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WHY DID JAPAN'S HOUSEHOLD SAVINGS RATE FALL IN THE 1990s?

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Abstract

This paper investigates empirically why Japan's household savings rate fell in the 1990s. We constructed an economic model consisting of two types of household: unconstrained life-cycle households and liquidity-constrained households. Unconstrained households generally save, but liquidity-constrained households consume all of their disposable income. We found that the proportion of liquidity-constrained households increased sharply in the late 1990s, which led to a decline in Japan's household savings rate. Our simulation analysis demonstrated that if the proportion of liquidity-constrained households in the 1990s had stayed at the level as that of the late 1980s, the household savings rate would have increased by four percent points in 2001 and 2002.

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1. Introduction

The Japanese economy remained stagnant throughout the 1990s, a period that has often been described as the "lost decade." The household savings rate exhibited a declining trend during this period.[1] Figure 1 shows Japan's household savings rate since 1970. After the savings rate reached its peak (20%) in the middle of the 1970s, it declined steadily over the 1980s and 1990s and fell to a level of 5% in 2001.[2] Japan's household savings rate, once prominent for its strength, is now approximately one-fourth of its peak.

One theory explaining the household savings rate decline focuses on Japan's aging population. According to the celebrated Life Cycle theory of consumption, consumers save to provide for their old age while they work, and spend their savings after retirement to maintain consumption levels. Therefore, if the Life Cycle theory is at all applicable when it comes to explaining the saving behavior of Japanese households, aging can indeed account for the fall of Japan's household savings rate in the 1990s.[3] However, it is questionable whether the pace of aging in the late 1990s was fast enough to produce the rapid reduction in the household savings rate that occurred at that time. Thus, the obvious question is: do any other factors exist that could have caused the fall of the household savings rate in the late 1990s? The aim of this study was to answer this question empirically by providing another theory for the decline of the household savings rate in the late 1990s.

Through our study we found that an increase of liquidity-constrained households in the late 1990s contributed to the fall in the household savings rate. We put forward the idea that when Life Cycle savers are trapped into liquidity constraint, possibly via unemployment, their savings drop to zero. Therefore, as the proportion of liquidity-constrained households increases, the household savings rate falls. In a later section of our study, we provide evidence demonstrating that this was indeed the case for Japan in the late 1990s. Simulation analysis shows that without an increase of liquidity-constrained households, the household savings rate would not have declined so rapidly in the late 1990s.

First we examined the effect of liquidity constraints on the household savings rate based on a simple theoretical model. Then, we undertook empirical analysis to evaluate quantitatively the relationship between liquidity constraints and household savings rates derived from the theoretical model. Finally, we drew conclusions from our analysis.

2. A Simple Model to Determine the Household Savings Rate

We assumed two types of household in the economy. Some households make their consumption and saving plans in order to maximize utility over their lifetime. They save a positive portion of their income while they work, and spend from the wealth they have accumulated during their working period after retirement, in order to attain a smooth path of consumption over their lifetime. We called this household type “Life Cycle households,” abbreviated as LCY households. The other households we grouped together are liquidity-constrained or “rule of thumb” households. Consumption of liquidity-constrained households hinges entirely upon current disposable income, either because they do not hold any liquid assets or because they are unable to borrow to sustain the consumption level that maximizes lifetime utility.[4]

Consumption of the i-th LCY household is determined under certainty equivalent assumption as follows:

$$C_{it} = \alpha_{it} TW_{it} \qquad (1)$$

where $TW_{it} = A_{it} + \sum_{t=0}^{\infty} \frac{Y_{it}}{(1+r)^t}$

C_{it} : consumption of the i-th household at year t

TW_{it} : real total wealth of the i-th household at the beginning of year t

A_{it} : real non-human wealth, sum of net financial wealth and tangible wealth, of the i-th household at the beginning of year t

Y_{it} : real labour income of the i-th household at year t

r : real discount rate

α_{it} : marginal propensity to consume from total wealth

Consumption is based on total wealth, which is composed of human wealth and is defined as discounted present value of labour income, net financial wealth, and tangible wealth. Savings is defined as the difference between real disposable income（YD_{it}）and consumption:

$$S_{it} = YD_{it} - C_{it} \qquad (2)$$

Conversely, the savings of liquidity-constrained households amount to zero, because their consumption is equal to their disposable income. Current consumption and savings of liquidity-constrained households are given as follows:

$$C_{it} = YD_{it} \qquad (3)$$

$$S_{it} = YD_{it} - C_{it} = 0 \qquad (4)$$

Household savings as a whole (S_t) are the sum of savings by the LCY households and liquidity-constrained households, the latter of which is zero. Formally, S_t may be written as:

$$S_t \equiv \sum_{i \in W,L} S_{it} = \sum_{i \in W} S_{it} \qquad (5)$$

where W : an index standing for LCY households

L : an index standing for liquidity-constrained households

The household savings rate (s_t) is defined as follows:

$$s_t \equiv \frac{S_t}{YD_t} = \frac{\sum_{i \in W} S_{it}}{\sum_{i \in W,L} YD_{it}} = \frac{\sum_{i \in W} YD_{it} - \sum_{i \in W} C_{it}}{\sum_{i \in W,L} YD_{it}} \qquad (6)$$

where YD_t : disposable income of households as a whole $YD_t \equiv \sum_{i \in W,L} YD_{it}$

Let λ_t $(0 < \lambda_t < 1)$ be the proportion of disposable income held by liquidity-constrained households. Substituting eq.(1) into eq.(6), we obtained the following expression for the household savings rate:

$$s_t = 1 - \lambda_t - \frac{\sum_{i \in W} \alpha_{it} TW_{it}}{YD_t} = 1 - \lambda_t - \frac{\alpha_t \sum_{i \in W} TW_{it}}{YD_t} \qquad (7)$$

where $\alpha_t \equiv \sum_{i \in W} \left(\frac{TW_{it}}{\sum_{j \in W} TW_{jt}} \right) \alpha_{it}$

