Working Paper Series

Does a Decrease in the Real Interest Rate Actually Stimulate Personal Consumption?†
- An Empirical Study -

Shinobu Nakagawa* And Kazuo Oshima**

Working Paper 00-2

Research and Statistics Department
Bank of Japan

C.P.O BOX 203 TOKYO

100-8630 JAPAN

*e-mail:shinobu.nakagawa@boj.or.jp

**e-mail:kazuo.ooshima-1@boj.or.jp

Does a Decrease in the Real Interest Rate Actually Stimulate Personal Consumption?[†]

- An Empirical Study -

Shinobu Nakagawa[*]
Kazuo Oshima[**]

February 2000

[†] The opinions expressed herein are those of authors, and do not represent the official opinion and view of the Bank of Japan or of the Research and Statistics Department.

[*] Economic Research Division, Research and Statistics Department, Bank of Japan (E-mail: shinobu.nakagawa@boj.or.jp).
[**] Economic Research Division, Research and Statistics Department, Bank of Japan (E-mail: kazuo.ooshima-1@boj.or.jp).

Abstract

1. **As a remedy for Japan's distressed economy, Professor Paul Krugman of MIT has suggested that a reduction in real interest rates caused by inflation expectations would stimulate personal consumption. Although that is controversy whether inflation causing policy is effective or feasible, we must still ask whether a decrease in real interest rates actually stimulated personal consumption in Japan.**

2. **Generally a decrease in real interest rates stimulates personal consumption, which is what Professor Krugman has pointed out. When the real interest rate goes down, in other words, the magnitude of the substitution effect, which stimulates consumption, outweighs that of the income effect, which reduces interest income. Scatter diagrams and estimation results of consumption functions show that negative relationships between the real interest rate and per capita consumption growth exist in the USA and UK, but there is no clear relationship in Japan.**

3. **We find no clear relationship between the real interest rate and personal consumption because the Japanese people like to save and they don't want to consume by drawing on savings or by taking consumer loans even if real interest rates go down. In contrast, the use of consumer credit to buy durable goods is observed everywhere and every day in the USA and UK.**

4. **There is also the fact that Japanese households have over 60 percent of safety assets such as deposits in savings and the older the household is, the larger this ratio is. Although consumption is stimulated by a decrease in real interest rates, it seems that at the same time and at the same scale interest income is reduced by that decrease, so that the substitution effect and income effect cancel each other out. Yet, in the USA and UK, the shares of safety assets are about 15 percent and 20 percent, respectively at the end of 1998, so the income effect in each country seems to be smaller than that of Japan.**

5. **In conclusion, Professor Krugman's proposition that stimulating consumption by making the real interest rate decline makes sense in the USA and UK. Statistical evidence, however, shows that is not the case in Japan, because of the reluctance to use consumer credit in general and the likelihood that Japanese households will accumulate safety assets under any circumstances.**

1. Introduction

As a remedy for Japan's distressed economy[1], Krugman (1998) suggested that a reduction in real interest rates caused by inflation expectations would stimulate personal consumption. Although it is controversial whether an inflation-causing policy (e.g. inflation targeting, monetary expansion policy) is effective or feasible, we must ask whether a decrease in real interest rates would actually stimulate personal consumption in Japan.

To answer this question, we analyze the direct relationship between real interest rates and personal consumption using time series data. We adapt the same empirical approach to the developed countries, the USA, UK and France, to verify Professor Krugman's assertion, although we are primarily concerned with Japan.

2. Relationship between the Real Interest Rate and Personal Consumption - Theory and Evidence -

2-1. Theory

Economic theory indicates that the effect of real interest rates on personal consumption depends on the relative magnitudes of the substitution effect and the income effect. The former is the amount that a consumer wins benefit from a decrease in real interest rates by consuming today rather than saving for tomorrow, so it results in an increase in consumption today. The latter is the effect that a decrease in real interest rates causes by decreasing today's consumption since the amount of lifetime income declines by the reduction in the return on savings. In general, it is said that the substitution effect is larger than the income effect, which is that Professor Krugman has pointed out.

2-2. Data and Evidence

Before analyzing the relationship between real interest rates and personal consumption, we define the real interest rate. The real interest rate is defined as the difference between the nominal interest rate and the expected inflation rate. Although the representative nominal interest rate that a consumer faces should be used, due to constraints on the latest data, we actually use the deposit rate (weighted average over each maturity) in Japan and France and the three-month TB rate in the USA and UK[2]. We also substitute the quarter-to-quarter change rate in the seasonally adjusted CPI for the expected inflation rate, assuming that inflation expectations are formed by individual forecasts of future inflation rates based on today's inflation. Personal consumption, seasonally adjusted in SNA, is also calculated with a quarter-to-quarter change rate. To eliminate the impact of population growth on consumption, the data is normalized on a per capita basis.

Taking a closer look at the relationship between the real interest rate and per capita consumption growth rate, we find no clear relationship in Japan (Chart 1-1, upper). Some downward tendencies are found in the USA (Chart 1-2, upper) and UK (Chart 1-3, upper) however, which means that the substitution effect is dominant in each country. In France (Chart 1-4, upper), there also seems to be negative relationship. In those three countries, this evidence tell us that Professor Krugman's assertion is acceptable.

In addition, since individuals have risky assets such as equities and mutual funds, we should consider the wealth effect, or the degree to which today's consumption is stimulated by the increase in stock returns. To analyze the wealth effect, we also examine the relationship between

[1] Precisely, Japan's economy has fallen into the liquidity trap, which has a horizontal LM curve and a near zero equilibrium interest rate.

[2] The correlation coefficient between the TB3M rate and the deposit rate is very high: 0.98 with the 3M deposit rate, 0.97 with the 6M deposit rate (USA, 63/1-98/4Q), and 0.96 with the deposit rate (UK, 57/1-98/4Q), respectively. So we accept the opinion that there is no problem in substituting the TB3M rate for the deposit rate.

the rate of return on stocks (including dividends in Japan) and the per capita consumption growth rate. Although there is no clear evidence in Japan (Chart 1-1, lower), UK (Chart 1-3, lower) and France (Chart 1-4, lower), we observe a clear upward slope in the USA (Chart 1-2, lower), which shows that the wealth effect significantly influences consumption growth in the USA.

2-3. A Case Study during Oil Shocks

In scatter diagrams (Chart 1-1 through 1-4), we show the white dots in two oil-shock eras to distinguish the effect of high inflation. In each upper chart white dots show that there are upward relationships between the real interest rate and personal consumption in the USA, UK and France. The large decline in the real interest rate caused by high inflation, creating a negative real interest rate in many cases, does bring about the negative consumption growth. Therefore, we have to say that the negative relationship between the real interest rate and personal consumption does not always hold even in the USA, UK and France. During severe recessionary periods, such as in today's Japanese economy, personal consumption is strongly affected by the factors other than real interest rates (e.g. sharp decreases in current income, pessimistic expectations about future economic growth, etc). These points must also be considered.

