Population Aging, Intergenerational Transfers, and Saving in Japan

(Draft)

Naohiro Ogawa,
Nihon University Population Research Institute

Amonthep Chawla
Thailand Development Research Institute

Rikiya Matsukura
Nihon University Population Research Institute

Paper Submitted for the 2009
XXVI IUSSP International Population Conference
Marrakesh, Morocco, September 27-October 2, 2009

Abstract

There has been no consensus with regard to the magnitude of the impact of age structural transformations upon saving rates. Several empirical studies have found that saving rates are substantially affected as population age structures shift. Some other studies have concluded that changes in age structures generate only a minor effect on aggregate saving rates.

In our proposed paper, by applying Japanese micro-level data to the framework of the National Transfer Accounts, we analyze the nexus between population aging and saving rates. The data to be employed were collected from five rounds (1984, 1989, 1994, 1999 and 2004) of the National Survey of Family Income and Expenditure. It should be noted that during the period of 1984-2004, Japan's population aged very rapidly and its household saving rate declined to a considerable degree. Moreover, by utilizing NTA as a base for analysis, we will be able to shed light on how and to what extent changes in intergenerational transfers, coupled with population aging, influence saving behavior.

Research for this paper was funded by parallel grants awarded by UNFPA to Prof. Andrew Mason and by the MEXT "Academic Frontier Project (2006-2010)" to NUPRI

1. Introduction

Changes in population age structure influence saving rates. The conventional lifecycle saving hypothesis implies that the elderly heavily rely on dis-saving to support their consumption during retirement periods. If this model is correct, saving rates will decline as population ages. Recent econometric studies have provided evidence for this possibility. However, there are controversial and important empirical issues concerning how much change in age structure can account for a significant change in saving rates. Several empirical studies, based on the analysis of aggregate cross-national panel data, show that saving rates change substantially (i.e. Higgins and Williamson 1997; Kelly and Schmidt 1996) as population age structure changes. Other groups of studies, based on disaggregated measures of saving rates using cross-sectional family income expenditure surveys, and historical and projected population age structure conclude that change in population age structure has modest effects on aggregate saving rates (i.e. Deaton and Paxson 2000; Lee et al. 2000).

One possible resolution for this empirical controversy is to include intergenerational transfers with lifecycle saving to measure changes in saving rates due to population aging. Recent empirical studies by Mason et al. (Mason et al. forthcoming; www.ntaccounts.org) in the "National Transfer Flow Accounts" show that intergenerational transfers are substantial and important for providing support for the elderly. This paper sheds light on measuring to what extent change in age structure can account for an important change in saving rates, using the National Transfer Flow Accounts methodology.

In terms of methodology, this paper follows the lifecycle hypothesis, relying on the empirical framework developed by Deaton and Paxson (2000). This model is based on the assumption that age profiles of consumption and income are fixed for all cohorts, resulting in the fixed age profiles of saving.

We decided to use Japan as the country of our analysis because its population aging is unprecedented in terms of speed and level. A substantial decline in saving rates in Japan during the two decades or so is generally believed to be associated with population aging. There are several important studies on the effects on demographic changes on saving in Japan, for example Hayashi (1997), Horioka (1990), Takayama and Kitamura (1994) and Kitamura et al. (2000). However, none of them have taken into account comprehensive measures of intergenerational transfers to analyze the effects of population aging on saving rates. In addition, we have found that mechanisms, patterns and preferences related to transfers and asset transactions to be used for supporting the prolonged period of retirement life among the Japanese elderly have changed dramatically over the past few decades (Ogawa et al. 2009). Public pensions have increased whereas interest rates have declined considerably. The Japanese people may be less motivated to save or rely on their accumulated assets to finance their retirement.

This paper is organized as follows. In section 2, the literature on the effects of demographic changes, economic growth and transfers on saving is reviewed. Section 3 presents data used for the estimation. In section 4, saving rates are simulated based on Deaton and Paxson (2000)'s model with the application of the National Transfer Account methodology and Japanese data. Section 5 concludes the study.

2. Literature Review

There is a large body of literature that investigates the effects of population age structure on saving rates. Most studies based on the lifecycle hypothesis of saving show that changes in age structure and economic growth influences saving rates. However, few studies include intergenerational transfers with lifecycle saving to measure the effect of change in age structure on saving rates. This study includes comprehensive measures of transfers from both the family and the public sector to measure the effect of change in population age structure on saving rates.

Most studies that discuss the effects of demographic changes on saving are based on the lifecycle hypothesis of saving, developed by Modigliani and Brumberg (1954). Assuming a perfect annuity market and no bequests, individuals choose an optimal consumption path subject to the constraint that the present value of lifetime consumption cannot exceed the present value of lifetime earning and current assets. The major assumption for this model is that the shape of the lifetime path of consumption is independent of the shape of the expected path of income. Based on the lifecycle hypothesis, rational forward looking individuals will not consume more in one period than another period. Individuals' income may increase with age until individuals reach the retirement age and earn no income. Individuals save some fraction of their income when they earn more than they consume during working ages in order to dis-save when they earn no income during retirement. Thus, consumption by the elderly does not necessarily decline with income because the elderly can dis-save or run down assets to support consumption during the elderly years.

The lifecycle model predicts that both demographic and productivity growth will generate savings. There will be no net saving in the economy as a whole if there is neither of these. Given positive population growth, the young are more numerous than the old, which is why the total saving by young people offsets the total dis-saving by old people, and leads to positive net saving in the whole economy. Similarly, productivity growth allows younger workers to be richer than their elderly counterparts when they were young, leading to a larger level of saving than that in older generations. Thus, there exists positive net saving in the whole economy. Based on this prediction, population aging is likely to lower net saving because the share of the elderly, who dis-save, increases relative to working ages, who save.

