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PUBLIC DEBT AND UNITED STATES SAVING: A NEW TEST OF THE NEUTRALITY HYPOTHESIS

MICHAEL J. BOSKIN*
Stanford University
National Bureau of Economic Research
and
LAURENCE J. KOTLIKOFF
Boston University
National Bureau of Economic Research

The significant postwar decline in the United States saving rate is a startling stylized fact that invites explanation. Since 1980 the United States has been saving 4.7 percent of its net national product. This figure contrasts with the 7.8 percent average saving rate of the 1970s, the 8.7 percent average rate of the 1960s, and the 8.8 percent average rate of the 1950s.[1] The United States saving rate is quite low not only relative to its own recent past level but also relative to the saving rates of its principal trading partners. Since 1960 the United States net national saving rate has averaged only 55 percent of the European OECD rate and 34 percent of the Japanese rate.[2] Over the postwar period the United States economy has experienced remarkable changes in fertility rates, the median age of retirement, and the rate of female labor-force participation; but each of these changes appears more likely to have raised rather than lowered the rate of saving.

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[1]These average annual net national saving rates are based on NIA data. The 1984 saving rate is 5.2 percent, a lower value than observed in any year in the 1950s. The saving rate over the past 15 years has averaged only slightly more than three-quarters of the average rate of the previous two decades.

[2]Kotlikoff (1984), Table 2.

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The search for a culprit in explaining the saving reduction has led naturally to the federal government's doorstep. This paper examines the government's potential role in influencing postwar United States saving. As argued in the next section, a "smoking gun" in this mystery, if one is to be found, is most likely hiding amidst the government's intergenerational transfer policies. Intergenerational transfer policies are referred to here as debt policies; they may be explicit, in the sense of altering the government's official measure of its liabilities, or implicit, in which case cross-generational transfers arise but have no direct impact on accounting deficits.

Resolving the impact of debt policy on saving is no easy task. There are only a few, rather subtle, testable differences between, for example, the life-cycle model (Modigliani and Brumberg (1954)) that predicts crowding out from debt policies and the infinite-horizon Barro (1974) model that predicts no crowding out. Section II contains a short discussion of this point and a description of tests that can potentially discriminate between these models. The main contribution of this paper is to examine empirically Barro's model of intergenerational altruism. A restatement of the proposition that intergenerational transfers do not influence saving is that saving is invariant to the age distribution of resources.[3] This proposition is directly tested by measuring the excess influence of the age distribution of personal income and components of personal income on aggregate consumption given the level of consumption predicted by our formulation of the Barro model.

This model, which is described in Section III, differs from that underlying the traditional time series consumption regression (e.g., Feldstein (1974), Barro (1978), Munnell (1974), and Darby (1979)) by explicitly incorporating earnings uncertainty, rate of return uncertainty, and demographic change into the optimal consumption decision. From the perspective of uncertainty models, the standard consumption specification seems quite naive; indeed, the failure explicitly to model uncertainty produces major conundrums over squeezing data from an uncertain world into a certainty model (Leimer and Lesnoy (1981)). Our approach to including uncertainty in the analysis involves estimating simple stochastic processes for earnings and the return to savings and explicitly solving for the optimal consumption path of the infinitely-lived Barro-type family. We then test whether, given the optimal predicted consumption program, the age distribution of resources has an impact on actual aggregate consumption. Since the age distribution of resources is obviously influenced by changes in the population age structure, the model controls for such changes by taking explicit account of variations in the size and age distribution of the population.

Section IV contains a description of the data and the specification of earnings and return uncertainty. The empirical findings are discussed in Section V, and concluding comments appear in Section VI.

[3] Lawrence Weiss stressed this point and its implications for empirical tests in a conversation with one of the authors several years ago.

I. GOVERNMENT FISCAL POLICY AND NATIONAL SAVING

In considering the government's potential impact on saving, one might ask whether postwar growth in total (federal, state, and local) government consumption relative to NNP could be a key factor. The ratio of government consumption to NNP has increased, but the increase has been modest. Government consumption averaged 21.4 percent of net national product in the 1950s, 23.0 percent in the 1960s, 23.5 percent in the 1970s, and 23.1 percent in the period 1980-1984. If, during the last 5 years, government consumption had been 21.4 percent rather than 23.1 percent of NNP and if private consumption as a share of NNP had not changed, the net national saving rate would have averaged 6.5 percent rather than 4.7 percent. Assuming that private consumption is invariant to changes in government consumption seems, however, highly unrealistic. At one extreme, government consumption may substitute perfectly for private consumption (David and Scadding (1974)). In this case the 1.7 percentage point increase in the ratio of government consumption to NNP between the 50s and early 80s, abstracting from issues of tax distortions and redistributions, would have been completely offset by a 1.7 percentage point decrease in the ratio of private consumption to NNP, leaving the net national saving rate unchanged. With government consumption a perfect substitute for private consumption, the private sector's ultimate disposable income is simply NNP; and the private saving rate would coincide with the net national saving rate. From this perspective, the key question is why the private sector's saving behavior changed such that total consumption, private plus government, rose as a share of NNP.

At the other extreme, government consumption might not enter private

utility functions at all, or might enter separably. One would expect the private sector in this case, in choosing its consumption level to view NNP-G, where G is government consumption, as its ultimate disposable income, since current government consumption must ultimately be financed by the private sector.[4] In the 1950s the private sector saved 10.9 percent of this definition of disposable income. In the 1980s the corresponding saving rate has been only 6.1 percent. Had the private sector maintained its 1950s 10.9 percent rate of saving out of NNP-G, the rise in the ratio of government's consumption to NNP would have generated only a 4.5 percent decline in the net national saving rate between the 1950s and 1980s, rather than the 46.6 percent drop actually observed. From this perspective the increase in the government's rate of consumption out of NNP contributed, at most, a small amount to the decline in the net national saving rate. Again, the real question is why an appropriately defined private saving rate fell during this period.

A second accusation that could be levelled at government policy is that the use of distortionary taxes to finance both its consumption and transfer expenditures has reduced incentives to work and save. While there was some increase in average marginal taxes on labor earnings, the increase was modest and seems unlikely to account for the decline in the United States saving rate. A recent article by Barro and Sahasakul (1983) suggests that the average marginal tax on labor income was 22 percent in the 1950s, 22 percent in the 1960s, and 27 percent in the 1970s.[5]

These marginal tax figures exclude social security's payroll tax. However, there is reason to believe that inclusion of Social Security's tax and benefit provisions in the analysis would reduce rather than raise estimated marginal labor taxes, particularly in the 1970s. Blinder and Gordon's (1981) analysis suggests that Social Security's tax and benefit provisions constitute a sizable subsidy to labor earnings of married males and others, leaving net effective marginal taxes on labor earnings for these groups quite low. Boskin and Hurd (1984) confirm the significant size of the Gordon effect. Crediting the public with the perspicacity and knowledge required to assess correctly the marginal social security return on the marginal tax contribution may be unrealistic; but the opposite assumption, that workers believe they receive no return at the margin for marginal social security tax payments, seems equally implausible. If one takes an intermediate view that workers view marginal social security taxes as providing marginal social security benefits of equal present value, then the post-1950 rise in the average marginal tax on labor income is adequately captured by Barro and Sahasakul's estimates.

