THE EFFECTS OF SOCIAL SECURITY ON INCOME AND THE CAPITAL STOCK

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Chapter 1

INTRODUCTION AND SUMMARY

After a long period of neglect, the social security program is being reexamined on a wide front: equity, actuarial soundness, and economic impact. This monograph focuses on the economic aspect of the Old Age and Survivors Insurance (OASI) program -- particularly in terms of how the program affects aggregate income and the capital stock. Dramatic claims can and have been made about the significance of the program for saving and the capital stock. But these claims are like hitting a mule over the head with a two-by-four to get his attention. Interest in the effects of social security is already aroused. A careful assessment of the actual effects is in order prior to making radical changes in public policy.

Martin Feldstein in his seminal study 1/ estimated that social security reduced U.S. saving and capital stock by 38 percent. In a climate of anxiety over a capital shortage,2/ this estimate raised serious concern over the economic impact of social security. This concern was expressed in proposals to change social security to a fully-funded from a pay-as-you-go basis as well as others.

The current study makes no attempt to evaluate these proposals. Instead the focus is on evaluating the empirical and theoretical basis on which the capital effects have been estimated and improving these so that policy may be made in a more informed environment.

The social security program influences the aggregate levels of income and the capital stock through two proximate determinants: (1) the ratio of aggregate saving (or investment) to aggregate income, and (2) the supply of labor offered for employment. Generally a reduction in either the saving-income ratio or the fraction of the population participating in the labor force will lower income and the capital stock.

Most differences in the estimated effects of social security arise from disagreement over whether and by how much OASI reduces the saving-income ratio. The bulk of the work reported here is an examination of this issue. Ultimately, in Chapter 5, these effects are combined with labor supply changes in a model of long-run growth equilibrium.

The theoretical analysis of saving-income ratio effects of social security has been almost universally carried out in terms of a model of the lifetime consumption-saving-labor decision with no expected bequests. This model is extended in Chapter 2 by the inclusion of expected bequests. Such bequests arise not only out of concern for the welfare of the heirs but also because assets serve as a form of generalized insurance against life contingencies.

The theoretical model suggests five channels by which social security may affect saving relative to income. (1) First there is the dual effect of income-smoothing which reduces aggregate saving and of induced retirement which increases aggregate saving. I term the net impact the Feldstein/Munnell effect after Martin Feldstein and Alicia Munnell who developed it. (2) A second channel results to the extent that social security forces people to buy life annuities which they would not otherwise. This reduces the risk of outliving any given amount of capital. So the precautionary motive for expected bequests and the associated saving is lessened. (3) However social security benefits are uncertain in amount which would tend to increase life-cycle saving. (4) Saving is increased if the real interest rate used by individuals in making their life-cycle decisions exceeds the approximately 3½ percent yield implicit in social security. (5) Finally, the induced reduction in labor supply would tend to reduce both bequest saving and income proportionately.

No unambiguous conclusions can be drawn from theory as to whether the social security program would tend to increase or decrease the saving-income ratio. The extended model does suggest that analyses which concentrate exclusively on the Feldstein/Munnell effect may miss some important effects which would alter the answer to the question at hand.

One factor tends to reduce the size of all the effects except that deriving from induced labor supply changes: This is that in part social security does not change life-cycle income but rather the labels applied to it. OASI has replaced in part both public welfare financed by taxes and private income transfers from young workers to retired parents. The replacement of these transfers with social security benefits and taxes should have no effect on saving behavior.

The novel view that the zero-bequest life-cycle model does not tell the whole story about aggregate saving is explored further in Chapter 3. Actually the whole idea of retirement is fairly modern. So it seemed appropriate to see whether saving during the period when people typically worked until they died conformed to the predictions of the zero-bequest life-cycle model. That model implies that the saving income ratio increases with the ratio of expected retirement to expected working life. In fact, the saving-income ratio was if anything higher during the 1890-1930 period than presently and tended to fall as the ratio of expected retirement to expected working life rose. This is exactly contrary to the zero-bequest model and therefore seems to suggest a dominant role for bequest saving. Indeed the saving-income ratio during 1890-1930 was 3 to 4 times higher than can be explained on even a generous reading of the zero-bequest model.

To confirm that the relative importance of life-cycle and bequest saving has not changed in more recent years, net worth data from the 1967 Survey of

Economic Opportunity were examined. Total net worth by age was broken down into a component held for life-cycle purposes and the remainder accumulated for expected bequests. The method of estimation tended to overestimate the portion held for life-cycle purposes, but these still amounted to only 29 to 13 percent of total assets depending on the interest rate used in the calculations. Once again bequest saving appears to be empirically important.

In making these calculations, it was straightforward to calculate the maximum possible Feldstein/Munnell effect. This occurs if net social security wealth replaces life-cycle assets dollar-for-dollar and there is no induced retirement. Using the cross-section S.E.O. data, this maximum ranged (depending on the interest rate) from 23 to 12 percent of total assets inclusive of social security wealth. Similar calculations based on 1971 aggregate benefit data ranged from 21 to 11 percent. Feldstein's own net social security wealth estimate was 25 percent at an interest rate corresponding to the 23 and 21 percent figures.

Approaches to directly estimating social security effects on the saving-income ratio are considered in Chapter 4. Past efforts to estimate this effect using international cross-section data have been plagued with reverse causation: To the extent that the saving-income ratio is negatively correlated with the scale of the social security program, it is unclear whether large social security programs depress saving or are demanded where saving is low. The use of the long and high quality U.S. time series data appeared a more promising approach to estimating these effects. The U. S. time series data have been used for this purpose by three other researchers.

Alicia Munnell estimated a net effect equal to an about 5 percent reduction in private saving relative to income, but this estimate was not statistically significant (distinguishable from zero).

Martin Feldstein reported an estimate of a 38 percent reduction in the private saving-income ratio, but this estimate was not supported by a careful reading of his published results. First, using the statistically and theoretically superior net social security wealth concept and deleting an erroneous correction for social security effects on disposable income, the estimated reduction in the saving-income ratio is 26 percent. More importantly, his estimated effects was "statistically significant" only after the unemployment variable was deleted from his regression equation on what appear to me to be unacceptable grounds.

Robert Barro also demonstrated the sensitivity of Feldstein's results to the unemployment variable and period of estimation. Using Feldstein's social security wealth variable and his own benefit-coverage variable, Barro finds that social security is never statistically significant unless unemployment (which is statistically significant) is deleted.

I report my own regression results for four alternative social-security scale variables: Feldstein's gross and net social security wealth concepts, Barro's benefit-coverage variable, and OASI taxes. Using a refined consumer expenditure function derived from the permanent income model which explicitly allows for bequests, statistically significant reductions in the private saving-income ratio were estimated for 1929-1974 data except for Barro's variable. These reductions of about 20 percent may be due to the social security variables (other than Barro's) serving as an indicator of whether or not there is a depression. It has been argued that consumption would be overestimated during the depression because exhaustion of buffer stocks of liquid assets would cause a greater reduction in consumption than otherwise. Postwar regressions show no effect of social security on saving. It is concluded that the effect of social security on the saving-income is still a very open question, but the 20 percent reduction is likely upward biased with the actual reduction closer to or less than the mean 10 percent reduction estimated here.

The weight of empirical evidence seems to indicate that the private saving-income ratio has been reduced from 0 to 10 percent, although a reduction of 20 to 25 percent cannot be ruled out. The range of labor supply effects seems somewhat narrower -- 0 to 3 percent -- although rather less research has been done on this magnitude. These estimated effects are combined in Chapter 5 to obtain estimated long-run equilibrium effects on income and the capital stock.

Because the U. S. capital market is connected to the world capital market through international capital flows, it is necessary to distinguish between the capital stock used in the U. S. (regardless of by whom owned) and the capital stock owned by U. S. residents (regardless of where located). A corresponding distinction between output produced in the U. S. (N.D.P.) and U. S. income (N.N.P.) allows for the yield on net foreign capital holding.

For the relevant range of interest rates, owned capital and income are likely to be reduced somewhat less than were the U. S. a completely closed economy. Used capital and output are reduced even less. Various calculations suggest that owned capital is reduced from 5 to 20 percent and used capital from 0 to 15 percent. The corresponding reductions in income and output range from 2 to 7 and 0 to 4 percent, respectively.

It is incorrect to jump to the conclusion that these reductions imply that changes must be made in the social security system. First an analysis must be made of whether the capital stock is more or less than socially optimal on either definition. If it is desired to alter the capital stock, funding the social security system is simply an attempt to increase investment through running a government surplus. Whether this is the most desirable way to do so relative to such alternatives as tax law changes remains a very open question. Other factors than capital stock effects would seem basic to any evaluation of the social security program per se.

Footnotes to Chapter 1

1/ Martin Feldstein, "Social Security, Induced Retirement, and Aggregate Capital Accumulation," vol. 82 (September/October 1974), pp. 905-26.

2/ A succinct review of the capital shortage literature is found in Robert Eisner, "Capital Shortage: Myth and Reality," American Economic Review, Papers and Proceedings, vol. 67 (February 1977), pp. 110-15.

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CHAPTER 2

A MODEL OF THE EFFECTS OF SOCIAL SECURITY ON THE SAVING-INCOME RATIO

The saving-income ratio of an economy in a long-run growth equilibrium may be either a behavioral desideratum or an artifact due to proportionate growth in the desired capital stock and aggregate income. If one models an economy peopled by infinitely-lived individuals or (what is the same thing) families with intergenerational transfers, it is most reasonable to think of a desired growth rate of consumption and hence a desired ratio of saving to (permanent) income. If one instead considers an economy of mortal individuals who neither give nor receive bequests, it is plausible to relate a desired level of assets to accumulation of wealth for retirement. In this case saving would occur because of the growing numbers and earning potential of asset holders. This chapter attempts to present a model combining these two sources of aggregate saving — accumulation for bequests and retirement — and to examine how social security might effect them.

Let us first examine how a growing desired capital stock and hence aggregate saving would occur in a world without bequests. The individual's lifetime consumption-asset-saving-labor decision or plan has been examined under a variety of assumptions using the general framework of the life-cycle model introduced by Modigliani, Brumberg, and Ando.[1] A simple version of this approach will be discussed and expanded here.

The unit of analysis is the individual, but this may be interpreted as a couple who marry at or before the beginning of the working life and die together at the end of retirement. Departures from this standard pattern must be considered in the later analysis of cross-section data although they do not appear important considerations for the aggregate analysis here.

The simplest form of the model is illustrated in Figure 2.1. Here age is dated from the beginning of the working life 0 to death at T. The vertical axis measures the relevant variables in terms of the logarithm of real (inflation-corrected) dollars. The curved line is the chosen path of labor income over the life cycle. The humped shape reflects both variation in hours of work and wage rates.[2] Planned consumption of goods is drawn as a straight line which implies a constant growth rate over the life cycle. Consumption should rise over time because more goods can be acquired later (with accumulated interest) than sooner with the same current payment. Therefore the marginal utility of goods must decline over time if planned consumption is to distribute current wealth to highest valued uses.[3] The rate of saving from labor income at any age t is given by subtracting consumption from labor income. The individual's personal saving is found by adding the interest on accumulated past personal saving.

If inheritances and other intergenerational transfers were zero, the typical pattern of asset holdings would be as illustrated in Figure 2.2. This case -- which dominates the theoretical literature -- can result in net <u>aggregate</u> saving if population and productivity are growing. Then the high saving of the relatively richer and more numerous middle-aged can more than offset the dissaving of the elderly and young people.[4] Roughly speaking, aggregate saving depends on the mismatch between the shape of labor income and consumption and factors which reduce the mismatch would reduce aggregate saving.

Figure 2.3 depicts the pattern of asset holdings for a typical individual on the assumption that positive bequests are left at the end of life and are received throughout life. In this case <u>aggregate</u> personal saving will reflect

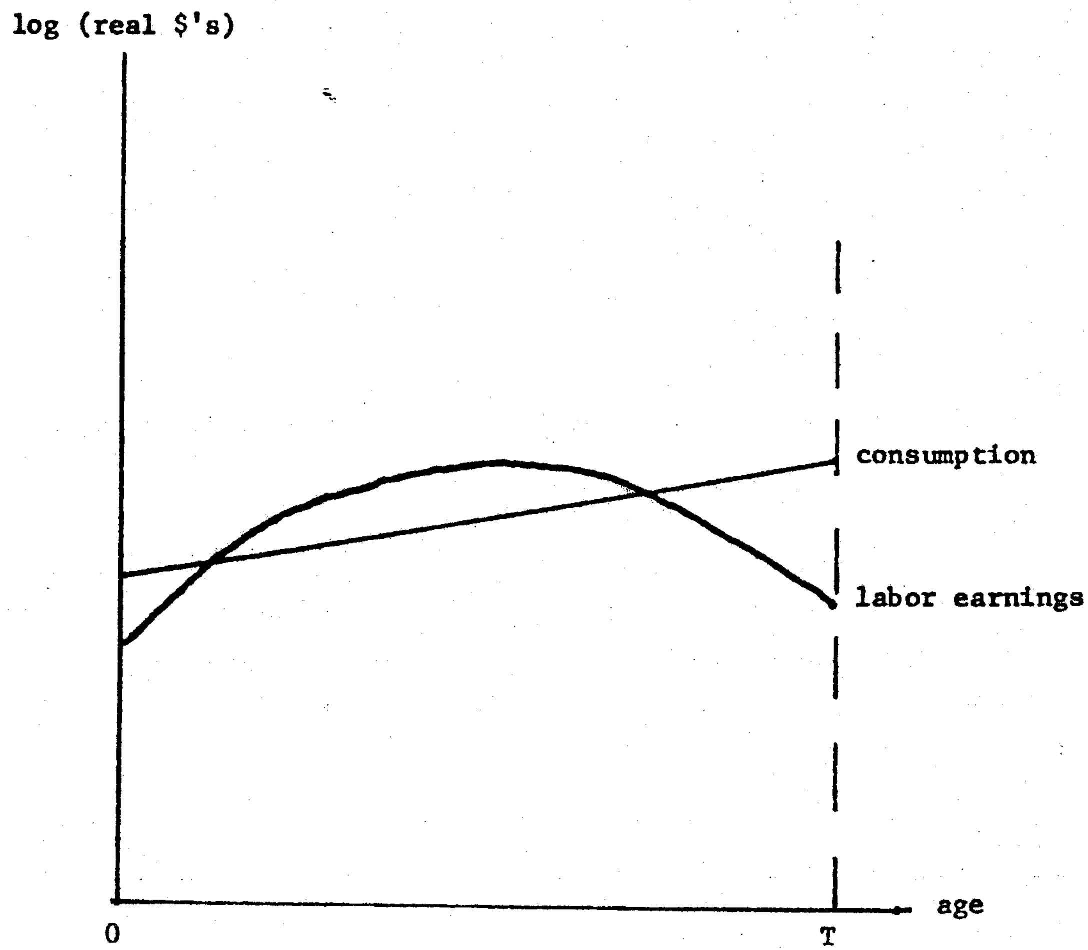


Figure 2.1

Life-cycle pattern of labor earnings and consumption in simple model

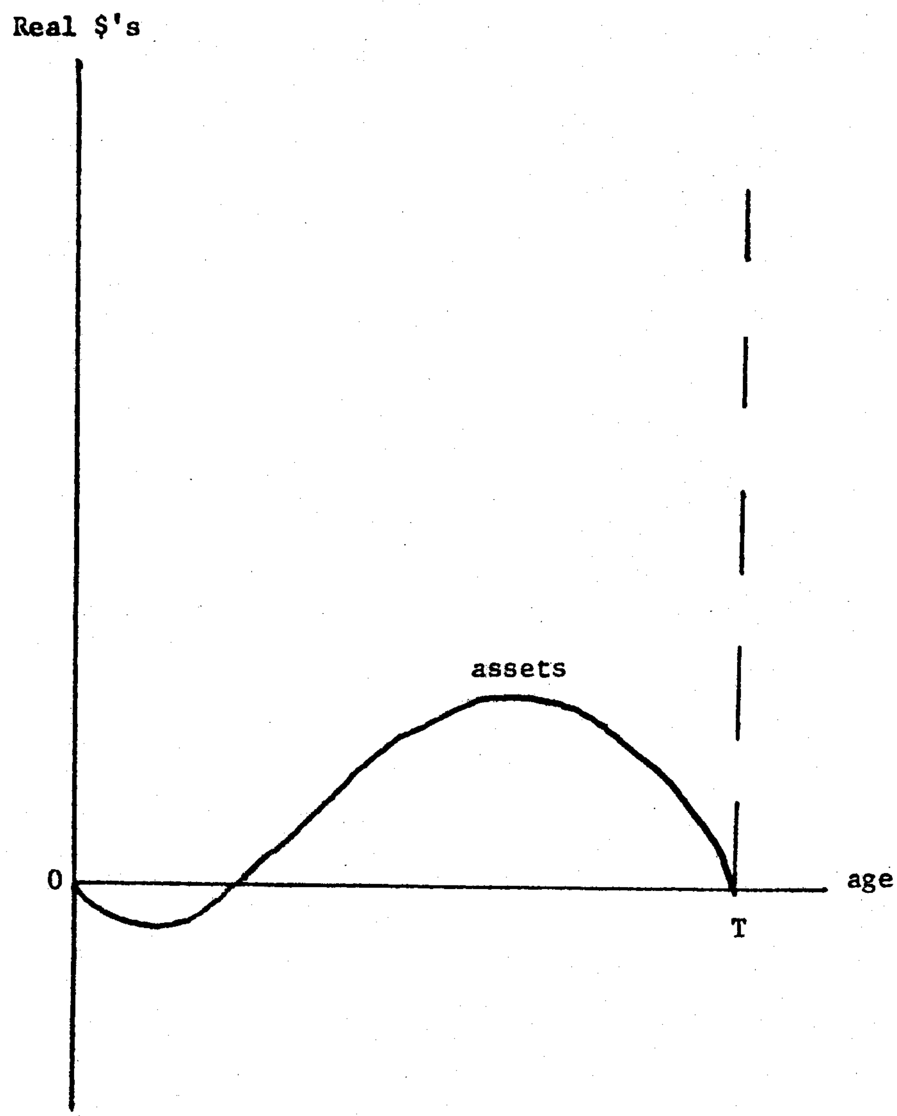


Figure 2.2

Life-cycle pattern of assets in a simple
zero-bequest model

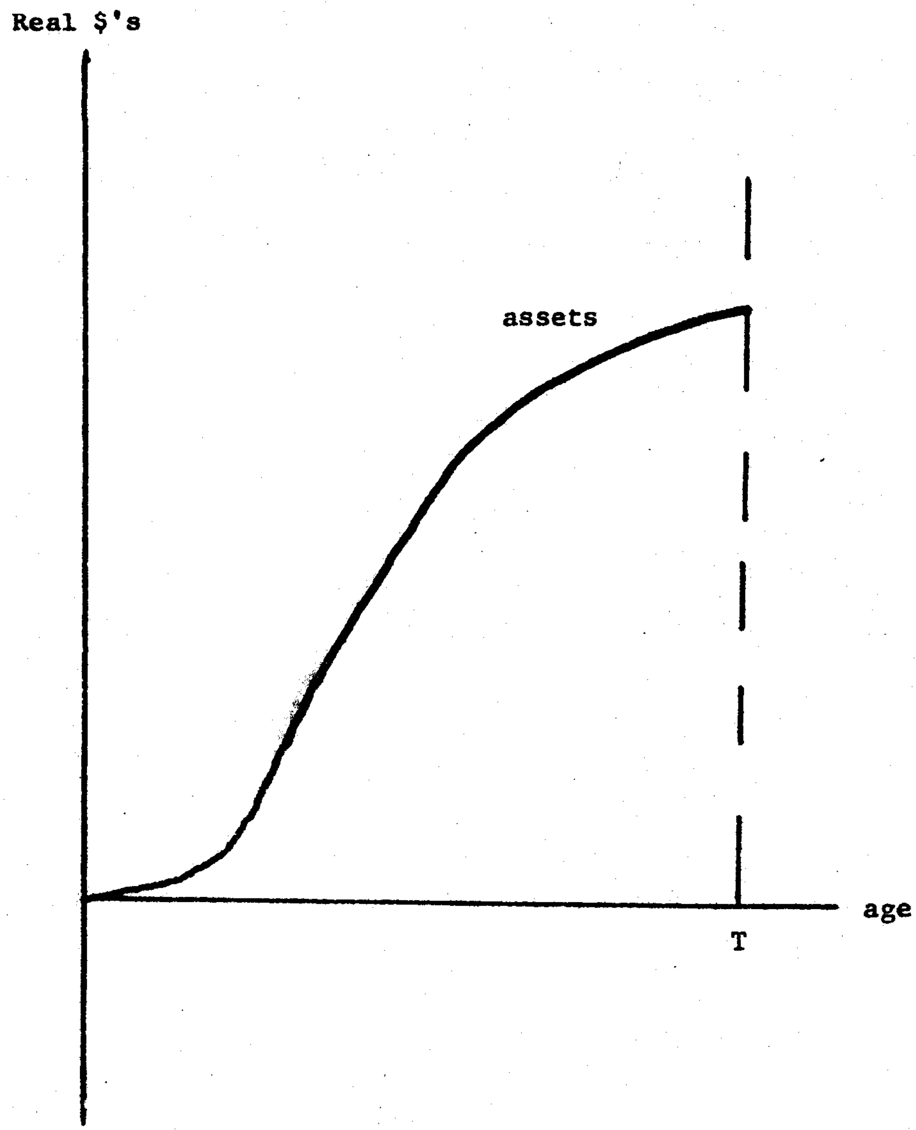


Figure 2.3

Life-cycle pattern of assets in a simple positive-bequest model both (1) variations in the rate of saving by age as in the simple zero-bequest model and (2) any accumulation of funds for bequests at a faster rate than bequests are received. The latter source of aggregate saving occurs because the life-cycle consumption path of each individual shifts down relative to the zero-bequest case so that total saving at each instant of time is increased.[5]

Motivations for Bequests

The motivations for bequests and other intergenerational transfers are rarely considered. Indeed these transfers are often dismissed as irrational because they typically involve transferring consumption opportunities to younger generations which are wealthier — in a lifetime sense — then the generation giving the transfer. But a current sacrifice of consumption can provide much more future consumption at compound interest. So parents can indeed rationally decide to forego some consumption in order to obtain more consumption for their wealthier children.

