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Abstract

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Keywords: cash demand, mattress deposits, credit cards
JEL codes: D14, E41, E52

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1. INTRODUCTION

Following the global financial crisis, many researchers have pointed out that currency usage has shown a surprising recovery in most advanced economies. For example, during the period from 2002 to 2017 (Figure 1), the currency to gross domestic product (GDP) ratio increased from 14% to 19% in Japan, from 6% to 8% in the US, and from 3% to 10% in the Eurozone. Important exceptions to this trend are Canada, where the currency to GDP ratio has remained stable, and Sweden, where the currency to GDP ratio has been falling.[1] It is puzzling to note that the ratio of currency in circulation to nominal GDP increased despite the advances in noncash means of payments in Japan, the US, and the Eurozone, which would induce people to choose to pay by credit cards or debit cards, rather than cash.

Figure 1 also indicates that currency to GDP ratios accelerated following the global financial crisis in Japan, the US, and the Eurozone. However, the Japanese currency to GDP ratio was 14% in 2002, but only 6% in the US and just 3% in the Eurozone. Clearly, Japan is an advanced economy with a sophisticated banking system. Why was the Japanese currency to GDP ratio already so high in 2002?

To appreciate this finding better, the solid line in Figure 2 plots the long-run trend in the Japanese currency to GDP ratio from 1955 to 2017. By the middle of the 1990s, the currency to GDP ratio was about 6–8%, but since then it has increased steadily. In addition, in 1995 the Bank of Japan (BOJ) became the first advanced-economy central bank since World War II to set an effective zero-lower bound for the nominal interest rate, as depicted by the dashed line in Figure 2. This suggests that we need to pay close attention to the factors unique to Japan prior to the global financial crisis,

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[1] See Jobst and Stix (2017) and Goodhart and Ashworth (2017) for cross-country evidence. See Judson (2017) and Riksbank (2018) for the US and Swedish experiences, respectively. In Canada, the value of bank notes in circulation as a percentage of GDP has remained stable. Jiang and Shao (2014) provided a model that emphasizes that the substitutability between cash and other means of payment is uneven across different economic activities. If some agents use cash receipts in less cash-intensive sectors to finance spending in more cash-intensive sectors, then the total demand for money may not decrease even if cash plays a diminishing role in transactions.

to understand the reasons underpinning the steady increase in the currency to GDP ratio in Japan observed since 1995.

Why did the ratio of currency in circulation to nominal GDP increase despite the advances in noncash means of payment in Japan? We argue that the cash demand for hoarding was so strong that it outweighed the negative effect of the substitution to noncash means of payment for day-to-day payments. To support our argument, we examine the trends in cash usage in Japan with a special emphasis on cash hoarding and its substitution with electronic means of payment, such as credit cards and electronic money, using both aggregate data since 1955 and household survey data after 2007. First, we begin by illustrating the steady increase in cash in circulation in Japan, especially after 1995. Second, after listing the possible reasons for this increase, we examine the extent to which this increase could be attributable to the increase in cash hoarding (so-called mattress deposits). Third, we examine whether there were any structural breaks in the Japanese aggregate cash demand function after the mid 1990s. In particular, we test whether the income, semi-log, and log-log interest rate elasticity of aggregate cash demand changed consistently with the acceleration in cash demand. Fourth, after identifying data sources that provide breakdowns of cash holdings by individuals and firms in Japan, we provide estimates of the decrease in cash holdings for day-to-day one-off payments arising from the substitution of cash with credit cards and electronic money using the household survey data from Fujiki (2019), which is based on Fujiki and Tanaka (2018a, 2018b).

Our main findings are as follows. First, our analysis using aggregate data suggests that cash hoarding could account for as much as 42% of the total cash in circulation in Japan. Second, assuming a semi-log cash demand function, there is a significant structural change in the parameters of the Japanese cash demand function, especially its interest rate semi-elasticity in the late 1990s or early 2000s. If we instead assume a log-log cash demand function, there are no structural changes in the parameters of the cash demand function, suggesting that its implied interest rate semi-elasticity, defined as the interest rate elasticity divided by the interest rate, became very large in the late 1990s and early 2000s. Third, our back-of-the-envelope

calculations of the maximum impact of possible decreases in cash demand for daily one-off payments on the substitution from cash to noncash payment methods may not be so large, and at most 0.4% of the total cash in circulation in 2017 in Japan.

Using these findings to forecast the trends in cash usage in Japan, we argue that the BOJ should be more concerned about the decline in cash hoarding, for example, because of the increase in the policy interest rate in the future, than any substitution of cash for credit cards in daily transactions. An important reservation is that our evidence concerning the substitution of cash for noncash payments implicitly relies on the technology available in the period 2007–2017. Of course, it would be possible to further reduce the demand for cash for person-to-person (P2P) transactions if some new technology were to prevail, say, P2P electronic bank transfers using a cellphone QR code app developed by large Japanese banks.

Before moving on to the details of our analysis, let us briefly touch on the Japanese demand for cash literature. Empirical studies on the demand for cash as financial technologies evolve include Fujiki and Tanaka (2018a, 2018b, 2014) and Fujiki (2019), who used the Survey of Household Finance to examine the substitution of cash for electronic money and credit cards, while Nakata (2012) employed a panel data set and found that electronic money users held as much cash as nonusers. Other studies employed Japanese aggregate time-series cash data, such as Kitamura et al. (2009) and Nanba and Watanabe (2011).

The remainder of the paper is organized as follows. Section 2 reports our aggregate data evidence. Section 3 discusses Japanese data sources that break down cash demand by sector. Section 4 reports our evidence using household survey data. Section 5 concludes the paper.

2. AGGREGATE DATA EVIDENCE

2.1. Aggregate cash holdings

Figure 2 shows the ratio of currency in circulation to nominal GDP in Japan (solid line) and Japanese policy interest rate (dashed line). As shown, the ratio of currency

to nominal GDP was stable up until 1995 (averaging 6.8% from 1955 to 1995), but afterwards the ratio increased steadily, reaching 19% by 2017. Figure 2 also shows that the Japanese policy interest rate has remained around zero since 1995 (averaging just 0.14% from 1996 to 2017). Several factors possibly drove the accelerating demand for currency well above the nominal economic growth rate in Japan after 1995; however, apart from this, policy interest rates were subsequently very low. From 1997 to 1998, Japan experienced a banking crisis (orange bars in Figure 2), which saw the removal of the blanket guarantee for bank time deposits in 2003 and bank ordinary deposits in 2005. While the major banks had regained much of their financial strength by 2006, the BOJ began its Quantitative and Qualitative Easing Program in April 2013 and enacted a negative interest rate policy in January 2016. Note that the ratio of currency in circulation to nominal GDP increased despite the rapid increase in online purchases in Japan, which would induce people to choose to pay by credit cards rather than cash. According to White Paper on Information and Communications in Japan 2018,[2] the percentage of households making online purchases increased from 5.3% in 2002 to 27.8% in 2016, as indicated by the solid blue line in Figure 2.

In addition to these monetary factors, the rapid growth of foreign tourism in Japan after 2014 may also relate to the increase in cash demand. Some researchers also suggest that the introduction of a social security and tax number system (the My Number system) in 2016 may also have increased the demand for cash because information on financial institution accounts under this new system is passed on to the authorities if an account holder has a My Number. As some wealthy people may prefer not to disclose their financial asset holdings to the government for many reasons, they may well have withdrawn bank deposits in exchange for cash and then retained the cash in safe deposit boxes. Alternatively, did the ratio of currency in

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[2] See the website of the Ministry of Internal Affairs and Communications of Japan for the full text of the White Paper on Information and Communications in Japan, 2018. http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2018/2018-index.html (accessed February 1, 2019).

circulation to nominal GDP increase because of an expansion of the shadow economy, rather than cash hoarding? However, Medina and Schneider (2018) show that the size of the shadow economy in Japan remained stable from 1991 to 2015, as the dotted blue line in Figure 2 shows. These episodes suggest that cash hoarding, especially in the form of 10,000 yen notes (the largest denomination note), may be prevalent in Japan. We present an estimate of possible cash hoarding in Japan in the following subsection.

2.2. Cash hoarding

We update the estimates of cash hoarding by Fujiki and Tomura (2017) using the method proposed by Otani and Suzuki (2008). Otani and Suzuki (2008) assumed that people only use 10,000 yen notes for cash hoarding, and that the transaction demand for 1,000 yen notes (the major means of day-to-day one-off transactions) and 10,000 yen notes are proportional to each other. Hence, they assume that the transaction demand for 10,000 yen notes will grow at the same rate as that for 1,000 yen notes. Otani and Suzuki (2008) set 1995 as the base year in which there was no cash hoarding in Japan, and estimated cash hoarding as the difference between the total number of 10,000 yen notes in circulation and the estimated transaction demand for 10,000 yen notes. Figure 3 illustrates the estimates of cash hoarding in Japan using this method, with 8.2% of the 19.4% ratio of currency in circulation to nominal GDP in 2017 categorized as cash hoarding. In other words, some 45 trillion of the 106 trillion yen currency in circulation in Japan in 2017, or 42% of the total cash in circulation, could result from cash hoarding.