3. Estimation of the Consumption Function

3-1. All Consumption

Since scatter diagrams only provide rough images, we also estimate the consumption function to measure the quantitative effect of real interest rates on personal consumption. We set up an estimation formula based on the theoretical relationship between the real interest rate and personal consumption, which is called C-CAPM (Consumption-based Capital Asset Pricing Model), following Lucas (1978) and Breeden (1979). See the appendix for details.

[Equation-1]

$$\log\left(\frac{c_{it}}{c_{it-1}}\right) = \alpha_1 + \alpha_2 R_{it} + \alpha_3 S_{it} + \alpha_4 V_{it-1}$$

c: per capita consumption (real, s.a.)

R: real interest rates (deposit rate<Japan, France>, TB3M<USA, UK>)

S: rate of change in real stock prices (including rate of dividends in case of Japan)

V: uncertainty indexes (see Chart 2)[3]

The estimation results in Chart 3-1 indicate that all variables are not significant in Japan as shown in the scatter diagrams. On the other hand, the real interest rate (parameter α_2) has a significant negative impact on consumption in the USA and UK, which means that the substitution effect is dominant. In addition, the stock return (parameter α_3) has a positive impact on consumption in the USA, which confirms that the wealth effect exists. Furthermore, lowering the significance level shows that the substitution effect is relatively strong in France, while the income effect seems to be dominant in Japan[4].

3-2. Durable Goods

To precisely estimate the consumption function, durable goods of all consumption must be

[3] We use the conditional variances of error terms regressed each country's real wage by GARCH model as substitute variables for uncertainty, one of the factors that hinders the consumer's rational intertemporal choice. See Ooyama and Yoshida (1999) in detail.

[4] The reason why the income effect is relatively dominant in Japan is analyzed in section 4.

excluded[5]. For example, Mankiw (1985) expressed the empirical result that the real interest rate had a significantly negative effect on durable goods. We analyze the relationship between the real interest rate and durable goods to investigate this point. Avoiding the problems stated in footnote 5 when handling durable goods, we employ an indirect method that subtracts durable goods from all consumption in equation-1 (see equation-2). Concretely speaking, we compare two estimated parameters in equation-1 and equation-2 to investigate the direct relationship between the real interest rate and durable goods[6].

[Equation-2]

$$\log\left(\frac{cnd_{it}}{cnd_{it-1}}\right) = \alpha_1 + \alpha_2 R_{it} + \alpha_3 S_{it} + \alpha_4 V_{it-1}$$

cnd: per capita non-durable and service consumption (real, s.a.)

While the estimation results in Chart 3-2 show almost the same results as those in Chart 3-1, we observe some interesting facts. First, the result in the USA shows that the values of parameters, α_2, α_3, are lowered by 30-40% compared to those in Chart 3-1. Second, we find that the substitution effect is diminished in the UK and it disappears in France. We conclude that both the substitution effect and the wealth effect have stronger impacts on durable goods. In the meanwhile, no significant relationship is recognized in Japan in Chart 3-2 even if durable goods are excluded.

3-3. Liquidity Constraint

One of the reasons why a real interest rate has little impact on personal consumption in Japan is probably that consumer finance has not been widely established in Japan. In other words, people are reluctant to borrow money for today's consumption. The use of the consumer credit for buying durable goods (e.g. cars, electric appliances) is observed everywhere and every day in the USA and UK. In these countries, the decline in real interest rates, which leads to a decrease in real borrowing costs for individuals, is likely to induce an increase in personal consumption, especially in durable goods. The proportion of consumer credit outstanding to nominal GDP is 7.5% in Japan, 15.2% in the USA and 13.1% in the UK, respectively[7]. It is significant and revealing that the substitution effect is dominant in the USA and UK, where the proportion of consumer credit outstanding outweighs that of Japan.

This indicates that current income condition is thought to be important in deciding current consumption in Japan. In other words, consumers in Japan are likely to face on liquidity constraints. To confirm this point, we also employ the following equation, which adds today's income growth to explanatory variables.

[Equation-3]

$$\log\left(\frac{c_{it}}{c_{it-1}}\right) = \lambda \log\left(\frac{y_{it}}{y_{it-1}}\right) + \alpha_1 + \alpha_2 R_{it} + \alpha_3 S_{it} + \alpha_4 V_{it-1}$$

y: per capita disposable income (real, s.a.)

---

[5] As for durable goods, there exists some lags between expenditure (e.g., purchasing a car) and consumption (e.g. consuming services from driving a car purchased). Due to lags, when analyzing consumption behavior based on the utility function, it is necessary to estimate by making the service flow from the expenditure on durable goods as in Bernanke (1985) and Mankiw (1985).Making this flow has many calculation difficulties, such as the rigid assumption that depreciation rate is always constant.

[6] The estimation procedure that excludes the durable goods in all consumption is employed in many instructive papers. See, for example, Hall (1978), Flavin (1981).

[7] We use consumer credit outstanding based on the flow of funds of each country. In the UK, however, the figures don't include non-bank accounts, so the actual figure may be larger.

The results in Chart 3-3 show that the parameter conditions regarding α_1 through α_4 are almost the same as those in Chart 3-1[8]. As for income parameter, λ, however, it is possible to divide these four countries into a high elasticity group (Japan and France) and a low elasticity group (the USA and UK). For example, in Japan where consumer finances are not well-established nationwide, we conclude that consumers are prone to be affected by current income condition, or in other words they face liquidity constraints[9].

4. Relationship between the Real Interest Rate and Consumption - Japan's Case -

4-1. A Reason Why the Income Effect Is Dominant

According to the estimation result in section 3-1, there is no clear evidence in Japan that the real interest rate has an influence on personal consumption, but we could say that the income effect is outperforming relative to that of the USA, UK and France. To consider the reason for this, we turn to the portfolio of savings held by Japanese households. We know that in Japan the ratio of safety assets such as deposits to all savings is over 60 percent, and the older the household is, the larger this ratio is[10]. This suggests that the effect of a reduction in income caused by the decline of (fixed) interest payments, the income effect, outweighs the effect of stimulating consumption by decreasing real interest rates (the substitution effect), especially for the elderly who have larger amounts of savings. In contrast, in the USA and UK, the shares of safety assets are about 15 percent and 20 percent, respectively at the end of 1998, so the income effect of both countries seems to be smaller than that of Japan[11].

4-2. Relationship between the Real Interest Rate and Consumption Behavior Classified by the Household's Savings Outstanding and by Its Age

To confirm these points empirically, we take a closer look at the relationship between the real interest rate and average propensity to consume by household characteristics in scatter diagrams[12]. In Chart 4-1, the average propensity to consume does not change very much in the households which have less than 3 million yen of savings outstanding even when the real interest rate goes up. The larger the amount of savings outstanding becomes, however, the steeper the slope, in other words, the larger the income effect. In Chart 4-2, the slopes are nearly zero in households whose heads are their 20s and 30s, where both the substitution effect and the income effect are almost cancelled out. The older the head of household is, however, the more dominant the income effect becomes.