We can simplify eq.(7) by making certain assumptions about the distribution of human and non-human wealth in LCY households and liquidity-constrained households. Specifically, we made two different assumptions. Under the first assumption, the proportion of human wealth, as well as non-human wealth, held by liquidity-constrained households is the same as that of disposable income.[5] There exists less inequality of wealth distribution between liquidity-constrained households and the LCY households under this assumption, because liquidity-constrained households hold the same proportion of human wealth and non-human wealth as disposable income. Under this assumption, the total wealth held by the LCY households is written as:

$$\sum_{i \in W} TW_{it} = (1 - \lambda_t) TW_t \qquad (8)$$

where $TW_t \equiv \sum_{i \in W, L} TW_{it}$

Substitution of eq.(8) into eq.(7) yields the following expression:

$$s_t^1 = (1 - \lambda_t)\left(1 - \alpha_t \frac{TW_t}{YD_t}\right) \qquad (9)$$

The proportion of liquidity-constrained households affects household savings rate changes in the following manner:

$$\frac{\partial s_t^1}{\partial \lambda_t} = -\left(1 - \alpha_t \frac{TW_t}{YD_t}\right) \qquad (10)$$

When the household savings rate is positive, we obtained the following result:

$$\frac{\partial s_t^1}{\partial \lambda_t} < 0$$

When the household savings rate is positive, the rise in the proportion of liquidity-constrained households reduces the household savings rate. For example, a positive household savings rate means that the LCY households, as a whole, save positive amounts of savings. Therefore, when some of the LCY households are trapped into liquidity constraints, their savings are reduced to zero; thus, aggregate household savings decrease, leading to the fall of the household savings rate.[6]

An alternative assumption regarding the distribution of human and non-human wealth is stated as follows: the proportion of human wealth held by liquidity-constrained households is the same as that of disposable income, but LCY households hold, exclusively, the non-human wealth. Under this assumption, there exists a large inequality in wealth distribution between the LCY households and liquidity-constrained households, because the LCY households hold all the tangible assets, as well as financial assets. Under this assumption, the total wealth held by the LCY households is written as:

$$\begin{aligned}\sum_{i\in W} TW_{it} &= (1-\lambda_t)\sum_{t=0}^{\infty}\frac{Y_t}{(1+r)^t} + A_t \\ &= TW_t - \lambda_t \sum_{t=0}^{\infty}\frac{Y_t}{(1+r)^t}\end{aligned} \qquad (11)$$

$$\text{where } \; Y_t \equiv \sum_{i\in W,L} Y_{it}$$

$$A_t \equiv \sum_{i\in W,L} A_{it}$$

Let ϕ_t be the ratio of non-human wealth to human wealth for the households as a whole. Then, it is easily shown that:

$$\sum_{t=0}^{\infty}\frac{Y_t}{(1+r)^t} = \frac{1}{1+\phi_t} TW_t \qquad (12)$$

Substituting eq.(12) into eq.(11), which is further substituted into eq.(7), and arranging the terms, we obtained the following expression for the household savings rate:

$$s_t^2 = 1 - \lambda_t - \alpha_t\left(1 - \frac{\lambda_t}{1+\phi_t}\right)\frac{TW_t}{YD_t} \qquad (13)$$

The effect of the proportion of liquidity-constrained households on the household savings rate is given by:

$$\frac{\partial s_t^2}{\partial \lambda_t} = -1 + \frac{\alpha_t}{1+\phi_t}\frac{TW_t}{YD_t} \qquad (14)$$

Comparing eq.(10) with eq.(14), it is shown that:

$$0 > \frac{\partial s_t^1}{\partial \lambda_t} > \frac{\partial s_t^2}{\partial \lambda_t}$$

The more concentrated the wealth holding in the LCY households, the larger in absolute value is the effect of the proportion of liquidity-constrained households on the household savings rate. For example, suppose that the proportion of disposable income held by liquidity-constrained households increases, keeping the total disposable income intact. Under the first assumption, the proportion of non-human and human wealth of the LCY households decreases in the same proportion. Alternatively, when LCY households exclusively hold non-human wealth, the total wealth of the LCY households does not decrease proportionately, nor does consumption of LCY households decrease proportionately. The implication is that the decrease of consumption is smaller than that of disposable income for the LCY households, leading to a larger fall of the household savings rate.

These two assumptions on wealth distribution are at two extremes. One assumption implies that the income distribution is the same as the wealth distribution, and less inequality of wealth distribution exists between the LCY households and liquidity-constrained households. Under the other assumption, the LCY households exclusively hold the non-human wealth, and liquidity-constrained households do not hold any non-human wealth. The actual situation will lie somewhere in between these two assumptions.

3. Liquidity Constraints and Household Savings Rate: Quantitative Evaluation

In this section we applied our theoretical model of household savings rate determination to the Japanese aggregate data and evaluated quantitatively to what extent a change in the proportion of liquidity-constrained households affects the household savings rate. In order to translate the theoretical model to the real world, we needed the time series data of wealth, income, consumption, and savings, and we had to assign certain values to the parameters underlying the model.

Specifically, in order to characterize the model, we needed the time series data of the household savings rate (s_t), proportion of liquidity-constrained households (λ_t), disposable income (YD_t), human wealth ($\sum_{t=0}^{\infty} \frac{Y_t}{(1+r)^t}$), non-human wealth (A_t), and total wealth (TW_t). Next, we explained the procedure to construct each data series.

