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DEMOGRAPHIC CHANGE, GENERATIONAL ACCOUNTS, AND NATIONAL SAVING IN THE UNITED STATES

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Abstract

The recently developed method of generational accounting facilitates detailed measurement of fiscal policy's impact on the intergenerational distribution of resources. Earlier studies for the United States, using the Social Security Administration's intermediate population projections, concluded that current U.S. fiscal policy embodies a significant generational imbalance. This paper examines the sensitivity of that imbalance to alternative population projections. In addition, following a framework for data organization suggested by the life-cycle hypothesis of consumer behavior, it analyzes the impact of the ongoing and projected demographic transition on national saving.

The paper finds that the conclusion of imbalance is robust over a wide range of U.S. population projections involving alternative assumptions about fertility, mortality, and immigration. It also finds that the ongoing demographic transition may have contributed significantly to the decline in national saving during the 1980s. However, projected changes in the population's age structure are not expected to generate a rebound in national saving.

I. Introduction

In recent years, the role of fiscal policy in redistributing resources across generations has been subjected to intense scrutiny. This is not surprising, because fiscal policy has played an increasingly important role in transferring resources between generations, especially in developed economies.[1] Until recently, however, no technique was available for measuring the extent of intergenerational wealth redistribution via the public channel. This gap has now been filled by "generational accounting," a method for estimating prospective and lifetime resource flows toward or away from different generations as a result of the government's tax and spending policies (Auerbach, Gokhale, and Kotlikoff [1991, 1994]; Kotlikoff [1992]).[2]

A generational account is the present value of taxes (net of transfers) per capita that members of a given generation may expect to pay to the government during their remaining lifetime if current fiscal policy is maintained. Generational accounting studies of the United States reveal a sizable imbalance in U.S. fiscal policy -- that is, the continuation of current policy for those now alive will entail the imposition of enormously larger fiscal burdens on generations to come. Similar conclusions emerge from generational accounting analyses for Italy, Germany, Norway, and Canada.[3]

Long-range population projections, which are usually fairly reliable over the short horizon, are a critical input in calculating the accounts. However, long-run trends in

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[1] Resources are, of course, redistributed across generations through a variety of channels of which public policy is but one. Markets and families are the other two important institutions that redistribute wealth across generations. Markets play a role as young savers and new entrepreneurs purchase housing and capital stocks from older generations and firms. The family plays a role as the old provide inter vivos transfers and bequeath wealth to their offspring. Intrafamily intergenerational transfers also occur in the form of time and care provided by the young to the old. For a broader discussion and framework, see Lee (forthcoming).

[2] Fehr and Kotlikoff (1995) use a simulation model to measure the relative sizes of direct and indirect wealth redistribution induced by fiscal policy changes. In many of the cases they analyze, direct redistribution accounts for most of the total redistribution.

[3] See Gokhale, Raffelhüschen, and Walliser (1995) for the case of Germany; Auerbach and others (1992) for the case of Norway; Oreopoulos (1995) for that of Canada; and Franco and others (1994) for Italy.

mortality, fertility, and immigration cannot be estimated precisely beyond a couple of decades. Despite the important role of population projections, the sensitivity of generational accounting's conclusions to alternative population projections has not been investigated to date. One goal of this paper is to perform such an analysis.

A second goal is to analyze the impact of changes in the age structure of the population on national saving. Under the life-cycle hypothesis with certainty (Ando and Modigliani, 1963), an individual's current consumption depends upon his or her age-specific propensity to consume out of lifetime resources. If this hypothesis is true, the age structure of the population becomes a potentially important determinant of national saving. Understanding the trend in national saving would, then, require the measurement of the total resources available to each generation (and these would be affected by its generational account), generation-specific propensities to consume out of those resources, and the current and projected age structure of the population.

Studies for the United States that use the framework for data organization suggested by the life-cycle hypothesis (LCH) show that ongoing resource transfers away from young and future generations, and toward older generations, can explain a sizable fraction of the recent decline in U.S. saving (Gokhale, Kotlikoff, and Sabelhaus [1995]). However, the effect on aggregate saving of changes in the population's age structure has not been explored in much detail. This paper asks and answers two questions with regard to the impact of changes in the population's age structure on national saving: First, to what extent has the evolving age structure contributed to the decline in U.S. saving since the early 1960s and, second, what is the probable role of the ongoing demographic transition in determining future U.S. national saving?

This paper first describes the methodology of generational accounting, presents the accounts for the United States, and describes the sensitivity of the results under alternative interest-rate and growth-rate assumptions and under alternative projections of federal health care expenditures. Next, it describes the nature of the demographic transition currently underway in the United States, and performs sensitivity tests on U.S. generational accounts under different assumptions regarding future mortality, fertility, and immigration rates. Finally, the paper utilizes a framework based on the LCH to examine how demographic change influences national saving in the United States.

II. The Method of Generational Accounting

The method of generational accounting takes the present-value budget constraint of the government (also known as the government's intertemporal budget constraint) as its starting point. This constraint may be written as:

(1) $PVG_t = NWG_t + PVL_t + PVF_t$.

Equation (1) says that at time t (the current period), the present value of government purchases of goods and services, PVG_t, must be paid for by the sum of three items: The net wealth of the government, NWG_t, the present value of *net tax payments* by living generations at time t, PVL_t, and the present value of net tax payments by future generations PVF_t. The term "net tax payments" refers to taxes paid to the government net of transfers received from it. The "generational account" of a generation is a dollar amount, and it is defined as the *actuarially discounted present value of net tax payments per capita* over the generation's remaining lifetime. Note that equation (1) can be viewed as a financing constraint. Under a given policy for government purchases and given the government's current net worth, future generations must assume the burden of paying for government purchases, which is not covered by the net tax payments made by living generations. The focus of generational accounting is the trade-off between PVL_t, and PVF_t. The following describes the method of estimating the components of equation (1).

The sum of generational accounts over all members of living generations, PVL_t, can be written as:

$$(2) \qquad PVL_t = \sum_{j_t=0}^{D} [\eta^m_{j_t,t} p^m_{j_t,t} + \eta^f_{j_t,t} p^f_{j_t,t}],$$

where D is the maximum age of life. A distinction is made between male and female generations whose populations are represented by $p^m_{j_t,t}$ and $p^f_{j_t,t}$, and the terms $\eta^m_{j_t,t}$ and $\eta^f_{j_t,t}$ represent the generational accounts in year t of male and female generations aged j in year t (indexed by $_{j_t}$).

The generational account, $\eta^x_{j_t,t}$, where the superscript x stands for male or female, is defined by:

$$(3) \qquad \eta^x_{j_t,t} = \frac{1}{p^x_{j_t,t}} \sum_{s=t}^{t+D-j_t} p^x_{j_t,s} [\sum_{i=1}^{m} q^x_{i,j_t,s}] R^{s-t}.$$

Here, R = 1/(1+r), and r is the discount rate. In equation (3), $q^x_{i,j_t,s}$ stands for the per capita payment (or receipt, when q is negative) of type i in a future period s by a member of the generation of sex x aged j in year t. The sum within square brackets over the m types of per capita payments in period s provides the net payment per capita in that period. This term, times the population of such persons in period s, $p^x_{j_t,s}$, provides the total net payment that individuals of sex x aged j in year t make in year s. For the us, estimates of $p^x_{j_t,s}$ are those of the Social Security Administration (SSA). Summing such discounted values for each period s over the remaining lifetime of individuals aged j in year t provides their total discounted value of net payments. Division by $p^x_{j_t,t}$, the population of such persons in year t, converts this discounted sum to a per capita amount and represents the generational account of the generation aged j in year t. Note that multiplying the sum of net payments in each period s by the number of surviving members in period s of the generation aged j in year t, and finally dividing by their population in period t amounts to actuarially discounting their future net payments.

