

Fujiki, Hiroshi; Tanaka, Migiwa

Conference Paper

Choice of payment instrument for low-value transactions in Japan

International Cash Conference 2017 - War on Cash: Is there a Future for Cash? 25 - 27 April 2017, Island of Mainau, Germany

Provided in Cooperation with:

Deutsche Bundesbank

Suggested Citation: Fujiki, Hiroshi; Tanaka, Migiwa (2017) : Choice of payment instrument for low-value transactions in Japan, International Cash Conference 2017 - War on Cash: Is there a Future for Cash? 25 - 27 April 2017, Island of Mainau, Germany, Deutsche Bundesbank, Frankfurt a. M.

This Version is available at:

<https://hdl.handle.net/10419/162909>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Choice of payment instrument for low-value transactions in Japan

Hiroshi Fujiki* and Migiwa Tanaka**

May 5, 2017

Abstract

In this paper, we examine the determinants of the choice of payment instrument for low-value day-to-day transactions. Using Japanese household data from 2007 to 2014, we find that three payment instruments, namely, cash, electronic money, and credit cards, comprise the major payment choices for transactions with values less than 1,000 yen (about 8.7 euros). We also find that high-income, financially sophisticated households in urban areas tend to use both electronic money and cash. Further, family households choosing electronic money and cash do not have higher cash holdings compared with family households exclusively choosing cash, holding all other variables constant. We obtain weak evidence that single-person households choosing electronic money and cash have higher cash holdings compared with single-person households exclusively choosing cash, holding all other variables constant.

Keywords: Cash demand, electronic money
JEL classification: E41

* Professor, Faculty of Commerce, Chuo University, 742-1 Higashinakano, Hachioji-shi, Tokyo 192-0393, Japan. (fujiki@tamacc.chuo-u.ac.jp)

** Charles River Associates (migiwa@gmail.com)

While working on this research, the authors participated in the Research Group on the Survey of Household Finances and received permission from the Central Council for Financial Services Information (CCFSI) to use data from the Survey of Household Finances. The authors would like to thank the CCFSI for providing the data. The authors acknowledge the financial support of a Japan Society for the Promotion of Science Kaken Grant (No. 15K03551). The authors thank Fumiko Hayashi for her helpful comments to our companion paper.

1. Introduction

The Japanese have long depended on cash transactions for one-off, low-value payments, as Humphrey (2010) has observed. The gray bars in Figure 1 display the increasing demand for currency in Japan. Specifically, in 2015, total Japanese currency in circulation (the annual average of the monthly average outstanding) was 91 trillion yen (or 790 billion euros at 1 euro = 115 yen), a sixfold increase from the 15 trillion yen (132 billion euros) in circulation in 1980. Can we explain this continuing increase in the demand for currency as a result of the growth of Japanese economy? The answer is no, because as shown by the solid line in Figure 1, the ratio of the currency in circulation to nominal GDP in Japan was about 6% to 8% before 1995. However, since then the ratio has continued to increase, reaching about 18% of GDP in 2015.

We can identify several reasons underpinning the accelerating demand for currency beyond the nominal economic growth rate after 1995. The dashed line in Figure 1 illustrates the yearly change in Japanese currency in circulation. As shown, this has accelerated on several occasions: the Japanese stock and real estate bubble of the late 1980s, the Japanese banking crisis from 1997 to 1998, the removal of the blanket guarantee of Japanese bank time deposits in 2003 and that of bank ordinary deposits in 2005, and the rapid growth of foreign tourism in Japan after 2014. We should also point out that Japanese nominal interest rates have been very low since 1995.

The suggestive evidence shown in Figure 1 may be well known to many readers. However, less well known is the small but continuing shift from the use of low-denomination to high-denomination bills. In Figure 2, the thin solid line plots the ratio of 10,000 yen (87 euros) bills in circulation (the highest-denomination bill available in Japan) to overall bills in circulation. As shown, this denomination represented about 80% of bills in circulation in the early 1980s, but its circulation has increased since 1995, and it accounted for about 88% of bills in circulation in 2015. By contrast, the thin dashed line shows that the share of the 1,000 yen (8.7 euro) bill (the lowest-denomination bill in circulation) has dramatically declined, falling from 10% in 1982 to just 4% in 2015. However, note that the evidence does not imply a drastic shift from coins to bills, because the share of notes in circulation (the thick solid line)

has been stable at about 95%, and the share of coins in circulation (the thick dashed line) has been stable at around 5%, except for the period between 1987 and 2000, which contained a one-off event relating to the insurance of high-denomination special coins. However, the ratio of coins in circulation gradually fell from 2002 to 2015, from about 6% to about 5%. The question is whether the upward trend in the use of high-denomination bills suggests a decrease in the number of lower-denomination bills in circulation (as distinct from their share in overall bill circulation, which we know has declined). The answer is no because the number of bills in circulation, including the lowest-denomination 1,000 yen bill, has continued to increase after 2007. Another question is whether the gradual shift from coins to bills represents a decrease in the number of low-denomination coins in circulation? The answer is yes because the number of coins in circulation, especially low-denomination coins with face values between 1 and 10 yen, decreased from 2008 to 2014 (See details in our working paper version, Fujiki and Tanaka (2016b), Figures 3 and 4).

In this paper, we take as given the evidence discussed above suggesting a small but continuing shift toward the infrequent use of low-denomination coins or banknotes. We then investigate whether the increasingly frequent use of electronic money since 2007 has been one of the reasons behind this continuing shift. Underpinning this question, between 2008 and 2015, the value of transactions made by credit card increased 1.5 times, from 33 trillion yen to 49 trillion yen, while the value of those made by electronic money increased about six times, from 0.8 trillion yen to 4.6 trillion yen. During this time, the number of credit cards per person has been stable at around two. However, the number of electronic money cards per person has increased from 0.77 in 2008 to 2.32 in 2015. The value per transaction using electronic money has also increased, from 720 yen (6.3 euros) in 2008 to 993 yen (8.6 euros) in 2015. According to Nikkei PB (2015), if consumers use major brands of Japanese electronic money, average transaction values are between 300 and 800 yen (2.6 to 6.9 euros). This could lead to some decrease in the use of coins after 2008 (See details in our working paper version Fujiki and Tanaka (2016b), section 1).

Based on this evidence, it is reasonable to ask the following two questions. First, what are the determinants of the choice of payment instrument for low-value, one-off, day-to-day transactions of less than 1,000 yen? Second, does the use of

electronic money for these transactions reduce the demand for cash by households?

To respond, we use the same data and methodology as Fujiki and Tanaka (2016a). They use repeated cross-sectional data sets on Japanese family and single-person households from the Survey of Household Finance (SHF) conducted by the Central Council for Financial Services Information from 2007 to 2014. While the focus of Fujiki and Tanaka (2016a) is the payment method for day-to-day transactions with values between 10,000 and 50,000 yen, with special attention to the shift from cash to credit cards, we focus on day-to-day transactions with values less than 1,000 yen to examine the shift from cash to electronic money. The major findings in this paper are as follows.

First, the major payment choices for low-value day-to-day transactions, typically those less than 1,000 yen, comprise three payment instruments: cash, electronic money, and credit card. Second, high-income, financially sophisticated, and well-educated family households living in urban areas tend to use both electronic money and cash. Similarly, high-income, financially sophisticated, and well-educated single-person households also tend to use both electronic money and cash. Finally, family households choosing electronic money and cash do not have greater cash holdings than households exclusively choosing cash, with all other characteristics held constant. We obtain weak evidence that single-person households choosing electronic money and cash have greater cash holdings compared with households exclusively choosing cash, holding all other variables constant.

Before discussing the details of our data sets and estimations, we summarize two strands of the literature related to our study. First, our study relates to work on consumer payment method choices and their determinants; recent contributions include Ching and Hayashi (2010), Cohen and Rysman (2013), Koulayev et al. (2016), Arango et al. (2012), and Wakamori and Welte (2016). Second, our study also relates to empirical studies on changes in the demand for cash as financial technology evolves using individual data sets; Fujiki and Tanaka (2014, 2016a) by a Japanese data, Stix (2004) by an Austrian data, Attanasio, Guiso, and Jappelli (2002) and Lippi and Secchi (2009) by an Italian data, Chen, Felt, and Huynh (2014) by a US panel data, Fung, Huynh, and Sabetti (2012) by a Canadian data (See the details of those papers in our working paper, Fujiki and Tanaka (2016b)).

The organization of the rest of this paper is as follows. Section 2 documents our data. Section 3 reports our model. Section 4 reports the data used for the regressions. Section 5 provides the results of our regressions for the choice of payment method. Section 6 reports the results of our regression concerning the demand for cash. Section 7 concludes.

