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Japan's Household Savings Rate: An Application of the Life-Cycle Hypothesis

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Abstract

This paper develops and tests a model of Japan's household savings rate, based on the life-cycle hypothesis that the primary motive for savings is provision for retirement. The paper shows that Japan's high household savings rate in recent decades reflects the positive influence of rapid economic growth, leading to a prolonged retirement period through the wealth and life-expectancy effects of an income change, which has initially outweighed the negative combined influence of improvements in public pension benefits and the aging of the population. It projects that the savings rate will decline substantially in coming decades as the negative influence accelerates.

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Summary

This paper develops and tests a model of Japan's household savings rate, based on the life-cycle hypothesis that the primary motive for savings is provision for retirement. The life-cycle hypothesis implies that households save during their working years in order to finance their consumption during retirement. Thus, the expected length of the retirement period (relative to the economic life span) and the public pension ratio are two of the most important determinants of the household savings rate. Changes in the real value of household assets also affect the savings rate in the short run, as households temporarily adjust their asset accumulation plans for retirement. The paper shows that the life-cycle hypothesis can account for both long-term trends and short-term variations in the savings rate of Japanese households, whereas Japan's unique institutions, such as the bonus system and tax exemptions on interest income, have played only a minor role in the determination of the savings rate.

Aggregate time-series tests support the applicability of the life-cycle hypothesis to Japan. They confirm the importance of both real disposable income, through its wealth and life-expectancy effects on the expected length of the retirement period, and the public pension ratio in the determination of Japan's household savings rate. The life-cycle hypothesis is further supported by the finding that the tangible and financial wealth effects, implied by the life-cycle hypothesis, have dominated other effects that are expected to work in opposing directions. For example, the savings rate has responded negatively to an increase in the housing/land price, thereby indicating that the tangible wealth effect dominates the target effect implied by the housing-price hypothesis. Moreover, the savings rate has responded positively to inflation, thereby indicating that the direct and indirect financial wealth effects dominate the intertemporal substitution effect via the real interest rate.

The life-cycle hypothesis, applied in the context of economic and demographic developments, suggests that Japan's high household savings rate in recent decades reflects the positive influence of rapid economic growth, leading to a prolonged retirement period through the wealth and life-expectancy effects of an income change, which has initially outweighed the negative combined influence of improvements in public pension benefits and the aging of the population. Japan's household savings rate, however, is projected to decline substantially in coming decades as the negative influence gradually accelerates: it is expected to become eventually little different from the savings rates of other industrial countries. Thus, the life-cycle hypothesis predicts that Japan's household savings rate goes through a "life cycle."

I. Introduction

This paper, which presents an aggregate time-series analysis of Japan's household savings rate, has two objectives. The first is to identify the determinants of the household savings rate as well as the magnitudes of their individual contributions. The second is to forecast the future movement of the household savings rate. In order to achieve these objectives, the paper develops a model of Japan's household savings rate in the context of economic and demographic developments. The model is based on the well-known life-cycle hypothesis that the primary motive for savings is provision for retirement and, therefore, that the consumption-savings decision of a household at each point of time reflects a conscious attempt to achieve the preferred distribution of consumption over the life-cycle. 1/ This paper shows that the life-cycle hypothesis can satisfactorily account for the savings behavior of Japanese households when it is applied in the context of economic and demographic developments. 2/

Household savings account for most of Japan's total domestic savings, and have played an important role in the development of the Japanese economy. A high savings rate of Japanese households has contributed to Japan's exceptionally rapid economic growth in the postwar period by making it possible for the economy to expand domestic investment without serious deterioration in its external payments position. In recent years, however, given a lower potential growth rate of the Japanese economy, domestic investment opportunities have been reduced and, consequently, a large excess of domestic savings over investment has emerged. The emerging domestic investment-savings gap has been associated with increasingly large Japanese capital outflows and

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1/ See Modigliani (1980), which presents a collection of both theoretical and empirical papers on the life-cycle hypothesis of savings. See also Modigliani (1986) for a brief summary of the implications of the life-cycle hypothesis. Although the present model is based on Modigliani's life-cycle hypothesis of savings, it differs from his models in many specifics.

2/ In this paper, the life-cycle hypothesis refers to the original hypothesis that the primary motive for savings is provision for retirement, and not to Modigliani's propositions derived from his life-cycle models. Many of Modigliani's propositions are derived under the steady-state assumption, and therefore are not necessarily valid in the context of economic and demographic developments. Thus, empirical findings that contradict Modigliani's propositions do not necessarily indicate the deficiency of the life-cycle hypothesis per se, but often the inadequacy of his steady-state assumption (see Section II). This point is particularly important when the life-cycle hypothesis is applied to Japan because that country has been going through dramatic economic and demographic changes.

correspondingly large current account surpluses. 1/ This new development has strained Japan's trade relationship with the United States, which has one of the lowest savings rates among OECD member countries and has experienced large current account deficits in recent years.

Although it is often assumed that Japan's household savings rate has always been high and stable, it has actually changed substantially over the years (Chart 1). During the postwar period, the household savings rate (defined as the ratio of household savings to disposable income)--which began at well below 10 percent--demonstrated a steady upward trend. When it peaked in 1974, the household savings rate was nearly 24 percent. Since then, however, it started to decline and, by the early 1980s, has fallen below 18 percent.

This paper argues that the savings rate of the Japanese household sector, analogously to that of an individual household, has been going through a "life cycle" of its own. Immediately after the war, the economy was at a subsistence level and the life expectancy was short. Most disposable income was consumed, and the household savings rate therefore was low. As the economy with a large young working population grew rapidly and the life expectancy of its population increased, households were able, and found it necessary, to save more for a prolonged retirement period, and consequently the savings rate continued to rise. Since the mid-1970s, however, an increasing proportion of the Japanese population has reached a retirement age and the average public pension benefits have rapidly improved, thereby reducing the average need to save for retirement. Consequently, the household savings rate has shown a downward movement in recent years. This process of gradual decline in the savings rate is expected to continue until improvements in public pension benefits and the aging process of the population are complete. Then, Japan's household savings rate will be little different from the savings rates of other industrial countries.

If the above argument is correct, Japan's high household savings rate in recent decades can be viewed as a result of rapid economic growth, leading to a prolonged retirement period through the wealth and life-expectancy effects of an income change, which has initially outweighed the negative combined influence of improvements in public pension benefits and the aging of the population. In 1980, when Japan's income per capita and life expectancy had already become comparable to that of other major industrial countries, both its aged dependency ratio (the ratio of population aged 65 and over to population aged 15-64) and its aggregate public pension ratio (the ratio of public pension expenditure to disposable income or GDP) were still among the lowest in that