For future years, the per capita payments of each type of tax (or transfer) are estimated either by distributing projected aggregate payments of that type in future years using relative profiles by age and sex or, if projections of aggregate payments are not available, by applying a growth factor to similarly estimated per capita payments for the base year t for which the aggregate payment is available. In the latter case,

$$(4) \qquad q^x_{i,j_t,s} = q^x_{i,j_t,t}(1+g)^{s-t} .$$

The relative profiles used for distributing base (or future) year aggregate payments by age and sex are obtained from household surveys that contain the pertinent information.[4] These empirically determined relative profiles and the associated aggregate payments and receipts collectively constitute an element of the time-t intergenerational stance of fiscal policy, in that they specify the pattern of payments and receipts imposed on different living generations at time t. The relative profiles are normalized to 1 for males aged 40 in year t (or s). Hence, the per capita payment for 40-year-old males can be expressed as

$$(5) \qquad q^x_{i,40_t,t} = \frac{Q_{i,t}}{\sum^{D} [\, r^m_{i,j_t,t} p^m_{j_t,t} + r^f_{i,j_t,t} p^f_{j_t,t}]} ,$$

[4] In the case of the United States, these data are taken from the University of Michigan's Survey of Income and Program Participation, the Census Bureau's Current Population Survey, the Social Security Administration's Annual Statistical Supplement to the Social Security Bulletin, the Health Care Financing Administration, and the Survey of Current Business. For a discussion of the treatment of individual taxes and transfers, see Auerbach, Gokhale, and Kotlikoff (1991, 1994).

$j_t=0$

where $r^x_{i,j_t,t}$ represents the amount of payment (or receipt, if negative) of type i that a person aged j in year t makes relative to the payment of a 40-year-old male in year t, and $Q_{i,t}$ is the aggregate payment of type i made in year t. Of course,

(6) $q^x_{i,j_t,t} = q^x_{i,40_t,t} r^x_{i,j_t,t}$, for x = m,f; $j_t = 0...D$.

This completes the description of the method of estimating the generational accounts and the aggregate net tax payments, PVL_t, of living generations. The term PVG_t is estimated by discounting future projections of aggregate purchases back to period t. If projections of aggregate future government purchases are not available, PVG_t can be estimated by dividing government purchases at time t into several age-specific categories, assuming that the age-specific purchases per capita for each category will remain constant in the future, and using population projections to project the path of future aggregate purchases.[5] The division of government purchases into several age-specific categories is determined empirically, and also represents an element of the current intergenerational stance of fiscal policy.

Government net wealth, NWG_t, can be estimated by computing the cumulative sum of past government deficits. It should be noted that existing assets of the government, like parks and infrastructure, are a part of net wealth. However, they also represent consumption of public goods, the present value of which would have to be included in PVG_t, if their asset value is included in NWG_t. Because the value of government assets must, by definition, equal the present value of their consumption flow, the exclusion of assets from both sides of equation (1) leaves the constraint unchanged. That is, the trade-off between PVL_t and PVF_t,

[5] A large chunk of government purchases, such as those for defense and general administration, cannot be attributed to specific age groups. These are attributed equally to all individuals alive at time t.

which is the focus of generational accounting, remains unaffected by the omission of the value of government assets from NWG_t.

Because equation (1) must hold at time t, and because three of the four elements in that equation have been estimated, one can calculate the fourth term, PVF_t, as a residual. How this residual net payment that must be imposed on unborn generations will actually be distributed among those generations is not clear from the vantage point of time t. As an illustrative device, an equal, growth-adjusted distribution of the residual, PVF_t, among members of all future generations is assumed. In so distributing the residual burden, the net payment by unborn males relative to unborn females is maintained equal to that between newborn male and female generations (who are treated as members of living generations) under current policy. Hence

$$(7) \qquad PVG_t - NWG_t - PVL_t = \sum_{s=t+1}^{\infty} [\eta^m_{0s,s} p^m_{0s,s} + \eta^f_{0s,s} p^f_{0s,s}] R^{s-t},$$

where $\eta^x_{0s,s}$ is the value as of period s of the net payment of the generation of sex x aged 0 in period s, and $p^x_{0s,s}$ is the population of such individuals in period s. Each future generation's aggregate net payment is discounted back to period t. Let ϕ^m be 1 and $\phi^f = \eta^f_{0s,s}/\eta^m_{0s,s}$, $s=t+1,...\infty$, the net payment of future female generations relative to future male generations. Further, let $\eta^m_{0s+1,s+1}/\eta^m_{0s,s} = (1+g)$, $s=t,...\infty$. Thus, each future generation is assumed to pay (1+g) times the net payment of the immediately preceding generation, where (1+g) is the gross rate of growth of labor productivity. Dividing and multiplying the right-hand side of equation (7) by $\eta^m_{0t+1,t+1}$ and manipulating the expression within square brackets yields

$$(8) \qquad \eta^m_{0t+1,t+1} = \frac{PVG_t - NWG_t - PVL_t}{\sum^{\infty} [\phi^m p^m_{0s,s} + \phi^f p^f_{0s,s}] R^{s-t} (1+g)^{s-(t+1)}}.$$

$s=t+1$

The term on the left-hand side of equation (8) represents the net payment (as of period t) of the generation born in period t+1.[6] Because period t newborns and future generations have their entire lifetimes ahead of them, it is possible to compare the net payment of the generation born in period t to that of the average net payment of those born in period t+1. Note, again, that the latter represents the growth-adjusted burden on all future generations, since it is computed under the assumption of an equal distribution of the residual burden, PVL_t, across all future generations. The difference between the two measures, computed as a percentage

$$(9) \qquad P = \left[\frac{\eta^{m}_{0_{t+1},t+1}}{\eta^{m}_{0_t,t}(1+g)} - 1 \right] \times 100$$

provides a measure of the degree of imbalance embedded in current fiscal policy.

An alternative measure of the fiscal burden on a generation is the *lifetime net tax rate* that a generation faces under current policy. This is computed as the ratio of the generational account *at birth* to the present value of per capita labor income over the generation's entire lifetime. Thus, we can express the lifetime net tax rate, τ, as

$$(10) \qquad \tau_{j_t,t-j_t} = \frac{\eta^{x}_{j_t,t--j_t}}{\sum_{s=t-j_t}^{t+D-j_t} \varepsilon^{x}_{j_t,s} R^{s-(t-j_t)}},$$

where $\tau^{x}_{j_t,t-j_t}$ is the lifetime net tax rate of the generation of sex x aged j in year t, and $\varepsilon^{x}_{j_t,s}$ stands for this generation's average labor earnings in year s.[7] Note that the summation is

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[6] Note that the summation in the denominator goes upto infinity. Our population projections extend only through the year 2200. The calculations are adjusted to account for payments by generations born after the year 2200.

