NBER WORKING PAPER SERIES

JAPAN'S SAVING RATE: NEW DATA AND REFLECTIONS

Fumio Hayashi

Working Paper No. 3205

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1989

This paper was prepared for presentation at the Giorgio Rota Conference on household saving and wealth held in Torino, Italy, on 18 November, 1989. The author is grateful to Professor Kanemi Ban of Osaka University for consultations. This paper is part of NBER's research program in Productivity. Any opinions expressed are those of the author not those of the National Bureau of Economic Research.

NBER Working Paper #3205
December 1989

JAPAN'S SAVING RATE: NEW DATA AND REFLECTIONS

ABSTRACT

This paper examines available evidence on Japan's wealth accumulation. Time-series evidence over the last one hundred years indicates that the phenomenon of extraordinarily high Japanese saving rate is limited to the high-growth era of 1965-1975. Micro evidence about consumption and saving by age can be more easily explained by the dynasty model than by the life-cycle hypothesis. The infinite horizon neoclassical growth model, while capable of generating the hump in the saving rate and explaining why it was preceded by the rapid GNP growth in the post-war period, leaves unanswered the question of why wealth accumulation in pre-war Japan was so slow. Perhaps growth in pre-war Japan was hampered by harmful effects of misguided government policies.

Fumio Hayashi
Department of Economics
University of Pennsylvania
Philadelphia, PA 19104

1. Introduction and Summary

There is a strong perception that the Japanese outsave Europeans and North Americans by a wide margin. I wish to make two points in this paper. First, in the last one hundred years of Japanese economic history, the phenomenon of high saving is limited to the high growth era of the 1960s and early 70s. Second, the standard neoclassical growth model explains Japan's rapid post-war wealth accumulation reasonably well.

This first point, while possibly controversial, is what emerges from my examination of available data on Japan's aggregate saving in section 2. For the post-war period, Japan's saving rate appears very high, especially compared to the U.S. However, much of the gap is a statistical illusion due to differences in the way national income statistics are compiled. If one calculates Japan's national saving rate as percent of NNP using the U.S. definition that excludes government capital and values depreciation at replacement cost, the adjusted national saving rate for Japan gets much lower. It shows a quite rapid decline after the 1970 peak of about 26%. Newly available national accounts data for the period since 1955 indicate (after the depreciation adjustment) that Japan's national saving rate between 1955 and 1965 was nowhere near the 1970 peak. The national saving rate for the pre-war period was even lower than that. The long term economic statistics that cover the period between 1885 and 1940 indicate the pre-war national saving rate was between 5% and 10%.

My claim that except for its large hump in the 1960s and early 1970s Japan's saving rate is not extraordinarily high by international standards is fully reflected in Japan's national wealth over the last 100 years. Japan's national wealth before World War II had a time trend with a growth

rate of only about 3% per annum. Of course much of the wealth was destroyed during the war. The extent of wartime destruction is hard to estimate, but there is no question that the rapid wealth accumulation associated with the extraordinarily high national saving between 1965 and 1975 has put Japan's national wealth well above the pre-war trend line.

The analysis of the data in section 2 naturally leads one to ask the following two "big" questions about Japan's economic development over the last one hundred years. First, why was Japan's post-war wealth accumulation so rapid, especially between 1965 and 1975? Second, why didn't the rapid growth take place before the war?

Economics offers two competing explanations. The life-cycle hypothesis views the national economy as consisting of overlapping generations. The alternative theory, the dynasty model, posits that each generation is linked to the next by altruism so that all generations act as if they form a single immortal dynasty. Section 3 examines cohort data to see which theory is closer to the truth. For the U.S., recent empirical work seems to support the life-cycle hypothesis. The elderly in the U.S. hold typically very low assets with their consumption financed mainly by pension benefits. The kind of inter-dependence between parents and their adult children that is predicted by the dynasty model cannot be found in available micro data on income and saving. For Japan, the dynasty model fares better. The elderly do not seem to run down assets after retirement. Calendar time rather than age seems to be the dominant determinant of household saving. Despite the rapid productivity growth, consumption by the old today is as high as consumption by the young whose lifetime income is several times that of the old today.

Section 4 then utilizes the standard neoclassical growth model -- a version of the dynasty model -- to answer the two questions about Japan's economic development. The first question is relatively easy to deal with. To converge to the equilibrium growth path from the low capital stock, Japan had to grow rapidly at some stage during the transition phase. It cannot be immediately after the war because people were too poor to save. It takes a number of years to set up the stage where the rapid growth can be sparked. Recent work shows that it is in fact possible to construct a simple theoretical growth model that generates the hump-shaped saving rate. This answer makes the second question even harder. Why didn't the rapid growth take place before World War II? I do not have too much to say about this. Perhaps it is the bad government. Japan's pre-war economic history is a history of the government taking up ever-larger share of resources. Very often, as too many less developed countries have witnessed, big governments are impediments to growth.

The last section, section 5, contains brief concluding remarks and conjectures about the future of Japan's economic development.

2. Macro Evidence

2.1. Post-War Evidence

At first glance, Japan's postwar saving rate is extraordinary. The national accounts data indicate that in 1987 Japan's national saving rate is more than 20% while the U.S. rate is below 5%. However, as I argued in Hayashi (1986, 1989), much of the apparent gap is a statistical illusion. Two of the most important differences in the way Japan and the U.S. compile their national income statistics are (1) depreciation accounting, and (2)

treatment of government capital formation.

It is perhaps useful to remember that saving as usually defined is net saving, which equals gross saving minus depreciation. Depreciation should be valued at replacement costs, that is, the correct measure of loss of value due to depreciation is how much it costs to replace worn out assets at current market prices. In the Japanese national accounts, depreciation is at book or acquisition value, which in an inflationary environment is much less than depreciation at replacement costs. This leads to a significant over-statement of net saving. According to my calculation, the discrepancy between depreciation at replacement costs and depreciation at book value on private depreciable assets is as much as several percent of GNP (it is about 5% of GNP for 1980). My procedure for estimating the replacement cost depreciation is merely to infer the Japanese government's estimate that is implicit in the national accounts, which include a section on balance sheets by sector at replacement costs. Briefly, I use the following procedure:

change in wealth = gross saving
- depreciation at replacement costs
+ capital gains
- residual losses.

The change in wealth, gross saving and capital gains can be calculated from the Japanese national accounts. I measure the replacement cost depreciation as gross saving plus capital gains minus the change in wealth, so that my measure includes residual losses, a component that should average out to zero over time.

The second important difference is that the U.S. national accounts fail

to credit the government sector for its capital formation. All of government expenditures are treated as consumption, so that government saving in the U.S. national accounts simply equals a government budget surplus. Japanese national accounts do include government capital formation as part of government saving.[1]

To make the saving rates from the two countries comparable, I calculated Japan's national saving rate according to the U.S. definition. This means that capital consumption adjustment and government capital formation are taken out from saving for Japan. In Hayashi (1986) the calculation was for the period 1970-1984 only. Recently, the Japanese government has published the long-awaited estimate of national income accounts from 1955 to 1969. In Hayashi (1989) I expanded the calculation to cover the period 1955-1987. Figure 1 reproduces the result of the calculation.[2] It displays the adjusted and unadjusted national saving rate along with the U.S. national saving rate. As clearly seen from the Figure, the adjustment makes a big difference. In 1979 the U.S. national saving rate was higher than Japan's. Comparing Japan's adjusted rate with that of the U.S., we can make the following observations. First, the phenomenon of the extraordinarily high saving rate is limited to the ten year period of 1965-1975. Second, after rapidly declining from the 1970 peak of 26%, Japan's saving rate has turned

---

[1] The OECD national income statistics for the U.S. include government capital formation. However, data on government capital formation for Japan in the OECD statistics come from the Japanese national accounts, which grossly over-estimate (net) government capital formation for two reasons. First, only buildings are depreciated. Second, for buildings, depreciation is at book value. For 1987, the GNP share of government capital formation reported in the Japanese national accounts is 5.7%. If all government assets are depreciated at replacement cost, it falls to 3.6%.