It is useful to regard bequests in connection with what might be termed a precautionary motivation for holding assets. Uncertainties as to length of life, state of health, and other "rainy days" can be met either through insurance (such as life insurance and major medical insurance) or by holding assets which can be called on to meet any such emergency. The costs of administration, adverse selection, and moral hazard may make voluntary insurance unattractive relative to a fund of assets to be used if needed and otherwise bequeathed to the children. A pattern of receiving bequests in middle age to supplement ones own retirement savings is clearly functional for an ongoing family as well as a source of social saving.

Thus precautionary motivations can be viewed as supplementing bequest motives — or the bequest motive as supplementing the precautionary motive. However one wishes to phrase it both aspects will be involved in choosing a life-cycle consumption plan that does not completely exhaust expected income over the life-cycle.

Effects of Social Security on the Saving-Income Ratio

A useful way to examine the effects of a social security program on aggregate saving is via the effects on consumption. Saving is the difference between income and consumption and consumption effects are more directly observable.

The institution of the old age pension portion of the social security program might alter the planned consumption path of the representative individual through four different channels: (a) induced early retirement and other changes in hours worked, (b) differences in present value of benefits and taxes, (c) changes in precautionary demand for assets, and (d) changes in the market interest and wage rates.

Induced Retirement Effects

The social security program induces changes in life-cycle labor supply because of the earnings test and the payroll tax. The earnings test has been changed from time to time, but as presently constituted imposes a high tax rate in the form of reduction in benefits for retired workers aged 62-71 on all labor income above a small monthly base until benefits are exhausted. In addition income and payroll taxes are payable on these earnings so that working may even cost after-tax income in certain circumstances. Some retirees earn just up to the maximum allowable without loss of benefits while others find the fixed costs of working and reduced part-time wages make even that a losing proposition. Workers with relatively high wages find it worthwhile to forego the retirement benefit entirely.

The payroll tax reduces the effective (after-tax) wage rate by a substantial amount. For example, if the marginal income tax rate is 22%, and the employer's and employee's F.I.C.A. payroll tax rates are 4.95% each, the effective tax-rate is increased from 22% to 30.6% by the payroll tax.[6] Whether hours worked before the induced retirement age would increase or decrease cannot be determined theoretically because of offsetting wealth and substitution effects.

The income and consumption paths of the representative individual after social security are shown in Figure 2.4. The solid lines show the labor income and consumption with social security and the dotted lines show what they would be in the absence of social security. Note that social security pension benefits are treated here as labor income while social security taxes are deducted from labor income. Induced retirement at age R is assumed due to the earnings test.

Consider Figure 2.4 on the assumption that the net present value of social security taxes and benefits are equal at age 0. For a going system in steady-state equilibrium this implies that the sum of the growth rates of population and productivity equal the real interest rate. In this sense the worker who chooses to retire loses no wealth directly. However the involuntary nature of the social security system in which taxes must be paid and benefits are conditional on retirement causes people to retire as the "lesser evil." They would prefer to continue working if they could also receive the benefits which their past taxes had "purchased." Thus the net effect of social security here is to reduce labor supply in old age and to shift some labor earnings to old age.

Martin Feldstein and Alicia Munnell -- working with zero bequest models -- have made much of these changes in the life cycle pattern of income. Their argument can be summarized as follows: If the individual would have retired at age R anyway, then social security would reduce the mismatch between income and consumption and hence aggregate saving.[7] If the individual would not otherwise retire, the life cycle pattern of income and consumption match less well under social security[8] and aggregate saving would rise. If the individual

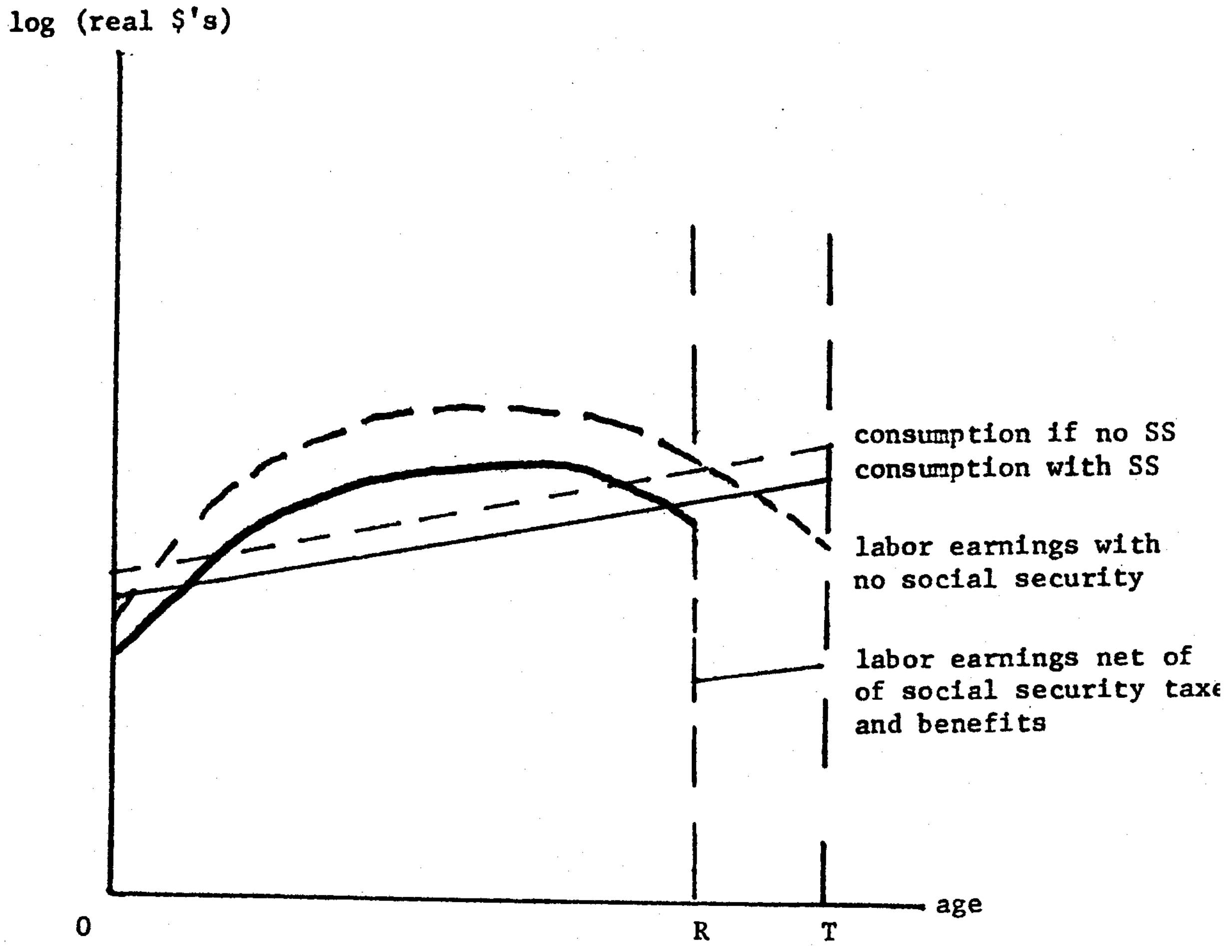


Figure 2.4

Life-cycle pattern of labor earnings and consumption
with social security

would retire between age R and T, the case is intermediate and aggregate saving could be increased or decreased.

The Feldstein/Munnell analysis thus suggests that the net effect on aggregate saving of income transfers from young to old and induced retirement is ambiguous as a matter of theory. The empirical importance of these induced changes in life-cycle asset demand will be considered in future chapters, but it is illuminating to consider the analysis a bit further here.

Consider the case of the individual who would have retired at age R anyway. If social security is actuarily fair,[9] there is no change in net wealth of the individual nor any reason to change his consumption pattern.[10] If this were true for all individuals, then aggregate consumption and labor input would be unaffected yet saving falls. The apparent paradox is resolved by noting that total income will fall by the interest rate times the reduction in the desired asset (or capital) stock. Since social security can be actuarially fair in a steady-state only if the real interest rate equals the growth rate of total income and the capital stock, the reduction in saving is just the amount required for the reduced capital stock to grow at the same rate as before. Note that although income, saving, and the capital stock are reduced, no individual reduces his consumption and the generations alive at the institution of the program are able to consume more to eat up the excess capital stock.[11] Therefore the analysis would seem to provide little support for concern over any reduction in saving on welfare grounds. The main concern so far as this analysis goes would seem to occur because of the reduced consumption (but increased saving!) due to induced early retirement. Thus Feldstein's analysis does not support concern over reduced saving and capital stock on welfare grounds. One may of course question some of the effects omitted from the analysis as well as some of the implicit assumptions.[12]

Consideration of the bequest portion of aggregate saving introduces a saving effect of induced retirement opposite to that argued on the Feldstein/Munnell analysis. The induced fall in lifetime labor supply reduces the wealth (net present value at age 0) which can be allocated between lifetime consumption and bequests. If over the life cycle only a fraction of income is devoted to consumption with the rest going to bequests, the reduced income will result in a more or less proportionate fall in consumption, bequests, and saving for bequests. If there were no (or negligible) life-cycle saving, the saving-income ratio would be unchanged if the fall in consumption were proportionate to the fall in the wealth value of labor earnings.[13] A smaller (larger) fall in consumption would cause the saving-income ratio to rise (fall).

Unless one makes special assumptions, there is no presumption as to whether this effect would tend to increase, decrease, or leave unchanged the saving-income ratio. However later when we consider empirical estimates of the effects of social security on saving for given income levels, we must remember to adjust for the fall in income due to the induced fall in labor supply.

Present Value of Benefits and Taxes

The previous discussion assumed that lifetime command over goods was altered only through induced changes in labor supply. This requires that the social security system be actuarily fair in the sense that at the beginning of the working life (age 0) the net present values of expected taxes and benefits are equal. For a system in steady-state equilibrium with a constant payroll tax rate and benefit replacement ratio, per-capita benefits will grow at the growth rate of real income. If the real interest rate used in discounting these benefits equals the growth rate of real income, the system will be actuarily fair because benefits grow as fast as would a similar investment in real capital.

If the appropriate real interest rate is instead greater than the growth of real income -- say 10% versus 3½% per annum -- then the involuntary social security program will involve a net decrease in the wealth value of life-cycle labor income. Such a reduction in wealth would cause both the desired level of consumption and bequests to fall. The fall in consumption of each individual would increase aggregate saving, but this increase is less in the presence of positive bequests than it would be if bequests were zero.[14] Precisely opposite effects would occur were the growth rate of real income to exceed the real interest rate, but this case is unlikely on both empirical and theoretical grounds.[15]

The fact that social security may produce a deadweight wealth loss in the steady-state pattern of taxes and benefits provides the possibility of ending the system so that everyone now living is made better off.[16] Although benefits of some people now living would be paid by the yet unborn if the system continues, the resulting losses to younger workers may be great enough to pay off those nearing retirement and forego taxation of future generations. If this is the case, then the social security system -- like a tariff -- created a net wealth loss to those living when it was created.

Precautionary Effects

It was previously argued that the precautionary motive for holding assets is intimately connected with the bequest motive. This is so because the value of the potential use of assets in emergencies reduces the cost of bequests. The social security program in effect forces individuals to buy life annuities.[17] These annuities might of course be attractively priced compared to those available in the private market where adverse selection would increase the loading. Nevertheless a certain annuity is determined given the individual's work history and marital status and no more or less can be purchased.

Generally this forced purchase of a life annuity should tend to decrease the desired level of bequests. The exception would be for individuals who would otherwise purchase an equal amount of life annuities in the private insurance market. For most people the danger of outliving ones income is reduced by social security so that assets for planned bequests lose some of their value as a reserve for emergencies.

It can be argued however, that since the social security benefits "purchased" with present taxes are uncertain,[18] individuals save more during their working years and then dissave more during their retirement than would be the case were benefits certain. The higher saving during working years represents a fall in consumption associated with a fall in expected wealth. Consumption then would rise during retirement years as higher than expected benefits are received. The net effect here is to increase the life-cycle portion of saving.

Interest and Wage Rate Effects

The discussion so far has considered the possibilities of significant changes -- up or down -- in the saving-income ratio on the assumption that the real rate of interest and the real wage rates are fixed. In a closed economy of the neoclassical growth model, this makes no sense unless the elasticity of substitution between capital and labor is nearly infinite. However for a relatively open economy such as the United States, one might want to argue that real interest rates and wages are determined in the world markets. In this case a reduction (increase) in U.S. saving would show up as a decrease (increase) in net U.S. investment abroad.

It may be objected that the U.S. economy is either too large or too closed or both to be characterized as a small open economy only trivially affecting the world interest and wage rates. If this is so, a fall in the saving-income ratio would be expected to reduce the capital-labor ratio and real wage rate and increase the interest rate. It would appear that this would lead to further ambiguous but presumably small changes in the saving-income ratio. No attempt to analyze these second order effects is made here.

Private Alternatives to Social Security

A cautionary note should be added here lest it be forgotten that the social security program in part just replaces intergenerational transfers from young workers to retired parents that would otherwise take place. That is, social security may replace private income transfers which would otherwise take place with no real effect on the life-cycle pattern of income for most individuals who are part of an ongoing family. Robert Barro[19] has discussed this possibility at length.

Summary of the Possible Effects

A useful alternative way to classify the effects of the social security system on the saving-income ratio is by whether the life-cycle demand for assets is changed or the accumulation of assets for bequests is changed.

The life-cycle portion of aggregate saving is potentially changed by the changed match of income and consumption due to the income-shifting and induced-retirement aspects of the social security program -- the Feldstein/Munnell effect. If the real interest rate exceeds the growth rate of real income, the shift of income to retirement years will reduce consumption and increase saving because of the lower wealth value of life-cycle earnings. The uncertain nature of social security benefits may increase saving by decreasing consumption in the working years and increasing consumption during retirement.

The bequest portion of saving would be reduced more or less in proportion to the induced reduction in labor supply. If all the other effects were zero, this would leave the saving-income ratio more or less unchanged. On the other hand the reserve for emergency function of expected bequests is partially satisfied by social security which should tend to decrease the saving-income ratio.

The bequest portion of aggregate saving is expected to fall more than in proportion to income then. As to the life-cycle portion, it is not known whether it will rise or fall whether in absolute terms or relative to income. Thus our broader analysis of possible effects of the social security system does not alter Feldstein's conclusion:

> As is often the case, a theoretical analysis can illuminate the ways in which a public policy affects individual behavior, but it cannot yield an estimate of the magnitude of the effect nor even an unambiguous conclusion about its sign. For this we must turn to an empirical investigation.[20]

This is the subject of Chapters 3 and 4.

Footnotes to Chapter 2

[1]Some of the more important references are to Franco Modigliani and Richard Brumberg, "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data," in K. E. Kurihara, ed., Post Keynesian Economics (New Brunswick: Rutgers University Press, 1954); Albert Ando and F. Modigliani, "The Life Cycle Hypothesis of Saving: Aggregate Implications and Tests," American Economic Review, March 1963, 53: 55-84; F. Modigliani, "The Life Cycle Hypothesis of Saving, the Demand for Wealth, and the Supply of Capital," Social Research, June 1966, 33: 160-217; David Cass and Menahem E. Yaari, "Individual Saving, Aggregate Capital Accumulation, and Efficient Growth," in Karl Shell, ed., Essays on the Theory of Optimal Growth (Cambridge: MIT Press, 1967); James Tobin, "Life Cycle Saving and Balanced Growth," in William Fellner et al., Ten Economic Studies in the Tradition of Irving Fisher (New York: John Wiley & Sons, 1967); Gilbert R. Ghez and Gary S. Becker, The Allocation of Time and Goods over the Life Cycle (New York: National Bureau of Economic Research, 1975); and James J. Heckman, "A Life-Cycle Model of Earnings, Learning and Consumption," Journal of Political Economy, August 1976, 84: 511-544.

[2]These factors could in turn be related to the life-cycle plan for investment in and depreciation of human capital. See, for example, Gilbert R. Ghez and Gary S. Becker (1975). The effects of social security on human capital plans will not be explicitly considered here although they would appear to reinforce the effects of induced retirement discussed below. For simplicity, wage rates over the life cycle are taken as determined by age alone.

[3]Formally, a first order condition for optimality requires that:

$$\frac{\text{marginal utility of consumption at } t}{\text{marginal utility of consumption at } t + \tau} = (1 + r)^{\tau},$$

where r is the (assumed positive) difference between the real rate of interest and the rate of pure time preference. In order for the numerator to exceed the denominator, consumption must be less in t than in t + τ. If the utility function is homothetic in consumption and bequests and these and leisure are separable, consumption will indeed grow at a constant rate. There is no a priori nor much empirical reason to depart from the straight line approximation.

[4]If the growth in population were high enough however, the dissaving of the young would predominate and aggregate saving would be negative. The complications of youthful dissaving are generally neglected in the literature.

[5]As will be seen below, a full analysis is complicated by the fact that an increase in saving relative to income will generally result in higher total income, higher wages, and lower interest rates. Higher wages will tend to increase the "life-cycle" portion of aggregate saving by exaggerating the mismatch between labor income and consumption. Lower interest rates will imply less steep life-cycle growth in consumption and hence less aggregate life-cycle saving. These two second round (or general equilibrium) effects need not precisely cancel out and could reinforce or partially offset the increase in savings due to the decrease in lifetime consumption.

[6]This calculation takes account of the fact that the "employer's contribution" indeed comes out of the employee's gross wage but is exempt from income tax. The 30.6% refers to the gross wage rather than the reported (after-employer-contribution) wage.

[7]Actually Munnell in The Effects of Social Security on Personal Saving (Cambridge: Ballinger Publishing Co., 1974), esp. pp. 59-60, errs in overlooking the reduced dissaving of retirees which partially offsets the reduced saving of workers. Saving is reduced only to the extent that workers are more numerous

and wealthier than retirees. Feldstein's early published work ("Social Security, Induced Retirement, and Aggregate Capital Accumulation," Journal of Political Economy, September/October 1974, 82: 905-62) is unclear on this point as well.

