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The Decline of Japan's Saving Rate and Demographic Effects

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Abstract

This paper investigates the phenomenon in which Japan's household saving rate showed a sharp decline even during the long stagnation period called "the lost decade." Our empirical results show that the sharp decline in the saving rate in the 1990's can be explained by the significant impact of demographic factors. Furthermore, the estimated life-cycle curve is hump-shaped and this means that the prediction of the life-cycle model is confirmed with time-series data on the Japanese saving rate.

Keywords: Saving rate, Demographics, Life-cycle model.
JEL classifications: E21, E27

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1 Introduction

The Japanese economy experienced a long stagnation called "the lost decade" and consumption was dampened throughout the 1990's. However, the household saving rate declined sharply during this period as shown in Figure 1. In this paper, we investigate the cause of this phenomenon by conducting an empirical analysis.

Regarding previous studies of the Japanese saving rate, there have been many empirical analyses (see, for example, Ando, et al. (1986), Hayashi (1986), Hayashi, et al. (1988), Ishikawa (1988), Horioka (1990), and Yashiro and Maeda (1994)). However, those studies explored the background of the high saving rate before the sharp decline of the 1990's. Thus, the recent sharp decline in the saving rate makes it necessary to clarify the reasons for the decline from a time-series perspective. We need to reexamine the relationship between this phenomenon and the life-cycle model because Japan has recently been experiencing a rapid aging of its population.

The main features of this paper are as follows. First, we analyze demographic dynamics considering not only the proportion of the elderly but also other age groups, rather than using a single variable represented by the dependency ratio as in past studies (for example, Horioka (1997)).

Second, we overcome the lack of reliable time-series data classified by age, which would have been used to analyze heterogeneity among age groups. In our analysis, this heterogeneity is taken into consideration when analyzing the determinants of the aggregate saving rate, and we clarify that the prediction of the life-cycle model can be confirmed using time-series data on the Japanese saving rate.

In this paper, we find that demographic dynamics was a major cause of the decline in Japan's saving rate, especially in the 1990's. The relationship among the saving rate, the demographic factor, and the income factor can be described using a cointegration and error-correction representation. Our result shows that there exists a force that brings deviations back to the long-run equilibrium when the above mentioned factors are cointegrated. Moreover, in equilibrium, the effect each age group has on the macroeconomy is described as a hump-shaped curve, which is consistent with what the life-cycle model implies.

The paper is organized as follows. Section 2 introduces the empirical specification and Section 3 clarifies the data source and our calculations. Section 4 describes the empirical analysis. Section 5 concludes.

2 The theoretical framework

We describe a theoretical framework to prepare for the empirical analysis in the next section. In this setup, we first present a commonly-used permanent income model where each consumer has motive for consumption smoothing in its finite lifetime, and then introduce the assumption where the rule-of-thumb consumers also exist in the economy.

The consumer who is born at age a_0 and dies with certainty at age A decides the level of consumption c_a to maximize the discounted expected lifetime utility given below.

$$V_a(x_a) = \max_{c_a} u(c_a) + \beta E_a[V_{a+1}(x_{a+1})],$$

where $V_a(x_a)$ is the value function at age a, E_a is the expectation operator conditional on information available at age a, and β is a discount factor which is equal to $1/(1+r)$ where r is real rate of return. $x_a = w_a + y_a$ denotes individual's cash-on-hand as the sum of accumulated wealth w_a and income y_a. Income consists of after-tax labor income and net social transfers from government: $y_a = (1-\tau)l_a + tf$ where τ, l_a, and tf denote the rate of tax, labor income, and transfers, respectively. $u(\cdot)$ is an instantaneous utility function.

The function is maximized subject to the intertemporal budget constraint $x_{a+1} = (1+r)(x_a - c_a) + y_{a+1}$ and zero constraint of bequest $x_{A+1} = 0$.

Given this maximization problem, the consumer wants to consume all lifetime income by the end of its lifetime, and therefore the lifetime budget constraint can then be expressed as

$$\sum_{i=0}^{A-a} \left(\frac{1}{1+r}\right)^i E_a(c_{a+i}) = w_a + \sum_{i=0}^{A-a} \left(\frac{1}{1+r}\right)^i E_a(y_{a+i}).$$

Here, the utility function is assumed to be quadratic in c_a and therefore the Euler equation below holds for all time periods by repeated iteration.

$$c_a = E_t(c_{a+i}).$$

We insert the above equation into intertemporal budget constraint and obtain

$$c_a = \frac{w_a + \sum_{i=0}^{A-a}(1/(1+r))^i E_a[y_{a+i}]}{\sum_{i=0}^{A-a}(1/(1+r))^i} = y_a^p.$$

Permanent income y_a^p is defined by the second equality and this equation shows the households decide their level of consumption in the usual permanent income framework where the certainty equivalence holds and income uncertainty does not have effects on the decision of consumption and saving.