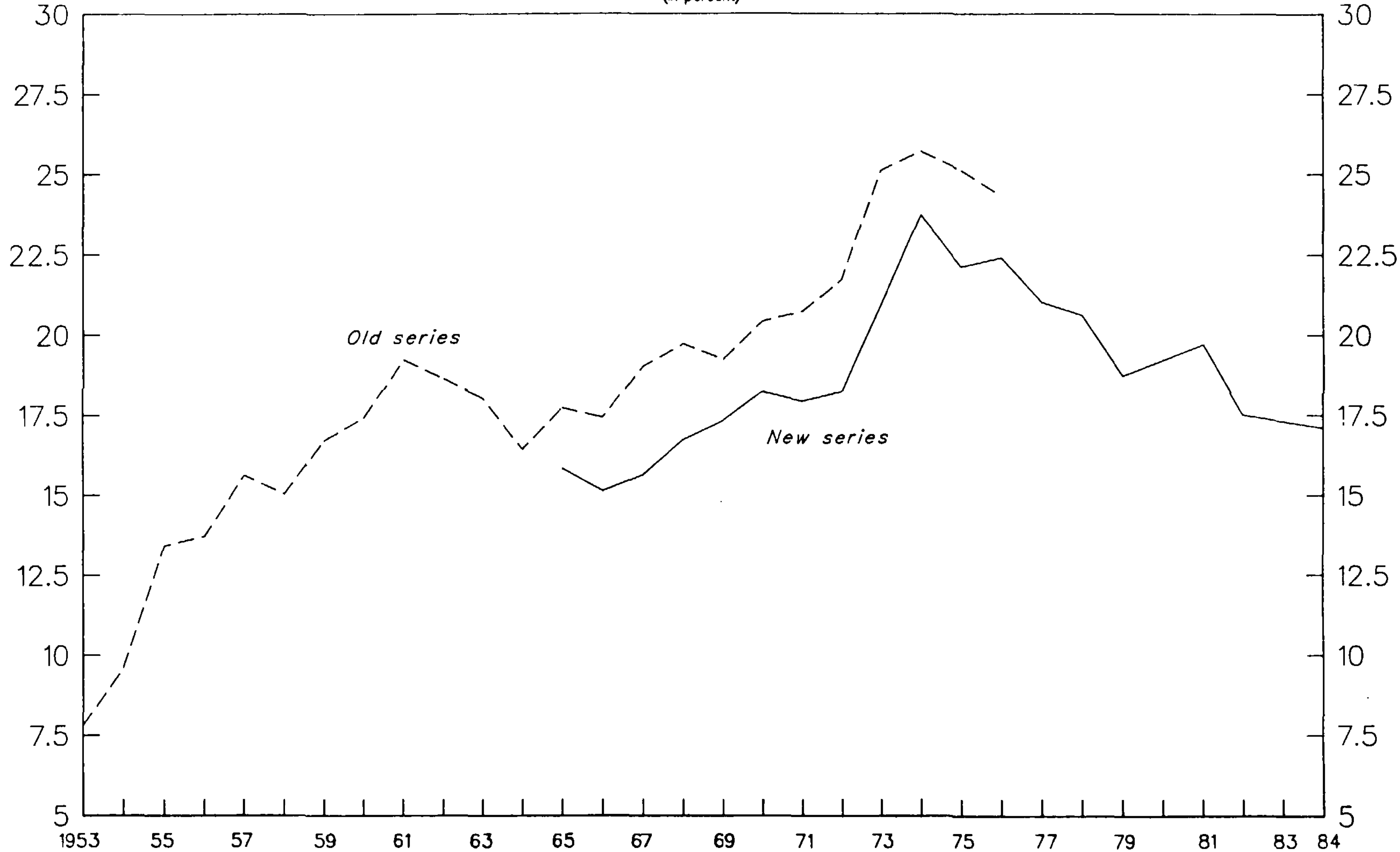
1/ Sato (1982) discusses the relationship between Japan's investment-savings gap and external imbalance.

CHART 1

JAPAN

HOUSEHOLD SAVINGS RATES, 1953–84

(In percent)



Sources: Economic planning Agency, *Annual Report on National Income Statistics*(1978) for the old series, and *Annual Report on National Account*(1985) for the new series.

group of countries. 1/ Of course, these two variables are closely related because the aggregate pension ratio for the economy is an increasing function of the average pension benefits and the aged dependency ratio. Moreover, in a democratic society where the political strength of a group depends on its size, the level of the average public pension benefits is, in general, positively related to the aged dependency ratio.

The remainder of the paper is organized as follows: Section II presents a model of Japan's household savings rate based on the life-cycle hypothesis; Section III estimates the model and tests the life-cycle hypothesis; Section IV projects the future course of the household savings rate based on the estimation results of the previous section; and Section V concludes the paper.

II. A Life-Cycle Model of Japan's Household Savings Rate

This section develops a model of Japan's household savings rate, based on the life-cycle hypothesis that the primary motive for savings is provision for retirement. The life-cycle hypothesis implies that households save during their working years in order to finance their consumption during retirement. Thus, the ratio of the retirement period to the economic life span is the most fundamental determinant of the household savings rate: a longer retirement period should be associated with a higher rate of household savings because it requires more savings during the working years. Since public pension benefits are a perfect substitute for personal savings, the ratio of public pension benefits to disposable income is another important determinant: a higher public pension ratio, which generally reflects, in a democratic society, a higher proportion of the elderly in the population, should be associated with a lower rate of household savings. Moreover, changes in the real value of household assets affect the savings rate in the short run, as households temporarily adjust their asset accumulation plans for retirement.

Although the rate of income growth has often been suggested as having a positive influence on the savings rate, this does not generally follow from the life-cycle hypothesis as such. Modigliani (1980) has argued that a high rate of income growth should be associated with a high savings rate because each successive cohort will receive a lifetime income larger than the preceding one and, therefore, savings by the pre-retired cohorts will be greater than dissavings by the retired cohorts. This proposition, however, holds only under a steady-state assumption. Modigliani's proof assumes that income growth occurs from one cohort to another, but not during the lifetime of each cohort; in particular, income is assumed to be constant for each cohort until retirement. By contrast, when income is assumed to grow during the lifetime of each cohort, an increase in the rate of income growth will

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1/ See Heller, Hemming, and Kohnert (1986).

reduce, rather than increase, the savings rate of the young, since it will raise their permanent income and, hence, will raise their current consumption relative to their current income. The ultimate effect of the rate of income growth on the savings rate is thus ambiguous and generally depends on demography. The rate of income growth may have a negative influence on the savings rate if most of the population are young, as has been the case in Japan. Thus, notwithstanding Modigliani's widely believed proposition, which is valid only under his steady-state assumption, 1/ confirmation of the life-cycle hypothesis does not require evidence of a positive influence of the rate of income growth on the saving rate. 2/

The existing literature on Japan's household savings rate includes Blumenthal (1970), Mizoguchi (1970, 1973), Boltho (1975, Chapter 4), Shoji (1976), Shiba (1979), Economic Planning Agency (1982), Hamada and Kurosaka (1984), and Makin (1985). These studies, however, lack systematic theoretical and empirical underpinnings from the viewpoint of a consistent theory of savings. A contribution of the present paper, therefore, is the presentation of a consistent life-cycle model of Japan's household savings rate and its estimation as well as hypothesis testing. In this respect, this paper supplements Horioka (1984, 1986). Horioka (1984) specifically discusses, but does not formally test, the applicability of the life-cycle hypothesis to Japan, using cohort data (on household income, wealth, savings motives, etc.), and makes some international comparisons. Horioka (1986) presents a study of the cross-country differences in savings rates, which indicates the importance of life-cycle factors for Japan's high savings rates. His use of a weighting procedure in regressions, however, appears to have caused heteroscedastic disturbances that make the classical hypothesis tests (based on the obtained t-values) unreliable because they tend to inflate the significance of estimated coefficients.

Hayashi (1986) argues that the life-cycle hypothesis does not apply to Japan because bequests, not provision for retirement, are the primary motive for savings in Japan. His arguments are based on the following two observations: First, his steady-state simulation results under the life-cycle hypothesis diverge substantially from the observed savings

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1/ Japan will not reach a demographic steady-state, which is necessary for Modigliani's proposition to hold, until year 2020 (see Table 3).

2/ Shoji (1976) has shown, and my preliminary regressions have also strongly confirmed, that Japan's savings rate is strongly related to the level of income, but not to the rate of income growth. Moreover, neither the upward trend in the savings rate before 1974 nor the downward trend after 1974 can be explained by the sudden and permanent drop in the rate of income growth in 1974 (from 10 percent to 3 percent), which would have caused, at best, a once-and-for-all decline in the savings rate after 1974. Since this did not happen (see Figure 1), the rate of income growth cannot explain the time-series behavior of the savings rate.

rates. Second, the elderly in Japan do not dissave their assets during retirement and leave substantial bequests to their children. I think, however, that these two observations do not reject the applicability of the life-cycle hypothesis to Japan. First, the Japanese household savings behavior should be viewed in the context of economic and demographic developments, not in a steady state. Indeed a main objective of this paper is to demonstrate that the time-series behavior of Japan's household savings rate can be explained by the life-cycle hypothesis when it is applied in the context of economic and demographic developments. Second, as Horioka (1984, p. 54) has argued, "bequests" in Japan should be viewed as being indirectly used to finance consumption during retirement. The elderly in Japan are typically supported by their children during retirement. They, in effect, "borrow" from their children in order to finance their living expenses during retirement and repay these "debts" in the form of a bequest at the time of death. *Therefore, even if the major motive for savings in Japan is ostensibly* bequests, it really amounts to provision for retirement, which is achieved through the implicit loan contract between the elderly and their children. 1/ Thus, Hayashi's observations do not amount to the rejection of the life-cycle hypothesis. 2/

1. The life-cycle model

The life-cycle hypothesis implies that households save during their working years in order to finance their consumption during retirement. Thus, the ratio of the retirement period to the economic life span (= the working period + the retirement period) is the most fundamental determinant of the household savings rate (see Modigliani (1980: Part II) and Horioka (1984)). Let us call this ratio the relative retirement period. Since public pension benefits are a perfect substitute for savings for retirement, the ratio of public pension benefits to disposable income is another important determinant of the savings rate. Let us call this ratio the public pension ratio. Then, a simple model of the aggregate household savings rate can be written as follows:

(1) $S/RDI = b(R/L) + b_2(PENSION/RDI)$

where: S = real household savings

1/ Horioka (1984) lists several reasons for the prevalence of such implicit loan contracts: the elderly's risk aversion for uncertain lifespan, the difficulty of liquidating the elderly's assets in the form of land and housing, and so on. See also Kotlikoff and Spivak (1981), which provides an analysis of the role of the family as an annuity market.

