THE INTERGENERATIONAL DISTRIBUTION OF RESOURCES AND INCOME IN JAPAN

by

Andrew Mason, Yoke-Yun Teh,
Naohiro Ogawa, and Takehiro Fukui

Working Paper No. 89-3R
September 1991

The Intergenerational Distribution of Resources and Income in Japan

Andrew Mason
Yoke-Yun Teh
Naohiro Ogawa
Takehiro Fukui

Revised September 1991

Seminar on the Family, the Market and
the State in Aging Societies,
Sendai City, Japan, September 19–21, 1988

This paper was prepared as part of a collaborative project of the Statistics Bureau of Japan, Nihon University Population Research Institute, and the East-West Population Institute. The authors would like to express their appreciation to Yuki Miura, Japan Statistical Association, and Takinosuke Dateki, Bureau of Statistics, for their support and encouragement. We would also like to thank David Ho and Wai-Man Wu for their research assistance.

There are two distinct ways in which the term *intergenerational distribution of income* is applied. In some instances it is used to describe the relative lifetime economic status of successive generations. In a country such as Japan, rapid economic growth insures that the material standard of living of current generations substantially exceeds that of previous generations. And, if rapid growth continues, future generations will be considerably better off than those living today.

The term is also applied in a more static sense to compare standards of living among members of different generations, the old and the young, for example. The issue is of particular concern in a society aging as rapidly as is Japan's, because the burdens on the younger generation, either through public provision of social security or through familial support, may be substantial if the elderly are an economically disadvantaged class.

The rapid growth in the number of elderly over the next few decades may itself lead to deterioration in their relative economic wellbeing. As the number of older workers grows, suitable jobs may be increasingly scarce and wages may decline relative to those paid to young workers. Because saving rates among the elderly in Japan are so high by international standards, they have been less dependent on labor income to maintain higher household income. However, the returns to capital relative to labor may well decline in the coming decades as changes in the age composition of the population increase the abundance of capital relative to labor.

Demographic trends may also undermine the traditional system of familial support for the elderly. The multi-generation extended family, still common in Japan today, should come under increased pressure as Japan's low childbearing cohorts reach old age. A decline in the availability of surviving offspring, along with improved standards of living, will almost assuredly lead more elderly to live independently of their children than is the case today. Thus, more elderly in the future may be relying on their own economic resources and less on the resources of other, younger household members.

Of course, the role of the state in the provision of old age support is pervasive in most aging societies, and no analysis of intergenerational inequality can be complete without a discussion of the impact of aging on social insurance schemes and other government programs. The government of Japan today actively provides services and funds to the elderly, and the combined tax and transfer system effects a significant redistribution of income across generations. What will be the needs of the future and how will economic realities be compromised with political necessities in the years to come?

The research results reported below attempt to shed some light on these issues. The first part of the paper presents a macroeconomic model used to determine the distribution of national income among households. The model distinguishes four sources of income: labor income; property income, including returns to domestically invested capital and assets held abroad; intergenerational transfers in the form of bequests; and net government payments, *i.e.*, transfers less taxes. The income attributed to households is different from the traditional notion of disposable income in one important respect. Essentially, we have lifted the corporate veil by attributing all corporate earnings, retained or not, to households on the basis of ownership of assets.

The second part of the paper implements the theoretical model relying on data from Japan from a variety of sources. This sort of undertaking is possible only with a considerable number of simplifying assumptions. Frequently we must rely on data that was collected or analyzed for another purpose and is not ideally suited to our needs. Fortunately, vast amounts of high quality economic and demographic data are available for Japan. Even so, the findings reported should be considered quite tentative in nature and merely suggestive of what the next four decades of aging is likely to bring. One would be well advised to view the results here as representing a hypothetical country sharing many of Japan's particular features.

The third part of the paper reports the results of a simulation starting in 1980 and running to 2025 based on: (1) continued growth in national product equal to that observed from 1980 to 1985; (2) additional improvements in mortality conditions and a continuation of below replacement fertility; (3) an absence of fundamental changes in the family system; and, (4) no change in the redistributive role of the public sector. The discussion of the results highlights three features of the simulation — changes in the distribution of household income, changes in the distribution and level of bequests, and the rapid increase in foreign investment.

THE MODEL

The purpose of the model is to examine changes in the intergenerational distribution of income likely to accompany the dramatic aging of Japan's population. The accompanying flow chart, Figure 1, provides a schematic view of the model. The level and distribution of economic resources controlled by households lies at the core of the model. The factor income accruing to each household cohort is determined by the human and physical resources of the cohort and the relative returns to those resources.

Over time the resources of households change. Labor resources respond to changes in household composition, labor force participation, and the household's labor productivity relative to that of other households. Physical resources are determined by the saving behavior of households and the transfers of wealth between cohorts in the form of bequests.

In addition, redistributive policies of the government influence the distribution of household income by imposing taxes and providing benefits that vary with the generation to which the household belongs.

Household disposable income

Household disposable income consists of four components: labor income (Y^L), returns on assets (Y^A), net government payments, *i.e.*, transfers less taxes (G), and private transfers (T^P).

$$Y^D_{xt} = Y^L_{xt} + Y^A_{xt} + T^P_{xt} + G_{xt} \tag{1}$$

Factor income is distributed in proportion to the real resources, human and physical, owned by each cohort of households. The share of aggregate labor income earned by age

x households is equal to the share of total labor resources, measured in productivity units (L_{xt}/L_t), of members of age x households.[1]

$$Y_{xt}^L = Y_t^L L_{xt}/L_t \tag{2}$$

In like fashion, the share of asset income is determined by the share of national assets owned by age x households. Asset income includes returns to assets held abroad (Y_t^F), as well as, returns to domestically invested assets or *capital*.

$$Y_{xt}^A = (Y_t^K + Y_t^F)A_{xt}/A_t \tag{3}$$

Domestic factor income

Net national product is determined by an exogenously given rate of growth, but the factor distribution of income is modeled using an aggregate production function with two factors of production, capital and effective labor, and Hicks-neutral technological growth:

$$Y_t = \Gamma_t F(K_t, L_t) \tag{4}$$

and assuming constant returns to scale, total product is exhaustively divided between workers and owners of capital:

$$Y_t^L = \Pi_t^L Y_t \tag{5}$$

$$Y_t^K = \Pi_t^K Y_t \tag{6}$$

Assuming further that the production function, F, is translog, factor shares are linear in the natural logs of the ratio of capital to effective labor, k_t:

$$\Pi_t^L = \beta_0 + \beta_1 \ln k_t \tag{7}$$

$$\Pi_t^K = 1 - \Pi_t^L \tag{8}$$

Foreign factor income

Aggregate income from foreign assets, Y_t^F, is determined as the product of assets held abroad, A_t^F, and an exogenously given rate of return, i_t:

$$Y_t^F = i_t A_t^F \tag{9}$$

[1] Age x households are those in which the household head is age x.

Labor supply

The national labor supply, L_t, and the labor resources of each household cohort, L_{xt}, are measured in productivity units that account for variation in labor productivity associated with the age and sex of workers. Productivity differentials are captured by weights for male and female workers, w_{at}^m and w_{at}^f.

$$L_t = \sum_a w_{at}^m L_{at}^m + \sum_a w_{at}^f L_{at}^f \tag{10}$$

The relative productivity of different age groups rises, in general, with age (experience) but is also influenced by cohort size.

$$w_{at}^i = f_a(L_{at}^i / L_{0t}^i) \tag{11}$$

where L_{at}^i is the number of workers aged a and sex i.

The labor resources of households aged x are determined by the number of workers belonging to each household cohort and their productivity relative to other workers. The number of workers is determined by the number of household members in each age-sex group, N_{axt}^i, and by exogenously given forecasts of age-sex specific labor force participation rates, l_{at}^i.

$$L_{xt} = \sum_a w_{at}^m l_{at}^m N_{axt}^m + \sum_a w_{at}^f l_{at}^f N_{axt}^f \tag{12}$$

Saving and the accumulation of wealth

The assets of households aged x, A_{xt}, are determined by three factors: assets five years earlier, total saving over the preceding five years, and net private transfers (bequests) during the preceding five years.

$$A_{xt} = A_{x-5,t-5} + S_{x-5,t-5} + 5T_{x-5,t-5}^P \tag{13}$$

Household saving by each cohort is calculated as a fraction of its annual factor income plus net government payments.

$$S_{xt} = \beta s_{xt}[Y_{xt}^L + Y_{xt}^A + G_{xt}] \tag{14}$$

Annual saving is inflated to quinquennial saving using the factor, β.[2] Based on research by Ando, 1985 to be described in more detail below, the saving ratio, s_{xt}, depends on household age, the asset-income ratio, and demographic characteristics of the household.

[2]The factor, β, would equal 5 in the absence of growth in cohort income during the quinquennia in question. It will exceed 5 given positive growth, the more typical case.

$$s_{xt} = f(A_{xt}/Y^D_{xt}, x, N_{axt}) \tag{15}$$

Household assets are allocated among three end uses, domestic investment in fixed capital and inventories, foreign investment, and housing. The capital stock in each year, K_t, and foreign assets, A^F_t, are calculated as:

$$K_t = \kappa_t \sum_x A_{xt} \tag{16}$$

$$A^F_t = \gamma_t \sum_x A_{xt} \tag{17}$$

whereas the remainder gives the value of housing.

Net private transfers

Net private transfers consist entirely of "bequests", B_{xt}, associated with the "death" of households belonging to each cohort. The percentage of cohort assets bequeathed in any period is equal to the percentage decline in the number of households aged x, H_{xt}.[3] Cohorts which do not decline during the preceding five year interval do not generate bequests. Of course, the number of households may decline because the household head dies or because the headship mantle is passed on to the next generation. Private transfers generated by either event are not distinguished.

$$\begin{aligned} B_{xt} &= A'_{x-5,t-5}(H_{xt} - H_{x-5,t-5})/H_{x-5,t-5} && \text{if } \Delta H_{xt} \leq 0 \\ &= 0 && \text{if } \Delta H_{xt} > 0 \end{aligned} \tag{18}$$

where A' measures pre-bequest assets.

All bequests are assumed to be made to the descendant generation, *i.e.*, from the household of the head to the offspring of the head. Offspring are assumed to share inheritances equally without respect to their parity. The share of bequests from households aged x inherited by all individuals aged a in year t, h_{axt}, is calculated using procedures described below. Per capita inheritances is given by:

$$I^{pc}_{at} = \sum_x h_{axt} B_{xt}/N_{at} \tag{19}$$

and the inheritance of the age x household cohort is:

---

[3]This approximation is based on the assumption that wealth and mortality are independent and will be violated to the extent that the demise of a household is affected by the depletion of its financial resources. This assumption no doubt imparts a downward bias to the age distribution of bequests.

$$I_{xt} = \sum_a N_{axt} I_{at}^{pc} \tag{20}$$

Finally, net private transfers received by each cohort are calculated as the difference between inheritances received and bequests made:

$$T_{xt}^{P} = I_{xt} - B_{xt} \tag{21}$$

Net government payments

Net government payments to households aged x are equal to transfer payments received, R, less taxes paid, T.

$$G_{xt} = R_{xt} - T_{xt} \tag{22}$$

Taxes paid by each household cohort, T_{xt}, are assumed to be generated by proportional income taxes applied to factor income. Government benefits received by each household cohort, R_{xt}, are modeled in like fashion by assuming that transfers paid to any household are a fixed proportion of factor income. Both tax and benefits rates vary with age of the household head, x.

$$T_{xt} = \tau_{xt}[Y_{xt}^{L} + Y_{xt}^{A}] \tag{23}$$

$$R_{xt} = r_{xt}[Y_{xt}^{L} + Y_{xt}^{A}] \tag{24}$$

IMPLEMENTATION OF THE MODEL

Factor Shares

Labor's share, equation 7, is estimated after introducing a term to control for short-term fluctuations in the economy which are associated with variation in capacity utilization and unemployment and, hence, labor's share of domestic product. The basic model estimated, then, is:

$$\Pi_t^L = \beta_0 + \beta_1 \ln k_t + \beta_2 f_t + e_t \tag{25}$$

where f_t measures short-run fluctuations as explained below.

All of the independent variables are measured using readily available published data. Capital is measured as private capital in billions of yen deflated using the private capital deflator provided by the Economic Planning Agency. Labor is measured by the labor force (tens of thousands of workers) reported by the Statistics Bureau. Short-run fluctuations

in the economy are captured using the average annual unemployment rate measured in percent.

Estimates of the labor share are difficult to construct for Japan because a large, but declining, fraction of workers are self-employed or unpaid family workers. Thus, labor share estimates require the imputation of wages for a large number of workers. Our estimate of labor share was constructed using the following data: (1) the denominator of the share variable is gross national product; (2) the numerator for wage and salaried workers, consists of compensation including year end bonuses and employers' contribution to social security. Both series are extracted from the Japan Statistical Yearbook; (3) the real compensation of self-employed and family workers is imputed based on the average compensation of employees and data on the number of self-employed and family workers as reported by the Japan Statistical Yearbook.