We next introduce the other type of households in addition to the permanent income households described above, following the manner of Hayashi (1982) and Campbell and Mankiw (1987), who considered the liquidity constrained households in the aggregate consumption function. It is the rule-of-thumb household, which consumes a certain proportion of the disposable income y_a^d gained at each period. As Attanasio, et al. (1995) among others showed that consumption and saving behavior reflects the family size, age-specific taste shift, or lifetime uncertainty, we suppose that this proportion depends on the age of household head. The consumption of the rule-of-thumb household is determined as follows,

$$c_a = \theta(a) y_a^d.$$

Thus, the saving for the permanent income households $s_{1,a}$ and the rule-of-thumb households $s_{2,a}$ are given below, using the identity that $y_a^d = c_a + s_a$ which means that disposable income is the sum of consumption and saving.

$$\begin{aligned} s_{1,a} &= y_a^d - y_a^p, \\ s_{2,a} &= y_a^d - \theta(a) y_a^d, \end{aligned}$$

where $\theta(a)$ is the proportion of consumption to disposable income and assumed to be a function of age.

Therefore, the aggregate savings in the overall economy at time t is described below,

$$\begin{aligned} S_t &= \eta_1 \sum_{a=a_0}^{A} p_{a,t} s_{1,a,t} + \eta_2 \sum_{a=a_0}^{A} p_{a,t} s_{2,a,t} \\ &= \sum_{a=a_0}^{A} p_{a,t} \left[y_{a,t}^d - \eta_1 y_{a,t}^p - \eta_2 \theta(a) y_{a,t}^d \right], \end{aligned}$$

where η_1 and η_2 are the shares of two kinds of households, and their sum is equal to one, and $p_{a,t}$ denotes the population of each age group a at time t.

The saving rate SR_t is described by dividing S_t by aggregate disposable income Y_t^d.

$$SR_t = 1 - \eta_1 \frac{Y_t^p}{Y_t^d} - \eta_2 \sum_{a=a_0}^{A-a} p_{a,t} \theta(a) \frac{y_{a,t}^d}{Y_t^d},$$

where $Y_t^d = \sum_{a=a_0}^{A} p_{a,t} y_{a,t}^d$ and $Y_t^p = \sum_{a=a_0}^{A} p_{a,t} y_{a,t}^p$.

Next, we set up the empirical specification used in the next section. First we redefine the parameters and get the expression given below.

$$SV_t = \lambda \frac{Y^p}{Y^d} + \sum_{a=a_0}^{A-a} \psi_a p_{a,t} \omega_{a,t}, \tag{1}$$

where we denote $SV_t = SR_t - 1$, $\lambda = -\eta_1$, $\psi_a = -\theta(a)\eta_2$, and $\omega_{a,t} = y_{a,t}^d / Y_t^d$.

Then we add one more assumption to the specification of this ψ_a. Instead of grasping consumption and income at individual level for every age a, we capture them at the household-level by dividing households into k age groups based on the age of household head.

The second term in equation (1) is the demographic factor at time t. It is represented as the sum of the product of the age-specific factor ψ_k, which can be regarded as the life-cycle effects, population $p_{k,t}$, and income share $\omega_{k,t}$ for each age group. We capture these effects of $p_{k,t}$ and $\omega_{k,t}$ with actual data. The life-cycle effects ψ_k is estimated with the parameter restriction represented by a quadratic function of the index number k to capture the heterogeneity among the age groups.

We impose the restrictions on parameters following the specification used in the work on consumption of Fair and Dominguez (1991) and Attfield and Cannon (2003),

$$\psi_k \quad = \quad \rho_0 + \rho_1 k + \rho_2 k^2.$$

When we estimate equation (1) with the above restriction, we also impose the restriction that the ψ_k's among all k's sum to zero. In this specification, when $\rho_1 > 0$ and $\rho_2 < 0$, the life-cycle effect on the saving rate turns out to be hump-shaped. We can confirm in the empirical analysis below whether the curve is hump-shaped or not—that is, whether the prediction of the life-cycle model can be confirmed by Japanese time-series data.

3 Empirical analysis

3.1 Data

(1) Saving rate

We define SV, the left hand side variable in equation (1), as the saving rate SR minus one. The saving rate SR is the ratio of household saving to household disposable income. We also use an alternative variable and denote it as SVJ. It is based on the adjusted saving rate which is calculated with adjusted disposable income including net social transfers in kind (for example, benefits for medical care and education). When we refer to the relationship between the saving rate and its determinants, for ease of exposition, we refer to SV and SVJ as saving rate hereafter.

