The Japanese Saving Rate between 1960-2000: Productivity, Policy Changes, and Demographics

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Abstract

In this paper, we use an overlapping generations model to study the factors generating the saving rate in Japan between 1960-2000. The model economy allows for observed aging of the population, total factor productivity, and fiscal policy to affect the national saving rate. Our calibrated general equilibrium setup is able to generate saving rates that are reasonably similar to the data during this period. We conduct counterfactual experiments to isolate the quantitative impact of the changes in demographics, social security benefits, and total factor productivity growth on saving behavior. Our results indicate that changes in the TFP growth rate are the main reason for the observed saving rates in Japan.

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1 Introduction

The Japanese saving rate has declined from an average of 20% in the 1960s to about 5% in the late 1990s with significant fluctuations in between. During the same time perioud, there have been considerable changes in demographics, fiscal policy and total factor productivity (TFP) growth rates in Japan. For example, lifetime expectancy increased from 71 to 79 and the population growth rate declined from almost 5% to zero between 1960 and 2000. In addition, the social security replacement rate which was about 17% until the early 1970s increased to about 40% after late 1970s. There has also been a gradual increase in the capital income tax rate and a decline in the TFP growth rate in the same period. This paper examines the quantitative impact of these changes on the Japanese saving rate between 1960-2000.

Given the demographic changes taking place in many countries, the impact of aging on the saving rate has been a focus of several papers. For example, Ando and Moro (1995) examine the period 1985-2090 in Japan under different fertility assumptions and conclude that the saving to income ratio will initially increase slightly due to the declining fertility rate and then decrease as the proportion of older individuals in the population go up. Braun, Ikeda, and Joines (2004) find that the combined effects of demographics and slower total factor productivity growth in Japan can explain the declines in the saving rate between 1990-2000. Gokhale, Kotlikoff and Sabelhaus (1996) examine the decline in the U.S. saving rates since the postwar and argue that the growth in Social Security, Medicare, and Medicaid benefits was responsible for the decline which redistributed resources from young generations with low consumption propensities toward older generations with high consumption propensities. Summers and Carroll (1987) suggest that younger cohorts in the U.S. are saving too little due to expected social security benefits. Chen, İmrohoroğlu and İmrohoroğlu (2005) report that the secular movements in the Japanese saving rate can be accounted for by the changes in the TFP growth rate reasonably well. However, their model abstracts from the impact of demographics or the social security programs.

In this paper, we use a calibrated general equilibrium model populated with overlapping generations of households to explore the role of the aging of the Japanese population in affecting the net national saving rate between 1960 and 2000. Our setup incorporates potentially important public institutions such as social security that can address the change in the size of the retirement benefits over time, as well as actual the time paths of Japanese TFP and government fiscal policy instruments. [1]

Our model consists of overlapping generations of 65-period lived individuals facing mortality risk and borrowing constraints. Private annuity markets and credit markets are closed

[1] Our approach follows the recent work that uses general equilibrium models to address short run issues, pioneered by Ohanian (1997) and Kehoe and Prescott (2002). Related work includes Cooley and Ohanian (1997), Cole and Ohanian (2002, 2004), and all the papers in the 2002 special issue of *Reivew of Economic Dynamics,* entitled 'Great Depressions of the 20th Century'.

by assumption. Until the mandatory retirement age, agents in this economy work an exogenously given number of hours and accumulate assets to provide for old age. After retirement agents receive social security benefits that are financed by a payroll tax. The return on asset holdings and the wage rate are determined by the profit maximizing behavior of a firm with a constant returns to scale technology. We specify the optimization problem of the individual as a finite state, finite horizon dynamic program and use numerical methods to solve the dynamic programs and to characterize equilibria. We calibrate the model to Japanese data for the 1960-2000 period. We conduct deterministic simulations to quantify the effects of changes in the social security system, demographics, and the growth rate of TFP on the saving rate. The benchmark simulation takes the actual capital stock in 1960 as the initial condition and uses the time series path of the observed social security replacement rate, population growth rate, and survival probabilities while keeping the tax rates on labor and capital as well as the deprecation rate equal to their long-run averages. We carry out counterfactual experiments to assess the relative contributions of all these factors. Our results indicate that the annual movements and the secular decline in the saving rate between 1960 and 2000 are mostly due to the observed path of the TFP growth rate in this time period.

The paper is organized as follows. Section 2 presents the model. Data and calibration issues are discussed in Section 3, and the quantitative findings are presented in Section 4. Concluding remarks are given in Section 5.

2 An Overlapping Generations Model

2.1 The Environment and Demographics

At each date $s = 0, 1, \ldots$, a new generation of individuals is born. We denote the growth rate of newborn individuals from time $s-1$ to time s by η_s. They face long but random lives, work until the mandatory retirement age of j_R, and might live through maximum possible age J. Life-span uncertainty is described by $\psi_{j,s}$, the conditional survival probability that an individual of age-j at time s survives to age $j+1$ at time $s+1$. We assume $\psi_{J,s} = 0$ for all $s \geq 0$.

Let $N_{j,s}$ denote the measure of age-j individuals at time s. The law of motion for $N_{j,s}$ is given by:

$$\begin{aligned} N_{1,s+1} &= N_{1,s}\left(1+\eta_s\right), \\ N_{j+1,s+1} &= N_{j,s}\psi_{j,s}, \qquad j = 2,3,\ldots,J,\ s \geq 0. \end{aligned}$$

As a result, the cohort shares of age-j individuals at time s, $\{\mu_{j,s}\}_{j=1}^{J}$, are computed as

$$\mu_{j,s} = \frac{N_{j,s}}{\sum_{i=1}^{J} N_{i,s}}, \tag{1}$$

where $\sum_{i=1}^{J} N_{i,s} = N_s$ is the population size at time s.

In an economy with stationary demographic structure, the cohort shares, $\{\mu_j\}_{j=1}^{J}$, are given by

$$\mu_j = \frac{\psi_{j-1}}{(1+\eta)}\mu_{j-1}, \text{ where } \sum_{j=1}^{J} \mu_j = 1. \tag{2}$$

2.2 Technology

There is a representative firm with access to a constant returns to scale Cobb-Douglas production function with deterministic total factor productivity A_s:

$$Y_s = A_s K_s^{\alpha} {H_s}^{1-\alpha}, \tag{3}$$

where K_s and H_s are aggregate capital and labor inputs at time t, respectively, and α is capital's output share. TFP grows at the rate ${g_s}^{1/(1-\alpha)} > 0$. We assume that $H_s = \bar{h}N_s$.

The aggregate capital stock evolves according to the law of motion:

$$K_{s+1} = (1-\delta_s)K_s + X_s,$$

where X_s is aggregate gross investment and δ_s is the rate of depreciation of capital at time s.