Specification of the Size of Liquidity-Constrained Households

As for the proportion of liquidity-constrained households, we used “the proportion of households with no saving balance” reported in *Public Opinion Survey on Household Financial Assets and Liabilities* compiled by The Central Council for Financial Services Information.[7] Figure 2 shows the proportion of households with no savings balance in the period from 1970 to 2002. The data exhibited an increasing trend in the 1990s, notably in the late 1990s to 2000s. The increase was 4.3% from 2000 to 2001, reaching its peak (16.7%) in 2001.

Table 1 shows the proportion of households with no savings balance in the period from 1995 to 2002 by occupation. From 2000 to 2001 a large increase of the proportion of households with no savings balance was observed in “other” households (6.3-percent-point increase), managers (4.9-percent-point increase), households of agricultural, forestry, and fisheries (4.5-percent -point increase), and business proprietors (4-percent-point increase). Note that the proportion of households with no savings balance totaled 20% in “other” households, households of agricultural, forestry, and fisheries, and business proprietors in 2001. “Other” households included unemployed households, which are likely to be liquidity-constrained, given that unemployed households are more likely to run through all of their liquid assets in order to maintain consumption levels while unemployed. The unemployment rate rose rapidly in the late 1990s, which might have been responsible for the increase in the proportion of liquidity-constrained households. To examine this supposition, we regressed the proportion of liquidity-constrained households on the unemployment rate. Preliminary examination indicates that the two variables have unit roots and are not co-integrated. Therefore, we applied the Cochrane-Orcutt method to estimate the relationship.[8] The estimation results are follows:

$$\lambda_t = -0.0044 + 3.1903 AVEUNEMP \qquad \overline{R}^2 = 0.7877$$

$$(-0.20) \qquad (4.29) \qquad\qquad (15)$$

$$\rho = 0.6382$$

where λ_t : proportion of households with no saving balance

$AVEUNEMP_t$: unemployment rate averaged over the current year and the past three years.

ρ : coefficient of first order serial correlation

The values in parentheses are t-values.

The unemployment rate exerts a significantly positive effect on the proportion of liquidity-constrained households. An increase of the averaged unemployment rate by one percent point raises the proportion of liquidity-constrained households by 3.2 percent points.[9]

Construction of Income, Wealth, and Savings Time Series Data

Time series data of income, wealth, and savings are taken from the *2004 Annual Report on National Accounts* (Economic and Social Research Institute, Cabinet Office). However, the items in the Income and Outlay Accounts based on 93SNA are available only from 1980 forward, and those in the Closing Balance Sheet Account are available from 1990 forward. Therefore, we constructed a new series from the period 1970 to 2002 by linking the 93SNA-based series with the 68SNA based series. Both of the 93SNA-based and the 68SNA-based series of the items in income and outlay accounts are available for 1980 to 1984. Thus, we calculated the average ratio of 93SNA-based series to 68SNA-based series over this period, and we multiplied by this ratio the 68SNA-based series prior to 1980. As for the items in the Closing Balance Sheet Account, the link coefficient is the average ratio of 93SNA-based series to 68SNA-based series in the period from 1990 to 1994.[10] As for disposable income, we used an adjusted disposable income series that is consistent with the treatment of social transfer in kind in 68SNA.[11] Accordingly, we also adjusted the household savings rate.

In constructing our wealth series, we defined non-human wealth as tangible assets (land, fixed assets, and inventories) and net financial assets at the beginning of period. Human wealth is defined as the expected discount value of after-tax labour income (LY_t). After-tax labour income is the sum of compensation of employees, receivable and net mixed income minus taxes on income. In other words,

$$HW_t \equiv E\left[\sum_{i=0}^{\infty} \frac{LY_{t+i}}{(1+r)^i} \middle| \Omega_t \right] \qquad (16)$$

where r : subjective discount rate including risk premium

$E_t[\ |\Omega_t]$: expectation operator conditional on the information set available to households in period t

Stochastic process of the after-tax labour income should be specified to calculate human wealth based on eq.(16). We first conducted the unit root test of after-tax labour income, and could not reject the null of unit root. Therefore, we estimated the AR process of the first-differenced series of after-tax labour income.[12] Akaike Information Criteria chose the order of the AR process. It turns out that the first difference of the after-tax labour income is generated by the following AR(1):

$$\Delta LY_t = a_0 + a_1 \Delta LY_{t-1} + u_t \qquad (17)$$

where u_t : stochastic disturbance

Then it can be shown that the human wealth is computed as follows:

$$HW_t = \frac{1+r}{r}\left(LY_t + HW2_t\right) \qquad (18)$$

where $HW2_t = \frac{1}{1+r-a_1}\left(\frac{1+r}{r} a_0 + a_1 \Delta LY_t\right)$

To calculate the time series of human wealth based on eq.(18), we needed parameter estimates of eq.(17) and the subjective discount rate. As for the subjective discount rate, we used 6.2% per annum, which is taken from Takenaka and Ogawa (1987). Eq,(17) is estimated by annual time series covering the period from 1970 to 2002. In estimation, after-tax labour income is divided by the deflator of final consumption expenditure of households and converted into a per household basis by dividing by the number of households. The estimated results are as follows:

$$\Delta Y_t = 0.0190 + 0.4756 \Delta Y_{t-1} \qquad \overline{R}^2 = 0.1949$$
$$(0.91) \qquad (2.87) \qquad \text{Durbin h} = -0.2340 \qquad (19)$$

where $\overline{R}^2$: coefficient of determination adjusted for degree of freedom

Durbin h : Durbin's h-statistics

The time series of human wealth thus calculated is multiplied back by the number of households to obtain aggregate human wealth. Table 2 shows the estimated aggregate human wealth together with tangible wealth, net financial wealth, and the share of each wealth. Human wealth, 2559.511 trillion in 1971, exhibited a gradual upward trend and reached its peak (5181.52 trillion yen) in 1997. The share of human wealth, 83% in 1971, declined steadily over the 1970s and 1980s and reached its lowest point (64%) in 1990. In the 1990s, the share of human wealth rose and stayed around 69% after the mid-1990s.