2/ During the postwar period, the bequest motive should have been on the wane along with a gradual breakdown of the extended family structure in Japan. Thus, Hayashi's claim is not consistent with the observed upward movement of the savings rate (until the mid-1970s) and the gradual breakdown of the extended family structure during the postwar period.

RDI = real disposable income

PENSION = real public pension benefits

R = average retirement period

W = average working period

L = average economic life span (= W + R)

$b > 0$ and $b_2 < 0$.

The equation represents the implications of the life-cycle hypothesis that the househlold savings rate (S/RDI) is an increasing function of the relative retirement period (R/L) and a decreasing function of the public pension ratio (PENSION/RDI).

Now we must consider how the relative retirement period (R/L) is determined. Modigliani (1980: Part II) treats W, R and L as given parameters of his model. It is more appropriate, however, to postulate that households choose R/L or W/L, while L depends on the state of economic development. We assume, therefore, that R/L is determined by the utility-maximizing household who chooses the relative retirement period (R/L) and the annual consumption level (C/L) subject to his lifetime budget constraint. 1/ Then, it can be shown that the relative retirement period (R/L) is an increasing function of the level of real disposable income (RDI) if the wealth effect of an income change outweighs the substitution effect. There is some evidence that the wealth effect indeed dominates the substitution effect in modern Japan. First, Japan's average monthly working hours declined from about 203 hours in 1960 to 175 hours in 1983, as the real wage rate increased rapidly during the same period. 2/ Second, despite a dramatic increase in life expectancy (of a male at birth) from 65 years in 1960 to 74 years in 1983, the average retirement age seems to have changed relatively little

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1/ The life-cycle hypothesis implies that the household smooths out consumption expenditures over lifetime. Thus, the household's decision problem can be formulated as choosing between the relative retirement period (R/L) and the annual level of consumption (C/L) subject to the lifetime budget constraint:

$$\max U(C/L, R/L) \quad \text{subject to } C/L = RDI \times (1 - R/L)$$

where C/L and R/L are assumed to be both normal goods. In this formulation, RDI can be viewed as the (average) annual wage rate. It is easy to show, under standard conditions, that $\partial(R/L)/\partial RDI$ is positive if and only if the wealth effect outweighs the substitution effect.

2/ Prime Minister's Office, Statistics Bureau, Japan Statistical Yearbook (1985), p. 110.

during the same period. 1/ These observations suggest that, as real disposable income (RDI) has increased, Japanese households have opted for more leisure in their choice between W/L and R/L. In addition to the wealth effect, an increase in RDI might have lengthened R/L more directly through its positive effect on life expectancy. To the extent that the household's marginal disutility of work increases with age, an income-induced increase in L should increase R proportionately more than W, thereby increasing R/L. Because of these wealth and life-expectancy effects of RDI, we expect that the relative retirement period (R/L) is an increasing function of real disposable income (RDI), and it is convenient to write:

$$(2) \quad R/L = \frac{b_0}{b} + \frac{b_1}{b} (1/RDI)$$

where we expect b_0 to be positive and b_1 to be negative (i.e., the wealth effect and the life-expectancy effect outweigh the substitution effect). Note that under the assumed signs of b_0 and b_1, the functional form of equation (2) incorporates the notion that R/L is bounded from above, and thus that the marginal contribution of RDI to R/L declines as RDI increases.

In summary, the life-cycle hypothesis and the utility maximization postulate suggest the following simple model of Japan's household savings rate:

$$(3) \quad S/RDI = b_0 + b_1(1/RDI) + b_2(PENSION/RDI)$$

The term $(b_0 + b_1(1/RDI))$ represents the contribution of real disposable income to the savings rate through its wealth and life-expectancy effects on the relative retirement period ($b_0 > 0$ and $b_1 < 0$). 2/ The next term b_2 (PENSION/RDI) is approximately equal to the replacement

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1/ Ibid., p. 55. During 1960-83, about 96 percent of "formal" retirement ages in Japan remained between 55 and 60 with a slight increase in the average "formal" retirement age (ibid., p. 82). In Japan, however, most people who had "formally" retired traditionally worked some additional years at reduced wages or entered another occupation. It is thus plausible that business firms have simply adjusted their "formal" retirement ages so as to more appropriately reflect "actual" retirement ages, while Japan's "actual" average retirement age has remaind the same or has even declined. In any case, there seems to be little doubt that the relative retirement period has increased steadily in modern Japan, along with dramatic increases in life expectancy (cf. Section III.3).

2/ It does not make any practical difference whether we use real income or real income per capita because they are almost perfectly collinear.

ratio (the ratio of average pension benefits to average income) multiplied by the aged dependency ratio (the ratio of aged population to working population). 1/ The public pension ratio, therefore, summarizes the combined influence of the public pension system and the demographic element that are expected to be important under the life-cycle hypothesis. Moreover, the life-cycle hypothesis implies that, since public pension benefits are a complete substitute for personal savings, the coefficient b_2 should be close to minus one. To the extent, however, that public pension also reduces uncertainty about the necessary amount of savings for retired life (because the lifespan of an individual household is subject to great uncertainty), the size of the coefficient b_2 may be greater than one by the amount of the precautionary savings that the certainty of public pension during lifetime will eliminate. 2/

According to the life-cycle hypothesis, an increase in the public pension ratio, whether it comes from a rise in the average pension benefits or in the number of beneficiaries, should reduce the aggregate household savings rate. 3/ Moreover, there is strong presumption that the replacement ratio is an increasing function of the aged dependency ratio and therefore the two ratios move together. In a democratic society, the replacement ratio reflects the relative political power of beneficiaries, which is an increasing function of the aged dependency

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1/

$$\text{PENSION/RDI} = \frac{\text{average pension benefits}}{\text{average household income}} \times \frac{\text{number of pension beneficiaries}}{\text{number of total households}}$$

$$= (\text{replacement ratio}) \times (\text{aged dependency ratio}).$$

2/ It has been said that the influence of a public pension system on the savings rate is ambiguous because it may encourage earlier retirement, thereby offsetting its negative influence on the savings rate. In Japan, however, there is little evidence for a fall in the average retirement age during the last several decades. In any case, if the public pension system were to induce earlier retirement, the estimated coefficient of the pension ratio should show a deviation from minus one toward zero. Thus, we can test whether there is any induced retirement effect by looking at the estimated coefficient of the public pension ratio.

3/ This follows from the two lemmas that public pension benefits are a perfect substitute for personal savings and that retired pension recipients still consume but no longer save. Both lemmas are implied by the life-cycle hypothesis that the primary motive for savings is provision for retirement. The Japanese survey data on family income and expenditure reveal relative stability of the savings rate over different family-head age groups. This, however, is due to the fact that middle-aged families typically include their retired parents. Thus, the reported savings rate of middle-aged families is a mixture of those of working and retired households.

ratio. Therefore, the two ratios should be positively correlated. In this case, regressions which treat the two ratios as independent variables would favor the significance of the aged dependency ratio at the expense of the replacement ratio. This problem can be avoided by a two-stage estimation method, which enables us to separate the direct influence on the aggregate savings rate of the aged dependency ratio from its indirect influence through the replacement ratio. Although this is an important question, it is left for future research when relevant data are available. This paper treats the public pension and demographic elements as a single factor that is expected to be important in the determination of the aggregate household savings rate. The pairing of the replacement and aged dependency ratios as the public pension ratio is justified, although not entirely, by the implication of the life-cycle hypohtesis that the two ratios affect the aggregate savings rate in a similar way, as well as by the strong presumption that the two ratios move together. 1/

2. Wealth factors in the life-cycle model

While the above life-cycle model provides an explanation of the long-term movements of the savings rate, some additional theory is needed to account for its medium- and short-term variations. Fortunately, the life-cycle hypothesis also implies that changes in the real value of household wealth affect the savings rate because households save part of current income and accumulate wealth in order to support their lives during retirement. For example, an increase in the valuation of household assets should reduce the savings rate because the increased real wealth replaces savings for retirement. In the following, we first consider the effects of changes in the valuation of tangible assets, and then those of financial assets. It is important to keep in mind that Japanese households hold their wealth mainly in the form of net financial assets (deposits) before their purchase of houses and land, and more in the form of tangible assets after the purchase.

a. Tangible assets (land)

The life-cycle hypothesis implies that an increase in the real value of tangible household assets, which consist mainly of

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1/ To the extent that the two ratios do not move together or move in opposite directions, the estimated coefficient of the public pension ratio should neither exhibit statistical significance nor have the predicted value (about minus one). Thus, if the estimated coefficient turns out to be statistically significant and have the predicted value, then it will support my arguments.