Marginal saving incentives are also determined by capital income taxes. Several studies argue that effective capital income taxes, at least on corporate source income, rose substantially in the 1970s (e.g., Feldstein and Summers (1979)). But in contrast to this popular belief that such taxes rose between 1950 and 1980, extensive calculations contained in King and Fullerton (1984) suggest a small decline in effective marginal taxes on capital income over this period. The 1981 tax act lowered effective marginal capital income taxes more significantly. Based on a 10 percent pretax return to capital and the prevailing inflation rate, King and Fullerton calculate that the overall effective marginal capital income tax rate was 48 percent in 1960, 37 percent in 1980, 26 percent in 1981, and 32 percent in 1982. In combination with the figures just cited for marginal taxes on labor income, these findings suggest that the distorting effects of government fiscal policy cannot explain the drop in the United States saving rate over the last 35 years.

Another type of policy that could potentially be blamed for the saving decline is intragenerational redistribution from the rich to the poor. The poor may have a higher rate of time preference than the rich. Alternatively, the poor may be liquidity constrained. In either case the poor within any age group will have larger marginal propensities to consume than their better-endowed contemporaries; and intragenerational transfers from the rich to the poor will lower saving. Emily Lawrence (1983) recently examined the potential effect of intragenerational redistribution on saving, using a life-cycle simulation model. Lawrence considered substantial differences in time preference rates between the rich and poor as well as liquidity-constrained consumption by the poor. She found that even significant intragenerational redistribution, such as that characterizing United States welfare programs, has only minor effects on saving in life-cycle models.

The explanation for these small changes in the case of differences in time preference rates is simply that neither the associated differences in marginal consumption propensities across the two groups nor the size of the simulated transfers are sufficiently large to have much impact on the

[4] This assumes the economy is below the golden rule growth path.

[5] Barro and Sahasakul (1983), Table 2, post 1980, column 2.

economy's total wealth accumulation. Those poor who are liquidity constrained have marginal consumption propensities of unity; but the change in disposable income multiplying their unitary propensities is only the amount of current transfers. For rich, unconstrained transferers, the reduction in current consumption equals their much smaller marginal propensity to consume multiplied by the present value of transfers, which is typically considerably larger than simply the current payment. The reduced consumption of the rich offsets to a significant extent the increased consumption of the liquidity-constrained poor, producing only a small reduction in national saving despite a substantial program of intragenerational transfers. We conclude from this and related models that intragenerational redistribution is probably not a major determinant of the decline in the United States saving rate since 1950.

A fourth channel by which government policy may have reduced saving is by transferring resources from younger and future generations to older generations. Intergenerational transfers towards older generations, which is referred to here as debt policy, can be and have been conducted in subtle ways. The unfunded financing of the United States Social Security System is by now a well-understood, if nonetheless quite subtle, debt policy (Feldstein (1974)). Less well-understood debt policies are changes in the tax structure that shift the burden of taxation from older to younger age groups (Summers (1981a), Auerbach and Kotlikoff (1983a)) and changes in tax provisions that raise market values of financial assets and, thereby, transfer resources to older age groups who are the primary owners of such assets (Feldstein (1977), Summers (1981b)). An example of the former type of policy is switching from income taxation to wage taxation. An example of the latter policy is reducing investment incentives (Auerbach and Kotlikoff (1983b)). Since investment incentives in the United States are effectively provided only to new investment, old capital, capital that has been fully or partially written off, sells at a discount reflecting the differential tax treatment. A reduction in investment incentives means a smaller discount and a capital gain to owners of old capital. Younger and future generations are worse off as a result of such policies because they must now pay a higher price to acquire claims to the economy's capital stock.

In addition to these more subtle mechanisms of transferring to older generations, governments can engage in debt policies by reducing taxes levied on current generations and raising taxes levied on future generations. Intergenerational redistribution of this variety may eventuate in

large officially reported deficits. An example in which even this more obvious form of redistribution does not necessarily alter official debt calculations is when such tax cuts and tax increases are coincident, respectively, with equivalent reductions and increases in the level of government consumption.

The fact that significant intergenerational redistribution can be run without its ever showing up on government books suggests that officially reported deficits are at best a poor indicator of underlying economic debt policies.[6] This proposition notwithstanding, there has been an enormous public interest, especially in recent years, in officially reported deficits. Curiously, public attention has focused only on a subset of official liabilities of the federal government and has essentially ignored both the official assets of the federal government and the official assets and liabilities of state and local governments. As discussed by Boskin (1982, 1985), Eisner and Pieper (1984), and the 1982 Economic Report of the President, the market value of the United States federal government's official assets may currently equal if not exceed the market value of its official liabilities.

In light of the quite significant if not overwhelming difficulties of gauging the extent of true debt policies from official reports, it seems safer to assess postwar United States debt policy by asking the following question: were the lifetime budget constraints of older generations expanded significantly in the postwar period as a consequence of government policy at the expense of contracted budget constraints for young and future generations? One might point, in this context, to the enormous expansion of the Social Security System which greatly increased the budget opportunities of the elderly. The problem, however, with considering any one component of government policy is that it may have been instituted to offset another component; i.e., the postwar redistribution through social security to the elderly may simply represent the government's way of compensating the elderly for higher income taxes over their lifetimes or for their contribution to the nation during World War II. Just as there is no single correct way to measure official deficits, there is no single correct way of posing counterfactuals about observed government transfer policies. To put this point differently, intergenerational redistribution

[6] Boskin (1982, 85) and Kotlikoff (1984) provide extensive discussions of the failure of officially recorded debt to measure underlying redistribution to older generations.

must always be assessed relative to some benchmark, and the choice of a benchmark seems inherently subjective. The implication of this point is that any calculation of the magnitude of postwar intergenerational transfers will be arbitrary.[7]

Having conceded this point, we believe that at least one interesting, if arbitrary, counterfactual to pose with respect to postwar United States debt policy is an economy with either a very small unfunded Social Security program targeted toward the elderly poor or a larger, but fully funded, Social Security System. There is little need to review here the well-known facts about the magnitude of the United States Social Security System whose unfunded liabilities appear to range between 4 and 6 times the size of the United States government's official liabilities.[8] The growth of this program was coincident with the decline in the net national saving rate. The Social Security System appears to represent the only (potentially) discrete postwar intergenerational transfer policy capable of producing a major drop in the national saving rate. Simulation studies of the potential savings impact of an unfunded Social Security System suggest a possible reduction in long-run savings of 20 to 25 percent (Kotlikoff (1979a) and Auerbach and Kotlikoff (1983c)).

