CENTRE of POLICY STUDIES and the IMPACT PROJECT

Eleventh Floor
Menzies Building
PO Box 11E, Monash University
Wellington Road
CLAYTON Vic 3800 AUSTRALIA

Telephone: (03) 9905 2398, (03) 9905 5112 — from overseas: 61 3 9905 5112 or 61 3 9905 2398

Fax: (03) 9905 2426 — 61 3 9905 2426

e-mail: impact@buseco.monash.edu.au

web site: http://www.monash.edu.au/policy/

WHY DO SOME COUNTRIES SAVE MORE THAN OTHERS?

by

SHUSAKU YAMAMOTO

Centre of Policy Studies, Monash University

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The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to quantitative analysis of issues relevant to Australian economic policy.

Why do some countries save more than others?

Shusaku Yamamoto*
Centre of Policy Studies, Monash University, Australia
Email: shusaku.yamamoto@buseco.monash.edu.au

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Abstract

Some countries have the resources and capacity to save more than the other countries. This paper analyses the determinants of annual saving. The analysis uses the optimal saving function which is derived from the household inter-temporal utility maximisation. The predictions from the comparative statics are compared with micro survey data in Japan and the US. In addition, the preference of inter-temporal consumptions is estimated. These comparisons and estimations suggest that higher annual saving could be explained by higher income, lower interest rates, shorter saving spans, longer retirement spans, and higher preference for retirement-span consumption.

Keywords: retirement; saving; utility maximisation; wealth accumulation; consumer preference

JEL Classifications; D11; D12; D91; E21

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Contents

Introduction

This paper analyses different levels of annual household savings through an optimal saving function. This function is derived from the inter-temporal utility maximisation. A household wealth accumulation mechanism augments the budget constraint. According to the derived function, an optimal household saving level could be determined by a saving span (number of years to retirement), retirement span, household income, initial savings (or wealth), and a real interest rate. Comparative statics of the saving function are used to analyse the effect of a unitary change in these determinants. The results of the comparative statics are then compared with the survey data of Japanese and American households.

Horioka (1990) surveys the determinants that could explain the level of saving. These determinants are categorised into six major groups: cultural, demographic and socioeconomic, institutional, government policies, economic, and miscellaneous factors. This survey explicitly covers possible structural factors to explain levels of saving. Based on these factors, major determinants are further examined in Horioka & Watanabe (1997). The major determinants are retirement, precautionary, education, marriage, housing, consumer durables, leisure, tax, business, bequest, and other motives. Using micro-data from the 'Comparative Survey of Savings in Japan and the United States (1996),'[1] Horioka & Watanabe (1997) found that the retirement and precautionary motives are the major determinants which explain household saving levels in Japan and the US.

Retirement saving is further examined in Horioka & Okui (1999) and they suggest that the retirement savings are partly explained by variables in the extended life cycle model such as an expected annual cost of living during retirement.

The life cycle model, which was first suggested by Modigliani and Brumberg (1954), provides the theoretical framework for analysing household saving behaviour. The framework is an inter-temporal utility maximisation approach. A household maximises the life time utility function which is subject to a life time budget constraint. However, this budget constraint does not distinguish between a saving span and

[1] c.f. Institute for Posts and Telecommunications Policy (1996).

retirement span. Moreover, the proposed household optimisation is not solved, and hence, the optimal saving function was not derived. In this paper, the Modigliani and Brumberg (1954) framework is expanded by distinguishing both a saving and retirement span, and by deriving an optimal saving function. The comparative statics results are derived from the optimal saving function. These results are compared with survey data of American and Japanese households. Furthermore, household preference in relation to the consumption in the saving span and the retirement span are estimated and examined.

