Bank of Japan Review 2008-E-5

Background to the High Level of Banknotes in Circulation and Demand Deposits

Monetary Affairs Department
Akira Otani and Takashi Suzuki*

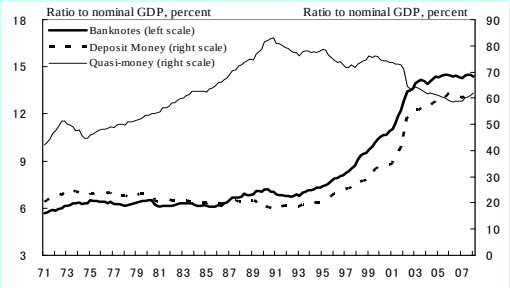
September 2008

Banknotes and demand deposits have exhibited high growth since the late 1990s, and remain at historically high levels. We examine the background to these developments by using available data such as the volume of banknotes in circulation by denomination and the volume of demand deposits by depositor age. We find the main reason for the growth in banknotes and demand deposits is an increase in "non-transaction demand" for savings and other purposes by the household sector, especially by the elderly. Moreover, as for the outlook, as long as changes in interest rates remain limited, the amounts of banknotes in circulation and demand deposits are likely to remain high because the holding behavior of the elderly will probably remain unchanged. We should note, however, that any changes in the sensitivity of the elderly to interest rates may alter their choice of financial assets.

Introduction: Growth of the Money Stock since the 1970s

Banknotes in circulation and demand deposits have exhibited high growth since the late 1990s, and their levels remain historically high. Let us examine the time series data for the amounts of banknotes in circulation, demand deposits, and time deposits. The data for banknotes in circulation are available from the *Monetary Base Statistics* and those for demand and time deposits from the *Money Stock Statistics*. Figure 1 shows the long-term developments. The ratio of banknotes in circulation to nominal GDP remained stable at around 6 percent for a long period of time, but started to increase from the mid-1990s, followed by a rapid increase to 14 percent with the partial removal of blanket deposit insurance[1] in 2002. This banknotes to GDP ratio has remained essentially flat since that time. The ratio of demand deposits to nominal GDP generally parallels the banknotes to GDP ratio. The demand deposits to GDP ratio held around 20 percent for a long period of time, drastically increased from the late 1990s to around 60 percent in 2002, and has subsequently stayed around that level. On the other hand, the ratio of time deposits to nominal GDP moderately declined in the 1990s and then further decreased in 2002. This movement is opposite to those of banknotes in circulation and demand deposits, and this implies that funds shifted from time deposits to banknotes and demand deposits.

(Figure 1) A Bird's-eye View from *Monetary Stock Statistics*, etc.

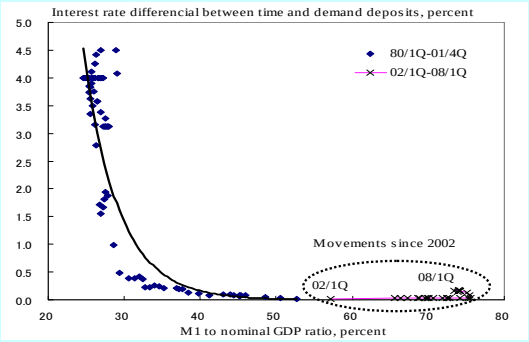


Source: Bank of Japan, *Bank of Japan Statistics*, Cabinet Office, *National Accounts*.

Some papers identify low interest rates and financial system instability as the background to the changes in the amounts of banknotes in circulation and demand deposits.[2] Figure 2 is a scatter diagram showing the ratio of M1 to nominal GDP together with the interest rate differential between demand deposits and time deposits. The curve slopes downward to the right, indicating that low interest rates are one factor contributing to the continued high volume of M1.[3] The shift in the ratio of M1 to nominal GDP in 2002 apparently reflects a transfer of funds from time deposits to banknotes and demand deposits with the partial removal of blanket deposit

* Currently, Financial Market Department.