There are several studies on how the lifecycle hypothesis is used to explain the effects of the change in age structure on saving. Many models are also used to predict saving rates. There are two general ways that the lifecycle model is used to study the effects of age structure on aggregate saving.

One approach is highly aggregative, using cross-national panel data, and depends on estimating a saving model that includes one or more measures of age structure. There are many examples: Leff (1969), Mason (1987, 1988), Bloom et al. (2003), Higgins and Williamson (1997) and Kelly and Schmidt (1996). Most studies find that population aging (or slow population growth) will lead to lower saving rates. A recent study by Kinugasa and Mason (2006) raises the possibility that saving rates may not decline with aging if increases in life expectancy have a sufficiently strong effect.

The second approach, and the one that is emphasized here, is more disaggregated and relies on simulation. The authors of this approach explicitly model the age profile of saving (or consumption and income). Age specific saving rates are then aggregated using a historical or projected population age structure to determine the household or national saving rates. Three different approaches are used to defining the age profile. One uses the household as the unit of analysis and constructs profiles by the age of household head (Paxson 1996; Deaton and Paxson 1997; 2000; Jappelli and Modigliani 2003; Attanasio 1998). The other approach uses the individual as the unit of analysis and constructs the age profile of the individual (Deaton and Paxson 2000; Demery and Duck 2006; Mason and Lee 2006). Further, some simulation studies have relied on consumer theory, such as the lifecycle model, to determine the age profile of saving. Cutler et al. (1990) use the Ramsey Model, while Lee et al. (2003) and Attanasio (1998) use the lifecycle model.

Even though the lifecycle hypothesis is important to describe the relationship between age structure and saving, it does not present a comprehensive view of the support systems. Apart from saving, intergenerational transfers are large and important mechanisms used to support consumption by children and the elderly. People make transfers when they are productive, and receive transfers when they earn lower or no income. Combining transfers with lifecycle saving is necessary to explain the effect of change in age structure on saving rates. Population aging leads to more burdens for the working ages to provide larger transfers to the elderly because the share of the elderly who receive transfers increases, whereas the share of working ages declines. The working ages have fewer resources available to save, resulting in a decline in saving rates. Overlooking the importance of intergenerational transfers may mislead the measurement of saving by people in different age groups and the effect of change in age structure on saving.

The contribution of this paper is to apply the methods by Deaton and Paxson (2000) with comprehensive measures of intergenerational transfers estimated using the methods of the National Transfer Flow Accounts to measure effects of change in age structure on national saving rates in Japan. One main difference between this simulation model and the one implemented by Deaton and Paxson are the ways in which the age profiles of saving are modeled. In the Deaton and Paxson model, individuals rely only on dis-saving without intergenerational transfers to support consumption during the retirement period. Age specific saving rates, measured from age profiles of consumption and income using repeated cross-sectional surveys, are fixed for all cohorts. In our model, individuals rely on both reallocations through assets and intergenerational transfers received from younger ages to support their consumption during the retirement period.

In summary, the lifecycle hypothesis is a fundamental framework to explain how changes in age structure and economic growth affect saving rates. The lifecycle hypothesis is important; however, it does not take into account intergenerational transfers. Change in age structure affects intergenerational transfers from working ages, which could affect saving rates. Thus, overlooking the importance of transfers could mislead the measurement of how change in age structure can account for change in saving rates.

3. Data

There are three sources of data used to estimate saving rates: household income and expenditure surveys, national income accounts, population projections by age. First, the household income and expenditure surveys of Japan called the National Survey on

Family Income and Expenditure (NSFIE) are used to estimate age profiles of consumption, earning, and other sources of income. There are five rounds of surveys used in this paper: 1984, 1989, 1994, 1999 and 2004. The NSFIE is undertaken by the Statistics Bureau of Japan. The survey provides information at the household level, such as household expenditures and income, and at the individual level, such as age and sex of each household member and his or her work status. There are, on average, 200,000 individuals from 60,000 households interviewed in each survey year. Data from each survey include 91 cohorts, or all individuals aged 0 to age group 90 and older. The total includes 111 cohorts (i.e. born between 1894 and 2004) who are observed for up to 21 years each (i.e. cohorts born in 1984[1] are observed until aged 20 in 2004). The data for cohorts in each survey are then pooled to estimate age and cohort effects in consumption and income. A descriptive summary of the surveys is shown in Table 1.

[1] Cohort born in 1894 is observed in the NSFIE 1984 survey at age 90.