To summarize this section, we have identified four stylized features of fiscal policy, viz., government consumption, the extent of distortionary taxation, intragenerational transfers, and intergenerational transfers, each of which can affect a nation's saving behavior. We have tried to argue, although hardly exhaustively, that of these four features of fiscal policy, intergenerational transfers are the most likely to have generated a decline in the United States saving rate over the last three-and-a-half decades.

We turn next to a brief discussion of recent empirical attempts to resolve the impact of debt policies on saving. In the course of reviewing this literature, we indicate that there have been surprisingly few tests

[7]One might argue that zero intergenerational transfers is an objective benchmark. There are at least two problems with such a benchmark. First, distinguishing negative intergenerational transfers from taxes required to finance government consumption is completely arbitrary. Second, past intergenerational transfers imply (require) offsetting current or future intergeneration transfers. Hence, taking zero intergenerational transfers as the benchmark requires considering a world in which intergenerational transfers in the past had always been zero.

[8]1982 Economic Report of the President, Appendix to Chapter 4.

designed to distinguish sharply among broad models of saving. Rather than testing more fundamental propositions of particular saving models, most of the research has concentrated on the empirical impact of particular policy variables on consumption and savings. This focus has been excessive; indeed, in many studies the predicted impact of policy variables on dependent variables is the same under models with quite different implications about the affect of debt policies on national saving.

II. EMPIRICAL ANALYSES OF DEBT POLICIES

Much of the recent empirical research relating to the effects of economic deficits falls into two categories: cross-sectional analysis of Social Security's impact on household wealth accumulation and time series analysis of the consumption impact of government policy variables, such as Social Security wealth. Many cross-sectional studies have proceeded without clearly formulating rejectable hypotheses concerning Barro's (1974) conjecture of intergenerational altruism. These studies, including those of Feldstein and Pellechio (1979) and Kotlikoff (1979b), involve regressions of household private wealth on Social Security tax and transfer variables. The central question posed in much of this literature is whether households reduce their private asset accumulation when young because of the anticipation of receiving net windfall transfers when old. The evidence here is mixed, but even if each of these studies had strongly confirmed the proposition that expected future windfalls lead to higher current consumption and, therefore, less private wealth accumulation, the results would still leave unresolved the issue of altruism. The altruistic hypothesis, like the life-cycle hypothesis, suggests that increases in the future resources of a particular household should raise that household's consumption and lower its own savings. In the altruistic case, however, the future windfall to the household in question would also raise the consumption of all other altruistically linked households in the extended family. Indeed, a central proposition of the altruism hypothesis is that the consumption of particular extended family members depends on the resources of other extended family members. Unfortunately, this latter proposition is not tested in the cross-sectional empirical literature, nor does it appear capable of being tested, at least for the United States, given available micro data sources (although Kurz (1982) indirectly examines altruistic behavior using data on transfers).

While this distinguishing implication of the altruism model has not been tested, a distinctive implication of the pure life-cycle model, that the elderly have larger marginal consumption propensities, has been directly tested by Blinder, Gordon, and Wise (1981). Their findings are weakly supportive of this proposition. Other implications of the life-cycle model have also been analyzed. For example, Kotlikoff and Summers (1981) find that life-cycle saving cannot explain the bulk of United States savings. Several studies addressing dissaving after retirement by Darby (1979), Mirer (1979), David and Menchik (1980), and Bernheim (1984) find either no dissaving or too little to be consistent with the strict life-cycle model.

The time series analyses of Feldstein (1974, 1982), Munnell (1974), Barro (1978), Darby (1979), Leimer and Lesnoy (1981), and numerous others have proved inconclusive. The econometrics here is plagued by problems of aggregation, simultaneity, and errors in defining variables such as Social Security wealth. Auerbach and Kotlikoff (1983c) demonstrate the problem of the time series statistical approach by running the standard time series specification on simulated data that conformed perfectly to the nonaltruistic, life-cycle hypothesis. The coefficients on the critical Social Security wealth variable as well as many other variables proved extraordinarily sensitive to the choice of sample period. Auerbach and Kotlikoff concluded that the standard time series approach could easily reject the strict life-cycle, no-altruism hypothesis even if it were true.

Curiously, the time series studies have been vague with respect to which of several (e.g., life-cycle, Keynesian, or altruistic) saving models is being tested. As a consequence a variety of ad hoc specifications have been employed. In a time series context, taking the life-cycle model as the null hypothesis immediately runs afoul of the paucity of cohort specific time series data. When these data are absent, key parameters cannot be identified and one cannot test two basic propositions of the life-cycle models alluded to above: first, that consumption of a particular cohort depends only on its own resources and not on collective societal resources; and second, that older cohorts have larger marginal consumption propensities.

The Barro model is much more suited to analysis with time series data since only collective, rather than cohort specific, resources are predicted to influence aggregate consumption. This proposition is particularly useful in incorporating government policy in the model. In a certainty model the private Barro economy's budget can be written as the economy's

total human plus nonhuman resources (including those owned by the government), less the present value of government consumption. As described below an analogous private budget constraint, involving only government consumption, i.e., requiring no information about taxes, arises with uncertainty.

As mentioned earlier, the key proposition of the Barro model, that consumption depends on collective resources and does not depend on the age distribution of resources, is the focus of our empirical work. To test this proposition, we specify the Barro model under earnings and rate of return uncertainty and determine whether, given the consumption predicted by this model, variables measuring the age distribution of resources significantly influence actual consumption. Data obtained from annual Current Population Surveys on the age distribution of income, including wages and salaries, property income, and government transfer payments, are used for this test. In addition, we use data complied by Dean Leimer and Selig Lesnoy (1981) on the distribution of net Social Security wealth by age.