[2] Consumer durables as well as all government expenditures are treated as consumption.

up again in the mid 1980s. This coincides with the rapid improvement of the government budget deficits.[3] Third, Japan's national saving rate showed erratic behavior between 1955 and 1960. Depreciation for this period was implausibly high. The residual losses component of my estimate of depreciation may have been quite substantial during that period. This is born out in the capital stock series available in the balance sheet section of the Japanese national accounts: it shows no increase during the same period of 1955-1960, which is a bit of mystery. I will briefly come back to this point later on in this section.

Given the magnitude of the adjustment, some may be suspicious about my estimate of depreciation. The question really is whether the depreciation rate implicit in my estimate of depreciation at replacement costs is reasonable. For 1987, the implicit depreciation rate -- the ratio of depreciation at replacement costs to the capital stock -- is 9.8% according to my calculation.[4] This is significantly smaller than the U.S. figure of 5.7%,[5] mainly because the assumed depreciation rate for residential structures in Japan (made of paper and wood) is much higher (about 9%). If the depreciation rate for the depreciable assets of the household sector in Japan is constrained to be 4%, then the overall implicit depreciation falls to 7.5%. Since the Japanese private capital-GNP ratio for 1987 is about 1.7, the GNP

---

[3] In 1987, the government sector started to run a surplus.

[4] By the very nature of my estimation of replacement cost depreciation, which relies on the capital stock series in the Japanese national accounts, this depreciation rate of 9.8% must be very close to the depreciation rate implicit in the national income capital stock.

[5] It is the ratio of depreciation in the U.S. national accounts to the stock of private capital stock (excluding consumer durables) in the Balance Sheet of the U.S. Economy compiled by the Board of Governors of the Federal Reserve System.

fraction of depreciation must then be about 17% (9.8% times 1.7). In other words, one has to subtract about 17% of GNP from gross saving to arrive at net saving for Japan.[6]

2.2. Pre-War Evidence

My conclusion that the phenomenon of high Japanese saving rate is limited to the period of 1965-1975 is reinforced in a longer time span. Figure 2 includes the gross and net national saving rates as percent of GNP since 1885. The data for the pre-war period are from the Long Term Economic Statistics (Ohkawa et. al. (1966), hereafter the LTES[7]) painstakingly put together by a group of economists at Hitotsubashi University. For the per-war period, gross national saving is defined as GNP minus private consumption minus government consumption including military expenditure, which by the national income identity equals domestic capital formation (excluding military expenditure) plus the current account. Thus national saving here includes statistical discrepancies and government capital formation but excludes military expenditures. For the post-war period, national saving includes government capital formation but excludes statistical discrepancies. The GNP share of depreciation -- the difference between the ratios of gross and net savings as percent of GNP -- is as much as 20% for the post-war period, because here, unlike in Figure 1, depreciation on government capital is included. For the pre-war period, the GNP share of depreciation is only slightly more than 10%. As acknowledged in the LTES, the pre-war estimate of gross saving is subject to a great deal of uncertainty (statis-

[6] If government capital is included in saving, the replacement cost depreciation is about 20% of GNP.

[7] An English summary is Ohkawa et. al. (1979).

tical discrepancies are often quite substantial). It is possible that both gross saving and depreciation are under-estimated. Figure 2 also includes the current account as percent of GNP. That the most volatile component of national saving for the pre-war period was the current account can be clearly seen. The large deficit in trade balance in 1905 indicates that much of the Russo-Japanese war was financed by external debt, while the huge surplus during World War I is due to the capital outflows to finance the war effort by the Allies and China.

To state the conclusion again: except for its large hump in the late 1960s and early 1970s, Japan's saving rate is not extraordinarily high by international standards. This fact is fully reflected in the history of Japan's national wealth. National wealth here is the sum of the capital stock (tangible depreciable assets including housing and non-military government capital but excluding inventories[8]) and net external financial assets. To be consistent with the definition of national saving in Figure 2, I exclude land from national wealth because saving in land for a nation as a whole is always zero.[9] **Figure 3** displays in log scale the real value of the capital stock and national wealth in 1934-36 yen. (I currently do not have data on external assets for the pre-war period, so only the capital stock is plotted for the pre-war period.) For the pre-war period, the capital stock has a time trend with a growth rate of only 3.1% per annum, which is the same as the growth rate of U.S. capital stock for 1889-1940 of

---

[8] Inventories are not available in the LTES.

[9] For 1987 the value of land is more than two times the value of the capital stock, according to the Japanese national accounts. The value of land fluctuates over time wildly, thus obscuring our analysis. The exclusion of land in growth analysis can be justified with suitable separability assumptions. See Hayashi (1989).

3.1%.[10] Japan was probably a net debtor before the war, so the growth of national wealth must have been a bit lower.

There are no reliable records for constructing consistent capital stock series between 1940 and 1955 which includes World War II. See Data Sources at the end of this paper for my procedure of splicing the pre-war and the post-war capital stock series. The capital stock series since 1955 is from the stock section of the Japanese national accounts. One curious feature of the pre-war capital stock is the slight decline between 1955 and 1960, which corresponds to the puzzlingly large depreciation that is apparent in Figure 1. One possible explanation offered above was that the residual losses component of my estimate of depreciation may have been substantial. However, available estimates of the gross capital stock for the same period do not show a decline, which is inconsistent with the residual losses explanation. My conjecture is that the 1955 value of the capital stock, which is heavily influenced by the 1955 National Wealth Survey (a sampling survey of the replacement value of capital), is over-valued relative to the subsequent periodical benchmark estimates, so that, given an independent estimate of gross investments, depreciation had to be scaled up.

Leaving aside the mysterious disappearance of the capital stock during 1955-1960, the capital stock series linking the pre- and post-war periods is consistent with whatever scant evidence there is about the wartime destruction of the capital stock by Americans. Okita (1949) reports that about 25% of the capital stock was destroyed during World War II. If one

---

[10] For the U.S., data on the capital stock are taken from Goldsmith (1956). Since the population growth rate for the U.S. over this period is higher by 0.4 percentage points than that of Japan, the percapita growth rate of wealth is slightly higher for Japan than for the U.S.

extrapolates the prewar trend to obtain a capital stock value for 1945 and compares it with another value for 1945 that one obtains by "backcasting" using the 1950-55 trend, the gap is about 50% of the 1945 value implied by the prewar trend. This leaves 25% to be accounted for, but that may be attributable to the slowdown in non-military capital accumulation that must have taken place during the war.

No matter what the extent of wartime destruction was, there is no question that the rapid capital accumulation associated with the extraordinarily high national saving between 1965 or 1965 and 1975 has put Japan's capital stock well above the pre-war trend line. Even more amazing, this rapid accumulation was accomplished without much reliance on external debt. As clear from Figure 3, the discrepancy between national wealth and the capital stock, which is net external assets, became substantial only very recently.

2.3. Two "Big" Questions

Another noteworthy feature of the post-war wealth accumulation in Figure 3 is that it appears to be tapering off; it appears as though the time path of wealth is converging to a new time trend, which I think is significant because it is happening precisely when Japan's per-capita GNP has caught up with that of the U.S. The U.S., being the only developed country free from wartime destruction, has had at least a hundred years of uninterrupted wealth accumulation (with a relatively minor disruption during the Great Depression). It is therefore reasonable to suppose that the U.S. economy has been in a state of equilibrium. The view that the U.S. has been in equilibrium and Japan has been converging (on percapita basis) to that equilibrium from below is born out in **Figure** 4 where real GNP per capita is graphed for the two countries over the last 100 years. Here, I assume that

percapita GNP is the same for Japan and the U.S. in 1987. A remarkable fact about the U.S. GNP is the pre-war and the post-war trends are the same, which is consistent with the view that the U.S. has been on the equilibrium path. The Japanese pre-war trend is almost parallel to the U.S. trend; Japan's real percapita GNP before World War II was never more than 40% of that of U.S. for more than several years.

This prompts me to pose the following two closely connected questions about Japan's economic development over the last one hundred years.

(1) Why was the post-war wealth accumulation so rapid, particularly between 1965 and 1975?

(2) If Japan was able to reach the equilibrium growth path represented by the U.S., why didn't it take place before World War II? Why did Japan wait until after the war to decide to be rich?