Both SV and SVJ are based on data from the National Accounts of Japan (hereafter SNA, Cabinet Office). The other commonly used time-series data for the saving rate are those from the Family Income and Expenditure Survey (hereafter FIES, Ministry of Internal Affairs and Communications), but they are known to have smaller coverage both for population and composition of consumption and income. For example, the FIES does not include the self-employed or imputed rent on owner-occupied housing.[1]

(2) Income factor

Income factor is defined as the difference between disposable income and permanent income and is denoted by DR. For data for disposable income, we use the same estimates as we used above for calculating the saving rate or the adjusted saving rate. The name of the income factor using adjusted disposable income includes the letter J.

Past studies always faced the difficulty whereby permanent income is not observable and some assumptions are needed to measure it. To calculate permanent income in this paper, we define it as Flavin's (1981) permanent income, assuming each household calculates permanent income in a horizon long enough to be represented as infinity. It is the flow gained from the sum of human wealth (the discounted sum of future labor income) and non-human wealth that people have at the beginning of time t.

Non-human wealth is calculated as the sum of tangible assets and net financial assets. The former is the sum of land, fixed assets, and inventories from SNA which is transformed to quarterly data using the technique of Lisman and Sandee (1963). The latter is obtained by subtracting liabilities from the sum of currency, transfer deposits, time deposits, and shares from Flow of Funds Accounts (Bank of Japan).

Human-wealth, on the other hand, is calculated by assuming that the data generating process of future labor income is described by an ARIMA (1,1,0) model that the real rate of return r, is constant at 0.05. To capture future labor income, we use compensation of employees because other

[1] For the differences between data on the saving rate in the SNA and FIES, see Iwamoto, Ozaki, and Maekawa (1995, 1996).

components of disposable income have a fluctuation which is too large for households to foresee. We also use total disposable income as an alternative variable. The difference ratio DR calculated using each of them are named $DR1$ and $DR2$, respectively.

(3) Demographic factor

It is common in the earlier literature to use a single variable such as 'dependency ratios,' the ratios of the population of dependent groups such as the elderly or children (aged 65 and older, or aged under 15) to the working age population (aged 15 to 64), when considering the influence of the demographic effect on the saving rate.

However, this paper is novel in that we use a measure of demographic changes which reflects both the different impact each age group has on the macroeconomy and the change in the overall age distribution. Specifically, as explained above, the demographic dynamics are expressed as the sum of the products of the life-cycle effect $\psi_k = [\psi_1, \cdots, \psi_K]$, age group distribution $p_{k,t} = [p_{1,t}, \cdots, p_{K,t}]$, and income share $\omega_{k,t} = [\omega_{1,t}, \cdots, \omega_{K,t}]$. We capture the effects of $p_{k,t}$ and $\omega_{k,t}$ with actual data and ψ_k with estimation.

As for k, we use 10 age groups, starting at age 24 and under, then categories grouped by increments of five years, from ages 25-29 up to ages 60-64, and finally age 65 and over. These age groups are numbered from 1 to 10 as index k.

The distribution of households $p_{k,t}$ is calculated by multiplying the number of all households from Households Projections for Japan (National Institute of Population and Social Security Research) and the proportion of each age group from the FIES. The proportion in the FIES is the sample distribution adjusted to the population estimated by the Population Census (Ministry of Internal Affairs and Communications). The data are shown in Figure 2, and we can clearly observe two features: One is that baby-boomers, usually called the Dankai-generation, has shifted to an older age group, which can be considered a transitory shock on the distribution. The other is a large increase in households aged 65 and over, which is the result of declining fertility and can be understood as a permanent shock.

The SNA-based distribution of income across age groups is calculated by Hamada (2002), and we use his results to capture the effect of income share $\omega_{k,t}$. Because the National Survey of Family Income and Expenditure (hereafter NSFIE) is conducted only every five years, this calculation is carried out only for 1994 and 1999, both of which seem very similar. Thus, we use the latter calculation as a benchmark due to data limitations.

Regarding the life-cycle effect, we estimate the parameters that indicate the shape of the curve, assuming it is described as a quadratic function of the group index k. This assumption is consistent with the evidence that the Japanese household saving rate across age groups is hump-shaped, as Higo, et al. (2001) found. Their calculation is based on the NSFIE whose coverage ratio of population is much larger than that of the FIES.

When conducting the estimation, the demographic factor, the product of three effects, is transformed to two variables $Z_{1,t}$ and $Z_{2,t}$ based on the restrictions on the coefficients discussed above (see Appendix for details). $Z_{1,t}$ and $Z_{2,t}$ are first calculated on a yearly basis, then converted to a quarterly series using the technique of Lisman and Sandee (1963), and finally multiplied by 10^{-5} to adjust for scale.

3.2 Unit root properties of the data

We test the unit root property of the variables by employing ADF statistics to test the null of a unit root and KPSS statistics to test the null of no unit roots. The results of the tests are presented in Table 1. The test statistics indicate that they have unit roots in their levels and are stationary in their first differences except for the case in which the ADF test is applied to the first difference of Z_1 and Z_2, where the null of nonstationarity fails to be rejected by a slight margin. Therefore, we assume all variables are I(1).