Glancing at these results, it is clear that for the elderly who have the lion's share of safety assets such as deposits and whose main incomes are from pension benefits, consumption is suppressed by the reduction in interest payments when the real interest rate goes down. For young and middle-aged households who have a relatively small amount of savings and who don't hesitate to use consumer credits at least when compared to the elderly, we conclude that the data shows no clear relationship between the real interest rate and all consumption. This is consistent with the results in Charts 3-1 through 3-3.

---

[8] Although the estimation period is set from 70/2Q to the latest in chart 3-1 through 3-3, the results remain unchanged even if the starting point is set from 90/1Q to the latest (results are omitted).

[9] To test the hypothesis about liquidity constraints, it is usually necessary to check the correlation among explanatory variables and the interdependence between explanatory variables and error terms. See, for example, Campbell and Mankiw (1991).

[10] See Nakagawa (1999), Nakagawa and Katagiri (1999) for details.

[11] In the USA, the share of risky assets such as equities is above 40 percent, which is the prominent figure among developed countries (c.f. Japan: only a few percent). This makes the wealth effect more influential in households in the USA as previously described.

[12] We employ the average propensity to consume instead of per capita real consumption growth. This is because the effect of current income on consumption is significant in Japan as verified in Chart 3-3.

5. Concluding Remarks

Previous sections show that the Professor Krugman's proposition that stimulating consumption by making the real interest rate decline is supported in case of the USA and UK, where consumer are not so reluctant to borrow. Also, in the USA where the share of risky assets such as equities is high, we confirm that the wealth effect has a powerful effect. On the other hand, the data and statistical evidence show that what Professor Krugman proposes does not work in Japan, since Japanese households are relatively reluctant to use consumer credit and are likely to accumulate safety assets under any circumstances.

The conclusion of this paper doesn't deny that a decrease in the real interest rate stimulates the housing and business investment, which produces the economic cycle "an increase in company's profits leads to an increase in employee's incomes" and results in consumption growth[13].

[13] The relationship between the real interest rate and housing investment is analyzed in Bank of Japan (1998).

Appendix : C-CAPM - Outlines of Theory and Its Reduced Form[14] -

A representative household behaves to

$$\max \quad E_0\left[\sum_{t=0}^{\infty}\beta^t u(c_t)\right]$$

$$\text{s.t.} \quad \sum_{i=1}^{N} q_{it}Q_{it+1} + c_t = \sum_{i=1}^{N}(q_{it}+d_{it})Q_{it} + y_t \,. \qquad (1)$$

It chooses today's consumption and n-types of financial assets so as to maximize the discounted value of expected utility of future consumption under the budget constraint in each period. The variables in equation (1) are

- β : subjective discount rate
- c_t : consumption at t period (real, per capita)
- q_{it} : price of financial asset at t period
- d_{it} : dividend of financial asset at t period
- Q_{it} : amount of asset holding at t period (real, per capita)
- y_t : income other than return on assets at t period (real, per capita)
- $u(c_t)$: utility function of representative household
- $E_0(\bullet)$: conditional expectation based on the information available at t period.

Solving the equation (1) by Lagrange multiplier method, we obtain the following first order condition (Euler equation),

$$E_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}(1+r_{it+1})-1\right]=0\,. \qquad (2)$$

We here define r_{it+1} as

$$r_{it+1}=\frac{q_{it+1}+d_{it+1}}{q_{it}}-1, \qquad (3)$$

which is the return on financial assets. In addition, specifying the utility function of representative household as

$$u(c_t)=\frac{c_t^{1-\gamma}-1}{1-\gamma}, \qquad (4)$$

which is the constant relative risk aversion type, equation (2) is reduced to

$$E_t\left[\beta\left(\frac{c_{t+1}}{c_t}\right)^{-\gamma}(1+r_{it+1})-1\right]=0\,. \qquad (5)$$

Next, as for the equation (5), we define

$$\beta\left(\frac{c_{t+1}}{c_t}\right)^{-\gamma}(1+r_{it+1})-E_t\left[\beta\left(\frac{c_{t+1}}{c_t}\right)^{-\gamma}(1+r_{it+1})\right]\equiv\xi_{t+1}$$

$$E_t(\xi_{t+1})=0\ ,\ E_t(\xi_{t+1}^2)=\mathrm{Var}_t(\xi_{t+1})=\sigma_t^2, \qquad (6)$$

[14] The theory of C-CAPM and its derivation manner to the reduced form are explained in detail in Hamori (1996) and in Nakagawa (1998), respectively.

where ξ_{t+1} is called the Euler shock. Arranging and taking the logarithm of equation (6), we obtain ,

$$\log(\beta) - \gamma \log\left(\frac{c_{t+1}}{c_t}\right) + \log(1 + r_{t+1}) = \log(1 + \xi_{t+1}). \qquad (7)$$

Taking the second order Taylor-expansion for the right hand of equation (7), and also taking the expectation for both sides, we have

$$\log(\beta) - \gamma E_t\left[\log\left(\frac{c_{t+1}}{c_t}\right)\right] + E_t[\log(1 + r_{t+1})] \cong -\frac{1}{2}\sigma_t^2. \qquad (8)$$

Further extracting the expectation term and arranging the consumption growth rate in equation (8), we obtain[15]

$$\log\left(\frac{c_{t+1}}{c_t}\right) \cong \frac{1}{\gamma}\log(\beta) + \frac{1}{\gamma}\log(1 + r_{t+1}) + \frac{1}{2\gamma}\sigma_t^2 + \varepsilon_{t+1}. \qquad (9)$$

Finally, as for equation (9), the values at t period are staggered to the ones at t-1 period. Assuming that there are two kinds of financial assets (N=2), the real interest rate (R) and the rate of return on stocks (S), and that the conditional variance of the Euler shock is deemed to be the uncertainty index (V), we obtain

$$\log\left(\frac{c_t}{c_{t-1}}\right) = \alpha_1 + \alpha_2 R_t + \alpha_3 S_t + \alpha_4 V_{t-1} + \varepsilon_t. \qquad (10)$$

Equation (10) corresponds to [Equation-1] in the paper.

[15] We gather the difference between the expectation value and the actual one into the error term.

References

[Japanese Language]

Bank of Japan (1998), "*Saikin no juutakutoushi doukou ni tsuite*," (Recent Developments in Housing Investment), *Bank of Japan Monthly Bulletin, October 1998*.

Hamori, S. (1996), "*Shouhisha koudou to nihon no shisanshijou*," (Consumer Behavior and the Japanese Asset Market), *Toyo Keizai Shinpousha*.

Ooyama, T. and K. Yoshida (1999), "*Nihon no chochiku wa kajou nanoka : aruiwa oubeishuyoukoku no chochiku ga kashounanoka*," (Is Japan's Savings Rate too High? : Or Are Those of Western Countries too Low?), *Research and Statistics Department, Bank of Japan, Working Paper Series 99-5, December 1999*.