Tangible wealth is the second largest component of total wealth. It was 396.888 trillion yen in 1971 and increased substantially during the bubble period in the late 1980s, reaching 1794.963 trillion yen in 1991. However, after the bubble burst, it fell consistently, reaching 1234.956 trillion yen in 2002. The share of tangible wealth shows a similar trend. The share rose by 11.9 percent points from 1970 to 1990, but it declined by 8 percent points in the 1990s.

Net financial wealth increased steadily over the sample period. The net financial wealth in 2002 (1076.408 trillion yen) is 7.6 times as large as that in 1971 (140.961 trillion yen). Accordingly, the share of net financial wealth also rose from 5% in 1971 to 15% in 2002.

Estimates of α_t Series

Given the time series of wealth variables, we can obtain the ratio of non-human wealth to human wealth (ϕ_t), which in turn is used, together with other data series, to calculate the marginal propensity to consume from total wealth for LCY households (α_t) from eq.(9) or eq.(13). The α_t series thus obtained is shown in Table 3. It should be noted that the two series, albeit obtained under two different assumptions on wealth distribution, exhibit a similar trend. The α_t series obtained from eq.(9) and eq.(13) takes its minimum and its maximum in the same year. Two α_t series also increased gradually in the 1990s.

We expected that the population composition would affect the α_t series, because it represents the marginal propensity to consume of the LCY households as a whole. In particular, as the population enrolled at school and/or that after retirement increases, the α_t series will rise. To examine this supposition, we regressed the α_t series on the population who were younger than 15 years (POP15) and older than 65 years (POP65). It turns out that these three variables have unit roots and are not co-integrated, so we applied the Cochrane-Orcutt method to estimate the relationship. The estimation result, using the α_t series obtained from eq.(9) (abbreviated as the $\alpha 1_t$ series), is given as follows:

$$
\begin{aligned}
\alpha 1_t &= -0.0049 + 0.1277 POP14 + 0.1803 POP65 \qquad \bar{R}^2 = 0.8033 \\
&\quad\; (-0.46) \qquad (3.92) \qquad\qquad (5.07) \qquad\qquad\qquad (20) \\
\rho &= 0.5082
\end{aligned}
$$

where ρ : coefficient of the first order serial correlation

Conversely, the estimation result using the α_t series, obtained from eq.(13) (abbreviated as the $\alpha 2_t$ series), is given as follows:

$$
\begin{aligned}
\alpha 2_t &= 0.0008 + 0.1137 POP14 + 0.1468 POP65 \qquad \bar{R}^2 = 0.6932 \\
&\quad\; (0.07) \qquad (2.90) \qquad\qquad (3.45) \qquad\qquad\qquad (21) \\
\rho &= 0.5893
\end{aligned}
$$

We can see from both of the estimation results that the population increase of those who were younger than 15 years and/or older than 65 years has a significantly positive effect on the marginal propensity to consume with respect to the LCY households, as predicted by Life Cycle theory.

<u>Liquidity Constraints and Household Savings Rate</u>

Next we evaluated quantitatively the effect of liquidity-constrained households on the household savings rate based on eq.(10) or eq.(14). Table 4 shows the partial derivatives of household savings rate with respect to the proportion of liquidity-constrained households. As was shown theoretically in the previous section, the absolute value of partial derivative calculated from eq.(14) is larger than that calculated from eq.(10). The partial derivative calculated from eq.(14) ranges from

-0.4647and -0.3181, while that calculated from eq.(10) ranges from -0.2213 and -0.0646. The average is –0.3892 in the former series and –0.1453 in the latter series. The increase in the proportion of liquidity-constrained households by five percent points leads to the fall of the household savings rate by 1.9 percent points in the former case, while it leads to the fall of the household savings rate by 0.73 percent points in the latter case. It is clear that change in the proportion of liquidity-constrained households exerts a non-negligible effect on the household savings rate.

As was seen at the outset, the proportion of liquidity-constrained households increased substantially in the late 1990s. We calculated by simulation technique an alternative path for the household savings rate in the situation that the proportion of liquidity-constrained households had not increased so much. We also evaluated the impact of demographic change on the household savings rate to identify the relative importance of the change in liquidity constraint and demographic composition.

The simulation analysis took the following steps. First, we calculated the base solution of the household savings rate for the period from 1990 to 2002. Actual values of population younger than 15 years and older than 65 years are substituted into eq.(20) or (21) to obtain the α_t series for the period 1990 to 2002, which is further substituted into eq.(9) or (13) together with actual series of disposable income, wealth, and the proportion of liquidity-constrained households. Then we obtained the base solution of the household savings rate.

Next, we calculated the path of the household savings rate under the alternative assumptions on demographic composition and the proportion of liquidity-constrained households. The alternative scenario of demographic composition assumes that the average of POP15 and POP65 for the period from 1987 to 1989 lasts until after the period 1990 to 2002. Under this assumption, we calculated the α_t series to obtain the path of the household savings rate from eq.(9) or (13). Comparison of the base solution with this solution showed the extent to which the household savings rate is affected by demographic factors, especially low fertility and aging.

Similarly, we evaluated quantitatively the effects of liquidity constraints on the household savings rate. Specifically, we calculated the alternative path of the household savings rate under the assumption that the averaged proportion of liquidity-constrained households in the period 1987 to 1989 lasted from 1990 to 2001. Comparing the solution thus obtained with the base solution, we evaluated the effects of liquidity constraints on the household savings rate.