(residential) land in Japan, 1/ reduces the savings rate. Although what a majority of households are concerned with is the expected real value of the tangible assets during their retirement years, and not directly the current real value, a change in the current real value affects the savings rate in the following ways: First, an increased real value of the tangible assets makes retired asset-holding households wealthier, and therefore it increases their consumption. Second, to the extent that pre-retired asset-holding households cannot completely distinguish transitory from permanent land price increases, an increase in the current price leads to more consumption because households regard part of the current land price increase as a permanent increase in their real wealth. Thus, in both cases, an increase in the (residential) land price reduces the savings rate through the wealth effect. 2/

Some economists have claimed, however, that an increase in the housing/land price leads to an increase in the savings rate because households have to save more for land and housing purchases as a result of the higher price. This argument lies behind the so-called housing-price hypothesis that Japan's high household savings rate is the result of the high cost of houses and land. The argument goes as follows: because Japanese households are "target-savers" and the demand for housing is price-inelastic, a higher housing/land price induces the households to save more. Nonetheless, it is not clear whether this target effect on the savings behavior of the households who plan to purchase land and housing dominates the wealth effect on the savings behavior of the households who already own houses and land. There is some evidence that the target affect may be weak. First, the annual opinion surveys show a decline since 1978 in the percentage of households who responded that their primary purpose for saving was housing and land purchases. 3/ But, the residential land prices have been rising since 1978, which suggest that high housing/land prices may even discourage, rather than encourage, household savings. Second, the

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1/ Land accounts for about 80 percent of the tangible assets owned by the Japanese households (see the stock section of Annual Report on National Accounts by Economic Planning Agency). Moreover, residential land accounts for most of the total land value, and its price changes (often due to nation-wide land speculation) have been the major source of changes in the value of the tangible assets.

2/ There are several reasons that we use the (residential) land price index as a proxy for the value of tangible assets. The first is that land is a major part of the household tangible assets. The second is that accurate data on the tangible assets are not available (for example, Economic Planning Agency's Annual Report on National Accounts does not have data on tangible assets before 1969). The last, but not the least, reason is that we would like to test a competing housing-price hypothesis, which is discussed below, that an increase in the residential land price induces the Japanese households to save more for their housing purchase.

3/ Central Council for Savings Promotion, Public Opinion Survey on Savings (various issues).

savings rate in the urban areas, where housing/land prices are much higher, is about the same as that in the rural areas, 1/ which suggests that the elasticity of substitution between housing and other forms of savings may be close to unity. This finding is consistent with the life-cycle hypothesis that the primary motive for savings is provision for retirement and thus the form of savings matters little so long as the accumulated assets can finance expenditures during retirement. 2/

b. Financial assets

Japanese households hold most of their financial savings in fixed-price assets such as currency, deposits, and long-term bonds. Commercial stocks are a small portion of their total financial assets. Consequently, inflation directly and predictably affects the real value of household financial savings. Again, although households are concerned not just with the current price level but with the price level during their retirement years, a change in the current price level also affects the expected future price level. For example, a high (unexpected) inflation reduces both the current and expected real value of the accumulated financial savings and induces households to increase current savings in an attempt to restore the planned real asset accumulation for retirement. The life-cycle hypothesis, therefore, suggests that the household savings rate should increase when the inflation rate raises, and fall when the inflation rate declines.

More specifically, we assume that Japanese households adjust their savings in order to maintain a target ratio of real financial assets to real disposable income in the presence of price shocks. Let α stand for this financial target ratio, 3/ π for the inflation rate, and RDI for real household disposable income. Now consider $\pi = \pi_p + \pi_t$ where π_p is the permanent and π_t the transitory component of the inflation rate π. π_p may be regarded as the excess growth rate of money supply (money growth net of productivity and population growth). Its expected value $E\pi_p$ is assumed to be constant over periods while $E\pi_t$ equals zero. 4/ π_p and π_t are assumed to be uncorrelated. We also assume that

1/ Prime Minister's Office, Annual Report on the Family Income and Expenditure Survey (various issues).

2/ The relative illiquidity of housing and land has been cited as one of the reasons for the extended family structure and the implicit loan contract between the elderly and their children as a means to finance expenditures during retirement (see Section II).

3/ Precisely speaking, the financial target ratio α depends on the inflation rate π through its rate-of-return effect. As a linear approximation, however, the introduction of this element does not alter the final specification $A(\pi - E\pi_p)$ in the text, where A is a constant.

4/ This assumption is realistic in the case of Japan because the excess growth rate of money supply has shown little variation over the years (with a notable exception during 1972-73). Consequently, the value of β (see below) must have been relatively large during the sample period 1965-83.

households cannot directly observe π_p and π_t, but must infer them from the observed π. In this framework, households rationally calculate the transitory component of current inflation (that is, an unexpected permanent increase in the price level) as $E\pi_t = \beta(\pi - E\pi_p)$ where $\beta = Var(\pi_t)/Var(\pi)$. Consequently, the unexpected permanent depreciation in the household financial assets at a constant price is equal to $\beta(\pi - E\pi_p)$ times the financial assets at the constant price. Since the desired real financial assets are assumed to be the constant fraction (α) of real disposable income, the desired increase in the real savings, so as to maintain the planned accumulation of real financial assets, is given by $\alpha\beta RDI(\pi - E\pi_p)$. It follows that inflation will increase the savings rate by $\alpha\beta(\pi - E\pi_p)$ in the current period. Let us call this the positive direct wealth effect of inflation on the savings rate.

Inflation, however, may also influence the savings rate through its *effect on the real interest rate. Inflation can affect household* savings by lowering the real rate of return on savings if the interest elasticity of savings is significantly positive and the nominal interest rate is slow to adjust to inflation. 1/ In this case, inflation will reduce rather than increase the savings rate through the intertemporal substitution effect. The life-cycle hypothesis of savings, on the other hand, suggests that a reduced real rate of return on savings should increase the savings rate because the lower return on savings increases the current savings need for retirement years. With a lower real rate of return, a larger amount of savings during working years will be needed to generate the same amount of real wealth to be consumed during retirement. Let us call this the positive indirect wealth effect of inflation, which reinforces the positive direct wealth effect discussed earlier. We can test whether these positive direct and indirect wealth effects of inflation on the savings rate, both of which are implied by the life-cycle hypothesis, dominate the negative intertemporal substitution effect by examining the sign of the estimated coefficient of the inflation rate in the savings rate equation. Our presumption, based on the life-cycle hypothesis, is that the positive direct and indirect wealth effects of inflation dominates the negative intertemporal substitution effect via the real interest rate. In other words, inflation will increase, rather than decrease, the household savings rate.

To sum up: the life-cycle hypothesis, applied in the context of economic and demographic developments, has led to the following model of Japan's household savings rate:

$$(4) \quad (S/RDI) = b_0' + b_1(1/RDI) + b_2(PENSION/RDI) + b_3(LANDPRICE/RDI) + b_4(INFLATION\ RATE)$$

1/ The nominal interest rate was regulated during most of the sample period, and was very slow to adjust to inflation. Consequently the movement of the real interest rate was dominated by inflation.

where b_0' is a constant equal to $(b_0 - b_4 E\pi_p) > 0$. The term $(b_0 + b_1(1/RDI))$ represents the wealth and life-expectancy effects of real disposable income on the relative retirement period and, thereby, on the savings rate. The term b_2(PENSION/RDI) represents the public pension and demographic effect. The term b_3(LANDPRICE/RDI) represents the tangible wealth effect, and b_4(INFLATION RATE) the financial (direct and indirect) wealth effects. As discussed above, the life-cycle hypothesis of savings implies that the signs of coefficients are positive for b_0 and b_4, and negative for b_1, b_2, and b_3. Moreover, since the life-cycle hypothesis also implies that public pension benefits substitute for personal savings needed for retirement support, the size of the coefficient b_2 should be close to one or greater than one by the amount of the precautionary savings that the certainty of public pension during lifetime will eliminate.