2.3. Long-term cash demand function

In this section, we examine the long-term relationship between cash, nominal GDP, and interest rates in Japan using standard time-series analysis. The main question is whether the income (GDP) elasticity of cash demand is greater than unity after 1995, as suggested by Figure 2, and whether the interest rate elasticity of cash demand is stable after 1995. Behind this observation lies the fact that the BOJ has

kept the short-term interest rate close to zero since 1995. In this regard, several economists have examined whether Japan has been in a liquidity trap, in the sense that the demand for cash has increased substantially. For this purpose, these studies often estimate two types of money demand functions: either a semi-log money demand function as in equation (1) or a log-log money demand function as in equation (2):

$$\ln\left(\frac{Money\ stock}{PGDP}_t\right) = a0 + a1\ln(RGDP_t) + a2(Interest\ rate_t) + \varepsilon_{1t}, \quad (1)$$

$$\ln\left(\frac{Money\ Stock}{PGDP}_t\right) = b0 + b1\ln(RGDP_t) + b2ln(Interest\ rate_t) + \varepsilon_{2t}, \quad (2)$$

where *PGDP* is the GDP deflator and *RGDP* is real GDP.

For example, Nakashima and Saito (2012) and Miyao (2002, 2005) both specified M1 (the sum of cash and demand deposits) as the money stock and the nominal overnight call rate as the interest rate to estimate the interest rate elasticity in Japan using equations (1) and (2) to identify any structural breaks in the demand function after 1995. Miyao (2002, 2005) set the income elasticity of M1 (*a1* and *b1*) to one, whereas Fujiki and Watanabe (2004) used cross-sectional data across Japanese prefectures to set its value. Both studies also assumed that the income elasticities were constant and tested whether the interest rate elasticities increased substantially after 1995. Elsewhere, Nakashima and Saito (2012) examined the Japanese money demand function assuming both unitary and nonunitary income elasticities. In this paper, we extend this literature to estimate real banknote demand rather than real M1 demand in Japan as in Fujiki and Tomura (2016). We estimate equations (1) and (2) using cash as a proxy for the money stock. In doing so, we use bootstrap procedures that take into account small-sample bias in testing the null hypothesis of no cointegration against the alternative hypothesis of cointegration with breaks, in testing the null hypothesis of parameter constancy against the alternative of structural changes in parameters, and in estimating the confidence intervals of currency demand functions following Nakashima and Saito (2012), Appendix A1 to A3. See also Nakashima (2019) for details on the estimations.

Table 1 reports the mean, standard error (s.e.), minimum, maximum, and number of observations (N) of the variables of interest. Specifically, *lncr* is the log of cash in circulation deflated by *PGDP*, and *Lnyr* is the real GDP for the calendar year.[3] *Policyrate* is Japanese policy interest rates.[4] *Lnpolicyrate* is the log of *policyrate*. The sample period is from 1955 to 2015; thus, we have 61 observations because *policyrate* takes negative values after 2016 because of the BOJ's introduction of the negative interest rate policy in January 2016.

Before examining the income elasticity and interest rate elasticity of cash demand, we establish the existence of a unit root and a cointegrating relationship for cash, a scale variable, and interest rates. We first conduct unit root tests for each of the variables: the log of cash in circulation (*lncr*), real GDP (*Lnyr*), the level of the policy rate (*Policyrate*), and the log of the policy rate (*Lnpolicyrate*). We perform conventional tests including the augmented Dickey–Fuller and Phillips–Perron tests, and confirm that each variable has a unit root.

To establish the existence of a long-run relationship between cash, real GDP, and the policy rate, we apply Gregory and Hansen's (1996) test to equations (1) and (2) in Table 2. The null hypothesis is no cointegration and the alternative hypothesis is cointegration with breaks. We reject the null hypothesis of no cointegration for semi-log equation (1) at the 5% level of significance based on the critical values of the bootstrap distribution constructed by Nakashima and Saito (2012). For log-log equation (2), we also reject the null hypothesis at the 10% level of significance based on the critical values of the bootstrap distribution.

Given the rejection of the null hypothesis of no cointegration for both equations (1) and (2), we conduct parameter instability tests for all parameters (hereafter, we call this test the pure structural change test) and for one of the three parameters in

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[3] Real GDP in 2017 are first estimates, real GDP data from 1980 to 2016 use the 2011 National Accounts of Japan (SNA) database final estimates, and real GDP data from 1955 to 1979 are estimates from applying the annual growth rates in the 1968 SNA database to the 1980 data.

[4] The policy rate uses the following series: the basic discount and loan rate from 1955 to 1959, the call rate (collateralized overnight, average) from 1960 to 1984, and the call rate (uncollateralized overnight, average) from 1985 to 2017.

the cash demand function (hereafter, we call this test the partial structural change test). We assume that the timing of a structural break is treated as unknown and adopt the Sup-F test based on the largest F-Statistics in the middle-70 percent of the full sample. Table 3 reports the results of the parameter instability tests. The left panel shows the test results based on fully modified OLS (FMOLS) and the right panel shows the test results based on dynamic OLS (DOLS), where k is the number of leads and lags in estimating DOLS.

For semi-log equation (1), we find evidence for pure structural change in 1998, 2000, or 2001 based on the 10% critical values of the bootstrap distribution constructed by Nakashima and Saito (2012). We also find evidence for partial structural changes in the semi-log interest rate elasticity of cash demand in 1996 or 1998 based on the 10% critical values of the bootstrap distribution in both estimation methods. Overall, the test statistics for pure structural changes and partial structural changes suggest that there are pure structural changes in the late 1990s or early 2000s, which could be associated with the partial structural changes in the semi-log interest rate elasticity of currency demand in those periods. In contrast, for log-log equation (2), we find no evidence for pure structural changes and partial structural changes.

Using these results, we estimate the cointegration coefficients using FMOLS and DOLS before and after the pure structural changes using semi-log equation (1). For log-log equation (2), we use the full sample period because we find no evidence for pure structural change and partial structural change. Table 4 details the results from FMOLS (left panel) and those from DOLS (right panels, where k is the length of lags and leads) for equations (1) and (2). In this table, we report point estimates for the cointegration coefficients, their asymptotic confidence intervals, and bootstrap confidence intervals following Nakashima and Saito (2012). Regarding the results for equation (1), the point estimates before the pure structural changes are reasonably robust with respect to the choice of estimation method. However, the point estimates and bootstrap confidence intervals after the pure structural changes vary significantly depending on estimation method. The results indicate the difficulty of

approximating a Japanese cash demand function by fitting two linear semi-log cash demand functions before and after the pure structural changes around the end of the 1990s and early 2000s. In contrast, regarding the results for log-log equation (2), the point estimates are robust with respect to the choice of estimation method. The results suggest that the income elasticity of cash demand is about 1, and the interest elasticity of cash demand is about −0.1. If we divide the interest rate elasticity obtained from a log-log cash demand function by the policy interest rate, we can approximate the conventional semi-log interest rate elasticity of cash demand function (hereafter, implied interest rate semi-elasticity). The stable log interest rate elasticities lead to extremely small values of the implied interest rate semi-elasticities after the mid 1990s, especially around 2001 to 2006, when the BOJ conducted the first round of quantitative easing, from 2001 to 2006, as summarized in Table 5. For example, the implied interest rate semi-elasticity obtained by FMOLS was –153.333 in 2005, when the call rate was 0.00075%, and fell to –0.243 in 2007. After the introduction of comprehensive easing in 2010 and quantitative and qualitative easing in 2013, the implied semi-elasticities increased again to around –1.5 in 2015. Behind these relatively small changes in semi-elasticities compared with the changes from 2001 to 2006 lies the fact that the BOJ started paying interest on excess reserve balances in 2008, and the policy rate at that time was well above zero until the introduction of the negative interest rate policy in 2016.

In summary, if we assume a semi-log cash demand function as per equation (1), the parameter estimates of the income elasticities of the cash demand functions before the pure structural changes are reasonably stable around one. However, there is a partial structural change in the semi-log interest rate elasticity of cash demand in 1996 or 1998. This is broadly consistent with the assumption made by Otani and Suzuki (2008), who set 1995 as the base year marking the beginning of cash hoarding in Japan. If we instead assume a log-log cash demand function as per equation (2), there is no evidence for pure structural change or partial structural change, and the long-run income elasticity of the demand for cash is one. However, the implied interest rate semi-elasticity of cash demand takes extremely small negative values,

especially during the period of the first round of quantitative easing from 2001 to 2006. Overall, an accelerating growth rate in the demand for cash that exceeds the nominal economic growth rate after the mid 1990s could be explained by a combination of a stable unitary income elasticity of cash demand and very large implied interest rate semi-elasticity of cash demand in the low interest rate period.

The long-run stability of M1 demand has also been the subject of investigation in many other economies. In the US, for example, Ireland (2009) and Lucas (2000) examined whether the semi-log or log-log money demand function was the better specification assuming that the income elasticity of M1 is one. More recently, Benati et al. (2017) explore the long-run demand for M1 using a dataset of 32 countries since 1851, including Japan. Our results are partly consistent with Jobst and Stix (2017), who find stable cash demand in economies with no record of financial crisis and an increase in cash demand for economies experiencing a financial crisis in 2008. Note that there were very few financial institution failures in 2008 in Japan; therefore, we should date the beginning of the Japanese financial crisis as earlier than 2008.