III. THE BARRO MODEL WITH DEMOGRAPHICS AND UNCERTAIN EARNINGS AND RETURNS

The expected utility of the "infinite horizon" Barro family at time t, U_t, is written in equation (1).

$$U_t = E_t \sum_{\tau=0}^{\infty} \sum_{a=0}^{D} \alpha^{\tau} P_{t+\tau,a}\, \theta_a U(C_{t+\tau,a}) \qquad (1)$$

The function U( ) when multiplied by θ_a indicates the family's period $t+\tau$ utility associated with the consumption of a member age a at $t+\tau$, $C_{t+\tau,a}$. In this formulation of the utility from particular family members' consumption, the θ_a parameters can be thought of as age-specific utility weights. They determine the relative consumption of different family members at a point in time; i.e., they determine the shape of the cross-sectional age-consumption profile. $P_{t+\tau,a}$ is the number of family members age a (with maximum longevity of D) at time $t+\tau$, and α is a discount factor. Since we are applying this model to the entire United States economy, $P_{t+\tau,a}$ corresponds to the United States population age a at $t+\tau$. The function U( ) is assumed to be of the iso-elastic form, i.e.:

$$U(C) = \frac{C^{1-\gamma}}{1-\gamma} \tag{2}$$

Let A_t^p stand for the private sector's net worth at time t, G_t for government consumption at time t, $\tilde{r}_t$ for the stochastic pretax return to savings received at the end of period t, $\tilde{e}_t$ for the stochastic pretax labor earnings of the economy received at the end of period t, and $\tilde{T}_t$ for net taxes paid by the private sector at the end of period t. Private sector net worth evolves according to:

$$A_{t+1}^p = (A_t^p - \sum_{a=0}^{D} P_{t,a}C_{t,a})(1 + \tilde{r}_t) + \tilde{e}_t - \tilde{T}_t \tag{3}$$

The Euler equation associated with optimal choice of $C_{t,a}$ is:

$$E_t C_{t+1,a+1}^{-\gamma}(1 + \tilde{r}_t(1 - \delta_t)) = (\frac{1}{\alpha}\frac{\theta_a}{\theta_{a+1}})C_{t,a}^{-\gamma} \tag{4}$$

In (4) δ_t is the marginal effective capital income tax, which is assumed here to be nonstochastic.

At any point in time the relationship between consumption of different age groups is given by:

$$\frac{C_{t,a}}{C_{t,a+1}} = (\frac{\theta_a}{\theta_{a+1}})^{1/\gamma} \tag{5}$$

Turning to the government's budget constraint, let A_t^g and G_t stand, respectively, for government net worth and consumption at time t, then A_t^g grows according to:

$$A_{t+1}^g = (A_t^g - G_t)(1 + \tilde{r}_t) + \tilde{T}_t \tag{6}$$

Adding (6) to (3) gives the following expression for the evolution of total net worth in the economy, A_t:

$$A_{t+1} = (A_t - \sum_{a=0}^{D} P_{t,a}C_{t,a} - G_t)(1 + \tilde{r}_t) + \tilde{e}_t \tag{7}$$

In this model the distribution of tax burdens either at a point in time or over time has no impact on consumption choice; hence government policy is fully described by the evolution of G_t and the marginal effective capital income tax, δ_t. Given the time paths of these policy variables as well as earnings and return distributions, equations (4), (5), and (7) can be used in solving for the optimal choice of consumption at any point in time. In contrast to other analyses such as Feldstein (1974) and Barro (1978), this formulation avoids the difficulties of defining and measuring government debt policy variables such as Social Security wealth.

In this one good model all net worth terms, A_t^g, A_t^p, and A_t, are measured at replacement cost rather than market value. This method of expressing the private and government budget constraints plus the fact that $\tilde{r}_t$ is the pretax rate of return implies that $\tilde{T}_t$ includes taxes levied both on households and on businesses. To illustrate the point, consider an economy with a single tax levied on the profits of businesses at rate μ. Also assume the government permits full expensing of new investment. For simplicity assume private assets consist only of holdings of capital, K_t, and official government debt, D_t. As described in Auerbach and Kotlikoff (1983b), the market value of private capital is $(1-\mu)K_t$, where K_t is the replacement value of capital at t. Since the return on capital paid by businesses with full expensing is the pretax return, the private-sector budget constraint with assets valued at market prices is:

$$(1-\mu)K_{t+1} + D_{t+1} = [(1-\mu)K_t + D_t - \sum_{a=0}^{D} P_{t,a}C_{t,a})](1 + \tilde{r}_t) + \tilde{e}_t \tag{8}$$

Rewriting (8) yields:

$$A_{t+1}^p = K_{t+1} + D_{t+1} = (K_t + D_t)(1 + \tilde{r}_t) + \mu(K_{t+1} - K_t) - \mu\tilde{r}_t K_t \tag{8'}$$

Note the $\mu(K_{t+1} - K_t)$ corresponds to expensing rebates obtained from the government, and $\mu\tilde{r}_t K_t$ corresponds to business profits taxes. The corre-

sponding government equation is:

$$D_{t+1} = (D_t + G_t)(1 + \tilde{r}_t) - \mu\tilde{r}_t K_t + \mu(K_{t+1} - K_t) \qquad (9)$$

Subtracting (9) from (8') yields (7).

The three equations (4), (5), and (7) that are used to solve for the optimal consumption program can be further simplified by using (5) to express (4) and (7) in terms of the consumption of a Barro family member age a*:

$$E_t C_{t+1,a^*}^{-\gamma}(1 + \tilde{r}_t(1 - \delta_t)) = \frac{1}{\alpha} C_{t,a^*}^{-\gamma} \qquad (4')$$

$$A_{t+1} = (A_t - \sum_{a=0}^{D} P_{t,a}(\frac{\theta_a}{\theta_{a^*}})^{1/\gamma} C_{t,a^*} - G_t)(1 + \tilde{r}_t) + \tilde{e}_t \qquad (7')$$

Solving for the Optimal Consumption Program

Our method of determining the optimal consumption plan is to solve the finite period analogue to the infinite horizon model for a time horizon sufficiently large so that extending it would make no difference to our results. Specifically we solve the finite period model for successively larger values of $\bar{\tau}$, where $\bar{\tau}$ is the number of periods, until the consumption programs for each of the first 50 periods converge. Our data cover 1946 through 1984; we choose 2060 as the terminal year. The optimal consumption values for the years 1946 to 1984 based on a terminal year of 2059 were less than a half percent different from those derived using 2060 as the terminal year.

The finite period problem is solved using dynamic programming. At time $t+\bar{\tau}$ the consumption function $\hat{C}_{t+\bar{\tau},a^*}$,a* is given by:

$$\hat{C}_{t+\bar{\tau},a^*}(A_{t+\tau}) = A_{t+\bar{\tau}} - G_{t+\bar{\tau}} \; . \qquad (10)$$

Substituting this expression into the Euler relationship (4') for period $t+\tau+1$ yields:

$$\frac{1}{\alpha} C_{t+\bar{\tau}-1,a^*}^{-\gamma} = E_{t+\bar{\tau}-1} \hat{C}_{t+\bar{\tau},a^*}(A_{t+\bar{\tau}})^{-\gamma}(1+\tilde{r}_{t+\bar{\tau}-1}(1-\delta_{t+\bar{\tau}-1})) \qquad (11)$$

The accumulation equation (7') for $A_{t+\bar{\tau}}$ can now be plugged into (11):

$$\frac{1}{\alpha} C_{t+\bar{\tau}-1,a^*}^{-\gamma} = \qquad (11')$$

$$E_{t+\tau-1}\hat{C}_{t+\tau,a^*}[(A_{t+\bar{\tau}-1} - h_{t-1}C_{t+\tau-1,a^*} - G_{t+\bar{\tau}-1})(1+\tilde{r}_{t+\bar{\tau}-1}(1-\delta_{t+\bar{\tau}-1}))$$

$$+ \tilde{e}_{t+\bar{\tau}-1}]^{-\gamma}(1+\tilde{r}_{t+\bar{\tau}-1}(1-\delta_{t+\bar{\tau}-1})) \; ,$$

where $h_{t-1} = \sum_{a=0}^{D} P_{t-1,a}(\frac{\theta_a}{\theta_{a^*}})^{1/\gamma}$.