(Figure 2) M1 to Nominal GDP Ratio and Interest Rates



Source: Bank of Japan, *Bank of Japan Statistics*, Cabinet Office, *National Accounts*.

insurance. That ratio, however, has still not returned to the levels observed prior to 2002, despite the removal of the zero interest rate policy in 2006 and the resolution of financial instability.

In this paper, we explore new insights into the background to the recent movements in banknotes in circulation and demand deposits. Our findings are not necessarily different from those of prior research, but they clarify that the change in financial asset selection by the elderly – in response to financial instability and the partial removal of blanket deposit insurance under a low interest rate environment – is the main reason why the amounts of banknotes in circulation and demand deposits have increased and remain at high levels.

We proceed with our analysis assuming that common factors lie behind the similar movements of banknotes in circulation and demand deposits. This assumption is justified by the fact that households with more cash tend to hold more demand deposits.[4] In addition, banknotes and demand deposits have similar characteristics such as high liquidity and extremely low interest rates, and they are both classified as M1 in the *Money Stock Statistics*.

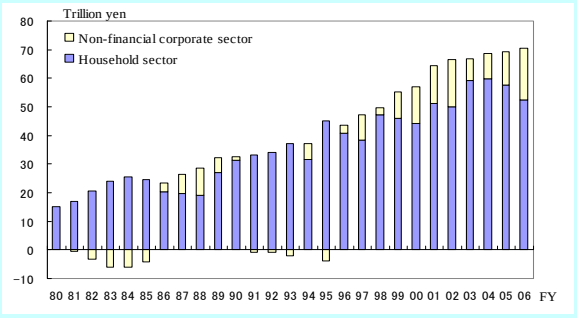
Due to data constraints, we cannot fully analyze both banknotes in circulation and demand deposits in detail. So we proceed with our analysis by applying the empirical results on banknotes in circulation to demand deposits and vice versa, assuming that some common factors are at work.

Sectoral Holdings of Banknotes and Demand Deposits

As the first step of the empirical analysis, let us examine which sectors have increased their holdings of banknotes and demand deposits.

For banknotes, there are no statistics which cover the volumes held by the household and non-financial corporate sectors. This limitation leads us to estimate the volume of cash (i.e., the sum of banknotes and coins) held by each sector using the *Flow of Funds Accounts* and *Financial Statements Statistics of Corporations by Industry*.[5,6] The results show that while the amount of cash held by the non-financial corporate sector has moderately increased since the late 1990s, the amount of cash held by households has risen drastically (Figure 3).

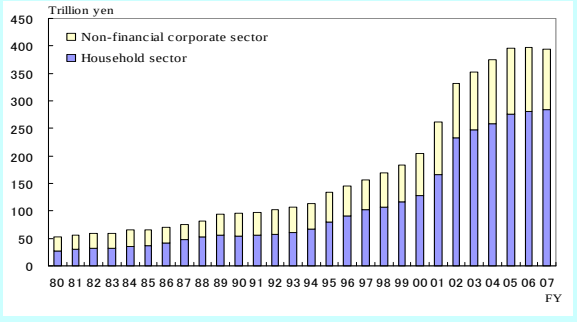
(Figure 3) Volume of Cash Held by Household and Corporate Sectors



Source: Bank of Japan, *Bank of Japan Statistics*, Ministry of Finance, *Financial Statements Statistics of Corporations by Industry*.

Next, data on the volume of demand deposits held by each sector are available from the *Flow of Funds Accounts*. The data show that demand deposits held by households have risen by far more than those held by the non-financial corporate sector (Figure 4), similar to the developments in cash holdings .

(Figure 4) Volume of Demand Deposits Held by Household and Corporate Sectors



Source: Bank of Japan, *Bank of Japan Statistics*.