Table 1: Summary of Mean Statistics from Surveys, Real Prices

	No. of Observations	No. of Households	Household Size (persons)	Age of Head (years)	Age of Individuals (years)	Household Consumption (Yen/Month)			Household Income (Yen/Month)		
						Education	Health	Total	Earnings	Business income	Interest, rent and dividend
1984	202,174	55,030	3.7	46.0	33.5	10,034	6,181	257,490	334,197	85,711	16,947
				(12.8)	(21.4)	(23,286.0)	(13,736.1)	(167,430.0)	(300,273.7)	(209,418.5)	(85,987.1)
1989	217,487	60,189	3.6	47.8	35.6	12,165	6,801	265,133	385,347	53,671	17,388
				(14.2)	(21.8)	(32,112.4)	(14,032.2)	(179,154.0)	(381,877.3)	(191,591.6)	(104,233.9)
1994	206,870	60,791	3.4	49.7	37.6	14,085	7,660	275,654	415,165	41,809	19,262
				(14.4)	(22.2)	(37,462.1)	(17,042.0)	(171,159.7)	(400,360.6)	(197,285.8)	(114,010.1)
1999	195,436	60,738	3.2	50.9	39.8	12,020	8,362	269,174	383,188	36,848	15,415
				(15.3)	(22.5)	(37,193.1)	(16,188.9)	(177,473.8)	(389,040.5)	(176,629.2)	(104,202.5)
2004	185,247	60,059	3.1	53.5	42.0	13,712	11,228	287,817	362,827	34,295	19,132
				(15.2)	(22.9)	(47,073.6)	(21,772.5)	(199,983.8)	(392,399.6)	(180,788.4)	(142,087.6)
Total	201,443	59,361	3.4	49.6	37.6	12,446.6	8,077.4	271,287.9	376,971.8	49,818.5	17,638.9
				(15.2)	(22.9)	(44,110.8)	(20,383.4)	(188,514)	(392,479.5)	(181,253.2)	(132,969.5)

Source: Authors' calculation based on the NSFIE 1984-2004

Second, the National Income Accounts of Japan are used to control the aggregates from the surveys as well as the aggregates from other government documents. The National Income Accounts, which are the macroeconomic depiction of the national economic activities, measures the flows of five main institutional units that are embodied in the economy, i.e. non-financial corporations, financial corporations, government units (including social security funds), non-profit institutions serving households and households. The national income of Japan is compiled by the Cabinet Office. The methodology used to compile the national account of Japan follows the System of National Accounts (SNA) 1993 (UN 1993).

Third, we use the population estimates and projections by age made by the Nihon University Population Research Institute (NUPRI). Data for population projections up to 2025 are based on the assumption that the total fertility rates (TFR) are assumed to decline from 1.29 in 2005 to 1.25 in 2025. Net international migration is assumed to be zero though out the projection period**.** Between 2005 and 2025, life expectancy at birth for men and women is assumed to increase from 80.2 and 86.6 years to 83.9 and 89.4 years respectively.

Fourth, computation strategies used to construct the National Transfer Flow Accounts for Japan are described below. There are mainly three steps required to estimate components for the National Transfer Account.

The first step is to estimate consumption by individual. Surveys and government documents do not directly report consumption at the individual level. Individual's consumption for both private and public consumption can be estimated, distinguishing education, health, and others[2]. Per capita private education consumption is estimated

2 The estimation method for consumption used in this paper is different from the one by Deaton and Paxson (2000). Deaton and Paxson estimate consumption at the individual level using a regression model

using a regression model. The household consumption of education is regressed on the number of household members in each age group enrolled in school. The coefficients from the regression equation are used as weights to allocate household education consumption to enrolled members. Similarly, per capita private health consumption is estimated by regressing household health consumption on the number of household members by five-year age groups. In addition, a dummy for individuals at age 0 is added to the health consumption equation in order to capture the characteristic of a high level of health consumption by newborns and the cost of delivery. Per capita private consumption of other goods is estimated assuming that children consume less than adults and that the consumption is allocated to individuals in the household by using an equivalence scale that gives more weight to adults than children[3]. Public education consumption is allocated to students by using age- and education-level specific enrollment rates, assuming that the cost per student varies across primary, secondary, or tertiary education levels, but does not vary by age within the education level. Age profile of public health care consumption follows the government estimates of health expenditure by five-year age groups. Other public consumption of goods and services apart from education and health are allocated on a per capita basis.

The second step is to estimate income by individual. There are labor income, asset income, net public transfers received and net private transfers received. Most of these types of income are reported directly in the FNSFIE at the household level. Income is allocated to each member whose working status is agreed to each type of income by using a regression method. Earnings and a labor share of entrepreneurial income measure labor income; property income and other non-labor income measure asset income. Based

---

by regressing household consumption on the number of individuals of each age group in the household, with age running from 0 to 99, without a constant. The coefficients from the equation measure the average consumption of people in each age group. Their method is simple; however, it does not take into account of the different types of consumption needs by people in different age groups. For example, children are usually big consumers of education, while the elderly consume health care to a greater extent. In addition, coefficients from the regression may be negative for some age groups.

[3] For more details on the estimation of private consumption of other goods and services, please refer to http://www.schemearts.com/proj/nta/web/nta/show/Documents/Flow%20Account%20Methods#H-84r1w3

on Mason et al. (forthcoming), individual members receive labor income, but only household heads receive asset income. Net public transfers received is the difference between benefits individuals receive through the government (i.e. public consumption, social security benefits and other public cash transfers) and taxes or other contributions individuals made through the government. Net private transfers received include net transfers between households (inter-household transfers) and net transfers within households (intra-household transfers). Inter-household transfers can be tabulated directly from the survey data, and they are assumed to flow between household heads. For intra-household transfers, household members who consume more than their "disposable income" receive intra-household transfers from those who consume less than their "disposable income". Disposable income is defined as labor income plus net public cash transfers (cash inflows minus tax) plus net inter-household transfers. If a household has a higher total disposable income of all members combined than the total private consumption of all members combined, the surplus is transferred to the household head and saved. On the other hand, if a household has a smaller total disposable income than the total private consumption, the household head makes additional intra-household transfers to finance this deficit by using asset income, dis-saving or by acquiring debt. Intra-household transfers to support consumption are financed by imposing a household specific flat-rate tax on each member's surplus income. Within the household, each member is taxed at the same rate. The tax rate does not vary by age. For more detailed discussion, see Mason et al. (2009) and www.ntaccounts.org for more details.