Nakagawa, S. (1998), "*Fukakujitsuseika no shouhisha koudou*," (Consumer Behavior under Uncertainty), *Research and Statistics Department, Bank of Japan, Working Paper Series 98-6, June 1998*.

Nakagawa, S. and T. Katagiri (1999), "*Nihon no kakei no kin-yushisan sentaku koudou*," (Japanese Household's Portfolio Selection Behavior), *Bank of Japan Monthly Bulletin, November 1999*.

[English Language]

Bernanke, B. S. (1985), "Adjustment Costs, Durables and Aggregate Consumption," *Journal of Monetary Economics*.

Breeden, D. T. (1979), "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities," *Journal of Financial Economics 25*.

Campbell, J. A. and N. G. Mankiw (1991), "The Response of Consumption to Income," *European Economic Review, Vol.35*.

Flavin, M. (1981), "The Adjustment of Consumption to Changing Expectation about Future Income," *Journal of Political Economy 89*.

Hall, R. E. (1978), "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," *Journal of Political Economy 86*.

Krugman. P. (1998), "Japan's Trap," *at http://web.mit.edu/krugman/www/japtrap.html*.

Lucas, R. E. (1978), "Asset Prices in an Exchange Economy," *Econometrica, Vol.46*.

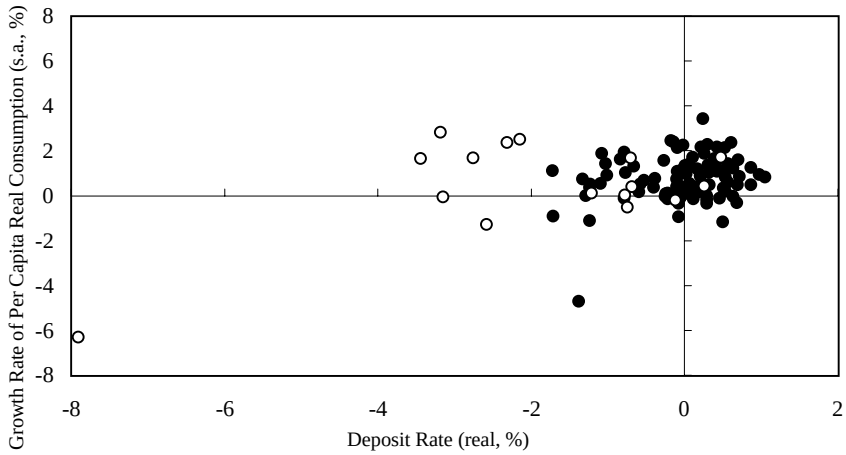
Mankiw, N. G. (1985), "Consumer Durables and the Real Interest Rate," *The Review of Economics and Statistics*.

Nakagawa, S. (1999), "Why Has Japan's Household Savings Rate Remained High even during the 1990s?"*at http://www.boj.or.jp/en/ronbun/ronbun_f.htm*. (The paper was originally published in Japanese in the Bank of Japan Monthly Bulletin, April 1999 issue.)

(Chart 1-1)

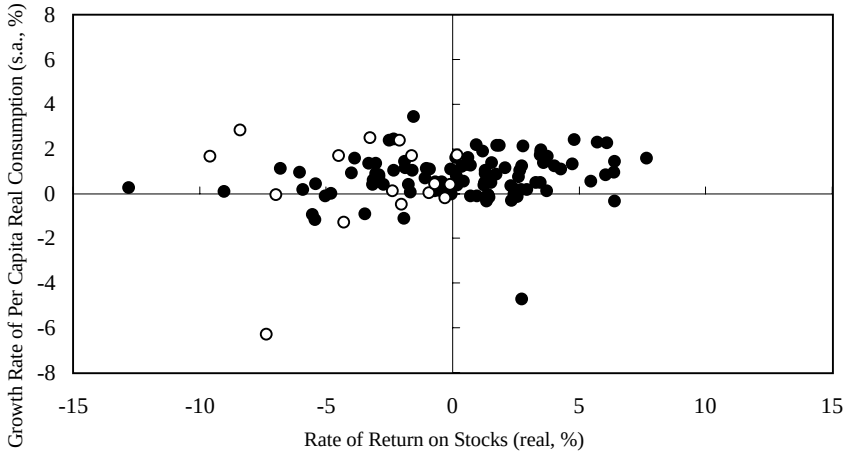
Rates of Return on Assets and Consumption Growth (Japan)

1. Deposit Rate



(Notes) 1970/1-99/3Q (Data in 1973-74 and 1979-80 are shown by white dots.)
Deposit Rate: Weighted average of each term (quarterly converted)

2. Rate of Return on Stocks (TSE 1st section)



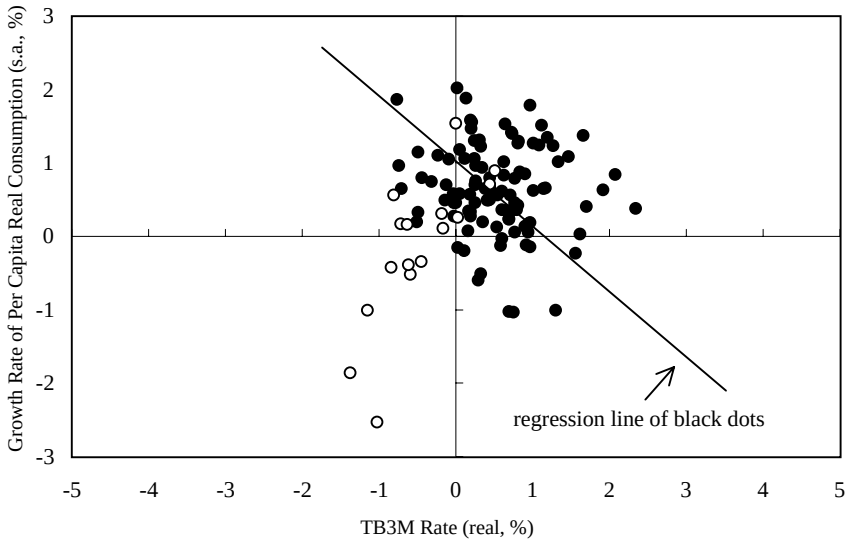
(Notes) 1970/1-99/3Q (Data in 1973-74 and 1979-80 are shown by white dots.)
Rate of Return on Stocks=Capital Gains+Rate of Dividends

(Sources) Economic Planning Agency, "System of National Accounts"
Management and Coordination Agency, "Consumer Price Index"
BIS, "International Financial Statistics"
Nihon Shouken Keizai Kenkyusho , "Rates of Return on Common Stocks"

(Chart 1-2)