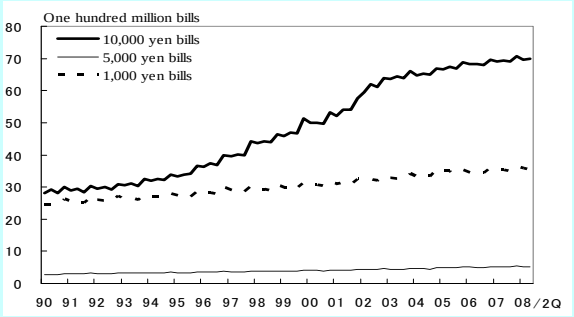
The above observations suggest that increased holdings by households are the main reason for the increases and continued high levels in the amounts of banknotes in circulation and demand deposits.

Increase in Non-Transaction Demand (Approach Utilizing Banknotes in Circulation by Denomination)

The demand for banknotes and demand deposits can be broadly divided in two: the volume held for settlement of goods and services transactions and the volume held for savings or lying unused. Hereinafter, we refer to the former as transaction demand and the latter as non-transaction demand. We now examine the background to the increase in the amounts of banknotes and demand deposits held by households utilizing data on the volume of banknotes in circulation by denomination.

Figure 5 presents the amounts of banknotes in circulation by denomination. The figure shows that while the volumes of 1,000 yen bills and 10,000 yen bills exhibited similar movements until the early 1990s, the volume of 10,000 yen bills has risen far more than the volume of 1,000 yen bills since the late 1990s. Here, 1,000 yen bills are considered to be held exclusively for transactions. This assumption is justified because small-denomination bills such as 1,000 yen bills are not suitable for savings (that would require a large number of bills and a large amount of storage space). In addition, it is not realistic to imagine that transactions using 10,000 yen bills have drastically increased compared with those using 1,000 yen bills. Therefore, it can be inferred that an increase in non-transaction demand lies behind the rapid increase in 10,000 yen bills in circulation compared with the increase in 1,000 yen bills.

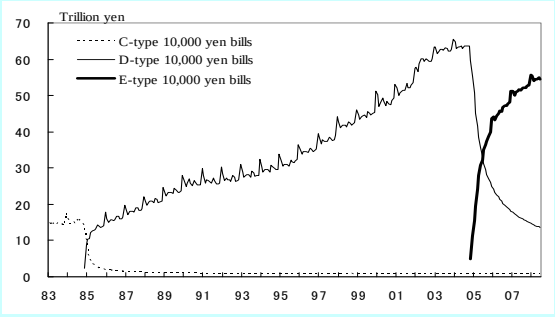
(Figure 5) Banknotes in Circulation by Denomination



Source: Bank of Japan, *Bank of Japan Statistics*.

Moreover, around 14 trillion yen of old 10,000 yen bills (D-type 10,000 yen bills), which were replaced by current 10,000 yen bills (E-type 10,000 yen bills) in 2004, are still in circulation (Figure 6). This phenomenon is completely different from the prior developments whereby the volume of C-type 10,000 yen bills in circulation rapidly declined when they were replaced with D-type 10,000 yen bills in

(Figure 6) Change in the Volume of D-type 10,000 Yen Bills

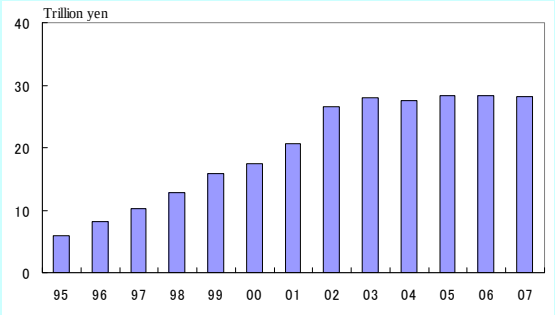


1984. When old 10,000 yen bills are used in transactions and brought into banks, they are exchanged with current issue 10,000 yen bills. Given these factors, it is highly probable that around 14 trillion yen of D-type 10,000 yen bills are being stored away. That fact also implies that it is an increase in non-transaction demand that has caused the volume of banknotes in circulation to have risen and to remain high.