The final estimates are based on an imputed annual wage for self-employed and family workers that is one-half the annual average earnings of wage and salaried workers. Efforts to statistically estimate relative wages of different types of workers did not prove to be successful. However, sensitivity analysis revealed that the relationship between the labor share and the capital-labor ratio is not sensitive to the weight used. Obviously, the level of the labor share will depend on the assumption employed. In 1986, about 25% of all workers were self-employed or family workers, so quite clearly any estimate of the labor share is subject to considerable uncertainty.

Two previous studies of the Japanese economy provide time series data necessary to estimate the labor share equation for earlier periods that can be compared with the results obtained here. Ohkawa and Rosovsky provide annual estimates of capital, labor, and the factor shares of each for the private non-agricultural sector for two periods: 1908–1938 and 1954–1964. Denison and Chung provides annual estimates for the non-residential business sector for the 1952–1971 period. Labor share equations using these series have been estimated with short-run fluctuations measured as the deviation in the annual rate of GNP growth from a five-year moving average.

Statistical results, corrected for first-order autocorrelation using Cochrane–Orcutt procedures are reported in Table 1.

The only issue of concern as far as the macro-model is concerned is the elasticity of the share with respect to the capital labor ratio. For the three post-war periods the elasticity is estimated at –0.119 for 1955–62; at –0.045 for 1954–69; and at 0.104 for 1965–85. Taken at face value, these results say that additional increments in the capital stock relative to the labor force during earlier periods did not depress the returns to capital relative to wages sufficiently to lead to a decline in capital's share. More recently, as the capital labor ratio has reached new heights, additional increases depress the returns to capital relative to wages so much that capital's share is actually declining.

For simulation purposes, we are unconcerned about short-run fluctuations in the economy or the share of labor. Thus, we set the unemployment rate at its mean, and labor's share is calculated as:

$$\pi_L = 0.2327 + 0.1038 \ln K/L \tag{26}$$

For the base year, total wages are calculated as the product of the calculated share and observed national product. Thereafter, national product is assumed to grow at the real rate observed between 1980 and 1985, 3.6% per annum.

Labor Supply

Labor supply is calculated as the product of age- and sex-specific labor force participation rates and the corresponding populations. The participation rates employed are based on forecasts from the Nihon University Population Research Institute's long-term macromodel, phase III (Ogawa, *et al.*, 1988). The major factors determining participation in the NUPRI model are (1) rising school enrollment among young adults, (2) declining fertility among childbearing women, and (3) increased pension benefits among elderly men.[4] Equations for two age groups of men, 15–24 and 60 and older, and four age groups of women, 15–24, 25–44, 45–54, and 60 and older, were statistically fitted to annual time series data for the 1965–1984 period.

Two trends are noteworthy. The increased participation among women of childrearing age is a continuation of recent changes and a by-product of reduced rates of childbearing. The decline in participation among elderly women and especially elderly men is primarily a consequence of changes in the age distribution of those 60 and older. Participation among prime age males, *i.e.*, those aged 25–59, is subject to little systematic variation and is held constant at the sample mean. More detailed age-specific rates were obtained by holding relative rates within broad age groups constant. The resulting age-specific rates are presented in Table 2.

Relative wages and labor productivity

Labor productivity is critical to two aspects of the model presented here. First, the distribution of national income between capital and labor varies with the capital-labor ratio which, ideally, measures both factors with provision for improvements in quality. Although we have made no provision for improvements in the quality of capital other than those captured by price changes, we estimate changes in labor quality associated with changes in the age-distribution of the labor force. Second, the share of labor income earned by labor force cohorts depends on both their numbers and their productivity relative to members of other labor force cohorts.

As is true in other countries, wages rise with the age of the worker and are higher for males than females. Are these differentials solely productivity related or do they reflect institutional features of the Japanese labor market? The seniority-based wage system,

[4]Participation rates are not endogenously determined in this paper, and labor force participation rates are not affected by differences in the way pension benefits are modeled in this and the NUPRI model. In any case, the effects of pensions are small and not statistically significant (Ogawa *et al.*, 1988.

whereby salaries are closely related to age and duration of service, is a major feature of the male labor market in Japan. Although productivity certainly rises with general and firm specific experience, it is widely believed that young workers are paid less than the value of their marginal product and older workers are paid more. In recent years, however, the wage system has been changing from a seniority-based system to a performance-based one that ties wages more closely to productivity. In 1984, for instance, only 5% of all Japanese companies relied exclusively on the seniority based system.

Sex differentials in wages also reflect "institutional" factors, as well as, differences in productivity. Until recently, female participation was relatively low in Japan. Women typically withdrew from the labor force upon marriage or the birth of their first child. Recent years have witnessed an impressive growth in female participation, but women generally have less experience than their male counterparts, work shorter hours, have slightly lower educational attainment and are in lower paying occupations. But the available evidence indicates that wage differentials are greater than can be accounted for by productivity-related factors alone (Ogawa, 1987).

The divergence between wages and productivity is more critical to determining the rate of growth of Japan's effective labor force and, hence, its share of total output, than in determining the distribution of labor's share among different labor cohorts. Japan's labor force has been undergoing two important demographic shifts: aging of the labor force and feminization of the labor force. To the extent that wage differentials overstate the relationship between age (experience) and productivity, using wages as a proxy for productivity will overstate recent growth in Japan's effective labor force. By contrast, to the extent that wage differentials understate the relative productivity of women, using wages will understate recent growth in Japan's effective labor force. In the absence of any clear basis for adjusting wages for non-productivity related components, we have assumed that the growth rate of the effective labor force is adequately measured using wages to age-sex productivity differentials.

The model employed here is also based on the assumption that the current sex differential in wages, in relative terms, will persist into the future. However, the age-earnings profile is expected to change in response to changes in the age composition of the labor force. Several studies (Martin and Ogawa, 1984; Mosk and Nakata, 1985) have analyzed Japanese data to examine the well known observation that if workers of different ages are not perfect substitutes in the production process, labor productivity and, hence, wages of any labor cohort will move inversely to its relative size.

The wage-earnings profiles estimated here are based on a replication of the Martin-Ogawa study using the Basic Survey on Wage Structure conducted annually by the Ministry of Labour. The survey is nationwide in its coverage and, in 1986, included about 70,000 firms with ten or more employees. The analysis here is based on data collected from 1962 to 1986. A very simple specification is employed. Wage equations are estimated separately for males and females in seven age groups. The regression equation used is:

$$\ln w^i_{at}/w^i_{0t} = \beta_0 + \beta_1 \ln L^i_{at}/L^i_{0t} + \beta_2 CYCLE_t + \eta_t \qquad (27)$$

where w^i_{at} and L^i_{at} are the wage and labor force for age group a and gender group i and w^i_{0t} and L^i_{0t} are the wage and labor force figures for male or female workers aged 20–24. $CYCLE$ is included to capture short-run effects associated with the business cycle and is the residual obtained from regressing the natural logarithm of per capita GNP on year. Ordinary least squares estimates exhibited first order autocorrelation and Cochrane-Orcutt procedures were used to obtain the statistical estimates presented in Table 3.

Despite the simplicity of the model employed, a partially supportive picture of the cohort-size effect emerges. For most male age groups, a one percentage point increase in the number of workers depresses wages by about 0.02 to 0.04 percentage points. Whereas for most female age groups, wages are depressed by about 0.03 to 0.07 percentage points. Most coefficients are not estimated with sufficient precision to satisfy standard criteria for statistical significance. The estimated coefficients for women sixty and older is large and positive contrary to our expectations.

The model is not intended to incorporate the estimated effects of short-run economic fluctuations so that $CYCLE$ is set to its expected value of zero for forecasting.

Consumption functions

The consumption functions employed in this model are based on extensive analysis of the 1974 and 1979 National Surveys of Family Income and Expenditure conducted by Ando (1985) in cooperation with the Economic Research Institute, Economic Planning Agency, Government of Japan. Ando employed a life-cycle framework to investigate the high rate of personal saving, particularly among the elderly. Of course, saving among the elderly in Japan continues to be a puzzle to proponents of the simple life-cycle model because Japanese households do not appear to be consuming a large portion of their wealth as they approach the "end of their life."

To summarize Ando's result quite briefly, he finds that among households under age 62, the marginal propensity to consume out of assets ranges from 0.03 to 0.04 and varies little with the age of the household head. For households over age 62, he estimates a marginal propensity to consume out of assets of only 0.016. Ando also analyzes the impact of demographic and other variables which we have been able to incorporate into our model in a limited way. For households under 62, he finds that the consumption ratio increases with additional members and that the effect depends upon the age of the member. Those over 56 have the greatest impact and those under 18 have the smallest impact on the consumption ratio.[5] For households 62 and older, Ando found no evidence of demographic effects.

It is not possible to incorporate the full detail of Ando's estimated consumption functions into our model. A number of variables have been excluded or collapsed into broader categories with compensating adjustments in the intercept. Also, Ando did not employ standard five-year age of head categories available from our household projections. There

[5] Ando's specification allows for non-linear relationships between consumption and household membership, but it is not possible to incorporate these into the macro level forecasts since the size distribution of household membership is not projected.

are also important definitional differences between variables measured at the aggregate level, on which we rely, and conceptually similar variables measured at the household level. Although we have tried to maintain as much consistency as possible there are some important slippages. For example, for older households consumption is measured as a fraction of disposable household income which would not include retained earnings, whereas our measure of disposable income does includes all corporate earnings whether distributed or not. To maintain consistency at the aggregate level to the extent possible, the consumption ratio has been adjusted by a constant fraction to the observed 1980 consumption ratio.

For households with a head under the age of 60, the unadjusted consumption function used is:

$$\begin{aligned} C_{xt}/Y_{xt}^{dL} &= 0.336 + 57.051/Y_{xt}^{dL} \\ &\quad + [0.034DA_1 + 0.032DA_2 + 0.036DA_3 + 0.035DA_4]A_{xt}/Y_{xt}^{dL} \\ &\quad + 0.055N_{xt}^{<19} + 0.06N_{xt}^{19-55} + 0.07N_{xt}^{56+} \end{aligned} \tag{28}$$

where C_{xt} is consumption by age x households in year t, Y_{xt}^{dL} is disposable labor income, DA_i are age of head dummies used to distinguish households with heads under 30, 30–39, 40–49, and 50–59, and N^i are the number of household members in the indicated age groups. All monetary variables are measured in ten-thousands of yen.

For households with a head 60 or older, the consumption function used is:

$$C_{xt}/Y'_{xt} = .310DA_1 + 0.299DA_2 + 0.262DA_3 + 82.41/Y'_{xt} + 0.016A_{xt}/Y'_{xt} \tag{29}$$

where Y'_{xt} is household disposable income net of private transfers and DA_i are dummy variables that distinguish households with heads aged 60–69, 70–74, and 75 and older.

Accumulation and the distribution of wealth

Saving by each household cohort x in year t is calculated as the difference between consumption and disposable income net of private transfers. Because forecast values are calculated at five year intervals, saving between t and $t+5$ is approximated. We assume that during the interval total saving grows at the same rate as NNP, and that, for any cohort, saving per household grows at the same rate as NNP per household.

Estates are settled at the end of each five year interval. Pre-bequest wealth of each household cohort is calculated as the sum of assets at the beginning of the period and saving during the five year interval. Cohort wealth is reduced in response to "mortality" among households and distributed to beneficiaries using procedures described below, to arrive at cohort wealth at the end of the five-year interval (or the beginning of the next interval).

Cohort wealth in the base year, 1980, is calculated as the product of the number of households age x and mean assets of age x households calculated on the basis of the

age profile reported in Ando (1985). Ando reports values separately for one-person and multi-person households in five year age categories, less than 21, 21–25, etc. We calculated weighted mean assets for all households based on our estimates of the relative size of one- and multi-person households. We adjusted the resulting profile to conform to standard age categories, *i.e.*, less than 20, 20–24, 25–29, *etc.*, using geometric interpolation. The resulting values are reported in Table 4. A final adjustment was undertaken by calculating total national wealth, comparing the results to independent estimates of total national wealth in 1980, and adjusting the age profile proportionately so as to maintain the Ando profile, but reproduce reported total wealth. Among other reasons, the Ando estimates understate total wealth because certain categories are excluded, e.g., family owned businesses. To the extent that excluded categories have age profiles differing from included categories, the age profile employed will deviate from the actual.