We can use our estimates of log-log equation (2) to infer that cash demand would decrease if the BOJ successfully achieved its inflation target of 2% and gradually increased short-term interest rates, because of the stability of our estimated log-log cash demand functions. Note that the log-log cash demand functions fit the pre-1995 data closely, with a cash–GDP ratio of about 8% and positive nominal interest rates, which represent normal economic conditions in Japan. One might wonder if the log-log cash demand functions are stable after the introduction of negative interest rate policy in 2016. However, Saito (2017) showed that the cash–GDP ratio from 1930 to 1955 was stable at around 10% except for around World War II; therefore, an 8% cash–GDP ratio may be a reasonable prediction of future values of the ratio.

Note that in 2016, Japan's Prime Minister, Shinzo Abe, announced a plan to increase Japanese GDP to 600 trillion yen by 2020. If his plan succeeds and if the BOJ helps the Japanese economy escape its current liquidity trap, then it is more likely that the demand for cash could fall to 8% of nominal GDP. In this case, there

would be 48 trillion yen (= 600 trillion yen of GDP × 8%) of cash in circulation in Japan, which is about 50% of the average cash in circulation in April 2018 of about 99 trillion yen. An additional concern is the extent to which some new form of payment instrument could reduce the demand for cash more than these estimates predict. It is for this reason we examine the substitution of cash and noncash payment methods in Section 4.

3. DEMAND FOR CASH BY FIRMS AND HOUSEHOLDS

In this section, we review Japanese statistics that break down the demand for cash by firms and households. We begin by discussing the Flow of Funds Accounts (FFA), which estimates the demand for cash by firms, and then move on to the Survey of Household Finances (SHF), which surveys the demand for cash by households.

3.1. Flow of funds accounts

The FFA, compiled by the BOJ, provides a breakdown of the cash holdings of households, private nonfinancial corporations, general government, and financial institutions. To prepare the FFA, the BOJ surveys the cash holdings of financial institutions and the general government, with the cash holdings of private nonfinancial corporations estimated using detailed information, including anecdotal evidence from private nonfinancial corporations, such as the ratio of cash holdings to sales proceeds by industry. The cash holdings of households are the difference between the total currency in circulation and the estimated cash holdings of nonfinancial private corporations, and the surveyed amount of cash holdings of financial institutions and the general government.

Figure 4 shows that as of the end of fiscal year 2016 (March 31, 2017), the share of cash holdings of financial institutions was 0.11, of private nonfinancial corporations was 0.08, of households was 0.78, and of general government was 0.03. There is a large increase in the cash holdings of households and a large decrease in the cash holdings of the private nonfinancial corporations in fiscal year 2004 (Figure

4). This is because a revision of the FFA in 2016 applied a new method of estimation to the cash holdings of sectors after the first quarter of 2005.[5]

Note that the estimates after March 2005 use detailed information, including anecdotal evidence regarding private nonfinancial corporations. Among these, the FFA uses the results of the Survey of Private Enterprise Economy by Ministry of Internal Affairs and Communications to estimate the demand for cash by private nonfinancial corporations, especially the cash–sales ratio. The survey asks approximately 4,000 private enterprises about business conditions, sales, profits, inventories, number of employees and their wages, and business investment, assets, and liabilities. As this survey focuses on private enterprises managed by families, the average number of employees reported in the survey is less than one person. Among the questions on business assets, the survey asks about cash holdings at the end of the year. Note that the definition of cash used in the survey includes cash holdings and checks; thus, the statistics overestimate the demand for cash by the firms. Table 6 provides the figures for sales, cash holdings, and the cash–sales ratio. As shown, the cash–sales ratio varies from industry to industry but ranges between 0.03 and 0.06. Note also that the number of establishments surveyed varies from industry to industry, and the number of establishments that respond to the questions on sales and cash are not the same. The cash–sales ratio reported in Table 6 is the ratio of mean sales and mean cash holdings computed from a different sample establishment.[6]

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[5] Note that the data in Figure 4 are at the end of the fiscal year; therefore, the data in 2004 correspond to the first data point of the revised data as of March 31, 2005. The breakdown of cash holdings by sector before the fourth quarter of 2004 is an estimate using the data from the Survey of Household Finances, which resulted in a larger proportion of cash holdings held by firms.

[6] Besides the Survey of Private Enterprise Economy, sources of government statistics for private enterprises include Economic Census by the Statistics Bureau, (conducted every five years) and Surveys for the Financial Statements Statistics of Corporations by Industry by the Ministry of Finance (conducted each quarter). Unfortunately, these statistics only provide information on the sum of cash and deposits; therefore, we cannot estimate the cash–sales ratio. For example, the ratio of average cash plus deposits to average sales as of fiscal year 2015 was 0.13 for manufacturing firms and 0.14 for nonmanufacturing firms. These numbers are far higher than those reported in the Survey of Private Enterprise Economy.

3.2. Survey of Household Finances

The Central Council for Financial Services Information (CCFSI) provides data on average cash holdings of Japanese single-person households from 2007 and family households from 1991 to 1994, 1996, and after 1998 in their SHF statistics.[7] The survey method for the family household data changed in 2004 and 2007; therefore, we depict three series of cash holdings for family households in Figure 5: family household 1 (red line), family household 2 (blue line), and family household 3 (black solid line), respectively, along with a series for single-person households (black dashed line).

Figure 5 illustrates that the demand for cash increased from the mid 1990s (see the red and blue lines), which is consistent with the trends in the aggregate cash in circulation. However, the family household data after 2007 (black solid line) suggests average cash holdings of about 150,000–190,000 yen, which is similar to the 1991–1994 data. Unfortunately, the reduction in average cash holdings by family household from 2006 to 2007 cannot be explained by changes in the survey method. Another puzzling aspect of the data after 2007 is that the average cash holdings of single-person households (black dashed line) is always larger than that of family households (black solid line). Unfortunately, we cannot compare these directly because the compilation of the data series after 2007 employs different methods. For the family household data set, the SHF used a stratified two-stage random sampling method to select 500 survey areas and then randomly selected 16 households consisting of two or more people from each area, totaling about 8,000 households. Of these, in each survey year, some 3,300 to 4,000 households responded. The single-person household data set includes 2,500 respondents from a pool of individuals registered with a survey company through the Internet. In choosing the 2,500 respondents, the SHF

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[7] The Japanese government does not publish data on the demand for cash by households. The National Survey of Consumption by the Statistics Bureau (conducted every five years) asks respondents about the stock of cash holdings, but the data are not available. The Family Income and Expenditure Survey by the Statistics Bureau (conducted each month) asks respondents about their stock of financial assets, including deposits, insurance, bonds, and stocks, but does not include a question about the amount of cash holdings.

equalizes the distribution of the respondents' ages (20 to 69 years), genders, and regions to the age, genders and regional distribution of the Japanese population measured by the Japanese Census. Therefore, the single-person household data set tends to include younger people and others accustomed to using the Internet compared with the family household data set.

One may ask precisely why the Japanese tend to use cash for daily transactions. Regarding this, the 73rd Opinion Survey on the General Public's Views and Behavior, conducted by the BOJ in March 2018 included an ad hoc question, "Why do you use cash to make daily payments? Choose all applicable answers." Figure 6 visually summarizes the results. According to this survey, 73.7% of respondents appreciated the finality of cash payment, 63.8% valued its general acceptance, 49.0% said the use of cash prevented overspending, and 37.8% preferred its low transaction cost. Note that Henk and Hernández (2017) (especially their Chart 37) reported a similar result regarding the reasons why people use cash for daily transactions in the Eurozone.

4. DEMAND FOR CASH BY HOUSEHOLDS: EVIDENCE FROM THE SURVEY OF HOUSEHOLD FINANCES

Fujiki (2019) employed repeated individual cross-sectional data sets from the SHF from 2007 to 2017, which asked respondents to identify their two most frequently used payment methods for day-to-day transactions, along with their demographic information and their amount of cash holdings. The study first examined the determinants of the choice of payment method by regressing an indicator variable of the choice of payment method, such as cash, credit cards, or electronic money, on household demographic variables using a multinomial logit model. To quantify the effect of the substitution from cash and noncash payment methods for daily payments on cash demand, it compared the cash holdings of households that exclusively used cash for their daily payments (cash only users) with the cash holdings of households that also used noncash payment methods. It paid particular attention to the fact that the choice of payment method is an endogenous decision made by households.

Specifically, Fujiki (2019) extended the analysis of Fujiki and Tanaka (2018b), which examined the substitution between cash and credit cards for day-to-day transactions using family household data (they did not obtain consistent results using the single-person household data) by adding analysis on the substitution between cash and electronic money, increasing the length of the sample periods, and modifying several explanatory variables to increase the sample size. In this paper, we begin our analysis by examining the major choice of payment methods for day-to-day transactions, and then reporting whether the users of credit cards or electronic money would have lower average cash holding than the cash only users based on Fujiki (2019).

4.1. Choice of payment method for day-to-day one-off payments

Fujiki (2019) used the SHF 2007–2017 family household data set and examined the choice of payment method for day-to-day one-off transactions. The original survey asks respondents to identify their two most frequently used payment methods. These are for day-to-day transaction values of less than or equal to 1,000 yen, more than 1,000 yen and less than or equal to 5,000 yen, more than 5,000 yen and less than or equal to 10,000 yen, more than 10,000 yen and less than or equal to 50,000 yen, and more than 50,000 yen. The four different payment methods are cash, credit card, electronic money (including debit card), and other. Hereafter, we refer to these transaction values intervals as less than 1,000 yen, between 1,000 and 5,000 yen, between 5,000 and 10,000 yen, between 10,000 and 50,000 yen, and more than 50,000 yen. Note that for this question, the SHF's definition of electronic money (typically a prepaid card with noncontact IC forms based on near-field communication technology) includes debit cards (typically a cash withdrawal card accepted only within Japan, not an international brand debit card). Fujiki (2019) assumed that the SHF data more effectively capture the use of prepaid cards than debit cards as in Fujiki and Tanaka (2018a, 2018b). This is because the value of transactions made by J-Debit, the major brand in Japanese debit cards, has been falling steadily 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.