The stand-in firm rents capital and hires labor from the households in competitive spot markets at the rates r_s and w_s, respectively, and maximizes its profits. This yields the condition that factor prices equal their marginal productivities:

$$\begin{aligned} r_s &= \alpha A_s \left(\frac{K_s}{H_s}\right)^{\alpha-1}, \\ w_s &= (1-\alpha) A_s \left(\frac{K_s}{H_s}\right)^{\alpha}. \end{aligned} \tag{4}$$

2.3 Households

A household who is i years old at time t solves the following problem:

$$\max \sum_{j=i}^{J} \beta^{j-i} \left[\prod_{k=i}^{j} \psi_{k,t-i+k}\right] u(c_{j,s})$$

subject to a sequence of budget constraints over the remaining lifetime:

$$(1+\tau_c)c_{j,s} + a_{j+1,s+1} = R_s a_{j,s} + (1-\tau_{h,s}-\tau_{n,s})w_s\varepsilon_j h + b_{j,s} + \ell_s, \tag{5}$$

where β is the subjective discount factor, $c_{j,s}$ is consumption of an age-j individual at time $s = t+j-i$. Asset holdings at the beginning of age j at time s are given by $a_{j,s}$. They earn the gross interest rate (net of taxes and depreciation) $R_s = [1 + (1 - \tau_{a,s})(r_s - \delta_s)]$. The tax rates on consumption, capital income, and labor income are denoted by τ_c, $\tau_{a,s}$, and $\tau_{h,s}$, respectively. $b_{j,s}$ denotes social security benefits received by an age-j individual at time s, to be described later, and $\tau_{n,s}$ is the payroll tax for social security at time s. Benefits $b_{j,s}$ are a fraction θ_s of average lifetime earnings. Each individual receives a lump-sum amount ℓ_s which is the sum of a government transfer (to clear its budget) and the redistribution of accidental bequests. Note that we allow for some of the tax rates and the rate of depreciation δ_s to vary over time. We also assume that there is no borrowing:

$$a_{j,s} \geq 0, \quad \text{all} \quad j, s, \tag{6}$$

with $a_{1,s} = a_{J,s} = 0$ for all s. Note that we have a representative individual for each cohort. Furthermore, we do not allow for annuity markets.[2]

The above notation allows for some transitional generations that will have to re-solve their remaining lifetime optimization problem in response to a changes in their environment, starting from an initial balanced growth path or given initial conditions. For a newborn at time t, the objective function simplifies to

$$\sum_{j=1}^{J} \beta^{j-1} \left[\prod_{k=1}^{j} \psi_{k,t+k-1} \right] u(c_{j,s}), \tag{7}$$

and $s = t + j - 1$.

We use recursive tools to solve the individual's perfect foresight decision problem. Let $V_{j,s}(a_{j,s})$ denote the value function of an age-j individual at time $s = t + j - 1$. We compute the value functions for $j = 1, 2, \ldots, J$, and $s = 0, 1, \ldots,$ using

$$V_{j,s}(a_{j,s}) = \max_{\{c_{j,s}, a_{j+1,s+1}\}} \left\{ u(c_{j,s}) + \beta \psi_{j,s} V_{j+1,s+1}(a_{j+1,s+1}) \right\} \tag{8}$$

subject to (5) and (6).

2.4 Social Security

Social security benefits are given by

$$b_{j,s} = \begin{cases} 0 & \text{for } j = 1, 2, ..., \; j_R - 1, \\ b_{j_R, t+j_R-i} & \text{for } j = j_R, j_R + 1, \ldots, J. \end{cases}$$

The pension received by a new retiree at time $t + j_R - i$ is calculated as

$$b_{j_R, t+j_R-i} = \theta_s \frac{1}{j_R - 1} \sum_{j=1}^{j_R - 1} w_{t+j-i} h \varepsilon_j (1+g)^{j_R - j},$$

[2] The lack of annuity markets can explain the hump-shape in the age-consumption profile over the life cycle. See for example Hansen and İmrohoroğlu (2004).

where θ_s is the replacement rate. Note that the retirement benefit received by an individual is constant throughout the individual's lifetime. However, successive cohorts receive successively larger benefits reflecting the rate of TFP growth.

We assume that the system is unfunded so that the payroll tax is selected to equate the total benefits to total taxes collected for each time period. Total benefits paid at time $s = t + j_R - i$ are equal to $\sum_{j=j_R}^{J} \mu_{j,s} b_{j,t+j_R-i} = b_{j_R,t+j_R-i} \sum_{j=j_R}^{J} \mu_{j,s}(1+g)^{j_R-j}$. The social security tax rate, τ_s, is given by

$$\tau_s = \frac{b_{j_R,t+j_R-i} \sum_{j=j_R}^{J} \mu_{j,s}(1+g)^{j_R-j}}{w_{t+j_R-i} h \sum_{j=1}^{j_R-1} \mu_{j,s}\varepsilon_j}. \tag{9}$$

2.5 Government

In addition to the unfunded social security system, the government needs to finance its per capita purchases G_s by taxing consumption, labor and capital income, and confiscating unintended bequests. We require period-by-period budget balance which necessitates a (per capita) lump-sum transfer ℓ_s.

$$\tau_c \sum_{j=1}^{J} \mu_{j,s} c_{j,s} + \tau_{h,s} \sum_{j=1}^{J} \mu_{j,s} w_s \varepsilon_j h + \tau_{a,s} \sum_{j=1}^{J} \mu_{j,s}(r_s - \delta_s) a_{j,s} + \sum_{j=1}^{J-1} (1-\psi_{j,s}) a_{j+1,s} \mu_{j,s} N_{s-1}/N_s = G_s + \ell_s. \tag{10}$$

2.6 Aggregation

Aggregate variables are computed in the usual way by obtaining the weighted average of different cohorts' decision rules, using the population weights determined by our demographic assumptions. For example, (per capita) aggregate capital and labor inputs are given by:

$$\begin{aligned} K_s/N_s &= \sum_{j=1}^{J} \mu_{j,s} a_{j,s}. \\ H_s/N_s &= \sum_{j=1}^{J} \mu_{j,s} \varepsilon_j h. \end{aligned}$$

2.7 Recursive Competitive Equilibrium

A *government policy* consists of $\{G_s, \tau_c, \tau_{a,s}, \tau_{h,s}, \tau_{n,s}, \theta_s, \ell_s\}_{s=s_1}^{s_2}$, where s_1 and s_2 are some initial and final dates. An *allocation* is given by a sequence of decision rules $\{A_{j+1,s+1}(a), C_{j,s}(a)\}_{j=1}^{J}$ over $[s_1, s_2]$. A *price system* is a sequence of pairs $\{w_s, r_s\}_{s=s_1}^{s_2}$. For a given government policy, a *Recursive Competitive Equilibrium* is an *allocation* and *price system* such that

- the allocation solves the dynamic program (8) for all individuals, given the price system and government policy,
- the allocation maximizes firms' profit by satisfying (4),
- the allocation and government policy satisfy the government's budget constraint (10) given the price system,
- the social security system is unfunded, that is (9) satisfied, and,
- the commodity market clears

$$C_s + X_s + G_s = Y_s.$$

3 Data and Calibration

We calibrate the model (both for steady state calculations and the 1960-2000 period) to the Japanese economy using data provided by Hayashi and Prescott (2003). The capital share parameter, α is set to its average value over this period. The subjective discount factor is set to 0.999 which results in a capital output ratio of 2 at the final steady state. The period utility function is given by

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

with risk aversion parameter $\sigma = 1.5$.