[8]Unless earnings in old age would fall below the social security benefit.

[9]That is, if the expected net present values of benefits and taxes were equal.

[10]This is the case discussed by Feldstein (1974) in the paragraph on pages 908-909.

[11]Reference should be made here to three articles by Paul A. Samuelson which treat these issues more satisfactorily: "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money," Journal of Political Economy, December 1958, 66: 467-82; "The Optimal Growth Rate for Population," International Economic Review, October 1975, 16: 531-38, and "Optimal Social Security in a Life-Cycle Growth Model," International Economic Review, October 1975, 16: 539-44.

[12]Several of these are discussed below.

[13]This assumes that the real interest rate used in discounting future consumption and labor income is equal to growth rate of effective labor units (and real income) as required for actuarily fair social security in the steady state.

[14]The consumption path of the representative individual would have to shift down by enough to cover the full wealth loss if bequests were zero.

[15]See Earl A. Thompson, "Debt Instruments in Both Macroeconomic Theory and Capital Theory," American Economic Review, December 1967, 57: 1196-1210.

[16]Edgar K. Browning has argued that we cannot unwind the social security system because of the loss to those currently living (see his "Social Insurance and Intergenerational Transfers," Journal of Law & Economics, October 1973, 16: 215-37). This of course need not be true where the real interest rate exceeds the growth rate of real income.

[17]Not to mention health and other insurance.

[18]There is no legally vested interest in social security, for example.

[19]R. J. Barro, "Are Government Bonds Net Wealth?," Journal of Political Economy, November/December 1974, 82: 1095-1117.

[20]Feldstein (1974, p. 910).

From Michael R. Darby, The Effects of Social Security on Income and the Capital Stock. Not for quotation without the author's permission.
D3: May 25, 1977

CHAPTER 3

THE RELATIVE IMPORTANCE OF INTERGENERATIONAL TRANSFERS AND LIFE-CYCLE MOTIVATIONS FOR AGGREGATE SAVING*

Recent empirical investigations1/ of the effects of social security on saving have been based on life-cycle models with zero bequests. This implicitly assumes that the life cycle portion of aggregate saving dominates the bequest portion as an empirical matter. This chapter attempts to analyze whether this assumption is a profitable guide for empirical work.

Two distinct approaches are used to obtain an idea of the relative importance of the life-cycle and bequest portions of aggregate saving.

The first is to examine the effect on the aggregate private saving rate of the substantial rise in retirement during the period 1890-1930. On the life-cycle approach, this should have caused a substantial rise in the saving-income ratio. In fact it is found that the saving-income ratio tended to decline during the period and was on the order of 3 or 4 times larger than could be explained by the life cycle model.

The second approach is to estimate the portion of total assets held for life-cycle purposes as opposed to bequest purposes. Estimates of the life-cycle assets which would have to be held to yield an annuity stream equivalent to social security benefits anticipated by people 20 years and over range downward from $943 billion for 1970 -- less than half of Feldstein's estimate for the same year. Cross section survey data were used to obtain estimates of the relative importance of life-cycle and bequest motives for holding the capital stock. It is found that the life-cycle demand for assets accounts for only 29 to 13 percent of total assets.

Previous studies of this question[2] did little more than assume "plausible" life-cycle income and consumption paths and growth rates to show that they are capable of explaining aggregate saving on the order of the observed 8 to 10 percent of private income. The results of this chapter raise serious question as to the empirical usefulness of the zero-bequest life-cycle model as a vehicle for analyzing aggregate saving in general and the effects of social security in particular.

Table 3.1

LABOR FORCE PARTICIPATION OF MALE POPULATION 65 YEARS AND OVER AND PROBABILITY OF A 20-YEAR-OLD WORKER LIVING TO AGE 65, 1890-1930

Year	Per Cent of Male Population 65 and Over in Labor Force (a)	Probability of 20-Year-Old Male Living to Age 65 (b)
1890	73.9	.41
1900	68.3	.51
1910	58.1	.52
1920	60.1	.60
1930	58.3	.60

Sources: Column a. Long, Clarence D., The Labor Force Under Changing Income and Employment, National Bureau of Economic Research, General Series 65 (Princeton: Princeton University Press, 1958), Table A.2.

Column b. (for 1900-1930) Computed from Greville, Thomas, N. E., United States Life Tables and Actuarial Tables 1939-1941 (Washington: U.S. Government Printing Office, 1946), Table J, p. 11. (for 1890) - computed from U.S. Bureau of the Census, 1890 Census, Vital Statistics, vol. IV, pt. 1, Table 10, p. 862.

Table 3.2

EXPECTED REMAINING LIFE AND EXPECTED RETIREMENT
OF 20-YEAR-OLD MALES, 1890-1930

Year	Expected Life (a)	Expected Retirement (b)	Expected Retirement / Expected Life (c)
1890	37.08	1.424	.038
1900	42.19	1.853	.044
1910	42.71	2.412	.056
1920	45.60	2.893	.063
1930	46.02	2.907	.063

Sources: a. See Table 3.1, column (b).

b. See Table 3.1, columns (a) and (b).

c. Column (b) ÷ Column (a).

Decade averages were computed for the saving-income ratio in order to smooth out short-run fluctuations due to the business cycle and other transient phenomena. There are a variety of definitions of saving and income which might be used. The most relevant definition is the ratio of private saving to private income. This definition includes in income all income received or accruing to private individuals -- including undistributed corporate profits -- and thus corresponds to the rational behavior posited by the life-cycle model much more closely than disposable personal income. Private income has in fact been found better at explaining post-World-War-II consumption and saving.3/ Private saving is the nonconsumption of this income or equivalently the sum of net investment, net exports, and the government deficit.

The private saving-private income ratio is given in column (a) of table 3.3. There is some question as to how rapidly changes in mortality and retirement patterns would be built into individual consumption/saving behavior. As the data on the expected retirement-expected life ratio show a strong downward trend, I have taken averages of the values at each end of the decades for comparison in Figure 3.1. One would present essentially the same picture if one instead supposed expectations to lag or lead actual events. Clearly there is no relation between the upward-trended retirement-life ratio and the untrended saving-income ratio. There is too little data for fancy statistical tests, but the correlation is not only insignificant but also of the wrong (negative) sign.

Yet if life-cycle motivations are an important source of aggregate saving, the saving-income ratio should have risen sharply. One possible explanation is that the definitions of saving or income are defective. A number of alternative definitions were considered with essentially the same results. Several of the more interesting alternatives are presented in Table 3.3.

Table 3.3

SAVING INCOME RATIOS, 1890-1929

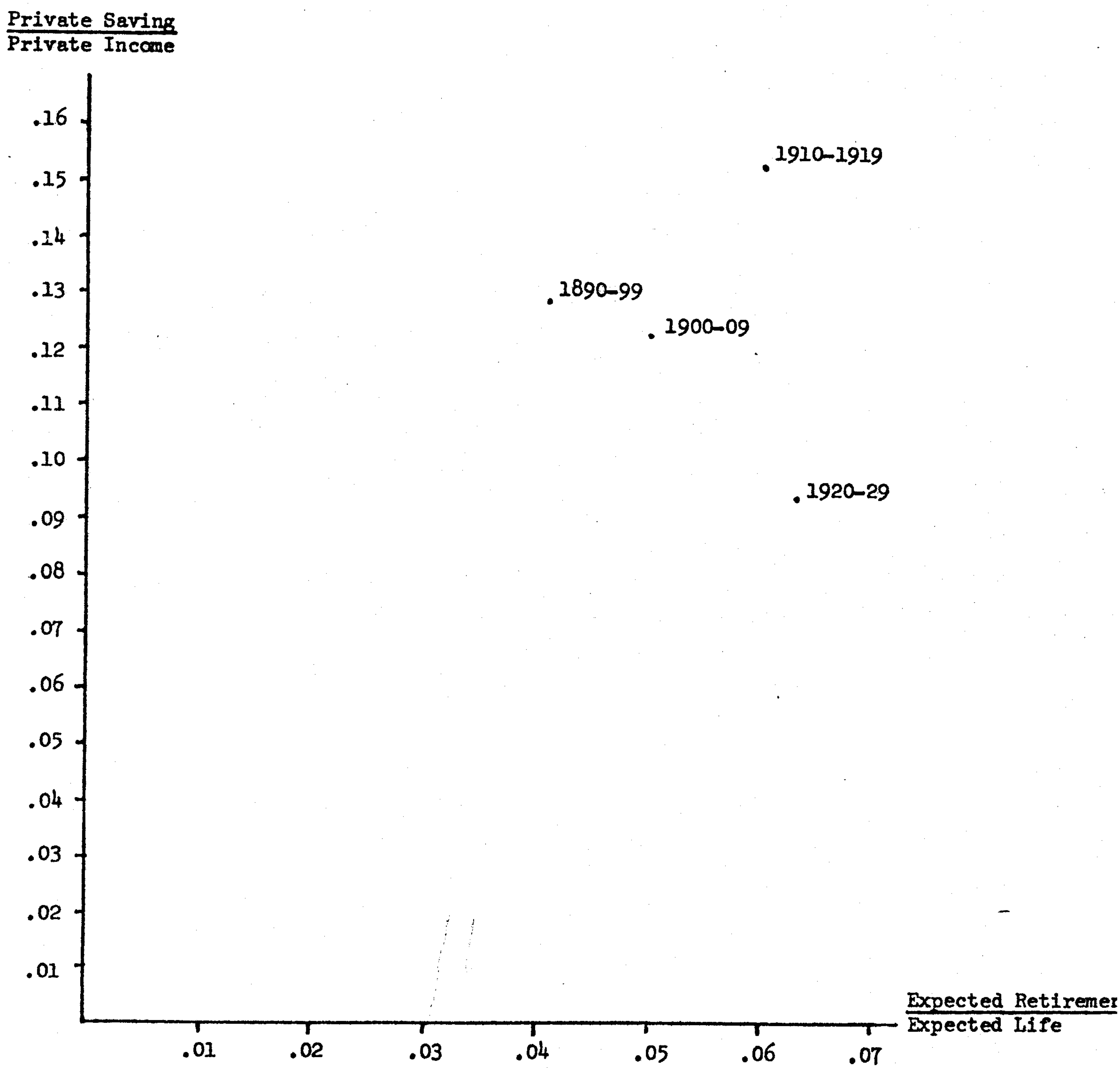
Decade	Private Saving / Private Income (a)	Gross Private Saving / Gross National Product (b)	Private Saving - Govt. Deficit / Private Income - Govt. Deficit (c)
1890-99	.129	.210	.122
1900-09	.123	.198	.117
1910-19	.153	.231	.087
1920-29	.094	.169	.094

Sources: Computations by the author based on data in: John W. Kendrick, Productivity Trends in the United States, National Bureau of Economic Research General Series 71 (Princeton: Princeton University Press, 1961); U.S. Bureau of Economic Analysis, Long Term Economic Growth 1860-1970 (Washington: U.S. Government Printing Office, 1973); U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957 (Washington: U.S. Government Printing Office, 1960); U.S. Bureau of the Census, Historical Statistics of United States, Colonial Times to 1970, 2 vols. (Washington: U.S. Government Printing Office, 1975); U.S. Bureau of the Census, 1890 Census, vol. XV, p. 77.

Figure 3.1

SAVING-INCOME RATIO VERSUS EXPECTED RETIREMENT-EXPECTED LIFE RATIO

1890-1929



Paul David and John Scadding[4] have argued that households include government -- as well as corporate -- spending and saving in determining their personal saving behavior. They proceeded to argue that the gross private saving ratio (gross private saving/gross national product) was an interesting behavioral concept. In their data they treated purchases of consumers' durable goods as part of gross investment and made a corresponding adjustment to gross national product for the yield on these goods. That was not feasible for these data, so column (b) of Table 3.3 reports the ratio of private saving plus capital consumption allowances to gross national product. The same trendless pattern -- and insignificant negative correlation with the expected retirement-life ratio -- is found as with the private saving-private income ratio.

At least since David Ricardo, a large number of economists have argued that government deficits will not reduce nor surpluses augment the amount of saving available to finance private investment. The basic idea -- most recently argued at the aggregate level by Robert Barro and Levis Kochin[5]-- is that individuals will deduct from their current income the present value of the future taxes required to service an increased issue of government bonds. As a result private saving will increase by just enough to finance the increased bond issues. Similarly private saving would contract were the government to run a surplus. On this argument, private income and saving are overstated by failure to deduct the tax liability corresponding to the government deficit.

Column (c) of Table 3.3 presents the saving-income ratio with the amount of the government deficit subtracted from both saving and income. It is indeed true that adjusting for the World-War-I deficits and post war surpluses makes for a more stable saving-income ratio. Apparently the assumption that the future taxes associated with deficits are only partially anticipated would make for a yet stabler ratio. The ratio as computed has a slight negative trend which is in fact the opposite of what would be predicted by the life-cycle model.

The question arises whether the lack of apparent effect on the saving-income ratio from a major change in retirement patterns is due to life cycle motivations being a trivial source of aggregate saving or to some fortuitously offsetting forces which masked the effect. Four candidates for such an offsetting force should be considered: (1) increases in wealth, (2) shifts in the population distribution, (3) changes in the growth rate of real income, and (4) reductions in economic uncertainty. The first two possibilities do not seem promising: Increases in wealth are usually argued to not affect or — if anything — increase the saving-income ratio and so might reinforce but not offset the predicted effect of increased retirement. The population did gradually age over this period; for example, 3.85% of the male population was 65 or older in 1890 as against 5.35% in 1930. But this aging is part and parcel of the increase in expected retirement relative to expected life which is on net supposed to increase aggregate saving relative to income.

The growth rate of real income is a relevant variable in the standard life-cycle model since higher growth rates imply more numerous or wealthier younger savers relative to older dissavers. There was a downward trend in the growth rate of real gross national product over the four decades — from 4.3% in 1890-99 to 4.2%, 2.3%, and then 3.4% in 1920-29.6/ The 21 percent decline in the growth rate from the 1890's to the 1920's would no more than partially offset the over 50 percent increase in the expected retirement-expected life ratio however. The interactions of growth rates and the retirement-life ratio are rather complex, depending on the precise life-cycle shape of income and consumption and on the interest rate. However illustrative calculations can be made by use of a formula given by Modigliani and based on certain simplifying assumptions. 7/ Using the average expected retirement and expected remaining life of a 20 year-old male for the 1890's and 1920's and the corresponding growth rates of 4.3% and 3.4%, Modigliani's formula would predict that aggregate (life-cycle) saving was 2.8 percent of income in the 1890's and 3.6 percent of income in the 1920's, a net increase of 0.8 percentage point or 29 percent. One must note however that even Modigliani's apparently favorable assumptions provide a relatively minor role for the life-cycle as a source of aggregate saving which averages around 10 percent of income. Nor is it surprising that a less than 1 percentage point change -- as large as it may be relative to life-cycle saving -- would be swamped by other determinants of aggregate saving.

A decrease in economic uncertainty might reduce the amount of assets accumulated and held jointly for bequests and reasons of precaution against emergencies. This would result in a decrease of intergenerational transfers relative to life-cycle saving. However it is hard to argue whether economic uncertainty increased or decreased over the period -- which included the Panic of 1907 and the Depression of 1920-21. Therefore this explanation too appears tenuous at best.

While one may still suppose that a combination of these and other special factors fortuitously offset the rise in the saving-income ratio due to increased retirement, it does not seem plausible that life-cycle savings accounted for a large share of aggregate saving during this period. Apparently the difference between saving for retirement by workers and dissaving of retirement assets by retirees was small relative to the accumulation of assets for intergenerational transfers.

Life-Cycle Assets after Introduction of Social Security

The data for 1890-1930 are consistent with declining asset-holdings and saving for bequests being (nearly) offset by rising asset-holdings and saving for life-cycle purposes. The possibility that life-cycle saving could have become relatively much more important since the institution of social security is considered here by estimating the amount of assets held for life-cycle as opposed to bequest motives. A maximum estimate of the amount of life-cycle assets displaced by social security is also computed.

The analysis of Chapter 2 showed that a person who expects to leave a bequest will hold higher assets at each age than an otherwise identical individual who plans no bequest and saves only to consume his life-cycle income more evenly over his life. For example, Figure 3.2 combines the life-cycle asset patterns originally shown in Figures 2.2 and 2.3. The curve marked total assets is the life-cycle asset pattern of a person expecting to leave a bequest. The curve marked life-cycle assets shows the assets which the individual would hold if he did not expect to make a bequest. The vertical distance between these two curves (plotted as bequest assets) is a measure of the assets held for bequest—and precautionary—purposes.

The largest possible reduction in saving due to the Feldstein/Munnell effect occurs if there is no induced change in retirement behavior. In that case social security taxes and benefits unambiguously reduce saving via income-smoothing. Consider first the situation before the introduction of social security where people retire at age 65 anyway.8/ This will imply a kinked peak of life-cycle assets at retirement age as in Figure 3.3 because people would first accumulate funds for retirement at compound interest and then draw them down during the retirement years. During the accumulation period, interest adds more and more each year; but during the retirement period less interest is received and more must be taken from principal each year.9/