The main findings in Fujiki (2019) are as follows. First, survey respondents tend to select cash and/or electronic money for transactions of less than 1,000 yen and cash and/or credit card for transactions of more than 10,000 yen, as Figure 7 shows. The use of cash for low-value transactions and the use of noncash payment methods for higher value transactions is also evident in many other economies (see Henk and Hernández (2017) for the Eurozone, Greene et al. (2017) for the US, and Henry et al. (2018) for Canada). Second, Fujiki (2019) then constructed an aggregate dummy variable for the choice of the five payment methods. These are cash only (respondents chose cash exclusively), card (respondents chose credit card exclusively, cash and credit card, or credit card and other), electronic money (respondents chose electronic money exclusively, cash and electronic money, or electronic money and other), other (respondents chose other exclusively or cash and other), and card and electronic money (respondents chose credit card and electronic money). Table 7 depicts the percentage of each payment method category in the family household data. As shown, cash only and card are two major choices for payments of more than 5,000 yen, and cash only, card, and electronic money are the three major choices for payments less than or equal to 5,000 yen.

Third, to examine the determinants of the choice of payment method, Fujiki (2019) estimated a multinomial logit model specifying the indicator variable of the five payment methods as the dependent variable. Fujiki (2019) included the following as independent variables: annual disposable income, amount of financial assets, dummy variables as proxies for financial knowledge,[8] whether the individual is in debt, home ownership, age, gender, occupation, educational attainment, and the size of the city of residence and number of household members. They also included dummy

[8] The dummy variables assign a value of one for those who have heard about the Deposit Insurance Corporation of Japan and what it does, for those who place an emphasis on lower service charges, and for those who consider online banking services offered via the Internet when selecting a financial institution.

variables identifying respondents who made mattress deposits to reduce investment risk,[9] the log of passengers per kilometer to control for regional variation in the accessibility of electronic money or credit cards to gauge the ease of using electronic money issued by public transportation companies and credit cards in many shops or restaurants around train stations. Compared with Fujiki and Tanaka (2018b), which focused on the effects of the use of credit cards on cash demand, Fujiki (2019) examined the impact of the use of both credit cards and electronic money on cash demand, and included more observations that did not respond to several questions by adding dummy variables for unanswered questions and replacing number of household members with household member dummies.

Fujiki (2019) found that a household with higher disposable income, more financial assets, better financial knowledge measured by knowledge of the Japanese Deposit Insurance Corporation, a younger or female head of household, higher educational attainment, not self-employed, living in a large city, and in areas with more passengers per kilometer tend to be card users (households choosing credit card exclusively, cash and credit card, or credit card and other), rather than a cash-only user (households choosing cash exclusively). Regarding the choice of electronic money for day-to-day payment values of less than 1,000 yen, similar results are obtained except for that the use of electronic money is negatively associated with the dummy variable of living in areas with more passengers per kilometer.

4.2. Substitution from cash to noncash payment methods for day-to-day one-off payments

Could we expect that the average cash holdings of households preferring to use credit cards or electronic money are lower than that for cash-only users? Fujiki (2019) estimated the demand for cash conditional on the choice of card (the cash demand of credit card users for households choosing credit cards exclusively, credit cards and

[9] They assign a value of one to respondents who increase cash holdings to reduce investment risk to themselves, either by reducing asset holdings or by suspending additional investment in other financial products.

cash, and credit cards and other methods), and conditional on the choice of cash exclusively (cash demand of a cash only user) using an empirical model similar to Dubin and McFadden (1984). Fujiki (2019) found respondents making mattress deposits to reduce investment risk, with more income and financial assets, who are not sensitive to service charges, have older household heads, and have a self-employed household head, tend to have larger average cash holdings conditional on the choice of payment method. The finding that older and rural area citizens prefer to use cash instead of noncash payment methods is also observed in many other economies (see Henk and Hernández (2017) for the Eurozone, Greene et al. (2017) for the US, and Henry et al. (2018) for Canada).

Armed with their estimates of the cash demand functions, Fujiki (2019) compared the forecast values of conditional cash demand for credit cards or cash only users. Fujiki (2019) found that holding household characteristics constant, credit card users tend to have smaller cash holdings by between 5,000 and 30,000 yen than cash-only users for day-to-day payment values of more than 1,000 yen. Using these results, Fujiki (2019) made a back-of-the-envelope calculation of the maximum impact on aggregate cash demand if all Japanese cash users became credit card users. First, according to forecasts by the National Institute of Population and Social Security Research, the number of Japanese nonsingle-person households was 34,904,000 in 2017.[10] Second, the SHF shows that about 40% of family households are cash-only users for day-to-day payment values exceeding 50,000 yen. Third, according to their estimations, a credit-card user's family household for payment values exceeding 50,000 yen tends to have cash holdings of about 30,000 yen less than a cash-only user household. Hence, if all Japanese cash-only user households for day-to-day transaction values exceeding 50,000 yen, corresponding to about 40% of Japanese family households, reduced their cash holdings by 30,000 yen as they became credit-

[10] For details of the projection of the number of Japanese households, see the website of the National Institute of Population and Social Security Research. We use the 2017 estimates for the result in http://www.ipss.go.jp/pp-ajsetai/j/HPRJ2018/hprj2018_gaiyo_kekka1.xls

card user households, the resulting decrease in overall cash demand would be 34,904,000 households × 40% × 30,000 yen/household = 419 billion yen. However, this represents just 0.4% of the 105 trillion yen in cash in circulation in Japan in 2017. Fujiki (2019) also compared the forecast values of conditional cash demand for electronic money users and cash only users, and found that holding household characteristics constant, electronic money users tended to have cash holdings of about 20,000 yen less than cash only users for day-to-day payment values less than 5,000 yen, which strengthens the results of Fujiki and Tanaka (2018a) that a family electronic money user household did not have greater cash holdings than a cash only user household, holding all other household characteristics constant.

5. CONCLUSION

Why has the ratio of currency in circulation to nominal GDP in Japan increased despite the advances in noncash means of payments? We argue that the cash demand for hoarding was so strong that it outweighed the negative effect of the substitution to noncash means of payment on the cash demand for day-to-day payments by analyzing two types of demand for cash separately: for hoarding (Fujiki and Tomura (2017) and Section 2 of this paper), for daily one-off payments (Fujiki (2019)). Specifically, we obtained the following results.

First, using aggregate data on cash in circulation in Japan, we find that cash hoarding could represent as much as 42% of the total cash in circulation if we assume that the hoarding of 10,000 yen notes began in 1995 and that the transaction demand for 1,000 yen and 10,000 yen notes increased at the same growth rate. If we assume a semi-log cash demand function, there is a significant structural change in the parameters of cash demand in the late 1990s or early 2000s. If we assume a log-log cash demand function, there is no structural change in cash demand. The long-run income elasticity of demand for cash is one, but the implied interest rate semi-elasticity of cash demand varies substantially especially during the period of the first round of quantitative easing. An accelerating growth rate of the demand for cash that

exceeds the nominal economic growth rate after mid 1990s could be explained by a combination of a stable unitary income elasticity of cash demand and very large implied interest rate semi-elasticity of cash demand.

Second, empirical evidence from the Japanese household survey data suggests that the possible decreases in cash demand from the substitution of cash for noncash payment methods for day-to-day transactions would not be very large. Our back-of-envelope calculations suggest that the substitution effects represent just 0.4% of the total cash in circulation in 2017. Note that as cash hoarding could represent as much as 42% of the total cash in circulation, any reduction in cash demand, if it ever took place, should imply a reduction in cash demand for saving purposes.

Based on this evidence, we argue that the BOJ should be more mindful about any reduction in cash hoarding, for example, because of an increase in the policy interest rate in the future, than about the substitution of cash for credit cards for daily transactions or regular payments, when forecasting the trends in cash usage in Japan.

An important reservation is that our evidence concerning the substitution of cash for noncash payment methods reflects the technology available in the period 2007–2017. The existing settlement service offered by Japanese private banks facilitates safe and efficient daily transactions using cash and electronic money for small-value transactions, and credit cards for high-value transactions. It also makes possible safe and efficient regular payments using bank account transfers or credit cards. Going forward, the BOJ's continuing policy of quantitative and qualitative monetary easing with yield curve control combined with population aging may change the retail payments landscape in Japan. This is because the costs of ATMs and bank branches could become prohibitive for Japanese banks wishing to retain the current structure of settlement services. It would certainly be possible to reduce the demand for cash for P2P transactions if some new technology were to be introduced, such as P2P electronic money transfers using QR codes in a smart phone app developed by three large Japanese banks. Let us make another back-of-envelope calculation to infer the impact on aggregate demand for cash if all ATMs were displaced because of the spread of transactions based on QR codes. Suppose that the ATMs of Japanese banks

and Japan Post Bank (136,994 units as of 2016) each have 25 million yen of banknotes on average, and the ATMs of three major convenience stores and AEON Bank (53,482 units) each have 10 million yen of banknotes on average. If these ATMs were displaced, the demand for cash would fall by about four trillion yen, or about 4% of the total cash in circulation as of 2017.[11] Note also that while the BOJ has not announced a plan to issue central bank digital currency (CBDC) to the public (see Amamiya (2018)), CBDC could reduce the demand for cash for daily transactions if it operates as a costless medium of exchange. However, it is unclear whether CBDC could replace mattress deposits if they are account based and interest bearing because they lack anonymity.