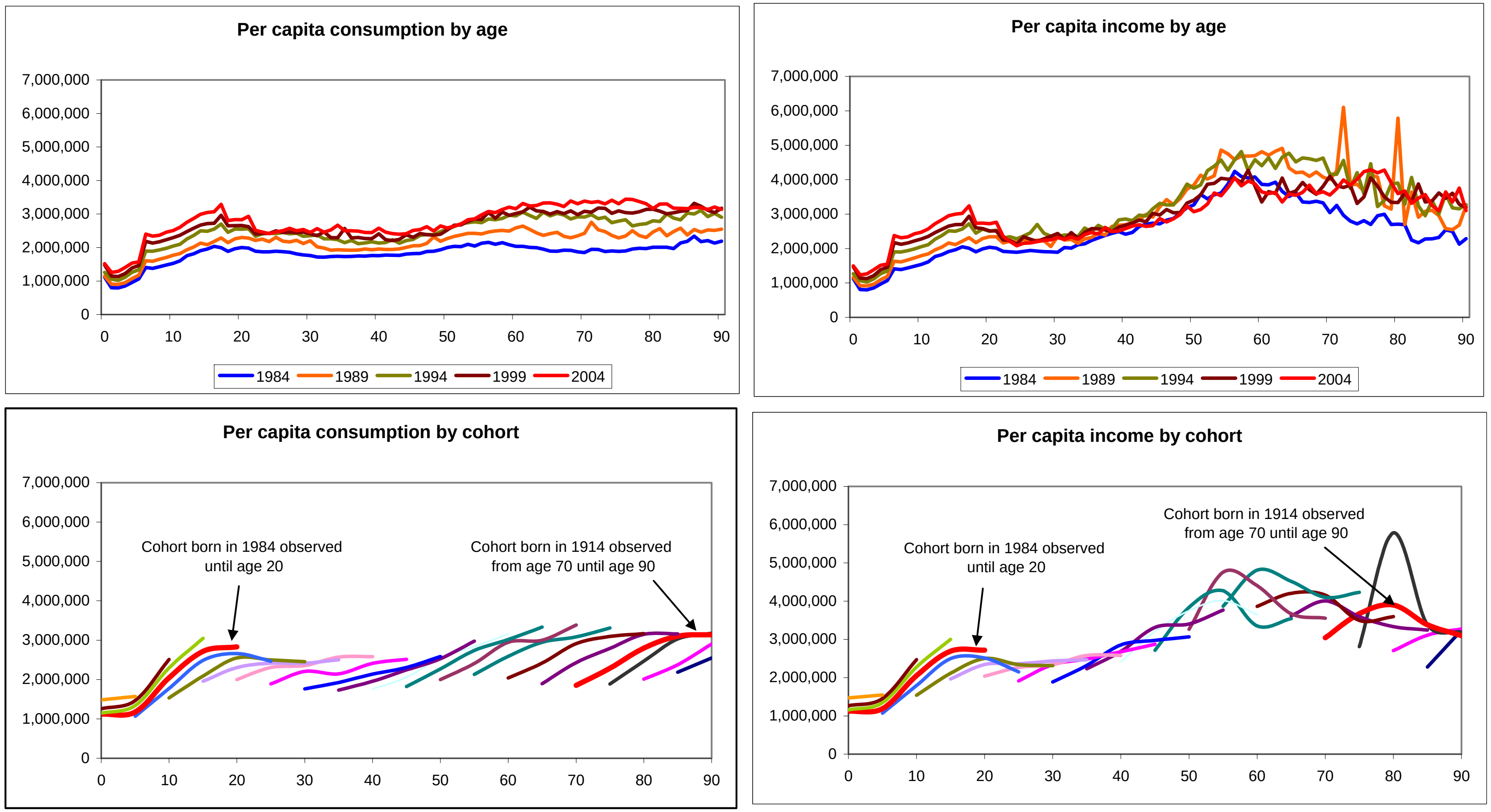
The third step is to adjust consumption and income estimated from the surveys to match with the aggregate private consumption and different sources of income reported in the national income accounts. Thus, saving rates estimated in this paper can be used for comparison with the aggregate national saving rates reported in the national income accounts.

The results shown in Figure 1 present per capita consumption and income by age and by cohort (for every fifth cohort). Please note that the income described here includes labor income, asset income and net transfers received from both the public and private sectors.

The upper panel shows cross-sectional income and consumption by age from 1984 to 2004. The shape of the cross-sectional age profiles of consumption does not change much over time, whereas the shape of the cross-section age profiles of income fluctuates around working and retirement ages. The changes in income are mainly caused by the decline in asset income after the burst of the bubble economy during the early 1990s. Children do not work or earn asset income. The major source of income for children is net private and public transfers received. Consumption by the elderly tends to be higher than that of the adults for most survey years. In contrast, cross-sectional income for most survey years shows that income increases with age during the working ages, before declining after around age 60 and over. The decline in income is mainly due to the decline in labor and asset income as these individuals are older.

The lower panel displays income and consumption by cohort. Every fifth cohort is shown. For example, the fourth line in Figure 1 is income and consumption for a cohort born in 1984 observed until age 20 in 2004; the fourth line from the right is a cohort born in 1914 observed from age 80 in 1984 until age 90 in 2004. The results show that most cohorts observed during working ages receive higher income with age. For example, real income for those born in 1949 increased at the rate of 2.6 percent per year between the ages of 35 and 55. However, as cohorts grow older, the rate of growth shrinks and eventually turns negative. There is not much difference from one cohort to another in consumption, unlike what was observed in income by cohort. Consumption by younger cohorts steeply increases with age. Consumption by older cohorts increases too, but less steeply than in younger cohorts.