Estimates of the distribution of wealth among capital, housing, and foreign assets are reported in Table 5 for 1969 to 1986. Capital includes both private and government capital. Government capital has been deflated using the deflator for private capital because no deflator for government capital is currently available. The labor share equation is a function of private capital which is assumed to remain a fixed proportion of total capital (0.8).

As is apparent from the table, Japan is exporting capital at a remarkable pace. The percentage of assets held abroad increased from 3% in 1970 to reach 13% by 1985. In the simulations presented here, the ratio of foreign to domestic assets is held constant at the 1985 level so long as the return to capital exceeds the interest rate for foreign assets, assumed to be 3% per annum. Otherwise, the foreign sector absorbs sufficient assets to maintain equal rates of return to foreign and domestic assets.

Net Private Transfers

All private transfers are generated by bequests which are assumed to be distributed equally among all surviving offspring. The number of surviving offspring aged a to women aged x in year t is designated as O_{axt} and is calculated as the product of the population aged a in year t, N_{at} and intergenerational weights, ω_{axt}, which are based on the distribution of births by age of mother in year $t - a$ (for details see Mason and Martin, 1982). The share of bequests by households aged x transferred to individuals aged a is given by h_{axt}, where:

$$h_{axt} = \frac{\omega_{axt} N_{at}}{\sum_a \omega_{axt} N_{at}}. \tag{30}$$

The Government Sector

The tax and benefit rates employed are based on a survey by the Ministry of Health and Welfare querying 7165 households about their income, taxes, and public sector benefits for the 1983 calendar year (Ministry of Health and Welfare, 1984).

The results of that survey are reported in Table 6. Income includes wages, salaries, rent, interest dividends, private pension benefits, gifts, and other private transfers. Taxes include social insurance contributions by the employer. Benefits include social security payments, other cash transfers, and in-kind benefits, e.g., publicly provided health care.

Tax rates, benefits rates, and net government transfer rates are calculated by dividing taxes, benefits, and net government transfers, respectively, by income. The average tax rate, thus calculated, is 17.8% of household income. This compares with household tax rate based on 1983 calendar year national income account statistics, calculated as the ratio of direct taxes plus social security contributions (including the employers contribution) divided by total household receipts, of 15.7%.

Taxes levied directly on households comprise only a portion of all taxes collected. In 1983, for example, roughly 56% of all taxes were paid by households (including social security contributions of employers) whereas the remaining 44% was comprised of indirect taxes and direct taxes on corporations. The impact of these taxes on the intergenerational distribution of disposable income is a complex issue beyond the scope of this study. We will assume that taxes not paid directly by households are neutral with respect to the intergenerational distribution of income, *i.e.*, that disposable income is reduced proportionately without respect to age of head.

Age-specific household tax rates and the non-household tax rate are held constant. Of course, both the overall tax rate and benefit rate will vary with the intergenerational distribution of pre-tax income. The tax rates, reported in Table 7, have been calculated by adjusting the unadjusted rates (adding a constant fraction to each age-specific rate) so as to achieve a total tax rate of 0.292 in the base year — the calculated tax rate for the 1980 calendar year.

The simple approach employed will no doubt fail to capture important changes in Japan's tax and transfer programs, many of which may be adaptations to the rapid increase in the number of elderly and changes in their relative economic well-being. Indeed, a number of important changes have been instituted since the survey on which our model is based.

In 1986, for example, a major pension reform was carried out, integrating fragmented, occupation-based programs and establishing a base pension level for all beneficiaries. The pension rights of spouses of employees were also broadened substantially. In this and in subsequent action, the government is attempting to achieve a uniform and older pensionable age. Major reform has also been undertaken in the health care area in recent years. Between 1965 and 1979, medical care expenditure grew by nearly twenty percent per annum, but the rate of growth slowed considerably in the eighties as the government began controlling price increases and, in 1983, abolished free health care for those 70 and older by requiring a nominal payment. Beginning in 1984, co-payment ranging from 10 to 30 percent of all costs is required of those covered by medical care insurance. Finally, a major change in the government tax system was implemented April 1, 1989 with the adoption of a nationwide 3% consumption tax.

The simple treatment of the government sector also affects results because we do not

explicitly model taxes on bequests. In Japan, transfers in excess of 600,000 yen per year are subject to a progressive tax, although there are means, *e.g.*, trust funds, by which inheritance taxes are frequently avoided. An additional complication is that a significant fraction of private transfers as defined in this paper would not be subject to tax, in any case. Inheritance taxes are included in the income redistribution survey used as the basis for our treatment of the government sector. Thus, inheritance taxes are implicitly included but they are not affected by changes in the relative magnitude of bequests or by changes in the distribution of bequests described below.

Household and Population Projections

Projections of households and household membership require as input projections of the population in five-year age groups separately for males and females and underlying age-specific fertility rates. The projections are drawn from Ogawa, *et al.*, 1986. Forecast trends in fertility are based on a Butz and Ward-like fertility specification applied to Japanese time series data (Ogawa and Mason, 1986). Continued improvements in mortality are factored into the projection. The projected values of key demographic data are reported in Table 8.

The number and demographic composition of households are projected using a macro-simulation model called *HOMES* (Mason, 1987). The model uses a headship method whereby age- and sex-specific headship rates are multiplied by projected population data to obtain the number of household heads and, hence, the number of households. Households with male and female heads are projected separately and four types of households are further distinguished: (1) intact households, those with head and spouse both present; (2) single-headed households, households in which the head's spouse is absent; (3) primary individual households, household consisting of unrelated individuals; and (4) one person households. The total number of households by age of head, the required input for the model presented here, is obtained by aggregating across sex of head and type of household.[6]

Headship rates are based on special tabulations from the 1984 Family Income and Expenditure Survey (FIES) prepared by the Statistics Bureau. The FIES is used to maintain consistency between the household projections and the consumption functions, which are also based on FIES data. The most important difference between the FIES and alternative sources of data, *e.g.*, the population census, is the way in which the household head is determined. The FIES employs a breadwinner concept that essentially designates the principal earner as the head. In the population censuses, on the other hand, the household head is designated by the household.

The practical implications of the definitional difference is apparent in Table 9, which compares FIES sex- and age-specific headship rates with those based on the 1985 population census (calculated from special tabulations prepared by the Statistics Bureau.) FIES definitions imply the transfer of headship at a much younger age and, hence, a much younger age distribution of heads at any point in time.

---

[6]To be more precise calculations are all oriented around the household *marker*, who is the female householder, if present, or the male head, if his spouse is absent.

Less apparent in the comparison of headship rates is a substantially lower incidence of one person headship in the FIES which is primarily a consequence of the procedures used to select the sample. In order to improve the representativeness of the projections, one person headship rates based on the 1985 census have been substituted for FIES rates.

For each age of head, sex of head, and household type group, the number of male and female members in five-year age groups is projected using a kinship or relationship to head basis. Five relationships are distinguished: spouse, child, grandchild, parent, and other household members. Because household structure in Japan is predominantly lineal, children, grandchildren, and parents, along with spouse and head, make up the great majority of household members. In 1980, for example, 98.7% of the members of ordinary households fell into one of the five relationship to head categories.

For details of the procedures employed to project household membership, the reader is referred to Mason (1987). The basic idea, however, is as follows. For each household group, the number of candidates for household membership as a child of head, parent of head, or grandchild of head, are calculated for the base year, 1984 in this case. The number of candidates is compared with the number of coresidents to calculate age- and sex-specific rates that quantify the likelihood that members of the population will reside in each household group. Using population projections and underlying age-specific fertility rates, the number of candidates for household members are then projected taking trends in mortality and the level and timing of fertility into consideration. The rates calculated for the base year are then applied to the projected number of candidates to distribute members of the population among households. Any undistributed members of the population, are allocated to the *other household member* category and distributed among households in proportion to the age- and sex-specific distribution observed in the base year.

The resulting projections of household membership provides the age and sex distribution of the household membership for all households classified by the age of the marker (female householder, if present; male householder, otherwise), sex of the head, and type of household. Projections of the number of households and household membership assume no changes in the underlying rules that govern household formation and coresidence. To the extent that Japan experiences such changes, the household projections used here will prove to be inaccurate. Recent experience in Japan does indicate important changes in household formation, *e.g.*, an increase in the prevalence of one person households, a delay in the age at which young adults marry and establish family households, and increased headship among Japanese elderly.

RESULTS

Aging in Japan

The broad outlines of future aging in Japan are captured in Table 8, presented above. The table shows that, whereas 1 in 10 Japanese is over 65 today, nearly 1 in 4 will be over 65 by the year 2025. Moreover, the very old are growing even more rapidly than the elderly as a whole. By 2025, over half of all elderly will be 75 or older.

The aging of Japan's population is reflected in projected characteristics of Japanese households, as well. Trends in the number of households by age of head, pictured in Figure 2, are dominated by two factors: the passing of the post-war baby boom generation and by population aging. The baby boom translates into a peak at ages 35–39 in 1985, a peak at ages 55–59 and its echo at ages 30–34 in 2005, and the remnants of the echo at ages 50–54 in 2025. Because of population aging, the number of households headed by those 65 and older is expected to increase quite rapidly over the next four decades. And during the later part of the projection, the increase in the number of households headed by those 75 and older is particularly noteworthy.

The response of average household size to population aging varies with the age of the household head. Among older households, average size is expected to decline markedly as reduced levels of childbearing affect the size and prevalence of three generation families. Among middle aged households, *i.e.*, those aged 40–54, average household size is projected to rise. This occurs as adults assume increased responsibility for their parents because their parents are living longer and because they have fewer siblings with whom to share the responsibility. The three panels of Figure 3 show the changes in average household size and the particularly large increases in the number of elderly per household among the offspring generation.

Overview of Economic Forecasts

Table 10 provides basic national income account statistics for the simulation. Net national product, by assumption, grows at 3.6% per annum over the 45 year simulation. National income, which includes returns on assets invested abroad, grows somewhat faster than NNP, particularly toward the end of the simulation, because the difference in returns to domestic and foreign assets narrows with time and a larger fraction of assets are invested abroad starting in 2005. Disposable income grows slightly faster than national income as the tax rate drops modestly between 1980 and 2010. Consumption as a fraction of disposable income increases steadily from 75.4% in 1980, peaking at 81.4% in 2005, and declining to reach 78.3% in 2025. Saving, as consumption's complement, grows somewhat more slowly than disposable income between 1980 and 2005 and somewhat more rapidly after 2005.

The dramatic changes in factor proportions and shares presented in Table 11 are quite a contrast to the gradual changes characteristic of the national income aggregates. Two distinct periods are evident. Between 1980 and 2005, the private capital stock is forecast to grow quite rapidly — at an average rate of 4.9% per annum. During the same period, growth of the effective labor force slows to a halt and, over the entire twenty-five year period, averages an annual increase of only 0.4%. As a result, the capital-labor ratio increases three-fold. As labor becomes increasingly dear, the growth of real wages, at 4.0% per annum, outpaces the general economy. At the same time, the returns to capital declines from an annual rate of 15.8% in 1980 to only 3.1% in 2005.

The last twenty years of the simulation are greatly influenced by the low rate of return to capital associated with the extraordinarily high capital-labor ratio. Private capital is actually forecast to decline in pace with the effective labor force as investors look abroad

for satisfactory rates of return. The rate of return is forecast to increase gradually because technological innovation is increasing output at a relatively fast rate even though factors of production are forecast to decline. For the same reason, the real wage continues to grow at 4% per annum even though labor's share of national product increases only marginally over the two decades tracked. The shift in the contribution of labor, capital, and foreign investment to national income is summarized in Table 12.

The Distribution of Economic Resources

The distribution of national income is the product of three factors: the distribution of human resources, the distribution of wealth, and the economic return to human resources vis-a-vis wealth. Figure 4 shows the per household distribution of effective labor in 1985, 2005, and 2025.[7] Labor resources are concentrated among young and middle-aged households because their membership includes more adults of prime working age. Moreover, because productivity among men increases substantially with age, peaking during the forties, households with middle-aged men are particularly advantaged with respect to labor resources.

Over the forty years pictured, the distribution of labor resources shifts even more in favor of young households. Several factors account for this change. First, labor force participation declines steadily among older adults as they choose to retire at a younger age. Second, the average number of adults of prime working ages living in elderly households declines significantly during the period. For example, the average number of adults 15–64 years of age living in a household aged 65–69 declines by over 50% from 0.7 to 0.3 between 1985 and 2025. During the same period, the number of adults 15–64 living in households aged 50–54 declines by much less, from 2.8 to 2.7 members per household in 2025. Third, the age productivity profile shifts in an unfavorable way for the elderly. In 1985, men 60 and older received a wage averaging 17% more than that received by men 20–24. By 2025, the premium had dropped to 14% in response to the increased supply of older workers. But of the three factors contributing to the changing distribution of labor resources, changes in the age-productivity profile had a relatively minor impact. In fact, the relative wage of women actually rose somewhat, offsetting the forecast decline among men.