3.3 Tests of cointegration and estimates of cointegrating vector

Given the time-series properties of the data, the empirical relationship between the variables is subject to cointegration analysis. We suppose that the dependent variable is SV and test for a cointegrating relationship using OLS-residual-based tests.

We first estimate the potential relationships among the saving rate and its determinants—the income factor DR_t and the demographic factor—in reduced form after relaxing the structural constraints described in the model. The demographic factor is reduced to two variables $Z_{1,t}$ and $Z_{2,t}$ by imposing the restrictions on the coefficients explained above. Then we estimate the equation given below by static ordinary least squares during the period from 1Q of 1981 to 1Q of 2003, during which data for all variables are available.

$$SV_t = \gamma_1 DR_t + \gamma_2 Z_{1,t} + \gamma_3 Z_{2,t},$$

where γ_1, γ_2, and γ_3 are coefficients of the equation. We next use the common and straightforward OLS-residual-based tests of Phillips and Ouliaris (1990) for our cointegration test. Table 2 shows that the stationary property of the residuals is confirmed and that the equation can be regarded as a cointegrating relationship.[2]

Thus, we estimate the cointegrating vector by dynamic ordinary least squares (DOLS) following Stock and Watson (1993). The results are displayed in Table 3, which shows that the demographic and income factors are statistically significant.

The signs of the coefficients are as theoretically expected and are statistically significant. The coefficient of the income factor is negative ($\gamma_1 < 0$), and the two coefficients of the demographic factor are positive ($\gamma_2 > 0$) and negative ($\gamma_3 < 0$), respectively. [3] Thus, we confirm that the effect each age group of households has on the aggregate saving rate is hump-shaped as described in Figure 3 and this verifies that the prediction of the life-cycle model can be confirmed with time-series data on the Japanese saving rate.

How much the demographic factor contributed to the saving rate during the estimation period is shown in Figure 4, which is calculated as the sum of the parameter γ_2 times Z_2 and γ_3 times Z_3. Our results show that the demographic factor follows the declining trend of actual values in the cointegrating relationship.

3.4 Estimates of the error-correction model

Given the result that the saving rate, the income factor, and the demographic factor are cointegrated, we estimate an error-correction model (ECM) to determine the short-run dynamics.

First, the long-run equilibrium model is re-written as an error-correction model. Here, the demographic dynamics are assumed to satisfy its exogeneity in the short-term adjustment mechanism.[4]

[2] The significance of the Z_α and Z_t statistics of Phillips and Ouliaris (1990) is evaluated based on the critical values $[-34.0, -26.1, -22.7]$ and $[-4.51, -3.85, -3.54]$ for significance at the $[1\%, 5\%, 10\%]$ levels, where the test is applied to the residuals of a cointegrating regression with 200 observations and without deterministic terms.

[3] The values of the parameters are not necessarily consistent with theoretical expectation. Misspecification of the equation and mismeasurement of the data can possibly affect these parameter estimates.

[4] Regarding the restrictions imposed on the four variables, we assume that the cointegrating rank is one and that the linear combination of the four variables shown above is the only stationary cointegrating relationship. We also suppose that the matrix of vector

We adopt the common method of Engle and Granger (1987) to estimate the following equation. We use the residuals calculated from the estimated value $\widehat{SV}$ of static ordinary squares in the previous subsection.[5]

$$\Delta SV_t = \sum_{n=1}^{N} \delta_{1,n} \Delta SV_{t-n} + \sum_{n=1}^{N} \delta_{2,n} \Delta DR_{t-n} + \delta_3 (SV_{t-1} - \widehat{SV}_{t-1}),$$

where Δ indicates a difference operator and δ_1, δ_2, and δ_3 are coefficients of each term. The number of lags in the ECM is set at no more than eight so that we accept the null of no serial correlation in the LM tests. The error-correction mechanism is found to exist when $\delta_3 < 0$ is satisfied in the estimation results.

The estimation results and diagnostic tests for residuals are displayed in Table 4. The table shows that the coefficient of the error-correction term is negative and statistically significant in all cases, and this clarifies the mechanism moving the model back to equilibrium whenever any deviations from equilibrium occur. δ_3, the adjustment speed parameter, ranges from -0.18 to -0.21. This implies that a 1% deviation from the equilibrium can be corrected within no more than six quarters, whichever variable set is chosen.

4 Conclusion

The Japanese economy experienced a long stagnation called "the lost decade," but the decline in the household saving rate also continued during this period. Our investigation provides an empirical analysis to explain this phenomenon.