From (11') and the implicit function theorem, we have that $C_{t+\bar{\tau}-1}$ is a monotonic increasing function of $A_{t+\bar{\tau}-1}$, i.e.:

$$C_{t+\bar{\tau}-1,a^*} = \hat{C}_{t+\bar{\tau}-1,a^*}(A_{t+\bar{\tau}-1}; S_{t+\bar{\tau}-1}) \qquad (12)$$

In (12) $S_{t+\bar{\tau}-1}$ is a vector of state variables conditioning the distributions of $\tilde{r}_{t+\bar{\tau}-1}$ and $\tilde{e}_{t+\bar{\tau}-1}$. The function $\hat{C}_{t+\bar{\tau}-1}(\;)$ can now be used to solve for $\hat{C}_{t+\bar{\tau}-2}(A_{t+\bar{\tau}-2}; S_{t+\bar{\tau}-2})$. Proceeding in this manner, one can calculate each consumption function $\hat{C}_{t+\tau}(A_{t+\tau}; S_{t+\tau})$ for $0 \le \tau \le \bar{\tau}-3$.

In general there are no simple closed-form solutions for the $\hat{C}_{t+\tau}(\;)$ functions, and these functions must be derived numerically. The numerical method we employ is to select a grid of potential values of $A_{t+\tau}$ and $S_{t+\tau}$. Next, we take random draws from the bivariate distribution of $\tilde{r}_{t+\tau}$ and $\tilde{e}_{t+\tau}$ conditional on the particular grid value of $S_{t+\tau}$. These draws are then used to evaluate (conditional on alternative values of $A_{t+\tau}$) the expectation of $\hat{C}_{t+\tau-1,a^*}(\;)^{-\gamma}(1+\tilde{r}_{t+\tau}(1-\delta_{t+\tau}))$ for alternative values of $C_{t+\tau,a^*}$. The value of $C_{t+\tau,a^*}$ producing an equality between this expectation and $\frac{1}{\alpha} C_{t+\tau,a^*}^{-\gamma}$, i.e., satisfying (4'), is stored as the function $\hat{C}_{t+\tau,a^*}(A_{t+\tau},S_{t+\tau})$. The number of grid points and random draws chosen are sufficiently large that our empirical results are invariant to further increases in their values.

IV. SPECIFICATION OF RETURN AND EARNINGS UNCERTAINTY AND DESCRIPTION OF THE DATA

The model outlined in Section III assumes that current and future population age distributions are known with certainty. To be consistent in modeling earnings uncertainty, we also assume that Barro family planners understand the impact of projected demographic change on future total labor earnings distributions. More generally, we assume that the age distribution of earnings is known with certainty. What is uncertain then is the level of earnings at future dates for a representative worker. Let $\tilde{w}_{t+\tau,a^*}$ be the random annual earnings of the benchmark worker age a^* at time $t+\tau$. Then total earnings at $t+\tau$, $\tilde{e}_{t+\tau}$, can be expressed as:

$$\tilde{e}_{t+\tau} = \tilde{w}_{t+\tau,a^*} \sum_{a=0}^{D} \lambda_{t+\tau,a}\, \psi_{t+\tau,a}\, P_{t+\tau,a}\,, \qquad (13)$$

where $\lambda_{t+\tau,a}$ is the nonstochastic ratio of earnings of a worker age a at $t+\tau$ to that of a worker age a^* at $t+\tau$, and $\psi_{t+\tau,a}$ is the nonstochastic work experience rate for the population age a at $t+\tau$.

We assume the following fairly simple bivariate process for $\tilde{w}_{t+\tau,a^*}$ and $\tilde{r}_{t+\tau}$:

$$\log \tilde{w}_{t+\tau,a^*} = c_0 + c_1 \log w_{t+\tau-1,a^*} + c_2 r_{t+\tau-1} + \varepsilon_w \qquad (14)$$

$$\tilde{r}_{t+\tau} = c_3 + c_4 r_{t+\tau-1} + c_5 \log w_{t+\tau-1,a^*} + \varepsilon_r\,,$$

where ε_w and ε_r are mean zero, bivariately-distributed normal errors with variances σ_ε^2, σ_r^2, and covariance $\sigma_{\varepsilon r}$. Since the distributions of $\tilde{w}_{t+\tau,a^*}$ and $\tilde{r}_{t+\tau}$ depend on their lagged values, these lagged variables represent the additional state variables ($S_{t+\tau}$) entering the $\hat{c}_{t+\tau,a^*}(\ )$ functions.[9]

Values of $w_{t+\tau,a^*}$ are calculated for the years 1946 through 1984 by dividing total annual earnings by the multiplicand of $w_{t+\tau,a^*}$ in (13). Total annual earnings equals NIA wage and salary compensation plus an updated version of Kotlikoff and Summers' (1981) estimate of labor earnings of the self-employed. Values for the relative earnings profile $\lambda_{t+\tau,a}$ come from Social Security data on median earnings by age and sex.[10] There is very little variation in this profile between 1946 and 1984. For years after 1984 the projected profile of relative earnings is set equal to the 1984 relative earnings profile. Work experience rates by age and sex are reported starting in 1959 in the Employment and Training Report of the President, although labor force participation rates are available for the entire period.[11] For the period 1946 through 1958 work experience rates are imputed based on a regression of work experience rates on labor force participation rates for the years 1959 through 1984. Work experience rates projected beyond 1984 are assumed to equal the 1984 rates.