For the steady state calculations we set the values for the share of government purchases, G_s/Y_s, the depreciation rate δ_s, tax rates on capital income, $\tau_{a,s}$, labor income, $\tau_{h,s}$, and consumption, τ_c, equal to their long-run averages. We set the growth rate of TFP to 2%, which is the long run average of Japanese TFP growth rate between 1960 and 2000.

The maximum number of model periods that an agent is alive is 65 and households retire at period $j_R = 45$. This maps into an economy in which individuals enter employment at age 21 and retire at age 65, with the maximum age 85. The growth rate of the population, n_s, at the final steady state is set to 0.6%, which is roughly the average growth rate of age 21 individuals between 1960 and 2000. The survival probabilities $\{\psi_i\}_{i=1}^{65}$ at the final steady state is taken to be the average of the age specific survival probabilities 1990 and 2000, which are described below.

In order to explore the impact of demographic transition on the saving rate, we need to specify the whole sequence of fertility rates, η_s, and survival probabilities $\{\psi_{i,s}\}_{i=1}^{65}$ along the transition path, together with the initial cohort shares at 1960, $\{\mu_{j,1960}\}_{j=1}^{65}$. We use the actual data to compute the initial cohort share at 1960, the fertility rates between 1960 and 2000 and the survival probabilities between 1976-2000. We linearly interpolate the age specific survival probabilities for years between 1960 and 1975, based on the corresponding data for 1960, 1965, 1970 and 1975.[3] After 2001, we assume that the age specific survival probabilities are fixed at their average values during 1990 - 2000 period. We assume that the fertility rates rise to their steady state value in 60 years, and remain at this value thereafter.

Since our main question is to examine the determinants of the saving rate in Japan between 1960-2000, our simulations take the actual capital output ratio in 1960 as the initial condition, which is 1.12. We use the data for the actual time path of TFP growth, depreciation rate, δ_s, share of government purchases, G_s/Y_s, and the tax rate on capital income, $\tau_{a,s}$ during this time period for our benchmark experiment.[4] We approximate the replacement rate for social security from Oshio and Yashiro (1997) who indicate that it was equal to 17% for 1961-1973, 35% between 1974-1979 and 40% afterwards. We assume that the steady state is reached in one hundred and twenty five years.

Table 1 summarizes the steady state calibration:

Table 1: Steady State

α	capital share	0.363
β	discount factor	0.999
σ	risk aversion	1.5
n	growth rate of pop.	0.006
g	TFP growth rate	0.02
G_s/Y_s	share of government	0.14
τ_h	labor income tax rate	0.107
τ_c	consumption tax rate	0.056
τ_a	capital income tax rate	0.35

[3] Following Braun, Ikeda, and Joines (2004), the initial cohort shares are computed using (1), and the fertility rate η_s is computed as

$$\eta_s = \frac{N_{1,s+1} - N_{1,s}}{N_{1,s}}.$$

Finally, we compute the survival probabilities $\{\psi_{j,s}\}_{j=1}^{J}$ $s = 1976, ..., 2000$ according to

$$\psi_{j,s} = 1 - death_{j,s}/N_{j,s}.$$

The data source for age specific population size $\{N_{j,s}\}_{j=1}^{J}$ is the *Annual Report on Current Population Estimates* by the Statistics Bureau of the Ministry of Internal Affairs and Communication. Age specific death numbers between 1976 and 2000 are taken from the Vital Statistics by the Ministry of Health, Labor and Welfare. Various Life Tables in Japan provide the death numbers in five-age interval for year 1960, 1965, 1970 and 1975. We use these data and the method of cubic spline to interpolate the age specific survival probabilities, assuming the survival probability of the middle age in each age interval is equal to the average survival probability of that age interval.

[4] The tax rates are obtained from Mendoza, Razin, and Tesar (1994) and cover the period 1965-1996. We have assumed the 1960-1964 period tax rate on capital income to equal its value in 1965 and 1997-2000 tax rates to equal the value in 1996.

4 Results

We start this section by discussing certain properties of the benchmark calibration. Later we conduct several counterfactual experiments to examine the importance of several factors including the role of the changes in demographics versus the growth rate of TFP in explaining the secular movements in the saving rate.

4.0.1 Properties of the Model Economy

Figure 1 presents the saving rate generated by the benchmark calibration of the model economy, and the data. Notice that the model economy generates a saving rate that is very close to the data. The model is able to capture the main fluctuations as well as the secular decline that took place in the saving rate in this time period. The main discrepancy between the model and the data occurs in late 1970s and early 1980s where the model predicted saving rates are higher than the data.