Currently, the volume of banknotes in circulation amounts to around 75 trillion yen. So, how many banknotes in circulation are being held for non-transaction demand? We estimate the volume of banknotes in circulation held for non-transaction demand by assuming that the difference between the growth rates of 1,000 yen and 10,000 yen bills was caused by a change in non-transaction demand. Our estimation results indicate that the proportion of non-transaction demand was 12 percent in 1995 and rose to 38 percent in 2007. In absolute terms, non-transaction demand rose from around 5 trillion yen in 1995 to around 30 trillion yen in 2007 (Figure 7; see "Banknotes in Circulation by Denomination Approach" in Box 1 for details on the estimation method). Using this estimation approach, the increase in non-transaction demand explains 70 percent of the

(Figure 7) Volume of 10,000 Yen Bills Held for Non-transaction Demand

< Banknotes in Circulation by Denomination Approach>

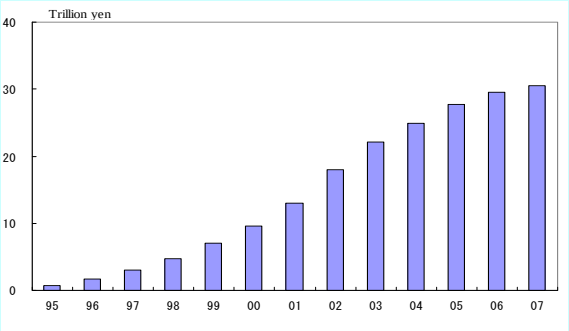


total increase in banknotes in circulation from 1995 to 2007.

We next estimate the amount of non-transaction demand using an alternative approach, which focuses on the difference in the seasonal variation in the volume of 1,000 yen and 10,000 yen bills. If we were to assume that the volume of 10,000 yen bills changes only due to transaction demand, then the seasonal variation of 10,000 yen bills should be similar to that of 1,000 yen bills, which are held exclusively for transaction demand. For example, transaction demand rises during the year-end bargain sales season and declines in January. In actuality, the seasonal variation of both bills exhibited extreme similarity until the mid 1990s, but has gradually diverged since then. Our estimation results based on the difference in the seasonal variation in the volume of the two bills indicate that the proportion of non-transaction demand was 2 percent in 1995 and rose to 40 percent in 2007. In absolute terms, non-transaction demand rose from around 1 trillion yen in 1995 to around 30 trillion yen in 2007 (Figure 8; see "Seasonal Variation Approach" in Box 1 for details on the estimation method).

(Figure 8) Volume of 10,000 Yen Bills Held for Non-transaction Demand

< Seasonal Variation approach>



Both estimation results indicate it is an increase in non-transaction demand that has caused the volume of banknotes in circulation to have risen and to remain high. Beyond that, we assume that the increase in non-transaction demand also raises the volume of demand deposits, and that the percentage of demand deposits held for non-transaction demand equals the

Box 1: Methods of Estimating the Non-transaction Demand for Banknotes

This box explains the details of the "Banknotes in Circulation by Denomination Approach" and the "Seasonal Variation Approach". Both approaches assume that while all 1,000 yen bills are held for transaction demand, 10,000 yen bills are held for both transaction and non-transaction demand.

Banknotes in Circulation by Denomination Approach

This approach focuses on the difference in the growth rates of 1,000 yen 10,000 yen bills. First, we assume that the difference in the growth rates of 1,000 yen and 10,000 yen bills from 1991 to 1994, i.e., 0.9 percent annually, is caused by the difference in the rate of change in the transaction demand for both bills. Then, the rate of change in the transaction demand for 10,000 yen bills equals the actual rate of change in the amount of 1,000 yen bills plus 0.9 percent. The amount of 10,000 yen bills held for non-transaction demand can be calculated by subtracting the amount held for transaction demand from the total amount of 10,000 yen bills in circulation.