These are "big" questions. I suppose that every economist seriously interested in Japan has his or her own answer. Explaining Japanese economic development in a coherent and simple fashion is a challenge to economics.

Modern economics offers two competing theories of wealth accumulation. The celebrated life-cycle hypothesis of Modigliani and Brumberg views the national economy as consisting of overlapping generations. Since each generation is finitely-lived, its saving behavior depends critically on age. The life-cycle hypothesis predicts, among other things, that national saving will be higher and wealth accumulation faster if the elderly, who are supposed to dissave after retirement, make up a smaller fraction of the population. The alternative theory, called the dynasty model, posits that each generation is linked to the next by altruism so that all generations

act as if they form a single immortal dynasty with infinite horizon. Which theory of saving and wealth accumulation is closer to reality is one of the most basic unresolved questions in economics. As can be easily imagined, the two theories have very different implications about how consumption and saving behavior should differ between age cohorts. In the next section, therefore, I examine cohort data on consumption and saving.

3. Evidence from Cohort Data

3.1. Cross-section vs. Longitudinal Profile of Consumption

When analyzing micro data, it is very important to distinguish between the cross-section age profile of consumption, which is a point-in-time profile of consumption for cohorts of different ages, and the longitudinal age profile, which tracks consumption over the life-cycle of a given cohort. It is the cross-section age profile of consumption where the predictions of the two theories of wealth accumulation differ sharply.

The life-cycle hypothesis predicts the well-known cohort effect in the cross-section profile of consumption: the slope of the profile must be less than the longitudinal age profile of consumption by the productivity growth rate of the economy. For example, if productivity grows at 5%, this year's, 30 year-olds are wealthier than last year's 30 year-olds (namely, this year's 31 year-olds) by 5%. Thus the level of consumption that this year's 30 year-olds expect for the next year is 5% higher than the level of consumption enjoyed by this year's 31 year-olds. Put differently, to obtain the longitudinal age profile of consumption, one needs to "tilt" counter-clockwise the cross-section age profile by the productivity growth rate.

The prediction of the dynasty model is that there should be no cohort

effect in that the cross-section age profile of consumption should be independent of the productivity growth rate. This is because in the dynasty model all cohorts are altruistically linked, so that gains from productivity growth are shared by all cohorts of different ages.

To be sure, both theories predict the cross-section age profile of consumption to shift upwards as productivity increases. The difference in prediction arises when one compares the cross-section profiles for two economies growing at different rates. The life-cycle hypothesis predicts that the age-consumption profile in a slow-growing country should be more positively sloped than in a fast-growing country. That is, "in more rapidly growing countries the old are much lifetime-poorer than the young so consumption of the old will be much lower relative to consumption of the young than in slowly growing contrives." (Carroll and Summers (1989)). The dynasty model predicts no such systematic relation.

3.2. Saving Rate

Perhaps the most well-known prediction of the life-cycle hypothesis is that the saving rate depends on age. More specifically, since households want the longitudinal profile of consumption to be smoother than the earnings profile, which is hump-shaped, the saving rate should be negative at both ends of the life-cycle. For the elderly, however, this prediction of negative saving rate should be modified if they have access to annuities, in which case (except for transactions purposes) their asset holdings should be zero with their consumption entirely financed by annuity benefits.

The prediction by the dynasty model is less clear-cut. In the dynasty model, generations are altruistically linked via inter-generational transfers. If inter-generational transfers are entirely in the form of bequests,

then the saving rate for the young (before they receive bequests) will be negative. The situation gets complicated if inter-generational transfers are in the form of the flow of transfer payments (inter vivos gifts) from parents to adult children. A variety of age profiles of saving rate is possible. If, as usually is the case, transfer payments are included in the definition of household income and if transfers payments are made to children when they are young, then the saving rate for the young may well be positive. If parents start transferring wealth to children after their retirement, then it may well be that their saving rate is positive while their wealth decumulates. In fact, Hayashi et. al. (1988) found that this is the age profile of saving and wealth for Japan.

Transfers may arise under the life-cycle hypothesis, which makes its prediction not as clear-cut as commonly thought. For example, suppose that it is difficult to purchase annuity contracts. A parent and a child may find it to their self interests -- even if they are not altruistic to each other -- to enter into a contract whereby the child would support the parent when old. The payment by the parent cannot be before the service is delivered by the child, because the child has every reason to renege the contract. The payment must be made after the service is delivered, namely when the parent dies, in the form of bequests. The child may even have to post a bond, in which case the parent would accumulate wealth toward death. The point here is that one has to be careful about the treatment of transfer income and payments. If transfers are excluded from income, the life-cycle hypothesis does predict negative or zero saving by the retired.

3.3. Measurement Problems, Conceptual and Practical

Before turning to evidence, let me briefly discuss some measurement

issues, because I think that defining income, consumption and saving in a way consistent with national income accounts for each cohort (and for each household for that matter) from household surveys is an issue that deserves more attention. Imputed rent from owner occupied housing should be part of income and consumption, while depreciation on housing should be subtracted from income and saving. Employer contribution to social security and other pension plans should be included in income and hence in saving. Government transfers in kind should be included in income and consumption. This is important for Japan where education is heavily subsidized and where there is a large national medical insurance system. Household surveys typically lack information on some or all of these items, especially employer contributions and accrued government transfers, so that it is impossible to incorporate them for each household in the survey, but calculating those items for a typical household of a given age cohort should be feasible.

There is a more conceptual problem. Should capital gains be included in saving? They should be if households can "see through" the corporate veil so that dividends and capital gains due to retentions are just alternative forms of income. If one extends this argument further and assume that households can see through the government veil, changes in future tax liabilities should be deducted from saving: a tax cut of $1 raises disposable income and hence saving, but it also raises, other things equal, the present value of future tax liabilities which should be deducted from saving. It may be possible to calculate capital gains and losses on marketable assets for each cohort if data on assets and liabilities are available, but it is impossible (unless one makes very specific assumptions) to calculate for each cohort accruals of future tax liabilities.

3.4 Evidence

For the U.S., evidence from household survey data seems broadly consistent with the life-cycle hypothesis. The elderly in the U.S. carry very low financial assets. According to Wise (1988), the median net financial assets for couples aged 68 to 73 was only about $16,000 in 1979, and consumption is almost exclusively financed by social security benefits. This is precisely the prediction of the life-cycle hypothesis. However, as I argued above, it is also consistent with the dynasty model. A more decisive evidence against the dynasty model was provided by Altonji, Hayashi and Kotlikoff (1989) who find that there is strong correlation between consumption and income within the family. If the dynasty model were true, the correlation should be zero.

The dynasty model fares better in Japanese data. **Figure** 5 displays the saving rate by age for several years over a 25 year period. The source is the published tabulations on after-tax income and saving by age from the National Survey of Family Income and Expenditures (hereafter the National Survey) which is undertaken every five years since 1959. It is not possible from the published tabulations alone to incorporate any of the required adjustments I just mentioned to make the saving rate by cohort comparable to the national income saving rate. Thus there is no reason for the cross-section average of the saving rates to agree with the national income definition of household saving rate for the same year which is also displayed in the Figure as the "macro" saving rate.[11]

One needs to exercise extra caution when one deals with Japanese cohort

[11] Another source of discrepancy is that the National Survey covers only September, October and November. Income and consumption are not seasonally adjusted. Also, singles are not included in the tabulation.

data, for several reasons.[12] First, no government household survey reports taxes paid by households other than the so-called "worker households" (households whose head is on a payroll), which means that one can never observe from published reports the saving rate for the retired. The saving rate displayed in Figure 5 is for the worker households only; the saving rate for the 65+ age bracket is really for those who are still working after turning the age of 65, a pool of people hardly representative of the 65+ age cohort. Second, extended families, which make up about a quarter of all households, are mixed with nuclear families in published tabulations by age. This obviously results in cohort mixing: what is included in the, say, 25-29 age bracket are extended families in which a 25-29 year old son is living with his parents. This partially masks the true age dependence of consumption and saving in simple tabulations by age. Furthermore, this cohort mixing is not random. Since the household head in an extended family is the main income earner, the 25-29 year old household head living with his father earns more than his father does. This means that the young in younger age brackets and the old in older age brackets are relatively wealthier people within their own respective age cohorts.[13]

Despite all these caveats, the saving rate in Figure 5 seems to be inconsistent with the life-cycle hypothesis. First, it shows no systematic

---

[12] For more details, see Hayashi et. al. (1988).