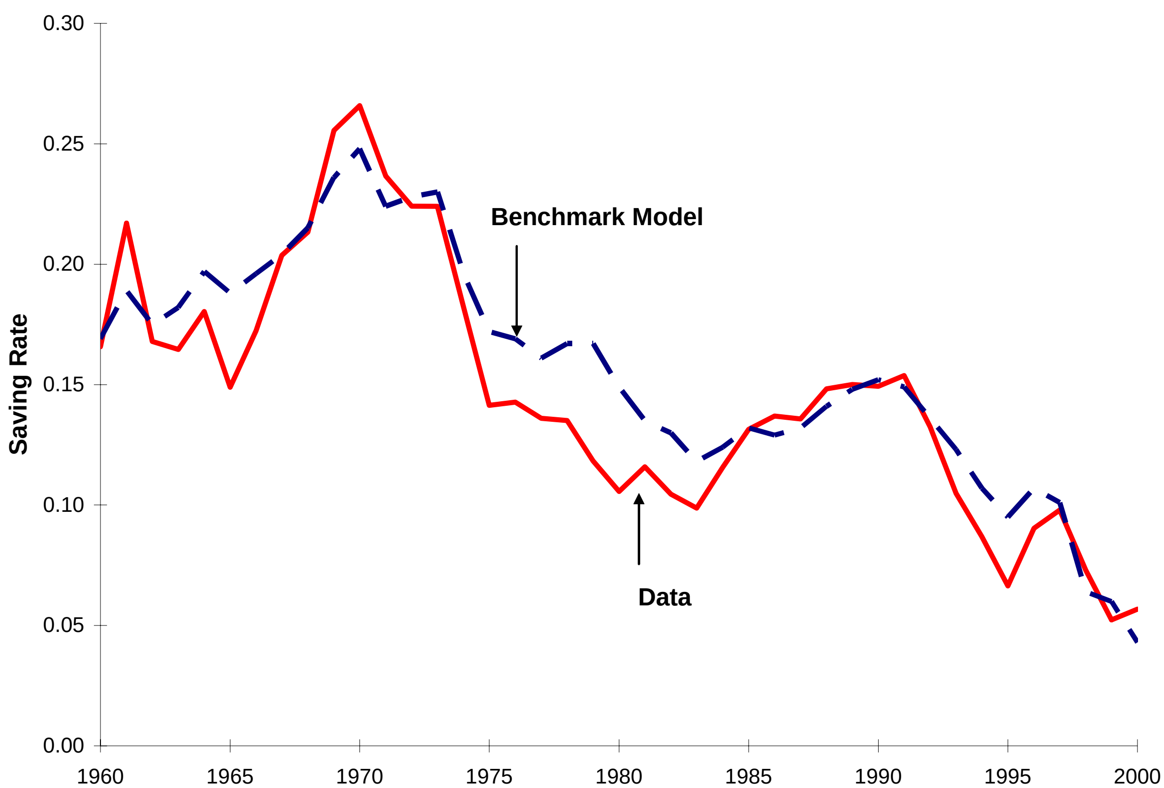

Figure 1: The Japanese Saving Rate: Data and the Model

In Figure 2 we display the after tax net real return to capital that is generated by the model. We compare that series to the after tax real interest rate (net of depreciation) from the data. The model generates high interest rates until mid-1970s after which there is a general decline.

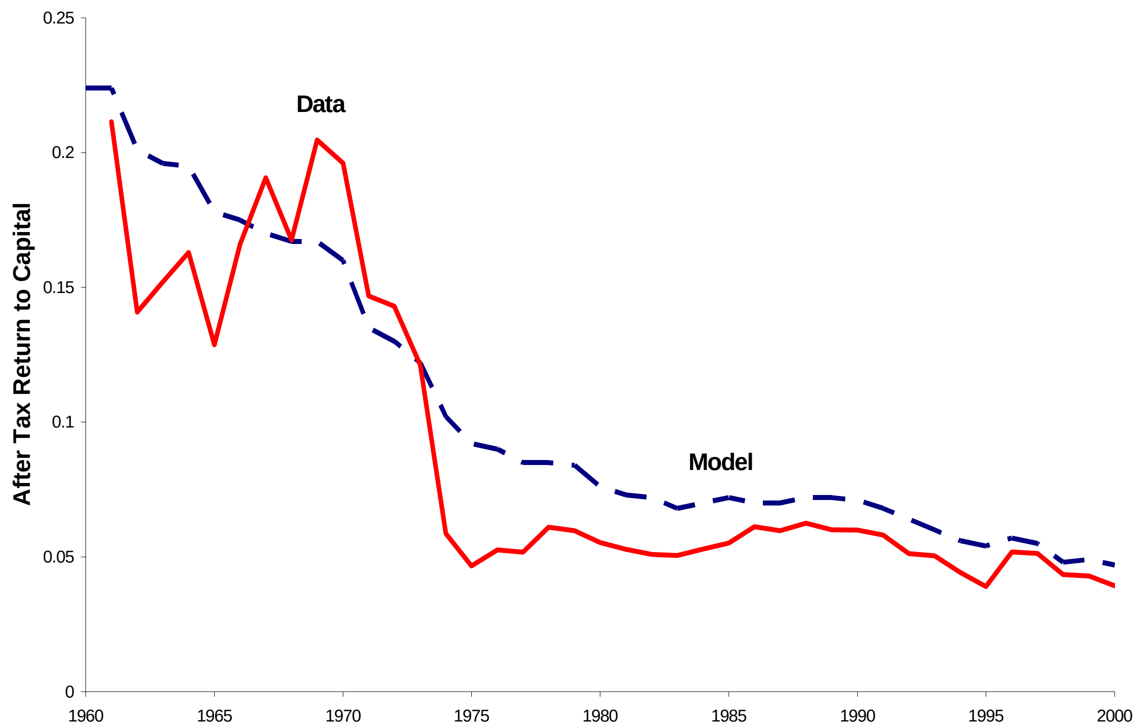

Figure 2: Additional Properties

As explained in the calibration section, the benchmark economy uses time series data for the changes in demographics, TFP growth and social security replacement rates. In Japan both of the components of demographics, the survival probabilities and the population growth rate have been changing significantly in this time period. The lifetime expectancy in Japan increased from 71 to 79 and the fertility rate declined from 0.139 to -0.01 between 1960 and 2000. In Figure 3 we display the changes in the age shares of the population that is implied by the survival probabilities and the fertility rates that we have used in the model. In particular, we graph the fraction of the population that is in four age groups, 21-35, 36-50, 51-63, and 64+ between 1960-2050. We can observe that in this time period the share of the age 21-35 group is declining and the share of 64 and older generation is increasing significantly. In fact, if these demographic trends continue, the share of the 64+ age group is expected to be higher than the 21-35 age group after 2010.