Seasonal Variation Approach

This approach focuses on the difference in the seasonal variation in the volume of 1,000 yen and 10,000 yen bills. This approach assumes that the seasonal variation of 10,000 yen bills held for transactions is the same as that of 1,000 yen bills, and that there is no seasonal variation in the amount of 10,000 yen bills held for non-transaction demand. Thus, the seasonal variation in 10,000 yen bills can be expressed as the seasonal variation of 1,000 yen bills multiplied by the share of 10,000 yen bills held for transactions α plus α-1. Then, α can be derived from this relation.

Note that this approach is one of the methods which the Federal Reserve Board developed to estimate the volume of US dollars in circulation abroad. FRB(Note) assumes that the seasonal variation in US dollars used in the US for transactions is the same as that of Canadian dollars, and estimates the amount of US dollars in circulation abroad.

(Note) For details, see Porter, Richard, D., Judson, Ruth, A., and James Walsh, "The Location of U.S. Currency: How Much Is Abroad?" *Federal Reserve Bulletin* October 1996, Board of Governors of the Federal Reserve System, 1996. This paper also introduces an alternative method of estimating US dollars in circulation abroad which focuses on the fact that the amount of large-denomination bills such as 50 and 100 dollar bills issued by certain Federal Reserve Banks such as the NY Fed is larger than that issued by other Federal Reserve Banks in light of the economic activity in each district. The method estimates the amount of US dollars in circulation abroad based on the excess of large-denomination bills in comparison with the economic activity in each district.

percentage of banknotes held for non-transaction demand. With these assumptions, simple calculations indicate that 120 trillion yen out of the present total of 310 trillion yen in demand deposits are being held for non-transaction demand.

Changes in the Behavior of the Elderly (Cohort Analysis on Demand Deposits)

The above analyses demonstrate that an increase in non-transaction demand especially by households is the main factor which has caused the volume of banknotes in circulation to rise and to remain high. Considering that banknotes in circulation and demand deposits exhibit similar movements, it seems likely that the same observation applies to demand deposits as well. Prior research has noted the following two factors as reasons behind the increase in non-transaction demand. The first is the decline in the opportunity cost of holding banknotes and demand deposits under the prolonged low interest rate environment. The second is the rising preference for safe financial assets such as banknotes and demand deposits due to financial instability and the partial removal of blanket deposit insurance in 2002. However, these factors do not explain why non-transaction demand still remains at a high level. We carry out cohort analysis on demand deposits to answer this question.

Before conducting the empirical analysis, let us consider the ratio of demand deposits to income by age segment (Table 1). Table 1 shows that this ratio rose from 1990 to 2005 in all age segments (by about 15-20 percent in age segments younger than 60), but nearly tripled for the age segment 60 and over. With this development, the share of demand deposits held by the age segment 60 and over rose to surpass 50 percent in 2000, and rose further by 2005 (Table 2).

(Table 1) The Ratio of Demand Deposits to Income by Age Segment

	1970	1980	1990	2000	1990→2000	2005	2000→2005
−29	12.8	7.9	10.4	17.1	6.7	32.8	15.7
30−39	14.2	9.5	10.0	20.5	10.5	27.2	6.7
40−49	14.8	10.1	10.6	16.0	5.4	26.0	10.0
50−59	19.3	12.8	13.5	21.0	7.5	31.1	10.0
60−	25.0	22.0	24.4	47.0	22.6	69.2	22.3

Source: Ministry of Internal Affairs and Communications, *Family Savings Survey*, *Family Income and Expenditure Survey*.

Based on the above observations, we now carry out cohort analysis on the demand deposits to income ratio to break it down into the "age effect" (the effect peculiar to any given age segment), the "time effect" (the effect peculiar to any given year), and the "cohort effect" (the effect peculiar to persons born in any particular year). (See Box 2 for the details on the cohort analysis). In addition to the above-mentioned three effects, we also decompose the ratio into two other effects: the "income effect" which captures the degree to which higher income lowers the ratio of demand deposits to income, and "the effect of changes in the behavior of the elderly" which specifies changes in the choice of financial assets by the elderly since 2000. We use five-year data from 1970 to 2000 for each five-year age segment from the *Family Savings Survey*.