Private consumption is measured here as NIA consumer expenditures on nondurables and services plus imputed rent on durables. The BEA consumer durables series was used in this calculation. The rate of imputation equals the annual average three-month Treasury Bill rate less the annual percentage increase in the PCE durables deflator plus an assumed 20 percent depreciation rate. Government consumption is also corrected for durables

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[9] Estimation results of this bivariate process are:

Dependent Variable	Constant	$\log \tilde{w}_{t+\tau-1,a^*}$	$r_{t+\tau-1}$	R^2
$\log \tilde{w}_{t+\tau,a^*}$	.028	.989	.00111	.992
	(.042)	(.015)	(.00094)	
$\tilde{r}_{t+\tau}$	17.11	.435	-3.57	.302
	(6.66)	(.149)	(2.38)	

The estimated covariance matrix of ε_w and ε_r is $\begin{pmatrix} \sigma_\varepsilon^2 & \\ \sigma_{\varepsilon r} & \end{pmatrix} = \begin{pmatrix} 5.403 \cdot 10^{-4} & \\ 13.37 & .05 \end{pmatrix}$

[10] Social Security Administration, Annual Statistical Supplement.

[11] Employment and Training Report of the President, 1982, Table B18, p. 234, and Table A3, p. 122; and Ibid, 1977, Table B15, p. 257.

consumption. The stock of government durables, both military and nonmilitary, was divided into equipment and structures. A 20 percent rate of depreciation was assumed for government equipment, and a 3 percent depreciation rate was assumed for government structures. Like demographics and the age distribution of earnings, we assume that the future course of government consumption is known with certainty. Future government consumption is determined by assuming that government consumption per capita after 1984 equals the 1984 level of government consumption per capita. Besides government consumption, the marginal tax on capital income is the only policy variable influencing the optimal consumption plan. A 30 percent marginal tax on capital income is used in calculating each of the consumption functions for the years 1946 through 2060.

Economy-wide net worth is measured as the sum of private plus government reproducible tangible wealth measured at replacement cost estimated by the BEA, plus the value of private land estimated by the Federal Reserve. These and other series are deflated to 1972 dollars. Given wealth in years t and t+1, and year t earnings, private consumption, and government consumption, equation (7) can be used to solve for $r_{t+\tau}$. This procedure was used to determine the pretax rate of return series for the period 1946 through 1984.

Data for the age distribution of resources, which, according to the Barro model, are irrelevant for aggregate consumption, were obtained from the annual Current Population Surveys (CPS) for the years 1968 through 1984. While the CPS data do not provide information about asset holdings, they do include property income, wage and salary income, and government transfers including welfare, food stamps, unemployment compensation, veterans' benefits, and Social Security retirement and disability benefits. These data and the CPS population weights are used to construct shares of total income as well as shares of labor income, property income, and Social Security income of households with heads whose ages fall in particular age categories.

V. TESTING THE INTERGENERATIONAL ALTRUISM MODEL

Equation (15) indicates the nonlinear regression model used to test intergenerational altruism.

$$C_t = \beta_1 + \beta_2 \hat{C}_t(A_t, \log w_{t-1}, a^*, r_{t-1}; \theta_0, \ldots, \theta_D, \gamma, \rho) + \lambda_1 s_{1t} + \ldots + \lambda_m s_{mt} + \varepsilon_{ct} \quad (15)$$

In (15) C_t is actual consumption, $\hat{C}_t(\ )$ is the level of total consumption predicted by our model and depends on the age-utility weights $\theta_0, \ldots, \theta_D$, the relative risk aversion coefficient γ, and the time preference rate ρ, where $\rho = \frac{1-\alpha}{\alpha}$. The variables s_{1t} through s_{mt} are year t shares of personal income or components of personal income of m different age groups. The error ε_{ct} is assumed to be normally distributed with mean zero and variance σ^2. A test of the altruism model is that all the λs are zero, conditional, of course, on both our specification of intergenerational altruism and our functional forms for utility, as well as earnings and return uncertainty. Note that the alternative hypothesis includes most other consumption theories such as the life-cycle model.

Before presenting the results of this regression, it is useful to describe values of the $\hat{C}_t(\ )$ series and changes through time in the share of personal income and its components received by different age groups. Table 1 presents actual consumption and consumption predicted by our model ($\hat{C}_t(\ )$) for selected years for alternative values of α and γ. Consumption is measured in 1972 dollars. The age-utility weights in this table are set such that θ_a equals .5 for age a less than 16, or age a greater than 80. At age 40 θ_a is set equal to 1. For ages between 15 and 40, θ_a rises linearly from .5 to 1, and θ_a declines linearly from 1 to .5 between ages 40 and 80. Quite similar results arise for other choices of the values of θ_a at ages 15 and 80.

From the preliminary examination of alternative parameters values described in Table 1, it appears that for certain sets of parameter values the model presented in Section III does fairly well in predicting actual consumption. Of the parameter combinations examined in the table, a value of γ equal to 2, ρ equal to .04, and θ equal to .5 produce the smallest root-mean squared error for consumption. These parameter values are within the middle range of those that have been estimated.

Table 2 contains, for selected years, various income shares of households whose heads are in particular age groups. The table also indicates the fraction of all households with heads in particular age intervals; and it displays the ratio of the average income of households with heads in a particular age category to the average income of all households. Table 2 indicates sizable changes in income shares of particular age groups between

TABLE 1

Comparison of Actual With Predicted Consumption

for Alternative Values of ρ and γ

Year	Actual Consumption	Consumption Predicted by Altruism Model			
		γ = 1.5 ρ = .05 θ = .3	γ = 2 ρ = .04 θ = .5	γ = 2 ρ = .03 θ = .5	γ = 4 ρ = .04 θ = .3
1947	298	262	273	260	322
1950	342	250	259	247	296
1955	399	318	335	318	400
1960	479	395	405	388	462
1965	581	465	488	465	565
1970	700	562	663	629	762
1975	785	809	831	798	938
1980	947	1006	1019	972	1132
1984	1087	1044	1032	964	1136
Root-Mean Square Error 1946-1984		69.7	58.3	75.6	78.6

All consumption values are measured in billions of 1972 dollars.

TABLE 2

Age Distribution of Income and Related Variables

Age of Head	Year	Fraction of All Households	Share of Total Income	Total Income Ratio	Share of Labor Income	Labor Income Ratio	Share of Property Income	Property Income Ratio	Share of Transfers	Transfer Income Ratio
15-24	1968	0.079	0.050	0.633	0.060	.759	0.009	.114	0.005	0.006
	1975	0.102	0.058	0.568	0.069	.676	0.009	.088	0.006	.006
	1984	0.092	0.043	0.465	0.051	.554	0.011	.120	0.003	.033
25-34	1968	0.177	0.186	1.048	0.214	1.209	0.049	.277	0.023	.130
	1975	0.213	0.219	1.029	0.257	1.207	0.062	.291	0.017	.080
	1984	0.243	0.225	0.927	0.273	1.123	0.063	.259	0.016	.066
35-44	1968	0.193	0.240	1.243	0.257	1.332	0.105	.544	0.055	.285
	1975	0.164	0.207	1.269	0.227	1.384	0.092	.561	0.042	.256
	1984	0.188	0.240	1.274	0.275	1.463	0.113	.601	0.035	.186
45-54	1968	0.193	0.250	1.296	0.258	1.337	0.193	1.000	0.081	.420
	1975	0.175	0.236	1.350	0.250	1.429	0.176	1.006	0.074	.423
	1984	0.138	0.193	1.403	0.214	1.551	0.125	.906	0.038	.275
55-64	1968	0.167	0.172	1.033	0.165	.988	0.243	1.455	0.121	.724
	1975	0.154	0.167	1.085	0.159	1.032	0.246	1.597	0.138	.896
	1984	0.144	0.166	1.154	0.153	1.063	0.238	1.660	0.134	.931
65+	1968	0.191	0.102	0.534	0.046	.241	0.400	2.094	0.714	3.738
	1975	0.193	0.112	0.583	0.037	.192	0.416	2.155	0.723	3.746
	1984	0.196	0.134	0.682	0.034	.173	0.450	2.296	0.774	3.949