Theoretical framework

The theoretical framework is based on an inter-temporal household utility maximisation approach. The budget constraint is obtained from a wealth accumulation equation which is similar to the one in Horioka and Watanabe (1997). The total household savings (S_T) at the beginning of retirement is obtained by the following equation:

$$S_T = (1+i)^w S_I + \frac{(M - c_b)(1 - [1+i]^w)}{-i} \tag{1}$$

where i is the real interest rate; w is the saving span in years; S_I is the initial savings; M is the annual income; and c_b is the annual consumption before retirement. This saving equation implicitly assumes that the real interest rate, annual income and annual consumption are stationary over periods. It also assumes that savings only occur before retirement. The difference between this equation and the one in Horioka and Watanabe (1997), is the concept of time. In Horioka and Watanabe (1997), a value at year *t* indicates a same value in the middle of the year. In this paper, a value at year *t* indicates a same value at the end of the year. For example, X_t in Horioka and Watanabe (1997) shows the value of X in the middle of year *t*, whereas, in this paper, it shows X at the end of year *t*. This leads to another difference in that a return on the investment is paid at the end of year *t* in this paper, whilst it is paid in the middle of year *t* in Horioka and Watanabe (1997). The end-of-year approach adopted here leads to simpler formulas than those in Horioka and Watanabe (1997).

A household withdraws its savings during retirement. The total savings (S_{Tr}) in *r* years from the beginning of retirement is shown in the following equation:

$$S_{Tr} = (1+i)^r S_T - \frac{c_a\left(1-[1+i]^r\right)}{-i}$$

where c_a is the annual consumption in a retirement span. It is assumed that a household does not leave any savings for bequest. This implies the following relationship:

$$S_T = \frac{c_a\left(1-[1+i]^v\right)}{-i(1+i)^v} \qquad (2)$$

where v is the number of years in the retirement span. Through equating equations (1) and (2), the budget constraint is obtained as follows:

$$M = \left(\frac{-i}{1-[1+i]^w}\right)\left(\frac{c_a\left[1-[1+i]^v\right]}{-i[1+i]^v} - [1+i]^w S_I\right) + c_b$$

This budget constraint implicitly assumes that no inflation occurs over a life span. In Modigliani and Brumberg (1954), the form of a utility function is not specified. However, this paper assumes that the Cobb-Douglas utility function represents the household utility. A representative household solves the following inter-temporal utility maximisation problem:

$$\max_{c_b, c_a} \; U = c_b^{w\alpha} c_a^{v\beta} \quad \text{s.t. } M = \left(\frac{-i}{1-[1+i]^w}\right)\left(\frac{c_a\left[1-[1+i]^v\right]}{-i[1+i]^v} - [1+i]^w S_I\right) + c_b$$

where $w\alpha + v\beta = 1$; and α and β are respectively the household preference for consumption during the saving span and retirement span. The following are the solutions:

$$c_b^* = \frac{M + \dfrac{-i[1+i]^w S_I}{1-[1+i]^w}}{1+\dfrac{v\beta}{w\alpha}} \qquad (3)$$

$$c_a^* = \frac{\left(M + \frac{-i[1+i]^w S_I}{1-[1+i]^w}\right)\left(1-[1+i]^w\right)(1+i)^v}{\left(1+\frac{w\alpha}{v\beta}\right)\left(1-[1+i]^v\right)} \tag{4}$$

With saving defined as the difference between income (M) and optimal consumption (c_b*), we find that the optimal saving function for the saving span is:

$$s_b^* = v\beta M - \frac{-i(1+i)^w S_I w\alpha}{1-(1+i)^w} \tag{5}$$

Equation (5) shows that household saving increases as the retirement span (v) increases, *ceteris paribus*. The higher is initial saving (S_I), the lower is household saves every year, *ceteris paribus*. The effect of a longer saving span (w) or higher interest rate (i) is not explicitly determined in equation (5). Comparative statistic result for a higher interest rate is as follows.

$$\frac{\partial s_b^*}{\partial i} \ (>/=/<)\ 0 \quad \propto \quad w - i^2 - 3i - 2\ (>/=/<)\ 0$$

This comparative static result indicates that the effect of higher interest rate on an optimal saving depends on initial values of saving span and interest rate. In case of household characteristics given by Table 1, a typical American and Japanese household save more at the higher interest rate. Another way of interpreting the above result is to obtain critical values for initial saving span (w) and interest rate (i). Critical values show the value at which the comparative statistic result changes. Given the saving span value from Table 1, critical values for a real interest rate for a Japanese household are about –553 and 261 percent per annum. At an initial interest rate between these critical values, a Japanese household increases saving at a higher interest rate. As for an American household, critical values are about –622 and 314 percent per annum. At an initial interest rate between these critical values, an American household increases saving at a higher interest rate. Similarly, critical values for initial saving spans (w) are computed given the values for an interest rate from Table 1. Both American and Japanese households increase saving at the higher interest rate unless the initial saving span is shorter than about two years. This implies that the households near the retirement decrease saving at the higher interest rate. Retiring household can achieve a target retirement fund with less saving at a higher interest rate. This would be a rationale for the case of decreasing saving at the higher interest rate.