2. Survey of Household Finance (SHF) data

We use the individual household data from the Survey of Household Finance (SHF) conducted by the Central Council for Financial Services Information from 2007 to 2014, as in Fujiki and Tanaka (2016a).¹ The SHF questions respondents about their household financial assets and liabilities, their selection of financial products, the amount (to the nearest 10,000 yen) and average cash holdings (in units of 10,000 yen). The SHF also asks survey respondents for details about various household characteristics, including annual disposable income, area of residence, and the age, gender, education, and employment status of household members.

In each survey year, the SHF data consist of a family household data set and a single-person household data set. For the family household data sets, the SHF used a stratified two-stage random sampling method to select a total of 8,000 samples in each survey year. The valid samples were eventually reduced to between 3,300 and 4,000 samples. For the single-person household data sets, some 2,500 respondents were selected from a pool of individuals registered with a survey company through the Internet in each survey year. The distribution of respondents' ages was from 20 to 69 years.

The SHF asks about the survey respondent's choice of payment method for transactions: Which payment method would you (or your family members) use to make a day-to-day transaction of (1) less than 1,000 yen, (2) between 1,000 yen and 5,000 yen, (3) between 5,000 yen and 10,000 yen, (4) between 10,000 yen and 50,000 yen, and (5) more than 50,000 yen? Choose from cash, credit card, electronic money (including debit card), and other.

Note that the SHF defines electronic money as noncontact integrated circuit (IC) forms based on Near Field Communication (NFC) technology as well as debit cards for

¹The following discussion draws heavily on Section 2 in Fujiki and Tanaka (2016a).

this question. We follow the definition of the SHF for electronic money for the remainder of this paper. We assume that the SHF data more effectively capture the use of electronic money rather than the use of debit cards, because the value of transactions made by J-Debit, the major brand of Japanese debit card, has been steadily falling from a peak of 0.8 trillion yen in 2005 to just 0.5 trillion yen in 2014, while the value of transactions made by electronic money has increased from 0.8 trillion yen in 2008 to 4 trillion yen in 2014. Even adding the transactions made by international debit cards to those made by J-Debit, the value of transactions made by debit card are only 16% of those made by electronic money (see Bank of Japan [2017], Chart 12).

We detail the choice of payment method for day-to-day transactions by the value of the transaction. In the SHF, survey respondents can select from 10 choices of payment method, but they usually select at most seven choices. We compare the popularity of the different payment methods for day-to-day transactions over the period 2007 to 2014 for family households in Table 1 and for single-person households in Table 2. We list those payment methods that were chosen by at least 1% (i.e., a proportion of 0.01) of the survey respondents, in descending order of popularity. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

Table 1 shows three things. First, for transactions of less than 1,000 yen, while the proportion of respondents that chose cash only decreased over time, this group still comprised 76% of all respondents in 2014. Meanwhile, the proportion of respondents that chose electronic money and cash increased from 2% of respondents in 2007 to 8% of respondents in 2014. Second, for transactions of between 1,000 and 5,000 yen in 2014, 65% of respondents chose cash only, 10% chose card and cash, 7% chose card only, and 6% chose electronic money and cash. Third, for transactions of between 5,000 yen and 10,000 yen, between 10,000 yen and 50,000 yen, and exceeding 50,000 yen, the major payment choices comprise three payment instruments: cash only, card only, and card and cash. The proportion of respondents that chose credit card only outweighed the proportion of respondents that chose cash only for transaction values more than 50,000 yen in 2010.

Table 2 shows qualitatively similar results to Table 1. However, on average, a single-person household is more likely to choose credit cards and electronic money than

a family household for the same transaction value. The construction of the survey data set could help explain why we obtain these results. First, the single-person household data are obtained from a pool of individuals registered with a survey company through the Internet. These individuals must be familiar with the Internet, and therefore they are also likely to be familiar with Internet shopping using credit cards for payment. Second, the single-person household data set includes individuals aged from 20 to 69 years only, while the family household data set includes heads of households aged 20 to 69 years and those aged 70 years and older. One may reasonably surmise that the chances of using electronic money, say, in railway stations in downtown areas, are higher for workers (typically aged less than 70 years) than for retired persons (typically aged more than 70 years).

Overall, the above evidence suggests that we should focus on the choice of payment methods for transactions with values less than 1,000 yen to examine whether the frequent use of electronic money could affect the demand for cash in Japan.

For the sake of later analysis, we construct a dummy variable for the following five aggregated choices of payment method for day-to-day transaction values less than 1,000 yen: cash (respondents chose cash exclusively), card (respondents chose credit card exclusively, cash and credit card, or credit card and other), emoney (respondents chose emoney exclusively, cash and emoney, or emoney and other), other (respondents chose other exclusively or cash and other), and card and emoney (respondents chose credit card and emoney). The aggregation of choices is motivated by the fact that the major payment choices by survey respondents comprise three payment instruments for day-to-day transaction values below 1,000 yen: cash only, electronic money and cash, and card and cash.

Table 3 provides the details of our aggregate dummy variables for family and single-person households. It is clear that cash and emoney are two major choices, followed by card. The proportion of survey respondents that chose cash decreased and the proportion of survey respondents that chose emoney generally increased over time, by about 8-9 percentage points between 2007 and 2014. In constructing Table 3, we dropped those respondents who did not report their choice of payment method (2,561 respondents in the family household data) and those whose cash holdings exceeded 9 million yen (78 thousand euros) (five responses each among the 30,369 family

household and 20,000 single-person household sample responses), which appear to be outliers. As a result, we have 27,803 observations for our family household data set and 19,995 observations for our single-person household data set. The next section explains our model.

3. Model

We consider the same theoretical and empirical model of consumer demand for cash and choice of payment method as Fujiki and Tanaka (2016a).²

We assume consumers will solve the following two-step decision problem.

In the first step, a consumer considers a portfolio choice model, as Merton (1992, Ch. 4) explains, to maximize his or her lifetime expected utility, and then uses this to determine the proportion of liquid assets (such as cash holdings or bank deposits) held among total financial assets (which also include stocks, bonds, and life insurance). After 1995, Japanese households have been facing extremely low levels of interest rates. We can safely assume that their bank deposits and cash holdings, which are both included in liquid assets, are perfect substitutes. In the second step, given the proportion of liquid assets that maximizes the consumer's lifetime expected utility, the consumer chooses the levels of cash holdings and bank deposits, and the payment method, such as electronic money or credit card. The consumer's choice depends on consumer characteristics, payment method attributes, and transaction characteristics.

For the sake of the empirical investigation, we focus on the second step. We assume that the utility to a consumer i at time t from using a given payment method for some transaction with characteristic j (for example, the value of the transaction), U_{ijt} , is defined as follows:

$$U_{ijt} = X_{it} \delta + Z_{ijt} \theta + v_{it}, \quad (1)$$

where X_{it} is a vector of consumer characteristics; Z_{ijt} is the consumer's chosen payment method (say, cash, cash and electronic money, cash and credit card, and so forth), which will depend on the transaction's characteristics; and δ and θ are vectors of parameters. v_{it} are unobserved factors that affect consumer choice, and independent and identically

²The following discussion draws heavily on Section 3 in Fujiki and Tanaka (2016a).

extreme-value distributed variables. Hence we can estimate equation (1) using a multinomial logit model.

Regarding the consumer demand for cash, we assume that C_{it} , consumer i 's demand for cash at time t , depends on the following: the usual determinants of the demand for cash, X_{it} , such as income or age; the consumer's chosen payment method when the transaction has characteristic j , Z_{ijt} , measured by dummy variables indicating the choice of payment method; and some random i.i.d. shocks ε_{it} , as shown below.

$$C_{it} = X_{it}\beta + Z_{ijt}\gamma + \varepsilon_{it}, \quad (2)$$

Given the proportion of liquid assets that maximizes the consumer's lifetime expected utility, the consumer's decision concerning demand for cash depends not only on the usual determinants of the demand for cash but also on the consumer's use of electronic money (Remember that the consumer needs to charge cash in advance to use electronic money). The consumer's decision concerning demand for cash determines the amount of bank deposits as the remainder of the liquid assets.

We are most interested in whether the use of electronic money on average reduces the demand for cash, compared with the demand for cash by consumers that prefer to use cash exclusively. For this purpose, we estimate equation (2) by adding some variables to X_{it} to ensure consistency with the first step of the model. To address the endogeneity between the demand for cash and the choice of payment methods, we assume that ε_{ijt} , the error term for the demand for cash if the person chooses an alternative Z_{ijt} , is identical to ε_{it} , the error term for the actual demand for cash. We estimate equation (1) using a multinomial logit model, and use the fitted value as the instrumental variable for Z_{ijt} in equation (2).

4. Data used for the regressions

Table 4 (1) reports the means and standard errors (S.E.) of the selected variables in the SHF from 2007 to 2014.