Table 5 shows the base solution of the household savings rate, as well as the divergence of the household savings rate from the base solution under alternative scenarios, on demographic factors and liquidity constraints for two different assumptions of wealth distribution. When the wealth distribution and the income distribution are the same for the LCY households and liquidity-constrained households, the effects of liquidity-constraint on the household savings rate are not large. The household savings rate increases by only 0.6-0.7 percent points, even in 2001 and 2002 when the household savings rate precipitated. Contrasted with the small impact of liquidity constraints on the household savings rate, the effects of demographic factors on the household savings rate are quite large. The household savings rate rose by 9.4 and 10.7 percent points in 2001 and 2002, respectively.

However, when the LCY households exclusively hold the non-human wealth, the mitigation of liquidity constraints has a much larger effect on the household savings rate. The household savings rate rose by 4.1 and 3.9 percent points in 2001 and 2002, respectively. Judging from the size of the demographic effects on the household savings rate, which are 7.2 and 8.3 percent points in 2001 and 2002 respectively, the effect of liquidity constraints on the household savings rate is not small. Because it is quite likely that the actual wealth distribution is between our two extreme assumptions on wealth distribution, it is fair to say that severe liquidity constraints in the late 1990s had a non-negligible impact on the household savings rate.

4. Concluding Remarks

Japan’s investment-saving balance changed dramatically in the 1990s. In the household sector the savings rate fell, which reduced financial surplus substantially. Some fear that Japan’s aging population might further reduce the surplus. Our study showed that the investment-saving balance of the household sector was also greatly affected by cyclical factors, such as the unemployment rate, factors that are closely linked to the size of liquidity constraints. The unemployment rate is partly determined by demand for labour by the corporate sector, which in turn is affected negatively by the debt burden of the corporate sector.[13] The upshot is that, as the corporate sector reduces its debt outstandings, it will lead to mitigation of liquidity constraints by way of the improvement of labour market conditions. Thus, it will contribute to the deceleration of the decline in the household savings rate. It is true that aging exerts a negative effect on the household savings rate. However, it should be remembered that demographic change is structural and slow in nature, so that a corresponding fall in the household savings rate will be gradual; in addition, the actual change in the household savings rate will be compounded by cyclical factors that are associated with liquidity constraints.

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Footnotes

[1] Horioka (2004) has analyzed the factors underlying the stagnancy of consumption in the 1990s.

[2] See Section 3 for the procedure to construct a consistent series of household savings rates from 1970 to 2002.

[3] Horioka and Watanabe (1997) have presented evidence to show that a large proportion of household savings in Japan is to provide for people's old age, lending support to the Life Cycle theory.

[4] Formulation of aggregate consumption as the sum of consumption of the LCY households and liquidity-constrained households dates back to Flavin (1981), Hall and Mishkin (1982) and Hayashi (1982). For empirical studies supporting this formulation, see Campbell and Mankiw (1989,1991), Jappelli and Pagano (1989), Ogawa (1990) Cushing (1992), Carroll, et al. (1994), and Chyi and Huang (1997).

[5] Liquidity-constrained households do not hold any liquid assets by definition, so that under this assumption the non-human wealth of liquidity-constrained households consists of illiquid financial wealth and tangible wealth.

[6] When the household savings rate is negative, increase in the proportion of liquidity-constrained households *raises* the household savings rate. This is because LCY households, maintaining high levels of consumption by negative savings, are forced to reduce consumption by raising savings to zero owing to liquidity constraints.

[7] *The Family Saving Survey,* integrated into *The Family Income and Expenditure Survey* in 2002 and conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications, also reports on the proportion of households with no savings balance. In the period from 1970 to 2000 it attains its maximum (1.3%) in 2000. In the same year, the proportion of households with no savings balance is reported as 12.4% in *The Public Opinion Survey on Household Financial Assets and Liabilities.* The difference might reflect the income size of sampled households. In *The Family Saving Survey* the averaged annual income in the period 1970 to 2000 is 7.21million yen, while it is 5.57 million yen in *The Public Opinion Survey on Household Financial Assets and Liabilities.* The former exceeds the latter by 26%, so that the estimate of the proportion of liquidity-constrained households in the former is smaller than that in the latter.

[8] See Hamilton (1994) pp.561-562 for justification in applying the Cochrane-Orcutt method to estimate the relationship among the variables with unit roots.

[9] Horioka et al. (2002) and Horioka and Kohara (2004) show the evidence that Japanese households break into their savings when facing unexpected events such as unemployment. Our estimation result is consistent with their findings.

[10] Link coefficients for each item are shown in Appendix.

[11] I thank Charles Yuji Horioka for suggesting this point.

[12] We conducted a unit root test for the first-differenced series of after-tax labour income and rejected the null of unit root at the conventional significance level.

[13] See Ogawa (2003) for the evidence of negative effects of debt outstanding on demand for labour.

Appendix

Procedure to Construct Time-series Data of Income, Savings and Wealth of the Household Sector

The time-series data of income, savings and wealth of the household sector come from *2004 Annual Report on National Accounts* (Economic and Social Research Institute, Cabinet Office). However, most of the data series based on 93SNA are available only up to 1980 or 1990. Therefore we have to link the 68SNA-based data with the 93SNA-based data to construct the data series from 1970. To link the 93SNA-based data series with the 68SNA-based data series in a consistent manner, we calculate the ratio of 1980-84 average of each variable based on 93SNA to that based on 68SNA and multiply the 68SNA-based data series between 1970 and 1979 by this ratio. As for the link multiplier of wealth variables, the ratio of 1990-94 average based on 93SNA to that based on 68SNA is calculated and the 68SNA-based data series between 1970 and 1989 is multiplied by the ratio. The link multipliers for income, savings and wealth series are shown below.