3. Institutional factors--an alternative theory

In contrast to our life-cycle theory of Japan's household savings rate, it has often been claimed that the high household savings rate is a result of Japan's unique institutions such as the bonus system and tax exemptions on interest incomes from savings. In Japan, about one fourth of annual income is paid in the form of twice-a-year lump sum bonus payments. If bonuses could be viewed as "transitory incomes," the permanent income hypothesis, which implies a higher propensity to save out of "transitory income" than "regular (permanent) income," would suggest that the bonus system had contributed to Japan's high household savings rate. This argument is weakened, however, by the fact that the bonus system has existed for a long time and bonuses have become an integral and anticipated component of worker compensation. Alternatively, it has been claimed, the bonus system has made it easy for households to develop a savings habit, because bonuses are paid in a lump sum, over and above the regular salary, making them ideally suited for savings.

Japan's tax system, moreover, is characterized by several tax exemptions designed to promote household savings. Among them, the most widely used are the tax exemption system for interest income from small savings (commonly known as Maru-Yu) and the tax exemption system for interest income from postal savings. Under each of the systems, interest on deposits is tax exempt so long as the amount of deposits does not go over a ceiling limit. By encouraging deposits up to the ceiling limits, these tax exemptions might have contributed to Japan's high household savings rate. The ceiling limits were revised several times before 1975. Since 1975, however, they have not been revised. Therefore, because the ceiling limits are set in nominal terms, the magnitude of the contribution of the tax exemptions on the savings rate, if any, must have been declining since 1975.

To test this alternative theory of Japan's household savings rate, which emphasizes Japan's unique institutional factors, against our theory, which emphasizes life-cycle factors, we must examine the contribution of the bonus system and the tax exemptions. This can be achieved by examining the additional explanatory power of the bonus ratio (the ratio of bonus to household disposable income) and the tax-exemption ratio, which is defined as follows: 1/

$$\text{(5)} \quad \text{Tax Exemptions Ratio} = \frac{\text{Ceiling Limits - Average Deposits}}{\text{Average Disposable Income}}$$

The idea behind this tax exemptions ratio is that the closer the average deposits are to the ceiling limits, the larger the number of the households that go over the ceiling limits and face very high marginal tax rates on their interest incomes. A high tax exemption ratio, therefore, should encourage household savings and raise the savings rate.

III. Estimation Results and Their Implications

This section reports the estimation results of our model and tests competing theories and hypotheses. The general model to be estimated adds the bonus ratio and the tax exemptions ratio to the life-cycle model represented by equation (4). 2/ The relevant data for estimation are presented in Table 1. The sample period is limited from 1965 to 1983 by the availability of the data. 3/ We estimate the savings rate function, rather than the savings function, in order to avoid a potential heteroscedasticity problem, which may result in an inefficient estimation. We also estimate the function by the method of two stage least squares (2SLS) estimation in order to avoid a potential simultaneity problem between the household savings rate and some of the explanatory variables, which may result in a biased OLS estimation. Specifically, real household disposable income, the inflation rate, the bonus ratio, and the land price ratio are regressed on "predetermined"

1/ The use of this ratio as a measure of the tax exemptions was suggested to me by Charles Horioka.

2/ This enables us to perform "non-nested hypothesis tests" (our life-cycle theory vs the institutional theory).

3/ Because lagged values of some explanatory variables are used in the first-stage estimation, the sample period for the final second-stage estimation is from 1966 to 1983.

Table 1. Japan: Household Savings Rate, Real Household Disposable Income, Inflation Rate, Bonus Ratio, Tax Exemptions Ratio, Pension Ratio and Land Price Ratio, 1965-83 1/

Year	Household Savings Rate (percent)	Real Disposable Income (trillion yen)	Inflation Rate (percent)	Bonus Ratio (percent)	Tax Exemptions Ratio	Pension Ratio (percent)	Land Price Ratio
1965	15.8	49.0242	7.10	20.83	2.52	0.363	3.177
1966	15.1	53.0835	5.51	21.32	2.27	0.409	2.954
1967	15.6	58.6507	4.59	21.17	2.00	0.431	2.811
1968	16.7	64.4858	5.59	22.44	1.75	0.432	2.820
1969	17.3	71.7161	4.54	24.92	1.49	0.447	2.905
1970	18.2	77.7513	7.59	25.80	1.22	0.530	3.052
1971	17.9	82.2338	6.39	25.29	1.05	0.569	3.193
1972	18.2	90.5826	5.21	24.90	1.53	0.663	3.153
1973	20.9	102.572	10.51	26.33	1.49	0.805	3.249
1974	23.7	105.641	21.74	27.24	2.22	1.331	3.269
1975	22.1	107.769	11.61	24.64	1.86	1.795	2.755
1976	22.4	111.904	8.80	23.98	1.62	2.304	2.475
1977	21.0	114.082	7.08	23.46	1.41	2.648	2.357
1978	20.6	118.736	4.72	22.72	1.30	2.940	2.266
1979	18.7	122.880	3.44	22.73	1.18	3.167	2.275
1980	19.2	125.216	6.81	22.92	0.98	3.468	2.357
1981	19.7	126.636	4.82	22.48	0.88	3.819	2.494
1982	17.5	128.815	2.69	22.40	0.77	4.073	2.606
1983	17.3	132.881	1.59	22.00	0.72	4.225	2.630

1/ The data sources and the definitions of the variables are discussed in the Data Appendix.

variables in the first stage, 1/ and then the predicted values of these variables are used for the estimation of the complete model in the second stage. Table 2 reports the final (second-stage) estimation results. Regression 1 reported in Table 2 contains a constant term and all the six explanatory variables, while the other regressions omit some of the explanatory variables.

1. General estimation results

In the regression results reported in Table 2, several features immediately stand out. The first feature is that the institutional factors (the tax exemptions and the bonus ratio) have very little power in explaining the household savings rate. Their coefficients are not statistically significant. Moreover, the estimated coefficient of the bonus ratio not only is statistically insignificant but has a "wrong" sign. Furthermore, an examination of the correlation matrix of the estimated coefficients reveals a high degree of multicollinearity between the bonus ratio and other explanatory variables. This point is also confirmed by regression 2, which omits the bonus ratio from the savings rate equation. The omission of the bonus ratio dramatically increases the t-values of the other explanatory variables without affecting their estimated coefficients, which indicates the presence of high multicollinearity. In addition, the adjusted R^2 slightly improves as a result of the omission of the bonus ratio. Thus, we conclude that the unique bonus system explains little about the behavior of Japan's household savings rate and that the bonus ratio should be excluded from the regression. 2/

The second feature is that the omission of the other explanatory variables (in addition to the bonus ratio), with the exception of the

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1/ The "predetermined" variables include a constant term; a trend; the one-period lagged values of real household disposable income, the inflation rate, the rate of exchange rate changes, the bonus ratio, the land price ratio; the current and the one-period lagged values of the oil price inflation rate in terms of the Japanese yen; and the oil crisis dummy with zero before 1973 and one after 1974. The exchange rate changes and the oil price inflation rates are calculated from International Financial Statistics (IMF). The data sources of other variables can be found in the Data Appendix of this paper.

2/ The OLS estimation of Regression 1 (Table 2) yields a positive coefficient (0.129) with a statistically insignificant t-value (0.33). This estimated coefficient suggests that the bonus system accounts for about 3 percentage points of the Japanese household savings rate, which is very similar to the figure estimated by Ishikawa and Ueda (1984) who also used the OLS estimation method. The present regression results obtained by the 2SLS estimation method indicate that this alleged contribution of the bonus system is entirely due to the simultaneity problem between the savings rate and the bonus ratio. In other words, the OLS estimation has picked up a positive cyclical comovement between the two variables during the business cycle.