Figure 3.2

DIVISION OF TOTAL ASSETS BETWEEN ASSETS HELD FOR LIFE-CYCLE CONSUMPTION SMOOTHING AND EXPECTED BEQUESTS

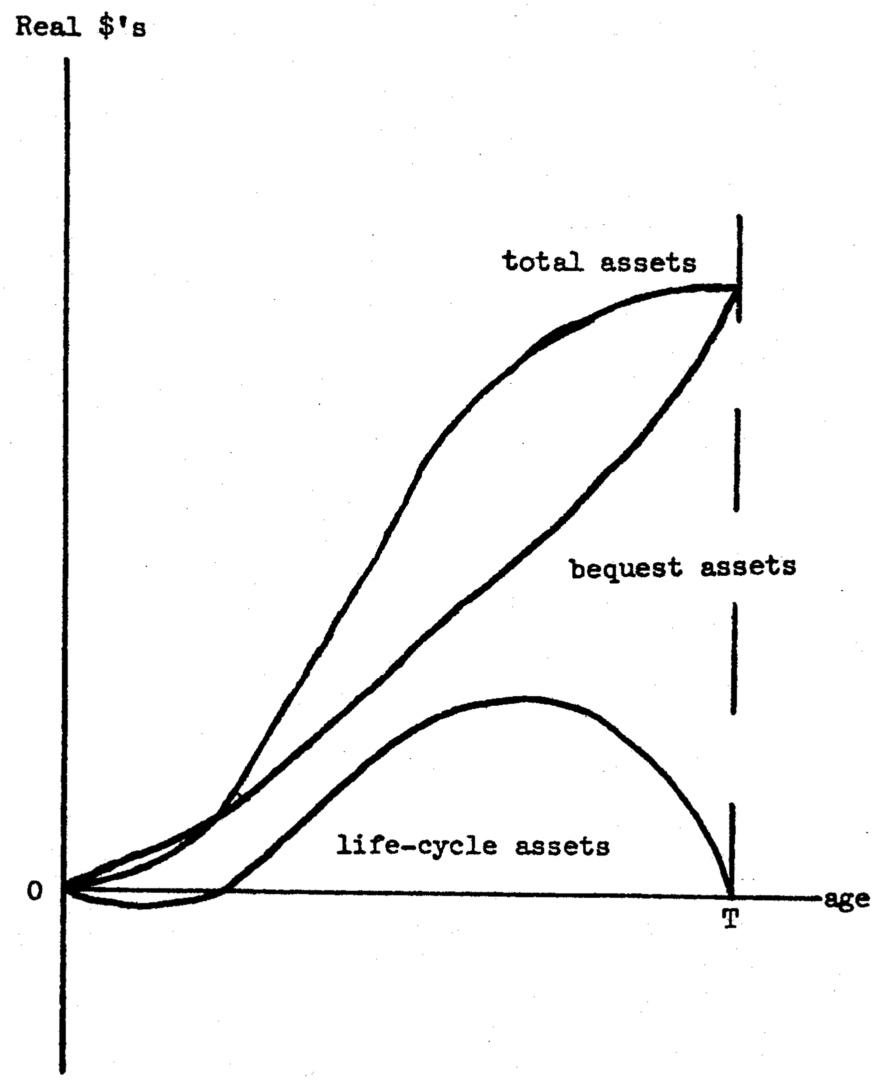
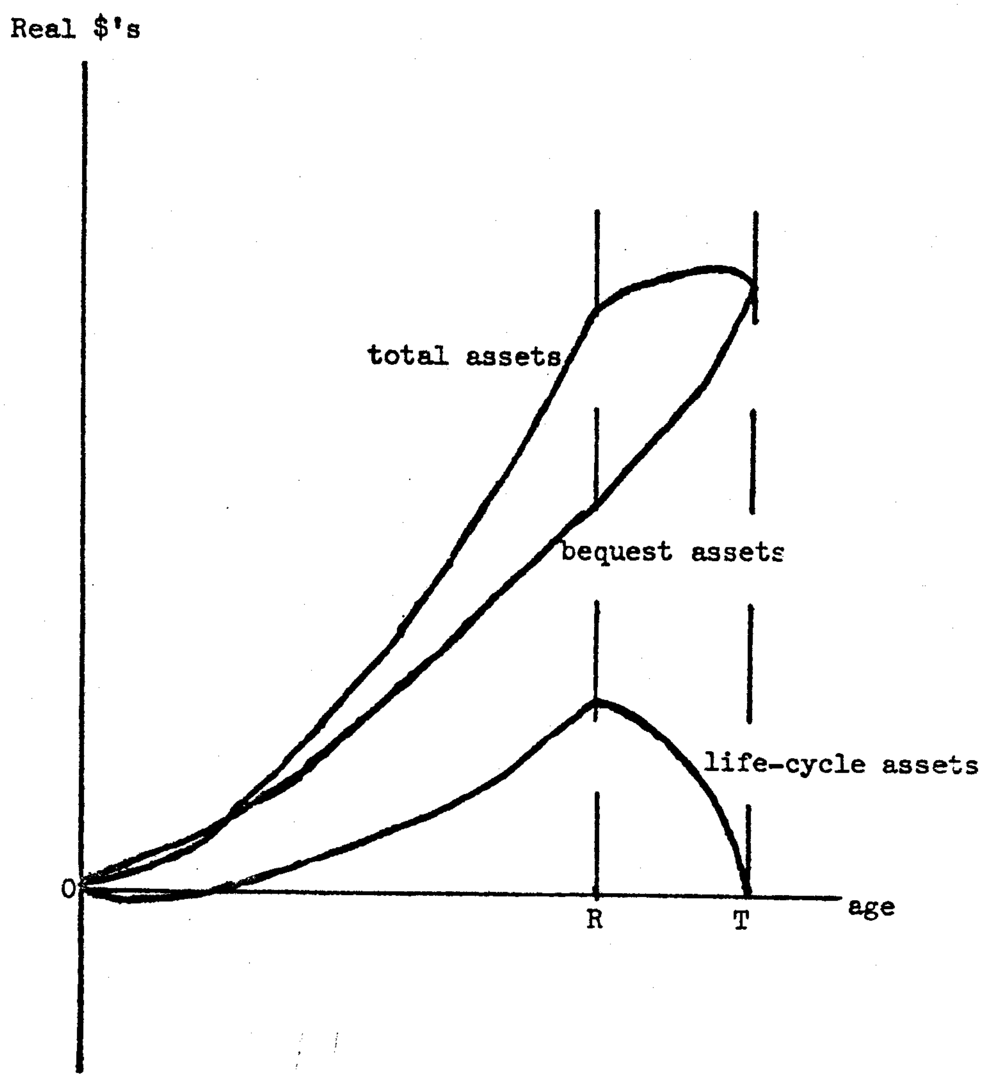


Figure 3.3

DIVISION OF TOTAL ASSETS WITH RETIREMENT BUT
WITHOUT SOCIAL SECURITY



After the introduction of social security on the assumption that no retirement changes are induced and neglecting the other effects discussed in Chapter 2, the Feldstein/Munnell effect is shown in Figure 3.4. Life-cycle assets at retirement age R are reduced by the value of an annuity equivalent in value to the social security benefits. The desired level of life-cycle assets is reduced everywhere except at the beginning and end of life—where they are zero.

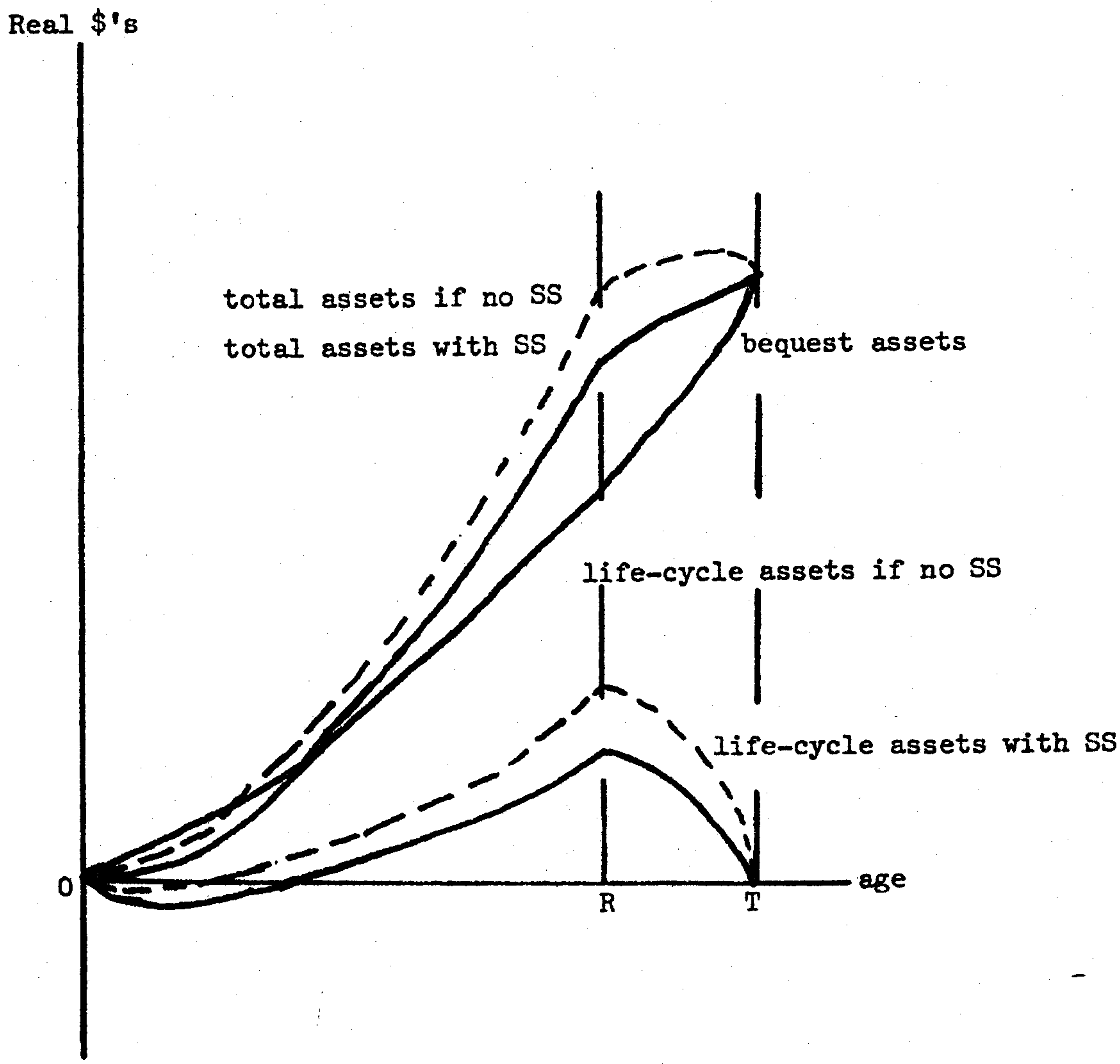
The reduction of assets depicted in Figure 3.4 is the maximum possible Feldstein/Munnell effect. Two alternative estimates of this maximum have been made: One based on aggregate benefit data and another on detailed survey data on household assets. Both estimates are based on computing the amount required at age 65 to pay the average social security benefits received over the remaining expected life of 13.0 years. This amount is assumed to be drawn down over the retirement years and built up between the ages of 20 and 65. To estimate the maximum (dollar-for-dollar) effect on total assets, the life-cycle asset equivalent of social security for the age 65 cohort is adjusted for the probability of living to 65 and for the greater life-cycle earnings of younger cohorts.

Feldstein estimated that the private capital stock was in fact reduced by \$2,029 billion (or 37 percent) in 1971.10/ This is supposed to be net of any increase in saving due to induced retirement and so should be well below the maximum possible Fedlstein/Munnell effect unless other effects were operative.

In 1971, total social security retirement benefits were \$33.4 billion. Divided by the expected life at 65 of 13.0 years this works out to be an average rate of \$2.57 billion.11/ This has an annuity value of \$27.33, \$22.75, or \$19.24 billion according to whether one assumes an average real yield of 3, 6, or 9 percent per annum, repsectively. These alternative benchmarks were used to estimate the assets which otherwise would be accumulated by younger cohorts and held by older

Figure 3.4

FELDSTEIN/MUNNELL EFFECT OF SOCIAL SECURITY ON ASSETS WITH NO INDUCED RETIREMENT



cohorts when allowance is made for growth in life-cycle earnings and population and for mortality.12/ Details of the computations are given in the appendix to this chapter.

The total life-cycle assets which would otherwise be held totalled over all age groups were estimated as $943 billion at an interest rate of 3 percent, $612 billion at 6 percent, and $418 billion at 9 percent. A 3 percent real interest rate corresponds--it is actually a bit under--to the effective yield on social security and is identical to the one used by Feldstein to make his case. So our estimate of the maximum possible Feldstein/Munnell effect is a $943 billion reduction in the capital stock which is less than half Feldstein's estimate of the actual reduction. Higher interest rates approaching the 10 percent yield implicit in aggregate consumer behavior,13/ would imply an even lower maximum. Applying these estimated maxima to the same wealth base as Feldstein, the corresponding maximum percentage reductions in the capital stock are 21, 15, and 11 percent depending on the interest rate.

In view of the large discrepancies between Feldstein's estimates and those reported here, cross-section data was analyzed to get a more detailed picture of asset holdings over the life-cycle. For this purpose, the 1967 Survey of Economic Opportunity 14/ was used. This survey contains detailed data on assets, liabilities, and income for American families. The results reported here are for primary white families.15/

The survey concept most closely approximating total assets of the previous theoretical discussion is total net worth. This concept is inclusive of nonhuman assets such as business, land, home, autos, bank accounts, stocks, and bonds and net of associated and personal debts. Some assets are omitted, however, such as household furnishings, most consumer's durable goods, clothing, rights to pension funds and life insurance contracts.

Average total net worth as reported in the survey is plotted in Figure 3.5 against the age of the head of household for the working life and expected retirement.16/ Because of the large sampling variance, overlapping three year moving averages are plotted. Total net worth rises rapidly during the working life and then flattens out around age 60 at about thirty thousand 1966 dollars.17/ This pattern is consistent with a life-cycle model with retirement and substantial expected bequests.

The omission of the value of private and government pension rights from total net worth would underestimate both total and life-cycle assets by an equal amount. A correction was made based on the reported income stream of retirees from these sources.18/ The estimated life-cycle assets due to private and government pension funds again varies with the interest rate used in the calculations, but Figure 3.6 illustrates the estimated net worth inclusive of pension funds for the lowest interest rate -- 3 percent -- which gives the largest estimate of life-cycle assets. Inclusion of pension rights does make for a more definite peak with noticeable dissaving during the retirement years. The picture is still quite consistent with the combined life cycle-bequest model.

The next step was to divide these total assets into separate life-cycle and bequest portions. The age 65 life-cycle asset benchmark was computed as the value of an annuity required to finance the estimated consumption stream derived from them.19/ Separate breakdowns were made for each of the three interest rates used previously. Figure 3.7 illustrates the life-cycle and bequest portions of total assets based on the 3 percent interest rate. This assumption gives the largest estimate of life-cycle assets.

These estimated life-cycle and bequest assets per-capita by age were then used to compute aggregate assets for steady-state growth taking account of growth