[13] In extreme situations the true age dependence is competely masked due to this non-random cohort mixing. Imagine that there are only two generations, young and old, and that the cross-section age profile of earnings is flat. The young and the old living in the same household have an equal chance to be the head, that is, the main income earner. Suppose all households are extended families, so that household consumption is the sum of consumption by the two generations. Then it is easy to see that the cross-section profile of household consumption by the age of the head will be flat irrespective of the productivity growth rate.

dependence on age. The cohort mixing would not completely mask the age dependence in the age tabulation. Second, this cross-section age profile of saving shifts up and down with the aggregate saving rate, meaning that macroeconomic events are much more important than age in determining individual saving. Put differently, the shifting age distribution -- the important determinant of aggregate saving under the life-cycle hypothesis -- has not been a major factor in the determination of aggregate saving in Japan. Third, the temporal variation is greater for older cohorts. It is true that households in the 65+ age brackets in published tabulations are those whose head is still working, so that their positive saving is not necessarily inconsistent with the life-cycle hypothesis. But, since their horizon is shorter than that of younger households, their saving rate should exhibit less volatility.

One really needs to have access to micro data to overcome the problems about Japanese data mentioned above. Age tabulations free from those problems were produced by Hayashi et. al. (1988) using the 1984 National Survey data tape[14]. Income tax and hence saving for all households (not just for worker households) are imputed, so that the retired can be brought into the age tabulations. Tabulation of the saving rate by age is done for nuclear households, so that the cohort mixing is eliminated. For extended families, the head is re-defined to be the younger generation (not necessarily earning more than their parents living together), so that the young in younger age brackets for extended families are representative of their own cohort. The definition of saving is strictly comparable to the national

[14] All the calculation was done at Osaka University during the 1986/87 year when I was a faculty member there.

income definition[15]. **Figure 6** reports the resulting saving rate for nuclear and extended families. Now the saving rate is much more dependent on age than is indicated in Figure 5, which is a testimony of the seriousness of the cohort mixing in published age tabulations. However, the evidence for negative saving for the old is very weak. There are two groups of old people: those maintaining an independent household, which are classified as old nuclear, and those living with their children. For both groups, only those who are really old dissave. For the former group, that fact is clear from the saving rate for old nuclear families. For the latter, their saving must be substantial because the saving rate for the extended families in the younger age brackets (where parents, whose adult children living with them are still young, are not very old) is higher than that for nuclear families in the same age bracket.

Thus, evidence about the saving rate is not favorable to the life-cycle hypothesis. What about the age-consumption profile? **Figure 7** displays the cross-section age profile of consumption taken from published tabulations for the last six National Surveys. Here, being derived from published tabulations, nuclear and extended families are mixed up, so the age profile is made flatter than it really is.[16] But still, young people are more numerous than old people in younger age brackets and vice versa in older age brackets. For a fast-growing country like Japan, the age profile -- albeit

---

[15] Except that the government transfers in kind (education and medical care) are not included in income and consumption. This (unavoidable) omission, however, does not affect the level of saving. The saving rate is only slightly affected because income is slightly under-estimated. Also, transfer payments and income to and from members outside the household is not included in income.

[16] Also, government transfers in kind are not incorporated.

contaminated by extended families in the published tabulations -- should be tilted more in favor of the young, according to the life-cycle hypothesis. However, as documented in Carroll and Summers (1989), the profile is more positively sloped in Japan than in the U.S. To see this point more clearly, one can create longitudinal profile of consumption by traversing across the cross-section profiles. For example, the longitudinal profile for the cohort aged 25-29 in 1959 is the line connecting the 25-29 node for 1959, the 30-34 node for 1964, and so forth. The cohort mixing puts an upward bias in the slope of the longitudinal profile thus obtained, but that alone would not explain why the profile is so much steeper than the profiles typically found for the U.S.

It is possible, however, to reconcile this last piece of evidence with the life-cycle hypothesis. The large-scale inter-generational redistribution of resources from the young to the old, which was brought about by the expansion of the social security system in the early 1970s, may have allowed the current old to consume more than they could have afforded had there been no such expansion. An equally plausible explanation is that the current old, when young, did not anticipate the rapid economic growth that took place in the 1960s and early 70s. Over their lifetime, they kept receiving more income than they anticipated, resulting in the old age asset holdings far larger than anticipated when young. It is this "excess" asset holdings that is financing the high old age consumption.

4. Explanation of Japanese Economic Development

To recapitulate: evidence from Japanese cohort data is consistent with the dynasty model. Is the dynasty model consistent with the aggregate

evidence discussed in section 2? I now try to answer the two "big" questions about Japan's economic development I posed at the end of section 2. The first question is relatively easy to deal with. If the U.S. economy is in a steady state equilibrium and if the only important difference between Japan and the U.S. immediately after the war is the huge disparity in the capital-labor ratio, then the standard neoclassical growth model -- which is a specialization of the dynasty model with the standard neoclassical aggregate production function -- predicts that Japan will eventually converge to the equilibrium path that the U.S. has been on. The idea is simple enough, but to fit the neoclassical growth model to the post-war Japanese data some modifications are needed. When the capital stock is low, the return from saving is unusually high because of diminishing returns to scale. This immediately sparks rapid capital accumulation which lasts until the capital-labor ratio gets close to the equilibrium growth path. This feature of the standard growth model is inconsistent with the post-war Japanese experience where the phenomenon of high saving did not occur until the mid 1960s.

Recent work by Christiano (1989) shows that it is indeed possible to modify the standard growth model to be consistent with the hump-shaped Japanese saving rate. Suppose that there is some subsistence level of consumption at which the marginal utility of consumption is very high and suppose Japan after the war was in that subsistence level. Then people would choose to consume rather than save even though the return from saving is extraordinarily high. People were too poor to save. But eventually, as the standard of living gradually improves, the high return from saving wins out, so that people start rapidly accumulating wealth. This is precisely what happened in the 1960s. Christiano (1989) simulated the neoclassical

growth model that has this subsistence feature to generate the hump-shaped saving rate. His model also predicts that the increase in the growth rate precedes the increase in the saving rate, another important feature of post-war Japanese economic growth noted by Romer (1986).

This answer makes the second question even harder. Why didn't the rapid growth take place before World War II? I really have no satisfactory answer. Perhaps it is the bad government. Japan's pre-war economic history is a history of the government taking up ever-larger share of GNP. This can be seen clearly in **Figure 8**. Here, aggregate demand or total expenditure, which is GNP minus net exports, is broken down between private consumption, private investment and government expenditure (government consumption plus government investment). It clearly shows the adverse impact on private expenditure of government war efforts, including the Sino-Japanese war of 1894, the Russo-Japanese war of 1904, and the invasion of Manchuria followed by World War II. As we all know, the resources taken up by the government did not bring about any benefits to the private sector. It is as if the aggregate production function had been shifted down. It also must have made the future too uncertain for the private sector to be tempted to save. It is perhaps not surprising that Japan's wealth accumulation did not take off until the bad government was removed.

5. Concluding Remarks

In this paper I have made two basic points. I hope by now I have convinced the reader of my first point -- that phenomenon of extraordinarily high Japanese saving rate is limited to the period between 1965 and 1975. As far as it goes, the second point -- that the standard neoclassical growth

model does a good job of explaining post-war Japanese economic development -- should not be controversial, either. This model should be taken seriously because it is also consistent with micro evidence about consumption and saving.