1968 and 1984. For example, the share of total income of households with heads age 25 to 34 rose from 18.6 percent to 22.5 percent over the period. For the 45-54 age group the income share fell during this period from 25.0 percent to 19.3 percent. Many of these changes are explained by changes in the age distribution of households; the first column of the table is clearly highly correlated with the second. But there were also changes in income shares over the period that are not directly related to demographic change. The figures in column 3 indicate that in 1968 households with heads age 45 to 54 had average incomes that were 1.30 times the overall average household income. In 1984 such households had average incomes that were 1.40 times the overall average. During this 17-year period the ratio of the average income of households with 45-to-55 year old heads to that of households with 25-to-34 year old heads rose by 22 percent. Shares of property income also changed significantly for certain age groups; the 45-to-54 year old group experienced a 35 percent drop in its share of property income between 1968 and 1984. Similar sizable changes in income shares and income ratios are indicated in Table 2 for labor income and transfer income.

Table 3 reports maximum likelihood estimates of equation (15) excluding income shares, including income shares of all age groups, and including only the income share of households age 65 and older. Maximum likelihood estimates were derived by searching over a grid of values of γ, ρ, and θ. For each combination of these parameters, (15) was estimated by OLS. The maximum likelihood estimates are those producing the smallest residual sum of squares. Following Amemiya (1983), standard errors were computed by replacing $\hat{C}_t(\ )$ in (15) with a first order Taylor's approximation taken around the maximum likelihood estimates and estimating the resulting equation by OLS. The coefficients on the first derivatives of $\hat{C}_t(\ )$ with respect to γ, ρ, and first θ are approximately equal to the maximum likelihood estimates, and the standard errors of these and other right-hand-side estimated coefficients are consistent and asymptotically efficient if ε_{ct} is i.i.d. normal.

The first column of Table 3 confirms the point made above, that our model tracks actual consumption fairly well. The R^2 is .958, and the estimated values of γ and ρ are both significant and reasonable. The coefficient on $\hat{C}_t(\ )$ is .772 and is significantly different from 1 at the 5 percent level. In addition, the intercept is significantly different from zero. Both of these results are at odds with the prediction of our model. Also at odds with our model is the significance of the 65+ income

TABLE 3

Excess Sensitivity of Consumption to Income Shares, 1968-1984, Maximum Likelihood Estimates (Standard Errors)

	Models		
	(1)	(2)	(3)
γ	1.5	2.0	2.0
	(.195)	(.164)	(.826)
ρ	.05	.03	.04
	(.017)	(.031)	(.016)
θ	.3	.5	.5
	(.291)	(.250)	(.294)
β_1	203.9	292.5	-7358.1
	(45.6)	(72.0)	(4825.3)
β_2	.772	.526	.993
	(.130)	(.071)	(.418)
Income Shares			
S_{65+}		62.9	86.8
		(26.0)	(40.7)
S_{55-65}			104.5
			(60.1)
S_{45-54}			80.4
			(59.2)
S_{35-44}			66.1
			(43.6)
S_{25-33}			61.7
			(52.2)
R^2	0.958	0.975	0.992
DW	1.12	.91	2.18
SSR	12083.6	7293.0	2334.6
SEE	28.4	22.8	15.3

Mean of Dependent Variable: 845.5

share in column (2) and the five total income shares included in column three. The critical F(5,7) for the inclusion of all the shares at the 5 percent level is 3.97, which is below the F of 5.85 calculated for the inclusion of the five shares. The sign and, to some extent, pattern of the income share coefficients accord with the prediction of the life-cycle model that redistribution from younger to older age groups raises consumption. According to these estimates a redistribution of 10 percent of income from the youngest to the oldest age group would raise United States consumption by .7 percent, evaluated at the mean value of consumption. With prevailing saving rates, a .7 percent increase in consumption would lower the net national saving rate by over 10 percent.

The significance of age-resource distribution variables does not apply to the three components of income for which we have separate data: labor income, property income, and Social Security income. To reduce computation costs we constrained γ, ρ, and θ in this analysis to equal their maximum likelihood estimates from column (1), Table 3. The F(5,10) values for the inclusion of the shares of labor income, property income, and Social Security income are 1.87, 2.08, and 1.51, respectively. While these values are each below the critical F of 3.33, if one constrains β_1 to equal zero and β_2 to equal 1, the respective F(5,12) values are 12.2 for total income shares, 14.8 for labor income shares, 9.9 for property income shares, and 5.6 for Social Security income shares. The critical F(5,12) for this test is 3.11. Hence, the data reject the hypothesis that age-resource shares are irrelevant given the model's predicted values of β_1 and β_2.

To examine whether the significance of the age-resource variables is robust to choices of γ, ρ, and θ that differ from the maximum likelihood estimates, we tested the significance of the total income shares for several different constrained choices of these three parameters. The critical F value for these tests is F(5,10)=3.33. For γ=10, ρ=.01, and θ=.5 the F statistic is 16.75; for γ=1.1, ρ=.04, and θ=.5 the F statistic is 1.59; for γ=2, ρ=.15, and θ=.5 the F statistic is 3.78; and for ρ=.05, γ=1.5, and θ=.8 the F statistic is 4.75. Hence, for a range of a priori choices of γ, ρ, and θ, most, but not all, of the test statistics for the inclusion of income shares are significant.