Figure 3.5

AVERAGE TOTAL NET WORTH BY AGE OF THE HEAD OF HOUSEHOLD

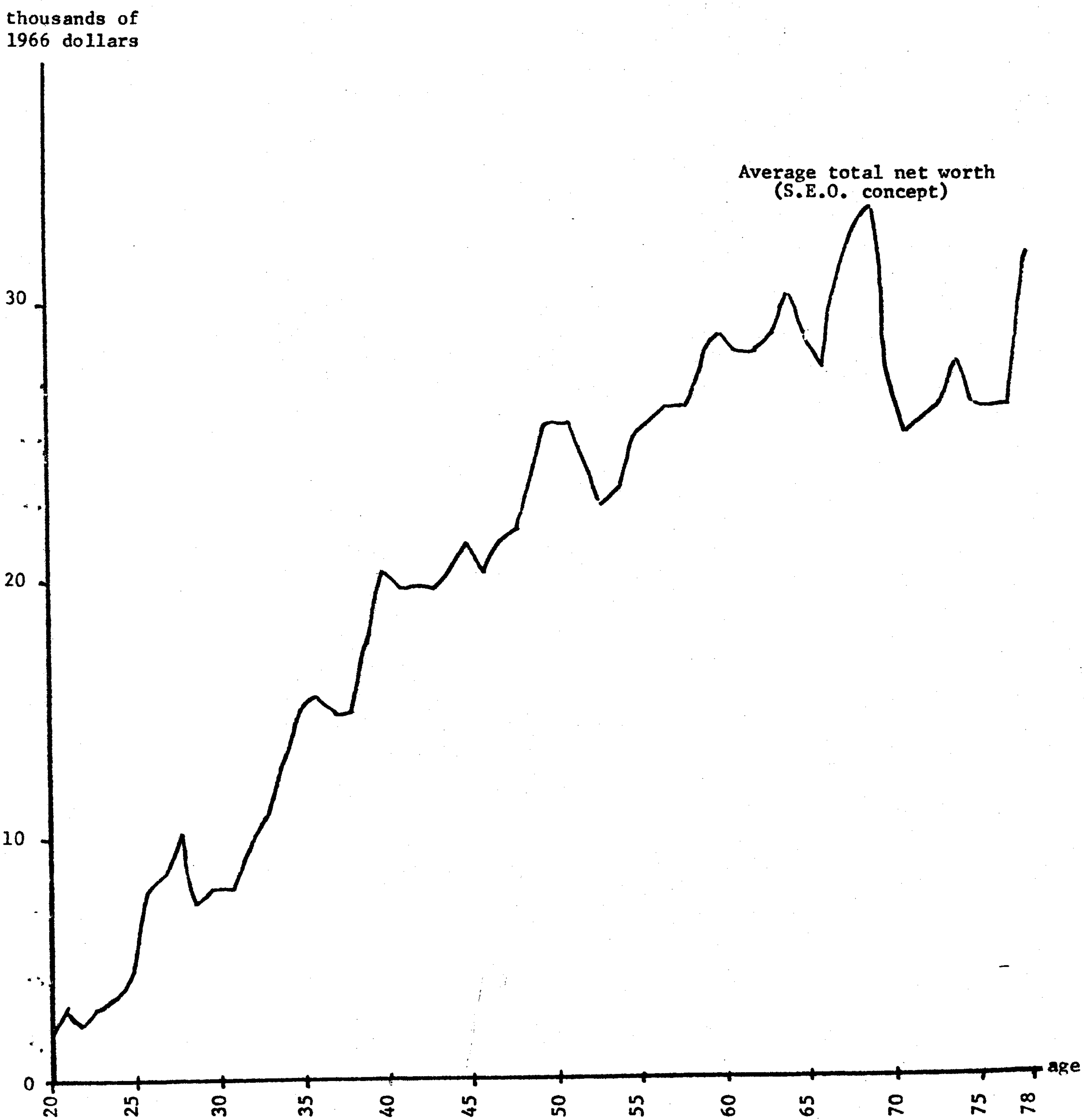


Figure 3.6

AVERAGE TOTAL NET WORTH INCLUSIVE OF IMPUTED PENSION RIGHT BY AGE OF THE HEAD OF HOUSEHOLD

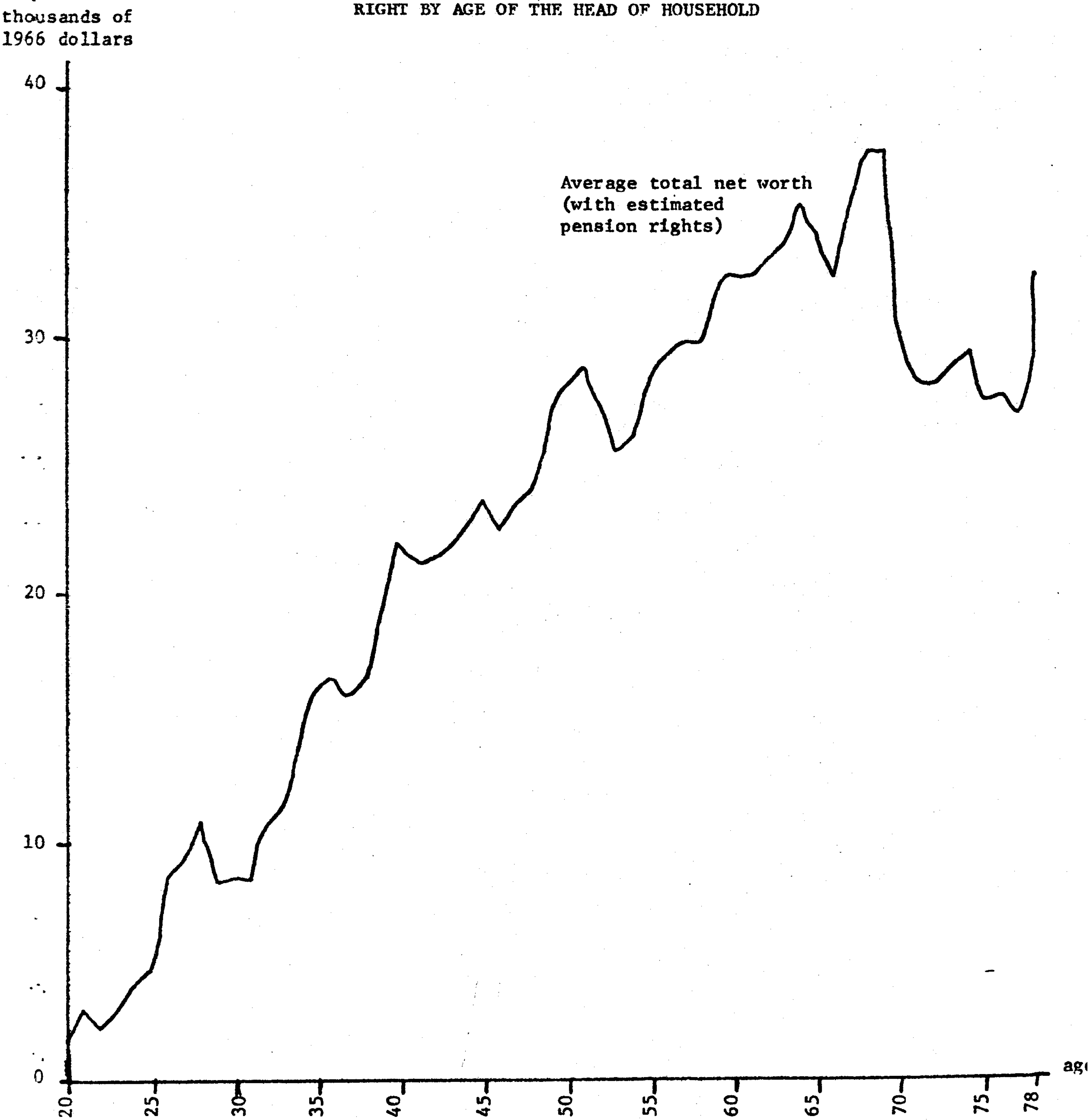
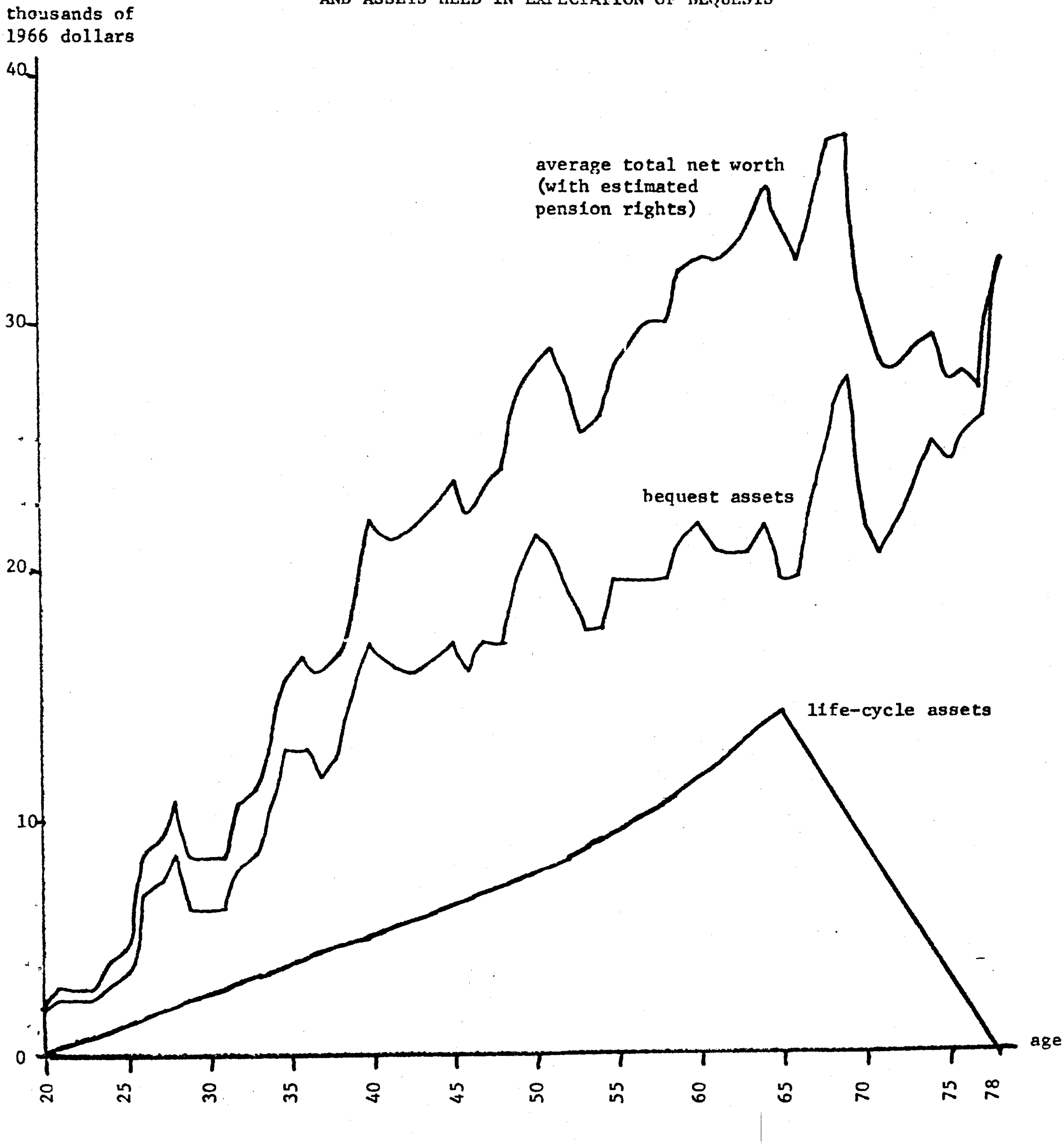


Figure 3.7

DIVISION OF AVERAGE TOTAL NET WORTH INCLUSIVE OF IMPUTED PENSION RIGHTS BETWEEN ASSETS HELD FOR LIFE-CYCLE CONSUMPTION SMOOTHING AND ASSETS HELD IN EXPECTATION OF BEQUESTS



in numbers in each age cohort and mortality.20/ On these computations, life-cycle assets accounted for 28.5, 18.9, and 13.0 percent of total assets for a 3, 6, and 9 percent interest rate, respectively. The method of computation was such that these estimates err, if anything, on the high side. It seems to me that this evidence suggests that the potential effects of social security on bequest assets may be empirically important and should be examined within a model in which bequests play an important role. This will be attempted in Chapter 4.

It is also possible to obtain an estimate of the maximum possible Feldstein/Munnell effect alternative to that made above for aggregate data. This was done by obtaining an age 65 life-cycle asset benchmark inclusive of the annuity value of social security benefits 21/ and supposing that the difference in life-cycle assets represents a dollar-for-dollar reduction in total assets. The age 65 benchmark values for social security wealth were $15,125, $12,590, and $10,647 for 3, 6, and 9 percent interest rates, respectively. The fraction of total assets inclusive of the imputed value of pensions and social security represented by social security wealth was estimated as 23.1, 16.7, or 12.1 percent according as to whether a 3, 6, or 9 percent interest rate was used.

Thus, the cross-section estimates of the maximum possible Feldstein/Munnell effect match closely with the estimated maximum of 21, 15, and 11 percent derived earlier from aggregate benefit data for 1971. Further had Feldstein used his estimate of net social security wealth -- the appropriate concept in terms of life-cycle rationality -- and calculated dollar-for-dollar replacement of the capital stock, he would have come up with a figure of 25 percent instead of 37 percent. So three rather different approaches to estimating net social security wealth place it at 21 to 25 percent of the sum of the capital stock and net social security wealth on a 3 percent interest rate. This percentage would be nearly halved if a 9 percent interest rate approaching that implicit in consumer behavior is used.

It must be emphasized that these are upper limits for the Feldstein/Munnell effect. Any induced retirement would reduce the actual effect below this maximum dollar-for-dollar replacement. Other factors also enter the total effect of social security on saving given income. For example, to the extent that social security benefits replace support from children or welfare during retirement, there is no change in the life-cycle of income or in saving. 22/ Both the possible wealth loss and uncertainty effects of social security would tend to increase saving. On the other hand the forced annuity purchase may reduce the precautionary value of expected bequests. So while Feldstein's estimates would appear to be impossibly high in terms of his own theoretical model, the importance of bequests in total wealth and saving makes it possible for saving to be reduced by more than the value of net social security wealth.

Appendix to Chapter 3

ESTIMATION OF LIFE-CYCLE ASSETS FROM RETIREMENT AGE BENCHMARKS

The problem is to estimate the assets now held for life-cycle purposes at different ages if people aged 65 hold an amount L_{65}. In doing so, it is necessary to take account of growth in population and life-cycle earnings and of mortality.

In a situation of steady growth, the real amount held by people then aged 65 will grow each year at the same rate as real income, say g. The amount held per-capita will grow, therefore at this rate less the growth rate (say π) of population or $g - \pi$. So looking at aggregate data we should think of people at age a as accumulating toward or decumulating from an amount equal to the benchmark amount adjusted for compounded growth, that is $(1 + g)^{65-a} \cdot L_{65}$. For per-capita data (such as the S.E.O.), the corresponding amount is $(1 + g - \pi)^{65-a} \cdot L_{65}$.

For per-capita data, we have to allow for the fact that mortality reduces the cost at younger ages of an annuity that starts paying at age 65. In other words the <u>expected</u> value of life-cycle assets at age 65 is less than the value of assets held by those who actually live to age 65. Denote probability that one is alive at 65 if one is alive at age a by P^a_{65}. Then the expected life-cycle assets at age 65 of people now age a is $P^a_{65} \cdot (1 + g - \pi)^{65-a} \cdot L_{65}$. Note that for aggregate data <u>by age cohort</u> no such adjustment is required since we want the assets to be accumulated by the cohort as a whole.

Because of the life-cycle growth in earnings, one would expect life-cycle saving from labor earnings to be concentrated in middle age. This would imply less life-cycle assets at each age than if the amount saved were the amount required to accumulate expected age-65 assets over 45 years of equal payments accumulated at interest. This latter amount is therefore a safe upper estimate of life cycle assets. For per capita data, life cycle assets at age a ($20 \leq a < 65$) is estimated as

$$(1) \quad L_a = s(a-20,\ r) \cdot \frac{P_{65}^{a} \cdot (1 + g - \pi)^{65-a} \cdot L_{65}}{s(45,\ r)},$$

where s(x,r) is the amount accumulated by saving $1 per year for x years at an annually compounded interest rate r.23/ The ratio gives the number of dollars that would have to be saved annually to accumulate the expected age 65 life-cycle assets over a working life of 45 years. This is multiplied by s(a-20, r) to obtain the amount that would be accumulated by saving at that rate since age 20. The corresponding formula for aggregate data by age cohort is24/

$$(2) \quad L_a = s(a-20,\ r) \cdot \frac{(1 + g)^{65-a} \cdot L_{65}}{s(45,\ r)}.$$

The value of life-cycle assets for ages over 65 can be approximated by assuming that everyone who reaches age 65 lives their expected life of 13 years and then dies. This avoids getting into the very old ages where total asset data is unreliable. Thus life-cycle assets are assumed to be drawn down by a constant consumption stream until they are exhausted at the end of 13 years. Until then, the remaining balance earns interest at the annually compounded rate r. For per-capita data, life-cycle assets at age a ($65 < a < 78$) is estimated as

$$(3) \quad L_a = v(78-a,\ r) \quad \frac{(1 + g - \pi)^{65-a} \cdot L_{65}}{v(13,\ r)},$$

where v(x, r) is the present value of $1 per year for x years at an annually compounded interest rate r.25/ The ratio gives the number of dollars per year for 13 years which could have been bought with age 65 assets and v(78-a, r) gives the values of that stream of dollars per year for the remaining years of life.

The corresponding formula for aggregate data by age cohort is 26/

$$(4) \quad L_a = v(78-a,\ r)\ \frac{(1+g)^{65-a} \cdot L_{65}}{v(13,\ r)} .$$

These formulas are used to derive (probably high) estimates of life cycle assets for alternative interest rates and values of life-cycle assets at age 65. In each case, real income growth and population growth were estimated by their long-run average values of $3\frac{1}{4}$ and 1.4 percent per annum respectively.27/

Footnotes to Chapter 3

*Pamela D. Barnes provided outstanding research assistance for the preparation of this chapter. She not only located the data and made the calculations for 1890-1930, but also contributed to the theoretical analysis.

1/ Reference is made here particularly to the studies by Feldstein, "Social Security and Capital Accumulation" and Munnell, Effect on Personal Saving and their numerous follow-up papers as well as to an interesting unpublished study by Laurence J. Kotlikoff, Christopher Chamby, and Anthony Pellechio, "Social Security and Private Wealth Accumulation," Department of Economics, Harvard University, November 1976.

2/ Modigliani, "Demand for Wealth and Supply of Capital;" Tobin, "Life Cycle Saving and Balanced Growth."

3/ See Michael R. Darby, "The Consumer Expenditure Function," Explorations in Economic Research, forthcoming 1978.

4/ Paul A. David and John L. Scadding, "Private Savings: Ultrarationality, Aggregation, and 'Denison's Law'," Journal of Political Economy, vol. 82 (March/April 1974), pp. 225-49.

5/ Barro, "Are Government Bonds Net Wealth?"; Levis A. Kochin, "Are Future Taxes Anticipated by Consumers?," Journal of Money, Credit, and Banking, vol. 6 (August 1974), pp. 385-94.

6/ These growth rates are for the Kendrick data from the year before the beginning of each decade to the last year in the decade.

7/ Modigliani, "Demand for Wealth and Supply of Capital," p. 169. It is assumed that earnings are constant over the working life, consumption is constant over the whole life, and that the rate of return is zero. The formula given was derived strictly for growth due to population gorwth which differs trivially in value from the formula for growth due to productivity growth.

8/ Age R = 45 counting from an average entry into the labor force at twenty.

9/ Drawing the figure for the expected age of death implies that the individual either buys a life annunity with life-cycle assets at time R or — because of the high loading cost of doing so -- allows the actual value of the bequest to vary with length of life.

10/ Feldstein, "Social Security and Capital Accumulation," p. 922. This estimate was Feldstein's gross social security wealth estimate which he noted "is remarkably close to the predicted long-run effect of 38 percent" based on his time-series consumption function estimates. The problems with both estimates are discussed at length in Chapter 4 below.

11/ This average is of course biased upwards by benefits received by retirees under 65 and downwards by lower benefits received by retirees over 65. There is little reason to suppose that the net bias is significant. The total benefits are from U.S. Social Security Administration, Social Security Bulletin, Annual Statistical Supplement, 1973, Table 28, p. 58. The life expectancy is for white males, age 65, in 1967, from U.S. Bureau of the Census, Statistical Abstract of the United States: 1971 (92d edition), Table 70, p. 53.

12/ It appears unnecessary to allow for any further growth in the coverage of the program since coverage of total paid employment was 79.5% in 1951, 85.3% in 1955, 87.9% in 1961, and 89.4% in 1971. (From Social Security Bulletin, Annual

Statistical Supplement, 1973, Table 27, p. 57.

13/ See Darby, "Consumer Expenditure Function."

14/ James P. Smith generously provided a clean data tape and advice on its use. Programming was done by Franklin Berger and computations were made by the RAND Corporation.

15/ The data for nonwhite families appeared insufficiently reliable for the current study although checks were made to confirm that the basic conclusions were not dependent on their exclusion.

16/ The S.E.O. oversampled poor households but provided weights for correcting the sample to correspond to the U.S. population. Those weights were used in computing the means reported here.

17/ Recall that the dollar amounts are based on 1966 prices and wealth.

18/ The average income stream from these sources for families with a head aged 65 through 77 was $387.23 per annum. This implies an age 65 benchmark asset value of $4639.70 at 3 percent interest, $3862.06 at 6 percent, and $3266.14 at 9 percent.

19/ The details of the calculation are as follows. Following James P. Smith, ("Assets, Savings, and Labor Supply," Economic Inquiry, vol. 15 (September 1977), forthcoming), consumption during the expected retirement period was estimated as income less the increase in assets. This consumption stream was reduced by current nonasset income (labor earnings, unemployment compensation, public welfare, and the like) and social security benefits. When averaged, this yields the average consumption stream to be financed by life-cycle assets. Since age 65 retirees would have higher life-cycle earnings, these averages were adjusted upward by the normal growth in per capita income for 6½ years (half of expected retirement): $(1.0185)^{6.5} = 1.1266$. This estimated consumption stream was then converted into an annuity value at 3,6, and 9 percent interest to derive 3 alternative benchmark estimates of age 65 life-cycle assets. Life-cycle assets for other ages were then computed as described in the appendix to this chapter.

Smith also suggested an alternative consumption concept which added to the cash consumption concept an imputed yield of 5 percent on owned assets. This concept was tried also, but no substantial differences arose when account was taken of the imputed yield in selecting interest rates for computation of asset values. (The total implicit yield is then the 5 percent imputed service yield plus the 2 to 3 percent reported pecuniary yield.)

20/ That is, each successive cohort was assumed to be 1.4% larger than the next previous cohort at age 20. The weighting of older ages was also reduced by the probability of death since age 20.

21/ The same procedure as applied to private and government pensions was used for social security.

22/ Alicia H. Munnell, The Future of Social Security (Washington: The Brookings Institution, 1977), p. 123, summarizes various surveys of OASDHI beneficiaries which indicate a significant decline from the 1940's to the 1960's in the percentage receiving public assistance and contributions from relatives.

23/ A well-known actuarial formula gives $s(x,r) = [(1 + r)^x - 1]/r$. For computational purposes equation (1) can be simplified to

$$(1') \quad L_a = \frac{(1 + r)^{a-20} - 1}{(1 + r)^{45} - 1} \cdot P^a_{65} \cdot (1 + g - \pi)^{65-a} \cdot L_{65} \cdot$$

24/ For computations, this is

$$(2') \quad L_a = \frac{(1 + r)^{a-20} - 1}{(1 + r)^{45} - 1} \cdot (1 + g)^{65-a} \cdot L_{65} \cdot$$

25/ A well-known actuarial formula gives $v(x,r) = [1 - (1 + r)^{-x}]/r$. For computations, this formula was used

$$(3') \quad L_a = \frac{1 - (1 + r)^{a-78}}{1 - (1 + r)^{-13}} \cdot (1 + g - \pi)^{65-a} \cdot L_{65} \; .$$

26/ For computations, this is

$$(4') \quad L_a = \frac{1 - (1 + r)^{a-76}}{1 - (1 + r)^{-13}} \cdot (1 + g)^{65-a} \cdot L_{65} \; .$$

27/ See U.S. Bureau of Economic Analysis, Long-Term Economic Growth 1860-1970 (1973), pp. 105, 107.

From Michael R. Darby, The Effects of Social Security on Income and the Capital Stock. Not for quotation without the author's permission.
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Chapter 4

DIRECT ESTIMATES OF THE EFFECT OF SOCIAL SECURITY ON THE SAVING-INCOME RATIO*

It is a strictly empirical question as to whether and by how much social security reduces the ratio of private saving to private income. Some work has been done on that question in the past and more is reported here.

Previous work has involved two major approaches: (1) international comparisons of saving-income ratios with the scale of the social security program, and other variables; (2) estimation of consumption (or saving) functions using the U.S. aggregate time series data. Neither approach has yielded consistent answers.

The international comparisons have sometimes found significant reductions in the saving-income ratio while in other studies the effect of social security is not statistically distinguishable from zero. The issue of reverse causality also arises, since the level of saving in a country may affect the demand for a social security program.

The time series regressions have been equally inconclusive. Feldstein estimated a 38 percent reduction in the private saving-income ratio. A careful reading of his published results implies a reduction of only 26 percent however. Munnell estimated an only 5 percent reduction while Barro obtained no evidence of any reduction. The Feldstein and Barro results are dependent on the respective sides of a methodological issue which they take.

New estimates for several alternative measures of the scale of the social security program are reported in this chapter. For the most part, a reduction of about 20 percent in the private saving-income ratio is estimated using data for 1929-1940, 1947-1974. If the estimation is confined to the postwar period, there is no evidence for a significant reduction in this ratio. There are good arguments why these — and Feldstein's — estimates contain an upward bias and serve to put an upper limit to the possible reduction in the saving-income ratio. This is consistent with the estimate of the largest possible Feldstein/Munnell effect reported in Chapter 3.

Previous Direct Estimates

Given the size of the program, there have been surprisingly few previous empirical studies of the magnitude of the effects of social security on saving. Those studies that have been made therefore require close reading for the information which they contain.

International Comparisons. The international comparisons have been made by Henry Aaron and Martin Feldstein. In the original analysis,1/ Aaron related the household saving-disposable income ratio for 22 countries in 1957 to income, the social security expenditures-national income ratio, and other variables. A significant negative effect of the social security expenditures-national income ratio was found. While this would appear to imply that social security reduced private saving, Aaron also presented the inverse hypothesis that low saving countries would tend to have high social security expenditures because of greater "need." No attempt was made to disentangle the direction of causality or relative size of these influences. In a later study which Aaron wrote with Joseph Pechman and Michael Taussig,2/ the negative correlation between the social security expenditures-national income and saving-income ratio was not statistically significantly different from zero for 1960 data.

Feldstein's estimates 3/ are based on a 15 country sample using data averaged over the late 1950's. So many different variables and equation forms were tried on this limited data base that the results can only be viewed as describing selected features of the data rather than testing any hypothesis. Nevertheless, Feldstein did produce "significantly" negative partial correlations between his measures of the scale of the social security program and the private saving-income ratio. Feldstein used an elaborate life-cycle model in which the expected retirement-expected life ratio affects saving and is also affected by the social security program. But no attempt was made to deal with the problems of reverse causality which Aaron considered, and so little substantive progress was made.