Per household wealth in Japan is concentrated among older households. The 1985 profile, shown in Figure 5, rises rapidly with age, peaking among households aged 55–59 and declining gradually thereafter. The cross-section reflects both the distinct saving behavior and the earnings history of each household cohort about which there is only limited information. From the evidence that is available, however, the lower per household wealth of older households no doubt reflects their lower lifetime earnings rather than any tendency to dis-save during the retirement years.

During the first two decades of the simulation there is a very clear shift in the distribution of per household wealth toward older households. And during the final two decades of the simulation, the distribution returns very nearly to the pattern "observed" in 1985.

[7]The values graphed in this and subsequent figures are the per household values for each age group divided by the simple average for all age groups.

Because of the complexity of the wealth simulation, it is difficult to untangle the reasons for these changes, but two factors stand out. First, older households, who did not participate fully in Japan's post-war economic miracle, are being replaced by households whose members were just entering the labor force at the end of World War II and have fully enjoyed the benefits of economic growth. A second factor is the change in the pattern of bequests. We will have more to say about this below, but there is a significant change in the distribution of inheritances between 1985 and 2005. In both 2005 and 2025, per household inheritances are much more heavily concentrated among households with a head aged 35–49 and much less heavily among those under aged 30 or over age 60. The changing pattern of inheritance leads to a somewhat slower accumulation of wealth among young households and a catching-up during the middle ages, followed by slower accumulation among the elderly.

The changes in the distribution of per household wealth between 1985 and 2005 are not a product of changes in saving behavior. In fact, the saving ratio of young households (those under 35 years of age) increases throughout the simulation in response to a decline in their wealth-income ratio. But the change in the wealth distribution after 2005 reflects a significant increase in saving among the young and a substantial decline in saving among middle aged households.

Beyond these elements there are several features of the model that may affect the reliability of our results, particularly estimates of the wealth of young households. First, for young households labor force participation is undoubtedly underestimated because no account is made of the statistical dependence between participation and headship. A higher percentage of young household heads are undoubtedly employed than we are forecasting. Second, there is no provision for private transfers other than bequests. To the extent that parents provide their offspring with "start-up" capital, we will under-estimate the wealth of young households and over-estimate the wealth of the parents of young household heads. Third, the initial distribution of wealth is based on incomplete data and subject to error that may be systematically related to age. But, all in all, the age distribution of wealth shows a surprising stability and a plausible trend despite the simplifying assumptions employed in the model and errors in the data.

The Distribution of Household Income

Between 1985 and 2005, shifts in both the distribution of wealth and the distribution of effective labor force contributed to an increased concentration of income per household among young households. Moreover, throughout the simulation, labor's share of income is increasing. Because labor resources are much more concentrated among young households than wealth, the increase in labor income relative to capital income contributed substantially to the shift in national income toward young households. Thus, all three factors contributed to the shift in per household income pictured in Figure 6.

For the remaining two decades of the simulation, national income is increasingly concentrated among young households. Although labor's share increases only marginally after 2005 and the distribution of wealth shifts toward older households, such a substantial percentage of national income accrues to labor, that the continued increase in effective labor

among young households dominates the trend in the distribution of national income.

Transfers have an important impact on the distribution of income. Government payments, combining taxes and transfers, raise the disposable income of households with a head 60 or older by a substantial amount: more than 20% in the case of households with a head 60–69 and by more than 40% in the case of households with a head 70 or older. Moreover, very young households are taxed at a somewhat lower rate than middle aged households. The shift in disposable income is apparent in Figure 7 which shows substantially higher relative income among older households. The impact of private transfers, or bequests, on the income distribution is somewhat mixed. In 1985, the greatest beneficiaries, in terms of the percentage increase in their disposable income, are households in their late twenties and early thirties, which had below average pre-transfer incomes. On the other hand, older households benefited the least from transfers so that in relative terms they are generally worse off.[8] After 1985, private transfers are increasingly concentrated among middle-aged households and quite clearly contribute to a less equal distribution of household income.

The trend in intergenerational inequality in per household income and the impact of transfers are summarized by Table 13 which presents the variance of the natural log of per household income. Two sets of values are provided — one that includes all age categories and a second that excludes households with a head aged under 25 years of age.[9] Several conclusions stand out. First, the impact of government transfers on the intergenerational distribution of income is quite significant. In 1985, the log-variance is reduced from 0.062 to 0.023 for households over the age of 25. Equally large effects of government taxes and transfers occur in the other two years presented, 2005 and 2025. Second, intergenerational inequality in income increases quite substantially throughout the simulation. Again, confining our attention to households over 25, the variance of the log of per household disposable income increases from 0.023 in 1985 to 0.060 in 2005 and to 0.099 in 2025.

However, a widely used alternative approach to measuring income inequality leads to quite different conclusion. Following Kuznets (1975) and Schultz (1982), we have calculated household income per capita by dividing per household income by the number of members. Table 14 presents new values of the log-variance based on per capita income. The differences are remarkable. First, the extent of intergenerational inequality is generally much lower using per capita income as an index of well-being rather than per household income. Second, once we control for variation in household size, intergenerational inequality in disposable income declines throughout the simulation and particularly between 1985 and 2005. Finally, the net impact of government payments is to increase rather than to reduce the extent of intergenerational inequality in 1985. On the other hand, the current

[8]This finding is true by construction because all transfers are assumed to be intergenerational in nature and no account is made of intra-generational transfers or reverse intergenerational transfers.

[9]These households are excluded because they have such a large impact on summary measures and because values for them are less reliably estimated.

tax and benefit policies very effectively equalize disposable per capita income in the future, reducing the log-variance to 0.007 in 2005 and to 0.003 in 2025.

The results as summarized are equally clear in the detailed plot of per capita household disposable income. In 1985, per capita household income increases almost monotonically and linearly with age. By 2005 and 2025, however, the age distribution of per capita household disposable income is very nearly uniform.

Bequest and Inheritance

Bequests arise in this model as a direct result of a net decline in any five year period in the number of households headed by individuals in a given five year age group. Thus, we do not distinguish the transfer of assets associated with the death of the head from a transfer associated with the merger of an old household into a young household or even the redesignation of the head within a household that in other respects experiences no changes in its demographic character. The relevant issue is control over wealth and the timing of the transfer of control from one generation to the next. Of course, in many instances no single point in time can mark the transfer of control, but there is no obvious measure of control preferable to the household headship designation.

An important shortcoming of the approach taken here is that the probability of "dying" and wealth are assumed to be independent. Individual mortality may be influenced by financial well-being and, perhaps more importantly, the continued existence of older households may be critically related to wealth. By failing to account for the statistical dependence we over-estimate bequests by younger households and under-estimate bequests by older households. Likewise, our estimates of the distribution of wealth and income described above are affected.

Setting these shortcomings aside, several clear trends in bequests and wealth stand out. First, total bequests are expected to grow quite rapidly. Figures reported in Table 15 show total bequests per quinquennia increasing from 69 trillion yen during the 1980–85 period to 648 trillion yen in the 2020–25 period. This amounts to an annual rate of growth of 5.0% as compared with a 3.6% rate of growth for NNP and a 4.6% rate of growth for total wealth. As a result, bequests per five-year period increase from about 10 per cent of wealth in 1980–85 to just over 15 per cent of total wealth in 2025. For the economy as a whole, bequests generate no increase in real wealth. But for households that continue to exist, inheritances constitute an importance means by which they increase their real wealth. Between 1980 and 1985, inheritances are estimated to equal 30% of total saving. But the percentages increase remarkably fast, peaking at 73% during 2005–10.

There are also important changes in the age distribution of bequests and inheritances. Figure 9 shows the age of head distribution of bequests and inheritances for the five year periods preceding 1985, 2005, and 2025. The distribution of bequests are systematically shifting toward older households. The mean yen weighted age of bequests increased from 65.1 years in 1985, to 66.6 years in 2005, and to 68.8 years in 2025. Although part of the shift between 1985 and 2005 is a consequence of a similar shift in the age distribution

of wealth described above, the driving force is the aging of the population because the average age of those dying increases, as well.

The age distribution of inheritances shifts in response to the aging of the bequest distribution. The average age of inheritance increases by about 2.4 years over the four decades tracked, increasing from 41.2 years of age in 1985 to 43.6 years of age in 2025. The mean age of inheritance increased by less than that of bequests because of an increase in the mean generation length, measured in this unusual way, from 23.8 years to 25.2 years between 1985 and 2025.

The economic impact of inheritance from the household's perspective is clarified by Figure 10. The contribution of inheritance to household disposable income declines steadily with household age. In 1985 the average annual inheritance exceeded 10% of disposable income for households 20–24 and 25–29, but declined steadily, contributing less than 5% of disposable income for households aged 40–44. For nearly all household ages, the importance of inheritance will increase remarkably over the next four decades, contributing nearly 20% of disposable income for households 30–34 in 2025. For households aged 35–64, the percentage contribution of inheritance will more than double.

What explains this remarkable increase? Two factors are primarily responsible. First, as indicated above, total bequests are growing more rapidly than national income. Second, the reduced level of fertility among successive cohorts of those who bequeath means that those who inherit must share their estates among fewer siblings.

Foreign Investment

One of the most startling results of the simulation is the decline in the returns to capital associated with a rapidly rising capital-labor ratio. Capital's share is projected to decline from one-quarter of net national product in 1980 to only 10% in the year 2000. The importance of changes in the relative returns to human and physical capital is highlighted above. The impact on foreign investment and economic relations between Japan and the rest of the world may be even more important.

The simulation model provides a relatively crude rendering of the likely course of foreign investment. During the first 20 years of the simulation, 1980–2000, the percentage allocations of investment between the private sector (excluding housing), the public sector, housing, and the foreign sectors are held constant at their 1985 levels. During that period, the rate of return to domestically invested capital has declined to 3% as the capital-labor ratio reached 140. Thereafter, additional investment, except that necessary to maintain a domestic rate of return of 3%, flows abroad.

Were this scenario to hold true, the percentage of Japanese wealth held abroad would be relatively constant at around 13% through 2005, but would increase to 33% in 2015 and 46% in 2025. From approximately 100 trillion yen (1980 prices) in 1985, assets held abroad would reach 1,000 trillion yen in 2015 and 2,100 trillion yen in 2025.

One can easily imagine variants to this broad phenomenon. First, the private sector may absorb a smaller share of total investment during the first two decades of the simula-

tion. In recent years the share of investment going to the foreign sector has increased and one could well expect this to continue. During the period 1986–88, dollar-denominated long-term capital transfers averaged twice the amount observed in 1985 (World Bank, 1990). However, a great deal of the increase could be traced to appreciation of the yen; yen-denominated long-term capital transfers in 1988 were no greater than those observed in 1985.

Second, the simulation assumes that the share of investment going to housing and the public sector will remain constant, but one can easily imagine a substantial increase in both components. Indeed, the government is already increasing spending on public infrastructure and the need for additional investment in housing has been widely noted.

Finally, the simulation assumes that changes in the rate of interest will have no impact on the saving rate. A decline in the return to capital should have some adverse impact on the rate of saving, reducing the amount of investable funds available.

Despite all of these qualifications, slower labor force growth and high rates of saving will no doubt guarantee rapid growth in the export of capital to the rest of the world.

CONCLUDING REMARKS

The results from an exercise as ambitious as this one must be subject to considerable scrutiny before reaching any firm conclusions. Any of the findings reported above should be viewed as tentative and subject to further research and revision. But accepting the tentative nature of our findings, what conclusions stand out?

A surprising conclusion is the lack of intergenerational inequality in per capita income in 1985. Even more surprising is the finding that per capita income of households headed by the elderly are quite satisfactory as compared with other households. Several factors contribute to this conclusion. First, the elderly have maintained high rates of saving, achieved relatively high levels of personal wealth, and interest income nearly sufficient to offset the decline in labor earnings associated with retirement. Second, the continued prevalence of extended households in Japan means that many elderly households have members of prime working age. Thus, effective labor per capita among elderly households is not that much less than in younger households. Third, government taxes and transfers have a very significant impact on the intergenerational distribution of disposable income — increasing income of those 60–69 by over 20% and of those 70 and older by over 40%.

In the same vein, the forecasts described above do imply a deterioration in per capita household income of elderly households relative to younger households, but current public policy seems sufficient to maintain a remarkably equitable intergenerational distribution of income.

The second important finding in this paper is the conclusion that inheritance will become an increasingly important component of disposable income. In general, we know very little about the impact of inheritance on household behavior. But in the model employed here, increased bequests have for many household age groups reduced the wealth income ratio and depressed the average rate of saving. In Japan, it is obviously important to have direct evidence about the impact on household saving or, alternatively, labor force

participation of a rise in inherited wealth.