The first row of Table 4 (1) shows that the mean cash holdings of a family household are 135.80 thousand yen (1,180 euros), and those of a single-person household are 175.48 thousand yen (1,520 euros). From the second row to the sixth row report the average cash holdings by choice of payment method for day-to-day transactions of less than 1,000 yen. On average, respondents who choose emoney

(emoney users) tend to have lower cash holdings compared with those who choose cash (cash users) in both data sets.

The seventh row provides the means and standard errors of a dummy variable for respondents who made mattress deposits (mattress) to cope with the financial crisis. We use this dummy variable because cash holdings for savings, such as money stored under a mattress, especially among the elderly, could amount to a substantial sum in Japan, as explained in Otani and Suzuki (2008).

From the eighth row, we report the means and standard errors for the five groups of independent variables used in the regressions in turn.

First, we use disposable income (income), financial assets (FA), annual debt payments (debtpay), and the ratio of liquid assets to total financial assets (liqratio). These variables correspond to the structural model we proposed in the previous subsection.

Second, we specify dummy variables for respondents who had never heard of the Deposit Insurance Corporation of Japan (DI no), who placed an emphasis on lower service charges when selecting a financial institution (cheapbk), and who placed an emphasis on online banking services offered via the Internet when selecting financial institutions (intbk). These variables should correlate with respondents' knowledge of financial products, which generally should help them select their preferred financial product.

Third, we use dummy variables indicating whether a survey respondent has an account in a financial institution (account), has no income (noincome), has not made any savings from his/her disposable income (nosaving), is a homeowner (homeowner), and is male (male), as well as the amount of the respondent's deposits (Dep). To control for the supply of electronic money, we use passenger kilometers (PKM), which is the sum of kilometers traveled by all passengers by major railway companies in Japan within a year. The reason is that major electronic money suppliers in Japan include public transportation service providers. The PKM data series has breakdowns by nine regions.

Fourth, we specify dummy variables indicating a survey respondent's job situation: whether a household head is a full-time worker (works11), a part-time worker (works12), self-employed (works13), a student (works14), or has no job and does not

attend school (works15). For a family household, we also use a dummy variable indicating whether the spouse of the survey respondent is a full-time worker (works21), a part-time worker (works22), self-employed (works23), a student (works24), or has no job and does not attend school (works25).

Table 4 (2) reports the means of dummy variables to indicate the educational attainment of a survey respondent: junior high school (edu1), senior high school (edu2), vocational college (edu3), junior college (edu4), university (edu5), graduate school (edu6), and other (edu7), and the means of dummy variable indicating the educational attainment of the spouse: junior high school (edu21), senior high school (edu22), vocational college (edu23), junior college (edu24), university (edu25), graduate school (edu26), and other (edu27). For the sake of empirical investigation, we add edu7 to edu1 and edu27 to edu21, because the number of households where edu7 and edu27 are one are very small.

Table 4 (2) also reports the means of dummy variables to indicate the age of the household head (25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94, and over 95 years for family households, and 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, and 65-69 years for single-person households), and the means of dummy variables for the survey respondent's residential area to indicate nine regions (Hokkaido, Tohoku, Kanto, Hokuriku, Chubu, Kinki, Chugoku, Shikoku, and Kyushu). We also report the means of dummy variables to denote four size categories for cities based on their population for the family data set. City sizes are classified into: (1) the 20 largest cities, (2) cities with more than 40,000 households, (3) cities with between 20,000 and 40,000 households, and (4) cities with under 20,000 households and villages. We use dummy variables to indicate city sizes, citi1, citi2, citi3 and citi4. We also specify dummy variables denoting the survey year.

5. Choice of payment method

We detail the results for the estimation of equation (1) by the multinomial logit regression using the STATA 13 command `mlogit`. Columns 2 to 5 and columns 8 to 11 in Tables 5 (1) through 5 (4) provide the results. We regard respondents that chose cash as the base group for our estimation, and thus the parameter estimates for this group are normalized to one. As the choice of cash, the choice of emoney, and the

choice of card accounted for more than 90% of respondents' choices, we focus on the results for the choices of emoney and card, which are reported in the columns labeled emoney and card.

Regarding the statistically significant parameter estimates for the first group of independent variables, from our family household data, Table 5 (1) shows that the log of income ($\ln y$) and the square of the log of income ($\ln y^2$) are negatively and positively correlated with the choice of emoney. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to a greater likelihood of choosing emoney if $\ln y$ is greater than 4.14 (or above the 14th percentile of the distribution of $\ln y$, 630 thousand yen). The log of financial assets ($\ln FA$) is negatively correlated, and the square of $\ln FA$ ($\ln FA^2$) is positively correlated, with the choices of card and emoney. The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest that an increase in $\ln FA$ leads to a greater likelihood of choosing card if $\ln FA$ is greater than 6.83 (or above the 67th percentile of the distribution of $\ln FA$, 9.25 million yen). The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest that an increase in $\ln FA$ leads to a greater likelihood of choosing emoney if $\ln FA$ is greater than 14.7, but the maximum of $\ln FA$ is 11.1, and thus the results mean that higher $\ln FA$ leads to a lower probability of choosing emoney. The log of annual debt payments ($\ln debtpay$) is positively correlated with the choices of emoney and card, and the ratio of liquid assets to total financial assets ($liqratio$) is negatively correlated with the choice of card and emoney.

For the results from our single-person household data, Table 5 (1) shows that the log of income ($\ln y$) is positively correlated and $\ln y^2$ is negatively correlated with the choice of card. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to a greater chance of choosing card if $\ln y$ is less than 7.28, or below the 99.73 percentile of $\ln y$, namely, for almost all single-person households. The parameter estimate for $\ln y^2$ is weakly statistically significant at the 7% level for the choice of emoney. The log of annual debt payments ($\ln debtpay$) is positively correlated with the choice of emoney, and the ratio of liquid to total financial assets ($liqratio$) is negatively correlated with the choices of card and emoney.

Regarding the statistically significant parameter estimates for the second group of independent variables, the dummy variable for respondents who had never heard of the Deposit Insurance Corporation of Japan ($DI\ no$) is negatively correlated with the

choices of card and emoney, while those indicating whether a survey respondent placed an emphasis on lower service charges (cheapbk) or on online banking services offered via the Internet (intbk) when selecting financial institutions are positively correlated with the choices of card and emoney for the results using both data sets. These results show that respondents who have better knowledge of financial products tend to use both electronic money and credit cards.

Regarding the statistically significant parameter estimates for the third group of independent variables, the dummy variable indicating whether a survey respondent held an account in a financial institution (account) is positively correlated with the choice of emoney for the results using the single-person household data set. The dummy variable indicating no income (noincome) is positively correlated with the choices of emoney and card for the results using the family household data. The dummy variable for a survey respondent that had not made any savings from his/her disposable income (nosaving) is negatively correlated with the choice of emoney for the results using both data sets. The log of deposits (lnDep) is positively correlated with the choice of emoney for the results using the family household data set. The dummy variable indicating whether a survey respondent was a homeowner (homeowner) is positively correlated with the choice of card for the results using the family data set, and negatively correlated with the choice of emoney for the results using both data sets. PKM is positively correlated with the choice of card and emoney in the results for both data sets. We did not use the dummy variables for regions in this regression to avoid multicollinearity because PKM is measured by regions.

Table 5 (2) reports the estimates of the dummy variables for the age of the household head. Old household heads tend to correlate negatively with the choice of emoney (ages 55-59 to 90-94 years in the family household data set and ages 45-49 to 65-69 years in the single-person household data set). Young household heads tend to correlate positively with the choice of card (for ages 25-29 and 30-34 years in the single-person household data set) and old household heads tend to correlate negatively with the choice of card (ages 55-59 to 65-69 years in the single-person household data set).

Table 5 (3) shows that among the statistically significant parameter estimates for the fourth group of independent variables, the dummy variable indicating whether a

survey respondent was male is negatively correlated with the choice of emoney for the results from the family household data and positively correlated with the choice of card for the results from the single-person household data. Regarding the dummy variables indicating a survey respondent's job situation, the self-employed (works23) dummy is negatively correlated with the choices of emoney and card in the family household data set. Regarding the dummy variables indicating educational attainment, the dummy variable for university (edu5) and that for graduate school (edu6) are positively correlated with the choice of emoney, for the results using both data sets. In the single-person family data set, the dummy variable for senior high school (edu2) is positively correlated with the choice of emoney. Two dummy variables indicating the educational attainment of the spouse of a survey respondent are positively correlated with the choice of emoney for the family household data set: university (edu25) and graduate school (edu26). These results appear to show that family households with a female household head with higher educational attainment and who is not self-employed tend to use emoney.

Table 5 (4) reports that family households living in the 20 largest cities (citi1) tend to choose emoney and card, family households living in cities with more than 40,000 households (citi2) tend to choose card, and the dummy variables for the survey year show that an increasing number of survey respondents have selected the choices of emoney and card over time.