The international comparisons appear inevitably plagued with serious questions of the direction of causality and with data of limited quality and quantity. As a result, there is little hope for informative direct estimates of social security effects from further cross-country analysis.

Time Series Analyses. A more promising avenue is to use the long and high quality U.S. time series data to study the effects of variations over time in the scale of the social security program. Here too there are statistical difficulties however: Because the social security program has been growing fairly steadily relative to income, the estimated effects may confound the influences of omitted variables with similar trends. This unavoidable difficulty with nonexperimental data is partially obviated by the wealth of evidence which has been developed on consumption and saving behavior. This literature can be considered in checking for potential omitted variables causing a spurious estimate of the correlation between social security and saving.

The two major time series studies published to date are by Alicia H. Munnell and Martin Feldstein.4/ These studies are very closely related as Feldstein was one of Munnell's thesis advisers.5/ As discussed previously in Chapter 2, Munnell and Feldstein utilize an extended version of the Ando-Modigliani life-cycle model in which social security has offsetting effects on saving: a decrease due to smoothing of life-cycle earnings and an increase due to an induced increase in the ratio of expected retirement to expected working life.

Munnell's results. Munnell's empirical work is succinctly summarized in an article in the National Tax Journal.6/ For personal saving (disposable personal income - personal outlays), Munnell found no statistically significant effects from either her income-smoothing variable (social security contributions ≈ benefits) or from her retirement variable (labor force participation of males 65 and older). These results were essentially the same when her estimate of social security wealth was used as the income-smoothing variable. The coefficient estimates -- for what they are worth -- combined with her estimate of induced retirement indicated a rather small net negative impact of social security on saving.7/ Note, however, that no change in saving for given income and other variables does not mean no change in saving if the induced retirement reduces income; this is the subject of Chapter 5. Munnell proposed a retirement saving concept measuring the change in certain assets (life insurance company assets - policy loans, pension plans, and government insurance and pension plans)8/ for which she obtained some statistically significant effects. Combined with the results on personal saving, this would suggest effects on the form of financial investments but not on aggregate saving and capital formation.

Feldstein's results. Martin Feldstein's much-cited 1974 article 9/ is the major bit of evidence for a large effect of the social security program on the saving-income ratio. The theoretical structure has been discussed at length in previous chapters, but the empirical work is largely independent of this structure.

His empirical work is based on a variant of a 1963 vintage Ando-Modigliani 10/ consumption function. His complete mathematical specification is

$$(1) \quad C_t = \alpha + \beta_1 Y_t + \beta_2 RE_t + \beta_3 Y_{t-1} + \beta_4 U_t + \gamma_1 W_{t-1} + \gamma_2 SSW_t.$$

The variables are: 11/

C_t consumer expenditures

Y_t disposable personal income

RE_t gross undistributed corporate profits

U_t unemployment rate

W_t wealth at the end of the year 12/

SSW_t present value of social security benefits, measured either gross ($SSWG_t$) or net ($SSWN_t$) of future taxes by those in the labor force.

These data will be discussed further below.

This particular specification of the consumption function is only one of many alternatives which could have been chosen.13/ A question arises whether this particular form has any characteristics which may seriously bias the answers to the questions which Feldstein poses.

The complete specification -- although eclectic and missing some variables -- does not do badly on this basis. Four basic factors -- as discussed at length below -- seem to explain consumer expenditures: (1) permanent income or the normal income stream from total human and nonhuman wealth, (2) transitory income or the difference between current and permanent income, (3) excess money supply, and (4) the stock of consumers' durable goods. The excess money supply is omitted but should be uncorrelated with social security wealth so that no bias in the estimated γ_2 is introduced.14/ There is no obvious reason for the omission of the consumers' durables stock to introduce any bias in γ_2 although the low level of the stock in 1947 after World War II and the big jump in social security wealth in that year might create problems.15/

Permanent income and transitory income are probably pretty well captured by the variables Y_t, RE_t, Y_{t-1}, U_t, and W_{t-1}. Disposable personal income plus (net) undistributed corporate profits is nearly the entire income available to the private sector for consumption or saving. 16/ Taken together, these five variables serve to estimate the levels and coefficients of permanent and transitory income, say $\delta_1 Y_{Pt} + \delta_2 Y_{Tt}$. Social security wealth might serve as a proxy for human wealth but the unemployment rate also captures differences of current labor income from what would be normally expected. So while there might be some positive bias in the estimated γ_2, this would be likely to be small.

Feldstein's social security wealth data are updated versions of calculations made by Alicia Munnell. 17/ Munnell estimated gross social security wealth as real personal disposable income per capita times a constant benefit ratio 0.41 times a weighted sum of numbers covered under social security. The weighted sum is over various age, sex, and marital groups with the weights reflecting projected future benefit streams with changes in widows benefits assumed anticipated. Thus Feldstein's gross social security wealth measure changes because of (1) changes in real disposable per capita income, (2) the numbers covered and their age-sex-marital distribution, and (3) change in the widow's benefit formula. 18/ Since real disposable income per capita is already included in the equation, SSWG per capita will capture only any interactions of this variable with the weighted-and-benefit-adjusted coverage per capita.

When Feldstein estimated his full specification (1), the coefficient on SSWG 19/ was positive but not statistically distinguishable from zero. However, Feldstein dropped the unemployment rate from his regressions and early presentation and was thereby able to obtain a "statistically significant" SSW coefficient for his four alternative estimates of social security wealth for the sample which included the prewar years 1929-1940. In no case was SSW statistically significant for the 1947-1971 sample. So Feldstein's whole case for social security's increasing consumption and decreasing saving depends critically upon deleting the unemployment rate from the equation estimated and the inclusion of the prewar data.

Feldstein's crucial argument for excluding the unemployment rate variable makes the presumption that SSW should be included and the unemployment rate excluded unless proven otherwise.20/ This seems to me to be methodologically untenable for someone introducing a previously untried variable of theoretically ambiguous sign. One can always find or construct variables that will appear to be "statistically significant" in an after-the-fact analysis of time series data if one is free to delete causal factors at will. Indeed for the 1929-1971 regression reported, the unemployment rate is just significant at the .10 level on the appropriate one-tailed t-test while the SSW coefficient fails the appropriate two-tailed test at the .20 level.21/ Feldstein argues that the insignificance of the 1947-71 SSW coefficients (even with U_t deleted) should be forgiven because they are similar in magnitude to those estimated for 1929-71. This too seems to be stretching to discover an effect.

Since a positive bias was to be anticipated in the estimated coefficient of SSW to the extent that SSW serves as a partial proxy for human wealth, I do not find it surprising that a "significant" positive coefficient is in fact achieved when the unemployment rate is deleted. My reading of Feldstein's own reported results is that there might be some effect of social security on saving and consumption, but it has not been demonstrated.

As to Feldstein's numerical estimates of the effect on saving, those too go rather beyond the statistical results even if one restricts oneself to the 1929-71 regressions deleting U_t. For example, the apparent moderation in using the 0.021 coefficient of SSWG1 instead of the larger 0.031 coefficient of the SSWN1 concept which fits best is spurious. Applying 0.021 to the larger SSWG1 amount results in an estimated saving reduction of \$43 billion instead of \$37 billion for SSWN1. Further SSWN1 not only fits better statistically, it is correct in terms of the theoretical model. The addition of another \$18 billion for reduction in disposable income due to social security taxes is clearly erroneous since benefits and taxes are nearly equal so that there is no net effect on disposable income. Correcting for these two factors would yield an estimate of \$37 billion instead of \$61 billion in 1971 or a 26 percent reduction in private saving as opposed to a 38 percent reduction.

In Chapter 3 it was argued that the maximum possible reduction in the capital stock due to the Feldstein/Munnell was on the order of 21 percent using the aggregate benefit data. In terms of the levels, my estimate \$943 billion of the life-cycle asset equivalent of social security for 3 percent interest corresponds pretty well to Feldstein's 1971 SSWN1 value of \$1162 billion.22/ But the total Feldstein/Munnell effect allowing for induced retirement should be less than the value of net social security wealth. So either even this smaller 26 percent effect is too high or else there are other -- presumably bequest -- significant effects which social security has on private saving.

Barro's results. Robert Barro has been carrying out a time-series analysis of the effects of social security simultaneously with the research reported here.23/ His approach overlaps with the current study (since he starts with my consumer expenditure function as do I) and with Feldstein's work (since their proxies for permanent and transitory income are similar and include an unemployment variable). On Barro's specification the unemployment variable is always significant while social security (whether Feldstein's or Barro's concept is used) is not except when the unemployment term is deleted. Indeed the social security coefficient is estimated as both positive and negative depending on the particular definitions used for the variables and periods over which the equations are estimated. Thus Barro's study serves to underscore the lack of evidence for any social security effect on saving which was implicit from a careful reading of Feldstein's own published results.

New Direct Time-Series Estimates

The permanent income approach is widely used in the literature as a method of estimating the normal yield from human and nonhuman wealth (that is, permanent income) and comparing that yield with current income. The approach is normally thought of as more congenial to analysis of saving for bequests than the life-cycle approach, but this is more a matter of analytical convenience than any real difference. We now turn to embedding a social security variable into a permanent income consumption function.

The Expanded Consumer Expenditure Function. A state-of-the-art consumer expenditure function was recently examined in my "The Consumer Expenditure Function." A convenient summary is also available.24/ This model combines factors effecting pure consumption and net investment in consumers' durable goods. It has very good explanatory power -- the ratio of standard error to mean for annual data from 1947 to 1973 is 0.6 percent for consumer expenditures25/ of 5.0 percent for private saving. With less background noise in the estimates, it may be possible to get a more precise estimate of the effect of social security.

The basic equation is:

$$(2) \quad C_t = \beta_0 + \beta_1 Y_{Pt} + \beta_2 Y_{Tt} + \beta_3 M_t + \beta_4 D_{t-1} + \beta_5 (P_D/P_{ND})_t + \beta_6 i_t.$$

C_t is consumer expenditures, Y_{Pt} is permanent income, Y_{Tt} is transitory income, M_t is real money balances, D_t is the stock of consumers' durable goods at the end of the year, $(P_D/P_{ND})_t$ is the ratio of the prices of durable and nondurable goods, and i_t is the market interest rate.

The analysis of Chapter 2 suggested that the social security program can affect consumption -- and hence consumer expenditures -- given income through (1) the theoretically ambiguous Feldstein/Munnell effect, (2) the negative wealth effect due to a higher real interest rate than the implicit yield on social security, (3) a negative uncertainty-of-receipt effect, and (4) a positive bequest effect due to forced purchase of an annuity. Clearly if the second and third effects were small, the combined effect of social security might cause a greater increase in consumption than would be possible if we confined the analysis to the Feldstein/Munnell effect alone.

To analyze the total effect of social security on saving, a term $\beta_7 SS_t$ is added to equation (2). If the estimated β_7 is significantly positive, this would imply that social security on net reduces saving, other things equal, and vice versa for a negative β_7. Four alternative measures of the scale of social security are tried in the empirical work: (1) the Feldstein/Munnell net and gross social security wealth concepts, (2) Barro's benefit x coverage variable,26/ and (3) OASI taxes paid.27/

Empirical Estimates. The expanded consumer expenditure function was estimated for data from 1929 through 1974 exclusive of the war years 1941-1946. These were the first and last years for which reasonably consistent data series were available for all the variables. All variables except $(P_D/P_{ND})_t$ and i_t are measured in billions of 1958 dollars. Sources are given in the data appendix to this chapter. Both the M_1 and M_2 concepts of money were used in the regressions. The narrow (currency and demand deposits) M_1 concept has performed better in post-war consumer expenditure functions than the broader (M_1 plus bank time deposits) M_2 concept. However the classification of demand deposits was largely arbitrary prior to the prohibition of interest payments on demand deposits in the Banking Acts of 1933 and 1935. So following Friedman and Schwartz,28/ the M_2 concept is tried as an imperfect but consistent proxy for the medium of exchange.

The estimated extended consumer expenditure functions using Feldstein's SSWG1 and SSWN1 concepts are presented in Table 4.1 and using Barro's benefit x coverage variable and social security taxes are presented in Table 4.2. As was expected, the M_2 money definition does not do nearly so well as M_1 in the even-numbered postwar regressions. But M_1 does yet worse if it is used for the whole period 1929-1974 because of the inconsistency in economic meaning in the early part of the period. Therefore the discussion will emphasize the M_2 regressions for the 1929-1974 period and the M_1 regressions for the 1947-1974 period. The reader can confirm that similar results obtain for the alternative money supply concepts. The coefficients of the variables other than the social security variables SS_t present no surprises and will not be reviewed here.

In no case was Barro's benefit x coverage variable significantly different from zero in either a statistical or economic sense. Since no strong theoretical case was presented by Barro for using this variable, only small weight can be put on the essentially zero estimated effect of social security on private saving reported in regressions number 9, 10, 13, and 14.

The other three social security scale variables -- Feldstein's net SSWN1 and gross SSWG1 wealth and social security taxes SSTax -- give different but mutually consistent estimates of the effects. Table 4.3 shows the estimated reduction in the 1971 saving-income ratio implied by each of the regressions. For 1929-1974, the M_2 regressions all imply about a 20 percent reduction in the 1971 private saving-income ratio. This is rather lower than Feldstein's own 38 percent estimate, but remarkably close to the 26 percent corrected estimate based on Feldstein's reported results. Further these three estimated coefficients are all statistically different from zero at the 10 percent level of significance.29/

Against this evidence of a substantial reduction in saving due to social security must be set the statistically insignificant and quite inconsistent

Table 4.1

EXTENDED CONSUMER EXPENDITURE FUNCTION ESTIMATES BASED ON

FELDSTEIN'S SOCIAL SECURITY WEALTH VARIABLES

Reg. No.	SS_t Concept	M_t Concept	Period of Estimation	Estimated Coefficient of								$\bar{R}^2$	S.E.E.	D-W
				Const.	Y_{Pt}	Y_{Tt}	M_t	D_{t-1}	$(P_D/P_{ND})_t$	i_t	SS_t			
1	SSWN1	M_2	1929-74	21.65	0.835	0.546	0.039	-0.148	-22.01	3.54	0.025	.9997	2.58	2.27
				(1.25)	(23.30)	(13.77)	(0.79)	(-2.57)	(-1.23)	(2.89)	(1.33)			
2	SSWN1	M_2	1947-74	-5.36	0.905	0.539	0.010	-0.178	-14.56	1.83	0.003	.9995	2.97	2.33
				(-0.09)	(13.36)	(6.90)	(1.15)	(-2.25)	(-0.32)	(0.90)	(0.09)			
3	SSWG1	M_2	1929-74	26.34	0.821	0.541	0.042	-0.149	-24.97	3.60	0.017	.9997	2.58	2.27
				(1.63)	(22.60)	(13.37)	(0.86)	(-2.56)	(-1.50)	(2.95)	(1.31)			
4	SSWG1	M_2	1947-74	-0.19	0.893	0.513	0.074	-0.203	-13.13	1.42	0.015	.9995	2.95	2.29
				(-0.00)	(12.66)	(5.63)	(0.89)	(-2.27)	(-0.29)	(0.65)	(0.50)			
5	SSWN1	M_1	1929-74	21.54	0.841	0.553	0.164	-0.155	-19.79	3.48	0.033	.9997	2.61	2.27
				(1.02)	(18.25)	(14.12)	(0.27)	(-2.62)	(-0.92)	(2.41)	(2.20)			
6	SSWN1	M_1	1947-74	-139.11	1.002	0.455	0.726	-0.229	17.26	1.78	-0.017	.9997	2.21	2.40
				(-2.49)	(17.92)	(7.42)	(4.31)	(-3.97)	(0.50)	(1.19)	(-0.79)			
7	SSWG1	M_1	1929-74	25.44	0.830	0.549	0.005	-0.159	-20.93	3.38	0.024	.9997	2.61	2.28
				(1.23)	(17.65)	(13.67)	(0.09)	(-2.63)	(-0.98)	(2.33)	(2.13)			
8	SSWG1	M_1	1947-74	-137.64	1.002	0.460	0.711	-0.226	17.99	1.90	-0.011	.9997	2.22	2.42
				(-2.40)	(16.76)	(6.77)	(4.08)	(-3.58)	(0.51)	(1.20)	(-0.59)			

Notes:
1. t-statistics are given in paretheses below the coefficient estimates.
2. S.E.E. is the standard error of estimate in billions of 1958 dollars.
3. 1929-1974 regressions exclude the war years 1941-1946.
4. D-W is the Durbin-Watson statistic, adjusted for 1 gap for the 1929-1974 regressions.

Table 4.2

EXTENDED CONSUMER EXPENDITURE FUNCTION ESTIMATES BASED ON BARRO'S BENEFIT-COVERAGE VARIABLE AND ON OASI TAXES PAID

Reg. No.	SS_t Concept	M_t Concept	Period of Estimation	Estimated Coefficient of								$\bar{R}^2$	S.E.E.	D-W
				Const.	Y_{Pt}	Y_{Tt}	M_t	D_{t-1}	$(P_D/P_{ND})_t$	i_t	SS_t			
9	Barro	M_2	1929-74	31.20 (1.95)	0.809 (16.66)	0.548 (13.32)	0.097 (2.03)	-0.110 (-2.10)	-36.20 (-2.49)	4.21 (1.42)	0.016 (0.65)	.9997	2.64	2.27
10	Barro	M_2	1947-74	-5.65 (-0.10)	0.883 (9.73)	0.531 (6.90)	0.130 (1.56)	-0.171 (-2.44)	-15.66 (-0.35)	2.01 (1.00)	0.021 (0.37)	.9995	2.96	2.38
11	SSTax	M_2	1929-74	14.61 (0.75)	0.828 (23.31)	0.548 (13.97)	0.063 (1.55)	-0.147 (-2.61)	-15.48 (-0.76)	3.41 (2.76)	0.803 (1.42)	.9997	2.57	2.26
12	SSTax	M_2	1947-74	-8.05 (-0.13)	0.903 (13.36)	0.542 (7.58)	0.101 (1.72)	-0.178 (-2.47)	-11.71 (-0.24)	1.87 (0.95)	0.152 (0.19)	.9995	2.97	2.32
13	Barro	M_1	1929-74	37.97 (1.78)	0.861 (15.28)	0.588 (15.39)	0.034 (0.51)	-0.101 (-1.75)	-41.20 (-2.02)	3.40 (2.00)	-0.008 (-0.36)	.9997	2.79	2.12
14	Barro	M_1	1947-74	-127.27 (-2.36)	0.973 (17.01)	0.436 (7.33)	0.675 (4.40)	-0.241 (-4.34)	17.58 (0.50)	1.66 (1.10)	0.012 (0.42)	.9997	2.23	2.41
15	SSTax	M_1	1929-74	18.42 (0.82)	0.828 (17.30)	0.564 (14.81)	0.052 (0.87)	-0.143 (-2.45)	-16.68 (-0.72)	3.53 (2.41)	1.107 (1.98)	.9997	2.64	2.23
16	SSTax	M_1	1947-74	-126.16 (-2.33)	0.981 (18.00)	0.439 (7.40)	0.641 (4.49)	-0.246 (-4.30)	20.43 (0.55)	1.57 (1.05)	0.096 (0.17)	.9997	2.24	2.41

Notes:
1. t-statistics are given in paretheses below the coefficient estimates.
2. S.E.E. is the standard error of estimate in billions of 1958 dollars.
3. 1929-1947 regressions exclude the war years 1941-1946.
4. D-W is the Durbin-Watson statistic, adjusted for 1 gap for the 1929-1974 regressions.

Table 4.3

ESTIMATED PERCENTAGE REDUCTION IN THE 1971 SAVING-INCOME RATIO DUE TO SOCIAL SECURITY

Period and Money Concept	Social Security Scale Variable			
	SSWN1	SSWG1	Barro	SSTax
1929-1974, M_2	20.1*	22.5*	2.8	18.0*
1947-1974, M_1	-20.6	-23.1	2.1	25.6
1929-1974, M_1	24.9**	29.0**	-1.5	23.2**
1947-1974, M_2	2.9	20.4	3.7	4.0

*Significant at 10% level.