[7] Lifetime labor income, rather than total income, is used because income from a normal rate of return on saving out of labor income reflects only an intertemporal reallocation of lifetime resources and not an increase in those

over the entire lifetime of the generation and the present values for both the numerator and the denominator are computed as of the generation's year of birth, t-j_t. The lifetime net tax rate represents the fraction of the present value at birth of lifetime labor earnings that will be paid to the government. Hence, in computing lifetime net tax rates for living generations, it is necessary to include past as well as future projected labor earnings in the denominator, and past as well as future projected annual net tax payments in the numerator.

III. Generational Accounts for the United States

Tables 1 and 2 show generational accounts for selected male and female generations in the United States, taking 1993 as the base year (year t). The computations use the data on aggregate taxes, transfers, and projections of government purchases through 2030 provided by the U.S. Office of Management and Budget. Projections of taxes, transfers, and spending after the year 2030 assume that per capita amounts will grow according to a 1.2 percent annual rate of productivity growth. Present values are calculated using a 6 percent rate of discount in all cases.[8]

The generational accounts (shown in the "net payments" column) for living generations exhibit significant differences among individuals in different stages of their life cycles: Younger generations' net payments are positive because they are in a high working and earning stage of life, while older generations have negative net payments because they are retired and receive large amounts of Social Security and health benefits.[9] The

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resources. Extra-normal returns on saving and receipts from intergenerational transfers should be included in the denominator in computing lifetime net tax rates. This is not done because of the lack of reliable data.

[8] The productivity growth rate chosen is close to that actually experienced over the last four decades. The discount rate is chosen to reflect that, although future transactions with the government (payment of taxes/receipts of benefits) are not as risky as the long-term return on private capital (about 9 percent), they are not entirely risk free.

[9] Generational accounts for other countries have very similar age profiles. See, for example, Gokhale, Raffelhüschen, and Walliser (1995) for the case of Germany; Auerbach and others (1992) for the case of Norway; Franco and others (1994) for the case of Italy; and Oreopoulos (1995) for Canada.

generational accounts for very young living generations are much smaller than for those who are middle aged, because the former are far in time from their working, earning, and high-tax-paying years.

The generational account for future generations is very large relative to that for living newborns (those aged 0 in 1993). The value of P in equation 9 turns out to be 146.1 percent. That is, future generations must, on average, make net payments that are one and a half times as large as those of current newborns if current fiscal treatment is extended to the latter throughout their lifetimes. Thus, under the illustrative assumption of allocating the residual burden equally among future generations, generational accounting reveals substantial imbalance in the intergenerational stance of current U.S. fiscal policy.

The last two lines of table 1 show that the lifetime net tax rate facing current newborns is 33.6 percent, whereas the average rate facing future generations is 82.8 percent.[10] The net tax rate for future generations represents the average rate that each member of all future generations will have to pay in order to balance the government's intertemporal budget shown in equation (1). Levying such an enormously high average rate on future generations is obviously infeasible. Hence, one may conclude that the current U.S. fiscal policy path is not sustainable.[11]

[10] To calculate lifetime net tax rates on newborn and future generations, it is assumed that future real labor earnings by age and sex will be the same as those for living generations, except for productivity growth. The latter is assumed to be 1.2 percent per year, which roughly corresponds to that experienced after World War II.

[11] A policy involving a lifetime net tax rate on current newborns that is less than the average net tax rate that all future generations must bear in order to satisfy constraint (1) is clearly unsustainable. If such a policy is maintained for some time, each successive newborn generation will contribute less than this average net tax rate, thereby increasing the average net tax rate that all remaining future generations must pay. Thus, at some future date, the average net tax rate on all remaining future generations will exceed 100 percent, which is not feasible.

IV. Sensitivity of Generational Accounts to Alternative Interest and Growth Rates

Tables 3a and 3b present the lifetime net tax rates on current newborn and future generations under alternative interest-rate and growth-rate assumptions. The baseline results are presented in the center columns and rows. Increasing the rate of interest increases the net tax rates on living newborns because higher interest rates imply that payments far out in the future receive lower weights. Since labor income and tax payments occur at roughly the same time during the lifetime, benefit receipts occur later. Hence, higher interest rates reduce the present value of future benefits by more than they reduce the present values of taxes and labor income. Hence, lifetime net tax rates are larger when the assumed discount rate is higher. The net tax rates are lower for higher assumed rates of productivity growth.

The average lifetime net tax rate on future generations is significantly higher than those on living newborns. It exceeds 100 percent for some interest- and growth-rate combinations. Table 3c shows the values of P for the different cases. In none of the cases is P less than 100 percent, implying that future generations may be expected to pay, on average, twice as much as would current newborns under current fiscal policy.

V. Sensitivity of Generational Accounts to Alternative Health Care Outlay Assumptions

An important and rapidly growing share of government outlays in the United States is devoted to providing health care insurance and services to the elderly (Medicare) and the poor (Medicaid). Because recent and projected growth in these two programs is extremely high relative to the rest of the economy, they account for a significant portion of the imbalance between the accounts of newborn and future generations. While the high growth rates in Medicare and Medicaid are expected to continue under current policies, legislation may be enacted in the future to reduce growth of outlays for these items.

The second pair of columns in table 4 show the accounts under the most optimistic assumption -- that the growth of federal health care outlays is "stabilized," beginning in 1996. Stabilization is taken to mean that the growth in outlays equals the growth rate of the recipient population plus the rate of productivity growth. Under this case, the lifetime net tax rate on living newborns increases to 38.1 percent and that on future generations declines to 50.5 percent. This implies an imbalance of 33 percent, compared to 146 percent under the base case. Thus, the rapid projected growth in federal health care outlays goes a long way in explaining the sizable generational imbalance in current U.S. fiscal policy.

The last pair of columns in table 4 show the results of assuming, more realistically, that the growth in health care outlays will not be stabilized until the year 2003.[12] Delaying the stabilization of health care outlays until then will substantially increase the lifetime net tax rates of future generations, and substantially increase the imbalance, now 90 percent.

VI. Sensitivity of Generational Accounts to Alternative Population Projections

Figure 1 shows actual (through 1995) and three alternative SSA projections of the U.S. population.[13] The Alternative II projections are used in the generational accounts estimates shown in tables 1 and 2. As is clear from figure 1, Alternative I represents a doubling of the population by the year 2200, compared with Alternative II. Under Alternative III, the projected population in the year 2200 is half as large as it would be under Alternative II. Another way of comparing the three alternatives is to compare their

[12] As these experiments were in progress, the U.S. Congress and the administration were negotiating a package to balance the federal budget by the year 2002. Since the new budget agreement is likely to have year-by-year projections of health care outlays through that year, the next year is selected for beginning the policy of stabilizing health care outlays.