As we have repeatedly warned, however, the findings must be qualified to the extent that important processes are underway in Japan not captured by our model. Most importantly the roles of both the government and the family are in transition. The simple tax and transfer model employed does not begin to capture the complexity of the issues that public policy makers will face in an increasingly aged society. The approach employed here implies a relatively slow growth in transfer payments even though the numbers of elderly are increasing rapidly. This is so because transfer payments are a fixed percentage of income received by each age group and the pre-tax and transfer income of the elderly grows much more slowly than their numbers. In 1980, for example, households headed by the elderly were 8.0% of all households and earned 6.6% of total factor income. Thus, they earned about 20% below their *prorata* share. But by 2000 we forecast an increase in the proportion of elderly households to 12.8% of the total while their share of factor income rises to only 7.4%. It may be unrealistic to expect a relative deterioration in transfer payments in step with the relative economic status of the elderly. On the other hand, it is unrealistic, as well, to expect public sector action sufficient to overcome the relative decline in the income of the elderly. Recent steps in Japan have signaled rather clearly the intent of the government to reduce the potential public sector burden of a rapidly aging population.

Important changes in the Japanese family may prove to be as important as changes in public policy. In the traditional Japanese family, elderly continued to live with their children apparently able to count on their economic and emotional support. In modern Japan elderly are increasingly likely to live independently of their children and, often, by themselves. In 1985, for example, elderly women were nearly twice as likely to live alone as they were in 1970 (Mason, *et al.*, 1989). With fewer children, increasing rates of divorce, and high rates of widowship among the very old, the percentage of elderly men and women living alone may continue to rise rapidly in Japan in the foreseeable future. It would be simplistic to equate separate living with isolation, however, because many Japanese children continue to be involved in their elderly parents' lives even when they are living separately (Martin, 1989; Martin and Tsuya, 1989). None the less, the economic problems faced by the elderly may be more serious than pictured here.

The macroeconomic implications of this model also merit further attention. The results presented here are based on the assumption that net national product will continue to grow at the same rate as during the first part of the 1980s. At the same time, returns to domestically invested capital are forecast to decline rapidly in the face of increased capital per worker. It seems questionable that technological innovation will be sufficient to sustain the rate of growth assumed in the face of a stagnant labor force and rapidly diminishing returns to capital. A slowdown in the rate of growth of the Japanese economy would generally twist the intergenerational distribution of income against younger generations and in favor of older generations. Of course, all generations, young and old alike, will be worse off in absolute terms with a slowdown in economic growth.

REFERENCES

Albert Ando, *The Savings of Japanese Households: A Micro Study Based on Data from the National Survey of Family Income and Expenditure, 1974 and 1979*, Tokyo, June, 1985.

Edward F. Denison and William K. Chung, *How Japan's Economy Grew So Fast: The Sources of Postwar Expansion* (Washington, D.C.: Brookings Institute, 1976).

Japan, Ministry of Health and Welfare, *Results from the Income Redistribution Survey, 1984*.

Japan, Prime Minister's Office, Statistics Bureau, *Japan Statistical Yearbook*, various.

Simon Kuznets, " Demographic Aspects of the Size Distribution of Income: An Exploratory Essay," *Economic Development and Cultural Change* 25 (October 1976) 1–94.

Linda G. Martin, "The Graying of Japan," *Population Bulletin* vol. 44 (June, 1989) forthcoming.

Linda G. Martin and Naohiro Ogawa, "The Effect of Cohort Size on Relative Wages in Japan, in Ronald D. Lee, *et al.*, eds., *Economics of Changing Age Distributions in Developed Countries*, (New York: Oxford University Press, 1988) 59–75.

Linda G. Martin and Noriko O. Tsuya, "Interactions of Middle Aged Japanese with their Parents," paper presented at the Population Association of America annual meetings, Baltimore, Md., March 29 – April 1, 1989.

Andrew Mason, *HOMES: A Household Model for Economic and Social Studies, Papers of the East-West Center* 106 (Honolulu: East-West Center, 1987).

Andrew Mason and Linda G. Martin, "Intergenerational Differences in Income: An Analysis of Japan," in Yoram Ben-Porath, ed., *Income Distribution and the Family, Population and Development Review*, Supplement to Volume 8 (1982) 179–192.

Carl Mosk and Yoshi-Fumi Nakata, "The Age-Wage Profile and Structural Change in the Japanese Labor Market for Males, 1961–1982," *Journal of Human Resources*, XX, no. 1 (1985) 100–116.

Naohiro Ogawa, "Sex Differentials in Labour Force Participation and Earnings in Japan, *Women's Economic Participation in Asia and the Pacific* (Bangkok: UN ESCAP, 1987) 305–332.

Naohiro Ogawa, *et al.*, *Jinko Keizai Iryo Moderu Ni Motozuku Choki Tenbo: Feisu II (Long-term Prospects Based upon a Demographic, Economic, and Medical Model: Phase II)*, (Tokyo: Nihon University Population Research Institute, 1986).

Naohiro Ogawa, *et al.*, *Jinko Keizai Iryo Moderu Ni Motozuku Choki Tenbo: Feisu III (Long-term Prospects Based upon a Demographic, Economic, and Medical Model: Phase III)*, (Tokyo: Nihon University Population Research Institute, 1988).

Naohiro Ogawa and Andrew Mason, "An Economic Analysis of Recent Fertility in Japan: An Application of the Butz-Ward Model", *Jinkogaku Kenkyu (The Journal of Population Studies)*, 9 (May 1986) 5–14.

Kazushi Ohkawa and Henry Rosovsky, *Japanese Economic Growth* (Stanford: Stanford University Press, 1973).

T. Paul Schultz, "Family Composition and Income Inequality," in Yoram Ben-Porath, ed., *Income Distribution and the Family, Population and Development Review,* Supplement to Volume 8 (1982) 137–150.

APPENDIX

Equation List

$$Y_{xt}^D = Y_{xt}^L + Y_{xt}^A + T_{xt}^P + G_{xt} \tag{1}$$

$$Y_{xt}^L = Y_t^L L_{xt}/L_t \tag{2}$$

$$Y_{xt}^A = (Y_t^K + Y_t^F)A_{xt}/A_t \tag{3}$$

$$Y_t = \Gamma_t F(K_t, L_t) \tag{4}$$

$$Y_t^L = \Pi_t^L Y_t \tag{5}$$

$$Y_t^K = \Pi_t^K Y_t \tag{6}$$

$$\Pi_t^L = \beta_0 + \beta_1 \ln k_t \tag{7}$$

$$\Pi_t^K = 1 - \Pi_t^L \tag{8}$$

$$Y_t^F = i_t A_t^F \tag{9}$$

$$L_t = \sum_a w_{at}^m L_{at}^m + \sum_a w_{at}^f L_{at}^f \tag{10}$$

$$w_{at}^i = f_a(L_{at}^i/L_{0t}^i) \tag{11}$$

$$L_{xt} = \sum_a w_{at}^m l_{at}^m N_{axt}^m + \sum_a w_{at}^f l_{at}^f N_{axt}^f \tag{12}$$

$$A_{xt} = A_{x-5,t-5} + S_{x-5,t-5} + 5T_{x-5,t-5}^P \tag{13}$$

$$S_{xt} = \beta s_{xt}[Y_{xt}^L + Y_{xt}^A + G_{xt}] \tag{14}$$

$$s_{xt} = f(A_{xt}/Y_{xt}^D, x, N_{axt}) \tag{15}$$

$$K_t = \kappa_t \sum_x A_{xt} \tag{16}$$

$$A_t^F = \gamma_t \sum_x A_{xt} \tag{17}$$

$$\begin{aligned} B_{xt} &= A'_{x-5,t-5}(H_{xt} - H_{x-5,t-5})/H_{x-5,t-5} && \text{if } \Delta H_{xt} \leq 0 \\ &= 0 && \text{if } \Delta H_{xt} > 0 \end{aligned} \tag{18}$$

$$I_{at}^{pc} = \sum_x h_{axt} B_{xt}/N_{at} \tag{19}$$

$$I_{xt} = \sum_a N_{axt} I_{at}^{pc} \tag{20}$$

$$T_{xt}^P = I_{xt} - B_{xt} \tag{21}$$

$$G_{xt} = R_{xt} - T_{xt} \tag{22}$$

$$T_{xt} = \tau_{xt}[Y_{xt}^L + Y_{xt}^A] \tag{23}$$

$$R_{xt} = r_{xt}[Y_{xt}^L + Y_{xt}^A] \tag{24}$$

Variable Names and Definitions

Y_{xt}^D — disposable income of households aged x in year t.

Y_{xt}^L — labor income of households aged x in year t.

Y_{xt}^A — asset income of households aged x in year t.

G_{xt} — net government transfers including taxes to households age x in year t.

T_{xt}^P — net private transfers to households age x in year t.

Y_t^L — total labor income in year t.

Y_t^K — total capital income in year t.

Y_t — total national product in year t.

Π_t^K — capital's share of output in year t.

Π_t^L — labor's share of output in year t.

Γ_t — Index of technology in year t.

K_t — capital stock in year t.

k_t — ratio of capital to effective labor in year t.

L_t — effective labor supply in year t.

L_{xt} — effective labor supply of households aged x.

A_{xt} — assets of households aged x.

A_t — total assets.

A_t^F — assets invested abroad.

Y_t^F — income on assets held abroad.

L_{at}^i — number of male (m) or female (f) workers in age group a.

w_{at}^i — relative productivity of male (m) or female (f) workers in age group a.

l_{at}^i — labor force participation rate of males (m) or females (f) aged a.

N_{axt}^i — number of males (m) or females (f) aged a in year t living in households with a head aged x.

S_{xt} — saving by households aged x in year t.

$s_{x,t}$ — ratio of saving to disposable income net of private transfers.

κ_t — fraction of total wealth invested in domestic enterprise excluding housing.

γ_t — fraction of total wealth invested abroad.

i_t — real interest rate (international).

R_{xt} — government transfers to households aged x.

r_{xt} — benefit rate for households aged x.

T_{xt} — taxes paid by households aged x.

τ_{xt} — tax rate for households aged x.

B_{xt} — "bequests" by households aged x during the interval t-5 to t.

h_{axt} — proportion of bequests made by households aged x received by individuals aged a.

I_{at}^{pc} — per capita inheritances received by individuals aged a.

I_{xt} — inheritances received by households aged x.

Table 1. Statistical Estimates for Labor Share Equation.

			Ohkawa/Rosovsky		Denison/Chung	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Intercept	0.255	0.116	0.574	0.038	0.779	0.030
ln K/L	0.109	0.037	0.059	0.047	–0.045	0.028
f	–0.0101	0.0287	–0.000172	0.000173	0.000179	0.000771
D	—	—	0.146	0.040	—	—
D * ln K/L	—	—	–0.178	0.085	—	—
D * f	—	—	–0.000470	0.000537	—	—
N	21		40		16	
$\bar{R}^2$	0.904		0.957		0.480	

Note: D = 1 for year greater than 1954.

Table 2. Age and Sex Specific Labor Force Participation Rates.

	Age Group							
Year	15–19	20–24	25–29	30–34	35–39	40–49	50–59	60+
Males								
1980	0.202	0.750	0.975	0.986	0.987	0.982	0.960	0.564
1985	0.172	0.703	0.957	0.974	0.966	0.974	0.928	0.478
1990	0.183	0.750	0.957	0.974	0.966	0.974	0.927	0.492
1995	0.207	0.847	0.957	0.974	0.966	0.973	0.928	0.463
2000	0.196	0.804	0.957	0.974	0.966	0.973	0.929	0.418
2005	0.181	0.740	0.957	0.974	0.966	0.973	0.924	0.385
2010	0.172	0.705	0.957	0.974	0.966	0.974	0.925	0.379
2015	0.178	0.730	0.957	0.974	0.966	0.974	0.927	0.317
2020	0.193	0.790	0.957	0.974	0.966	0.973	0.928	0.283
2025	0.194	0.793	0.957	0.974	0.966	0.973	0.928	0.278
Females								
1980	0.185	0.714	0.493	0.463	0.554	0.618	0.549	0.224
1985	0.164	0.716	0.542	0.509	0.593	0.682	0.561	0.220
1990	0.174	0.756	0.535	0.503	0.586	0.677	0.564	0.224
1995	0.168	0.733	0.565	0.531	0.618	0.700	0.564	0.215
2000	0.169	0.736	0.588	0.552	0.644	0.735	0.580	0.205
2005	0.158	0.689	0.587	0.552	0.643	0.746	0.577	0.205
2010	0.152	0.662	0.594	0.558	0.651	0.755	0.574	0.200
2015	0.156	0.678	0.607	0.571	0.665	0.773	0.591	0.189
2020	0.161	0.703	0.615	0.578	0.673	0.786	0.603	0.185
2025	0.159	0.692	0.626	0.589	0.686	0.802	0.614	0.188

Table 3. Statistical Estimates of Age-Earnings Profile.