6. Demand for cash

Columns 6 to 7 and columns 12 to 13 in Tables 5 (1) through 5 (4) summarize the results for the demand for cash equation (2) using ordinary least squares (OLS) and instrumental variable methods (IV) using the STATA 13 commands `reg` and `ivreg2`, respectively, where the reported t-test statistics are robust to heteroskedasticity. In addition to the variables used to estimate equation (1), we specify dummy variables for the four aggregate choices of payment method for day-to-day transaction values less than 1,000 yen (namely, card, emoney, other, and card and emoney) for respondents that chose cash as the base group for our estimation. We use the fitted value of the regression equation (1) as the instrumental variable for the four aggregate payment methods for the IV estimation. We also use a dummy variable for respondents who

made mattress deposits (mattress) to cope with the financial crisis, to control for the large amount of cash holdings intended as savings, and dummy variables for regions instead of PKM.

The first to eighth rows in the columns 6 to 7 and 12 to 13 in Table 5 (1) show the parameter estimates for the dummy variable for the choice of payment method for day-to-day transaction values less than 1,000 yen. First, columns 6 to 7 show that using the family household data set, the parameter estimates for the dummy variable for the choice of emoney from the OLS regression and from the IV regression are both positive but not statistically significantly different from zero. Second, columns 12 to 13 show that using the single-person household data set, the parameter estimate for the dummy variable for the choice of emoney from the OLS regression is negative and statistically significantly different from zero. This suggests that emoney users have 5% lower cash holdings than cash users. However, the parameter estimate for the dummy variable for the choice of emoney from the IV regression is positive, with the probability value that the estimates are different from zero being 0.073, consistent with Fujiki and Tanaka (2014). As we believe that the choice of payment method is endogenous, we adopt the results using the IV regressions as our benchmark results. Overall, we conclude that a family household that chooses emoney does not generally have greater cash holdings than a household that chooses cash, when all other household characteristics are held constant. We also obtain weak evidence that a single-person household that chooses emoney does have greater cash holdings than a household that chooses cash, holding all other variables constant.

As the choice of payment method is endogenous, we focus on the results obtained from the IV regressions below. The parameter estimates for mattress deposit dummies are statistically significant and positively correlated with average cash holdings in both data sets. The parameter estimates for $\ln y$ and the square of $\ln y$ are significant in both data sets. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to an increase in demand for money if $\ln y$ exceeds 2.96 (193 thousand yen) or is above the 14th percentile of $\ln y$ in the family household data set, and that an increase in $\ln y$ leads to a decrease in demand for money for all values of $\ln y$ in the single-person household data set. The parameter estimates for $\ln FA$ and $\ln FA^2$ are significant in both data sets. The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest

that an increase in lnFA leads to an increase in demand for money if lnFA exceeds 3.17 (240 thousand yen) or is above the 33rd percentile of lnFA in the family household data set, and for all values of lnFA in the single-person household data set.

The remaining rows in the columns 6 to 7 and columns 12 to 13 in Table 5 (1) show that a respondent with lower debt payments, more liquid assets, and home ownership tends to have greater cash holdings in both data sets, and that a respondent who is more sensitive about service charges tends to have lower cash holdings in both data sets. A respondent who places an emphasis on online banking services offered via the Internet when selecting financial institutions tends to have higher cash holdings for the results from the family data set. The effects of knowledge of the Deposit Insurance Corporation of Japan and the dummy variables on the demand for cash vary between the two data sets. The dummy variables indicating no income (noincome) and the log of deposits (lnDep) are negatively correlated with the demand for cash, and the dummy variable for not saving money from income (nosaving) is positively correlated with the demand for cash for the single-person household data.

The columns 6 to 7 and 12 to 13 in Table 5 (2) show that older household heads tend to have greater cash holdings (from 70-74 and 80-89 years for the family household data and from 50-54 to 65-69 years for the single-person household data) in the IV regressions. This is consistent with the result that an older household head tends to choose cash, holding all other variables constant.

Columns 6 to 7 and 12 to 13 in Table 5 (3) show that a family household with a self-employed (works13) household head who has completed senior high school (edu2) or junior college (edu4) tends to have greater cash holdings, while a family household in which the spouse of the household head is a part-time worker (works22) tends to have lower cash holdings. The table also shows that a single-person household with a male household head tends to have greater cash holdings, while a single-person household consisting of a full-time worker (works11) or a student (works14) with an educational attainment other higher than junior high school (edu2-edu6) tends to have lower cash holdings.

Columns 6 to 7 and 12 to 13 in Table 5 (4) show that family households living in REGION2, 3, 5, 6, 7 and 8 tend to hold large amounts of cash. It also shows that single-person households living in REGION6 have greater cash holdings.

7. Conclusion

What are the determinants of the choice of payment method? Would the use of electronic money for day-to-day transactions with values less than 1,000 yen reduce the demand for cash by households?

To respond to these questions, we used repeated Japanese cross-sectional data sets obtained from the Survey of Household Finance conducted by the Central Council for Financial Services Information from 2007 to 2014. We first estimated the probability that a consumer would choose a particular payment method, such as cash, credit card, or electronic money, using a multinomial logit model. We then estimated the demand for cash to test whether the use of electronic money for day-to-day transactions with values less than 1,000 yen reduced the demand for cash. We obtained the following results.

First, the major payment choices for low-value day-to-day transactions, typically those less than 1,000 yen, comprise three payment instruments: cash, electronic money, and credit card. Second, high-income, financially sophisticated, and well-educated family households living in urban areas tend to use both electronic money and cash. High-income, financially sophisticated, and well-educated single-person households tend to use both electronic money and cash. Third, a family household that chooses electronic money and cash does not generally have greater cash holdings than a household that exclusively chooses cash, holding all other household characteristics constant. We obtain weak evidence that a single-person household that chooses electronic money and cash generally has greater cash holdings than a comparable household that exclusively chooses cash.

These findings should be interpreted in light of the following reservations. We should not take these estimates as representative of the overall impact of developments in noncash payments on the Japanese demand for cash, as they do not include the demand for cash by firms, or mattress savings by households because our model excludes samples with cash holdings greater than 9 million yen from the estimations.

References

Arango, Carlos, Kim Huynh, Ben Fung, and Gerald Stuber, 2012. The changing landscape for retail payments in Canada and the implications for the demand for

- cash. Bank of Canada, Bank of Canada Review, Autumn 2012.
- Attanasio, Orazio P., Guiso Luigi, and Jappelli Tullio, 2002. The demand for money, financial innovation, and the welfare cost of inflation: an analysis with household data. *Journal of Political Economy* 110 (2), 317-351.
- Bank of Japan, Payment and Settlement Systems Department, 2017, Saikin no debit card doukou ni tsuite (in Japanese, Recent development on Debit Card), <http://www.boj.or.jp/research/brp/psr/data/psrb170501a.pdf>
- Chen, Heng, Marie-Helene Felt, and Kim P. Huynh, 2014. Retail payment innovations and cash usage: accounting for attrition using refreshment samples. Bank of Canada Working Paper No. 2014-27.
- Ching, Andrew T., and Fumiko Hayashi, 2010. Payment card rewards programs and consumer payment choice. *Journal of Banking and Finance* 34 (8), 1773-1787.
- Cohen, Michael Andrew, and Marc Rysman, 2013. Payment choice with consumer panel data. Federal Reserve Bank of Boston, Working Paper No. 13-6.
- Fujiki, Hiroshi, and Migiwa Tanaka, 2014. Currency demand, new technology, and the adoption of electronic money: micro evidence from Japan. *Economics Letters* 125 (1), 5-8.
- Fujiki, Hiroshi, and Migiwa Tanaka, 2016a. How do we pay under evolving retail payment technology? Evidence from Japan, mimeo.
- Fujiki, Hiroshi, and Migiwa Tanaka, 2016b. Choice of payment instrument for low-value transactions in Japan, mimeo.
- Fung, Ben S. C., Huynh Kim P, and Sabetti Leonard, 2012. The impact of retail payment innovations on cash usage. Bank of Canada, Working Paper No. 2012-14.
- Humphrey, David B., 2010. Retail payments: new contributions, empirical results, and unanswered questions. *Journal of Banking and Finance* 34 (8), 1729-1737.
- Koulayev, Sergei, Marc Rysman, Scott Schuh, and Joanna Stavins, 2016. Explaining adoption and use of payment instruments by U.S. consumers. *The RAND Journal of Economics* 47 (2), 293-325.
- Lippi, Francesco, and Secchi Alessandro, 2009. Technological change and the households' demand for currency. *Journal of Monetary Economics* 56 (5), 222-230.
- Merton, Robert C., 1992. *Continuous-Time Finance*, Revised edition, Blackwell.
- Otani, Akira, and Takashi Suzuki, 2008. Background to the high level of banknotes in

- circulation and demand deposits, Bank of Japan, Bank of Japan Review, 2008-E-5.
https://www.boj.or.jp/en/research/wps_rev/rev_2008/data/rev08e05.pdf.
- Nikkei BP, 2015. Study Group on the Cashless Revolution 2020, Khasyules Kakumei 2020 (Cashless Revolution in 2020) (in Japanese), Nikkei BP.
- Stix, Helmut, 2004. How do debit cards affect cash demand? Survey data evidence. *Empirica* 31 (2), 93-115.
- Wakamori, Naoki, and Angelika Welte, 2016. Why do shoppers use cash? Evidence from a shopping diary. *Journal of Money, Credit and Banking*, in press.