[13] The Social Security Administration projects the U.S. population through the year 2070 for making long-range actuarial projections for the U.S. Social Security system. In generational accounting calculations, these projections are used after extending them through the year 2200. The extended projections use assumptions on mortality, fertility, and immigration applicable in the Social Security Administration's projections in the year 2070.

population counts for the year 2200 to the population's actual size in 1993. Under Alternative I, the population increases to over three times its current size by the year 2200. Under Alternative II, it increases by about 50 percent between 1993 and 2200. It declines, however, under Alternative III, so that the population in 2200 is about 70 percent of its 1993 level. Thus, these three alternatives encompass a reasonably wide range of possibilities for future population growth.

The SSA designed these three alternative projections to represent low-cost (Alternative I), intermediate-cost (Alternative II), and high-cost (Alternative III) assumptions for purposes of computing the long-range actuarial balance of the Social Security system. Alternative I embodies high fertility, mortality, and immigration rates. Under this alternative, the high fertility and immigration rates imply that there will be a large number of future young cohorts who will pay taxes. On the other hand, high mortality rates imply that current and future old generations will die off quickly, thus receiving a smaller present value of Social Security benefits. Alternative III embodies the opposite assumptions of low fertility, mortality, and immigration rates. This high-cost scenario implies that fewer younger generations in the future that will pay taxes, and more numerous and longer-lived older generations will receive benefits.

Table 5 reports net payments under Alternatives I, II, and III. A well-known feature of the mortality rates is that they are extremely low at ages less than 50, and that they rise rapidly with age thereafter. Hence, most of the *difference* in mortality rates between the three alternatives occurs at older ages. As expected, then, living generations' net payments are higher under Alternative I than Alternative II. This is because, at each age, a higher mortality rate implies a lower present value of benefits when old but, because the difference in mortality rates is not large at young ages, tax burdens on the young are not much affected. Net payments are smaller under Alternative III for the opposite set of reasons.[14]

The generational account of future generations under Alternative I is smaller than under Alternative II because the higher fertility rates of the former imply larger future cohorts among which the residual burden can be distributed. In contrast, the average net payment burden on future generations is larger under Alternative III because of the lower fertility rates embodied in it.

Among the three alternatives, the percentage differences between newborn and future generations range from 120 percent under Alternative I to 175 percent under Alternative III. Future generations' lifetime net tax rates range from about 71 percent under Alternative I to 95 percent under Alternative III. Thus, even under Alternative I's optimistic assumptions about population growth, the conclusion that current U.S. fiscal policy contains a sizable imbalance and is set on an unsustainable course remains true.

VII. Generational Accounts and Private Budgets[15]

The generational accounts of living generations represent a net drain on their total resources under current fiscal policy. Generational accounts are, therefore, an element of the prospective lifetime budget constraints for living generations. The total resources in year t of an individual aged j in year t can be expressed as

$$(11) \qquad \rho^{x}_{ji,t} = \omega^{x}_{ji,t} + \sum_{s=t}^{t+D-ji} [\varepsilon^{x}_{ji,s} + \pi^{x}_{ji,s}]R^{s-t} - \eta^{x}_{ji,t},$$

[14] The future evolution of fertility, mortality, and immigration rates is uncertain. Small changes in all three could possibly completely alter the population shares of different generations. This is exemplified in Tuljapurkar and Lee (forthcoming). An alternative procedure would be to conduct a similar excercise, estimate the distribution of generational accounts, and compute confidence intervals around the point estimates presented in earlier sections. Such an analysis is beyond the scope of this paper. However, the procedure followed here may be viewed as a close substitute.

[15] The argument in this section follows that in Gokhale, Kotlikoff, and Sabelhaus (1995).

where $\rho^{x}_{j_t,s}$ represents resources per capita, $\varepsilon^{x}_{j_t,s}$ the average labor earnings, $\pi^{x}_{j_t,s}$ the average pension earnings, and $\omega^{x}_{j_t,s}$ the total net worth, in year s of a member of the generation of sex x aged j in year t. Thus, a generation's per capita resources are the sum of its per capita nonhuman, human, and pension wealth, less its generational account. Relative profiles by age and sex of labor earnings and of public and private pension benefits are used to distribute aggregate labor and pension incomes to obtain the human and pension wealth components of total resources. The procedure for distributing the aggregates is similar to that given in equations (5) and (6) earlier. The nonhuman wealth component is obtained by distributing aggregate private net worth by age-sex relative profiles of net worth from micro data surveys.[16] Figure 2 shows the age-sex distribution of resources per capita. As would be expected, resources of younger women are much lower than those of men, primarily because of their smaller human wealth stemming from their lower rates of labor-force participation and earnings.

VIII. Population Age Structure and National Saving

According to the life-cycle hypothesis (LCH), consumption in year t of an individual aged j_t depends upon the *average* propensity to consume out of lifetime resources at that age. Thus, aggregate consumption in period t can be expressed as

$$(12)\qquad C_t = \sum_{x}\sum_{j_t=0}^{D} c^{x}_{j_t,t}p^{x}_{j_t,t} = \sum_{x}\sum_{j_t=0}^{D} \alpha^{x}_{j_t,t}\,\rho^{x}_{j_t,t}p^{x}_{j_t,t},$$

[16] For the U.S., labor earning and pension profiles are based on the Census Bureau's Current Population Surveys. The relative profiles for private net worth are from the Federal Reserve System's Survey of Consumer Finances. The aggregates distributed according to these profiles are from the National Income and Product Accounts published in the July 1994 Survey of Current Business, and from the Federal Reserve System's Balance Sheets of the U.S. Economy.

where c is consumption per capita and α is the average propensity to consume out of lifetime resources.[17] Generation-specific estimates of $\alpha_{j,t}$ are obtained by distributing aggregate personal consumption expenditures in period t according to age-sex profiles of consumption, and dividing the per capita amounts by total resources per capita.[18] Figure 3 depicts average propensities to consume by age and sex for the United States as of 1993 (year t for this analysis). Consistent with the predictions under the LCH, the propensity to consume increases with age. For males it increases from 2.0 percent at age 20 to nearly 15 percent by age 80. For female generations, it increases from just under 4.0 percent for 20-year-olds to over 17 percent for 80-year-olds. Women's consumption propensities are much higher than men's, especially at younger ages. This reflects the fact that the current consumption of women relative to men inadequately reflects their lower total resources because of lower lifetime labor earnings -- a result of the substantial joint consumption of goods and services that occurs within families.

The net national saving rate can be expressed as

$$\frac{S_t}{NNP_t} = 1 - \frac{C_t}{NNP_t} - \frac{G_t}{NNP_t}. \tag{13}$$

Here, S_t stands for aggregate saving, G_t for government purchases, C_t for aggregate personal consumption expenditures, and NNP_t for the net national product in period t. Together with the fact that propensities to consume increase with age, equations (12) and (13) imply that the age structure of the population may be potentially important in determining the aggregate

[17] We assume that average and marginal propensities to consume out of lifetime resources are equal and depend only on age -- a result that emerges when lifetime utility is maximized subject to the lifetime budget constraint under the life-cyle hypothesis with certainty.

[18] Aggregate personal consumption expenditures are those from the National Inome and Product Accounts, and the relative profiles for distributing the aggregate are based on the Census Bureau's Consumer Expenditure Surveys 1987-1990. For a detailed description of the method of allocating consumption within households, see Gokhale, Kotlikoff, and Sabelhaus (1995).

saving rate. Figure 4 shows male and female population counts for every twentieth year between 1900 and 2080.[19] The charts clearly show the significant baby boom that begins in the 1940s and traverses the age distribution over time. As is well known, the occurrence of that baby boom, together with a lengthening average life span, is expected to increase the fraction of the elderly in the population.