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[11] For information on the amount of currency in the ATMs of Japanese banks see http://www.oeildemouche.net/hokuyo17.html. We assume the amount of banknotes in the ATMs in convenience stores are about 50% of those in the banks. The number of ATMs are taken from https://www.zenginkyo.or.jp/fileadmin/res/abstract/stats/year1_01/cont_2017/nenpo2907.xls for banks, and the websites of Seven-bank, E-net, Lawson and Aeon bank.

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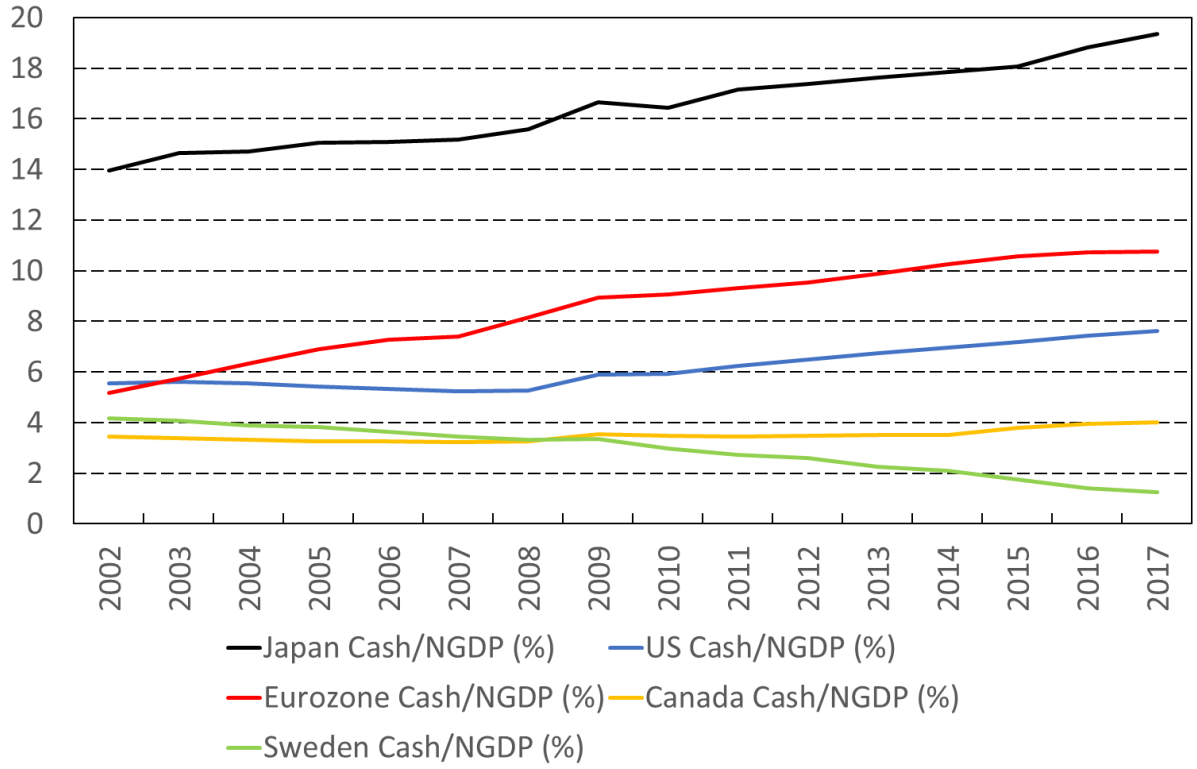
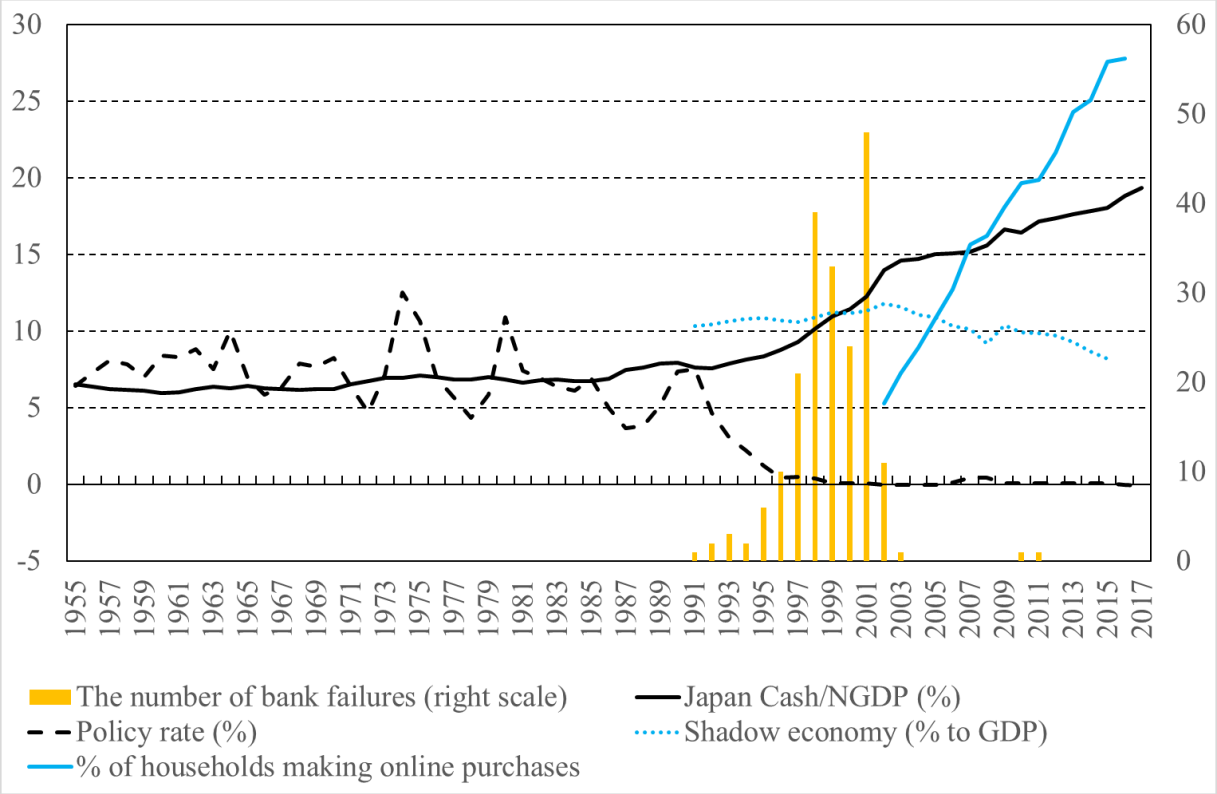
Figure 1 Currency to GDP ratio in Japan, US, Eurozone, Canada, and Sweden



Source: Bank of Japan, Cabinet Office of Japan, European Central Bank, Board of Governors of the Federal Reserve System, Bank of Canada, International Monetary Fund, and author's calculations.

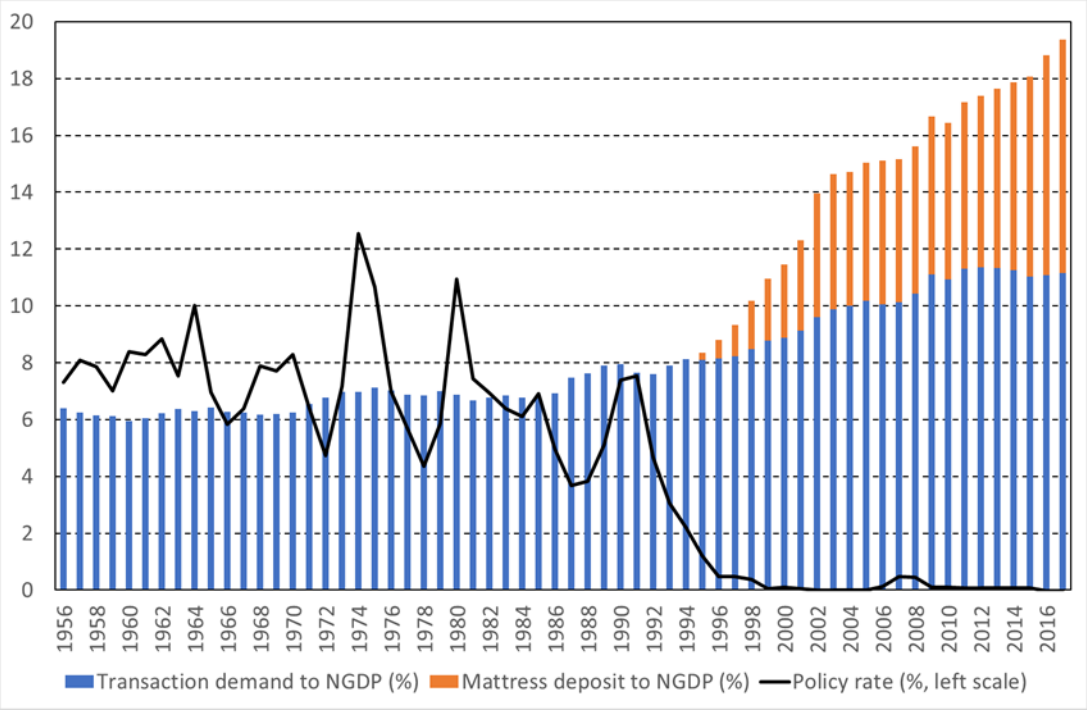
Figure 2 Currency GDP ratio and policy interest rate



Source: Bank of Japan, Cabinet office, Deposit Insurance Corporation of Japan, Medina and Schneider (2018), and Ministry of Internal Affairs and Communications of Japan.