Age Group	INTERCEPT	L_{at}/L_{ot}	$CYCLE_t$	R^2
Males				
15 – 19	–0.29893	–0.01858	0.23374	0.94
	(0.08069)	(0.04660)	(0.12029)	
25 – 29	0.23845	0.01590	–0.01547	0.79
	(0.01814)	(0.03229)	(0.06247)	
30 – 34	0.43866	–0.03630	–0.15908	0.77
	(0.01147)	(0.03174)	(0.06662)	
35 – 39	0.54267	–0.02677	–0.24393	0.77
	(0.01101)	(0.02983)	(0.06612)	
40 – 49	0.63797	–0.02844	–0.36849	0.87
	(0.01944)	(0.02565)	(0.07324)	
50 – 59	0.57969	–0.04188	–0.39134	0.87
	(0.01291)	(0.02579)	(0.07628)	
60 +	0.17960	–0.11204	–0.49531	0.91
	(0.01293)	(0.04474)	(0.08320)	
Females				
15 –19	–0.23320	–0.06335	0.02236	0.88
	(0.01455)	(0.01259)	(0.03547)	
25 – 29	0.10205	–0.03014	–0.16601	0.79
	(0.00814)	(0.02487)	(0.04442)	
30 – 34	0.10060	–0.04570	–0.53359	0.93
	(0.00755)	(0.02168)	(0.04843)	
35 – 39	0.08215	–0.04035	–0.39324	0.84
	(0.01960)	(0.05135)	(0.11156)	
40 – 49	0.12376	–0.06810	–0.27263	0.80
	(0.02068)	(0.02733)	(0.07867)	
50 – 59	0.10497	–0.00905	–0.33947	0.68
	(0.01273)	(0.02680)	(0.08735)	
60 +	0.02809	0.20729	–0.04917	0.82
	(0.02319)	(0.07449)	(0.13248)	

Table 4. Estimated Age-Wealth Profile, 1980.

Age	Number of Household	Per HH Wealth	Cohort Wealth	Adjusted
15–19	639,299	60.5	386.9	493.2
20–24	2,532,778	227.0	5,749.9	7,329.5
25–29	3,957,034	605.1	23,943.6	30,521.4
30–34	4,945,355	993.7	49,141.0	62,641.1
35–39	4,422,225	1,266.3	55,999.9	71,384.4
40–44	4,095,544	1,456.3	59,642.2	76,027.2
45–49	4,052,603	1,633.5	66,198.9	84,385.1
50–54	3,606,936	1,786.1	64,424.6	82,123.4
55–59	2,853,402	1,890.5	53,942.4	68,761.6
60–64	2,004,401	1,866.6	37,413.7	47,692.1
65–69	1,444,539	1,785.5	25,792.7	32,878.5
70–74	833,324	1,740.7	14,505.5	18,490.5
75–79	392,739	1,691.1	6,641.7	8,466.2
80–84	154,447	1,572.0	2,427.9	3,094.9
85+	52,545	2,022.7	1,062.8	1,354.8
Total			467,273.6	595,643.8

Table 5. Real Wealth Estimates.

Year	Private Capital	Total Capital	Housing	Foreign Capital	Total Wealth
1969	132,780	161,177	16,054	5,642	182,872
1970	453,460	545,789	20,678	7,278	573,745
1971	172,630	208,188	24,873	10,088	243,149
1972	193,520	230,412	36,476	13,427	280,315
1973	212,950	254,762	51,392	14,646	320,799
1974	231,630	282,948	61,367	17,230	361,545
1975	248,150	304,998	68,800	17,967	391,766
1976	264,470	328,157	82,487	20,941	431,585
1977	280,570	351,113	90,873	24,659	466,644
1978	297,100	373,367	101,808	27,781	502,956
1979	317,640	398,034	122,919	27,885	548,838
1980	339,940	423,341	133,684	38,618	595,644
1981	363,210	451,714	140,349	43,944	636,007
1982	385,750	479,835	146,478	53,051	679,364
1983	410,866	511,918	149,179	64,454	725,551
1984	439,580	548,392	154,831	78,819	782,042
1985	497,480	611,993	159,136	111,176	882,305

Table 6. Results of Government Redistribution Survey.

Age of Head	Income	Taxes	Benefits	Net Gov't Transfers	Disposable Income
< 30	255.7	32.0	15.8	−16.2	239.5
30 – 39	402.2	61.4	34.8	−26.6	375.5
40 – 49	479.3	83.2	43.5	−39.7	439.5
50 – 59	544.0	104.9	65.3	−39.6	594.4
60 – 69	343.7	68.5	150.5	82.0	425.7
70 +	276.6	57.4	159.8	102.4	379.0
All	424.1	75.3	69.5	− 5.8	418.3

Source: Income Redistribution Survey.

Table 7. Tax and Benefit Rates for Government Sector.

Age of Head	Tax Rate	Adjusted Tax Rate	Benefit Rate	Net Rate
< 30	0.125	0.246	0.087	–0.159
30 – 39	0.153	0.274	0.112	–0.162
40 – 49	0.174	0.295	0.116	–0.179
50 – 59	0.193	0.314	0.145	–0.169
60 – 69	0.199	0.320	0.463	+0.143
70 +	0.208	0.329	0.603	+0.274
All	0.178	0.292	0.164	

Table 8. Key Demographic Variables.

Year	TFR	e_o^m	e_o^f	Population (millions)	Percent 65 +	Percent 75 +
1985	1.76	74.9	80.4	121.1	10.3	3.9
1990	1.70	75.8	81.4	124.0	11.9	4.7
1995	1.72	76.8	82.4	126.8	14.2	5.4
2000	1.75	77.6	83.2	129.9	16.5	6.3
2005	1.74	77.9	83.4	132.1	18.5	7.7
2010	1.76	78.0	83.5	132.7	20.6	9.2
2015	1.80	78.1	83.6	131.8	23.4	10.2
2020	1.80	78.1	83.6	130.1	24.6	11.3
2025	1.82	78.1	83.6	128.2	24.5	13.0

Source: Ogawa, et al., 1986.

Table 9. Headship Rates, 1984 FIES and 1985 Census.

	Males		Females	
Age	FIES	Census	FIES	Census
15 – 19	0.052	0.047	0.026	0.025
20 – 24	0.311	0.301	0.118	0.188
25 – 29	0.534	0.494	0.063	0.074
30 – 34	0.726	0.681	0.057	0.064
35 – 39	0.854	0.798	0.069	0.079
40 – 44	0.903	0.892	0.091	0.103
45 – 49	0.939	0.932	0.118	0.122
50 – 54	0.966	0.960	0.141	0.139
55 – 59	0.972	0.971	0.170	0.158
60 – 64	0.936	0.941	0.198	0.187
65 – 69	0.878	0.893	0.200	0.217
70 – 74	0.769	0.819	0.188	0.217
75 – 79	0.623	0.703	0.162	0.200
80 – 84	0.489	0.565	0.135	0.155
85 +	0.366	0.413	0.095	0.110

Table 10. National Income Aggregates, 1985–2025.

Year	Net National Product	National Income	Disposable Income	Consumption	Saving	Taxes Net of Transfers
1980	206,860	209,183	182,495	137,516	44,979	26,687
1985	247,656	250,875	218,970	171,241	47,729	31,905
1990	296,499	300,669	263,209	209,302	53,907	37,460
1995	354,973	360,220	315,981	253,580	60,401	44,239
2000	424,980	431,483	378,738	306,504	72,234	52,745
2005	508,793	517,068	455,362	370,516	84,845	61,707
2010	609,136	629,470	557,884	444,396	113,488	71,587
2015	729,269	764,939	677,547	534,842	142,705	87,392
2020	873,093	927,074	818,099	643,587	174,512	108,976
2025	1,045,282	1,122,134	989,666	774,891	214,775	132,467

Note: All values in billions of yen, in 1980 prices.

Table 11. Factors of Production and Their Share.

Year	Private Capital	Effective Labor	Capital Per Labor	Labor Share	Rate of Return	Wage
1980	328,795	7,150	46.0	0.749	0.158	2.17
1985	455,577	7,434	61.3	0.801	0.108	2.67
1990	590,268	7,790	75.8	0.838	0.082	3.19
1995	742,672	8,124	112.8	0.869	0.063	3.79
2000	920,406	8,157	140.0	0.901	0.046	4.69
2005	1,119,435	7,993	140.0	0.933	0.031	5.93
2010	1,088,002	7,771	140.0	0.935	0.036	7.33
2015	1,065,971	7,614	140.0	0.941	0.041	9.01
2020	1,063,722	7,598	140.0	0.947	0.044	10.88
2025	1,049,200	7,494	140.0	0.953	0.047	13.29

Note: Private capital is measured in billions of yen; effective labor in tens of thousands of workers; and wage in millions of yen per year.
All values are deflated to 1980 prices.

Table 12. National Income By Source.

Year	Labor	Capital	Foreign Investment
1980	74.1	24.8	1.1
2005	91.8	6.6	1.6
2025	88.8	4.4	6.8

Table 13. Variance in Log of Per Household Income.

	All Households		15 – 24 Excluded	
	National	Disposable	National	Disposable
Year	Income	Income	Income	Income
1985	0.151	0.131	0.062	0.023
2005	0.175	0.120	0.138	0.060
2025	0.217	0.155	0.187	0.099

Table 14. Variance in Log of Per Capita Income.

	All Households		15 – 24 Excluded	
	National	Disposable	National	Disposable
Year	Income	Income	Income	Income
1985	0.026	0.048	0.022	0.039
2005	0.019	0.010	0.020	0.007
2025	0.022	0.006	0.024	0.003

Table 15. Trends in Bequests and Wealth (trillion of yen).

Year	Wealth	Bequests	Bequests Wealth (%)	Bequests Share (%)
1980	596	–	–	–
1985	825	69	9.7	30.0
1990	1,069	103	10.9	42.2
1995	1,345	143	11.8	51.8
2000	1,667	192	12.7	59.6
2005	2,043	258	13.9	68.6
2010	2,485	324	14.3	73.3
2015	3,075	403	14.5	68.3
2020	3,816	496	14.4	66.9
2025	4,723	648	15.2	71.4