Given that the elderly consume more out of lifetime resources than do the young, a significant change in the share of the elderly may be expected to boost aggregate consumption and reduce aggregate saving. How large is this effect? To investigate this, population counts for year t, $p^{x}_{j,t}$ in equation (12) are replaced by those consistent with the population age distribution for year s, $s \neq t$, while at the same time maintaining the total population at its year-t level. This experiment isolates the impact on the net national saving rate of changes in the age distribution of the total population, assuming that age-specific propensities to consume and per capita resources remain at their year-t (1993) levels.

Figure 5 depicts saving rates that result from substituting the year-s age structure of the population into equation (12) for s ranging from 1960 to 2030. This time span is chosen because the oldest baby boomers entered the labor force during the early 1960s and the youngest boomers will have retired by 2030. The figure suggests that the impact of the population's age structure on national saving can be quite substantial. It also shows that changes in this structure may have contributed significantly to the decline in U.S. national saving rates that began in the mid 1970s and continued through the 1980s and early 1990s.[20]

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[19] Population counts after 1995 are from the Social Security Administration's population projections, and extensions of these projections made by the author as described earlier.

[20] The changing age structure prior to 1975 should have increased U.S. saving rates. However, other factors like shifting age-resource profiles in favor of older generations may have helped to maintain saving rates. See Gokhale, Kotlikoff, and Sabelhaus (1995) for a description of the evolution of U.S. saving rates during the post-war period, and for an analysis of other factors affecting national saving.

In 1993, the aggregate saving rate was 2.7 percent. With the population age structure that existed in the late 1970s, when a significant fraction of the population (the baby-boom generation) was in its low-consumption-propensity years, the 1993 saving rate could have been over 85 percent higher than its actual 1993 level. Figure 5 also shows that the population structure in the coming century is not likely to provide a fillip to national saving. Just after the turn of the century, members of the baby boomlet that will follow the baby boomers are expected to reach ages when consumption propensities are low, while the baby boomers themselves will not yet have entered ages with significantly higher consumption propensities. Using the population age structure from the year 2010 produces only a slight uptick in the saving rate. Substituting in the age structure projected after 2010, however, produces a decline, reflecting a predominant increase in the number of baby boomers at ages with high consumption propensities.

IX. Conclusion

The technique of generational accounting enables the measurement of the intergenerational resource transfers that occur through fiscal policy. A generational accounting analysis of the United States shows that the nation's fiscal policy is unsustainable, in that its continuation will require placing immense fiscal burdens on future generations. This conclusion remains robust over a reasonably wide range of future discount- and growth-rate assumptions and over optimistic federal health care outlay and population projections. Under optimistic health care projections, about half of future generations' lifetime labor earnings will have to be taxed away, on average. Under optimistic demographic projections, 70 percent will have to be taken away.

The ongoing demographic transition in the United States most likely boosted national saving prior to 1980, and probably accounted for a sizable part of the decline in U.S. national saving rates thereafter. Any future increase in the number of young individuals with low consumption propensities will be outweighed by the entry of the baby boomers into ages with high consumption propensities. As a result, future demographic changes are likely to exert further downward pressure on national saving.

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Table 1. The composition of male generational accounts (r=.06, g=.012)
(Present values in thousands of 1993 dollars)

		tax payments				transfer receipts		
generation's age in 1993	net payment	labor income taxes	capital income taxes	payroll taxes	excise taxes	OASDI	health	welfare
0	86.8	39.8	9.6	38.2	34.4	8.8	22.5	3.9
5	106.9	49.1	12.1	47.7	40.1	10.9	26.3	5.0
10	130.2	60.0	15.2	59.0	46.2	12.9	31.0	6.3
15	160.0	73.7	19.2	73.7	52.7	14.9	36.4	8.0
20	188.6	86.6	24.1	88.1	57.0	16.7	40.8	9.7
25	199.5	92.1	28.5	94.4	57.1	19.8	42.5	10.3
30	195.4	90.7	33.7	92.9	55.9	23.7	44.3	9.9
35	182.5	86.1	39.9	88.0	54.6	28.9	48.0	9.2
40	158.4	78.0	45.0	79.8	53.3	35.7	53.4	8.6
45	119.4	65.8	47.7	67.6	50.1	43.8	60.1	7.9
50	67.7	50.6	48.2	52.5	45.7	54.2	67.8	7.3
55	6.9	34.0	46.2	35.5	40.2	67.4	75.1	6.6
60	-57.2	18.1	42.5	18.9	34.1	83.8	81.0	5.9
65	-105.2	7.2	37.3	7.2	28.2	93.6	86.3	5.1
70	-108.4	3.1	29.5	3.2	22.6	85.7	76.6	4.5
75	-100.6	1.6	19.8	1.6	17.1	71.5	65.4	3.7
80	-85.8	0.9	9.9	0.9	11.9	54.3	52.5	2.7
85	-75.3	0.6	0.0	0.7	7.9	41.8	40.9	1.8
90	-57.6	0.5	0.0	0.5	6.2	32.8	30.6	1.4
Future generations	213.6							

Lifetime net tax rate on future generations: 82.80
Lifetime net tax rate on age 0 generations: 33.64
Percentage difference, future vs. age 0: 146.13

Source: Author’s calculations.

Table 2. The composition of female generational accounts (r=.06, g=.012)
(Present values in thousands of 1993 dollars)

		tax payments				transfer receipts		
generation's age in 1993	net payment	labor income taxes	capital income taxes	payroll taxes	excise taxes	OASDI	health	welfare
0	53.0	23.0	10.2	23.2	33.1	8.4	18.4	9.8
5	64.3	28.3	12.8	29.0	38.5	10.3	21.6	12.3
10	77.2	34.6	16.1	35.9	43.9	12.2	25.6	15.4
15	93.1	42.3	20.4	44.7	49.4	14.0	30.4	19.2
20	109.2	49.4	25.5	53.2	53.2	15.7	34.6	21.7
25	114.7	51.1	30.7	55.7	53.8	18.8	38.5	19.4
30	109.2	48.4	35.8	53.1	53.3	22.4	43.2	15.8
35	97.3	44.3	41.2	49.0	52.8	27.4	50.1	12.5
40	76.0	39.1	44.5	43.6	51.4	33.8	59.1	9.7
45	42.4	31.8	45.3	35.8	48.5	41.8	70.0	7.3
50	-0.8	23.4	44.1	26.7	44.3	52.3	81.2	5.7
55	-50.4	14.7	41.8	16.9	39.3	66.0	92.5	4.6
60	-101.5	7.3	38.2	8.5	33.7	83.2	102.0	3.9
65	-139.5	2.6	32.1	3.0	28.0	92.2	109.6	3.5
70	-140.5	1.0	22.6	1.2	22.8	84.9	100.0	3.1
75	-131.1	0.5	12.4	0.5	17.3	72.0	87.1	2.6
80	-111.3	0.3	4.7	0.3	12.6	57.0	69.9	2.2
85	-88.3	0.1	0.0	0.1	9.4	42.8	53.4	1.7
90	-64.4	0.1	0.0	0.1	7.1	32.4	38.1	1.3
Future generations	130.4							

Source: Author’s calculations.