Table 2. Japan: Estimated Household Savings
Rate Functions (2SLS), 1966-83 1/

Regression Number	Coefficient of Explanatory Variables: Constant	1/RDI 2/	Pension ratio (percent)	Wealth variables: Land price ratio	Wealth variables: Inflation rate (percent)	Institutional variables: Tax exemptions ratio	Institutional variables: Bonus ratio (percent)	$\bar{R}^2$	DW	SSR
1	34.5	-820.2	-1.17	-2.65	0.222	1.39	-0.024	0.92	2.13	5.03
	(1.59)	(-2.71)	(-1.22)	(-2.54)	(1.21)	(0.91)	(-0.03)			
2	33.8	-811.5	-1.14	-2.66	0.216	1.43		0.93	2.14	5.01
	(10.22)	(-6.01)	(-3.83)	(-2.98)	(2.55)	(1.66)				
3	35.5	-658.7	-1.19	-3.39	0.335			0.93	1.90	5.30
	(11.4)	(-6.74)	(-4.05)	(-4.41)	(7.29)					
4	32.6	-1078.6	-1.24	-1.53		3.27		0.86	2.08	10.07
	(7.31)	(-9.28)	(-3.08)	(-1.45)		(5.10)				
5	25.4	-887.5	-0.64		0.090	2.69		0.88	1.65	9.11
	(11.4)	(-5.16)	(-2.01)		(0.94)	(2.77)				
6	22.6	-533.9		-0.75	0.259	1.74		0.86	1.41	10.04
	(10.73)	(-3.44)		(-0.74)	(2.26)	(1.49)				
7	28.3		-0.18	-3.68	-0.612	-2.10		0.76	1.52	17.84
	(4.91)		(-0.40)	(-2.31)	(-6.30)	(-1.84)				
8	9.73			-5.46	0.305	-0.09	0.943	0.84	1.42	11.63
	(1.59)			(-4.90)	(2.54)	(-0.11)	(2.85)			

1/ In parentheses are t-values. All regressions are estimated by the method of two-stage least squares estimation. In the first stage, real household disposable income, inflation rate, bonus ratio, and land price ratio are regressed on "predetermined" variables, and then the predicted values of these variables are used in the second stage estimation. $\bar{R}^2$ is the R^2 adjusted for degrees of freedom. DW is the Durbin-Watson statistic. SSR is the sum of squared residuals.

2/ RDI stands for real household disposable income (in trillion yen).

tax exemptions ratio, results in a significant reduction in the adjusted R^2. Therefore, all the life-cycle variables appear to constitute the relevant explanatory variables of the savings rate. The importance of the life-cycle variables are also supported by the high t-values reported in regressions 2 and 3. Their Durbin-Watson statistics indicate the absence of serial correlation in the residuals, and hence the unbiasedness of the obtained t-values of these regressions. Moreover, all the explanatory variables other than the bonus ratio, including the tax exemptions ratio, have the predicted signs. Although the coefficient of the tax exemptions ratio is not highly (statistically) significant, it should be retained as a relevant explanatory variable when we project the future savings rates because its omission may lead to biased estimates of the other coefficients. Consequently, we accept regression 2 as the most reliable estimation of the Japanese savings rate function, and use its estimated coefficients for projections of the future Japanese household saving rate in Section IV.

2. Confirmation of the life-cycle model

The regression results support our model of Japan's household savings rate, which emphasizes life-cycle factors, and rejects the alternative hypothesis that Japan's unique institutional factors have had a major influence on its savings rate. All the explanatory variables in our life-cycle model represented by equation (3) have the predicted signs and are statistically significant (see regressions 2 and 3). The coefficient (-811.5) of the inverse of real household disposable income has the predicted sign and supports our theory, with the t-value of -6.01, that the rising level of real disposable income raises the savings rate by increasing the household's permanent income (wealth) and raising their life expectancy, which induce households to save more for a longer retirement period. The coefficient (-1.14) of the pension ratio has not only the predicted sign, with the t-value of -3.83, but also the predicted size, which indicates the replacement of personal savings by public pension, as implied by the life-cycle hypothesis. This finding indicates that the induced retirement effect of the public pension system is negligible. The coefficient (-2.65) and the t-value (-2.54) of the land price ratio also support the life-cycle hypothesis, which predicts that an increase in the housing/land price reduces the savings rate through the tangible wealth effect, and rejects the housing-land price hypothesis that a high housing/land price induces Japanese households to save more. The coefficient (0.216) and the t-value (2.55) of the inflation rate also support the life-cycle hypothesis, which predicts that inflation increases the savings rate through the direct and indirect wealth effects on the real value of financial assets. This empirical finding suggests that the interest elasticity of Japan's household savings is either negative or, at most, slightly positive, so that it is dominated by the opposite wealth effects of inflation. 1/

In contrast, the bonus ratio seems to have no explanatory power, although the coefficient (1.43) and the t-value (1.66) of the tax exemptions ratio (in regression 2) indicate some contribution of tax exemptions to Japan's high household savings rate. The estimated coefficient (1.43) of the tax exemptions ratio suggests that tax exemptions on interest income from savings have contributed to the savings rate about 2 percentage points on average during 1966-83. In recent years, however, their contribution to Japan's household savings rate has been only about 1 percentage point because, as discussed earlier, the nominal ceiling limits on tax exemptions have not been revised since 1975, and consequently the tax exemptions ratio has been declining (Table 1). In any case, the impact of tax exemptions has been relatively small and can explain, at most, a very small part of the savings rate. 2/ Consequently, we can conclude that the institutional factors cannot explain much of Japan's high household savings rate.

Our conclusion that Japan's household savings rate is mainly determined by the life-cycle factors and not by the special institutional factors can also be established by non-nested F-tests. First, the null hypothesis that the coefficients of the institutional factors (the tax exemptions ratio and the bonus ratio) are zero cannot be rejected even at the 5 percent level of significance. The F-test statistic in this case is 0.32, which is much smaller than the critical value of F at the 5 percent level of significance (3.98). On the other hand, the null hypothesis that the coefficients of the main life-cycle factors (the inverse of real household disposable income and the pension ratio) are zero can be rejected at the 1 percent level of significance. 3/ The F-test statistic in this case is 7.27, which is larger than the critical value of F at the 1 percent level of significance (7.20). Thus, these F-tests also confirm our life-cycle theory of Japan's household savings rate.

1/ Makin (1985) reaches a similar conclusion on the small positive (or even negative) interest elasticity of Japanese savings. The use of the real interest rate in place of the inflation rate affects the regression results very little because inflation has dominated the movement of the real interest rate during the sample period. Moreover, the use of the inflation rate is more consistent with the life-cycle hypothesis of savings.

2/ This conclusion is consistent with our earlier finding about the small interest elasticity of Japan's household savings.

3/ As can be expected, the null hypothesis that the coefficients of the wealth variables, which are also suggested by the life-cycle hypothesis of savings, are zero in addition to those of the main life-cycle factors is much more easily rejected.

3. Account of the past household savings behavior

Our estimated life-cycle model of Japan's household savings rate implies that the general upward trend of the savings rate until 1974 (Figure 1) was mainly due to the rapidly rising level of real disposable income, which increased the relative retirement period through the wealth and life-expectancy effects of an income change. The positive contribution of real disposable income during the sample period 1965-83, for example, is calculated to have been 10.5 percentage points (= - 811.5x(1/132.9-1/49.0)) from Table 1 and regression 2. The following arithmetic also supports this result: The (additional) life expectancy of the 35-year old (male) increased from 36.3 years in 1965 to 40.9 years in 1983. 1/ This means that the relative retirement period should have increased by about 59 percent if people started working at age 20 and retired at age 65. This 59 percent increase in the relative retirement period, by itself, would have raised the savings rate by 10.2 percentage points (=(33.8 - 811.5/49.0) x 0.59) during 1965-83. This corresponds well to the estimated 10.5 percentage points contribution of real disposable income to the savings rate during that period. This arithmetic exercise is intended to be only suggestive, for the result is sensitive to the choice of the assumed retirement age. 2/ Nevertheless, it shows that the estimated contribution of real disposable income through its effects on the relative retirement period is perfectly reasonable.

On the other hand, the negative contribution of the public pension ratio is calculated to have been 4.4 percentage points (= -1.14x(4.23-0.36)) during 1965-83. It is noteworthy that the influence of the public pension and demographic factor accelerated rapidly after 1974 (Table 1). This coincided with the beginning of the downward movement of the savings rate, although the public pension and demographic factor alone cannot explain the large magnitude of the decline in the savings rate. A substantial decline in the inflation rate after 1974 was another major reason for this sharp decline (see the next paragraph). In any case, the mid-1970s heralded a transition period during which the negative influence of the public pension and demographic factor started to outweigh the positive influence of the income factor, and the trend of the household savings rate started to reverse its direction downward.

Inflation accounted for a large part of the short-term variations in the household savings rate through the financial wealth effects. The

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1/ Prime Minister's Office, Statistic Bureau, Japan Statistical Year Book (1985: p. 55).