Figure 1: Per Capita Consumption and Income by Age and by Cohort, Japan, Real Prices (2000 Prices)



4 Population Aging and Saving Rates

In this section, the effects of population aging on saving rates in Japan are simulated using the models developed by Deaton and Paxson (2000).

Model Specification

Saving rates can be simulated by using the age profile of income and consumption. However, age profiles of individual income and consumption cannot be simulated directly using cross-sectional surveys if age effects are confounded with cohort effects. For example, older people come from an earlier cohort, which may have different experiences and resources. Given continual technological progress, older cohorts are life-cycle poorer than younger cohorts. Thus, it is important to distinguish age and cohort effects in consumption and income in order to measure saving rates.

Consumption over the lifecycle, for any individual i born at date b and observed at age a (i.e., at date $b+a$), follows an age profile of consumption $f_i(a)$, *age effect*, and lifetime resources W_{ib}, *cohort effect*. The shape of the age profile of consumption is fixed for all cohorts, assuming there are no changes in tastes or in incentives to postpone consumption. The level of the age profile is set by lifetime resources. Thus, consumption c_{iab} is given by

$$c_{iab} = f_i(a)W_{ib}, \qquad 1$$

Then, the logarithm of consumption can be expressed as the sum of an age profile and a fixed lifetime wealth component:

$$\ln(c_{iab}) = \ln f_i(a) + \ln(W_{ib}). \qquad 2$$

There are no panel data for Japan that can track individual consumption trajectory overtime to measure age and cohort effects. Repeated cross-sectional surveys can be used to measure consumption by cohort. Some individuals may be observed only once in a survey; however, a sample from the same birth cohort is observed in a later survey. Thus, consumption can be tracked based on a representative sample of individuals of the same cohort. This can be done by taking averages of equation 2 across all individuals of the same cohort at the same age. In that case, equation 2 can be displayed as:

$$\overline{\ln c_{ab}} = \overline{\ln f(a)} + \overline{\ln W_b}, \qquad 3$$

where the lines over the variables denote means. For example, for a birth cohort born in 1950 observed at age 40 in 1990, the average logarithm of consumption is the sum of the age effect (that of age 40) and a cohort effect (that of persons born in 1950). Equation 3 can be obtained by regressing the average of the logarithm of consumption for those born in b and observed in $b+a$ on a set of age and cohort dummies[4], i.e.,

$$\overline{\ln c} = D^a \beta_c + D^c \gamma_c + u_c, \qquad 4$$

where $\overline{\ln c}$ is a stacked vector of log consumption with elements corresponding to each cohort in each year, D^a is a matrix of age dummy and D^c is a matrix of cohort dummy. The coefficients β_c and γ_c are the age effects and the cohort effects in consumption, and u_c is sampling error.

Similarly, income profiles retain a characteristic profile that does not change shape across cohorts and they are determined by lifetime resources. Taking averages of the logarithm of income can be decomposed into age and cohort effects, i.e.,

$$\overline{\ln y} = D^a \beta_y + D^c \gamma_y + u_y, \qquad 5$$

where β_y and γ_y are the age effects and the cohort effects in income, and u_y is sampling error.

If consumption is close to income, the ratio of saving to income is approximately equal to the difference between Equation 5 and Equation 4. Then, saving ratio can be decomposed into age and cohort effects, i.e.,

$$s/y \approx \overline{\ln y} - \overline{\ln c} = D^a(\beta_y - \beta_c) + D^c\left(\gamma_y - \gamma_c\right) + (u_y - u_c) \qquad 6$$

[4] The regression includes a constant term and drops one age and one cohort. Year effects are included in the regression model. However, year effects require some adjustment to avoid the multicolinearity problem with age and cohort. The adjustment method follows Deaton (1997) by restricting the year effects to zero sum and the orthogonal to time trend.

Assuming bequests are zero or an unchanging fraction of lifetime wealth, the level of the saving will be the same for all cohorts. In addition, the lifecycle hypothesis assumes that the lifetime consumption exhausts lifetime resources[5], thus the cohort effects in income and consumption will be the same. Consequently, equation 6 will have only age effects, which can be rewritten as:

$$s/y \approx D^{a}(\beta_{y}-\beta_{c})+(u_{y}-u_{c}) \qquad 7$$

Saving rates from the lifecycle hypothesis are estimated by dividing total saving, the difference between total income and total consumption, by total income. Total income is the sum of the product of population by age and the exponential of the age effects of income by age. Similarly, total consumption is the sum of the product of population by age and the exponential of the age effects of consumption by age. Consequently, the aggregate saving ratios in any given year can be calculated as:

$$\frac{s}{y}=\frac{\sum_{a}\eta_{at}(1+g)^{-a}[\exp(\beta_{ay})-\exp(\beta_{ac})]}{\sum_{a}\eta_{at}(1+g)^{-a}\exp(\beta_{ay})}, \qquad 8$$

where *s* and *y* are aggregate saving and aggregate income, η_{at} is the number of people aged *a* at time *t*, β_{ay} and β_{ac} are respectively the age effects in the logarithm income and consumption profiles, *g* is the growth rate of per capita income.

Empirical Results

Age effects of consumption and income are shown in Figure 2. We restrict cohort effects of consumption and income to be identical so that we can capture only the age effect that has implications on how population age structure change affects income and consumption and thus saving.