If a theory is capable of explaining existing facts, there is a good chance that its prediction about the future will be validated. Here I want to be a bit tentative. When I made the second point, I talked as if the U.S. represents the equilibrium path for the neoclassical growth model, which, if true, leads to the prediction that the U.S. and Japan will grow at the same rate for the rest of the future. However, my justification for that was rather tenuous, as an avid reader may have noticed. That the U.S. economy has been on or close to the same time trend for at least a century does not necessarily mean that the same path is the equilibrium path (on percapita basis) for Japan. In fact, as I argued in section 3, the U.S. wealth accumulation may well be consistent with the life-cycle hypothesis. In both the overlapping generations economy inhabited by life-cycle consumers and the infinite-horizon neoclassical growth economy, the equilibrium growth rate is the rate of technical progress. The level of the equilibrium growth path, however, may be different. It may be that the equilibrium path for the neoclassical model is parallel to the U.S. path but lies above it. If so, the prediction is that Japan will break away from the U.S. and other developed countries in terms of percapita GNP. The evidence presented in this paper is consistent with both predictions. The next several years should be a very interesting period to students of the wealth of nations.

Data Sources

Figure 1. Hayashi (1989).

Figure 2. For the pre-war period, the data are from Ohkawa *et. al.* (1979). Gross saving is defined as: Y - CP - CG - (I - NMLI), where

Y = "gross national expenditure at market prices" (Table A1),
CP = "personal consumption expenditure" (Table A1),
CG = "general government consumption expenditure" (Table A1),
I = "gross domestic fixed-capital formation" (Table A1, A38),
NMLI = "gross domestic fixed capital formation excluding military" (Table A38).

Depreciation is "Provisions for the consumption of fixed capital" (Table A7). The current account is calculated as "exports of goods and services and factor income received from abroad" (Table A1) less "imports of goods and services and factor income paid abroad" (Table A1).

For the post-war period, the data source is Table A1 and A2 of Hayashi (1986) and an update by the author.

Figure 3. The capital stock for the pre-war period is from Table 1, Vol. 3 of the LTES. For the post-war period, data splicing is needed. The 1950 value of the real capital stock is assumed to be 1.1 times the 1938 value. This factor of 1.1 was taken from Chapter 4 of *ibid.*. There, the *gross* capital stock in the LTES for 1938 was converted in 1960 prices using price indexes for various assets for 1938 and 1960, and then it was compared to the 1950 value in 1960 prices of a gross capital stock series (the H series reported in Table 4-1 of Chapter 4 of *io. cit.*). It turned out that the latter was 1.1 times the former. I assume that the same factor of 1.1 applies to (net) capital stock. For 1950-55, I use the growth rate of the net capital stock is the same as that of the gross capital stock series from the the H-series. The net capital stock series since 1955 and net external assets since 1955 are taken from the Japanese national accounts (Table I-1, Part 2).

Figure 4. Japanese pre-war real GNP is taken from Table A3 of Ohkawa *et. al.* (1979). Table A4 of *op. cit.* reports two additional real GNP series: Y1 = "gross national expenditure in millions of 1934-36 prices for 1940-51 (excluding 1945), and Y2 = gross national expenditure in billions of 1965 yen for 1952-75. The pre-war real GNP series and Y1 can be used to cover the period 1885-1951 (excluding 1945). The Y1 and Y2 series do not overlap, so I assume that the growth rate of real GNP from 1951 to 1952 is the same as the real GNP growth rate from 1952 to 1953 given by Y2.

The Y2 series and the National Income series for 1955-87 are spliced at year 1955.

For the U.S. real GNP for 1885-1929 is taken from Balke and Gordon (1989). Real GNP since 1929 is taken from the U.S. National Income and Product Accounts.

The population for 1885-1940 and 1950-1970 is taken from Table A53 of Ohkawa et. al. (1979). The 1940-50 gap is filled by linear interpolation. Japan's population since 1970 and the U.S. population are from the census data.

Figure 5. The data for "worker households" on after-tax income and consumption are from the National Survey Reports (various years, hereafter NS). After-tax income is pretax income less income tax less social security contributions. The following published tables are used. Table 12, Vol. 1 of 1956 NS, Table 7, Vol. 1 of 1964 NS, Table 17, Vol. 1 of 1969 NS, Table 6, Vol. 1 of 1974 NS, Table 6, No. 1, Vol. 1 of 1979 NS, Table 6, No. 1, Vol. 1 of 1984 NS.

Figure 6. The data on saving and disposable income are from Table IIIA of Hayashi et. al. (1988). They incorporate: employer contribution to social security, imputed rent from owner-occupied housing, depreciation on owner-occupied housing, seasonal adjustment converting a monthly average over September through November to an annual rate. Singles are included in the pool of nuclear families.

Figure 7. For 1964, 1974, 1979 and 1984, the data are from published tables for all households excluding singles. Table 6, Vol. 1 of 1964 NS, Table 6, Vol. 1 of 1974 NS, Table 6, No. 1, Vol. 1 of 1979 NS, Table 9, No. 1, Vol. 1 of 1984 NS. For 1959 and 1969, the tables for "worker households" listed above for Figure 5 are used.

Figure 8. Let IP = gross private domestic capital formation, and IG = government capital formation. This figure the three-way breakdown of total expenditure (CP+IP+IG+GP) between private consumption (CP), private investment (IP), and government current and capital expeneiditure (IG+CG). For the pre-war period, the source for CP is listed above for Figure 1. IP equals I above minus IG ("government gross domestic fixed-capital formation including military") which is taken from Table A38 of Ohkawa et. al. (1979). G equals CG above plus IG. The data for the post-war period are from the Japanese national accounts (Tables I-1 and III-1 of Part 1).

References

Altonji, Joseph, Fumio Hayashi, and Laurence Kotlikoff (1989), "Is the Extended Family Altruistically Linked? Direct Tests using Micro Data", National Bureau of Economic Research Working Paper No. 3046.

Carroll, Chris, and Lawrence Summers (1989), "Consumption Growth Parallels Income Growth: Some New Evidence", National Bureau of Economic Research Working Paper 3090.

Christiano, Lawrence (1989), "Understanding Japan's Saving Rate: The Reconstruction Hypothesis", Federal Reserve Bank of Minneapolis Quarterly Review, Spring, pp. 10-25.

Goldsmith, Raymond (1955), A Study of Saving in the United States, Princeton University Press.

Balke, Nathan, and Robert Gordon (1989), "The Estimation of Prewar Gross National Product: Methodology and New Evidence", Journal of Political Economy, Vol. 97, No. 1.

Hayashi, Fumio (1986), "Why is Japan's Saving Rate so Apparently High", NBER Macroeconomics Annual, Vol. 1, pp. 147-210.

---------- (1989), "Is Japan's Saving Rate High?", Federal Reserve Bank of Minneapolis Quarterly Review, Spring, pp. 3-9.

Hayashi, Fumio, Albert Ando, and Richard Ferris (1988), "Life Cycle and Bequest Savings: A Study of Japanese and U.S. Households Based on Data from the 1984 NSFIE and the 1983 Survey of Consumer Finances", Journal of the Japanese and International Economies, Vol. 2, No. 4, pp. 417-449.

Ohkawa, Kazushi, et. al. (1974), Estimates of Long-Term Economic Statistics of Japan Since 1868, Toyo Keizai Shinposha.

Ohkawa, Kazushi, and Miyohei Shinohara, eds. (1979), Patterns of Japanese Economic Development: A Quantitative Appraisal, Yale University.

Okita, Saburo (1949), "Taiheiyo Sensou niyoru Wagakuni no Higai Sogo Hokoku-sho" (Comprehensive Report on the Damage in Japan During the Pacific War), Domestic Document No. 8, Economic Stabilization Agency, April.

Romer, Paul (1986), "Comment on Hayashi", NBER Macroeconomics Annual, Vol. 1, pp. 220-232.

Wise, David (1988), "Saving for Retirement: The U.S. Case", Journal of the Japanese and International Economies, Vol. 2, No. 4, pp. 385-416.