In our study, the relationship among the saving rate, demographic factor, and income factor can be described as a cointegration and error-correction mechanism. Our results show that there exists a force that brings deviations back to the long-run equilibrium where the above mentioned factors are cointegrated. Therefore, the demographic factor was a major cause of the

autoregressive parameters in the VECM representation is filled with zeros except for the parameters of the saving rate and income factor in the saving rate equation that are estimated in the ECM used here.

[5] While the generated least squares problem arises in usual two stage least squares, the standard error of the error correction term obtained from prior estimation is not biased when the variables are non-stationary and cointegrated, as McAleer et al. (1994) and McKenzie and McAleer (1997) showed in their studies.

sharp decline in the Japanese saving rate in the 1990's. Furthermore, in this equilibrium we estimate that the impact each age group has on the macroeconomy is described as a hump-shaped curve, which is consistent with what the life-cycle model implies.

Further examinations are left for future study. Though our framework has assumed that the effect of the life-cycle curve is constant, the shape might be determined simultaneously with consumers' labor supply decision. Due to the recent increase in the number of the elderly, giving consideration to their labor supply is of growing importance in analyses of consumption and saving behavior.

Appendix: The derivation of $Z_{1,t}$ and $Z_{2,t}$

We describe the explanation for decomposition of variables under quadratic restriction following Attfield and Cannon (2003).

As explained in the main text, the effect of the demographic dynamics at period t, namely ϕ_t, is the sum of products of ψ_k, $\omega_{k,t}$, and $p_{k,t}$.

Let $Q_{k,t}$ be the product of $\omega_{k,t}$ and $p_{k,t}$, then we have

$$\phi_t = \sum_{k=1}^{K} \psi_k Q_{k,t}.$$

Assuming that the life-cycle effect ψ_k is described as a quadratic function of the index number k, we obtain

$$\psi_k = \rho_0 + \rho_1 k + \rho_2 k^2.$$

We also suppose the sum of ψ_k among the all age groups is equal to 0. Then ψ can be expressed as the following equation.

$$\psi = CJ\rho,$$

$$\begin{aligned}
\text{where,} \quad \psi &= [\psi_1, \cdots, \psi_K]', \quad C = \left[I_K - K^{-1} i i'\right], \quad \rho = [\rho_1, \rho_2]', \\
J &= \begin{bmatrix} 1 & \cdots & K \\ 1 & \cdots & K^2 \end{bmatrix}', \quad \text{and} \quad \rho_0 = -K^{-1} i' J \rho.
\end{aligned}$$

(I_K is the identity matrix of size K and i is the vector of 1s.)

Then the demographic factor can be expressed as

$$\phi_t = Z_{1,t}\ \rho_1 + Z_{2,t}\ \rho_2,$$

where $[Z_{1,t}, Z_{2,t}] = QCJ$ and

$$Q = \begin{bmatrix} Q_{1,1} & \cdots & Q_{1,T} \\ \vdots & \ddots & \vdots \\ Q_{K,1} & \cdots & Q_{K,T} \end{bmatrix}'.$$

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Table 1. Results of Unit Root Tests

Test			SV		SVJ		DR1		DR1J	
ADF	Level	None	-1.90		-2.39	†	0.32		0.17	
		Constant	0.03		0.25		-2.10		-2.04	
	Difference	None	-10.23	††	-5.66	††	-3.03	††	-2.95	††
		Constant	-10.58	††	-6.32	††	-3.07	†	-2.96	†
KPSS	Level	Constant	1.14	††	1.16	††	0.59	†	0.50	†
	Difference	Constant	0.05		0.07		0.44		0.45	

Test			DR2		DR2J		Z1		Z2	
ADF	Level	None	0.25		0.14		1.98		1.80	
		Constant	-2.09		-2.02		1.63		1.80	
	Difference	None	-2.96	††	-2.91	††	-0.38		-0.39	
		Constant	-2.98	†	-3.74	††	-2.30		-2.14	
KPSS	Level	Constant	0.54	†	0.47	†	1.21	††	1.20	††
	Difference	Constant	0.42		0.45		0.11		0.17	

Notes:

1. SV: saving rate minus one. DR1: income factor using compensation for employees to calculate human wealth. DR2: income factor using disposable income to calculate human wealth. Z1 and Z2: demographic factor (See Appendix for details). The letter J denotes the variables derived with adjusted disposable income.
2. †† (†) denotes the rejection of the hypothesis at the 1% (5%) level.
3. Length of lags of ADF test is selected based on AIC.
4. For KPSS test, the method of estimating the frequency zero spectrum is Bertlet kernel.