Variables	Link multiplier	Data source
Saving, net	0.9319	Income and outlay accounts of households
Adjusted disposable income, net	1.0451	Income and outlay accounts of households
Compensation of employees, receivable	0.9916	Income and outlay accounts of households
Mixed income, net	1.0537	Income and outlay accounts of households
Taxes on income	0.9869	Income and outlay accounts of households
Labour income	--------	Compensation of employees, receivable + Mixed income, net - Taxes on income
Inventories	3.1552	Closing balance sheet account of households
Fixed assets	1.0047	Closing balance sheet account of households
Land	1.0151	Closing balance sheet account of households
Real assets	--------	Inventories + Fixed assets + Land
Financial assets	1.0792	Closing balance sheet account of households
Liabilities	1.0203	Closing balance sheet account of households
Net financial assets	--------	Financial assets - Liabilities
Deflator of final consumption expenditure of households （1995=1）	0.9388	Gross domestic expenditure (deflators)

The data series of savings, income and wealth are deflated by deflator of final consumption expenditure of households

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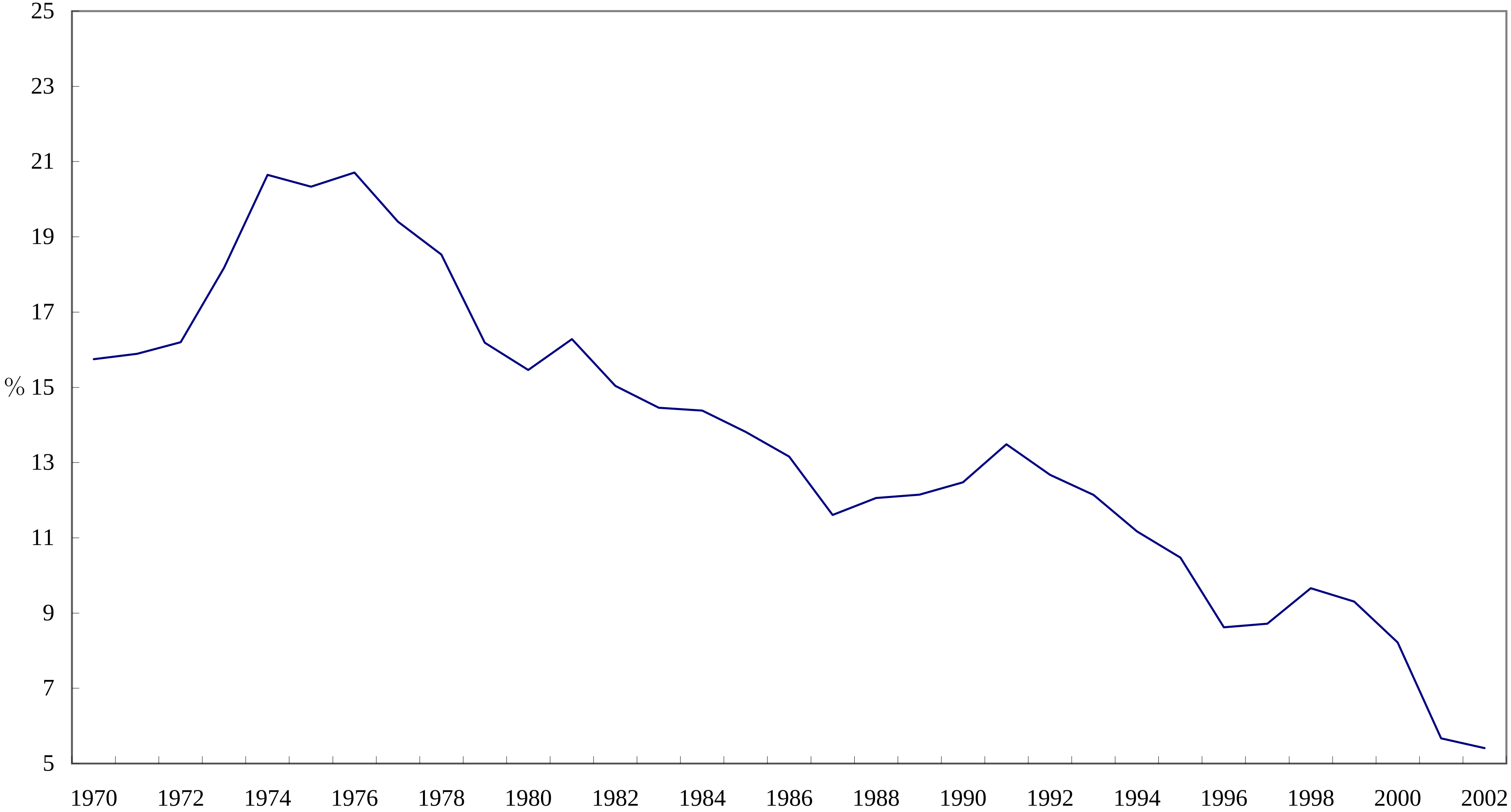
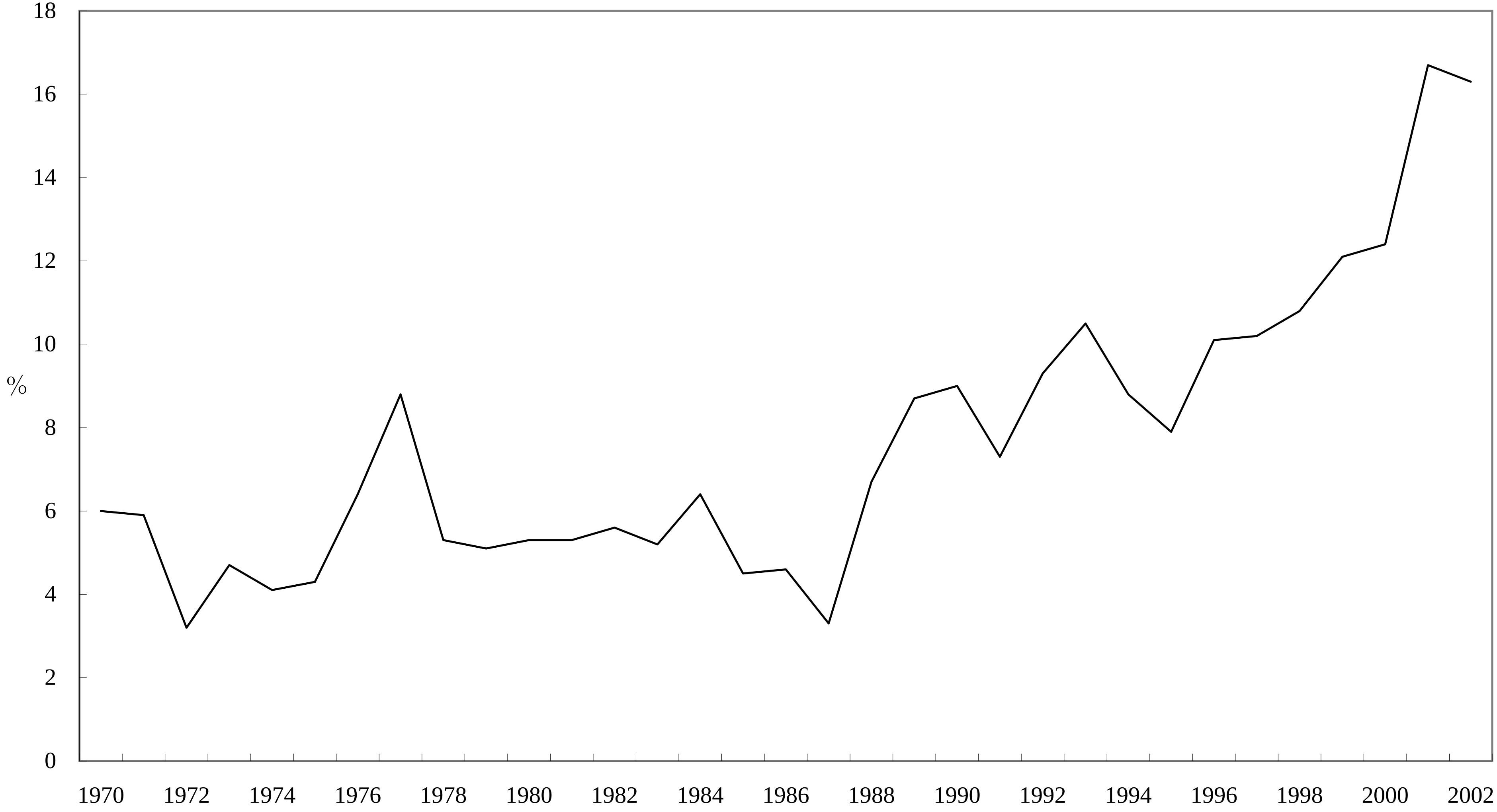
Figure 1 Hosehold Saving Rate in Japan