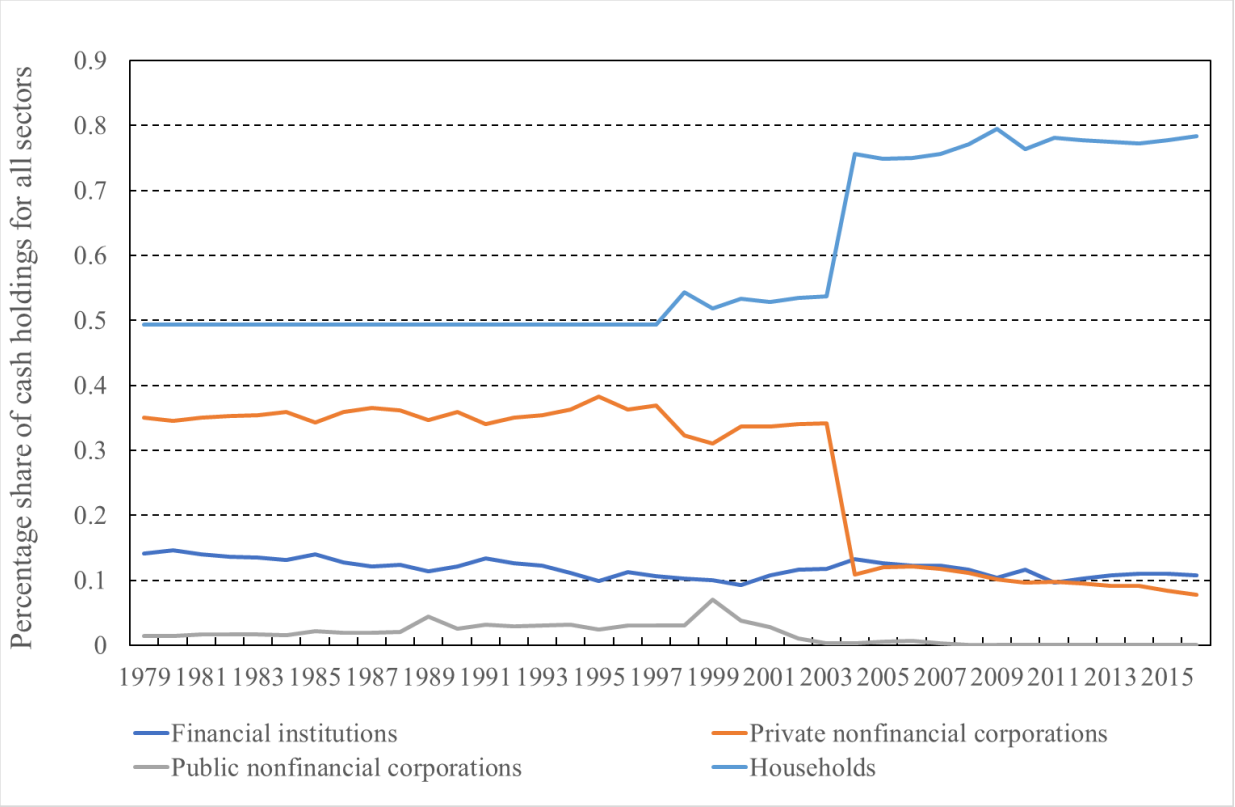
Notes: Japanese policy interest rates use the following series: 1955–1959, basic discount and loan rate; 1960–1984, call rate, collateralized overnight, average; 1985–2017, call rate, uncollateralized overnight, average. Nominal GDP for each year uses the following series: 2011 SNA data for 1980–2017, extended using the annual growth rates in 1968 SNA data for 1955–1979, 2017 data use first quick estimates. The number of bank failures is from the Deposit Insurance Corporation of Japan. The size of the shadow economy is from Medina and Schneider (2018). The percentage of households making online purchases is from the White Paper on Information and Communications in Japan 2017, and Ministry of Internal Affairs and Communications of Japan.

Figure 3 Cash hoarding in Japan



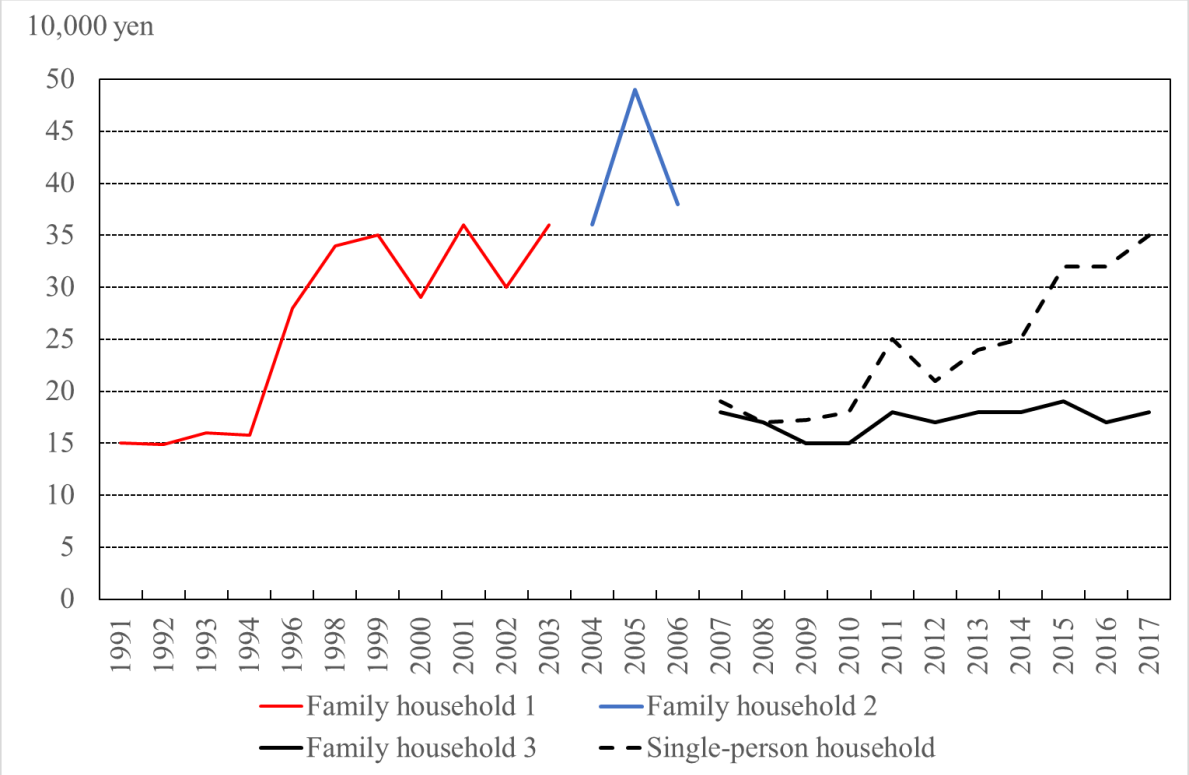
Source: Bank of Japan, Cabinet Office of Japan, and author's calculations.

Figure 4 Cash holdings by sector: the FFA



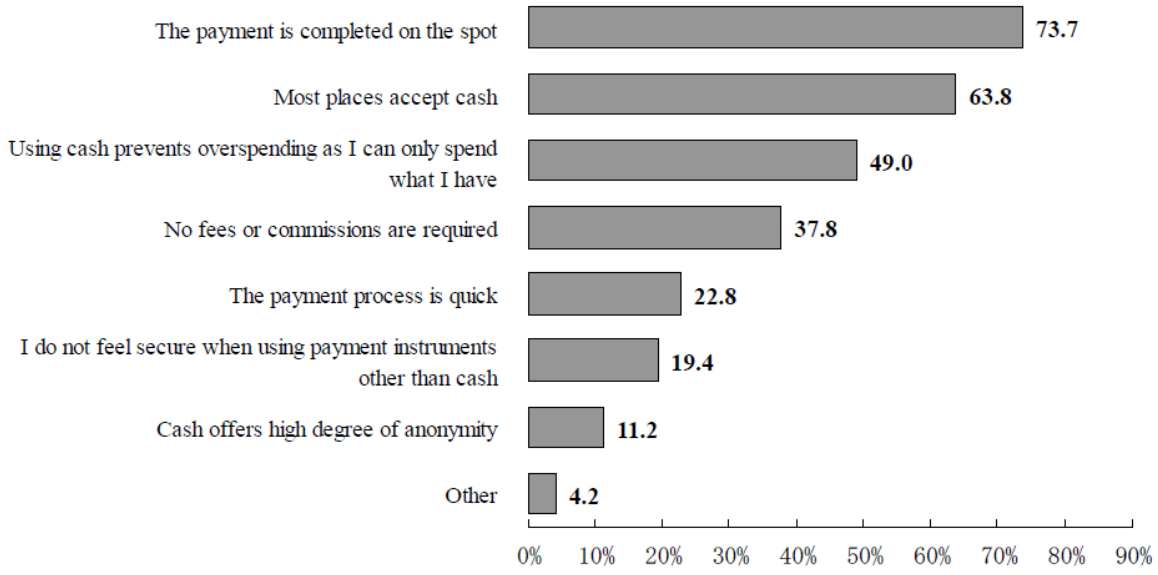
Source: Flow of Funds Accounts and Bank of Japan.
Note: Data in Figure 4 measured at the end of fiscal year; therefore, the data in 2004 corresponds to the first data point of the revised data as of March 31, 2005.

