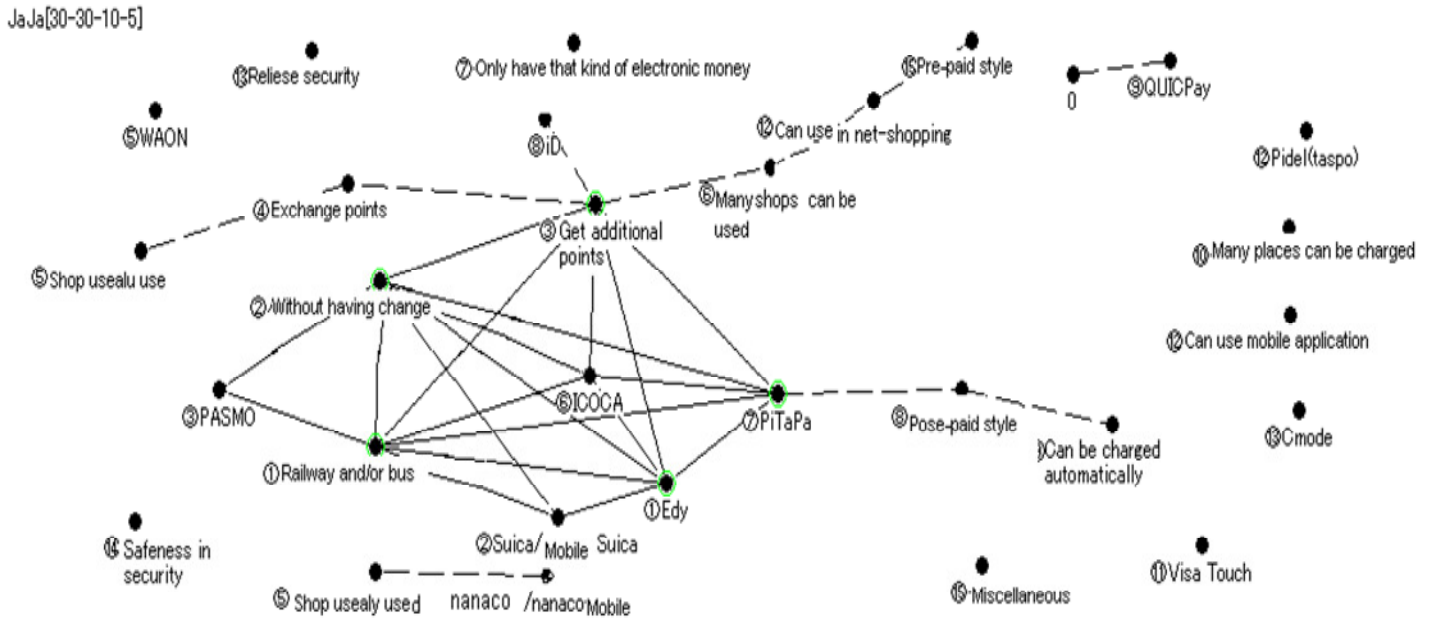ii) In Figure 22, high co-occurrence rate was observed between railways' IC card for their region (Kanto and Kansai).

JaJa[30-30-10-5]

Figure 21. Kind of electronic money and reason to use (Q1~Q4)
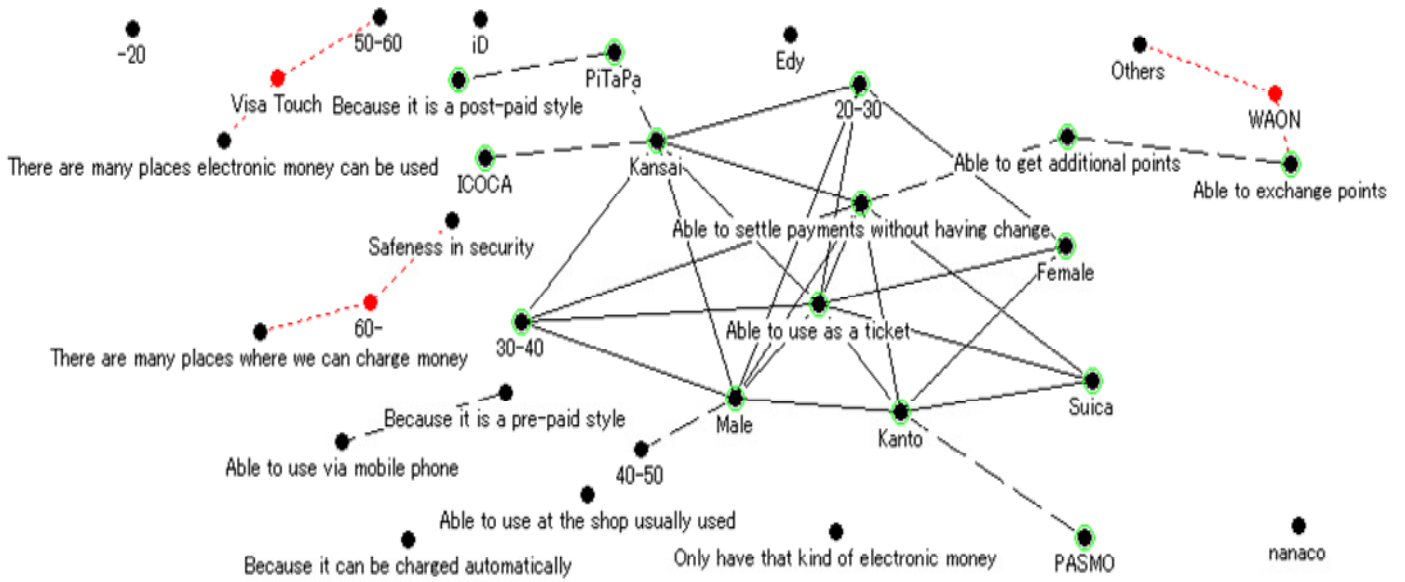
Figure 22. Most often used cards and its reason (Q3-4&Q13-15).