**Significant at 5% level.

Minus indicates an estimated increase.

postwar results. In the best-fitting M_1 regressions, social security is actually estimated to reduce consumption and increase saving for Feldstein's social security wealth variables.

So the social security variables indicate a statistically significant reduction in saving only if the 1930's are included in the regression. This is subject to two rather different interpretations. One is that there was so little variation of social security around trend in the postwar period that there was no way to detect an effect unless the period of rapid change is included. An alternative interpretation is that the social security variables serve to divide the period into depression and no depression parts.30/ So any changes in the economy, inadequacies in the linear regression in depressions, or problems in prewar/postwar data consistency will show up in the estimated coefficient. Barro's results discussed above show that an alternative method of dividing current income into permanent and transitory components (using the unemployment rate) yields no statistically significant social security effect.

So we see that the estimated effect of social security depends critically on the method by which current income is divided into permanent and transitory components. If the unemployment rate is used, no statistically significant effect is found. If Friedman's estimator — which may be interpreted as a perpetual inventory of wealth 31/ — is used, a significant reduction in saving is found for the postwar period. Those who doubt the existence of a social security effect would argue that the coefficient of transitory income was likely higher during the depression than during postwar years because buffer stocks of liquid assets were exhausted.32/ Since transitory income was negative during the depression, too low a coefficient would overestimate consumption and underestimate saving. This would be offset in the regression estimates by a lower permanent income coefficient and a positive coefficient on SS_t which is similar to permanent income except during the depression. It is true that the permanent income coefficients are lower in each of the 1929-1974 regressions than in the corresponding 1947-1974 regression.

There is no obvious way to resolve this impasse. One can obtain pretty much any result by a suitable choice among reasonable consumer expenditure functions and time periods. For the 1929-1974 time period, the regressions presented here indicate a 20 percent reduction in the saving-income ratio. For the 1947-1974 time period, the reduction is essentially nil. Averaging all the results one obtains a 10 percent reduction. While there are good reasons -- including the maximal Feldstein/Munnell effects estimated in Chapter 3 -- to view the 20 percent reduction as an overestiamte of the effect of social security, it might not be. So these results could be read as confirming Feldstein's results in principle if not detail. I interpret them as saying that the effect of social security on saving is still an open issue. The reduction in the saving-income ratio is probably not much bigger than 20 percent (if anything, an upward biased estimate) and likely closer to or less than the mean estimate of 10 percent.

Data Appendix

The sources for the data used in the regression estimates in this chapter are as reported below. The actual series are reported in Tables 4.4 through 4.7. National income accounts data were taken from the NBER data bank except as otherwise noted.

SSWG1: Feldstein's gross social security wealth variable computed using a net discount factor of 1.01 as described in his "Social Security and Capital Accumulation," pp. 914-16. Data through 1961 in billions of 1958 dollars are reported in Munnell, Effect on Personal Saving, p. 126. Feldstein's research assistant Anthony J. Pellechio has kindly provided us with revised data from 1962 through 1974.

SSWN1: Feldstein's net social security wealth variable corresponding to SSWG1. It is computed by subtracting from SSWG1 the present value of expected social security taxes to be paid by those currently in the labor force. The sources for the data are the same as SSWG1.

Barro: This is an aggregate version of Barro's coverage times benefits variable. Barro, "Social Security and Private Saving," p. 40, gives this series as dollars per person. His data are aggregated by multiplication by total population including armed forces overseas (from U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1970, p. 8; and Economic Report of the President, January 1977, p. 217) in billions. The aggregate data were divided by the implicit price deflator for personal consumption expenditures to obtain billions of 1958 dollars.

SSTax: Net total contributions to the old-age and survivors insurance trust fund (from the Social Security Bulletin, Annual Statistical Supplement, 1974, p. 62) divided by the implicit price deflator for personal consumption expenditures to obtain billions of 1958 dollars.

Y^{Priv}: Private sector income divided by the implicit price deflator for personal consumption expenditures to obtain billions of 1958 dollars. Nominal private sector income measures all income of the private sector whether received in cash or accrued (see Darby, Macroeconomics, p. 20, for a complete discussion).

Y: Measured income defined as real private sector income adjusted for the imputed yield on the stock consumers' durable goods (in billions of 1958 dollars). Where D_t is the real stock of durable goods at the end of year t (see below),

$$Y_t = Y_t^{Priv} + 0.1\, D_{t-1}.$$

Y_p: Permanent income in billions of 1958 dollars. Computed by the exponentially declining weight method as

$$Y_{Pt} = \beta Y_t + (1-\beta)(1+g)Y_{Pt-1},$$

where β is 0.1, g is the period's trend growth rate of 0.0386 per annum, and $Y_{P,\ 1929} = Y_{1929}$. The latter assumption was made because an initial value estimated from a trend regression is unduly depressed by the depression. The real income data for 1941-1946 were replaced by a log-linear interpolation from 1940 to 1947 to alleviate problems in the war year data. These years were not used in the regressions, but only to obtain $Y_{P,\ 1947}$. The reported conclusions are unchanged (although the $\bar{R}^2$'s of the regressions decline) if the reported war year Y's or war year Y's estimated from a time trend regression are used. For further discussion of the calculation of permanent income, see Darby, "The Consumer Expenditure Function," p. 11.

Y_T: Transitory income in billions of 1958 dollars, $Y_{Tt} = Y_t - Y_{Pt}$.

M_1: Money supply M_1 (average of monthly data in the NBER data bank) divided by the implicit price deflator for personal consumption expenditures to obtain billions of 1958 dollars.

M_2: Money supply M_2 (average of monthly data in the NBER data bank) divided by the implicit price deflator for personal consumption expenditures to obtain billions of 1958 dollars.

D : Stock of consumers' durable goods at the end of the year in billions of 1958 dollars. Estimated as a perpetual inventory by $D_t = 0.904282C^d_t + 0.8145D_{t-1}$, where C^d is real personal consumption expenditures for durable goods. Data from 1946 on were contained in Darby, "The Consumer Expenditure Function," p. 34. These were extended backward from the 1946 benchmark by inverting the inventory equation.

C : Personal consumption expenditures in billions of 1958 dollars.

P_D/P_{ND}: Relative price of durable to nondurable goods and services computed by dividing the implicit price deflator for personal consumption expenditures on durable goods by the implicit price deflator for personal consumption expenditures on nondurable goods and services.

i: Yield to maturity or long-term U.S. government bonds taken from the N.B.E.R. data bank.

Table 4.4

DATA FOR ALTERNATIVE SOCIAL SECURITY SCALE VARIABLES

Year	SSWG1	SSWN1	Barro	SSTax
1929	0.0	0.0	0.0	0.0
1930	0.0	0.0	0.0	0.0
1931	0.0	0.0	0.0	0.0
1932	0.0	0.0	0.0	0.0
1933	0.0	0.0	0.0	0.0
1934	0.0	0.0	0.0	0.0
1935	0.0	0.0	0.0	0.0
1936	0.0	0.0	0.0	0.0
1937	104.000	49.0000	72.9947	1.64516
1938	94.0000	44.0000	66.8942	0.783475
1939	156.000	97.0000	76.5832	1.28603
1940	175.000	108.000	83.1934	0.714287
1941	230.000	137.000	87.4372	1.62012
1942	287.000	170.000	75.2066	1.84672
1943	300.000	181.000	60.9961	2.06845
1944	299.000	182.000	52.8186	2.08228
1945	298.000	178.000	51.7563	1.96443
1946	310.000	172.000	53.8282	1.83688
1947	296.000	160.000	45.3285	1.99872
1948	310.000	164.000	41.3346	2.04739
1949	296.000	156.000	41.2322	2.03917
1950	329.000	169.000	51.4518	3.21713
1951	403.000	215.000	79.2506	3.79572
1952	423.000	225.000	79.2574	4.21989
1953	447.000	235.000	90.6057	4.30207
1954	442.000	233.000	93.2387	5.58162
1955	514.000	273.000	118.524	6.15625
1956	552.000	292.000	120.576	6.51055
1957	598.000	313.000	127.272	6.98567
1958	609.000	325.000	123.240	7.56600
1959	658.000	351.000	133.670	7.94868
1960	683.000	367.000	133.036	10.5598
1961	718.000	394.000	135.585	10.8614
1962	799.000	453.000	141.015	11.4957
1963	850.000	485.000	138.962	13.7050
1964	942.700	544.700	138.932	14.6080
1965	1041.10	600.100	153.174	14.7215
1966	1149.30	661.300	154.234	18.4574
1967	1232.30	713.300	149.104	20.2255
1968	1325.90	770.900	159.192	20.0330
1969	1406.80	815.800	154.100	22.6292
1970	1499.80	869.800	162.461	23.3399
1971	1563.20	922.200	169.278	25.0916
1972	1688.50	997.500	174.286	27.3974
1973	1875.20	1110.20	188.735	31.5114
1974	1869.90	1112.90	168.817	32.0499

Sources: See text.

Table 4.5

DATA FOR INCOME VARIABLES

Year	Y^{Priv}	Y	Y_P	Y_T
1929	153.121	159.182	159.182	0.0
1930	138.006	144.421	163.230	-18.8085
1931	126.451	132.843	165.856	-33.0128
1932	103.454	109.673	165.993	-56.3200
1933	101.323	107.148	165.869	-58.7208
1934	115.251	120.746	167.112	-46.3664
1935	129.313	134.639	169.664	-35.0256
1936	145.846	151.242	173.710	-22.4680
1937	152.417	158.123	178.179	-20.0561
1938	143.371	149.384	181.483	-32.0988
1939	156.461	162.462	185.879	-23.4167
1940	170.618	176.817	191.423	-14.6060
1941	177.680	184.239	197.347	-13.1082
1942	184.930	192.000	203.661	-11.6613
1943	192.480	199.296	210.292	-10.9958
1944	200.340	206.814	217.242	-10.4276
1945	208.510	214.633	224.520	-9.88657
1946	217.020	222.966	232.156	-9.18991
1947	225.960	232.657	240.262	-7.60553
1948	243.460	251.148	249.688	1.45963
1949	244.000	252.640	258.648	-6.00790
1950	259.670	269.275	268.687	0.588379
1951	265.770	276.731	278.815	-2.08374
1952	272.810	284.586	289.068	-4.48169
1953	282.120	294.497	299.642	-5.14526
1954	285.460	298.733	309.949	-11.2163
1955	307.210	321.222	321.833	-0.610596
1956	317.000	332.320	334.050	-1.73022
1957	322.480	338.665	346.104	-7.43823
1958	322.810	339.745	357.479	-17.7332
1959	341.290	358.511	369.987	-11.4758
1960	345.780	363.759	382.204	-18.4451
1961	355.630	374.333	394.680	-20.3464
1962	374.700	393.902	408.299	-14.3965
1963	387.310	407.399	422.377	-14.9785
1964	416.860	438.078	438.605	-0.526367
1965	446.710	469.328	456.897	12.4302
1966	471.670	496.115	476.674	19.4402
1967	486.460	512.854	496.834	16.0200
1968	503.970	532.060	517.597	14.4624
1969	512.470	542.701	538.069	4.63159
1970	528.423	560.787	559.013	1.77368
1971	553.835	587.773	581.288	6.48560
1972	581.954	617.933	605.124	12.8098
1973	620.514	659.225	631.532	27.6929
1974	597.481	639.282	654.223	-14.9402

Sources: See Text.

Table 4.6

DATA FOR ALTERNATIVE MONEY STOCK MEASURES

Year	M_1	M_2
1929	47.7397	83.5444
1930	47.3881	84.1419
1931	49.4781	87.0565
1932	48.6998	82.2696
1933	48.0296	75.8621
1934	49.4253	76.7817
1935	57.4325	86.4866
1936	65.3244	100.671
1937	64.5162	96.7743
1938	65.7896	98.4650
1939	74.5012	107.982
1940	85.7144	119.780
1941	94.2506	126.900
1942	100.730	129.380
1943	120.701	150.251
1944	134.810	169.146
1945	151.529	193.884
1946	150.355	196.312
1947	143.517	187.420
1948	136.452	179.952
1949	136.108	180.539
1950	137.636	181.906
1951	134.537	176.524
1952	138.343	182.210
1953	139.913	186.587
1954	140.865	191.568
1955	144.828	197.953
1956	143.460	197.047
1957	139.918	196.315
1958	138.400	201.200
1959	141.856	207.700
1960	139.456	206.511
1961	141.001	215.207
1962	142.707	225.644
1963	145.241	237.418
1964	149.162	249.442
1965	153.585	265.717
1966	156.682	279.372
1967	158.829	293.269
1968	164.189	308.531
1969	167.288	315.709
1970	166.976	328.616
1971	172.024	361.012
1972	178.100	363.597
1973	180.740	376.423
1974	171.508	367.077

Sources: See text.

Table 4.7

DATA FOR REMAINING VARIABLES IN THE CONSUMER EXPENDITURE FUNCTION

Year	D	C	P_D/P_{ND}	i
1928	60.6080	—	—	—
1929	64.1530	139.600	1.05860	3.60000
1930	63.9180	130.400	1.03600	3.29000
1931	62.1890	126.100	1.02610	3.34000
1932	58.2490	114.800	1.02270	3.68000
1933	54.9500	112.800	1.03460	3.31000
1934	53.2570	118.100	1.03110	3.12000
1935	53.9580	125.500	0.980400	2.79000
1936	57.0610	138.400	0.971500	2.65000
1937	60.1310	143.100	0.983900	2.68000
1938	60.0100	140.200	1.02520	2.56000
1939	61.9900	148.200	1.02220	2.36000
1940	65.5930	155.700	1.02490	2.21000
1941	70.6970	165.400	1.03960	2.05000
1942	68.1630	161.400	1.08850	2.46000
1943	64.7430	165.800	1.07680	2.47000
1944	61.2330	171.400	1.14070	2.48000
1945	59.4590	183.000	1.17180	2.37000
1946	66.9670	203.500	1.10110	2.19000
1947	76.8810	206.300	1.07087	2.25000
1948	86.4030	212.300	1.05589	2.44000
1949	96.0570	216.500	1.07258	2.31000
1950	109.617	230.500	1.07048	2.32000
1951	117.768	232.800	1.07440	2.57000
1952	123.774	239.400	1.06247	2.68000
1953	132.735	250.500	1.03290	2.94000
1954	140.125	255.700	1.00532	2.55000
1955	153.198	274.200	0.988406	2.84000
1956	161.856	281.400	1.00135	3.08000
1957	169.360	287.200	1.00898	3.47000
1958	172.216	290.100	0.999576	3.43000
1959	179.790	307.300	1.00149	4.07000
1960	187.041	316.100	0.977200	4.01000
1961	192.024	322.500	0.962749	3.90000
1962	200.895	338.400	0.953963	3.95000
1963	212.188	352.900	0.936349	4.00000
1964	226.180	373.700	0.924064	4.15000
1965	244.449	397.700	0.900126	4.21000
1966	263.941	418.100	0.863988	4.66000
1967	280.902	428.600	0.855488	4.85000
1968	302.313	452.700	0.848809	5.25000
1969	323.641	469.300	0.832743	6.10000
1970	339.380	478.400	0.815279	6.59000
1971	359.800	496.300	0.805295	5.74000
1972	387.110	529.700	0.781104	5.63000
1973	418.020	554.400	0.745972	6.30000
1974	433.720	545.100	0.721284	6.99000

Sources: See text.

FOOTNOTES TO CHAPTER 4

*John J. Antel gathered the data and performed the statistical computations for this chapter.

1/ Henry Aaron, "Social Security: International Comparisons," in Otto Eckstein, ed., Studies in the Economics of Income Maintenance (Washington: The Brookings Institution, 1967).

2/ Joseph A. Pechman, Henry J. Aaron, and Michael K. Taussig, "Appendix D: International Comparisons," in their Social Security: Perspectives for Reform (Washington: The Brookings Institution, 1968).

3/ Martin Feldstein, "Social Security and Private Savings: International Evidence in an Extended Life Cycle Model," Harvard Institute of Economic Research Discussion Paper Number 361, May 1974.

4/ Munnell, Effect on Personal Saving; Feldstein, "Social Security and Capital Accumulation."

5/ Indeed they are related to the earlier Brookings Institution work in view of Peckman, Aaron, and Taussig's acknowledgement in their Perspectives for Reform (p. viii) of "a major debt of gratitude to Alicia Munnell whose role far exceeded that of a research assistant."

6/ Alicia H. Munnell, "The Impact of Social Security on Personal Savings," National Tax Journal, vol. 27 (December 1974), pp. 553-67.

7/ This is for the 1900-1971 and 1929-1971 regressions. A larger effect is estimated for the 1946-1971 regressions, but Munnell rightly points out that these inconsistent results are probably due to omitted variables.

8/ Munnell, "Impact on Personal Savings," p. 557.

9/ Feldstein, "Social Security and Capital Accumulation."

10/ Ando and Modigliani, "Life Cycle Hypothesis of Saving."

11/ All variables except U_t were measured in 1958 dollars per capita.

12/ Feldstein used Ando and Modigliani's estimates of per capita household net worth as used in the FRB-MIT model.

13/ Several of these alternatives will be discussed below.

14/ Bias is introduced only where the omitted variables are correlated with included variables.

15/ Feldstein excluded the war years 1941-46 so that changes over this period first appear in the 1947 data. The stock of consumers' durable goods will be considered further below.

16/ Feldstein uses gross undistributed corporate profits (inclusive of capital consumption allowances) but notes that it does not significantly alter the results if he uses the net concept.

17/ See Munnell, Effect on Personal Saving, pp. 121-126, for details. His preferred SSWG1 concept for example is her series SSW for discount rate = 3 and growth rate = 2 multiplied by the ratio of the price index in 1971 to the price index in 1958 (by approximately 1.343) to convert her figures to 1971 dollars.

18/ Net social security wealth also varies because of pre-1971 variations in the ratio of taxes to disposable income as this ratio is assumed anticipated correctly before 1971 and to be constant after 1970.

19/ Reference is made here to equations 2.6 and 2.10, Feldstein, "Social Security and Capital Accumulation," p. 917. Only results for the SSWG1 concept were reported by Feldstein.

20/ Feldstein, "Social Security and Capital Accumulation," p. 219.

21/ Feldstein argues that the statistical problems with the SSW coefficient are not due to (partial) multicollinearity with the unemployment rate on what seem to me to be entirely spurious grounds. For the 1929-71 regression inclusive of both SSW_t and U_t, the coefficients of W_{t-1} and SSW_t are practically identical (0.013 and 0.010 respectively). So when Feldstein constrains them to be equal (0.012) and finds only a marginal improvement in the significance of the U_t coefficient (to the .08 level), he is nearly rerunning the original regression with the significance of the constrained coefficient due to the W_{t-1} dog and not the SSW_t tail.

22/ If Feldstein had calculated the effect if the $1162 billion otherwise would have been held as capital stock, he would have gotten 25 percent (as opposed to 37 percent using SSWG1).

23/ See Robert J. Barro, "Social Security and Private Saving -- Evidence from the U.S. Time Series," Department of Economics, University of Rochester, April 1977.

24/ Michael R. Darby, "Postwar U.S. Consumption, Consumer Expenditures and Saving," American Economic Review, Papers and Proceedings, vol. 65 (May 1975), pp. 217-222.

25/ This corresponds to an R^2 (adjusted) of .9996 and a Durbin-Watson statistic of 2.37.

26/ This is the product of (1) benefits per recipient in the old age survivors, and disability program, (2) the ratio of the number of workers with earnings taxable by social security at some time during the year to the total labor force, and (3) the total population. See Barro, "Social Security and Private Saving" for details.

27/ This variable treats (perhaps a fraction of) social security taxes as if they were viewed as income and savings.

28/ Milton Friedman and Anna J. Schwartz, A Monetary History of the United States, 1867-1960, Princeton: Princeton University Press, 1963.

29/ For the M_1 regressions, the estimated effects were a bit higher and significant at the 5 percent level.