Figure 1: National Saving Rate

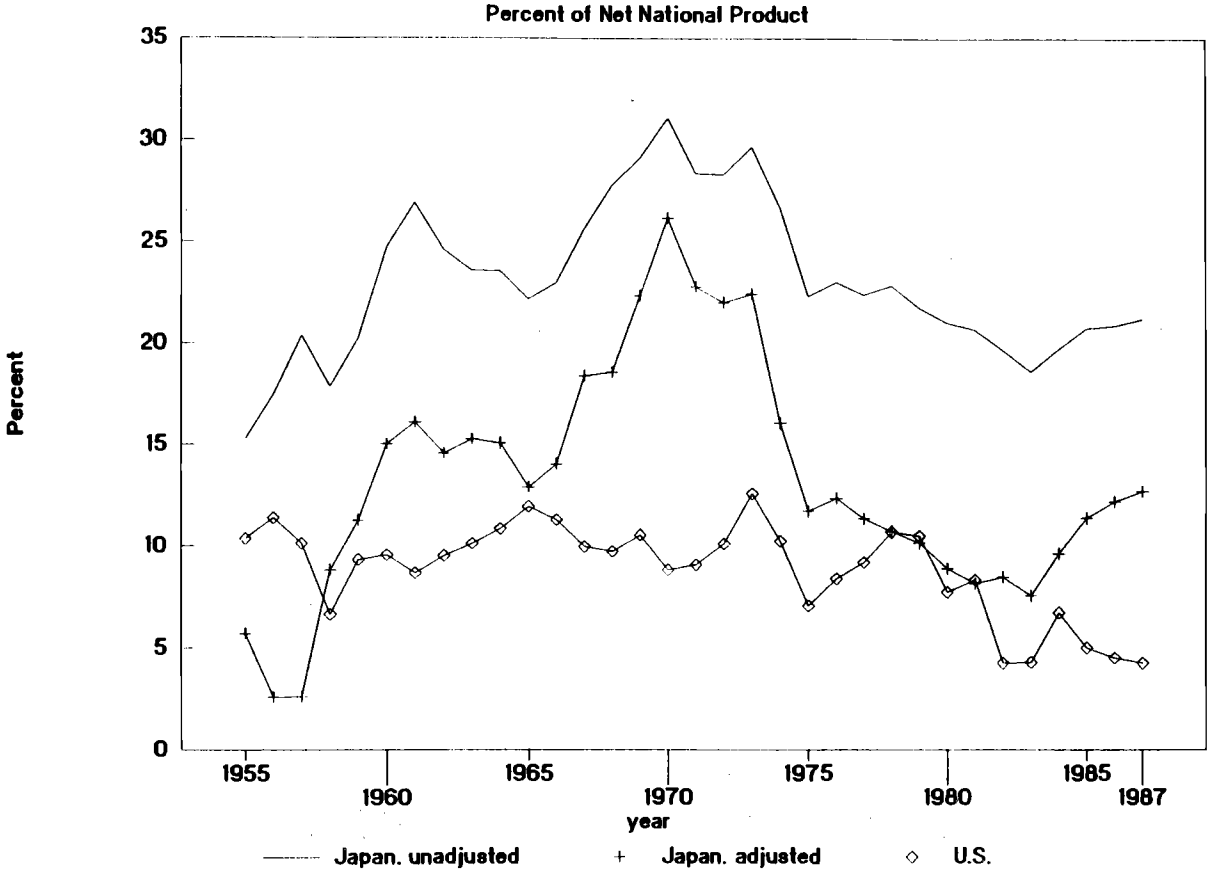

Figure 2:Saving and Current Account

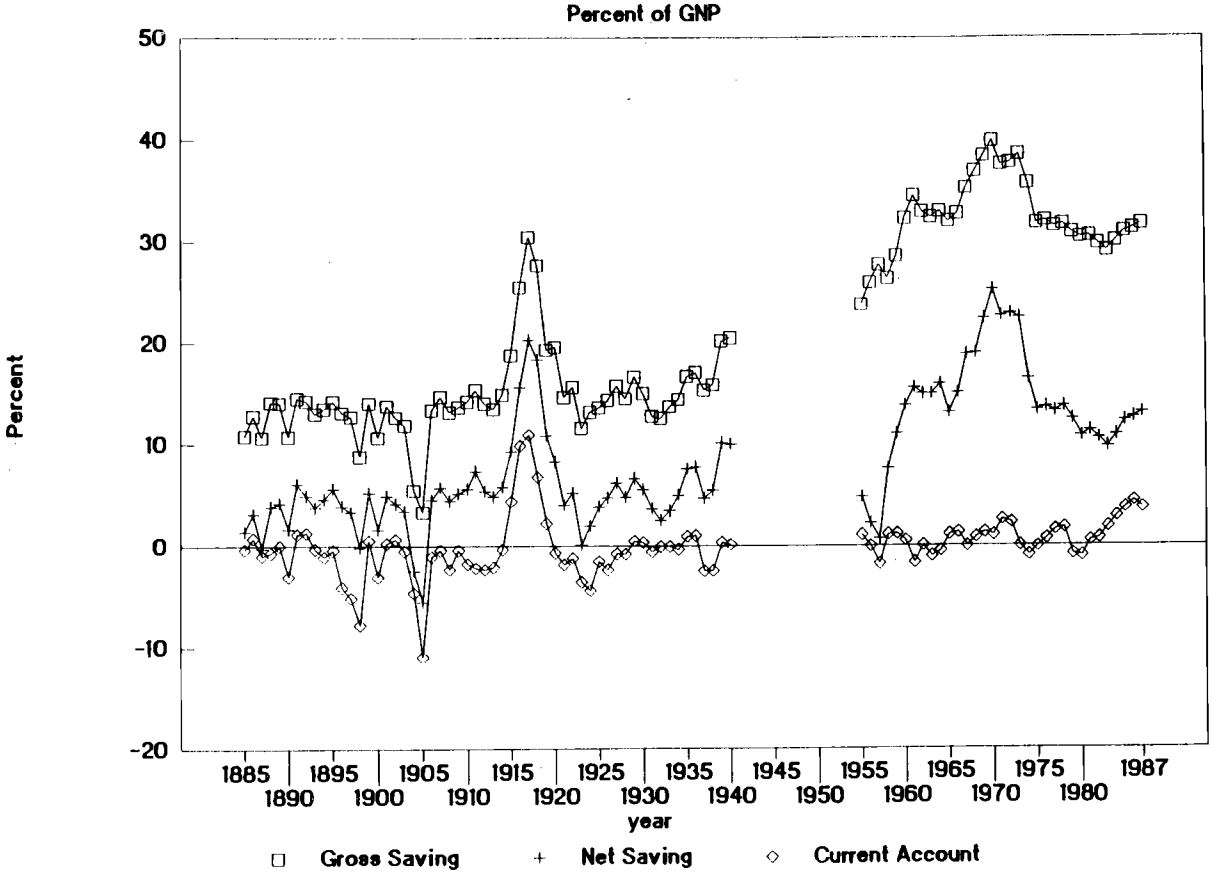

Figure 3: Real Capital Stock and Wealth