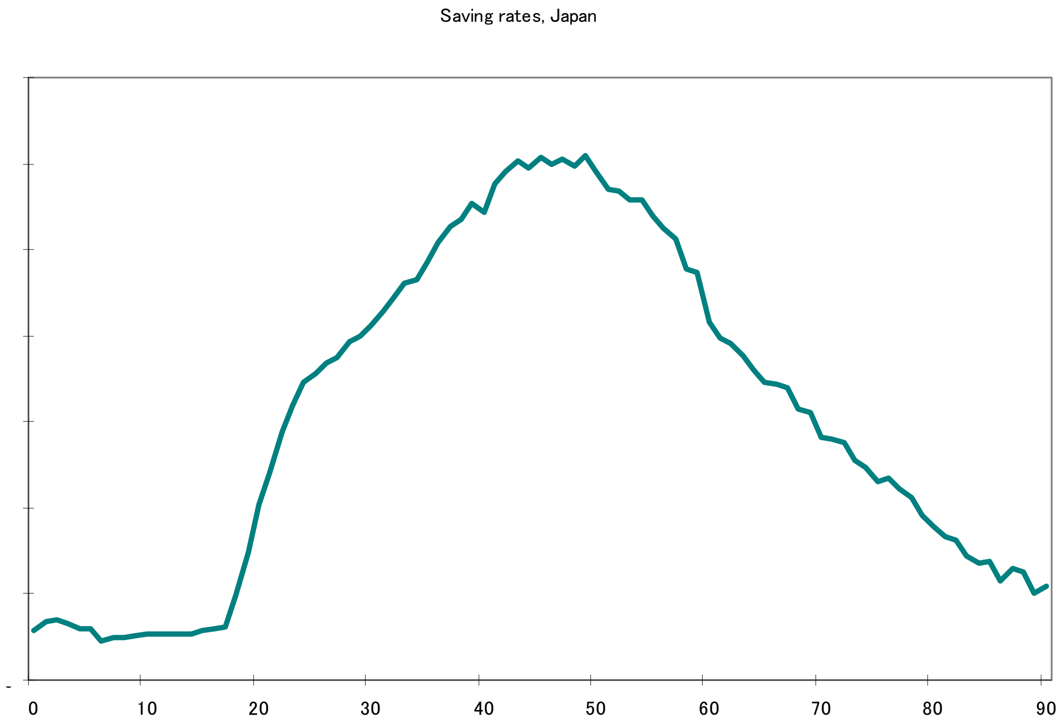
[5] However, at any period, consumption may not equal income. Borrowing and lending make up the difference between consumption and income at any period, assuming that capital markets are sufficiently developed to allow people to borrow against future income.

Age effects of consumption in Japan continuously increase with age. That consumption is growing is inconsistent with the prediction by the lifecycle hypothesis. Attanasio and Weber (1995) found, using the household model, that consumption by the age of the househould head can be hump shaped because of changes in the household composition. However, in the individual model, age effects of consumption are assumed to be flat in the lifecycle hypothesis. There are important studies that explain the age effects of consumption. For example, Carroll (1994) and Deaton (1992) explain that consumption follows income because of precautionary saving incentive and liquidity constraint.

That consumption among older ages increases more steeply than income is also interesting. An increase in consumption by the elderly could be covered by the income of others, not their own, because of intergenerational transfers, which is supported by Mason and Lee (2006). The results of downward sloping cohort effects and upward sloping age effects of logarithm income and logarithm consumption are similar to what Paxson (1996) found for Thailand using the ages of household heads instead of individuals.

The lower panel shows that the age profile of saving has a hump shape, suggesting an important relationship between age structure and saving rates. The results indicate that people save more as they grow older until they reach the peak around age 50. There are no findings regarding dis-saving by the elderly in Japan. The finding here, therefore, contradicts the lifecycle hypothesis.

Figure 2: Age Effects, Log Income, Log Consumption and Saving Rates, Japan



Finally, the effects of demographic changes on aggregate saving rates can be simulated using the age distribution of population in Japan from 1950 to 2005. Consumption and income at each age for each cohort is the product of lifetime wealth of cohort members and the exponents of the age effects in Figure 2. The cohort-specific lifetime wealth terms are assumed to grow from year to year at a constant rate of 2.0 percent, which is close to the average economic growth rate of Japan during 1984-2004, the period of the surveys used in the simulation. The estimation results show how age structure affects saving rates. It should be noted that the analysis does not explain how saving rates change due to short-term fluctuations, such as income shocks during the lost decade in the 1990s.