Table 2. Results of the Residual-Based Tests for Cointegration

	Zα		Zt		Variable Sets SR	DR
case 1	-34.62	††	-4.65	††	SR	DR1
case 2	-33.92	†	-4.61	††	SR	DR2
case 3	-34.59	††	-4.63	††	SRJ	DR1J
case 4	-33.33	†	-4.55	††	SRJ	DR2J

Notes:

1. Zα and Zt are defined in Phillips and Ouliaris (1990).
2. †† (†) denotes the significance at the 1% (5%) level.

Table 3. Estimates of the Cointegrating Vectors by Dynamic OLS

	Variables							
	DR		Z1		Z2		Adj-R2	S.E.
case 1	-1.986	††	1.204	††	-0.095	††	0.841	1.213
	(0.80)		(0.18)		(0.01)			
case 2	-1.908	††	1.203	††	-0.095	††	0.835	1.234
	(0.83)		(0.19)		(0.01)			
case 3	-1.603	††	0.929	††	-0.075	††	0.859	1.051
	(0.81)		(0.16)		(0.01)			
case 4	-1.505	†	0.930	††	-0.075	††	0.853	1.073
	(0.86)		(0.18)		(0.01)			

Notes:
1. Regressions are run with the number of leads and lags of 1.
2. The error process is assumed to be AR(1).
3. The upper and lower figures indicate estimated coefficient and adjusted standard error, respectively.
4. †† (†) denotes the significance at the 1% (5%) level.

Table 4. Estimation Results of the Error-Correction Model

						Diagnostic Checking			
	ECT		Length of Lags (N)	S.E.	Adj-R2	Breusch-Godfrey LM test	White test	Ramsey RESET	Jarque-Bera
case 1	-0.180	†	1	1.148	0.221	1.724	15.250	0.000	13.114
	(0.09)					(0.189)	(0.018)	(0.992)	(0.001)
case 2	-0.180	†	1	1.147	0.223	1.794	15.392	0.000	12.550
	(0.09)					(0.180)	(0.017)	(0.993)	(0.002)
case 3	-0.207	††	3	0.912	0.341	0.969	11.732	0.120	9.588
	(0.09)					(0.325)	(0.628)	(0.730)	(0.008)
case 4	-0.201	††	3	0.911	0.342	1.015	11.752	0.092	9.117
	(0.09)					(0.314)	(0.626)	(0.762)	(0.010)

Notes: 1.ECM denotes the erro-correction term, and the upper and lower figures indicate estimated coefficient and standard error, respectively.
2.For the diagnostic checking, the upper and lower figures indicate estimated statistics and p-value, respectively.
3. †† (†) denotes the significance at the 5% (10%) level.