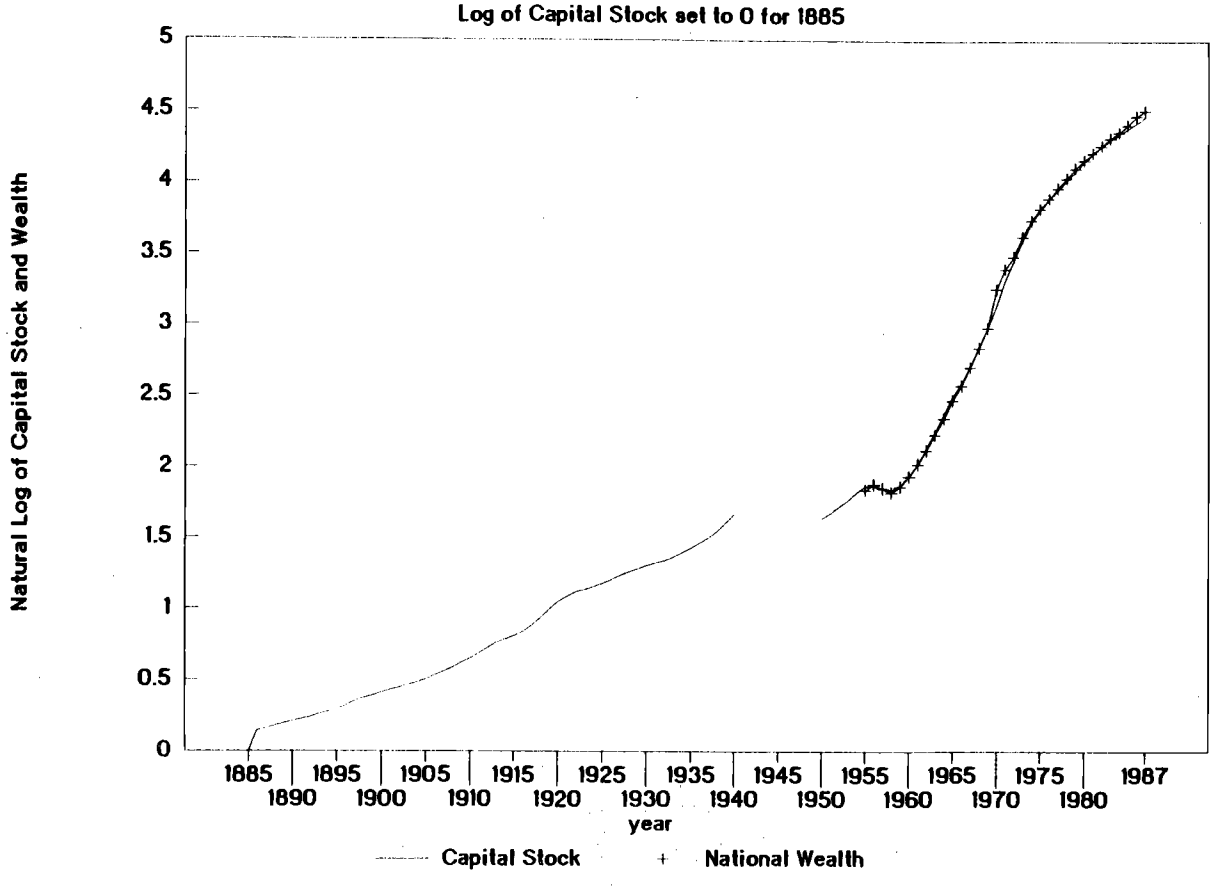

Figure 4: Real Percapita GNP

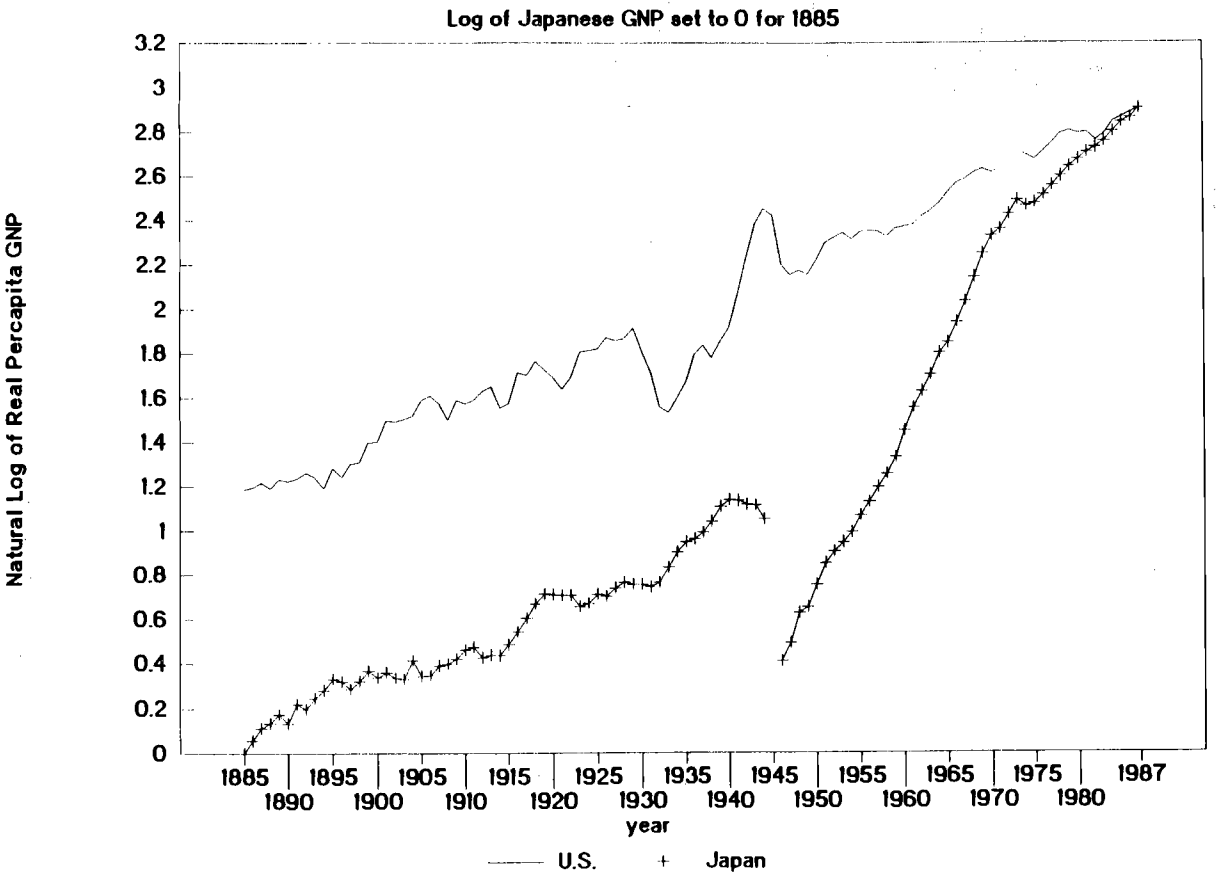

Figure 5: Saving Rate by Age

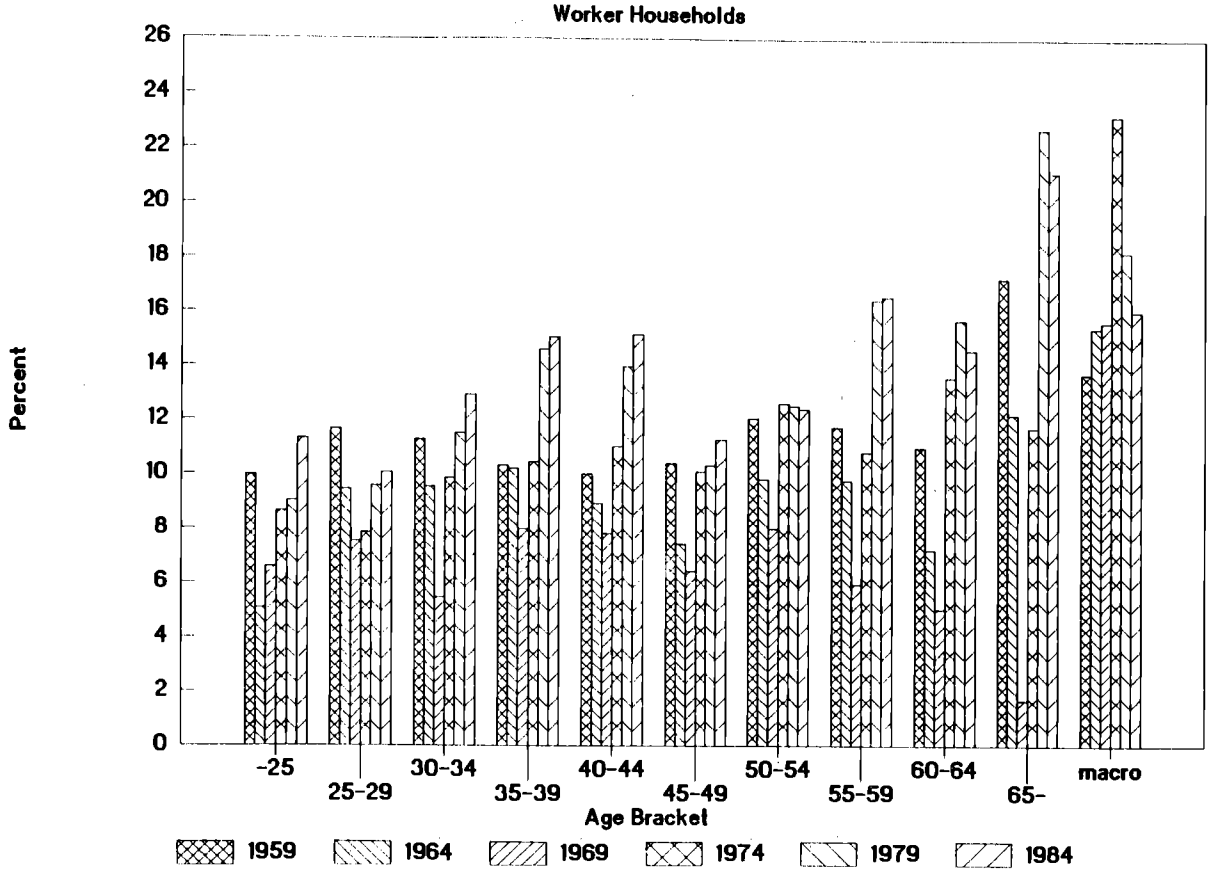