Figure 1. Flowchart of the Model

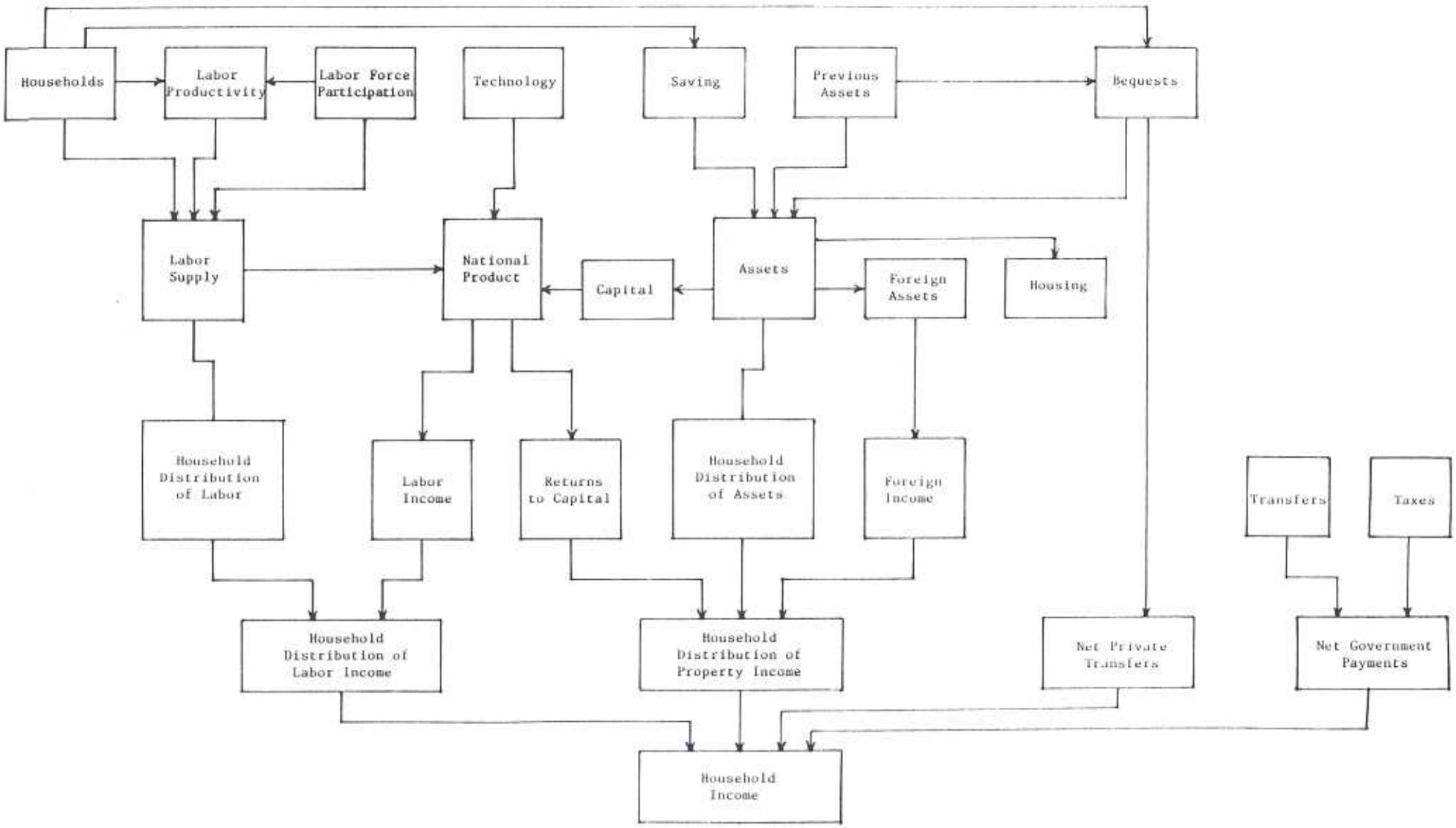


Figure 2

Number of Households

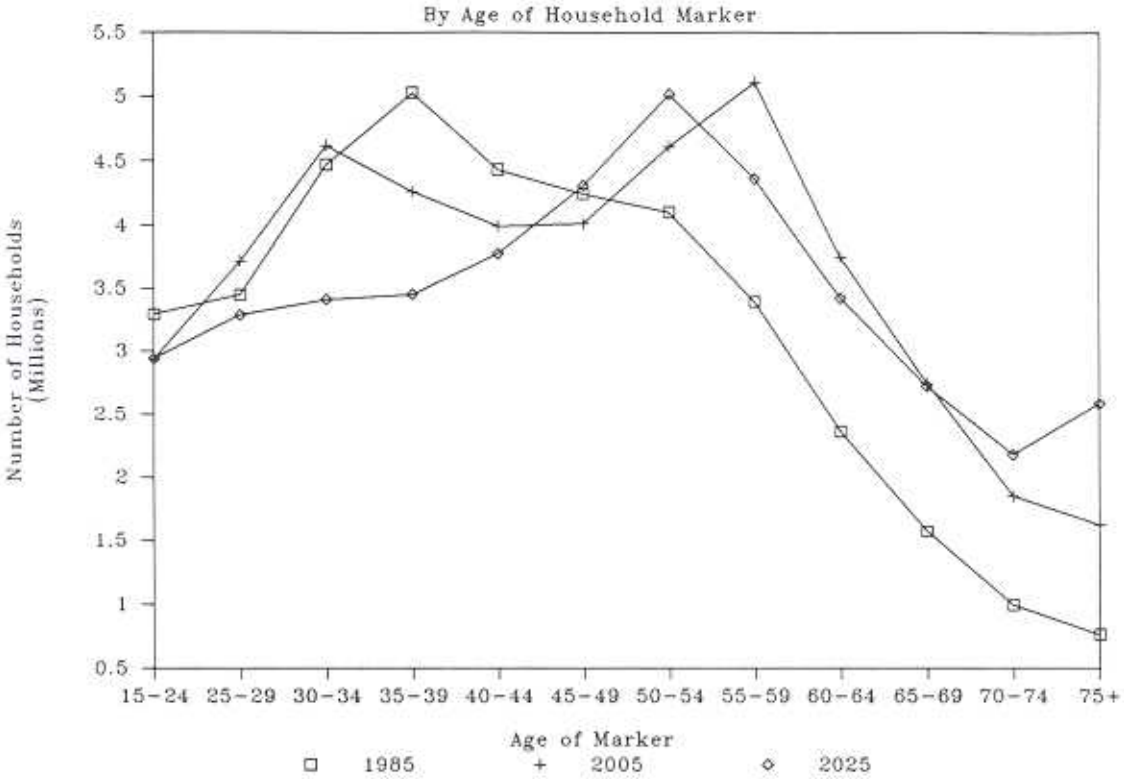
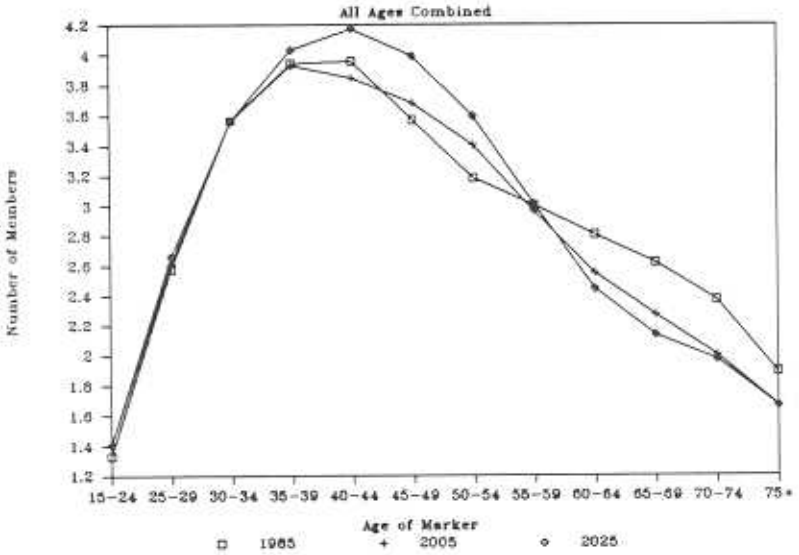
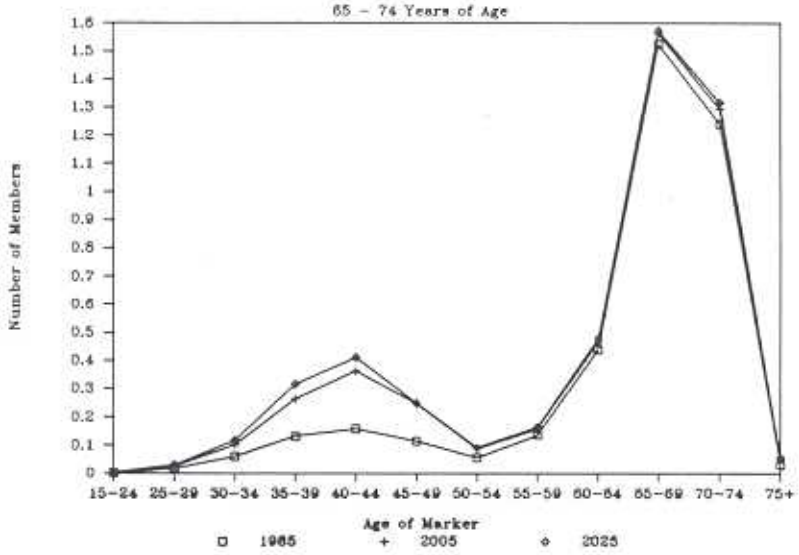