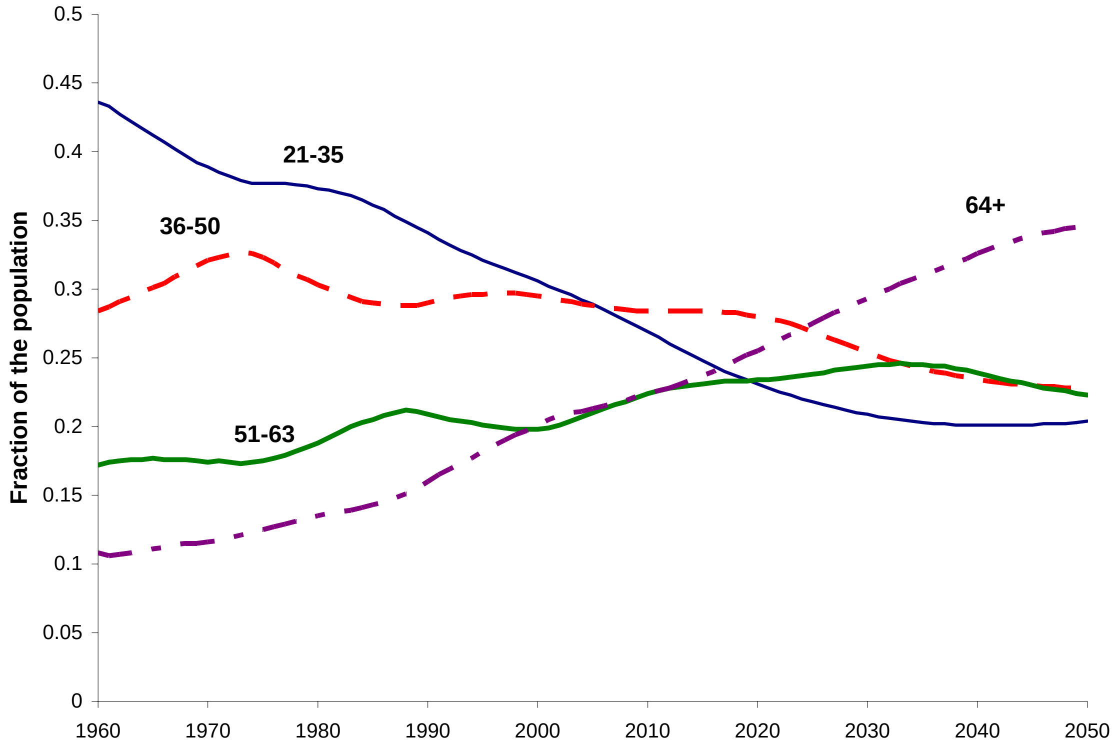

Figure 3: Population Shares

Changes in the population growth rate and survival probabilities affect the aggregate saving rate through two channels: the composition of the population and the individual saving rates. In Figure 4 we display the saving rates as a percent of disposable income for these age groups in 1985, 1990, 1995, and 2000 that are generated by our model economy. The age groups that constitute the majority of the savings in this framework are the 35-50 and 51-63 year olds. Our simulations report a decline in the saving rates of all the age groups in this time period. These findings are consistent with the results obtained by Boswoth, Burtless and Sabelhaus (1991) who provide data for household saving rates grouped by the age of the household in Japan for early 1970s, early 1980s and late 1980s. Their results indicate that there has been a secular decline in saving rates of all age groups in Japan.

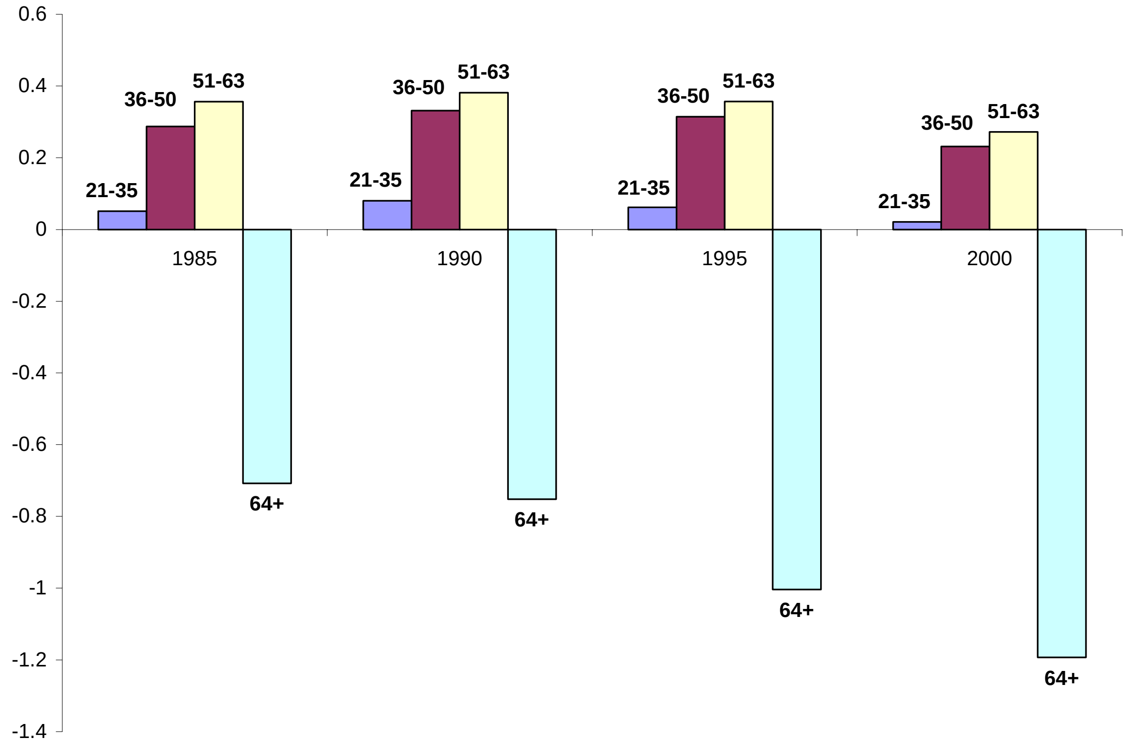

Figure 4: Saving Rates

Similar observation can be made in Figure 5 which displays the cross sectional saving rates by age where all age groups in 2000 have lower saving rates compared to earlier years.

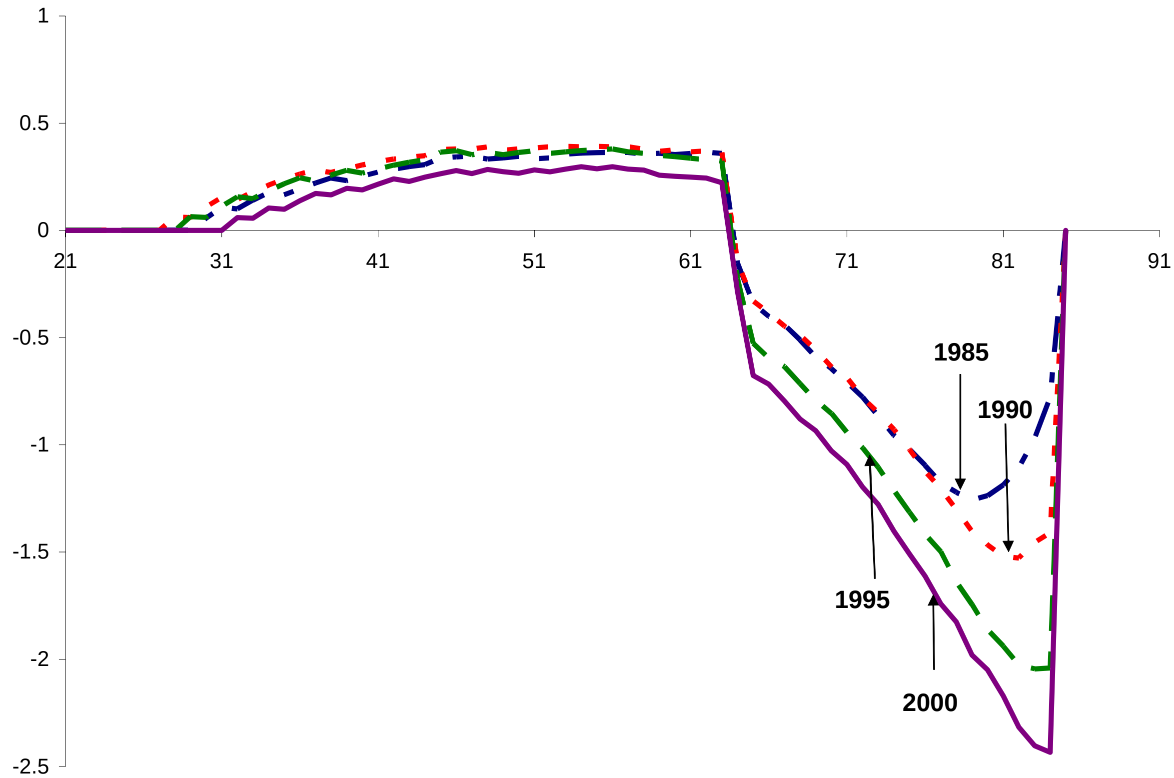

Figure 5: Cross Sectional Saving Rates

Ando and Moro (1995) provide detailed data for different demographic groups in Japan in 1985. The categories include families, single male head of households (HH) and single males. In our framework, while we calibrate to the properties of the entire economy, the agents act as if they do not have families. Consequently, it may be best to compare the model generated saving rates for different age groups to the data for taking into account all the three categories. For example, since our OLG model does not have intentional bequests, individual above 60 dissave sufficiently fast to exhaust all their savings by the terminal age. In the Ando and Moro (1995) data provided in Table 2, while families and heads of households display positive saving rates, single males do not seem to save after age 70. Up to the age 60, the model generated saving rate looks more similar to the saving rate data reported for single male head of the household.