Table 1 Choice of payment method for day-to-day transactions: Family household data

< 1,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.827	0.862	0.869	0.839	0.800	0.806	0.776	0.766
em and cash	0.021	0.021	0.025	0.046	0.049	0.061	0.072	0.087
card and cash	0.023	0.022	0.023	0.030	0.031	0.032	0.032	0.039
em only	0.002	0.003	0.003	0.005	0.009	0.008	0.012	0.013
card only	0.005	0.005	0.006	0.007	0.008	0.009	0.011	0.011
N.A.	0.118	0.083	0.069	0.066	0.096	0.079	0.091	0.074
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900
1,000 - 5,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.752	0.791	0.775	0.747	0.713	0.723	0.696	0.658
card and cash	0.084	0.072	0.084	0.090	0.096	0.090	0.103	0.102
card only	0.036	0.044	0.051	0.053	0.056	0.058	0.060	0.078
em and cash	0.010	0.010	0.016	0.029	0.028	0.042	0.043	0.062
em and card	0.001	0.003	0.003	0.005	0.007	0.006	0.009	0.014
em only	0.001	0.003	0.003	0.006	0.006	0.007	0.010	0.013
N.A.	0.110	0.075	0.065	0.067	0.091	0.071	0.076	0.068
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900
5,000 - 10,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.665	0.708	0.689	0.664	0.624	0.645	0.596	0.573
card only	0.094	0.102	0.109	0.121	0.130	0.132	0.145	0.159
card and cash	0.114	0.098	0.124	0.124	0.124	0.122	0.139	0.137
em and cash	0.005	0.004	0.008	0.012	0.010	0.016	0.016	0.030
em only	0.000	0.002	0.003	0.004	0.004	0.004	0.008	0.012
N.A.	0.113	0.079	0.061	0.064	0.093	0.070	0.083	0.072
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900
10,000 - 50,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.491	0.510	0.499	0.485	0.439	0.448	0.408	0.388
card only	0.248	0.263	0.266	0.279	0.290	0.306	0.319	0.341
card and cash	0.146	0.130	0.156	0.149	0.153	0.161	0.167	0.166
em and cash	0.002	0.001	0.003	0.004	0.006	0.003	0.006	0.010
other only	0.009	0.014	0.009	0.011	0.006	0.008	0.012	0.010
N.A.	0.093	0.071	0.054	0.060	0.089	0.062	0.075	0.066
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900
< 50,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
card only	0.337	0.352	0.375	0.383	0.381	0.411	0.419	0.436
cash only	0.392	0.408	0.389	0.380	0.354	0.359	0.315	0.317
card and cash	0.120	0.110	0.117	0.123	0.124	0.119	0.130	0.122
other only	0.028	0.032	0.032	0.028	0.021	0.022	0.026	0.024
N.A.	0.101	0.075	0.064	0.064	0.097	0.069	0.088	0.074
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900

Notes: em = electronic money; card = credit card. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

Table 2 Choice of payment method for day-to-day transactions: Single-person household data

< 1,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.668	0.648	0.622	0.578	0.546	0.502	0.503	0.467
em and cash	0.175	0.189	0.204	0.222	0.230	0.262	0.227	0.250
card and cash	0.078	0.085	0.080	0.092	0.103	0.111	0.116	0.107
card only	0.031	0.026	0.027	0.031	0.038	0.042	0.050	0.058
em only	0.023	0.021	0.030	0.031	0.033	0.032	0.034	0.040
em and card	0.011	0.010	0.016	0.021	0.024	0.026	0.029	0.032
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
1,000 - 5,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
cash only	0.540	0.506	0.502	0.475	0.434	0.423	0.380	0.370
card and cash	0.202	0.214	0.202	0.210	0.209	0.225	0.228	0.211
card only	0.130	0.134	0.137	0.135	0.159	0.145	0.180	0.169
em and cash	0.071	0.086	0.089	0.096	0.104	0.124	0.110	0.117
em and card	0.031	0.030	0.034	0.046	0.043	0.042	0.044	0.061
other only	0.011	0.010	0.013	0.017	0.020	0.017	0.024	0.034
em only	0.012	0.015	0.020	0.014	0.022	0.019	0.029	0.032
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
5,000 - 10,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
card only	0.252	0.267	0.275	0.283	0.304	0.298	0.347	0.333
cash only	0.436	0.420	0.424	0.390	0.364	0.362	0.321	0.315
card and cash	0.235	0.246	0.218	0.237	0.234	0.246	0.221	0.213
em and cash	0.025	0.024	0.028	0.026	0.027	0.035	0.033	0.043
other only	0.012	0.011	0.016	0.021	0.020	0.018	0.028	0.038
em and card	0.024	0.021	0.026	0.029	0.030	0.024	0.029	0.034
em only	0.011	0.008	0.010	0.007	0.014	0.014	0.017	0.018
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
10,000 - 50,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
card only	0.446	0.444	0.464	0.452	0.472	0.460	0.483	0.484
cash only	0.287	0.282	0.289	0.277	0.261	0.248	0.256	0.254
card and cash	0.203	0.215	0.182	0.206	0.200	0.223	0.180	0.166
other only	0.016	0.020	0.019	0.024	0.025	0.026	0.035	0.043
em and cash	0.011	0.010	0.014	0.008	0.006	0.010	0.011	0.018
em and card	0.024	0.018	0.020	0.019	0.018	0.016	0.018	0.017
em only	0.009	0.007	0.006	0.005	0.008	0.011	0.010	0.012
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
< 50,000 yen								
	2007	2008	2009	2010	2011	2012	2013	2014
card only	0.539	0.528	0.549	0.556	0.561	0.550	0.559	0.555
cash only	0.251	0.254	0.256	0.242	0.235	0.226	0.244	0.241
card and cash	0.133	0.144	0.115	0.130	0.126	0.140	0.112	0.105
other only	0.032	0.037	0.040	0.043	0.040	0.046	0.054	0.063
em and cash	0.007	0.007	0.006	0.005	0.005	0.006	0.006	0.010
em and card	0.018	0.012	0.012	0.009	0.010	0.008	0.009	0.010
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500

Notes: em = electronic money; card = credit card. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

Table 3 Proportions of observations for aggregated payment method choices for day-to-day transactions less than 1,000 yen

Family household data									
	2007	2008	2009	2010	2011	2012	2013	2014	Total
cash	0.938	0.940	0.934	0.900	0.886	0.875	0.854	0.828	0.893
card	0.031	0.030	0.032	0.039	0.043	0.045	0.047	0.054	0.040
emoney	0.026	0.026	0.031	0.055	0.065	0.074	0.093	0.108	0.060
other	0.004	0.003	0.002	0.004	0.005	0.003	0.004	0.007	0.004
card+em	0.000	0.001	0.002	0.002	0.002	0.003	0.002	0.004	0.002
N	2,861	3,498	3,699	3,707	3,384	3,561	3,487	3,606	27,803

Single-person household data									
	2007	2008	2009	2010	2011	2012	2013	2014	Total
cash	0.668	0.648	0.622	0.577	0.546	0.502	0.503	0.467	0.567
card	0.111	0.112	0.108	0.124	0.141	0.153	0.168	0.166	0.135
emoney	0.200	0.214	0.236	0.257	0.268	0.298	0.266	0.296	0.254
other	0.011	0.016	0.018	0.020	0.021	0.020	0.034	0.038	0.022
card+em	0.011	0.010	0.016	0.021	0.024	0.026	0.029	0.032	0.021
N	2,500	2,499	2,499	2,499	2,500	2,498	2,500	2,500	19,995

Notes: Cash (card) is the proportion of respondents who chose cash exclusively (credit card, cash and credit card, or credit card and other); emoney (other) is the proportion of respondents who chose emoney exclusively, cash and emoney, or emoney and other (other and cash and other); card + em is the proportion of respondents who chose credit card and emoney.