Table 3a. Lifetime net tax rates for 1993 newborn generations under alternative interest rate and growth rate assumptions

	interest rate (percent)		
growth rate (percent)	3.0	6.0	9.0
0.7	29.5	40.4	46.5
1.2	22.7	33.6	39.7
1.7	16.9	27.9	33.8

Source: Author's calculations.

Table 3b. Lifetime net tax rates for future generations under alternative interest rate and growth rate assumptions

	interest rate (percent)		
growth rate (percent)	3.0	6.0	9.0
0.7	65.1	103.8	175.8
1.2	49.9	82.8	142.5
1.7	37.7	65.7	115.2

Source: Author's calculations.

Table 3c. Percentage difference in net tax burdens: future generations versus current newborns under alternative interest and growth rate assumptions

	interest rate (percent)		
growth rate (percent)	3.0	6.0	9.0
0.7	120.3	157.2	277.8
1.2	119.7	146.1	259.1
1.7	122.4	135.8	241.0

Source: Author's calculations.

Table 4. Generational accounts under alternative federal health care outlay projections

	base case		health care stabilization begins in 1996		health care stabilization begins in 2003	
	male	female	male	female	male	female
0	86.8	53.0	96.8	61.4	91.5	57.1
5	106.9	64.3	118.6	74.3	112.3	69.2
10	130.2	77.2	143.8	88.9	136.3	82.9
15	160.0	93.1	175.5	106.9	166.8	99.9
20	188.6	109.2	205.2	125.0	195.9	117.0
25	199.5	114.7	216.8	132.4	207.3	123.5
30	195.4	109.2	213.9	129.2	203.9	119.2
35	182.5	97.3	203.1	120.9	192.3	109.2
40	158.4	76.0	182.1	104.1	170.2	90.5
45	119.4	42.4	147.0	75.8	133.7	60.2
50	67.7	-0.8	99.3	38.5	84.2	20.2
55	6.9	-50.4	40.8	-6.9	23.2	-28.8
60	-57.2	-101.5	-24.6	-58.0	-44.0	-82.6
65	-105.2	-139.5	-78.1	-101.1	-95.7	-124.5
70	-108.4	-140.5	-88.0	-109.7	-102.6	-130.2
75	-100.6	-131.1	-86.8	-109.0	-97.6	-125.2
80	-85.8	-111.3	-77.5	-97.5	-84.6	-108.7
85	-75.3	-88.3	-70.8	-80.9	-74.9	-87.4
90	-57.6	-64.4	-55.4	-61.0	-57.5	-64.3
Future Generations	213.6	130.4	128.5	81.5	173.7	108.4
Percentage difference	146.1		32.8		89.8	

<u>Lifetime net tax rates</u>:

	base case	health care stabilization begins in 1996	health care stabilization begins in 2003
Newborn	33.6	38.1	35.8
Future generations	82.8	50.5	67.9

Source: Author's calculations.

Table 5. Generational accounts under alternative population projections (r=.06, g=.012)
(Present values in thousands of 1993 dollars)

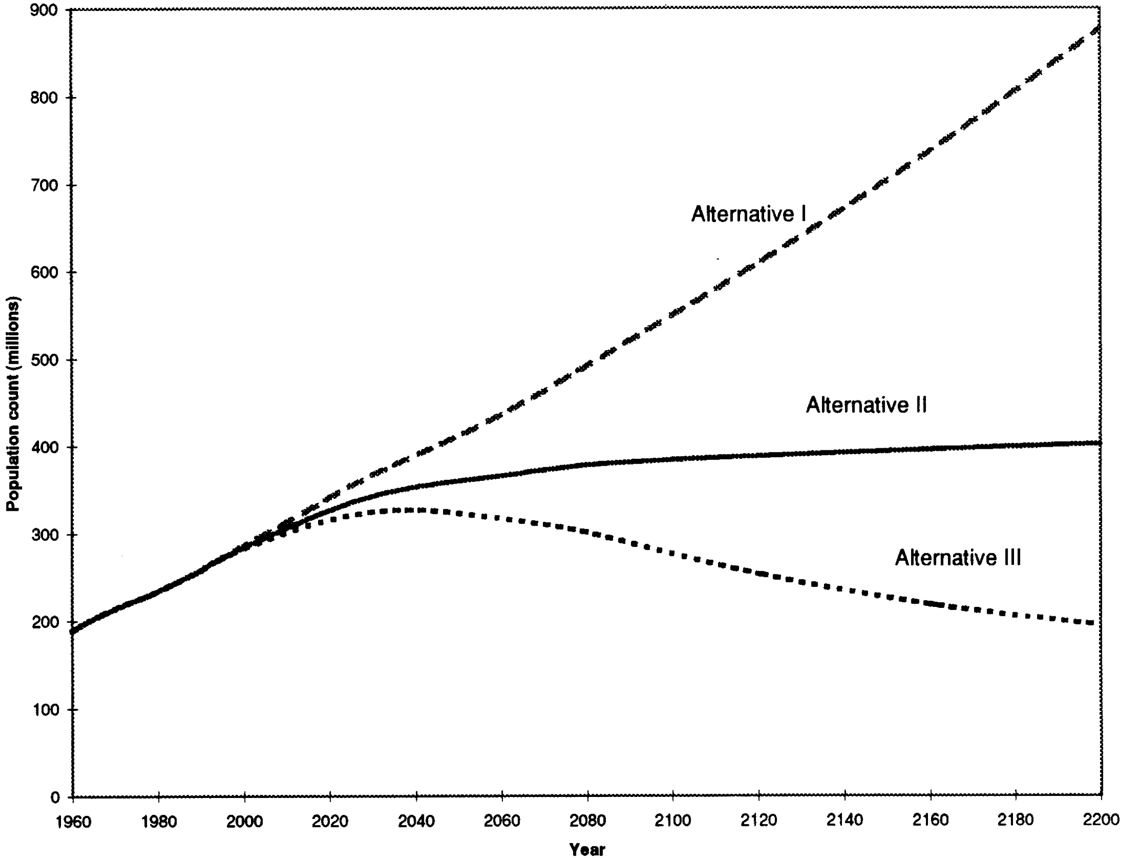
generation's Age in 1993	Alternative I male	Alternative I female	Alternative II male	Alternative II female	Alternative III male	Alternative III female
0	86.8	52.7	86.8	53.0	86.8	53.0
5	107.2	64.1	106.9	64.3	106.7	64.3
10	131.0	77.2	130.2	77.2	129.8	77.0
15	161.9	93.5	160.0	93.1	158.7	92.7
20	190.4	109.5	188.6	109.2	186.9	108.8
25	199.7	114.3	199.5	114.7	198.6	114.6
30	194.8	108.4	195.4	109.2	194.8	109.4
35	181.7	96.5	182.5	97.3	182.3	97.6
40	157.7	75.4	158.4	76.0	158.6	76.2
45	118.9	42.0	119.4	42.4	119.7	42.4
50	67.6	-0.7	67.7	-0.8	67.7	-1.0
55	7.4	-49.8	6.9	-50.4	6.3	-51.2
60	-55.9	-99.9	-57.2	-101.5	-58.4	-103.1
65	-103.3	-136.9	-105.2	-139.5	-107.0	-141.8
70	-106.2	-137.4	-108.4	-140.5	-110.5	-143.4
75	-98.5	-128.1	-100.6	-131.1	-102.6	-133.9
80	-84.2	-109.0	-85.8	-111.3	-87.4	-113.6
85	-74.2	-86.8	-75.3	-88.3	-76.4	-89.8
90	-56.9	-63.6	-57.6	-64.4	-58.2	-65.2
Future generations	191.2	116.1	213.6	130.4	239.4	146.2
Percentage difference	120.3		146.1		175.7	