Table 2: Saving Rates for Demographic Groups

	1985 Data			Model
	Families	Single Male HH	Single Males	
≤ 29	0.041	-0.061	0.218	0.000
30-39	0.108	0.144	0.370	0.163
40-49	0.119	0.194	0.415	0.312
50-59	0.136	0.225	0.421	0.354
60-69	0.176	0.248	0.303	-0.100
≥ 70	0.194	0.137	0.005	-0.938

4.0.2 Counterfactual Experiments

Survival Probabilities: In Figure 6, we examine the impact of the changes in the survival probabilities alone by generating saving rates under two different vectors of survival probabilities. The series labeled 'benchmark' uses the actual survival probabilities that are observed in Japan in this time period. The series labeled 'stationary survival probabilities' assumes that the survival probabilities that were present in the 1960-1969 period had remained constant. In other words, this experiment demonstrates the impact of the increase in the survival probabilities on the saving rates in Japan. With longer expected lifetime in the benchmark calibration households save more to insure against living longer that expected. This effect causes the saving rate for the benchmark case to be higher than the saving rate with constant survival probabilities all through this time period. In the early 1960s the differences are small since both series are generated using very similar survival probabilities. However, the differences are as high as 3 percentage points in the 1970s and 1980s.[5]

[5] We have assumed the same steady state survival probablilites, which are practically zero, in generating both of these series in order to be able to isolate the impact of the changes in the survival probabilities during the 1960-2000 period. That is why the two series converge to each other at the end of the period.

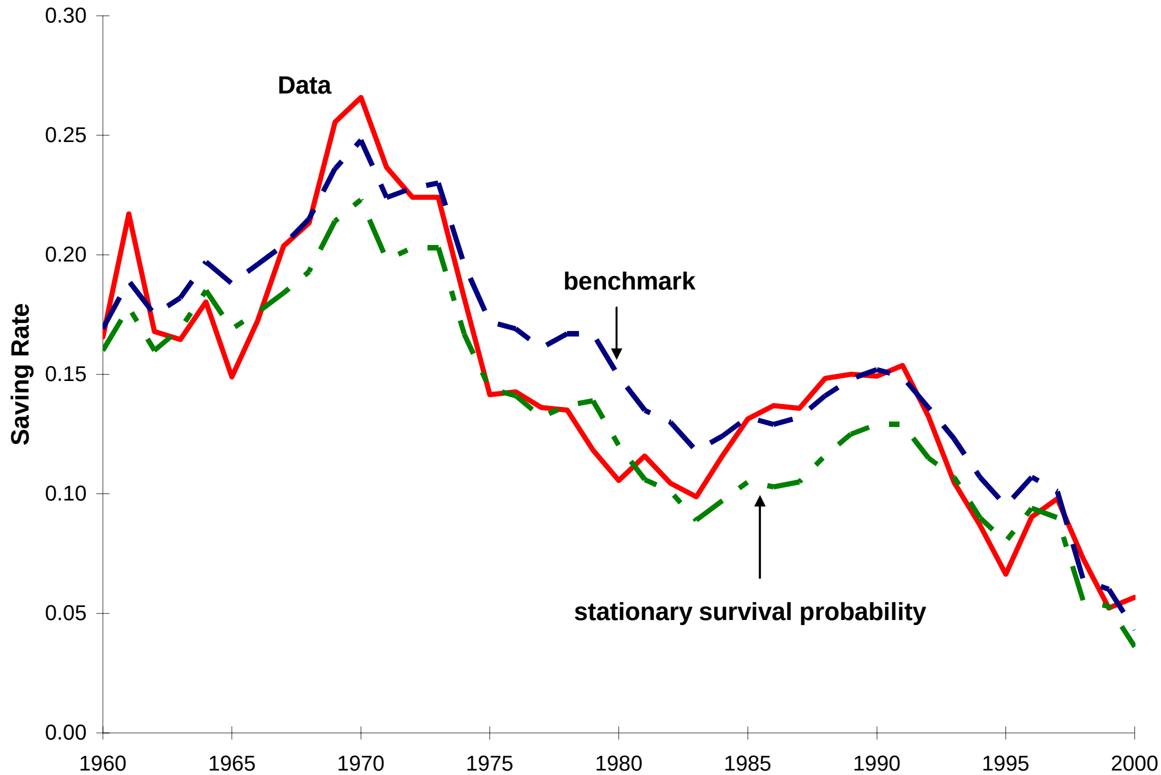

Figure 6: Role of Survival Probabilities

Population Growth Rate: In order to isolate the effect of the decrease in the population growth rate on the saving rate we compare the saving rate in the benchmark model (where the population growth rate is taken from the Japanese data which has been experiencing a decline starting in the 1980s) to the one generated under the assumption of a constant population growth rate of 2%, which is labeled 'constant population growth' in Figure 7. Declining population growth present in the benchmark case results in lower saving rates of 1 to 2 percentage points between 1990 and 2000. Before 1990s the effects are not significant.