2/ In Japan, a "formal" retirement age ranges between 55 and 60 (ibid., p. 55). In reality, however, most people who had "formally" retired typically worked some years at reduced wages or entered another occupation. Horioka (1984), for example, reports that about half of the aged 65 to 69 were still in the labor force. The "actual" average retirement age, therefore, may reasonably be assumed to have been 65.

contribution of (unexpected) inflation in 1974, for example, is calculated to have been about 4 percentage points (= 0.22x(21.7-4.0), assuming that $E\pi_p$ equals 4 percent). This figure can therefore explain a sudden jump in the savings rate during the first oil crisis as well as a substantial part of the subsequent decline in the savings rate (Figure 1 and Table 1). The tangible wealth effect accounts for the medium-term variations in the savings rate at the magnitude of a few percentage points. Finally, as discussed earlier, the contribution of the tax exemptions was about 2 percentage points on average during 1966-83. It, however, has been only about 1 percentage point in recent years because the nominal ceiling limits have not been raised since 1975.

IV. Future Behavior of Household Savings

This section projects Japan's future household savings rates, using the estimation result (regression 2 in Table 2) of the previous section. 1/ The projections show that the household savings rate will gradually decline, after decades of a steady rise, as the negative influence of the public pension and demographic factor start to dominate the positive influence of the income factor. This trend will accelerate around the year 2000, and continue until 2020.

1. Assumptions on the future explanatory variables

In order to make numerical projections, we must first make appropriate assumptions on the future movements of explanatory variables. As our confirmed life-cycle theory indicates, the income factor, through its effects on the relative retirement period, and the public pension and demographic factor explain the long-term movement of Japan's household savings rate, while the tangible and financial wealth factors explain the medium- and short-term variations of the savings rate. 2/ Therefore, the accurate projections of real household disposable income and the public pension ratio become our main task. To simplify the analysis, we assume an annual 3 percent growth rate of real household disposable income. A sensitivity analysis indicates that an alternative assumption of the 4 percent growth rate affects the future projections of the savings rate very little. 3/ This result is predictable because real disposable income affects the savings rate through the inverse function, and therefore its marginal contribution to raising the savings rate is becoming smaller. The projections of the savings rate, on the

1/ The use of Regression 1 or 3, instead of Regression 2, does not substantially affect any of the main results of this section.

2/ The ratio of tangible wealth (land) to disposable income had shown an upward trend until the mid-1960s. Since then, however, its trend appears to have stabilized and the ratio has been characterized more by medium-term variations than the trend movement (Table 1).

3/ The savings rate will be higher only by 0.6 perentage points even as late as 2030. The difference is, of course, less than this figure before 2030.

other hand, are more sensitive to the future movement of the pension ratio. It is particularly important, therefore, to carefully project the future course of the public pension ratio.

The public pension ratio consists of the replacement ratio and the aged dependency ratio. Projected official aged dependency ratios are presented in Table 3. Japan's public pension system consists mainly of two public pension programs: People's Pension and Employee's Pension. On the basis of information in Noguchi (his Table 5, 1983), the replacement ratio can be estimated to have been aproximately 9 percent for People's Pension and 37 for Employee's Pension in 1980. The difference in the replacement ratios is mainly due to the fact that People's Pension is a newer public pension program than Employee's Pension and, consequently, the contribution years are shorter. Similarly, the pension beneficiaries of People's Pension were about one fourth of the total public pension beneficiaries. Therefore, we estimate the average replacement ratio of Japan's public pension system as a whole to have been 30 percent (= 9x0.25 + 37x0.75) in 1980. As the Japanese Government has indicated its objective of achieving a replacement ratio of about 60 percent in terms of the regular earnings and the regular earnings are about three fourth of the total earnings, the replacement ratio in full maturity is expected to be about 45 percent (= 60x0.75) in terms of the total earnings (= regular earnings + bonuses). Noguchi (1983) also estimated that the full maturity would be achieved in 1999 by Employee's Pension and in 2016 by People's Pension. For the sake of simplicity, we assume here that Japan's public pension system as a whole achieves its full maturity in 2010. It is therefore projected that the replacement ratio (in terms of the total earnings) will increase from 30 percent in 1980 to 45 percent in 2010: a 50 percent increase in the replacement ratio. This represents a baseline scenario on the maturation process of the public pension system. Because some reduction in the replacement ratio is likely to occur in the near future, particularly in view of the recent government's efforts toward fiscal consolidation, we also consider a fiscal consolidation scenario, in which the growth in the replacement ratio at full maturity is limited to 30 percent instead of 50 percent.

The pension ratios are then projected from 1980 to 2030 according to the following formula (Table 4):

$$\text{(6) Pension Ratio} = 3.47 \times \frac{\text{Replacement Ratio}}{30.0} \times \frac{\text{Dependency Ratio}}{13.4}$$

where 3.47 is the actual 1980 figure of the pension ratio, 30.0 the estimated 1980 figure of the replacement ratio, and 13.4 the actual 1980 figure of the dependency ratio of aged population.

Finally, we assume the rest of the explanatory variables to maintain the following reasonable values (cf. Table 1) during the projection period 1985-2030: (1) the land price ratio = 3.25; (2) no unexpected inflation (i.e., $E\pi = E\pi_p = \pi$); (3) the tax exemptions ratio = 0.7. The

Table 3. Japan: Population Estimates, 1980-2030

(In thousands of persons)

Year	Total (A)	0-14 years (B)	15-64 years (C)	65 years and over (D)	Dependency ratio of aged population (D/C x 100)
1980	116,916	27,547	78,791	10,578	13.4
1985	120,301	25,737	82,366	12,198	14.8
1990	122,834	22,512	86,032	14,290	16.6
1995	125,383	21,405	86,897	17,082	19.7
2000	128,119	22,561	85,615	19,943	23.3
2005	130,008	23,941	83,839	22,228	26.5
2010	130,276	23,858	81,940	24,478	29.9
2015	129,332	22,427	79,593	27,311	34.3
2020	128,115	21,419	78,747	27,950	35.5
2025	127,184	21,929	78,176	27,079	34.6
2030	126,297	23,182	76,763	26,351	34.3

Source: Statistics Bureau, Prime Minister's Office, Japan Statistical Yearbook, 1983.

Table 4. Japan: Estimates of Pension Ratio and Real Household Disposable Income, 1980-2030

Year	Dependency Ratio of Aged Population (in percent)	Replacement Ratio 1/ (in percent)		Pension Ratio 2/ (in percent)		Real Household Disposable Income 3/ (in trillion yen)
		Baseline Scenario	Fiscal Consolidation Scenario	Baseline Scenario	Fiscal Consolidation Scenario	
1980	13.4	30.0	30.0	3.47	3.47	125.2
1985	14.8	32.5	31.5	4.15	4.02	145.1
1990	16.6	35.0	33.0	5.02	4.73	168.3
1995	19.7	37.5	34.5	6.38	5.87	195.1
2000	23.3	40.0	36.0	8.04	7.24	226.1
2005	26.5	42.5	37.5	9.72	8.58	262.1
2010	29.9	45.0	39.0	11.61	10.07	303.9
2015	34.3	45.0	39.0	13.32	11.55	352.3
2020	35.5	45.0	39.0	13.79	11.95	408.4
2025	34.6	45.0	39.0	13.44	11.67	473.5
2030	34.3	45.0	39.0	13.32	11.55	548.9

1/ The public pension system is assumed to reach full maturation in 2010.

2/ Pension Ratio = $3.47 \times \left(\frac{\text{Replacement Ratio}}{30.0}\right) \times \left(\frac{\text{Dependency Ratio}}{13.4}\right)$.

3/ Real disposable income in year t = $125.2 \times (1.03)^{t-1980}$.

land price ratio of 3.25 assumes the recovery of the ratio to the pre-oil crisis level. The assumption of no unexpected inflation is appropriate because we are interested in the future trend movement of the savings rate. We assume that $E\pi_p$ had been 4 percent during the sample period 1966-83; so that $b_0 = b_0' + b_4 E\pi_p = 34.7$ in equation (4). 1/ The tax exemptions ratio of 0.7 assumes periodic revisions of the ceiling limits so as to keep up with rises in household disposable income at the current ratio of about 0.7. If the tax exemptions are to be abolished in the near future, the projected household savings rates (in Table 5) should be adjusted downward by about 1 percentage point.