Figure 3

Members Per Household



Members Per Household



Members Per Household

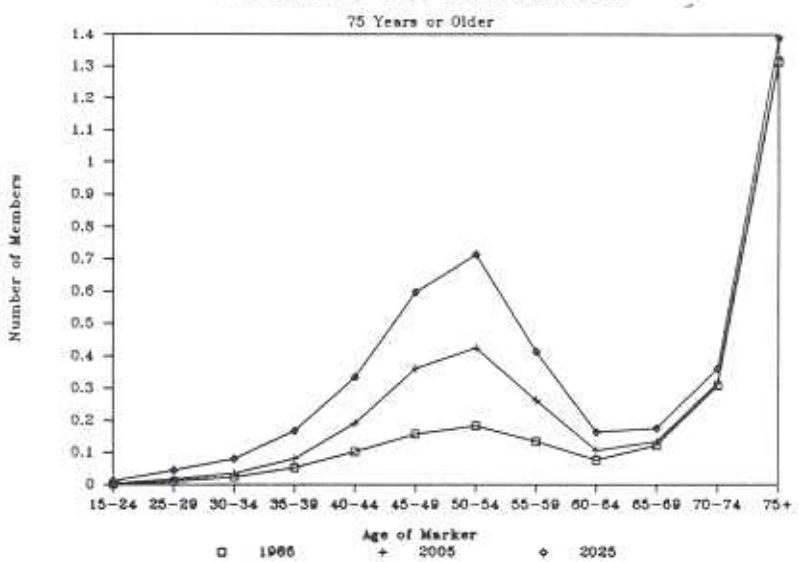


Figure 4

Per Household Effective Labor

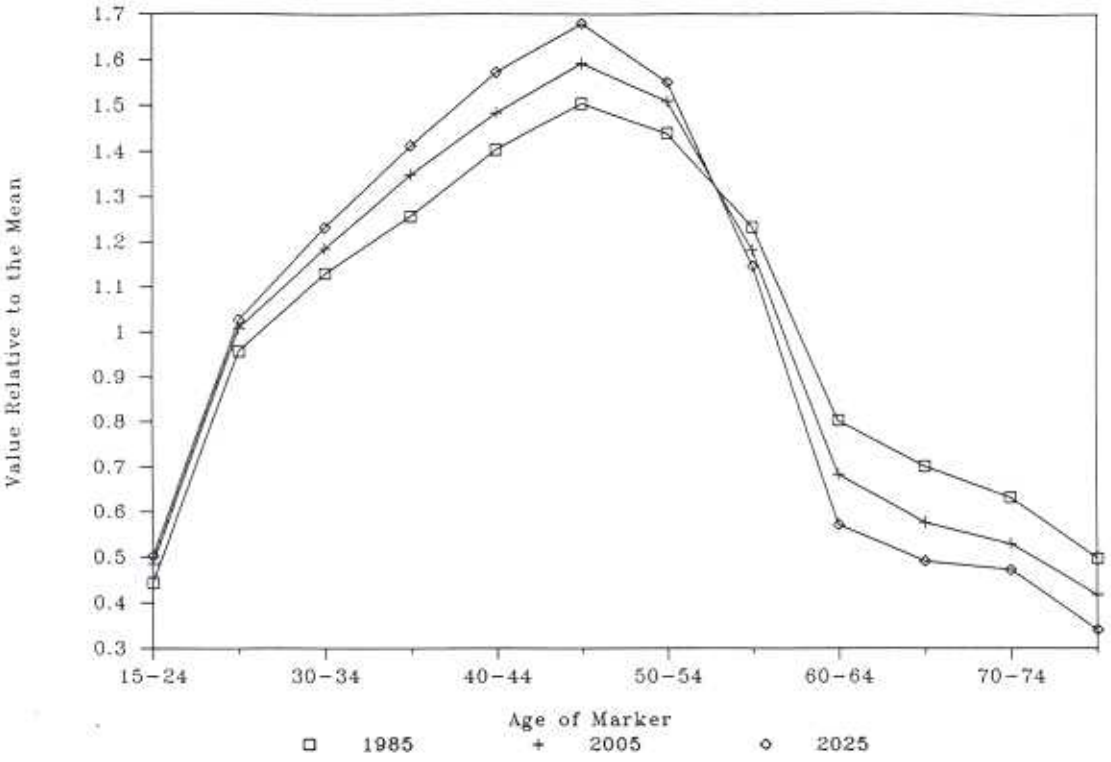


Figure 5

Per Household Wealth

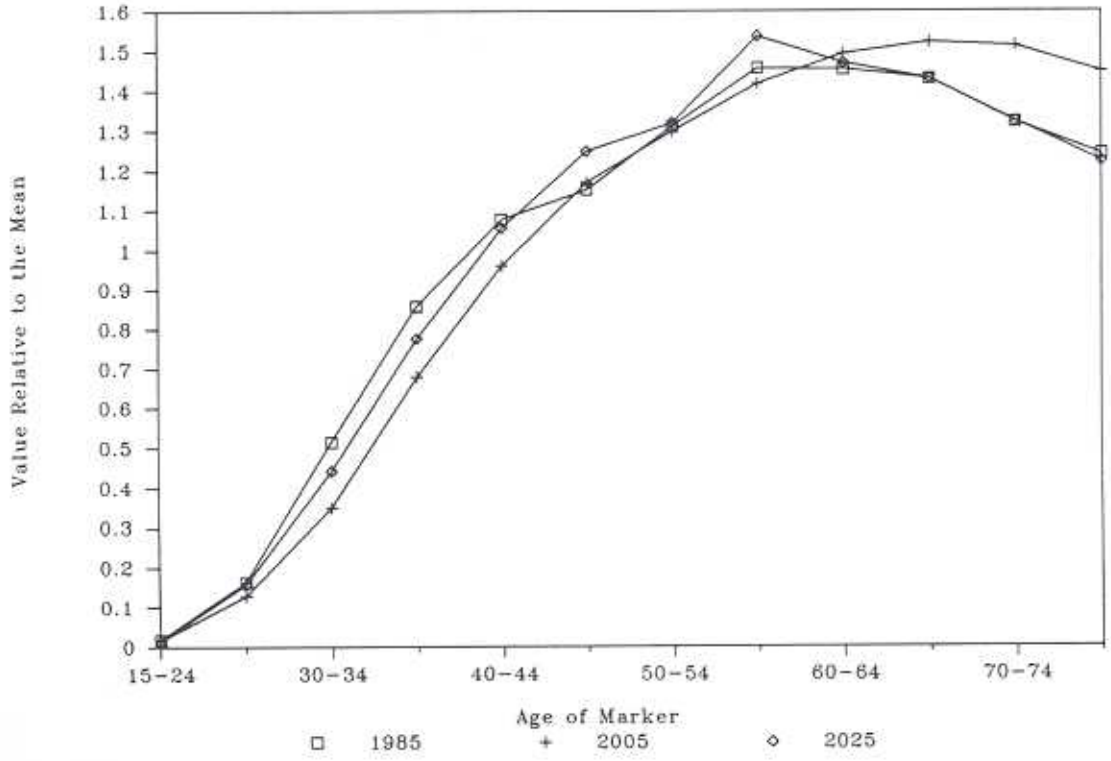


Figure 6

Per Household National Income

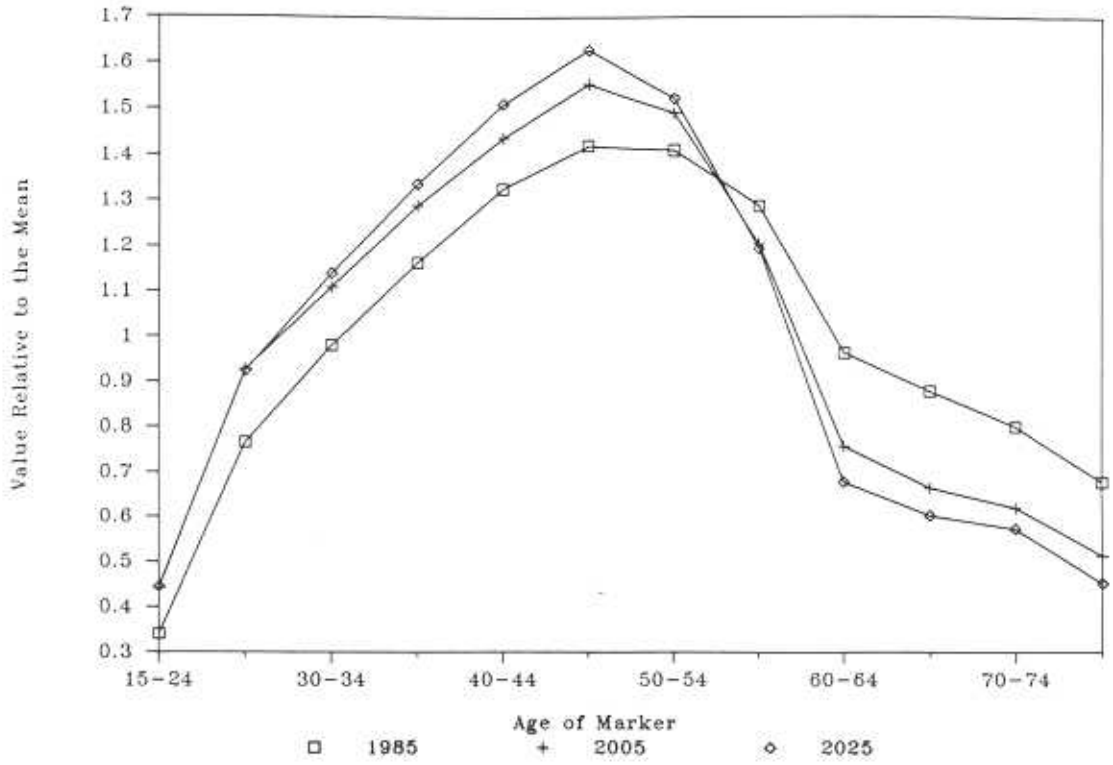


Figure 7

Per Household Disposable Income

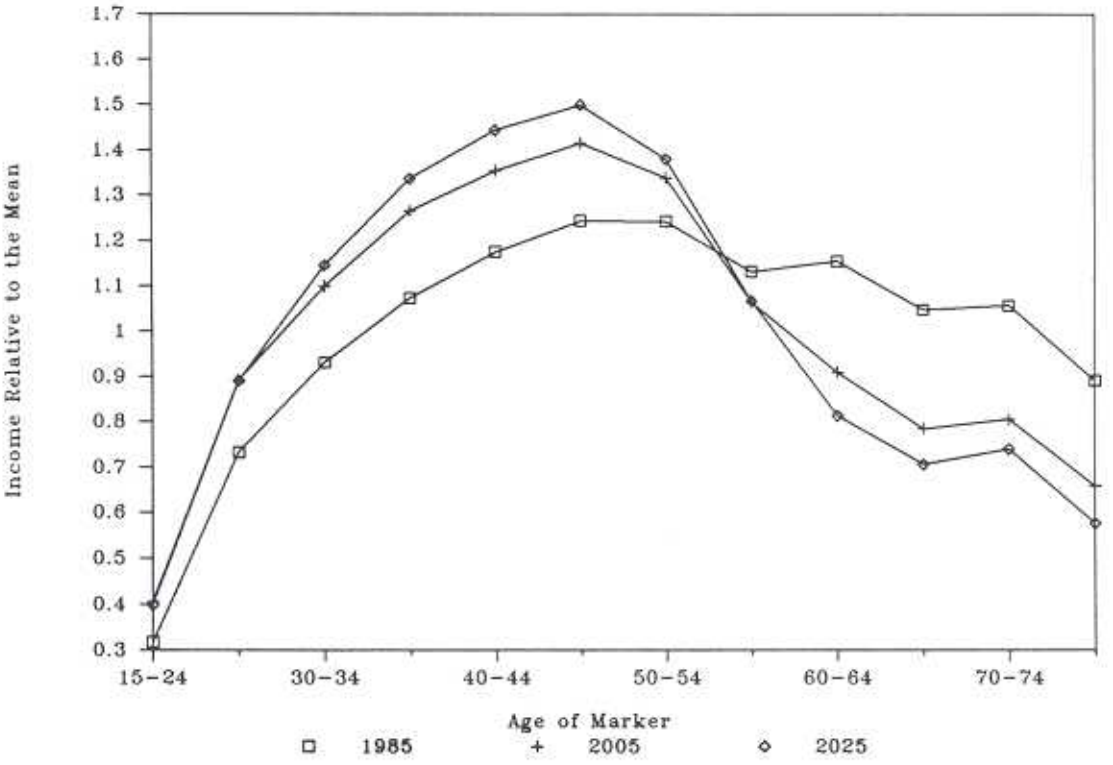


Figure 8

Per Capita Disposible Income

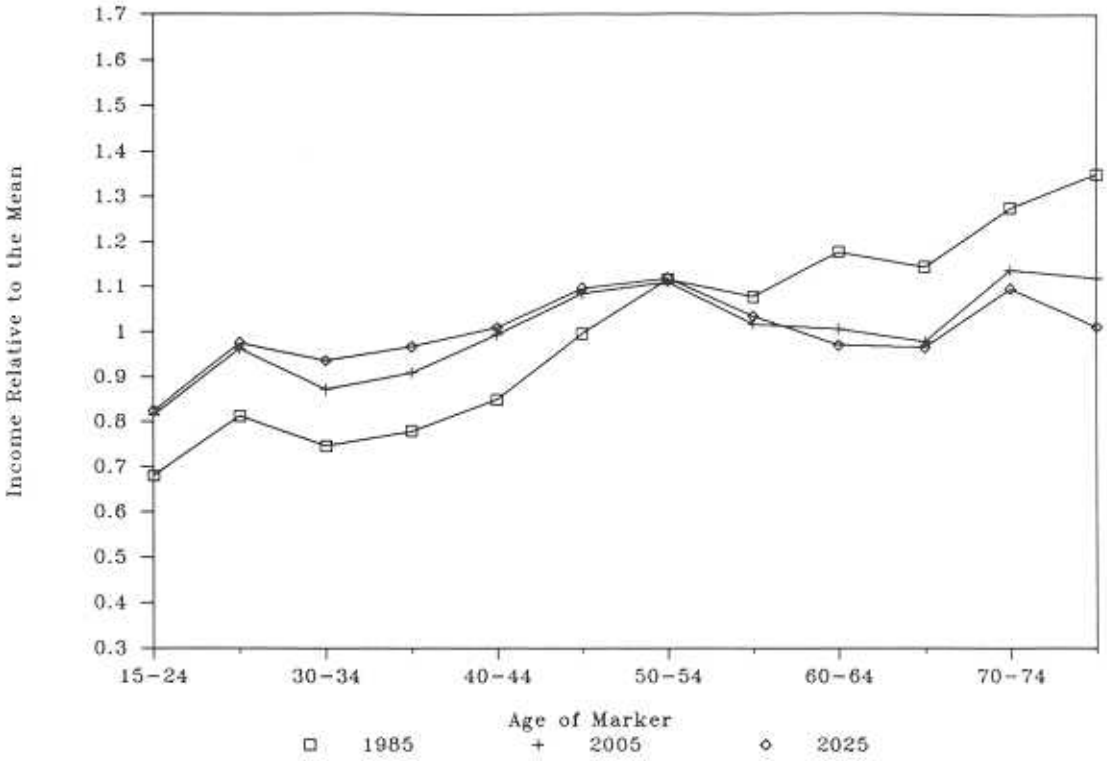


Figure 9

Bequests and Inheritances

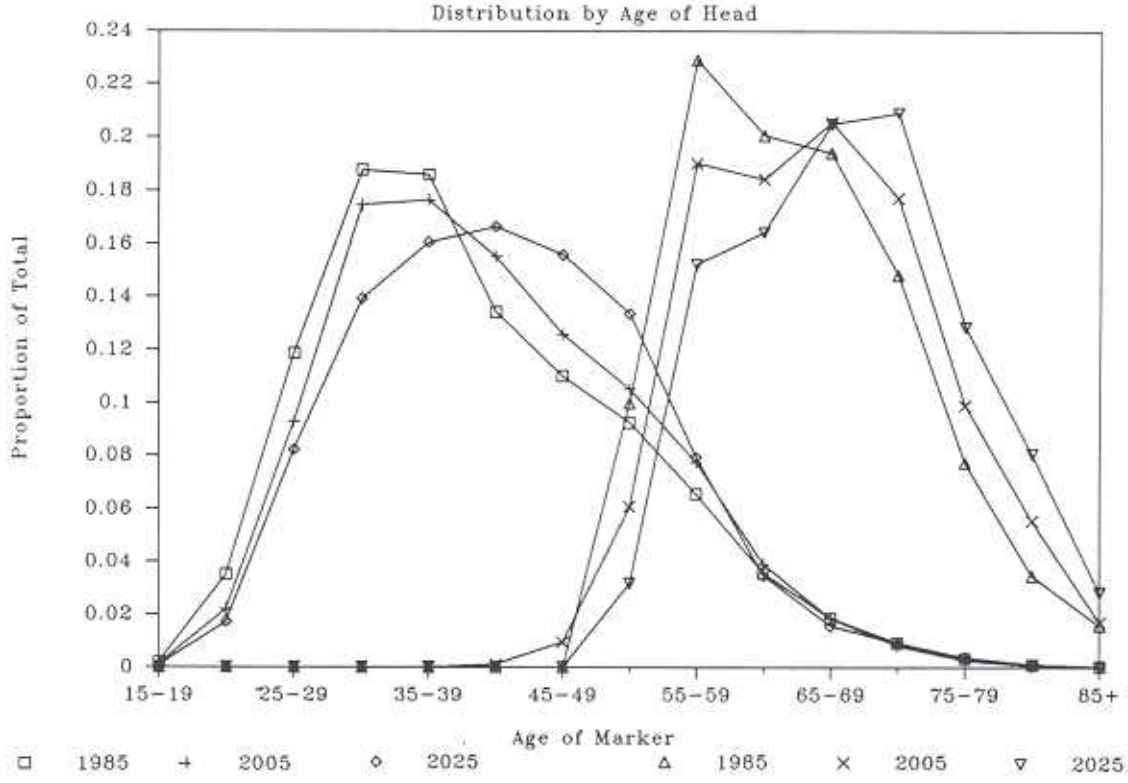


Figure 10

Inheritances