and their corresponding regions (Kanto and Kansai respectively).

iii) In Figure 23, the results are similar to those of single variable analysis.

iv) In Figure 24, the reason why 20 to 30 year-old people do not hold electronic money has high co-occurrence rate with "Do not feel merit by using it", "Feel uneasy for the security", "Troublesome for subscription", and "Uneasy to spend too much for post-paid card".

REMARKS

The difference between multi correspondence analysis and factor analysis was stated hereafter.

Figure 23. Attributes of answerers and usage condition of electronic money (Q13~Q15, Q8~10).

Figure 24. The analysis of electronic money's non holders (Q11,Q13-15).

Case of Q7

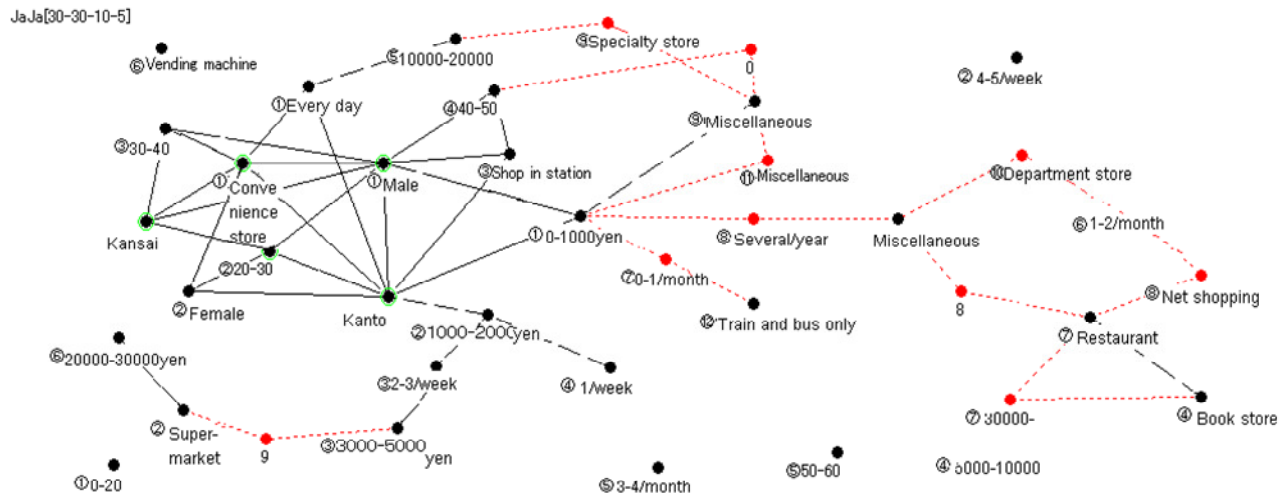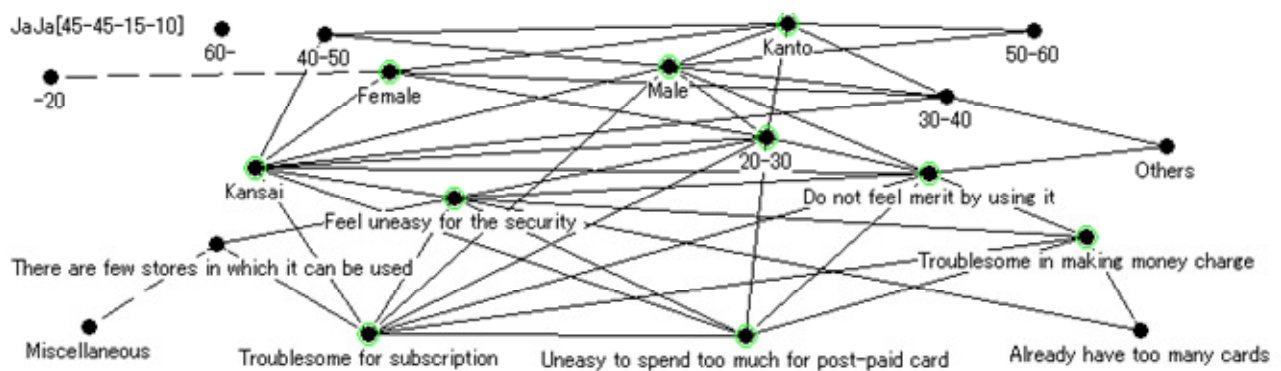We obtained the following 4 clusters from multi correspondence analysis:

Cluster 1: Easiness in confirming usage data and the reliability of card such as "⑨Able to confirm residual money", "⑭Able to confirm purchase history", and "⑯Upper bound restriction when using."

Cluster 2: Safety of card settlement such as "⑥Security is strengthened", "⑩Reliable company issues electronic money", and "⑪Convenient to settle debts."

Cluster 3: Additional services such as "①Able to use when buying at the shop (usually used)", "②There are many shops in which electronic money can be used", "⑤Points are added", "⑦Discount", "⑧Able to charge by various means", "⑫Ample service besides points and

discount", and "⑮Many people use it."

Cluster 4: Convenience for the usage such as "③Easy to handle", "④There are many places where we can charge money", and "⑬Able to use via mobile phone."

In factor analysis, we obtained the following 5 meaningful axes:

Cluster 4 (1st axis): Relief in using card based on such items as "⑬Able to use via mobile phone", "⑭Able to confirm purchase history", and ⑮Many people use it."

Cluster 1 (2nd axis): Reliability in using card based on such items as "⑯Upper bound restriction when using", and "⑰Have a variety of money charging services."

Cluster 3 (3rd axis): Additional value in using card based on such items as "⑤Points are added", "⑦Discount", and "⑫Ample service besides points and discounts."

Cluster 3 (4th axis): Convenience in using card based on such items as "①Able to use when buying at the shop (usually used)", and "②There are many shops in which electronic money can be used."

Cluster 2 (5th axis): Safety in using card based on such items as "⑥Security is strengthened", and "⑩Reliable company issues electronic money."

The analyses are relatively similar for both of them. In detail, factor analysis separated the items of Cluster 3 into two axes (3rd axis and 4th axis), therefore it can be conveniently said that factor analysis derives more detailed analysis in this case.

Case of Q12

We obtained the following 4 clusters from multi correspondence analysis:

Cluster 1: The expansion of usage channel and restriction of usage such as "⯑Increased kinds of mobile phone by which users can use electronic money", "⯑Age certification by electronic money card when the user enters into a bar or an adult movie theater", and "⯑Upper bound restriction when using."

Cluster 2: Convenience of settlement and safety such as "⑬Able to use by mobile phone", and "⑰Have a variety of money charging services."

Cluster 3: Convenience of its usage such as "⑤Increased places where users can charge money", and "⑥Easy explanation on how to use."

Cluster 4: Additional services such as "②Strengthen security", "⯑Add additional services such as points, discounts", "④Increased amount of shops in which electronic money can be used, "⑦Combination of credit card function and cash card function", and "⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines."

In factor analysis, we obtained the following 2 meaningful axes.

Clusters 1, 2, 3 and 4 (1st axis): Improvement of service quality based upon such items as ""⯑Combine plural electronic money", "⯑Strengthen security", "⯑Add additional services such as points, discounts", "④Increased amount of shops in which electronic money can be used", "⑤Increased places where users can charge money", "⯑Easy explanation on how to use", "⯑Combination of credit card function and cash card function, "⯑Certification of card owner using the electronic money card when the user uses net banking", "⯑Able to confirm purchase history", "⯑Many people use it", "⯑Upper bound restriction when using", and "⯑Have a variety of money charging services."

Clusters 1 and 2 (2nd axis): Convenience by the expansion of utilization channel based on such items as "⑨Increased kinds of mobile phone by which users can use electronic money", "⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines", "⑪Able to use to pay tax", "⑫Age certification by electronic money card when the user enters into a bar or an adult movie theater", and "⑬Able to use by mobile phone."