Table 4 (1) Summary statistics for the SHF from 2007 to 2014

	Family household		Single-person household	
	Mean	S.E.	Mean	S.E.
cash	13.580	39.228	17.548	60.298
cash user	13.676	39.709	17.927	60.856
card user	14.618	41.888	19.436	64.860
emoney user	11.047	19.931	15.517	55.509
other user	23.261	94.002	19.059	65.662
card+em user	7.851	14.571	18.142	63.875
mattress	0.013	0.115	0.013	0.114
income	446.276	367.477	283.559	485.083
FA	1081.821	2050.009	726.999	2556.910
debtpay	32.544	96.516	15.968	292.536
liqratio	0.721	0.334	0.667	0.299
DI no	0.194	0.395	0.285	0.451
cheapbk	0.092	0.289	0.183	0.386
intbk	0.075	0.264	0.370	0.483
account	0.782	0.413	0.965	0.184
noincome	0.006	0.078	0.066	0.248
nosaving	0.242	0.429	0.340	0.474
Dep	558.721	1169.942	326.585	1212.707
homeowner	0.721	0.448	0.250	0.433
PKM	85152.970	86158.910	110689.600	91465.220
male	0.924	0.266	0.593	0.491
works11	0.531	0.499	0.566	0.496
works12	0.062	0.242	0.097	0.296
works13	0.136	0.342	0.092	0.289
works14	0.003	0.057	0.088	0.283
works15	0.219	0.413	0.157	0.363
works21	0.148	0.355		
works22	0.243	0.429		
works23	0.049	0.216		
works24	0.001	0.034		
works25	0.393	0.488		
N	27,803		19,995	

Notes: cash, income, FA, debtpay and Dep are in units of 10,000 yen.

PKM is in units of billion passengers per kilometer.

Table 4 (2) Summary statistics for the SHF from 2007 to 2014

	Family household	Single-person household
	Mean	Mean
edu1	0.116	0.020
edu2	0.390	0.243
edu3	0.072	0.099
edu4	0.036	0.094
edu5	0.261	0.444
edu6	0.026	0.091
edu7	0.004	0.009
edu21	0.086	
edu22	0.394	
edu23	0.086	
edu24	0.133	
edu25	0.102	
edu26	0.005	
edu27	0.004	
age_25	0.003	0.139
age25_29	0.022	0.194
age30_34	0.052	0.106
age35_39	0.081	0.108
age40_44	0.095	0.073
age45_49	0.097	0.051
age50_54	0.107	0.096
age55_59	0.118	0.056
age60_64	0.129	0.122
age65_69	0.108	0.054
age70_74	0.086	
age75_79	0.055	
age80_84	0.030	
age85_89	0.011	
age90_94	0.002	
age95_	0.006	
REGION1	0.053	0.053
REGION2	0.082	0.055
REGION3	0.271	0.399
REGION4	0.053	0.029
REGION5	0.150	0.121
REGION6	0.156	0.160
REGION7	0.071	0.051
REGION8	0.032	0.026
REGION9	0.133	0.106
citi1	0.232	
citi2	0.399	
citi3	0.252	
citi4	0.117	
N	27,803	19,995

Table 5 (1) Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

	Family household data					Single-person household data						
	multinomial logit				Currency demand		multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV	card	emoney	other	card+em	OLS	IV
card					-0.0282	-1.222					-0.0111	-1.460
					(-0.80)	(-1.19)					(-0.38)	(-1.02)
emoney					0.0197	0.137					-0.0522*	1.367
					(0.68)	(0.48)					(-2.40)	(1.79)
other					-0.177	-0.00668					-0.107	-8.330***
					(-1.32)	(-0.00)					(-1.65)	(-5.01)
card+em					-0.0887	-2.339					-0.196**	0.757
					(-0.77)	(-1.13)					(-2.91)	(0.75)
mattress					0.539***	0.531***					0.559***	0.726***
					(6.92)	(6.56)					(5.89)	(4.85)
lny	0.111	-0.124*	0.141	-0.130	-0.0887***	-0.0832***	0.285*	-0.0418	-0.572**	-0.221	-0.402***	-0.558***
	(1.73)	(-2.18)	(0.80)	(-0.44)	(-6.11)	(-5.22)	(1.97)	(-0.36)	(-2.85)	(-0.67)	(-5.81)	(-4.53)
lny2	-0.0142	0.0299**	-0.0156	0.0165	0.0290***	0.0281***	-0.0391*	0.0214	0.0463	0.0333	0.0628***	0.0677***
	(-1.34)	(3.22)	(-0.52)	(0.32)	(11.72)	(10.41)	(-2.52)	(1.77)	(1.92)	(0.99)	(7.89)	(4.84)
lnFA	-0.138*	-0.218***	-0.0650	-0.0903	-0.0752***	-0.0794***	0.0871	-0.0494	-0.448**	0.456*	0.520***	0.463***
	(-2.42)	(-4.43)	(-0.41)	(-0.40)	(-5.60)	(-5.54)	(1.14)	(-0.86)	(-3.06)	(2.00)	(16.57)	(9.43)
lnFA2	0.0202***	0.0148**	0.0178	0.00312	0.0242***	0.0250***	0.00691	0.000643	0.0166	-0.0241	0.0139***	0.0198***
	(3.76)	(3.15)	(1.06)	(0.13)	(19.33)	(16.95)	(1.09)	(0.13)	(1.30)	(-1.32)	(4.84)	(4.08)
lndebtpay	0.0273	0.0612***	-0.127*	0.00365	-0.0132***	-0.0125***	-0.00839	0.0206*	-0.109**	0.0533	-0.0375***	-0.0632***
	(1.91)	(5.20)	(-2.16)	(0.06)	(-3.79)	(-3.32)	(-0.61)	(1.98)	(-3.09)	(1.83)	(-7.18)	(-6.97)
liqratio	-0.260	-0.781***	-0.229	-0.829	0.328***	0.321***	-0.350**	-0.451***	-0.725**	-0.742**	2.758***	2.711***
	(-1.53)	(-5.12)	(-0.42)	(-1.08)	(8.42)	(7.78)	(-3.12)	(-4.91)	(-2.66)	(-2.78)	(46.87)	(26.75)
DI no	-0.457***	-0.696***	0.0763	-0.384	-0.150***	-0.160***	-0.228***	-0.413***	0.546***	-0.190	-0.0167	0.209**
	(-4.49)	(-7.94)	(0.31)	(-0.97)	(-7.24)	(-6.90)	(-4.00)	(-9.19)	(4.78)	(-1.40)	(-0.73)	(2.92)
cheapbk	0.425***	0.447***	-0.664	0.718*	-0.0931***	-0.0683*	0.324***	0.381***	-0.000176	0.670***	-0.126***	-0.204**
	(4.81)	(6.14)	(-1.29)	(2.24)	(-3.95)	(-2.25)	(5.79)	(8.41)	(-0.00)	(5.89)	(-5.43)	(-3.09)
intbk	0.778***	0.804***	-0.577	1.472***	0.104***	0.162**	0.373***	0.541***	-0.0431	0.718***	0.0695***	-0.0686
	(8.96)	(11.36)	(-0.97)	(4.96)	(3.79)	(3.22)	(7.97)	(14.38)	(-0.36)	(6.78)	(3.56)	(-0.83)
account	0.156	-0.165	0.0691	-1.476	0.474***	0.474***	0.0290	0.409***	-0.598***	0.981	0.106*	-0.400**
	(0.79)	(-1.01)	(0.13)	(-1.45)	(9.14)	(8.85)	(0.21)	(3.45)	(-3.77)	(1.65)	(2.44)	(-3.10)
noincome	0.791*	0.804*	1.795**	-13.68	-0.0365	-0.0169	0.567	0.192	-1.308*	-0.327	-0.897***	-1.353***
	(2.02)	(2.06)	(2.99)	(-0.01)	(-0.35)	(-0.15)	(1.24)	(0.52)	(-2.28)	(-0.30)	(-4.47)	(-3.67)
nosaving	-0.0141	-0.410*	0.171	-1.842	0.0709	0.0661	0.314	-0.397*	-0.529	1.553	0.624***	0.662***
	(-0.06)	(-2.28)	(0.28)	(-1.81)	(1.24)	(1.12)	(1.23)	(-2.20)	(-1.46)	(1.93)	(7.15)	(4.16)
lnDep	0.0401	0.0980**	-0.0984	-0.0271	0.0126	0.0132	0.0164	0.0301	0.206*	0.0590	-0.413***	-0.396***
	(1.18)	(3.21)	(-1.15)	(-0.20)	(1.52)	(1.54)	(0.60)	(1.29)	(2.10)	(0.89)	(-23.02)	(-18.17)
homeowner	0.192*	-0.183**	-0.106	0.329	0.0843***	0.0958***	0.118	-0.110*	0.209	0.0601	0.232***	0.325***
	(2.37)	(-2.82)	(-0.45)	(0.98)	(4.51)	(4.58)	(1.93)	(-2.12)	(1.57)	(0.41)	(8.60)	(6.74)
PKM	1.977***	1.694***	2.888**	4.035**			1.284***	2.270***	0.771	4.163***		
	(5.48)	(5.49)	(2.58)	(2.59)			(5.24)	(11.52)	(1.42)	(7.17)		