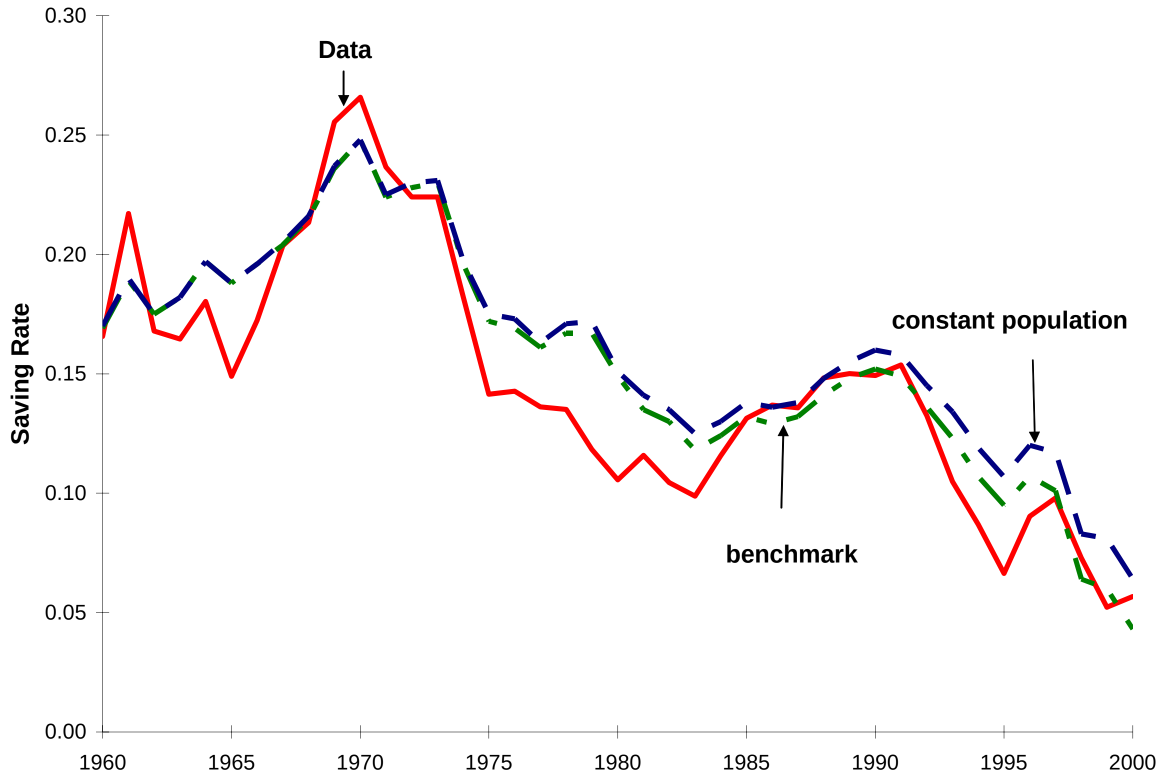

Figure 7: Role of Population Growth

Social Security Payments: Another change that happens in Japan during this time period is the increase in the generosity of the social security program. In particular, the social security replacement rate which is 17% until 1973 increases to 35% between 1974-1979 and to 40% after 1979. In Figure 8 we examine the impact of this change on the savings rate. The series labeled 'const SS Tax' displays the saving rate that results in an economy with the average social security replacement rate of 17% whereas the series labeled 'benchmark' feeds in the actual replacement rates. The increase that took place in the generosity of social security benefits results in lower saving rates of 1.3 to 0.5 percentage points in this time period.

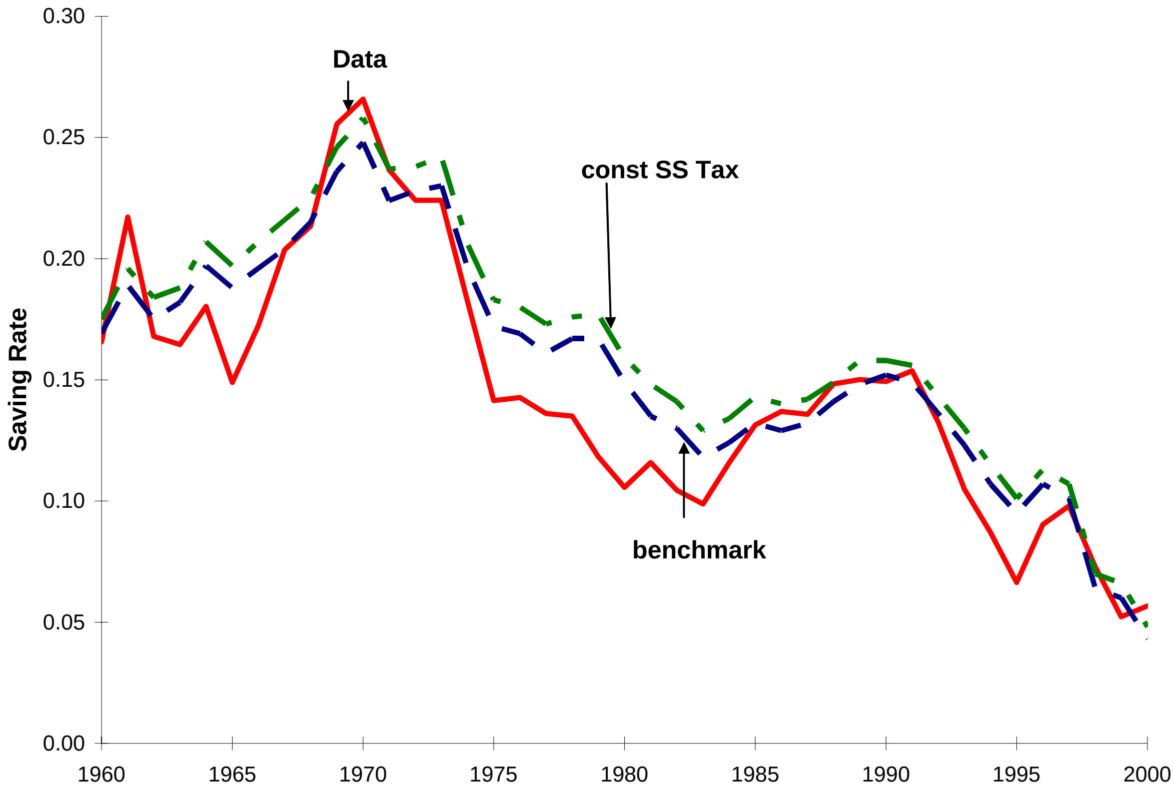

Figure 8: Role of Social Security

TFP Growth versus Demographics: In Figure 9 we compare the saving rate generated by our benchmark economy to the saving rate generated by the model where the only time series data that is used is the growth rate of TFP, labeled 'TFP growth only'. The results indicate that the growth rate of TFP is able to capture the fluctuations in the saving rate that occurred in this time period reasonably well.[6] The difference between the two simulated series demonstrates the impact of demographics and the social security benefits. The mean absolute percentage error between the data and the saving rate displayed in 'TFP growth only' is 12%. In other words, TFP growth rate alone is able to account for about 88% of the Japanese saving rate. Adding the demographic features to the model reduces the mean absolute percentage error between the data and the benchmark model to 11%. Overall, we conclude that the TFP growth rate is the major factor behind the fluctuations observed in the Japanese saving rate between 1960-2000.

[6]Indeed we find similar results in Chen, İmrohoroğlu, İmrohoroğlu (2005) which uses a one sector Neoclassical growth model that does not have the demographic or institutional richness of an overlapping generations model.