Lifetime net tax rates:

	Alternative I	Alternative II	Alternative III
Newborn	32.3	33.6	34.5
Future generations	71.1	82.8	95.0

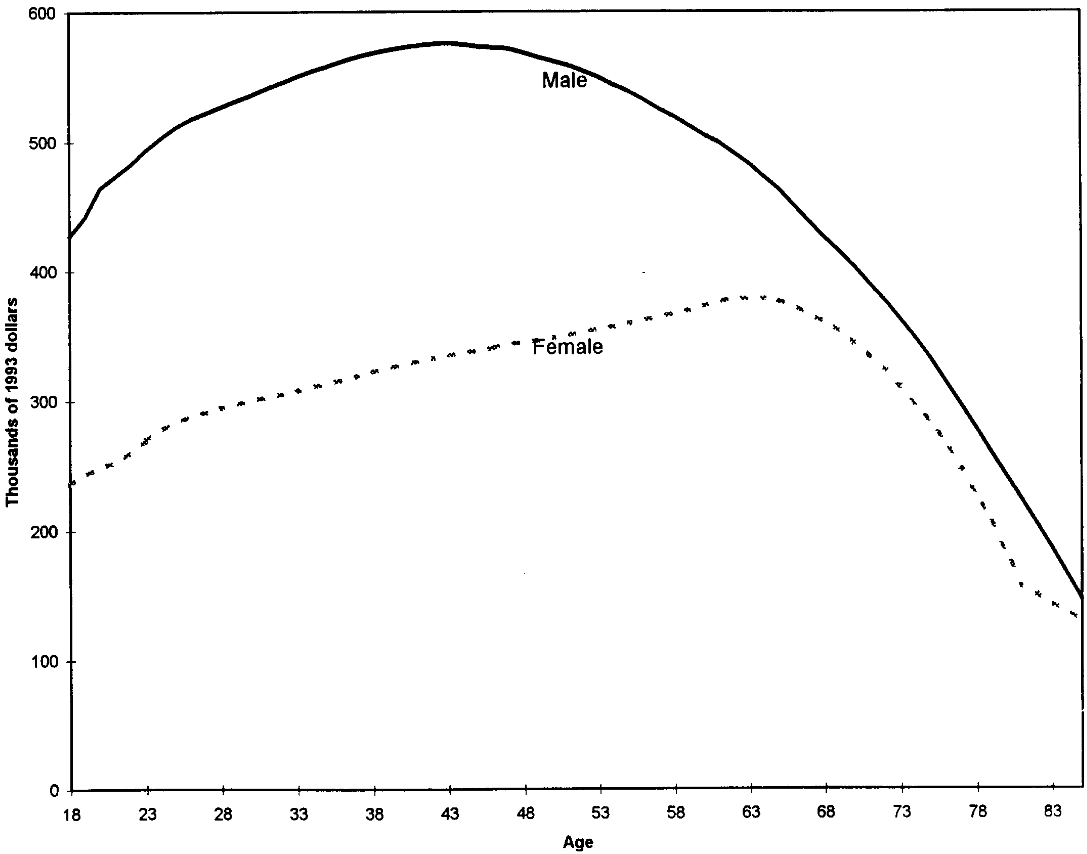
Source: Author's calculations.

Figure 1: Population of the United States, 1960-95, and projections through 2200



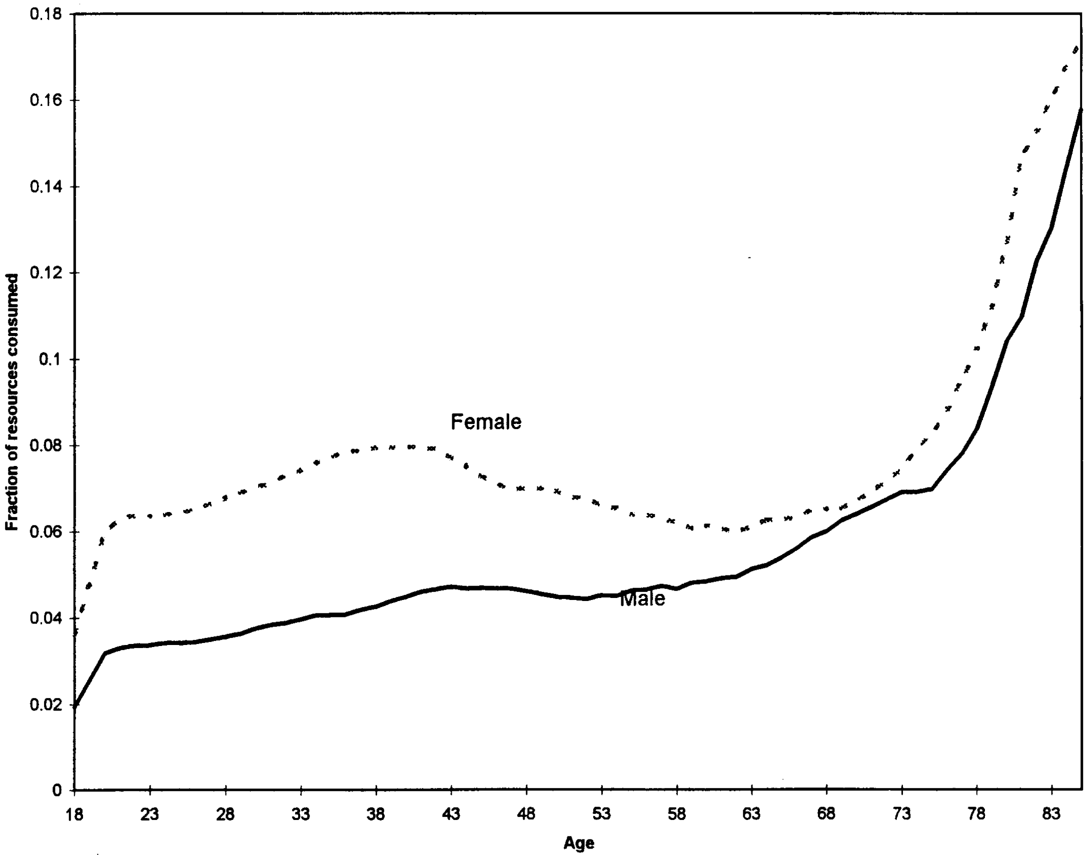
Source: Social Security Administration and author's calculations.