Figure 1. Saving Rate

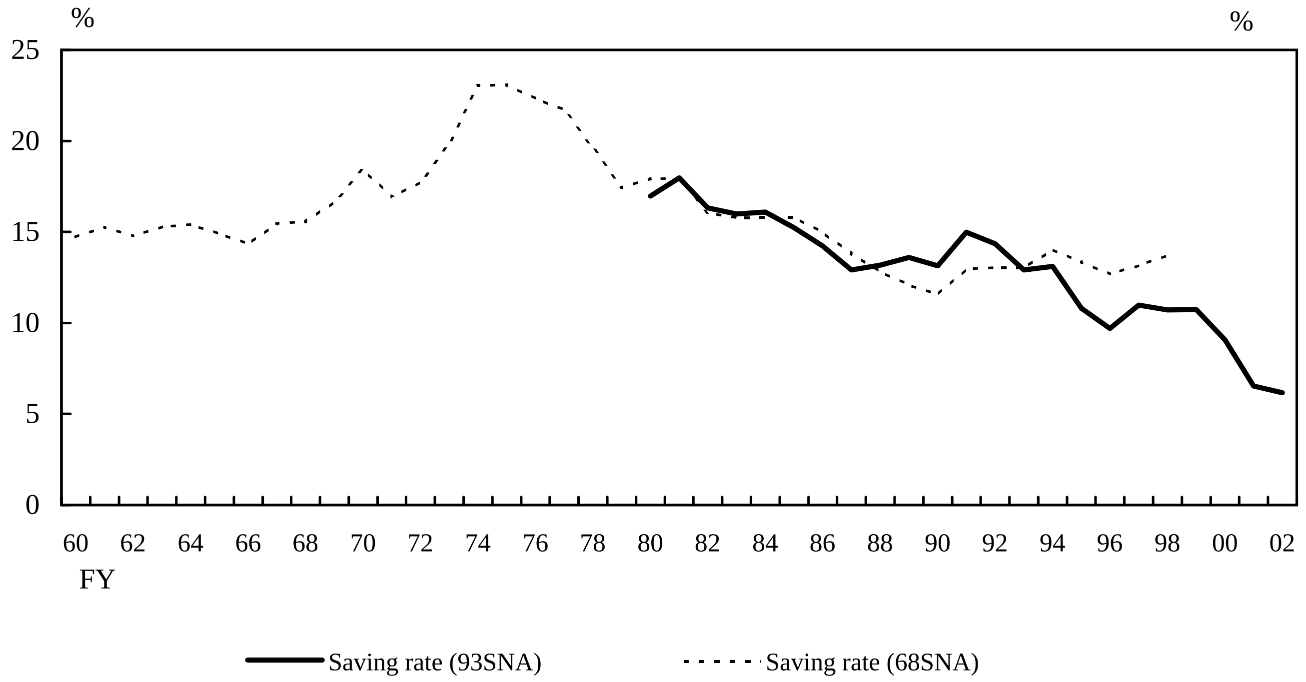
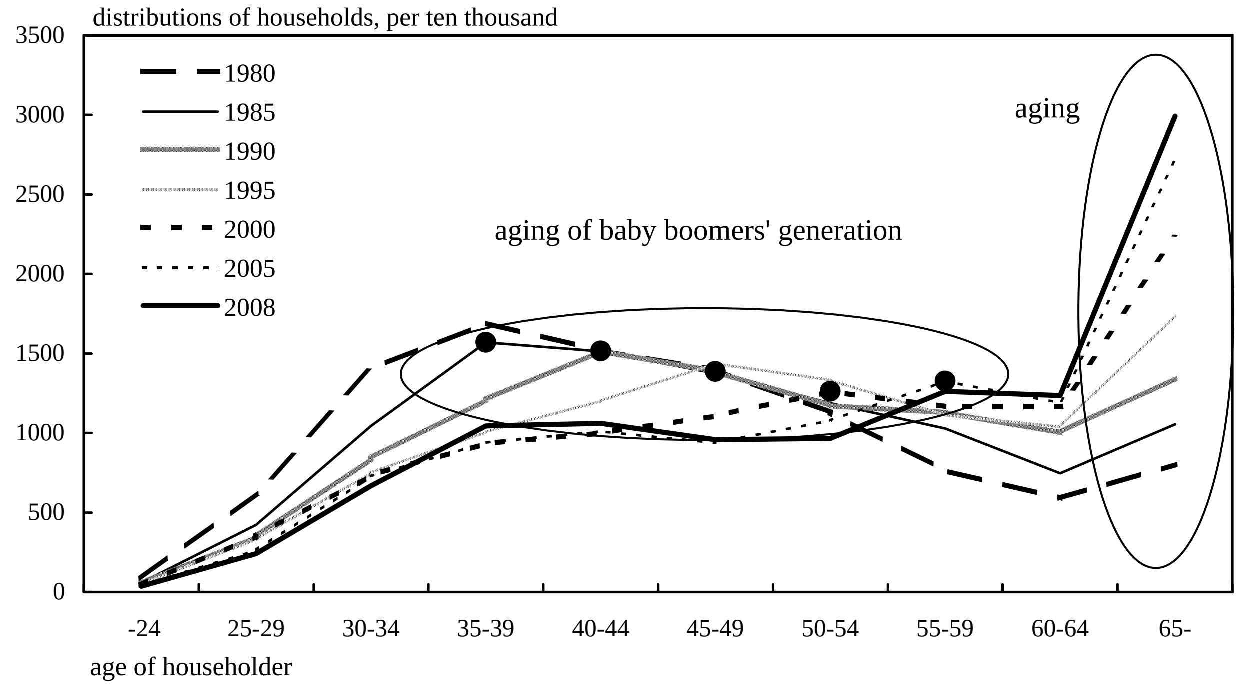
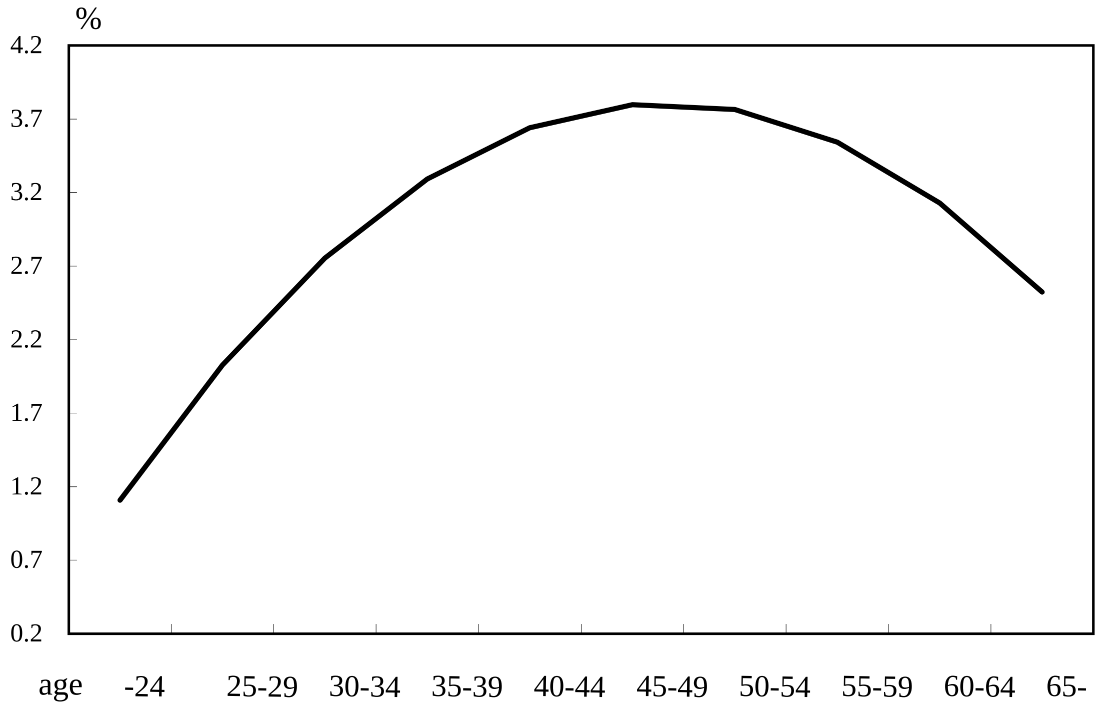