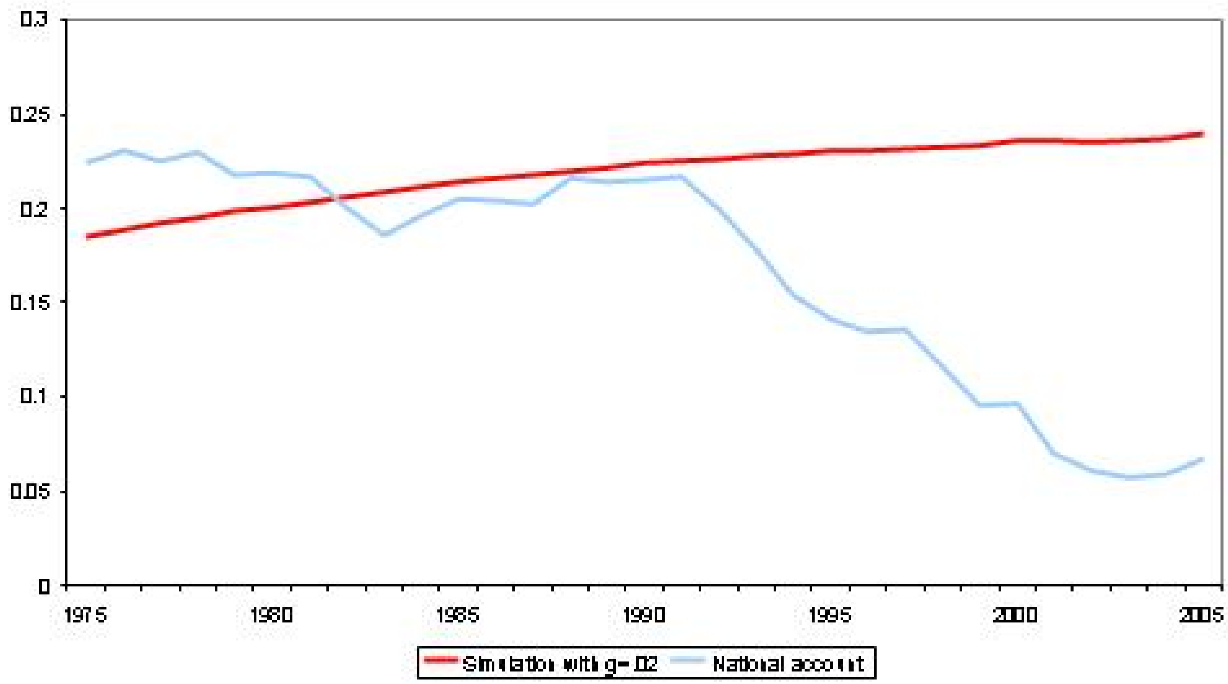
Figure 3 shows the predicted saving rates[6] and actual national saving rates. The simulated saving rates averaged at around 23 percent of national income during 1955-1990. There was an increase in saving rates because of a smaller share of consumption by children due to lower child dependency rates during 1955-1970, which left larger resources for saving. However, saving rates declined after 1970, which could be accounted for by various reasons. One of them could be an increase in the cost of children, such as education and health expenditure, which occurred despite an overall decline in the number of children.

Our calculations show that if the lifecycle hypothesis is applicable to data set at hand, the lifecycle model could explain the increase in saving rates in Japan during the 1980s. The simulated results fit the actual saving rates, which show that there was no secular trend during the period. However, it may not be able to explain the decline in saving rates after 1990. There is a study showing that the decline in saving rates during the 1990s is caused by the burst of the bubble economy. This paper shows that the large increase in saving observed in Japan, or many other East Asian countries, may not be caused by change in

[6] Coefficients of income and consumption estimated from the regression are adjusted to match with the aggregate control for income and consumption in the year 2000. This is implemented by adjusting the intercept to allow the sum of the product between the exponential of the coefficients (average of the logarithm of consumption and income) and population by age to equal aggregate consumption and income reported in the national income accounts.

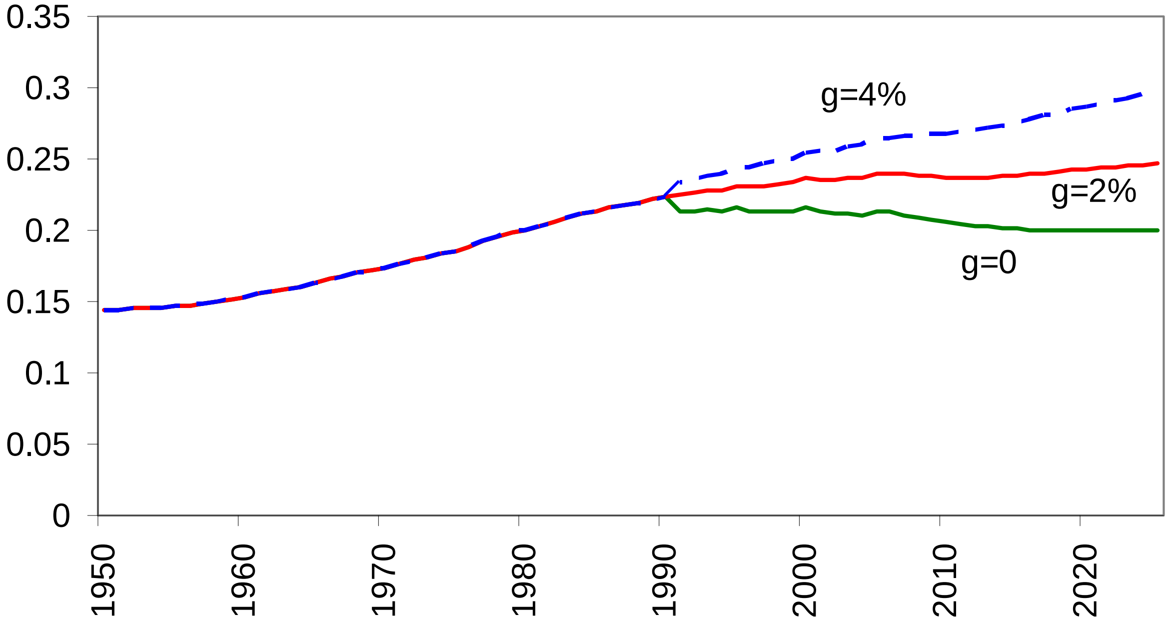
age structure as argued by Higgins and Williamson (1997) and Kelly and Schmidt (1996). In contrast, the lifecycle hypothesis as implemented by Deaton and Paxson, showed that change in saving rates was not mainly due to change in age structure or economic growth, but due to a secular trend. In addition, the results that change in saving rates is not mainly due to change in age structure as described by the lifecycle hypothesis are consistent with what Deaton and Paxson (2000) found for Taiwan.