Figure 5 Average cash holdings by households



Source: Survey of Household Finances.

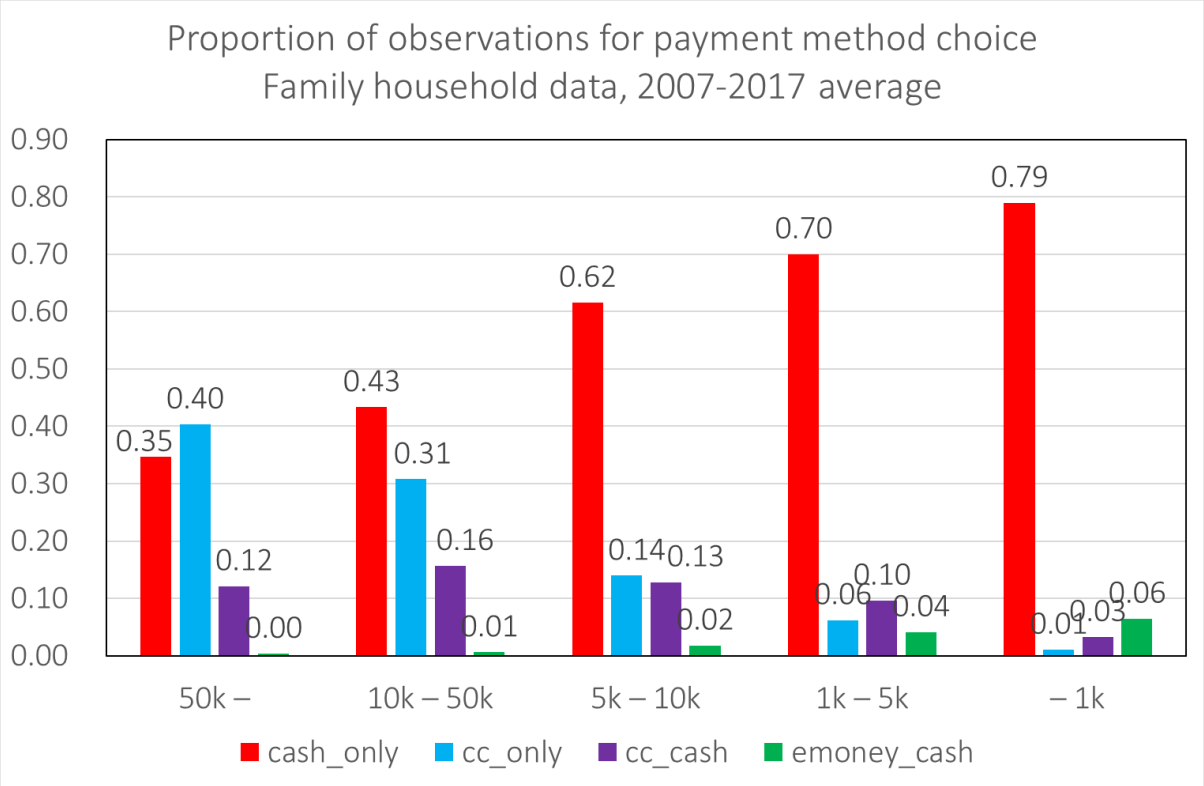
Figure 6 Reasons to use cash for daily payments



Note: 1. Multiple answers were allowed.

Source: Bank of Japan, 37th Opinion Survey on the General Public's Views and Behavior, Question #24, http://www.boj.or.jp/en/research/o_survey/data/ishiki1804.pdf.

Figure 7 Proportion of observations for payment method choice for day-to-day transactions



Notes: 'cc' stands for credit cards.
Source: Fujiki (2019).

Table 1 Summary statistics

	Mean	S.E.	Minimum	Maximum	N
lncr	9.967	1.055	7.920	11.446	61
lnyr	12.415	0.756	10.650	13.157	61
policyrate	4.570	3.612	0.001	12.539	61
lnpolicyrate	0.273	2.567	-7.195	2.529	61

Note: S.E. – standard error.

Table 2 Residual-based tests for cointegration with regime shifts (1955–2015)

	Test Statistics		5% c.v.		
			Asymptotic	Bootstrap	
	Semilog	Log-log		Semilog	Log-log
Inf-ADF	-6.16**	−6.27*	-5.50	-5.75	-6.61
Inf-Z_t	-5.85**	−6.33*	-5.50	-5.67	-6.75
Inf-Z_α	-45.80**	−47.97*	-58.33	-42.18	-52.13

1. Tests are based on the regime shift model proposed by Gregory and Hansen (1996).
2. Asymptotic critical values are from Gregory and Hansen (1996).
3. Bootstrap critical values are computed from 5,000 replications under the null hypothesis of no cointegration.
4. For Inf-ADF, the lag length is selected using the t-test in Gregory and Hansen (1996).
5. * and *** indicate the 10% and 1% levels of significance for the bootstrap tests, respectively.

Table 3 Tests for parameter instability of currency demand functions: Fully modified OLS and dynamic OLS (1955–2015)

Fully Modified OLS (1955-2015)

	Test Statistics		5% c.v. Asymptotic	5% c.v. Bootstrap	
	Semilog	Log-log		Semilog	Log-log
Sup F					
(1)	2817**	259.3	17.3	2215	936.3
	(1998)	(1964)			
(2)	22.34	16.47	10.75	61.80	31.55
	(1974)	(2002)			
(3)	21.33	16.36	10.71	63.61	31.43
	(1974)	(2002)			
(4)	2105***	18.25	9.98	1067	50.41
	(1998)	(1972)			

Tests are based on the fully modified OLS proposed by Hansen (1992).

Asymptotic critical values from Kuo (1998) for a partial structural change and Hansen (1992) for a pure structural change.

Bootstrap critical values are from 5,000 replications under the null hypotheses of parameter constancy using the sieve bootstrap proposed by Chang et al. (2006).

In each panel, the first row, denoted (1), comprises tests of the entire cointegrating vector, the second row (2) gives tests of the intercept, the third row (3) gives tests of the coefficient on y_t, and the fourth row (4) gives tests of the coefficient on i_t.

Data points with the largest F-statistics are in parentheses.

** and *** indicate the 5% and 1% levels of significance for the bootstrap tests, respectively.

Dynamic OLS (1955-2015)

$k = 1$	Test Statistics		5% c.v. Asymptotic	5% c.v. Bootstrap	
	Semilog	Log-log		Semilog	Log-log
Sup F					
(1)	26.57**	33.73	17.3	23.89	39.73
	(2001)	(2001)			
(2)	18.62	24.36	10.75	20.54	30.40
	(1995)	(1997)			
(3)	18.71*	24.43	10.71	19.27	27.82
	(1995)	(1997)			
(4)	24.39***	86.99	9.98	12.41	98.77
	(1996)	(2001)			

$k = 2$	Test Statistics		5% c.v. Asymptotic	5% c.v. Bootstrap	
	Semilog	Log-log		Semilog	Log-log
Sup F					
(1)	40.30**	41.54	17.3	38.43	63.40
	(2000)	(2000)			
(2)	30.20	28.94	10.75	46.01	49.24
	(1998)	(1996)			
(3)	30.32	29.00	10.71	43.71	47.68
	(1998)	(1996)			
(4)	39.78***	74.51	9.98	31.54	87.71
	(1996)	(2002)			

1. Tests are based on the dynamic OLS proposed by Stock and Watson (1993).
2. Asymptotic critical values from Kuo (1998) for a partial structural change and Hansen (1992) for a pure structural change.
3. Bootstrap critical values are from 5,000 replications under the null hypotheses of parameter constancy using the sieve bootstrap proposed by Chang et al. (2006).
4. In each panel, the first row, denoted (1), comprises tests of the entire cointegrating vector, the second row (2) gives tests of the intercept, the third row (3) gives tests of the coefficient on y_t, and the fourth row (4) gives tests of the coefficient on i_t.
5. Data points with the largest F-statistics are in parentheses.
6. ** and *** indicate the 5% and 1% levels of significance for the bootstrap tests, respectively.