The other undetermined effect on saving (s_b*) is of a longer saving span (w). Comparative statistic result for a longer saving span is as follows.

$$\frac{\partial s_b^*}{\partial w} \ (< / = / <) \ 0 \quad \propto \quad w(\ln[1+i]) + 1 - (1+i)^w \ (> / = / <) \ 0$$

This comparative static result indicates that the effect of longer saving span on an optimal saving depends on initial values of saving span and interest rate. In case of household characteristics given by Table 1, a typical American and Japanese household save less with the longer saving span. The longer saving span does not change an optimal saving unless one or both of initial values of saving span and real interest rate are zero. In other cases, a longer saving span motivate a household to save more.

Comparisons of household saving in Japan and the US

The previously mentioned comparative statics results can be compared with the household survey data in Japan and the US. Table 1 lists the selected results from 'Comparative Survey of Savings in Japan and the United States' in 1996. Based on this data, an average Japanese household had a higher income, initial savings, and annual savings than that of an American household during 1996. An American household had a higher real interest rate than that of Japanese, while a Japanese household had a shorter saving span and longer retirement span than that of an American.

The data in Table 1 also indicates that a Japanese household needed to prepare for a longer retirement span in the shorter period of time. This was reflected in the higher annual savings and the initial savings statistics. The lower real interest rate could have also caused a higher Japanese annual saving because the savings in Japan did not yield as much interest as that of the US.

Table 1 Typical household characteristics in Japan and US in 1996

	Country		
Item	**Japan (\108.8/$)**	**US**	**Difference**
Income (M)	\9,339,300 ($85,839)	$75,118	$10,721
Initial savings (S_I)	\7,868,500 ($72,321)	$50,419	$21,902
Annual saving (s_b)	\848,700 ($7,801)	$5,797	$2,004
Real interest rate (i)	3.0 %	3.5 %	– 0.5%
Retirement span (v)	22.56 years	19.13 years	3.43 years
Saving span (w)	16.62 years	21.29 years	– 4.67 years

Sources: exchange rate and interest rate are year 1996 values from 'OECD Economic Outlook 73': interest rates are computed by i = long-run interest rate – %Δ(CPI); and the other items are from 'Comparative Survey of Savings in Japan and the United States (1996)' by the Institute for Posts and Telecommunications Policy of the Japanese Ministry of Posts and Telecommunications.

The first two columns in Table 1 show typical household characteristics in Japan and U.S., respectively. The last column shows a difference that a U.S. value is subtracted form a corresponding Japanese value. These differences are compared with the previously obtained comparative statics results. Positive differences in income and retirement span satisfy the comparative statics results of the positive annual saving. However, the positive difference in initial savings contradicts the comparative statics results. The optimal saving function suggests that if the initial savings are higher, the annual saving is lower. The optimal saving function assumes that the initial savings are exogenous. In the context of the data, the initial savings, however, are not exogenous and are the result of all annual savings in the past. Therefore, the higher Japanese (or positive difference in) annual saving itself could explain the higher initial savings. In other words, the initial savings are endogenous in the survey rather than exogenous. Another related point in terms of the initial savings is that the average age of Japanese household heads (47.69 years old) was higher than that of American (42.64 years old). This implies that the Japanese household had saved for a longer period of time than that of the American.

The real interest rate could also be used to explain the different initial savings. The higher interest payments had accumulated on the initial savings at a higher interest rate, *ceteris paribus*. As a consequence, the higher initial savings could also be explained by the higher interest rate. However, effects of the longer saving span with the higher annual saving of a Japanese household was more than offsetting the effect of the lower real interest rate. This explained the higher initial savings of a Japanese household in the survey.