The results are rather different for both methods. As Q12 depicts an abstract question that seeks to know about the desire and expectation for electronic money in the future, factor analysis shows 2 big groups, that is, "Improvement for service quality" and "Expansion of the channel".

DISCUSSION

Comparison of each method

After examining each item, we can observe that the results obtained from both single variable and multivariate analyses are rather similar. While single variable analysis can make analysis only in one question item, multivariate analysis can make versatile analysis among items. In particular, users' "psychological evaluation" for IC card could be performed utilizing multivariate analysis, where nominal data are handled.

Key graph is used for analysis after visualizing the total structure of items. There is need for further study based on the results obtained from both the single variable and multivariate analyses. This study demonstrates that Key graph could grasp the total structure among items; moreover, it could grasp the psychological structure of each demographic and geographic variable.

Conclusion

We made analysis from various aspects and the following results were confirmed:

1. Nearly 80% of consumers hold IC card. These cards are mainly traffic cards.
2. Important points in using electronic money are "having many channels" and "convenience in settlement".
3. IC cards are often used in such places as convenience store, shop in station, railway ticket and vending machine.
4. Users are expecting IC card to increase places where they can use, combine plural electronic money, strengthen security and include additional services.
5. Reason for not holding electronic money is that it is troublesome and they do not feel merit in using it.

We could confirm that Key graph is useful in such

questionnaire investigation analysis. Based on the analysis results of the single variable, multi correspondence analysis, factor analysis, quantification method II and Key graph analysis were implemented. In utilizing them, we could confirm that systematic and effective versatile analysis could be made. Various fields should be examined hereafter.

RESEARCH LIMITATION AND FUTURE RESEARCH DIRECTION

After a comparison of the study's population was carried out, it was observed that the sampling number is limited. However, making suitable sampling of the population is a future issue to be resolved.

Based on the results obtained from this study, effective information was provided to each company concerning marketing strategy via IC card system, though further research may be carried out on these areas.

REFERENCES

Arcar DA, Day GS (1980). Marketing Research: Private and Public Sector Decisions. John Wiley & Sons, Inc.

Osawa Y, Nels EB, Yachida M (1999). Automatic Indexing by Segmenting and Unifing Co-occurrence Graphs. The Institute of Electronics, Information and Communication Engineers, Vol. J82-D-I No.2.

Osawa Y (2003). Information Technology of Finding Opportunity - Decision Support for Post Data mining Era. Tokyo Electrics University Press.

Osawa Y (1992). Marketing and Consumer Behavior: New wave of the Marketing Science. Yuhikaku Publishing.

Ueda T, Shibata N (1987). Occasion of Using Goods and Price Organization. Using of Radaring Methods and Text Mining 〜 For example "Beer & Sparkling Sake." Mark. J.

Oshima K (2005). Appication of Electronic Money to Payments. Univ. J. Nihon Univ., 6: 335-346.

Nakashima M (2007). New Development of Electronic money in Japan. Reitaku Int. J. Econ. Stud., 15(2): 97-112.

Oyama K, Nohara Y, Yasuura H (2006). Modeling of Cash Currency and Its Application to Implementation of Electronic Money System. IPSJ SIG Technical Report, 2006-MPS-59(9): 33-36.

Kurokawa A, Morita T, Kusakabe S (2003). Contactless IC card Technology "FeliCa" and New Approach. International Symposium on Speed-up and Service Technology for Railway and Maglev System 2003 (STECH'03), 2003.8.19-22 Tokyo, Japan, pp. 323-327.

APPENDIX

Questionnaire about using electronic money by IC card

Please answer the following questions. Please write down ○ to the answering items. Plural selection is allowed for Question 1, 2, 4, 6, 8, 11. Select ①～⑤ of the right column for Question 7 and 12.

1. What kind of electronic money do you have?

Q1 ①Edy ②Suica ③PASMO ④nanaco ⑤WAON ⑥ICOCA ⑦PiTaPa ⑧iD ⑨QUICPay ⑩Smartplus ⑪ Visa Touch ⑫ Pidel(taspo) ⑬ Cmode ⑭Do not have ⑮Miscellaneous ( )

2. What kind of electronic money do you use?

Q2　①Edy ②Suica ③PASMO ④nanaco ⑤WAON ⑥ICOCA ⑦PiTaPa ⑧iD ⑨QUICPay ⑩Smartplus ⑪Visa Touch ⑫Pidel(taspo) ⑬Cmode ⑭Do not have ⑮Miscellaneous ( )