Figure 6: Saving Rate by Age, 1984

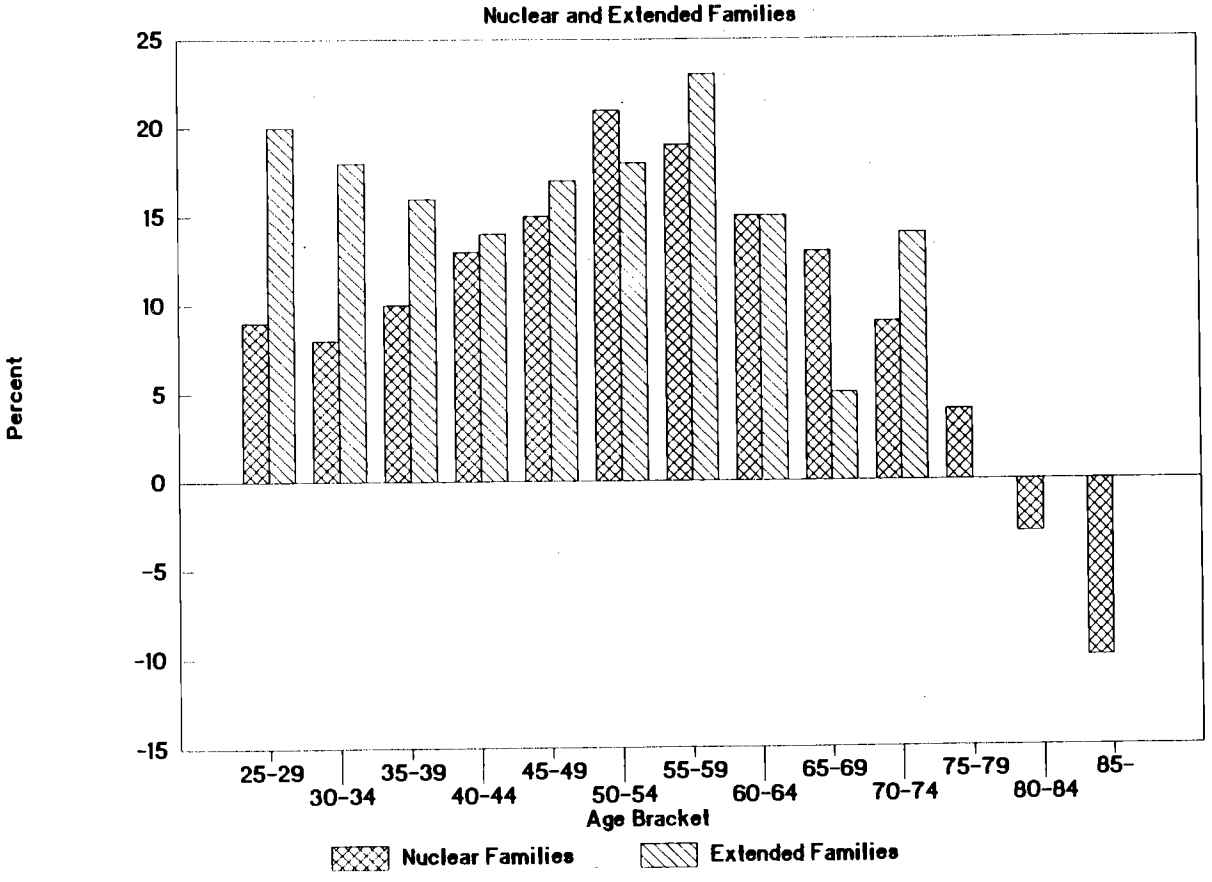

Figure 7: Age Profile of Consumption

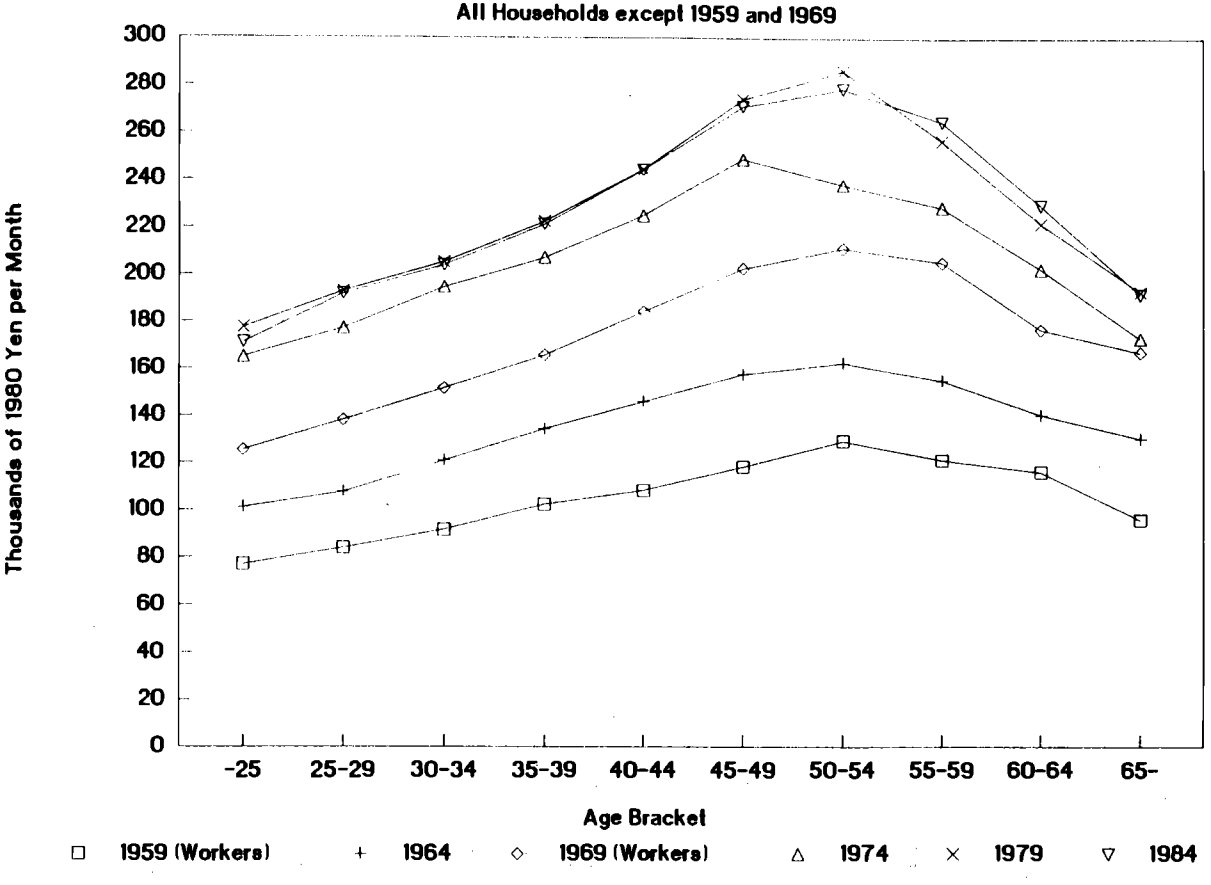

Figure 8: Aggregate Demand Components