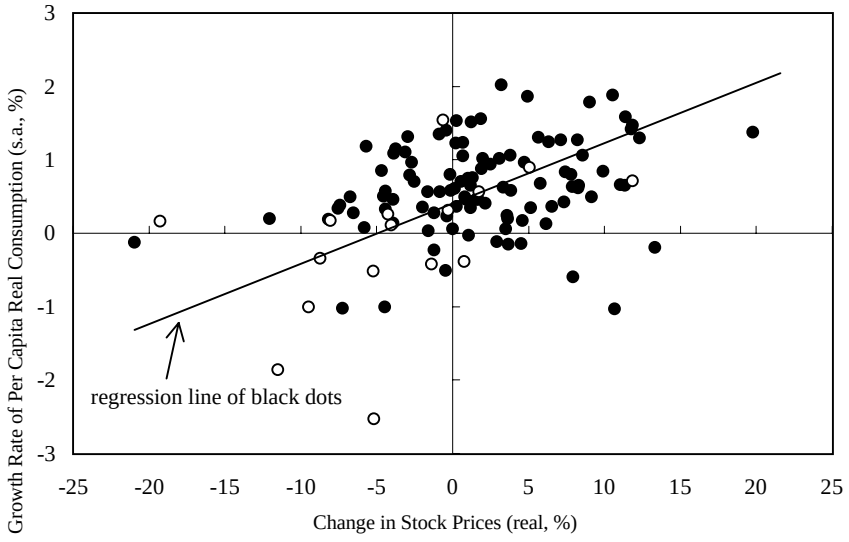
Rates of Return on Assets and Consumption Growth (USA)

1. TB3M Rate



(Notes) 1970/1-99/2Q (Data in 1973-74 and 1979-80 are shown by white dots.)

2. Rate of Change in Stock Prices (S&P500)



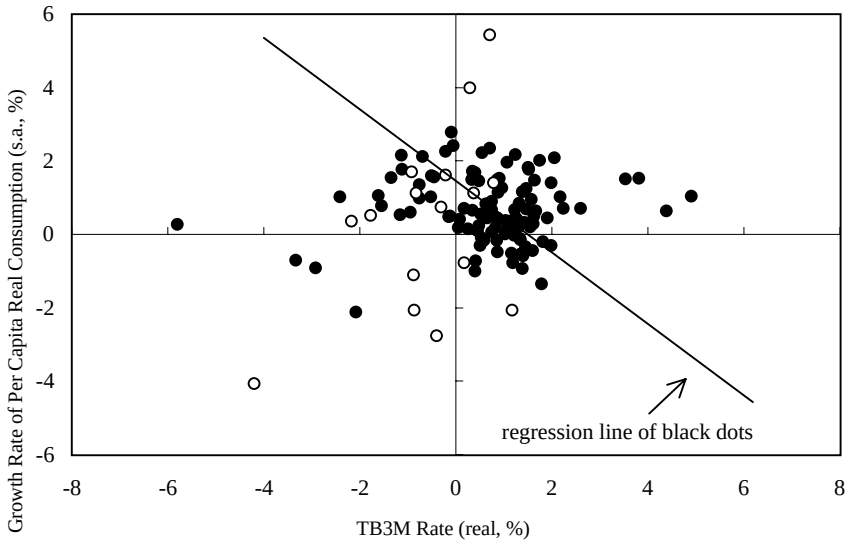
(Notes) 1970/1-99/2Q (Data in 1973-74 and 1979-80 are shown by white dots.)

(Sources) Department of Commerce, Department of Labor, FRB and S&P etc.

(Chart 1-3)

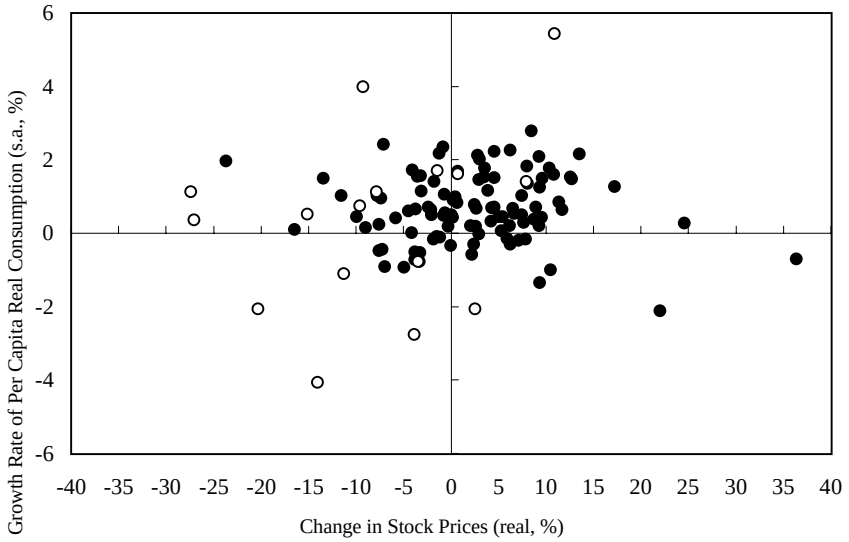
Rates of Return on Assets and Consumption Growth (UK)

1. TB3M Rate



(Notes) 1970/1-99/2Q (Data in 1973-74 and 1979-80 are shown by white dots.)

2. Rate of Change in Stock Prices (Industrial Average, IFS)



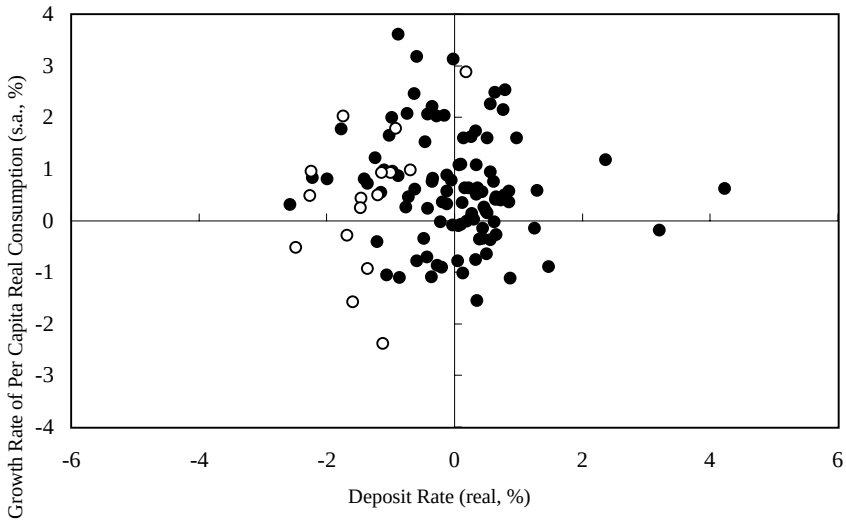
(Notes) 1970/1-99/2Q (Data in 1973-74 and 1979-80 are shown by white dots.)

(Sources) BIS and IMF etc.