2. Household savings rate projections, 1985-2030

Under the above assumptions on the future values of explanatory variables, we calculate the projected household savings rates from 1985 to 2030. The projections are based on regression 2 reported in Table 2, which we have accepted as the most reliable estimation of the household savings rate function. The projection results are reported in Table 5, which shows a substantial decline in the savings rate during 1985-2020. In both the baseline and fiscal consolidation scenarios, the projected decline in the savings rate is very gradual during 1985-95. 2/ But it starts to accelerate around 2000, and reaches its lowest level in 2020, and then recovers slightly thereafter. In the baseline scenario, the savings rate declines from 17 percent in 1985 to 16 percent in 1995, and then to 13 percent in 2005 and reaches the lowest level of 9 percent in 2020. In the fiscal consolidation scenario, on the other hand, it declines slightly less to 15 percent in 2005 and to 12 percent in 2020. As discussed earlier, these projections assume the maintenance of the current tax exemptions ratio (0.7). If, instead, tax exemptions were abolished in the near future, the projected savings rates would be lower than these figures by about 1 percentage point.

These projected figures indicate that Japan's household savings rate will eventually become little different from the savings rates of other industrial countries. The average household savings rate among the OECD member countries is calculated to be 11.4 percent during 1976-82 by Horioka (his Table 1, 1986). In the baseline scenario, Japan's household savings rate is expected to become less than the recent OECD average savings rate. This is not surprising in view of the fact that Japan's aged dependency ratio is expected to become the highest and Japan's public pension system (at full maturity) most gener-

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1/ The values of π and $E\pi_p$ do not need to be specified for the projections because they cancel out each other under the assumption of no unexpected inflation. But, the value of $E\pi_p$ during the sample period needs to be specified in order to obtain the value of b_0, which is used in the projections.

2/ The rapid decline in the savings rate observed during 1975-82 was exaggerated by a large fall in the inflation rate during the same period (see Section III.3).

Table 5. Japan: Projected Household Savings Rates, 1985-2030 1/

(In percent)

Year	Baseline Scenario 2/	Fiscal Consolidation Scenario 2/
1985	16.7	16.9
1990	16.5	16.8
1995	15.8	16.5
2000	14.4	15.5
2005	13.0	14.5
2010	11.2	13.2
2015	9.7	11.9
2020	9.4	11.7
2025	10.1	12.4
2030	10.5	12.7

1/ The savings rates throughout this paper are based on the time-series in Annual Report on National Accounts (1985). Care should be taken when one compares these projected figures with the savings rates in the newest Annual Report on National Accounts (1986) because the latter contains recently revised savings rates, which are generally lower by about one percentage point than the rates we have used in this paper.

2/ The baseline scenario assumes an increase in the replacement ratio from 30 percent in 1980 to 45 percent in 2010. The fiscal consolidation scenario, on the other hand, assumes an increase in the replacement ratio from 30 percent in 1980 to 39 percent in 2010. In the absence of the tax exemptions, the projected savings rates will be lower by about one percentage point in both scenarios.

ous among the OECD member countries. In this situation, the life-cycle hypothesis of savings implies that Japan's household savings rate should be lower than the OECD average rate, other things being equal.

V. Conclusion

This paper has developed and tested a model of Japan's household savings rate, based on the life-cycle hypothesis, and has used that model for projecting the future savings rates. The life-cycle hypothesis implies that households save during their working years in order to finance their consumption during retirement. Thus, the expected length of the retirement period (relative to the economic life span) and the public pension ratio are two of the most important determinants of the household savings rate: a longer retirement period requires more savings during the working years, whereas larger public pension benefits reduce the savings need for retirement. The paper has argued that Japan's rapidly rising level of real disposable income has led to a prolonged retirement period, through the wealth and life-expectancy effects of an income change, and thereby has steadly raised the savings rate during the past several decades. In recent years, however, the household savings rate has started to decline, as the negative combined influence of improvements in public pension benefits and the aging of the population has outweighed the positive influence of increases in real disposable income. This downward trend in the savings rate is projected to continue until improvements in public pension benefits and the aging process of the population are complete.

Aggregate time-series tests strongly support our model of Japan's household savings rate. As predicted by the life-cycle hypohtesis and the utility-maximization postulate, an increasing level of real disposable income has continuously raised the savings rate through its wealth and life-expectancy effects on the relative retirement period. Moreover, public pension benefits have replaced personal savings roughly by an equal amount, which indicates the absence of a strong induced retirement effect on the savings rate. The life-cycle hypothesis is further supported by the finding that the tangible and financial wealth effects, implied by the life-cycle hypothesis, have dominated other effects that are expected to work in opposing directions. For example, the savings rate has responded negatively to an increase in the housing/land price, thereby indicating that the tangible wealth effect, implied by the life-cycle hypothesis, dominates the target effect implied by the housing-price hypothesis. Moreover, the savings rate has responded positively to inflation, thereby indicating that the direct and indirect wealth effects, implied by the life-cycle hypothesis, dominate the intertemporal substitution effect via the real interest rate. Finally, Japan's unique institutions have played only a minor role in the determination of the savings rate. Although the tax exemptions on interest income from savings appear to have some effects, the bonus system has little evident effect on the savings rate.

The projections of Japan's household savings rate, which are based on our estimated life-cycle model, show a substantial decline in the savings rate during 1985-2020. Although the projected decline is very gradual until 1995, it accelerates around the year 2000. In the baseline scenario, the savings rate declines from 17 percent in 1985 to 16 percent in 1995 and 13 percent in 2005, and reaches its lowest level of 9 percent in 2020. In the fiscal consolidation scenario, the savings rate declines slightly less, falling to 15 percent in 2005 and 12 percent in 2020. These figures, however, reflect the assumption that periodic revisions are made in the nominal ceiling limits for tax exemptions to keep the tax exemptions ratio at its current level of 0.7. If, instead, tax exemptions were abolished in the near future, the projected savings rates should be about 1 percentage point lower in each year than the figures cited above.

*In conclusion, both the empirical findings and the projected house*hold savings rates support our theory that Japan's aggregate savings rate goes through a "life cycle" in the process of economic and demographic developments. According to this theory, Japan's high household savings rate in recent decades reflects the positive influence of rapid economic growth, leading to a prolonged retirement period through the wealth and life-expectancy effects of an income change, which has initially outweighed the negative combined influence of improvements in public pension benefits and the aging of the population. When the negative influence catches up, however, the household savings rate in Japan will become little different from the savings rates of other industrial countries. It should be repeated that our model of Japan's household savings rate is consistently based on the life-cycle hypothesis that the primary motive for savings is provision for retirement. Thus, the paper has also demonstrated that the life-cycle hypothesis can satisfactorily account for the savings behavior of Japanese households when it is applied in the context of economic and demographic developments.

Data Appendix

APPENDIX

This Appendix provides the definitions of the variables used in the text and their data sources.

Household savings rate = (household disposable income - household consumption expenditure)/household disposable income x 100. The data are obtained from the Annual Report on National Accounts (1985) and Keizai Hakusho (1982).

Real disposable income = household disposable income/the deflator of household final consumption expenditure. The data are obtained from the Annual Report on National Accounts (1985).

Inflation rate (T) = (the deflator of household final consumption expenditure (T)/the deflator of household final consumption expenditure (T-1) - 1) x 100. The deflators are obtained from the Annual Report on National Accounts (1985).

Bonus ratio = temporary salary and bonuses/(temporary salary and bonuses + regular salary) x 100. The data are obtained from the Annual Report on the Family Income and Expenditure Survey (1983).

Tax exemptions ratio = (ceiling limits - average household deposits)/average household disposable income. The ceiling limits are defined as the sum of the ceiling limits on the Maru-Yu and the postal savings tax exemptions. They are obtained from the Savings and Savings Promotion Movement in Japan (1982). The average household deposits are defined as the sum of the average time deposits (at banks, post offices and others) and the average demand deposits (at post offices). They are obtained from the Report on the Family Saving Survey (1984). The average household disposable incomes are obtained from the Annual Report on the Family Income and Expenditure Survey (1983).

Pension ratio = pension benefits/household disposable income. The pension benefits are defined as the sum of the Employee's Pension (Kosei Nenkin) and the People's Pension (Kokumin Nenkin). The data are obtained from the Annual Report on National Accounts (1985).

Land price ratio = the residential land price index/household disposable income. The residential land price index (1955=100) is used as a proxy for the tangible wealth because residential land acounts for most of the tangible wealth held by the Japanese households. The data are obtained from the Japan Statistical Year Book (various issues) and the Annual Report on National Accounts (1985).

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