Figure 3: Saving Rates, Japan



Saving rates of Japan can be forecast using NUPRI population projections and the age effects of consumption and income shown in Figure 2. The results of future saving rates vary depending on different assumptions about the per capita income growth. Each cohort is assumed to obtain new wealth effects due to a change in per capita income growth from 2 percent to other levels in the year 2000. It is also assumed that everyone will know immediately that the change is permanent. Figure 4 presents the changes in saving rates when per capita income growth rates are 0 percent, 2 percent and 4 percent. The results show that saving rates will increase for a short period of time. An increase in saving rates could be due to an increase in the share of the working ages as predicted by the lifecycle hypothesis. After increasing for a short period, saving rates are expected to decline. The decline in saving rates is predicted to be rapid in case of slow economic growth, as slow growth provides older ages with relatively more lifetime wealth than younger ages. Thus, slow economic growth will increase the share of dis-saving by elderly relatives to saving by working ages. On the other hand, if Japan can maintain a high economic growth rate, population aging is not likely to affect its saving rates at a substantial extent.

Figure 4: Saving Rate Projections with Different Growth Rates, Japan



5. Conclusions

Population aging leads to a decline in saving rates. However, the effects of population aging on saving rates are not so severe. Based on the simulation model implemented by Deaton and Paxson (2000), we assumed that the age profiles of saving are fixed for all cohorts. We proceeded to decompose savings in terms of age and cohort effects. We found that age effects of saving in Japan show a hump shape, i.e., that people save less during young working ages than old working ages. Also, saving rates can be simulated by using population estimates and projections. By taking such approach, we obtained results between 1975 to the mid 1980s that saving rates remain at relatively high level, which corresponds to the period when the fertility rates in Japan declined and the share of the working ages increased. Although Japan's national saving rates declined in the subsequent two decades, simulated saving rates show an upward trend. We also conclude that the change in simulated saving rates depends on the economic growth of Japan. Saving rates may decline more rapidly in case the economic growth is slow.

REFERENCES

Attanasio, O. P. (1998). "A Cohort Analysis of Saving Behavior by US Households." Journal of Human Resources **33**(3): 575-609.

Attanasio, O. P. and G. Weber (1995). "Is Consumption Growth Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey." The Journal of Political Economy **103**(6): 11221-1157.

Bloom, D. E., D. Canning, et al. (2003). "Longevity and Life-cycle Savings." The Scandinavian Journal of Economics **105**(3): 319-338.

Carroll, C. D. (1994). "How Does Future Income Affect Current Consumption?" The Quarterly Journal of Economics **109**(1): 111-147.

Cutler, D. M., J. M. Poterba, et al. (1990). "An Aging Society: Opportunity or Challenge?". Brookings Papers on Economic Activity **1990**(1): 1-73.

Deaton, A. (1992). Understanding Consumption. Oxford, Clarendon Press.

Deaton, A. (1997). The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. Baltimore and London, World Bank.

Deaton, A. and C. Paxson (2000). "Growth, Demographic Structure, and National Saving in Taiwan." Population and Development Review **26**(Supplement: Population and Economic Change in East Asia): 141-173.

Higgins, M. and J. G. Williamson (1997). "Age Structure Dynamics in Asia and Dependence on Foreign Capital." Population and Development Review **23**(2): 261-93.

Jappelli, T. and F. Modigliani (2003). "The Age-Saving Profile and the Life-Cycle Hypothesis." Center for Studies in Economics and Finance **Working Paper Number 9**.

Kelley, A. C. and R. M. Schmidt (1996). "Saving, Dependency and Development." Journal of Population Economics **9**(4): 365-86.

Kinugasa, T. and A. Mason (2006). "Why Nations Become Wealthy: The Effects of Adult Longevity on Saving." World Development.

Lee, R. D. (2003). "The Demographic Transition: Three Centuries of Fundamental Change." Journal of Economic Perspectives **17**(4): 167-190.

Lee, R. D., A. Mason, et al. (2000). "Life Cycle Saving and the Demographic Transition: The Case of Taiwan." Population and Development Review **26**(Supplement: Population and Economic Change in East Asia): 194-219.

Leff, N. H. (1969). "Dependency Rates and Savings Rates." American Economic Review **59**(5): 886-896.

Mason, A. (1987). National Saving Rates and Population Growth: A New Model and New Evidence. Population growth and economic development: Issues and evidence. D. G. Johnson and R. D. Lee. Madison, Wis., University of Wisconsin Press. **Social Demography Series:** 523-60.

Mason, A. (1988). "Saving, Economic Growth, and Demographic Change." Population and Development Review **14**(1): 113-44.

Mason, A. and R. Lee (2006). "Transfers, Capital, and Consumption over the Demographic Transition." NTA Working Papers, Number 06-01.

Mason, A., R. Lee, et al. (2009, forthcoming). Population Aging and Intergenerational Transfers: Introducing Age into National Accounts. Economics of Aging Series. D. Wise. Chicago, NBER and University of Chicago Press.

Modigiani, F. and R. Brumberg (1954). Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data. Post Keynesian Economics. K. K. Kurihara, Rutgers University Press**:** 388-436.

Paxson, C. (1996). "Saving and growth: Evidence from micro data." European Economic Review **40**: 255-288.

United Nations (1993). Systems of National Accounts 1993. New York, United Nations publication.