(Chart 1-4)

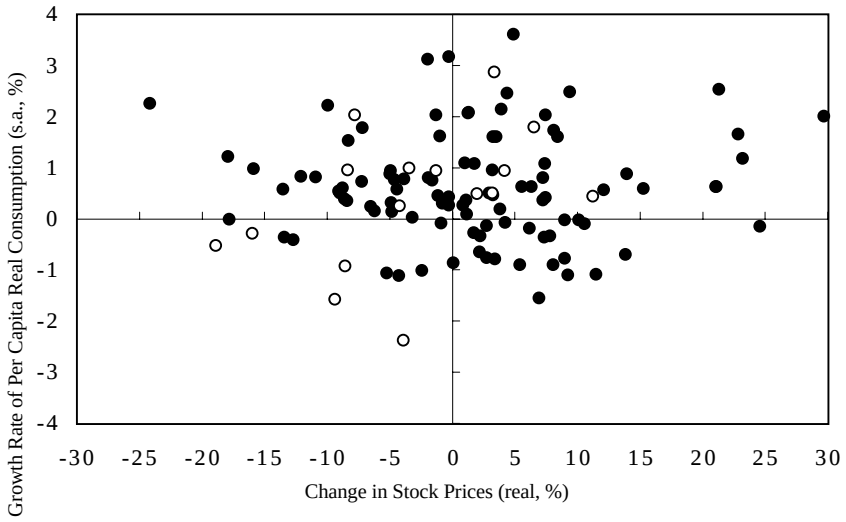
Rates of Return on Assets and Consumption Growth (France)

1. Deposit Rate



(Notes) 1970/2-98/4Q (Data in 1973-74 and 1979-80 are shown by white dots.)
Deposit Rate: Weighted average of each term (quarterly converted)

2. Rate of Change in Stock Prices (IFS)



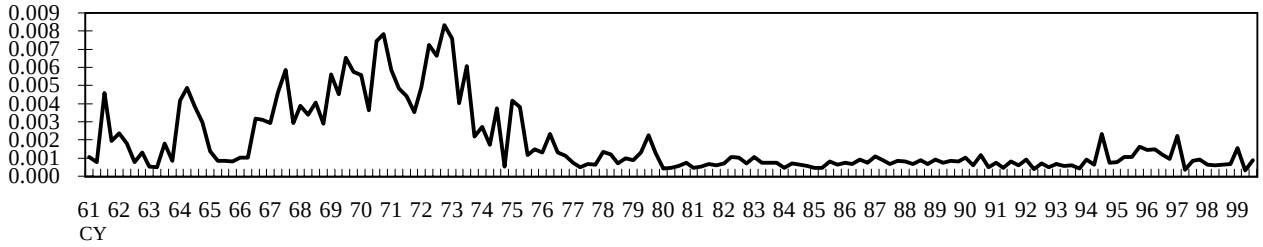
(Notes) 1970/2-98/4Q (Data in 1973-74 and 1979-80 are shown by white dots.)

(Sources) BIS and IMF etc.

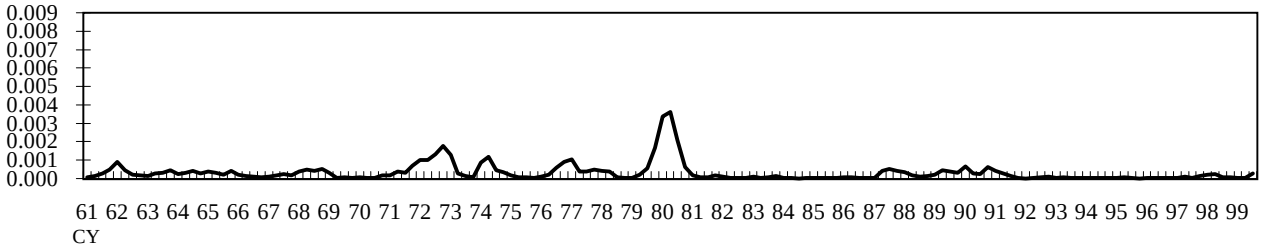
(Chart 2)

Uncertainty Indexes

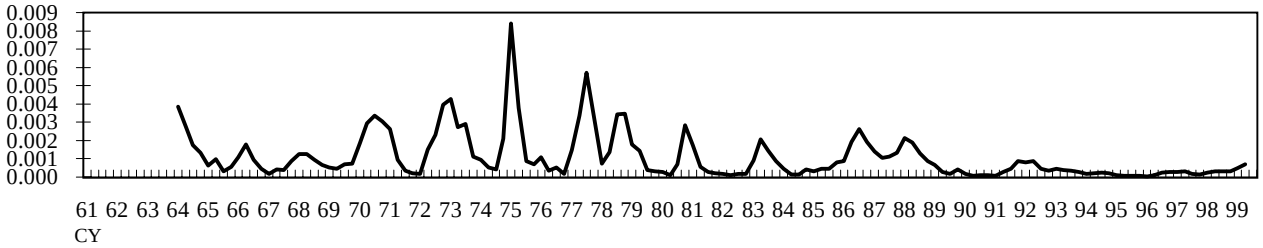
1. Japan



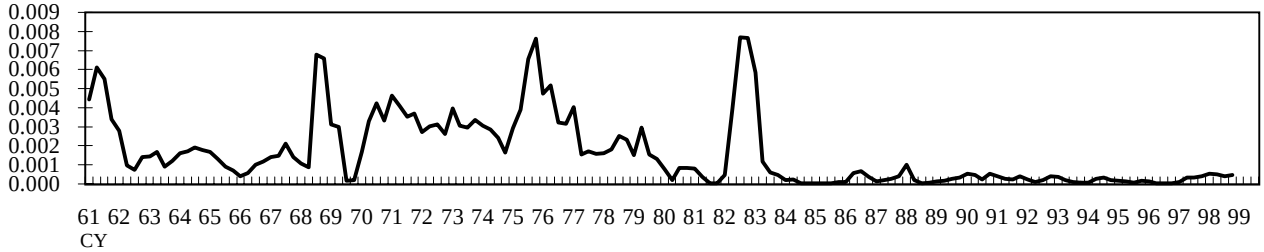
2. USA



3. UK



4. France



(Notes) Conditional variances of error terms regressed real wages by GARCH model (quarterly average)
(Sources) Ministry of Labour, "Monthly Labour Survey" BIS, "International Financial Statistics"

(Chart3-1)

Estimation Results of Consumption Function (all consumption)

(Equation)

$$\log\left(\frac{c_{it}}{c_{it-1}}\right) = \alpha_1 + \alpha_2 R_{it} + \alpha_3 S_{it} + \alpha_4 V_{it-1}$$

c: per capita consumption (real, s.a.)
R: real interest rates (deposit rate<Japan, France>, TB3M<USA, UK>)
S: rate of change in real stock prices (including rate of dividends in case of Japan)
V: uncertainty indexes (see Chart 2.)