(Table 2) The Share of Demand Deposits by Age Segment

	1990	2000	1990→2000	2005	2000→2005
−29	1.8	1.4	−0.4	1.7	0.3
30−39	12.5	10.7	−1.7	9.9	−0.9
40−49	23.4	13.3	−10.0	14.1	0.8
50−59	26.9	22.9	−4.0	20.9	−2.0
60−	35.5	51.6	16.2	53.4	1.8
Total	100	100	−	100	−

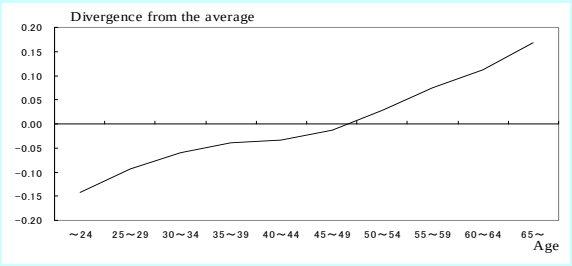
Source: Ministry of Internal Affairs and Communications, *Family Savings Survey*, *Family Income and Expenditure Survey*.

Figure 9 shows the estimated "age effect", "time effect" and "cohort effect". The figure indicates that i) the demand deposits to income ratio is higher among the elderly, ii) the ratio has risen since the late 1990s in every age segment and every cohort, and iii) the ratio is higher in cohorts born before 1945 and lower in cohorts born after 1945. The first finding is consistent with the life-cycle hypothesis, which considers the pattern of financial asset accumulation over an individual's lifetime.[7] The positive "time effect" since the late 1990s may be interpreted as capturing the decline in the opportunity cost of holding demand deposits due to low interest rates and the increase in the demand for safe financial assets due to financial instability.

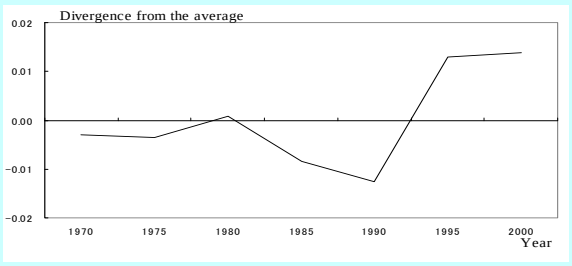
This analysis, however, has a drawback. Since the *Family Savings Survey* data are only available until 2000, the analysis cannot capture the effect from the partial removal of blanket deposit insurance in 2002. To compensate for this limitation, we next estimate the "time effect" and "the effect of changes in the behavior of the elderly" in 2005 using 2005 data for each 10 year age segment from the *Family Income and Expenditure Survey*.[8] Then, utilizing the estimated parameters, we decompose the demand deposits to income ratio weighted with the number of households by age into the various effects stipulated