Table 4 Fully modified OLS and dynamic OLS results for equations (1) and (2)

Fully Modified OLS (1955-2015)

	Period	95% C.I.	Constant	y_t	i_t
Semilog	1955–2015		-3.673	0.949	-0.096
		Asymptotic	(-1.302, -6.045)	(0.768, 1.129)	(-0.133, -0.060)
		Bootstrap	(-8.149, 8.096)	(0.402, 1.286)	(-0.326, -0.044)
	1955–1997		-5.586	1.060	-0.018
		Asymptotic	(-5.144, -6.442)	(1.014, 1.113)	(-0.022, -0.014)
		Bootstrap	(-6.716, -4.845)	(0.991, 1.137)	(-0.028, -0.010)
	1998–2015		-59.13	5.199	-0.394
		Asymptotic	(-77.63, -52.31)	(4.673, 6.609)	(-0.744, -0.048)
		Bootstrap	(-120.4, 25.60)	(-0.106, 10.72)	(-9.175, 0.026)
Log-log	1955-2015		-4.640	0.993	-0.115
		Asymptotic	(-6.876, -2.404)	(0.814, 1.172)	(-0.166, -0.065)
		Bootstrap	(-8.998, -1.652)	(0.738, 1.462)	(-0.192, -0.040)

1. The estimation method employs the fully modified OLS proposed by Phillips and Hansen (1990).
2. 95% C.I. is the 95% confidence interval.
3. Asymptotic and bootstrap are the asymptotic and bootstrap confidence intervals, respectively. The bootstrap confidence intervals employ the sieve bootstrap proposed by Chang et al. (2006).

Dynamic OLS (1955-2015)

$k=1$	Period	95% C.I.	Constant	y_t	i_t
Semilog	1955–2015		-3.629	0.952	-0.091
		Asymptotic	(-3.739, -3.520)	(0.944, 0.960)	(-0.093, -0.090)
		Bootstrap	(-21.37, 15.75)	(0.378, 1.513)	(-0.175, -0.041)
	1955–2001		-4.487	0.994	-0.045
		Asymptotic	(-4.521, -4.453)	(0.992, 0.997)	(-0.046, -0.044)
		Bootstrap	(-6.519, -2.552)	(0.790, 1.231)	(-0.067, -0.033)
	2002–2015		-37.95	3.574	0.336
		Asymptotic	(-44.52, -30.38)	(3.050, 4.098)	(0.249, 0.423)
		Bootstrap	(-44.61, -31.29)	(-5.730, 14.08)	(-6.242, 7.776)
Log-log	1955-2015		-5.130	1.041	-0.107
		Asymptotic	(-5.254, -5.006)	(1.032, 1.051)	(-0.109, -0.105)
		Bootstrap	(-8.164, -2.634)	(0.729, 1.498)	(-0.126, -0.084)

$k=2$	Period	95% C.I.	Constant	y_t	i_t
Semilog	1955–2015		-3.764	0.964	-0.094
		Asymptotic	(-3.891, -3.636)	(0.955, 0.974)	(-0.095, -0.093)
		Bootstrap	(-26.38, 22.76)	(0.173, 1.889)	(-0.146, -0.051)
	1955–2000		-4.333	0.982	-0.045
		Asymptotic	(-4.483, -4.183)	(0.973, 0.991)	(-0.049, -0.041)
		Bootstrap	(-5.498, -3.504)	(0.792, 1.229)	(-0.058, -0.039)
	2001–2015		-32.53	3.132	1.886
		Asymptotic	(-46.52, -18.54)	(2.036, 4.228)	(1.256, 2.516)
		Bootstrap	(-66.60, 4.234)	(-2.106, 5.292)	(-5.248, 7.596)
Log-log	1955-2015		-5.233	1.048	-0.113
		Asymptotic	(-5.333, -5.134)	(1.041, 1.056)	(-0.114, -0.112)
		Bootstrap	(-8.602, -2.251)	(0.849, 1.294)	(-0.169, -0.042)

1. The estimation method employs the dynamic OLS proposed by Stock and Watson (1993).
2. 95% C.I. is the 95% confidence interval.
3. Asymptotic and bootstrap are the asymptotic and bootstrap confidence intervals, respectively. The bootstrap confidence intervals employ the sieve bootstrap proposed by Chang et al. (2006).

Table 5 Implied semi-elasticity of cash demand functions

Year	Policyrate	Implied semi-elasticity		
		FMOLS	DOLS(k=1)	DOLS(k=2)
1955	6.448	-0.018	-0.017	-0.018
1956	7.300	-0.016	-0.015	-0.015
1957	8.095	-0.014	-0.013	-0.014
1958	7.851	-0.015	-0.014	-0.014
1959	7.000	-0.016	-0.015	-0.016
1960	8.400	-0.014	-0.013	-0.013
1961	8.291	-0.014	-0.013	-0.014
1962	8.838	-0.013	-0.012	-0.013
1963	7.544	-0.015	-0.014	-0.015
1964	10.024	-0.011	-0.011	-0.011
1965	6.968	-0.017	-0.015	-0.016
1966	5.840	-0.020	-0.018	-0.019
1967	6.390	-0.018	-0.017	-0.018
1968	7.880	-0.015	-0.014	-0.014
1969	7.700	-0.015	-0.014	-0.015
1970	8.284	-0.014	-0.013	-0.014
1971	6.414	-0.018	-0.017	-0.018
1972	4.723	-0.024	-0.023	-0.024
1973	7.161	-0.016	-0.015	-0.016
1974	12.539	-0.009	-0.009	-0.009
1975	10.671	-0.011	-0.010	-0.011
1976	6.977	-0.016	-0.015	-0.016
1977	5.680	-0.020	-0.019	-0.020
1978	4.357	-0.026	-0.025	-0.026
1979	5.857	-0.020	-0.018	-0.019
1980	10.930	-0.011	-0.010	-0.010
1981	7.434	-0.015	-0.014	-0.015
1982	6.935	-0.017	-0.015	-0.016
1983	6.392	-0.018	-0.017	-0.018
1984	6.100	-0.019	-0.018	-0.019
1985	6.914	-0.017	-0.015	-0.016
1986	4.961	-0.023	-0.022	-0.023
1987	3.669	-0.031	-0.029	-0.031
1988	3.835	-0.030	-0.028	-0.029
1989	5.117	-0.022	-0.021	-0.022
1990	7.398	-0.016	-0.014	-0.015
1991	7.525	-0.015	-0.014	-0.015
1992	4.660	-0.025	-0.023	-0.024
1993	3.059	-0.038	-0.035	-0.037
1994	2.196	-0.052	-0.049	-0.051
1995	1.213	-0.095	-0.088	-0.093
1996	0.472	-0.244	-0.227	-0.240
1997	0.484	-0.238	-0.221	-0.233
1998	0.372	-0.309	-0.288	-0.304
1999	0.058	-1.971	-1.834	-1.937
2000	0.108	-1.062	-0.988	-1.043
2001	0.059	-1.966	-1.829	-1.932
2002	0.002	-62.739	-58.374	-61.648
2003	0.001	-86.272	-80.270	-84.771
2004	0.001	-153.333	-142.667	-150.667
2005	0.001	-106.187	-98.800	-104.340
2006	0.125	-0.924	-0.859	-0.908
2007	0.473	-0.243	-0.226	-0.239
2008	0.462	-0.249	-0.232	-0.245
2009	0.105	-1.093	-1.017	-1.074
2010	0.094	-1.230	-1.144	-1.209
2011	0.078	-1.479	-1.376	-1.453
2012	0.083	-1.391	-1.294	-1.367
2013	0.075	-1.530	-1.423	-1.503
2014	0.068	-1.693	-1.575	-1.664
2015	0.073	-1.579	-1.469	-1.551

Table 6 Cash demand by individual firms

Per establishment
In thousand yen

	Manufacture			Wholesale and retail trade			Accomodation, food services			Services		
Year	Cash	Sales	cash ratio	Cash	Sales	cash ratio	Cash	Sales	cash ratio	Cash	Sales	cash ratio
2011	551	10,572	0.052	497	17,669	0.028	390	8,424	0.046	295	4,874	0.061
2012	366	9,403	0.039	518	17,759	0.029	304	8,772	0.035	341	5,436	0.063
2013	334	9,455	0.035	467	17,202	0.027	246	8,666	0.028	244	4,712	0.052
2014	393	9,806	0.04	585	16,203	0.036	345	8,602	0.04	257	5,353	0.048
2015	428	9,994	0.043	456	15,650	0.029	395	9,457	0.042	255	4,888	0.052
2016	376	10,461	0.036	449	14,895	0.03	344	8,532	0.04	260	5,063	0.051

Source: Survey of Private Enterprise Economy, and Ministry of Internal Affairs and Communications.

Table 7 Aggregate choice of payment methods, 2007–2017

Choice of payment method 2007-2017 (%)

	50k -	10k - 50k	5k - 10k	1k - 5k	less 1k
cash only	37.6	46.6	66.8	75.9	86.3
card	57.5	50.2	29.1	17.2	4.7
emoney	0.8	1.0	2.7	5.6	8.3
other	3.7	1.5	0.6	0.4	0.4
card + emoney	0.5	0.6	0.8	0.9	0.3

Notes: “Cash only” is respondents choosing cash exclusively; “card” is credit card exclusively, cash and credit card, or credit card and other; “emoney” is electronic money exclusively, cash and electronic money, or electronic money and other; other” is other exclusively or cash and other; “card + emoney” is credit card and electronic money.
50k –: more than 50,000 yen, 10k – 50k: more than 10,000 yen and less than or equal to 50,000 yen, 5k – 10k: more than 5,000 yen and less than or equal to 10,000 yen, 1k – 5k: more than 1,000 yen and less than or equal to 5,000 yen, less 1k: less than or equal to 1,000 yen.
Card+emoney less than 1,000 yen has 98 observations, and therefore, is dropped from the estimations because our multinomial regression models have 100 independent variables.