(Estimation Results)

	α_1	α_2	α_3	α_4	adjR^2	SE/DW
	-0.004	0.007			0.00	0.012
	(-0.42)	(1.09)				2.43
Japan	-0.003	0.006		0.046	-0.01	0.012
	(-0.31)	(0.92)		(0.04)		2.41
(est. period)	-0.004	0.007	0.0001	0.192	-0.02	0.012
1970/2-99/3Q	(-0.34)	(0.94)	(0.42)	(0.16)		2.41
	0.032	-0.017			0.10	0.007
	(4.45)	(-3.73)				1.61
USA	0.033	-0.018		7.652	0.10	0.007
	(4.33)	(-3.58)		(0.54)		1.58
(est. period)	0.026	-0.011	0.0039	42.732	0.18	0.007
1970/2-99/2Q	(3.35)	(-2.13)	(3.47)	(2.53)		1.94
	0.043	-0.022			0.05	0.012
	(3.08)	(-2.66)				2.24
UK	0.040	-0.019		-2.400	0.07	0.012
	(2.83)	(-2.31)		(-1.84)		2.29
(est. period)	0.039	-0.018	0.0003	-2.130	0.06	0.012
1970/2-99/2Q	(2.65)	(-2.08)	(0.30)	(-1.34)		2.30
	0.020	-0.009			0.02	0.008
	(1.57)	(-1.20)				1.98
France	0.023	-0.011		1.444	0.02	0.008
	(1.77)	(-1.45)		(1.05)		2.02
(est. period)	0.027	-0.013	-0.0005	1.039	0.01	0.008
1970/2-98/4Q	(1.62)	(-1.34)	(-0.37)	(0.59)		2.03

(Notes) Figures in parentheses show the t value.
The shadowed areas have a significance level of 5 percent.

(Chart3-2)

Estimation Results of Consumption Function (non-durable and service consumption)

(Equation)

$$\log\left(\frac{cnd_{it}}{cnd_{it-1}}\right) = \alpha_1 + \alpha_2 R_{it} + \alpha_3 S_{it} + \alpha_4 V_{it-1}$$

cnd: per capita non-durable and service consumption (real, s.a.)
R: real interest rates (deposit rate<Japan, France>, TB3M<USA, UK>)
S: rate of change in real stock prices (including rate of dividends in case of Japan)
V: uncertainty indexes (see Chart 2.)

(Estimation Results)

	α_1	α_2	α_3	α_4	adjR^2	SE/DW
	-0.001	0.005			-0.00	0.010
	(-0.12)	(0.75)				2.56
Japan	0.001	0.003		0.626	-0.01	0.011
	(0.11)	(0.44)		(0.61)		2.55
(est. period)	0.001	0.003	0.0001	0.681	-0.02	0.011
1970/2-99/1Q	(0.10)	(0.45)	(0.24)	(0.64)		2.56
	0.020	-0.010			0.09	0.004
	(4.49)	(-3.47)				1.29
USA	0.021	-0.011		7.726	0.09	0.004
	(4.50)	(-3.52)		(0.88)		1.28
(est. period)	0.015	-0.005	0.0030	33.511	0.23	0.004
1970/2-99/2Q	(3.34)	(-1.74)	(4.63)	(3.41)		1.57
	0.031	-0.015			0.06	0.008
	(3.34)	(-2.77)				1.63
UK	0.028	-0.013		-2.124	0.10	0.008
	(3.00)	(-2.29)		(-2.48)		1.70
(est. period)	0.026	-0.011	0.0006	-1.511	0.10	0.008
1970/2-99/2Q	(2.78)	(-1.97)	(1.00)	(-1.44)		1.73
	0.007	-0.000			-0.01	0.008
	(0.65)	(-0.07)				2.70
France	0.010	-0.003		1.345	-0.01	0.008
	(0.91)	(-0.44)		(1.04)		2.68
(est. period)	0.007	-0.001	0.0005	1.772	-0.02	0.008
1970/2-98/4Q	(0.50)	(-0.07)	(0.48)	(1.13)		2.68

(Notes) Figures in parentheses show the t value.
The shadowed areas have a significance level of 5 percent.

(Chart3-3)

Estimation Results of Consumption Function (with liquidity constraint)

(Equation)

$$\log\left(\frac{c_{it}}{c_{it-1}}\right)=\lambda\log\left(\frac{y_{it}}{y_{it-1}}\right)+\alpha_1+\alpha_2 R_{it}+\alpha_3 S_{it}+\alpha_4 V_{it-1}$$

c: per capita consumption (real, s.a.)
y: per capita disposable income (real, s.a.)
R: real interest rates (deposit rate<Japan, France>, TB3M<USA, UK>)
S: rate of change in real stock prices (including rate of dividends in case of Japan)
V: uncertainty indexes (see Chart 2.)

(Estimation Results)

	λ	α_1	α_2	α_3	α_4	adjR^2	SE/DW
Japan	0.30	0.005	0.001	-0.0002	1.066	0.11	0.012
(est. period)	(3.68)	(3.15)	(0.50)	(-0.70)	(1.62)		2.47
1970/2-99/1Q							
USA	0.21	0.024	-0.010	0.0121	-0.224	0.39	0.006
(est. period)	(5.46)	(4.08)	(-2.52)	(3.34)	(-0.21)		2.13
1970/2-99/2Q							
UK	0.18	0.025	-0.011	0.0124	1.353	0.17	0.011
(est. period)	(3.08)	(2.18)	(-1.54)	(1.86)	(1.55)		2.55
1970/2-99/2Q							
France	0.27	0.010	-0.004	0.004	0.072	0.04	0.008
(est. period)	(2.75)	(0.90)	(-0.57)	(0.55)	(0.15)		2.09
1970/2-98/4Q							

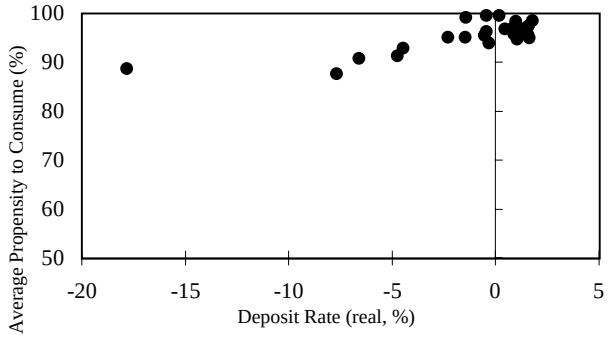
(Notes) Figures in parentheses show the t value.
The shadowed areas have a significance level of 5 percent.