Figure 2: Resources per capita by age and sex



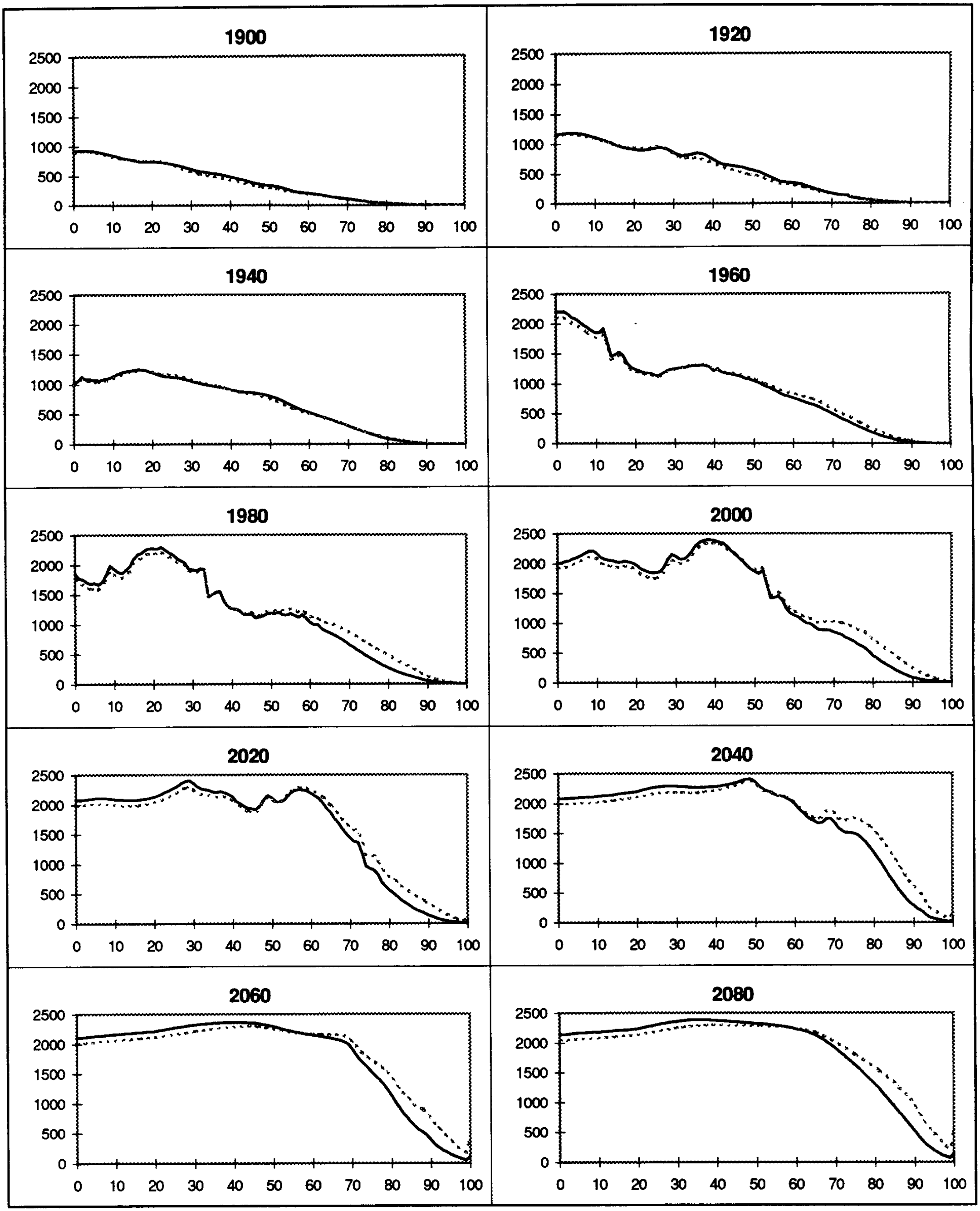
Source: Author's calculations.

Figure 3: Average propensities to consume out of total resources



Source: Author's calculations.

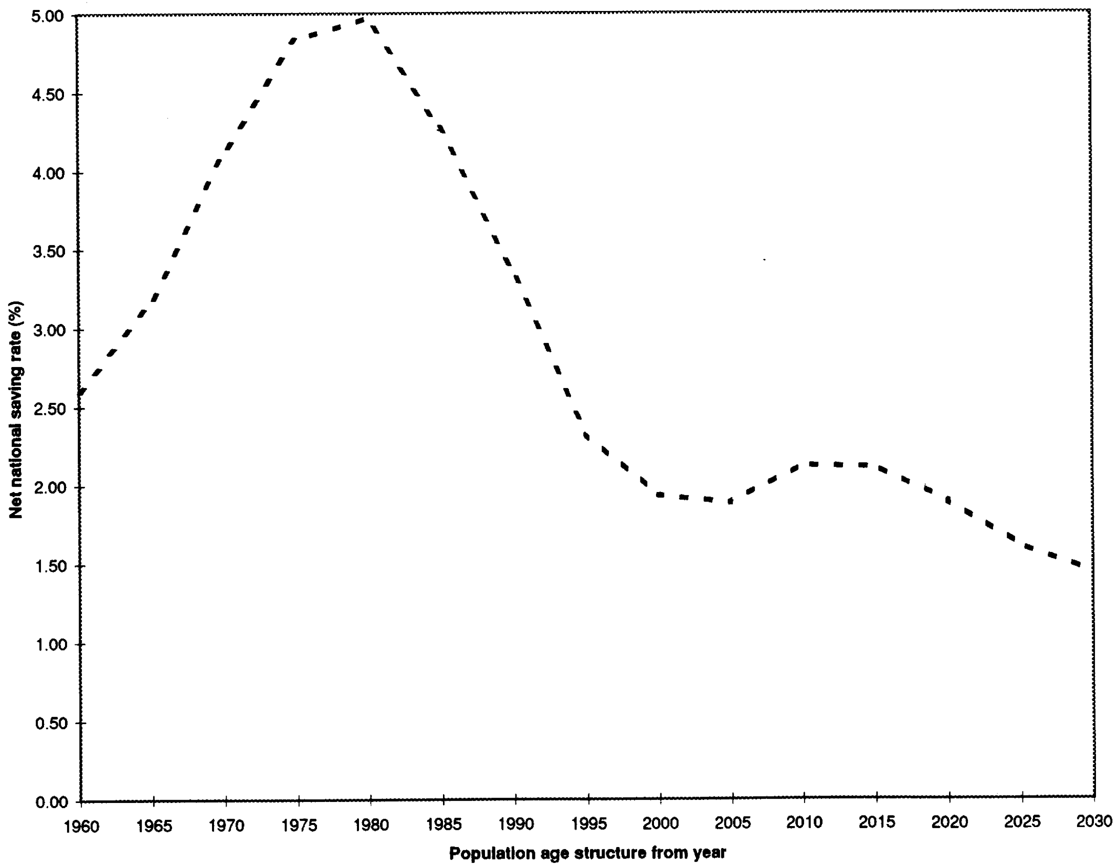
Figure 4. Actual (1900-80) and projected (2000-80) profiles of the United States by age and sex



____ Male .... Female

Sources: U.S. Census (1900-80), population projections of the Social Security Administration, and author's calculations.

Figure 5: Effect of a changing population age structure on aggregate saving



Source: Author's calculations.