As mentioned previously, the comparative statics results for real interest rates and saving spans depend on the initial data. In this case, the initial data is Japanese data which has already been shown to hold inverse relationships with an optimal saving. That is, the negative differences of interest rate and saving span satisfy the comparative statics results. Besides the initial savings, all micro data in Table 1 is compatible with the comparative statics results. Provided that the positive difference in initial savings was explained, the optimal saving function empirically holds.

Another way to use the data in Table 1 is computing household preferences for consumption in the saving span (α and $w\alpha$) and retirement span (β and $v\beta$). Substitution of the survey data into the optimal saving function allows an estimation of household preference in consumption during the saving span and retirement span. The following table presents the estimated preference:

Table 2 Revealed preference

	Country	
Item	**Japan**	**US**
Preference for the saving span consumption (α)	0.0514	0.0415
Preference for the retirement span consumption (β)	0.0065	0.0061
Preference for the whole saving span consumption ($w\alpha$)	0.8535	0.8829
Preference for the whole retirement span consumption ($v\beta$)	0.1465	0.1171

Note: substituting s_b^*, v, w, M, i, and S_I from Table 1 into equation (5): $s_b^* = v\beta M - \frac{-i(1+i)^w S_I w\alpha}{1-(1+i)^w}$

and assumption: $w\alpha + v\beta = 1$ allows to compute the above preferences.

Revealed preferences in Table 2 can be used for comparison of (i) preference at the saving span (α) and retirement span consumption (β), and (ii) preference for an American and Japanese household consumption (wα and vβ). The former compares preferences for the saving span (α) and retirement span consumptions (β) within the same country; a Japanese household preference is not compared with an American. The latter compares preferences of an American and Japanese household. Table 2 shows that both American and Japanese households have a higher preference for annual consumption in the saving span (α) than that of the retirement span (β). It seems contradict to a common knowledge that a Japanese household prefers more annual consumption in the saving span than that of the retirement span. However, a Japanese as well as American household actually consume more in each year than they save as seen in Table 1. To this extent, higher household preference to the saving span consumption than that of the retirement span is consistent with data in Table 1.

Another comparison uses preferences of the whole saving span (wα) and retirement span consumptions (vβ). Table 2 displays that an American household prefers less saving span (α) and retirement span consumptions (β) than a Japanese household. Scales for these two countries are different so that they are not comparable. Hence, the preferences of the whole span consumptions are used for a cross-country comparison. A Japanese household prefers less whole saving span consumption than an American. On the other hand, a Japanese household prefers more whole retirement span consumption than an American. This reveals that a Japanese household prefers to save more than an American household, *ceteris paribus*. This stronger Japanese preference for the retirement span consumption could be used to explain the higher annual saving, and hence, higher initial savings in Table 1.

Conclusion

In this paper, the optimal saving function is derived and validated with the household survey in Japan and the US. This optimal saving function considers the stock of saving; saving span; retirement span; interest rate; and income. The comparative statics results from the saving function could be used to predict the actual household saving. In other words, the results predict the higher annual saving for an average

Japanese household because of its higher income, longer retirement span, shorter remaining saving span, and lower interest rate than that of an American household. This prediction is compatible with the household survey data.

The household survey data also helps to estimate household preference in saving span and retirement span consumptions. In the optimal saving function, the household preference is exogenous. However, given the survey data, the preference is endogenous and can therefore be estimated. According to the estimation, the higher preference for the whole retirement span consumption could also be used to explain the household's higher annual saving in Japan.

Amongst the determinants, only data for the initial savings is not compatible with the comparative statics result. If the initial savings are considered as being accumulated annual savings, then the initial savings in the data would be endogenous. However, in the optimal saving function, the initial savings are exogenous. This problem can be resolved in two ways. One way is to obtain more detailed micro data such as that incorporating a time series for each item in Table 1. This allows the tracking of the saving behaviour over time, and hence, the correlations in the explanators could be eliminated. An alternative way is to augment the relationship between the initial savings and the other explanators through an optimisation problem which means endogenising the initial savings. This augmentation could also eliminate correlations between the initial savings and the other exogenous variables. In this case, the true "initial savings" actually means bequest. Thus, these two extensions of the framework could be areas for future research.

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