(Chart 4-1)

Interest Rate and Propensity to Consume (by household's outstanding of Savings)

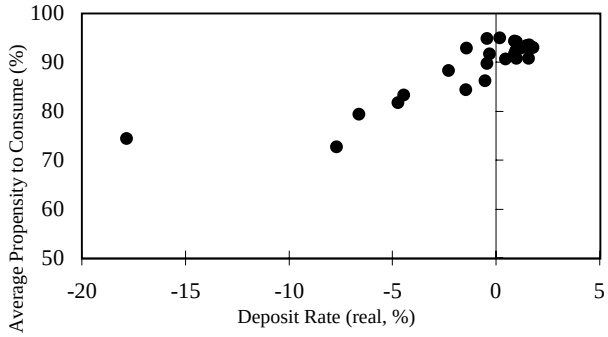
Less than 3 million yen

slope: 0.56 R-square: 0.60



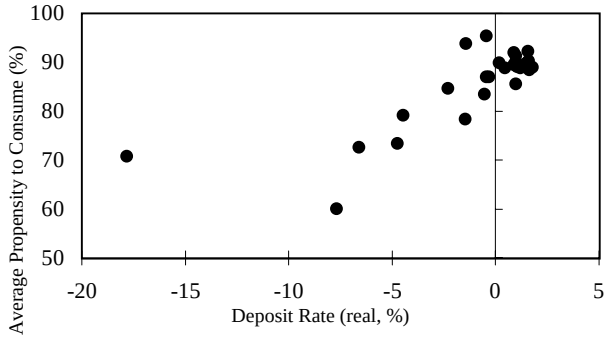
3 to 5 million yen

slope: 1.27 R-square: 0.75



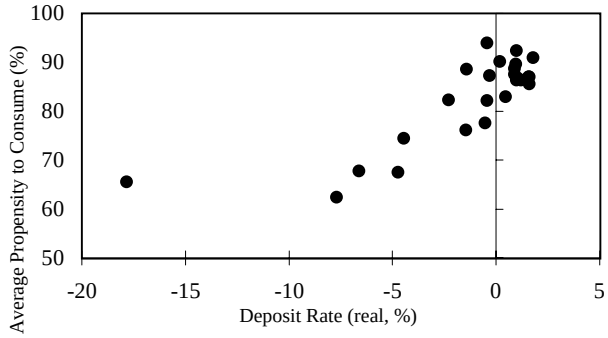
5 to 7 million yen

slope: 1.52 R-square: 0.61



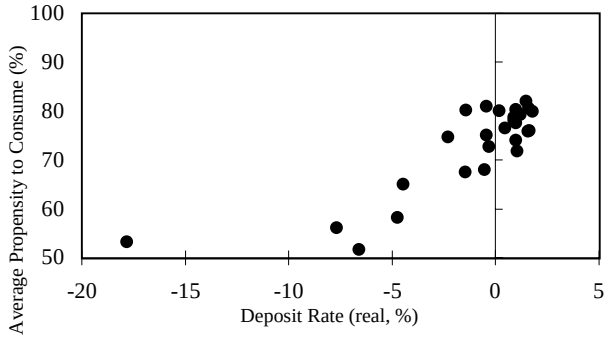
7 to 10 million yen

slope: 1.66 R-square: 0.65



10 million yen or larger

slope: 1.76 R-square: 0.69

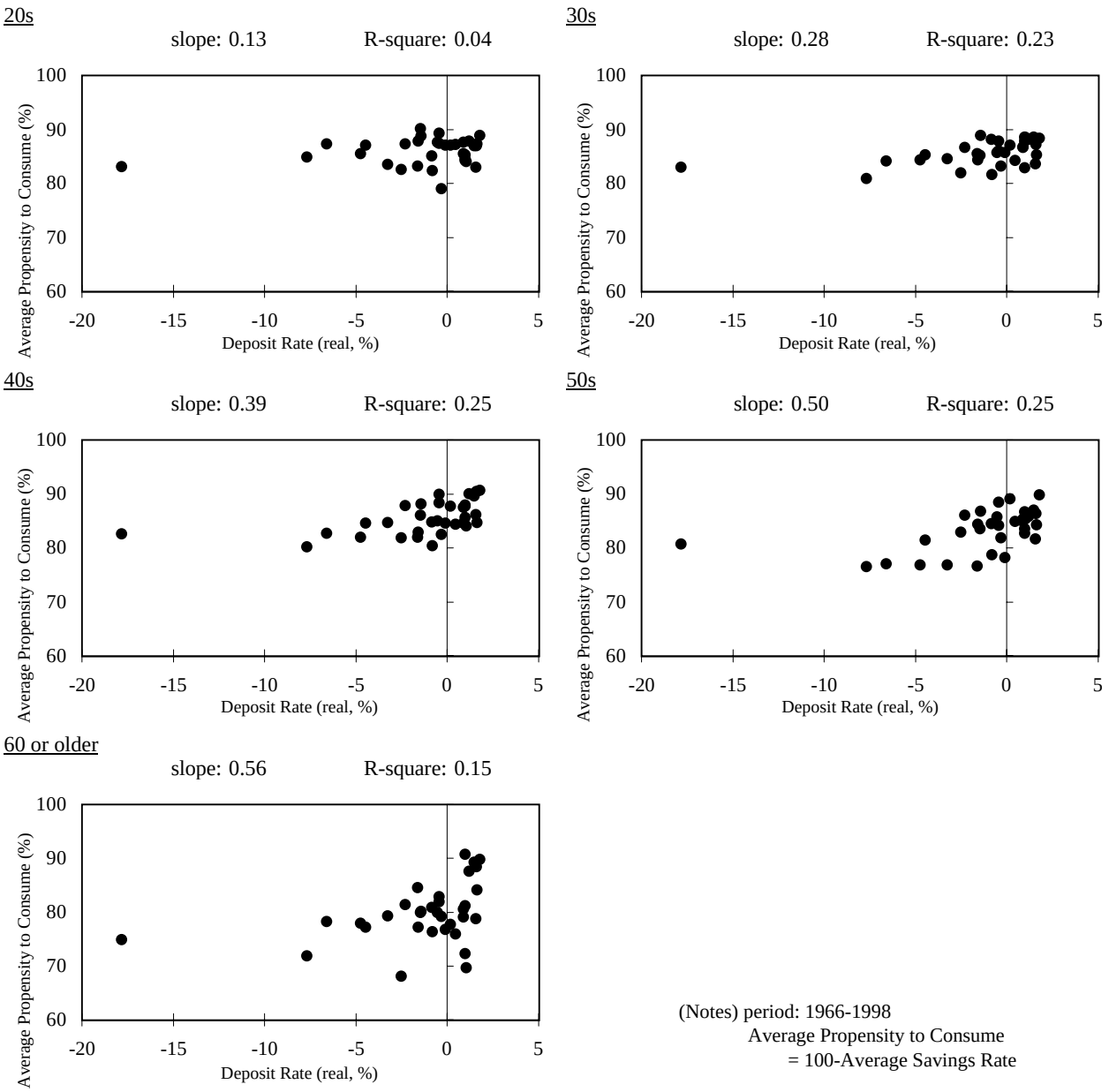


(Notes) period: 1973-1998
Average Propensity to Consume
= 100-Average Savings Rate

(Sources) Management and Coordination Agency, "Family Savings Survey" , "Consumer Price Index"
BIS, "International Financial Statistics"

(Chart 4-2)

Interest Rate and Propensity to Consume (by household's ages)



(Notes) period: 1966-1998
Average Propensity to Consume
= 100-Average Savings Rate

(Sources) Management and Coordination Agency, "Family Savings Survey" , "Consumer Price Index"
BIS, "International Financial Statistics"