Data Source: Economic and Social Research Institute, Annual Report on National Accounts

Figure 2 Proportion of Hoseholds without Saving Balance



Data Source: The Central Council for Financial Services Information, Public Opinion Survey on Household Financial Assets and Liabilities

Table 1 Proportion of Households without Saving Balance by Occupation

year	Agriculture, forestry and fisheries	Business proprietors	White-collar workers	Blue-collar workers	Managers	Professional workers	Others	Average
1995	9.2	8.0	5.1	9.0	3.5	14.0	9.3	7.9
1996	9.9	14.4	5.0	10.6	3.8	13.6	12.3	10.1
1997	18.4	11.6	6.0	12.4	2.7	11.6	12.8	10.2
1998	14.2	12.7	5.3	13.7	3.7	18.9	12.5	10.8
1999	15.5	14.2	6.9	13.9	5.2	17.2	13.2	12.1
2000	14.9	15.3	7.8	15.3	4.5	20.4	13.3	12.4
2001	19.4	19.3	8.4	17.6	9.4	23.4	19.6	16.7
2002	20.2	18.1	6.9	18.8	7.2	27.8	18.6	16.3

Data Source: The Central Council for Financial Services Information, Public Opinion Survey on Household Financial Assets and Liabilities

Table 2 Composition of the Household Wealth

year	Human wealth		Tangible wealth		Net financial wealth		Total wealth
	balance (billion yen)	share %	balance (billion yen)	share %	balance (billion yen)	share %	balance (billion yen)
1971	2559511	82.6	396888	12.8	140961	4.6	3097359
1972	2846035	82.4	450949	13.1	157945	4.6	3454928
1973	3231750	80.7	569418	14.2	202429	5.1	4003596
1974	3124578	79.5	611246	15.5	195783	5.0	3931606
1975	3251270	81.0	571195	14.2	193393	4.8	4015858
1976	3321145	81.5	559069	13.7	195745	4.8	4075959
1977	3377092	81.1	569587	13.7	218896	5.3	4165575
1978	3544324	81.1	589527	13.5	237552	5.4	4371404
1979	3616315	79.8	646377	14.3	269471	5.9	4532163
1980	3433227	77.3	723563	16.3	283694	6.4	4440484
1981	3601885	76.7	801673	17.1	293707	6.3	4697265
1982	3651648	75.3	874836	18.0	321150	6.6	4847634
1983	3679770	74.6	908164	18.4	343067	7.0	4931001
1984	3762268	74.5	912076	18.1	375774	7.4	5050119
1985	3904031	74.3	933343	17.8	413776	7.9	5251150
1986	3925257	73.2	983930	18.3	453498	8.5	5362685
1987	4012970	70.4	1162646	20.4	524158	9.2	5699774
1988	4311980	67.8	1458890	22.9	587425	9.2	6358295
1989	4452746	66.9	1545496	23.2	661743	9.9	6659986
1990	4482922	64.2	1720524	24.7	775878	11.1	6979324
1991	4757491	65.6	1794963	24.7	699995	9.7	7252449
1992	4817151	66.8	1665605	23.1	725604	10.1	7208360
1993	4839883	68.3	1524715	21.5	726759	10.2	7091357
1994	5001773	69.2	1463406	20.3	761172	10.5	7226351
1995	5064866	69.1	1437176	19.6	832121	11.3	7334163
1996	5126283	69.5	1387278	18.8	863124	11.7	7376685
1997	5181520	69.6	1365514	18.3	895972	12.0	7443006
1998	5169711	69.4	1357326	18.2	923215	12.4	7450251
1999	5073878	69.2	1331554	18.2	928908	12.7	7334340
2000	5123276	68.5	1314945	17.6	1043678	13.9	7481899
2001	5062778	68.3	1290817	17.4	1061838	14.3	7415433
2002	5097788	68.8	1234956	16.7	1076408	14.5	7409152

Table 3 Estimates of α_t Series

year	series1	series2
1971	0.0413	0.0408
1972	0.0406	0.0404
1973	0.0381	0.0378
1974	0.0390	0.0387
1975	0.0399	0.0395
1976	0.0402	0.0397
1977	0.0406	0.0399
1978	0.0411	0.0407
1979	0.0421	0.0417
1980	0.0434	0.0429
1981	0.0416	0.0411
1982	0.0420	0.0414
1983	0.0426	0.0421
1984	0.0425	0.0417
1985	0.0425	0.0420
1986	0.0431	0.0426
1987	0.0423	0.0419
1988	0.0395	0.0387
1989	0.0393	0.0381
1990	0.0391	0.0378
1991	0.0388	0.0378
1992	0.0401	0.0388
1993	0.0414	0.0399
1994	0.0420	0.0407
1995	0.0424	0.0413
1996	0.0433	0.0419
1997	0.0434	0.0419
1998	0.0432	0.0417
1999	0.0442	0.0424
2000	0.0442	0.0423
2001	0.0456	0.0429
2002	0.0463	0.0437

Notes: Series 1 is calculated under the assumption that the distribution of non-human wealth as well as human wealth is the same across the LCY households and liquidity-constrained households, while series 2 is calculated under the assumption that the non-human wealth is exclusively held by the LCY households.

Table 4 Effect of Liquidity-Constrained Households on Household Saving Rate

year	$\frac{\partial s_t^1}{\partial \lambda_t}$	$\frac{\partial s_t^2}{\partial \lambda_t}$
1971	-0.1689	-0.3206
1972	-0.1673	-0.3181
1973	-0.1907	-0.3529
1974	-0.2153	-0.3818
1975	-0.2125	-0.3678
1976	-0.2213	-0.3734
1977	-0.2128	-0.3732
1978	-0.1957	-0.3547
1979	-0.1706	-0.3453
1980	-0.1632	-0.3612
1981	-0.1719	-0.3732
1982	-0.1593	-0.3758
1983	-0.1525	-0.3762
1984	-0.1537	-0.3803
1985	-0.1447	-0.3717
1986	-0.1379	-0.3771
1987	-0.1200	-0.3866
1988	-0.1292	-0.4228
1989	-0.1331	-0.4381
1990	-0.1371	-0.4647
1991	-0.1455	-0.4542
1992	-0.1397	-0.4440
1993	-0.1357	-0.4313
1994	-0.1225	-0.4101
1995	-0.1137	-0.4038
1996	-0.0959	-0.3925
1997	-0.0971	-0.3924
1998	-0.1083	-0.4034
1999	-0.1058	-0.4066
2000	-0.0938	-0.4060
2001	-0.0681	-0.4018
2002	-0.0646	-0.3933

Table 5 Effects of Liquidity Constraints on Household Saving Rate: Quantitative Evaluation

(1) Case where wealth distribution and income distribution are the same across the LCY households and liquidity-constrained households

(%)

	Base solution of household saving rate	No change in fertility and aging since the 90s	No change in the proportion of liquidity-constrained households since the 90s
1990	11.15	-0.30	0.34
1991	10.86	-0.05	0.12
1992	11.92	0.46	0.40
1993	13.21	1.00	0.63
1994	12.38	1.87	0.35
1995	11.65	2.70	0.21
1996	10.39	3.75	0.45
1997	9.43	4.89	0.42
1998	8.93	5.98	0.46
1999	9.31	6.78	0.62
2000	6.58	8.45	0.46
2001	5.23	9.39	0.66
2002	4.78	10.71	0.58

(2) Case where non-human wealth is exclusively held by the LCY households

(%)

	Base solution of household saving rate	No change in fertility and aging since the 90s	No change in the proportion of liquidity-constrained households since the 90s
1990	10.81	-0.51	1.25
1991	11.13	-0.42	0.47
1992	11.70	-0.08	1.34
1993	12.84	0.31	1.86
1994	12.72	0.96	1.08
1995	12.40	1.56	0.70
1996	10.74	2.42	1.58
1997	9.99	3.33	1.59
1998	9.51	4.22	1.84
1999	9.66	4.90	2.40
2000	7.05	6.28	2.45
2001	4.51	7.21	4.11
2002	4.50	8.32	3.89