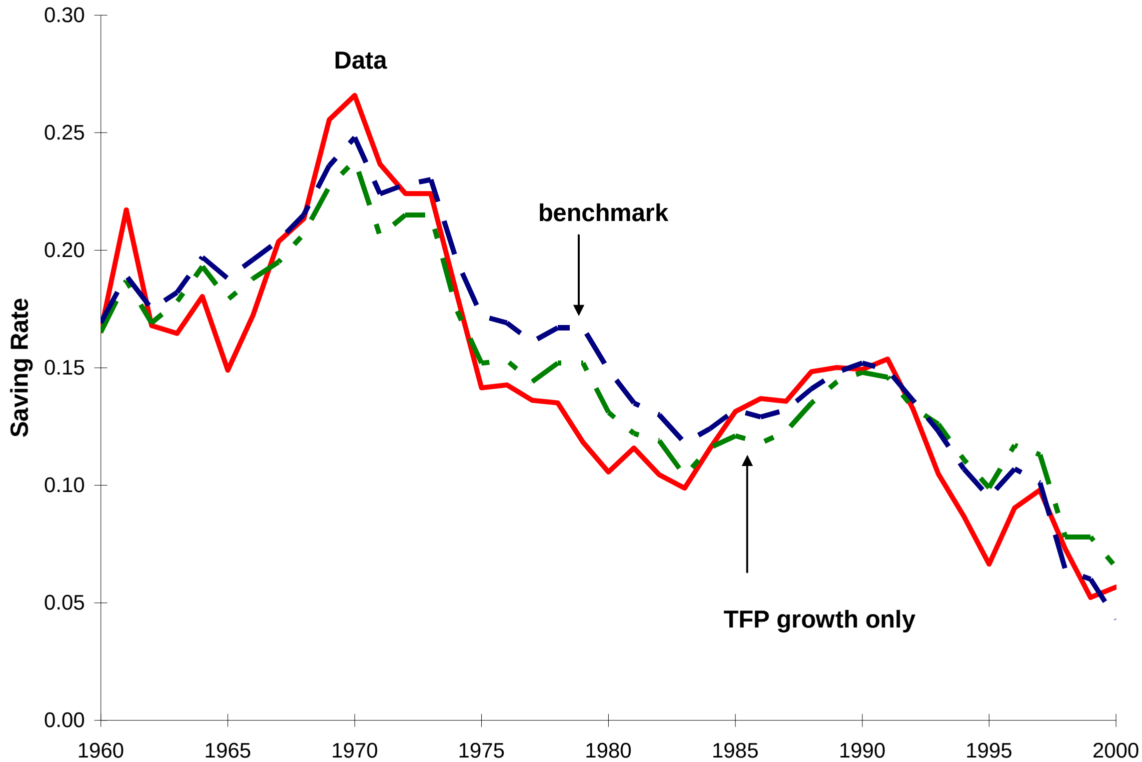

Figure 9: Role of TFP Growth Versus Demographics

Taxes and Depreciation: In the benchmark economy, tax rates and the deprecation rate were calibrated to their long run averages. However, in this time period there were significant changes in some of these variables. For example, the deprecation rate declined from an average of 16% in the 1960s to 8% in the 1990s. Tax rate on capital income, on the other hand, has increased from an average of 20% in the 1960s to 43% in the 1990s. In Figure 10 we compare the saving rates generated in the benchmark economy with constant depreciation and tax rates to the saving rates generated in a model where the entire time path of the deprecation and the capital income tax rates are fed into the model (labeled 'all series'). These variables do not seem to play a major role in this framework.

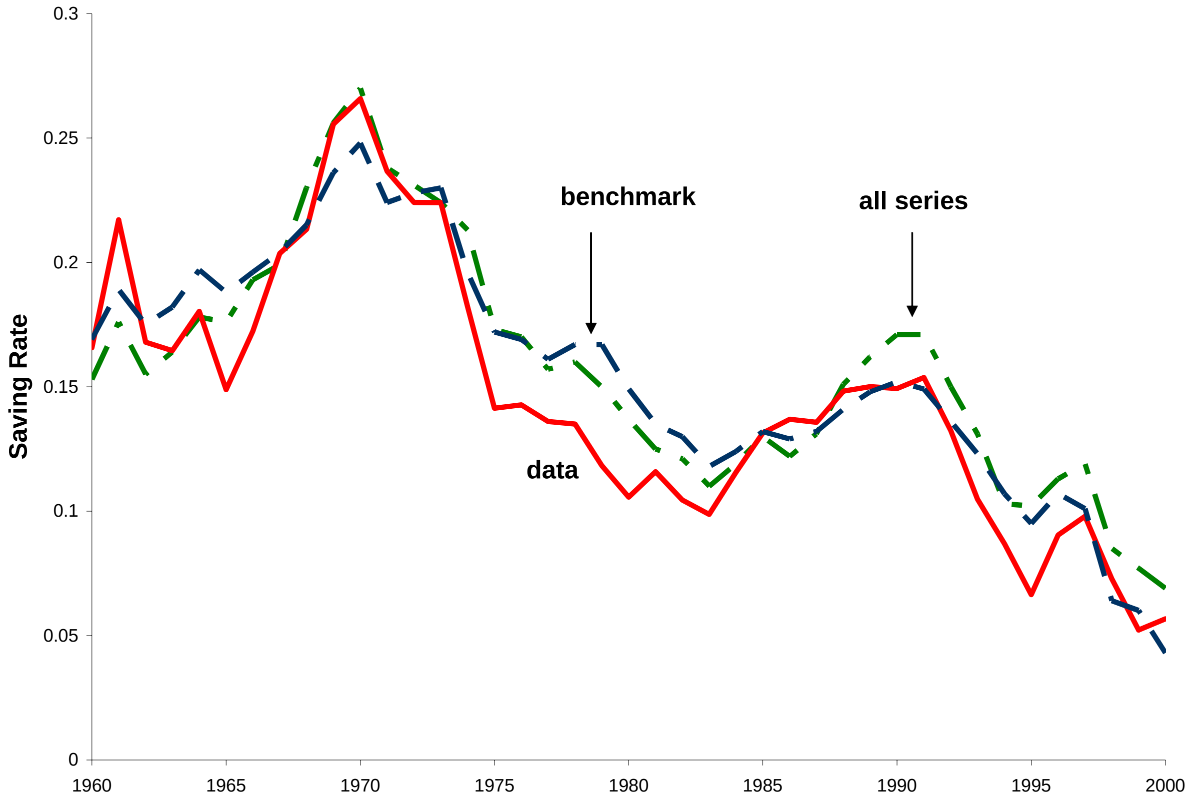

Figure 10: Role of Taxes and Depreciation

5 Conclusions

In this paper we examine the time path of the saving rate generated by an overlapping generations model that is calibrated to the Japanese economy for the 1960-2000 time period. Our model is populated by 65 period lived individuals who face borrowing constraints. We start the simulations at an initial time period that mimics the economic conditions in Japan in 1960. In our benchmark experiment, we feed in the observed paths of the TFP growth rate, social security replacement rate, population growth rate, and the time-varying survival probabilities in Japan in this period. We find that the benchmark economy is capable of generating saving rates that resemble the data. Next, we conduct counterfactual experiments to isolate the impact of several factors such as the social security system, demographics, and total factor productivity growth on the saving behavior. Our results suggest that the growth rate of TFP may be the most important factor in generating the secular movements in the Japanese saving rate in this time period.

6 References

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