(Figure 9) Age Effect, Time Effect, and Cohort Effect

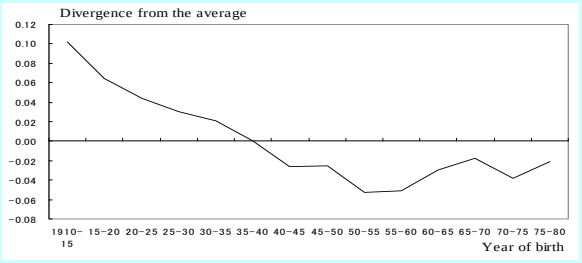
<Age Effect>



<Time Effect>

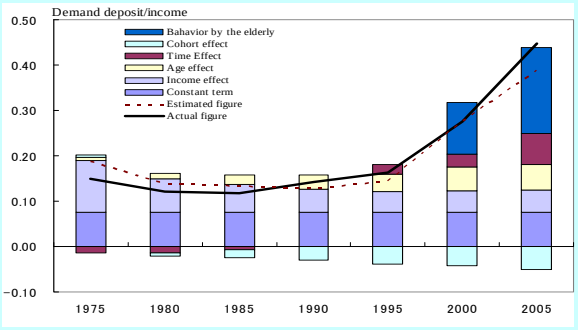


<Cohort Effect>



above (Figure 10). Figure 10 indicates i) the positive effect of the "age effect" rises due to population aging, ii) the negative effect of the "cohort effect" widens over time due to the decrease in people born before 1945, and offsets the positive effect of the "age effect", and iii) the "time effect" turns positive from the late 1990s and this positive effect grows larger in 2005 with the partial removal of blanket deposit insurance. In addition, the figure shows that "the effect of changes in the behavior of the elderly" makes the biggest contribution to the increase in the ratio in 2000 and 2005.

(Figure 10) Decomposition of Demand Deposits to Income Ratio



The reasons why "the effect of changes in the behavior of the elderly" has the greatest impact are as follows. First, the elderly have the largest share of demand deposit holdings as shown in Table 2, and thus the change in its behavior largely influences the whole ratio of demand deposit to income. Second, the prolonged low interest rate environment, financial instability and the partial removal of blanket deposit insurance are considered to have exerted their greatest influence on the elderly. Because the elderly hold the greatest share of time deposits by far (Table 3), so it is

Box 2: Cohort Analysis Outline and Estimation Details

What is Cohort Analysis?

Cohort analysis is a method to decompose changes in the subject of study into the age effect (the effect from differences among age segments), the time effect (the effect from changes in time), and the cohort effect (the effect from differences in year of birth). This method is used not only for macro empirical research on consumption but also for marketing research forecasting future demand for particular commodities.

Equation Used for the Estimation

The equation used for the estimation is:

$$Depositratio_{i,j,t} = c + c_i + c_t + c_j + \alpha \cdot Income_{i,j,t} + \beta_{i=60,j,t=2000} D_{i=60} \times D_{t=2000} + \beta_{i=65,j.t=2000} D_{i=65} \times D_{t=2000}$$

where *Depositratio* and *Income* represent the demand deposits to income ratio and income, respectively. *i*, *j*, and *t* express age segment, year of birth, and year. $D_{i=60}$ is a dummy variable with a value of 1 if the age is 60 to 64 and 0 otherwise, $D_{i=65}$ is a dummy variable with a value of 1 if the age is 65 or over and 0 otherwise, and $D_{t=2000}$ is a dummy variable with a value of 1 if year is 2000 and 0 otherwise. In the above equation, c_i, c_t, and c_j are the age effect, time effect and cohort effect, and the cross term represents the effect of changes in the behavior of the elderly in 2000.

Figure 9 presents the estimated values of c_i, c_t, and c_j.

deemed likely that the elderly had the greatest incentive to shift their financial assets from time deposits to demand deposits before the partial removal of blanket deposit insurance. It should be noted that while the elderly changed their financial assets selection behavior in response to the large shocks of financial instability and partial removal of blanket deposit insurance, they have not subsequently unwound this increased preference for liquidity, even though the financial instability has been resolved.

(Table 3) Volume of Time Deposits Held by Each Age Segment in 2000

	Volume of Time Deposits	
	(10 thousand yen)	Share in Total Financial Assets (%)
−29	95	22.3
30−39	192	34.2
40−49	275	35.3
50−59	527	39.5
60−	899	48.8

Source: Ministry of Internal Affairs and Communications, *Family Savings Survey*.

Conclusion

This brief paper shows that an increase in non-transaction demand by households is the main reason why the volume of banknotes in circulation has risen and remains at a high level. While the prolonged low interest rate environment, financial instability, and the partial removal of blanket deposit insurance have apparently exerted considerable influence on the entire household sector, the main factor behind the changes in the volume of banknotes in circulation and demand deposits since the 1990s is the drastic increase in the preference for banknotes and demand deposits by the elderly age segment in response to developments in the external environment. The elderly age segment continues to hold large amounts of banknotes and demand deposits.