3. What kind of electronic money do you use the most?

Q3　①Edy ②Suica ③PASMO ④nanaco ⑤WAON ⑥ICOCA ⑦PiTaPa ⑧iD ⑨QUICPay ⑩Smartplus ⑪Visa Touch ⑫Pidel(taspo) ⑬Cmode ⑭Do not have ⑮Miscellaneous ( )

4. Why ?

Q4 ①Able to use as a ticket for a railway and/or bus ②Able to settle payments without having change ③Able to get additional points ④Able to exchange points with other goods/services ⑤Able to use when buying at the shop (usually used) ⑥There are many shops in which electronic money can be used ⑦Only have that kind of electronic money ⑧Because it is a pre-paid style (not credit card style) ⑨Because it is a post-paid style ⑩Because it can be charged automatically ⑪There are many places where we can be charged ⑫Able to use in net-shopping ⑬Able to use an application of mobile phone ⑭Safeness in security ⑮Miscellaneous ( )

5. What kind of method do you often use when riding on a railway?

Q5 **<pre-paid style>** ①Suica ②PASMO ③ICOCA **<post-paid style>** ④PiTaPa

6. Why is that?

Q6 ①Able to use as a ticket for a railway and/or bus ②Able to settle payments without having change ③Able to get additional points ④Able to exchange points with other goods/services ⑤Able to use when riding on the railway ⑥Able to use when riding on the bus ⑦Only have that kind of electronic money ⑧Because it is a pre-paid style (not credit card style) ⑨Because it is a post-paid style ⑩Charging money is troublesome ⑪Able to use via mobile phone ⑫Miscellaneous ( )

7. What is the important point you note when you use electronic money?

Importance	Do not think so	Slightly do not think so	Ordinary level	Slightly think so	Think so very much
Q7: ①Able to use when buying at the shop (usually used) ②There are many shops in which electronic money can be used					
③Easy to handle					
④There are many places where we can charge money					
⑤Points are added					
⑥Security is strengthened					
⑦Discount					
⑧Able to charge by various means					
⑨Able to confirm residual money					
⑩Reliable company issues electronic money	①	②	③	④	⑤
⑪Convenient to settle debts					
⑫Ample service besides points and discounts					
⑬Able to use via mobile phone					
⑭Able to confirm purchase history					
⑮Many people use it					
⑯Upper bound restriction when using					
⑰Have a variety of money charging services					
⑱Miscellaneous ( )					

8. Where do you use electronic money most often?

Q8 ①Convenience store ②Super market ③Shop in station ④Book store ⑤Library ⑥Vending Machine ⑦Restaurant ⑧Net-shopping ⑨Specialty store ⑩Department store ⑪Miscellaneous (   )

9. How many often do you spend electronic money in a month?

Q9 ①every day ②4-5 times in a week ③2-3 times in a week ④ once in a week ⑤3-4 times in a month ⑥1-2 times in a month ⑦less than once in a month ⑧several times in a year ⑨Do not use/quite few

10. How much electronic money do you spend in a month?

Q10①-\1000 ②-\3000 ③-\5000 ④-\10000 ⑤-\20000 ⑥-\30000 ⑦\30000-

11. Why is there no electronic money?

Q11 ①Do not feel merit by using it ②Troublesome for subscription ③Feel uneasy for the security ④Troublesome in making money charge ⑤There are few stores in which it can be used ⑥Already have too many cards ⑦Uneasy to spend too much for post-paid card ⑧Miscellaneous (   )

12. What do you expect for electronic money in the future?

Importance	Do not think so	Slightly do not think so	Ordinary level	Slightly think so	Think so very much
Q12: ①Combine plural electronic money					
②Strengthen security					
③Add additional services such as points, discounts					
④Increased amount of shops in which electronic money can be used					
⑤Increased places where users can charge money					
⑥Easy explanation on how to use					
⑦Combination of credit card function and cash card function					
⑧Certification of card owner using the electronic money card when the user uses net banking					
⑨Increased kinds of mobile phone by which users can use electronic money					
⑩Age certification by electronic money card when the user uses Liquor or Tobacco vending machines	①	②	③	④	⑤
⑪Able to use to pay tax					
⑫Age certification by electronic money card when the user enters into a bar or an adult movie theater					
⑬Able to use by mobile phone					
⑭Able to confirm purchase history					
⑮Many people use it					
⑯Upper bound restriction when using it					
⑰Have a variety of money charging services					
⑱Miscellaneous ( )					

About yourself

Q13 <Age> ①-20 ②20-30 ③30-40 ④40-50 ⑤50-60 ⑥60-
Q14 <Gender>   ① Male ② Female
Q15 <Address> Prefecture : (   ) City : (   )