Figure 2. Distributions of Households



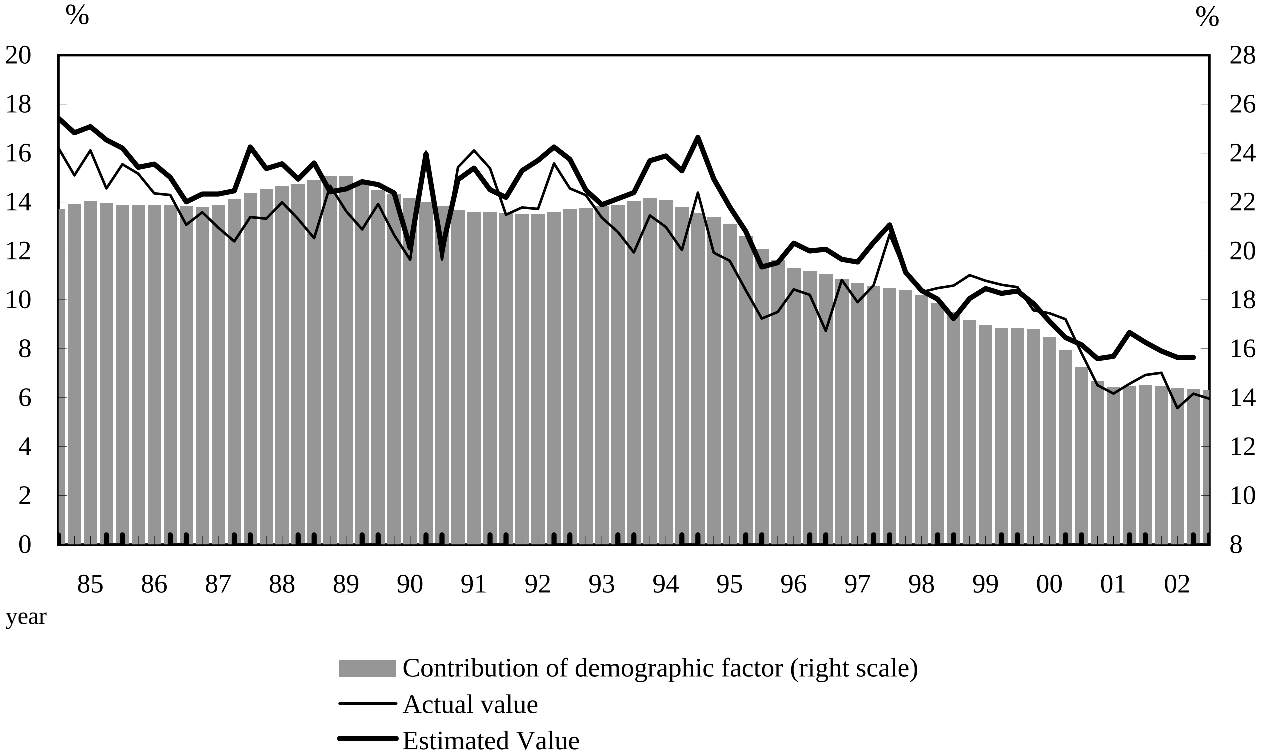
Sources: Ministry of Internal Affairs and Communications, "Family Income and Expenditure Survey"
National Institute of Population and Social Security Research, "Overview of Households Projections for Japan."

Figure 3. Estimated Curve of Age Group Effects on Aggregate Saving Rate



Note: The calculation is based on the parameters estimated in case 1.

Figure 4. Cointegrating Relationship of Saving Rate and Demographic Factor



Note: 1.The calculation is based on the parameters estimated in case 1.

2. Estimated value depicts the value gained from the estimation plus one to describe the series comparable with actual saving rate.