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Table 5 (2) Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

	Family household data						Single-person household data					
	multinomial logit				Currency demand		multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV	card	emoney	other	card+em	OLS	IV
age25_29	0.593 (0.57)	-0.507 (-1.01)	-1.206 (-0.97)	-1.633 (-1.36)	-0.104 (-0.81)	-0.112 (-0.83)	0.345*** (3.63)	0.0400 (0.56)	0.174 (0.90)	0.560* (2.29)	-0.0396 (-1.12)	0.0385 (0.51)
age30_34	0.932 (0.92)	-0.221 (-0.46)	-1.559 (-1.33)	-1.718 (-1.52)	-0.0989 (-0.81)	-0.0931 (-0.72)	0.408*** (3.79)	0.0979 (1.19)	0.370 (1.67)	0.737** (2.80)	-0.0760 (-1.85)	0.0230 (0.26)
age35_39	0.911 (0.90)	-0.399 (-0.83)	-1.470 (-1.32)	-1.620 (-1.46)	-0.102 (-0.84)	-0.0906 (-0.70)	0.141 (1.28)	0.0206 (0.25)	0.255 (1.13)	0.358 (1.32)	-0.0253 (-0.59)	0.0270 (0.37)
age40_44	0.753 (0.74)	-0.401 (-0.83)	-1.725 (-1.54)	-1.973 (-1.75)	-0.0776 (-0.64)	-0.0784 (-0.61)	-0.00469 (-0.04)	0.0905 (1.00)	-0.126 (-0.46)	0.177 (0.60)	-0.0612 (-1.32)	-0.116 (-1.48)
age45_49	0.704 (0.69)	-0.464 (-0.96)	-1.255 (-1.15)	-2.138 (-1.87)	-0.0651 (-0.53)	-0.0678 (-0.53)	-0.0753 (-0.57)	-0.228* (-2.23)	-0.132 (-0.44)	-0.194 (-0.59)	-0.0870 (-1.66)	-0.0407 (-0.47)
age50_54	0.463 (0.46)	-0.725 (-1.50)	-0.922 (-0.86)	-2.931* (-2.42)	-0.00685 (-0.06)	-0.0211 (-0.16)	-0.149 (-1.26)	-0.410*** (-4.44)	0.365 (1.59)	-0.285 (-0.92)	0.0424 (0.92)	0.219* (2.39)
age55_59	0.487 (0.48)	-0.979* (-2.02)	-1.174 (-1.09)	-4.298** (-2.88)	0.101 (0.82)	0.0893 (0.69)	-0.310* (-2.32)	-0.606*** (-5.57)	0.0616 (0.22)	-0.560 (-1.53)	0.109* (2.08)	0.259* (2.27)
age60_64	0.306 (0.30)	-1.221* (-2.50)	-1.169 (-1.09)	-4.289** (-2.86)	0.226 (1.85)	0.210 (1.63)	-0.668*** (-5.40)	-0.850*** (-8.65)	0.0974 (0.42)	-0.885* (-2.56)	0.153** (3.22)	0.304* (2.14)
age65_69	-0.108 (-0.11)	-1.630** (-3.27)	-1.978 (-1.77)	-3.342* (-2.48)	0.274* (2.22)	0.245 (1.88)	-0.985*** (-6.45)	-1.240*** (-9.45)	0.243 (0.87)	-1.853*** (-3.41)	0.278*** (4.69)	0.491* (2.55)
age70_74	-0.0595 (-0.06)	-2.007*** (-3.90)	-1.198 (-1.10)	-2.507 (-1.89)	0.328** (2.64)	0.303* (2.33)						
age75_79	-0.453 (-0.44)	-1.899*** (-3.60)	-1.938 (-1.68)	-3.070 (-1.95)	0.259* (2.06)	0.222 (1.66)						
age80_84	-0.896 (-0.84)	-3.117*** (-4.45)	-0.958 (-0.85)	-15.96 (-0.02)	0.359** (2.78)	0.315* (2.32)						
age85_89	-1.083 (-0.92)	-2.488** (-3.26)	-0.976 (-0.80)	-1.331 (-0.83)	0.553*** (3.86)	0.514*** (3.45)						
age90_94	-14.36 (-0.02)	-2.208* (-1.96)	-14.89 (-0.01)	-16.22 (-0.00)	0.287 (1.45)	0.230 (1.11)						
age95_	-0.591 (-0.48)	-1.027 (-1.53)	-0.588 (-0.46)	-1.117 (-0.74)	0.0852 (0.52)	0.0579 (0.35)						

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Table 5 (3) Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

	Family household data						Single-person household data					
	multinomial logit				Currency demand		multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV	card	emoney	other	card+em	OLS	IV
male	-0.244 (-1.71)	-0.306* (-2.45)	-0.537 (-1.47)	-0.0634 (-0.10)	0.0251 (0.76)	0.0178 (0.51)	0.150** (3.12)	0.00358 (0.09)	0.397*** (3.66)	0.588*** (4.76)	0.185*** (9.66)	0.274*** (7.08)
works11	-0.192 (-1.69)	0.0628 (0.56)	-0.371 (-1.16)	0.728 (1.08)	0.00755 (0.29)	0.00272 (0.10)	-0.105 (-1.28)	0.0852 (1.19)	0.126 (0.76)	0.195 (0.85)	-0.0836* (-2.40)	-0.119* (-2.02)
works12	-0.230 (-1.43)	0.0248 (0.16)	-0.876 (-1.60)	0.549 (0.61)	-0.0816* (-2.38)	-0.0895* (-2.42)	-0.0382 (-0.40)	0.0339 (0.41)	0.0985 (0.51)	0.0977 (0.35)	-0.0246 (-0.65)	-0.0377 (-0.61)
works13	-0.231 (-1.71)	-0.206 (-1.53)	-0.112 (-0.32)	-0.750 (-0.81)	0.249*** (8.30)	0.241*** (7.74)	-0.105 (-1.07)	-0.0679 (-0.79)	0.0352 (0.17)	-0.747* (-2.27)	0.117** (2.81)	0.127 (1.94)
works14	0.188 (0.41)	-1.105 (-1.48)	-14.22 (-0.01)	-11.97 (-0.01)	0.229 (1.33)	0.251 (1.44)	-0.197 (-1.62)	0.131 (1.36)	-0.333 (-1.47)	0.393 (1.26)	-0.00700 (-0.16)	-0.202* (-2.19)
works21	-0.138 (-1.44)	-0.0806 (-1.05)	-0.0887 (-0.25)	-0.142 (-0.38)	-0.0371 (-1.63)	-0.0436 (-1.83)						
works22	-0.0808 (-0.99)	-0.0605 (-0.89)	0.0936 (0.34)	-0.752 (-1.89)	-0.0890*** (-4.65)	-0.0963*** (-4.82)						
works23	-0.444* (-2.25)	-0.348* (-2.03)	0.504 (1.19)	0.644 (0.98)	0.0398 (0.99)	0.0304 (0.72)						
works24	0.00360 (0.00)	-0.802 (-0.77)	-13.39 (-0.00)	-12.89 (-0.01)	-0.253 (-1.06)	-0.251 (-1.07)						
edu2	0.0108 (0.09)	-0.0743 (-0.67)	-0.913** (-3.22)	-0.694 (-1.26)	0.0556* (2.18)	0.0542* (1.97)	-0.140 (-0.98)	0.285* (2.22)	-0.442* (-2.12)	0.116 (0.29)	-0.0668 (-1.20)	-0.341** (-3.04)
edu3	0.123 (0.77)	0.138 (1.02)	-1.416* (-2.51)	-0.568 (-0.81)	-0.0149 (-0.42)	-0.0138 (-0.36)	-0.0629 (-0.41)	0.215 (1.58)	-0.438 (-1.83)	-0.265 (-0.61)	-0.0498 (-0.83)	-0.280* (-2.46)
edu4	0.216 (1.16)	0.130 (0.79)	-0.684 (-1.22)	0.149 (0.20)	0.106* (2.38)	0.115* (2.47)	-0.116 (-0.76)	0.207 (1.51)	-0.810** (-3.00)	-0.260 (-0.58)	-0.0103 (-0.17)	-0.307** (-2.62)
edu5	0.228 (1.74)	0.230* (1.97)	-1.036** (-2.79)	0.0102 (0.02)	0.0246 (0.84)	0.0343 (1.08)	-0.0293 (-0.21)	0.380** (3.00)	-0.501* (-2.41)	0.0529 (0.13)	-0.0396 (-0.71)	-0.334** (-2.95)
edu6	0.338 (1.72)	0.417** (2.60)	-0.623 (-0.78)	0.260 (0.36)	-0.0308 (-0.60)	-0.0132 (-0.23)	0.237 (1.54)	0.511*** (3.71)	-0.940** (-3.08)	0.496 (1.20)	-0.0664 (-1.03)	-0.419** (-3.19)
edu22	-0.0218 (-0.19)	0.0842 (0.79)	0.574 (1.92)	0.390 (0.74)	-0.00596 (-0.24)	-0.00724 (-0.28)						
edu23	0.200 (1.39)	0.142 (1.11)	0.861* (2.04)	0.224 (0.35)	0.0143 (0.42)	0.0230 (0.62)						
edu24	0.0727 (0.54)	0.0652 (0.55)	0.298 (0.63)	-0.00114 (-0.00)	0.0282 (0.89)	0.0305 (0.93)						
edu25	0.196 (1.39)	0.327** (2.69)	0.667 (1.33)	0.375 (0.63)	0.0318 (0.92)	0.0416 (1.11)						
edu26	-0.228 (-0.54)	0.615* (2.40)	-14.52 (-0.00)	0.335 (0.28)	-0.0582 (-0.54)	-0.0971 (-0.80)						

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, and *** p<0.001.