In closing, let us consider the outlook for the volume of banknotes in circulation and demand deposits, based on the findings herein. The elderly, who have the greatest influence on the future levels of banknotes in circulation and demand deposits, have exhibited only a limited response to the recent modest increases in interest rates, implying that their sensitivity to interest rate changes is relatively low compared with that of other age segments. Therefore, as long as changes in interest rates remain limited, the behavior of the elderly is not likely to drastically change, and the amounts of banknotes in circulation and demand deposits are expected to remain high. We should, however, note that any changes in the sensitivity of the elderly to interest rates may alter their choice of financial assets.

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[1] In April 2002, the per depositor guarantee on time deposits at individual financial institutions was limited to principal not exceeding 10 million yen in total and accompanying interest payments.

[2] For example, see Yoshihito Saito and Hideki Takada, "Background to the Recent Decline in the Growth Rate of Banknotes in Circulation," *Bank of Japan Review*, 2004-E-3, Bank of Japan.

[3] To be precise, M1 consists of not only banknotes and demand deposits but also coins. The volume of coins (5 trillion yen in 2007) is, however, extremely small compared with banknotes (75 trillion yen) and demand deposits (315 trillion yen).

[4] For details, see Hiroshi Fujiki and Etsuro Shioji, "Bank Health Concerns, Low Interest Rates, and Money Demand: Evidence from the Public Opinion Survey on Household Financial Assets and Liabilities", *Monetary and Economic Studies*, Vol.24, No.2, 2006, pp.73-124.

[5] The data for the volume of cash held by each sector is available from the *Flow of Funds Accounts*. These statistics assume that the ratio of cash held by households to that held by the corporate sector is constant over time, and then estimates the amount of cash held by each sector by multiplying that ratio by the sum of cash held by the household and corporate sectors, which is derived by subtracting cash held by other sectors from total cash outstanding. Therefore, by definition, the rates of change in the amounts of cash held by the household and corporate sectors are the same.

[6] The volume of cash held by the non-financial corporate sector is derived as follows. The data for the sum of cash and deposits held by the non-financial corporate sector is available from *Financial Statements Statistics of Corporations by Industry*. In these statistics, time deposits whose maturity is more than one year are excluded from the data for the sum of cash and deposits. Thus, the amount of time deposits with a maturity of more than one year held by the non-financial corporate sector has to be estimated. We estimate this using the data on time deposits with a maturity of more than one year held by all sectors. The sum of cash and all deposits held by the non-financial corporate sector is calculated by adding the sum of cash and deposits held by the sector in *Financial Statements Statistics of Corporations by Industry* with the estimated amount of time deposits with a maturity of more than one year held by the sector. Then, the volume of cash held by the sector is estimated by subtracting the amount of deposits held by the sector in the *Flow of Funds Accounts* from the estimation of the sum of cash and all deposits held by the sector.

[7] The life-cycle hypothesis shows that since younger age segments have fewer financial assets as a buffer against various risks and tend to face liquidity constraints, the share of risky assets is low among young adults, rises in middle age, but becomes lower among the elderly. This implies that the elderly hold relatively large amounts of safe financial assets. In addition, under the risk-averse utility function, people tend to hold larger amounts of liquidity when they perceive future risks. Assuming that the elderly face more risks such as illness, they may tend to hold more liquidity in safe financial assets.

[8] To be precise, we utilize the estimated parameters for the constant term, income effect, age effect, and cohort effect using the data until 2000 to extract the unexplainable part of the 2005 data by these effects. For the 2000 data, we calculate the unexplainable part using factors other than the time effect and

rearrange it for each ten-year age segment. We regress the data for 2000 and 2005 for ten-year age segments, an age dummy and a cross term which captures the effect of changes in the behavior of the elderly in 2005 to obtain the time effect and the effect of change in the behavior of the elderly in 2005.

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