Table 4 presents maximum likelihood estimates of (15) for the period 1947 to 1977 using levels of net Social Security wealth of different age groups. For this 31-year sample period, the maximum likelihood estimates of γ, ρ, and θ are close to those reported in Table 3. While β_2 is not significantly different from unity, as predicted by the theory, β_1 is sig-

TABLE 4

Excess Sensitivity of Consumption to Social-Security Wealth Shares, 1947-1977, Maximum Likelihood Estimates (Standard Errors)

	Models		
	(1)	(2)	(3)
γ	2.0 (.783)	1.5 (.227)	1.5 (.092)
ρ	.03 (.014)	.05 (.009)	.03 (.010)
θ	.5 (.157)	.3 (.204)	.3 (.083)
β_1	114.1 (16.7)	23.1 (28.8)	155.4 (41.9)
β_2	.915 (.149)	1.237 (.159)	.764 (.195)
Social Security Wealth Levels			
L_{65+}		.377 (.098)	.014 (.359)
L_{55-65}			.644 (.570)
L_{45-54}			-.966 (.528)
L_{35-44}			2.022 (.338)
L_{25-34}			-1.526 (.564)
L_{14-24}			-.220 (.548)
R^2	0.979	.986	0.996
DW	.5	.9	1.6
SSR	18242.1	11796.2	3113.1
SEE	25.1	20.5	11.6

Mean of Dependent Variable: 540.8

nificantly different from zero. In addition, the Social Security wealth levels of different age groups are significant explanatory variables. The F(6,20) statistic for their inclusion is 16.2, which exceeds the 5 percent critical value of 2.60.

VI. CONCLUSION

The results presented here clearly reject our formulation of the altruism model. However, it should be restressed that the model imbeds strong assumptions not only about preferences, but also about the extent and nature of uncertainty. Rather than a rejection of altruism, the significance of the age-resource shares may reflect misspecification of the altruism model that is correlated with age-resource shares. For example, the age-resource shares might conceivably enter in the processes determining earnings and rates of return. In this case, the state variables, S_t, in $\hat{C}_t(\ )$ should include the age-resource information, and the exclusion of this information would bias the results. Alternatively, there may be a large number of discrete altruistic families with different age structures. In this case, changes in the age distribution of resources will typically be associated with changes in the interfamily distribution of resources, and such changes would be expected to alter aggregate consumption.[12]

The paper's contribution is, hopefully, not only to test a particular formulation of the Barro proposition, but also to stimulate additional research that directly tests central implications of life cycle and altruistic saving models.

[12]There may be fewer distinct altruistic Barro families than one might think. Kotlikoff (1983) and Bernheim (1984) independently demonstrate that marital ties can generate altruistic linkages across families, producing, effectively, extremely large Barro families.

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PUBLIC DEBT POLICIES AND UNITED STATES SAVING
A COMMENT

PAUL M. ROMER
University of Rochester

The paper by Boskin and Kotlikoff starts by presenting what appears to be ominous evidence concerning the behavior of aggregate savings in the United States. Since 1960, the United States rate has been roughly one-third of the Japanese rate and one-half of the European OECD rate. Moreover, the United States rate fell 46% between the 1950s and the first four years of the 1980s. Boskin and Kotlikoff focus on the time-trend in the United States rate and argue that only the assumption of incomplete intergenerational altruism combined with the postwar expansion of the Social Security System appears capable of explaining the fall in the saving rate. After a brief review of the difficulties in testing theories of saving, they test and reject a model with complete intergenerational altruism.

The primary contribution of this paper is to redirect attention in the debate about savings in general and the Social Security System in particular. Boskin and Kotlikoff are surely correct that it is essential to be explicit about models of individual behavior in any discussion of these issues. Because of its sharp predictions and analytical advantages, a model that captures complete intergenerational altruism by using an infinite-lived, representative individual is a natural null hypothesis in empirical work on such questions. Their implementation of this kind of model represents a useful extension beyond previous work. They explicitly incorporate demographic information and use a numerical-solution technique which allows them to move outside the conventional linear-quadratic specification into a setting with both interest-rate and income (i.e., earnings) uncertainty. The method is sensible and the parameter estimates given in Table 1 are reasonable. Presumably subsequent work will identify the extent to which these extensions lead to an improvement over previous models of consumption based on infinite-lived individuals.

The case for viewing with alarm the current behavior of savings in the United States is much less convincing. Because consumption is smoother

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than output, the saving rate varies procyclically. Using decade averages removes some of the cyclical component from the time variation, and the values of 8.8%, 8.7%, and 7.8% for the 50s, 60s and 70s show little evidence of a downward trend. The 4.7% average value for the early years of the 80s is considerably lower than these values but is not out of line with the historical behavior during recessions. For example, the saving rate in 1975 was 4.3%.

If one is primarily concerned with the potential impact of the expansion of the Social Security System on saving, there is other evidence one can consider. The figures cited here and in the paper are computed from National Income Accounts data, but the Federal Reserve Board calculates a separate savings series based on changes in private-sector wealth. This series uses only a partial measure of private wealth, neglecting the value of government obligations which are not traded in any market. Thus, it includes Treasury securities but not Social Security wealth or future tax liabilities. If the increase in the Social Security wealth had caused agents to accumulate less wealth of other forms, the FRB measure of savings should be falling over the period in question. In fact, this measure of savings is virtually constant as a fraction of Net National Product, with an average value of 9.6% in the 50s, 9.1% in the 60s, 10.0% in the 70s, and 10.4% for 1980 through 1983. Of course, one could argue that in the face of rising future tax liabilities, this measure of savings has not increased as fast as it should, but this seems tenable only for the most recent years.

In short, it is not at all clear that the fall in the United States saving rate that Boskin and Kotlikoff set out to explain even exists. The apparent divergence between United States and foreign saving rates does merit further study, but time series results for the United States alone offer little basis for discriminating among different explanations.

The formulation and testing of the model here is of interest independent of the motivation, but the appropriate response to the results reported here is to make the usual call for more research. The authors reject the model because income share variables have explanatory value for actual consumption in an equation which includes predicted consumption. As they note, this can be interpreted as evidence against intergenerational altruism or as indication of model misspecification. They point to possible problems with the specification of the stochastic processes determining rates of return and wages. A more likely source of difficulty lies in the life-cycle profile of consumption implicit in the weights θ_a. Under the

assumed form of these weights, the cross-sectional pattern of age specific consumption forms a symmetric hump which reaches a maximum at age 40. Over time, the ratio of the consumption of individuals of different ages is assumed to be constant. This specification of how consumption varies with age, and hence of how the age distribution of the population affects aggregate consumption, is quite restrictive. Any misspecification will induce errors that are correlated with demographic changes; these are in turn correlated with the income share variables. If the form of the consumption profile implies that individuals over the age of 65 consume less than they actually do, an increase in the fraction of individuals over 65 will cause the model to under-predict consumption, and the fraction of wealth held by this group will enter positively in a regression of actual consumption on predicted consumption. A trend over time towards relatively more consumption later in life because of income effects or changes in work habits or life expectancy will have the same effect. Using only aggregate data, there is little hope that these kinds of effects can be separated from a test for the presence of altruism. The focus here on specific models of individual behavior is welcome, but further progress in this area will probably require the incorporation of additional data, either aggregate data on age-consumption profiles or panel data on individual families.