Table 5 (4) Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

	Family household data				Single-person household data							
	multinomial logit				Currency demand		multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV	card	emoney	other	card+em	OLS	IV
REGION2					0.0928*	0.0892*					0.0155	-0.0302
					(2.31)	(2.18)					(0.31)	(-0.35)
REGION3					0.184***	0.197***					0.0611	-0.0591
					(5.37)	(5.21)					(1.58)	(-0.70)
REGION4					0.0490	0.0476					0.0962	0.111
					(1.11)	(1.05)					(1.50)	(0.99)
REGION5					0.112**	0.134**					0.0717	0.0734
					(3.11)	(3.06)					(1.61)	(0.87)
REGION6					0.225***	0.231***					0.122**	0.175*
					(6.24)	(5.84)					(2.90)	(2.09)
REGION7					0.106**	0.0892*					0.0540	-0.0413
					(2.62)	(2.12)					(1.05)	(-0.46)
REGION8					0.157**	0.147**					0.0668	0.111
					(2.96)	(2.72)					(1.01)	(0.99)
REGION9					0.0656	0.0570					0.0418	-0.0632
					(1.78)	(1.50)					(0.94)	(-0.79)
citi1	0.432***	0.343**	-0.416	-0.0152	0.0190	0.0343						
	(3.40)	(3.12)	(-1.13)	(-0.03)	(0.71)	(1.12)						
citi2	0.258*	0.185	-0.0549	0.183	-0.00701	0.00133						
	(2.12)	(1.74)	(-0.17)	(0.34)	(-0.29)	(0.05)						
citi3	0.0599	0.0464	0.0730	-0.650	-0.00493	-0.00611						
	(0.46)	(0.41)	(0.23)	(-1.00)	(-0.19)	(-0.24)						
year2007	-0.761***	-1.720***	-0.642	-2.726**	0.00512	-0.0192	-0.992***	-1.130***	-1.165***	-1.950***	-0.184***	-0.182
	(-5.67)	(-12.80)	(-1.75)	(-2.62)	(0.17)	(-0.46)	(-10.92)	(-15.15)	(-5.09)	(-8.34)	(-4.87)	(-0.98)
year2008	-0.794***	-1.713***	-0.774*	-1.772**	-0.00466	-0.0284	-0.945***	-1.027***	-0.801***	-1.982***	-0.0211	-0.00594
	(-6.26)	(-13.88)	(-2.15)	(-2.75)	(-0.16)	(-0.68)	(-10.50)	(-14.03)	(-4.04)	(-8.31)	(-0.57)	(-0.03)
year2009	-0.698***	-1.476***	-1.511**	-0.942*	-0.0578*	-0.0771	-0.905***	-0.810***	-0.723***	-1.347***	-0.0543	-0.0946
	(-5.71)	(-13.04)	(-3.28)	(-1.99)	(-2.04)	(-1.88)	(-10.02)	(-11.31)	(-3.78)	(-6.65)	(-1.48)	(-0.60)
year2010	-0.414***	-0.842***	-0.710*	-0.594	-0.0546	-0.0666	-0.650***	-0.590***	-0.546**	-0.936***	-0.0741*	-0.119
	(-3.60)	(-8.87)	(-2.03)	(-1.36)	(-1.92)	(-1.92)	(-7.42)	(-8.34)	(-2.97)	(-4.99)	(-2.05)	(-0.97)
year2011	-0.358**	-0.681***	-0.358	-0.886	0.0575	0.0449	-0.422***	-0.434***	-0.529**	-0.630***	0.0472	-0.00812
	(-3.11)	(-7.31)	(-1.12)	(-1.79)	(1.93)	(1.33)	(-4.94)	(-6.17)	(-2.92)	(-3.50)	(1.26)	(-0.08)
year2012	-0.273*	-0.473***	-0.826*	-0.517	0.0411	0.0324	-0.274**	-0.235***	-0.496**	-0.502**	0.0229	-0.0664
	(-2.43)	(-5.36)	(-2.25)	(-1.19)	(1.41)	(0.98)	(-3.25)	(-3.38)	(-2.71)	(-2.84)	(0.61)	(-0.86)
year2013	-0.187	-0.235**	-0.534	-0.622	0.0329	0.0239	-0.106	-0.238***	-0.0736	-0.245	-0.0456	-0.00562
	(-1.68)	(-2.79)	(-1.57)	(-1.38)	(1.12)	(0.76)	(-1.28)	(-3.38)	(-0.46)	(-1.43)	(-1.23)	(-0.08)
_cons	-3.742***	-0.767	-2.720	-1.366	-0.316*	-0.259	-1.942***	-1.144**	0.251	-6.157***	-1.548***	-0.120
	(-3.49)	(-1.36)	(-1.91)	(-0.71)	(-2.12)	(-1.55)	(-4.30)	(-3.15)	(0.41)	(-4.84)	(-8.14)	(-0.23)
N				27803	27803	27803				19995	19995	19995
Log-likelihood				-10624						-20455.3		
Pseudo R ²				0.1192						0.0764		
R ²					0.2398	0.2051					0.2896	-0.7143
F-value					131.15	124.15					143.45	57.85

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Figure 1 Currency in circulation in Japan

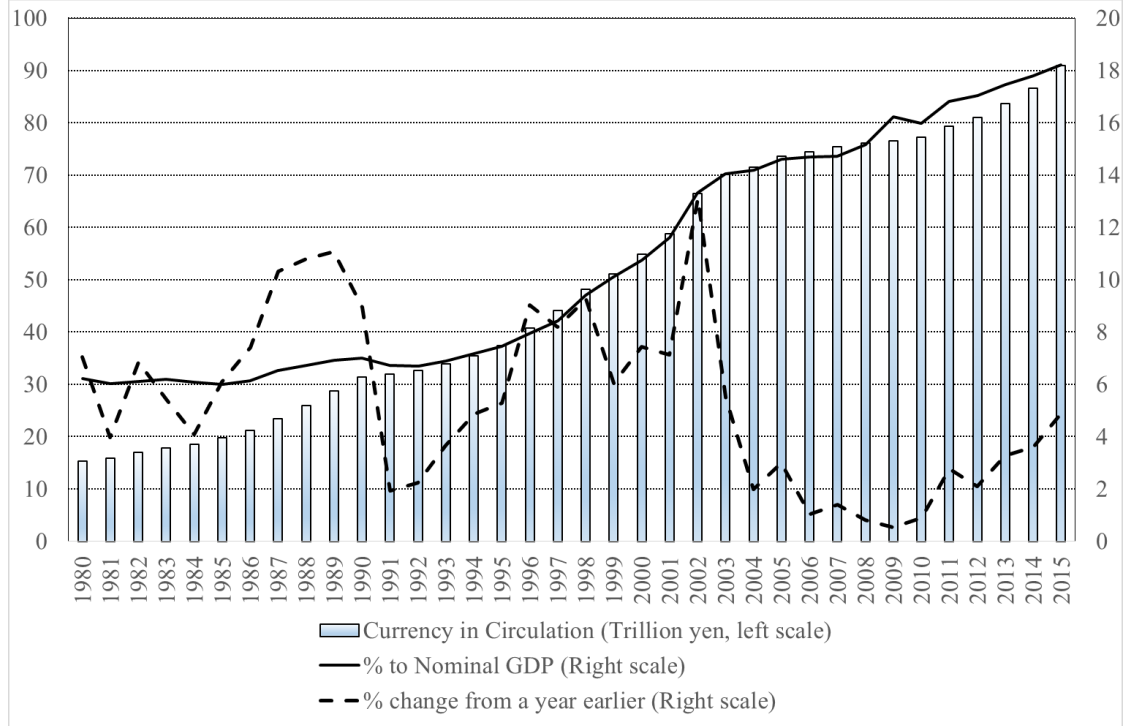


Figure 2 Share of bills and coins in circulation in Japan