30/ This does not occur for Barro's coverage x benefit variable however. The reason is that the zero's for 1929-1936 are offset by high values (about half of the 1970's values) for 1937-1940 for Barro's variable. For the other SS_t variables the 1937-1940 values average one tenth to one twentieth of their 1970's values.

31/ See Michael R. Darby, "The Permanent Income Theory of Consumption — A Restatement," Quarterly Journal of Economics, vol. 88 (May 1974), pp. 228-50.

32/For exactly this argument without reference to social security, see Axel Leijonhufvud, "Effective Demand Failures," Swedish Journal of Economics, vol. 75, no. 1 (1973), pp. 27-48, esp. p. 42.

From Michael R. Darby, The Effects of Social Security on Income and the Capital Stock. Not for quotation without the author's permission.
D 1: June 6, 1977

Chapter 5

INTEGRATION OF SAVING AND LABOR FORCE EFFECTS ON INCOME AND THE CAPITAL STOCK

The long-run equilibrium effects of social security on U.S. income and capital stock depend critically upon the role of the United States in the world economy. If we view the U.S. as insulated from the rest of the world by effective controls on capital flows, we have the polar case of a closed economy. If the U.S. is thought of as a small part of a large world capital market -- at least in the long-run -- then the U.S. is best characterized as a small open economy. In fact, the American economy falls between the bounds set by these polar cases -- somewhat open to capital flows and a significant factor in the world capital market. Nevertheless, it is useful in forming an opinion of the actual effects to pin down the nature and bounds on the effects by examinining each polar case in turn.

The case of a closed economy is examined first within the context of a simple neoclassical growth model. It is shown that in long-run equilibrium income and the capital stock are affected by both changes in the saving-income ratio and in the supply of labor induced by the social security program. Chapters 2 through 4 concentrated on the saving-income ratio. In this chapter, the results of those chapters are combined with the results of other researchers as to the labor supply effect to find the long-run general equilibrium effect. Since the separate effects on saving and labor supply are not known with precision, the income and capital effects are computed for a number of alternative combinations of saving-income ratio and labor supply impacts.

In the case of a small open economy, the effects of social security are quite simple to compute although the distinction between income of U.S. residents (NNP) and U.S. output (NDP) becomes important. Again the effects are computed for alternative combinations of saving-income and labor supply effects.

The Case of a Closed Economy

The long-run equilibrium of the economy can be characterized as one of balanced or steady-state growth. In such a growth equilibrium income and the capital stock grow at the same rate as the effective supply of labor. The growth of effective labor supply results from growth in population, hours worked per capita, education and training, and technological innovation. For a closed economy, growth in capital is determined by the domestic saving available to finance investment. Income grows because of the growth in the basic factors of production -- labor and capital.

The Neoclassical Growth Model. The long-run growth equilibrium is most conveniently analyzed by use of a simple neoclassical growth model.1/ The effective labor supply L_t measured in efficiency units is assumed to grow at a constant rate g per annum continuously compounded. So

$$(1) \quad L_t = L_0 e^{gt},$$

where L_0 is the labor supply at time 0. The model is completed by assuming a linear homogeneous (constant-returns-to-scale) aggregate production function

$$(2) \quad Y_t = f(K_t, L_t)$$

and constant saving-income ratio

$$(3) \quad \frac{dK_t}{dt} = \dot{K}_t = \sigma Y_t.$$

Here Y_t is the level of real income and output, K_t the capital stock, and $\dot{K}_t$ the rate of change in the capital stock (that is, investment).2/

Dividing equation (3) by K_t, we obtain the growth rate of the capital stock:

$$(3) \quad \frac{\dot{K}_t}{K_t} = \sigma \frac{Y_t}{K_t} .$$

Substituting equation (2) and simplifying,

$$(4) \qquad \frac{\dot{K}_t}{K_t} = \sigma f(1, L_t/K_t).$$

So the growth rate of the capital stock is an increasing function of the labor-capital ratio. Figure 5.1 graphs equation (4) together with the growth rate of labor g. Since the growth rate of labor exceeds the growth rate of capital for L_t/K_t less than (L/K)* and vice versa for L_t/K_t greater than (L/K)*, the labor-capital ratio will move towards and remain at (L/K)*. This long-run equilibrium value determines the equilibrium capital stock given equation (1) and hence the equilibrium income given equation (2). 3/

Figure 5.2 plots the moving equilibrium values of income, capital stock, and labor supply together on a graph with a vertical ratio scale.4/ Each variable grows at the constant growth rate of labor g. 5/

Equilibrium Effects of Social Security. The social security program affects income and the capital stock in the closed economy through two of the proximate determinants of the growth equilibrium: the saving-income ratio and the labor supply.

The change in the saving-income ratio induced by social security is ambiguous in theory but the empirical results discussed in Chapters 3 and 4 suggest that this ratio is either unchanged or decreased. Using a circumflex to denote values with social security we have

$$(5) \qquad \hat{\sigma} \leq \sigma.$$

Induced retirement causes a once-and-for-all decrease in the average hours worked per capita. This reduces the quantity of labor at any point in time to a fraction λ of what it would otherwise be. There is no reason for the growth

Figure 5.1

DETERMINATION OF EQUILIBRIUM LABOR-CAPITAL

RATIO IN THE SIMPLE NEOCLASSICAL GROWTH MODEL

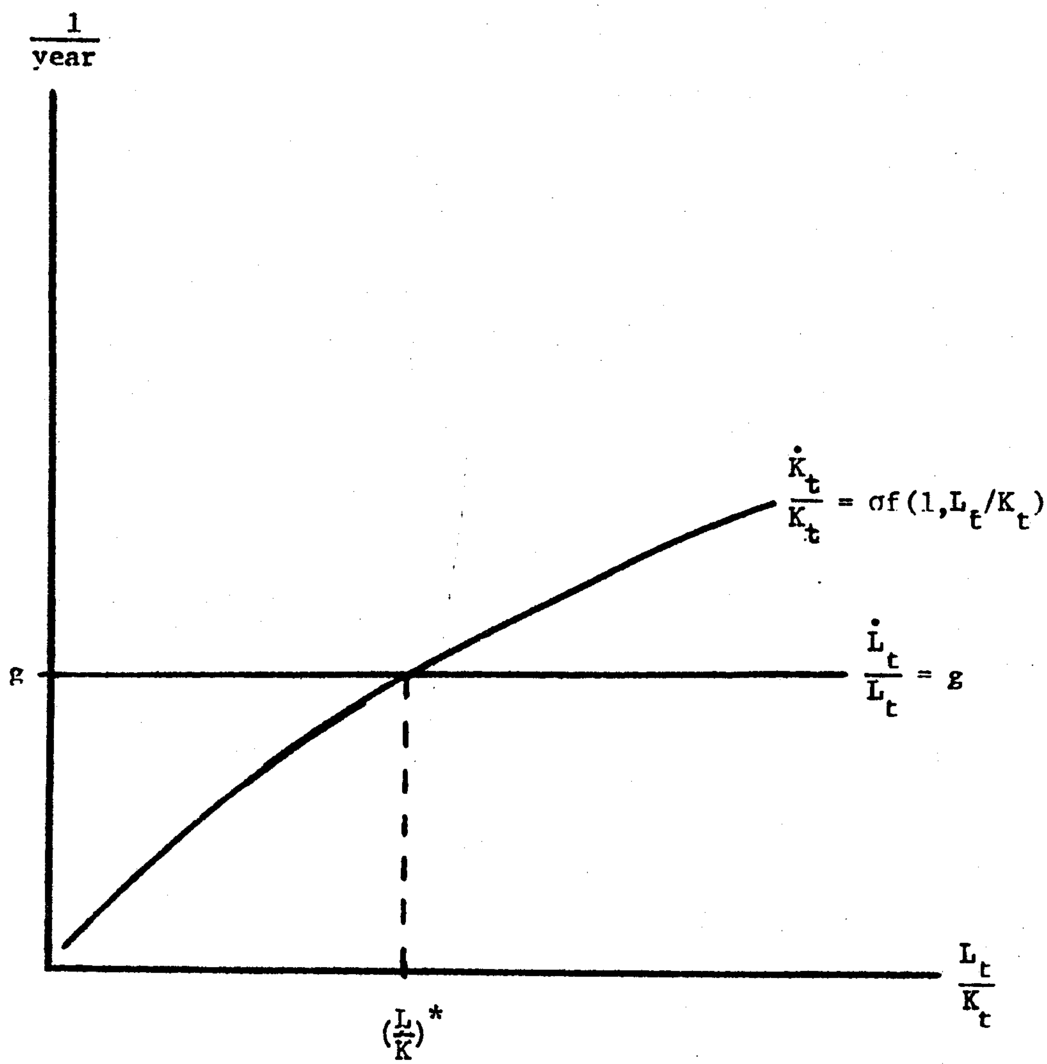
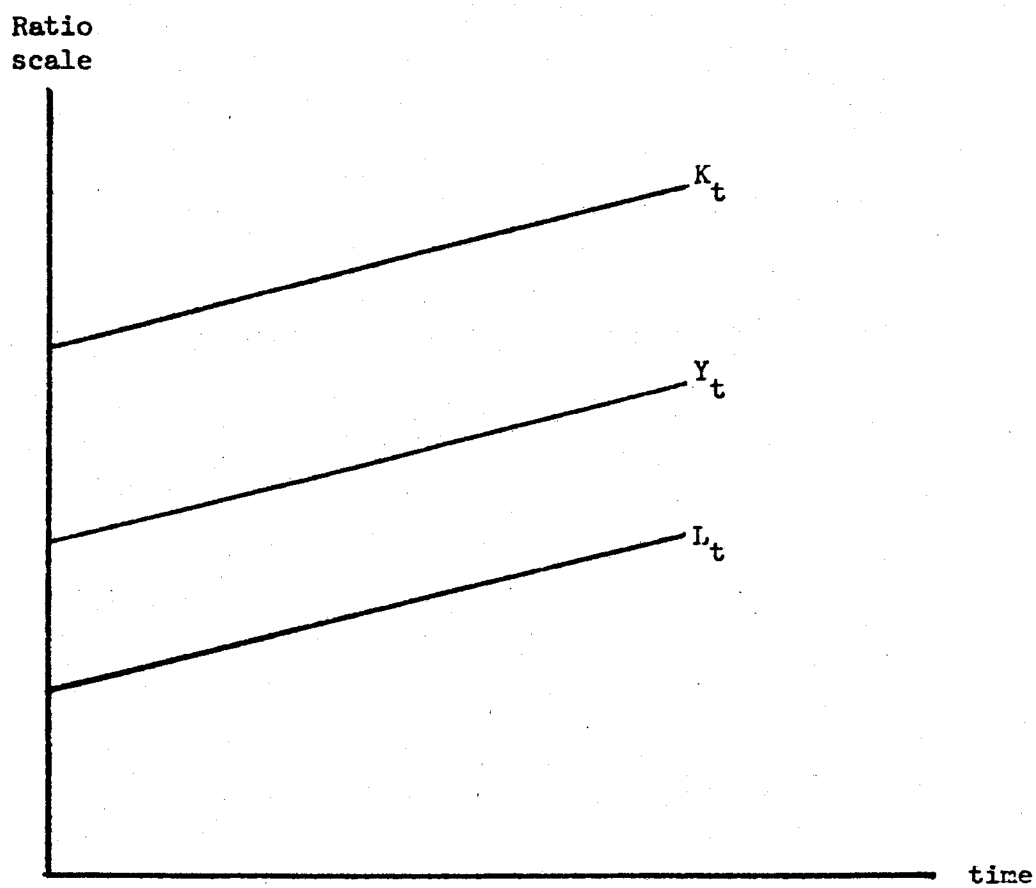


Figure 5.2

DEPICTION OF INCOME, CAPITAL STOCK, AND LABOR
SUPPLY GROWTH IN THE SIMPLE NEOCLASSICAL GROWTH MODEL



rate of labor to be affected except during the transitional period of rising retirement. So labor with social security is given by

(6) $\hat{L}_t = \lambda L_0 e^{gt}$,

where $\lambda < 1$.

If the saving-income ratio is not affected by social security ($\hat{\sigma} = \sigma$), the equilibrium described in Figure 5.1 is unchanged. In that case, since income and capital are proportional to labor, both are reduced in proportion to the fall in labor:

(7) $\hat{K}_t = \lambda K_t$;

(8) $\hat{Y}_t = \lambda Y_t$.

This result is illustrated in Figure 5.3 where the solid lines with social security are shifted down by equal amounts parallel to the dotted lines for the variables without social security.

If the saving-income ratio also falls ($\hat{\sigma} < \sigma$) as argued by Feldstein, the analysis is somewhat more complicated. Figure 5.4 shows that the fall in the saving-income ratio implies that the capital-labor ratio will also fall.6/ At the lower capital-labor ratio income per efficiency unit of labor will also fall. The growth rates of capital and income will be unaffected however, except during the period of adjustment to the new equilibrium.

For the United States, the capital stock per labor unit will fall by a greater percentage and income per labor unit by a smaller percentage than the fall in the saving income ratio.7/ If income per labor unit with social security is a fraction μ of what it would be without social security,8/ then the combined effect of the fall in the saving-income ratio and in labor supply on the long-run equilibrium values of capital stock and income is given by:

Figure 5.3

COMPARISON OF INCOME, CAPITAL STOCK, AND LABOR SUPPLY WITH AND WITHOUT SOCIAL SECURITY WITH NO SAVING-INCOME RATIO CHANGE

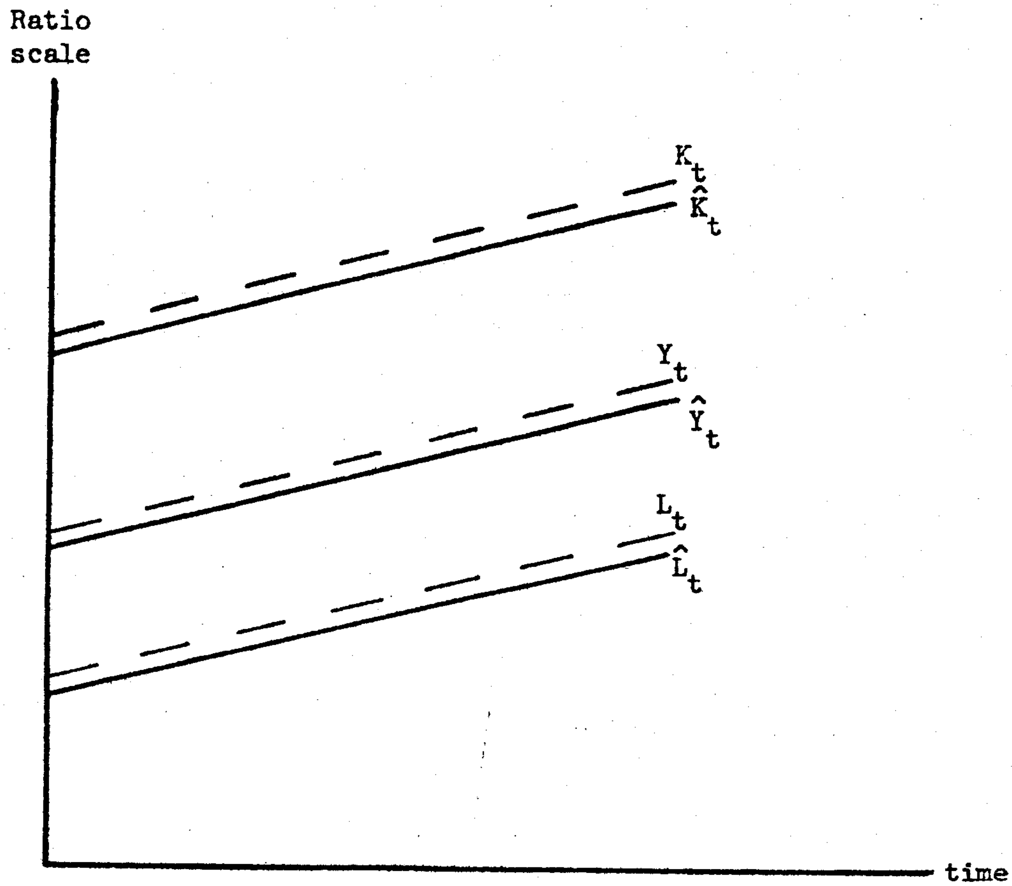
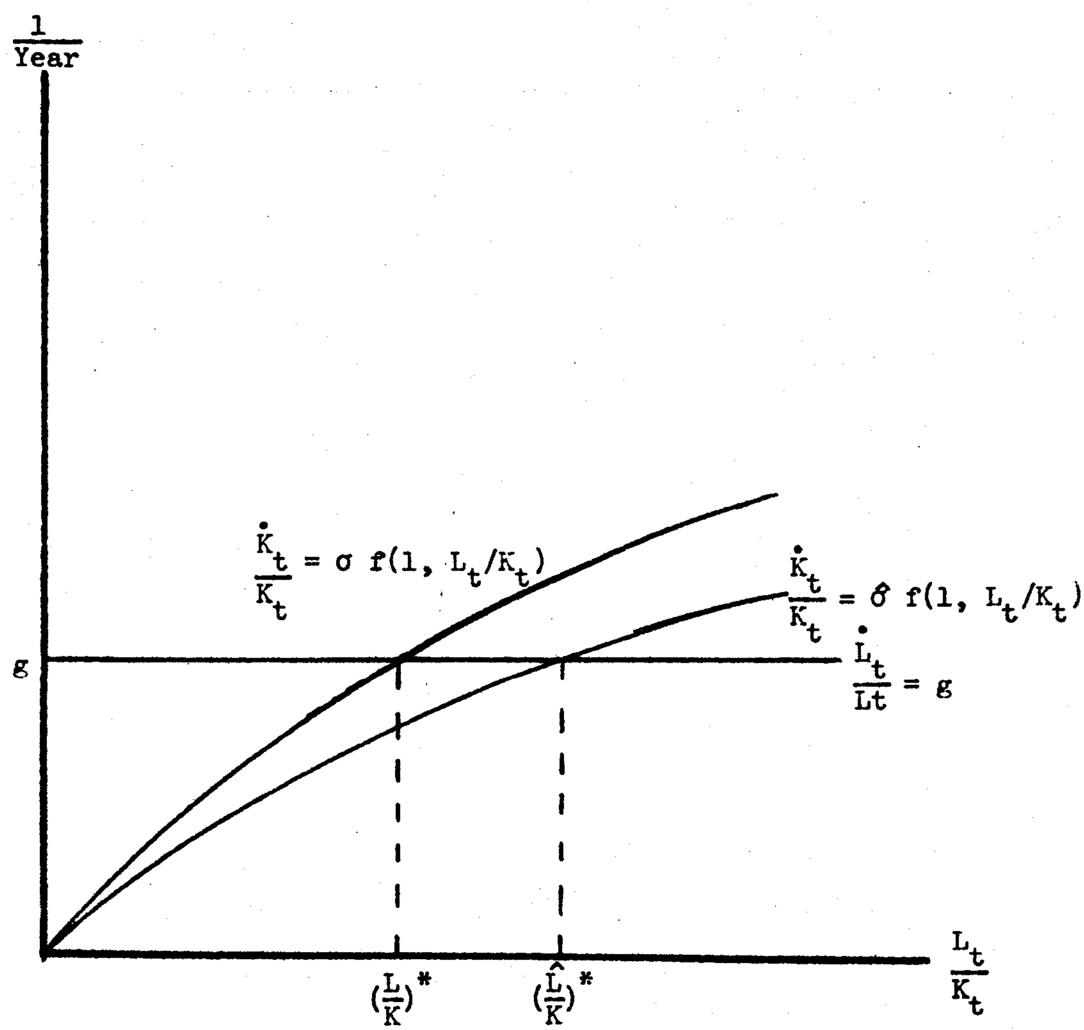


Figure 5.4

EFFECT OF SOCIAL SECURITY INDUCED FALL IN SAVING-INCOME RATIO ON THE LABOR-CAPITAL RATIO



(9) $\hat{K}_t = \frac{\hat{\sigma}}{\sigma} \mu\lambda K_t$;

(10) $\hat{Y}_t = \mu\lambda Y_t$.

So the capital stock falls more than in proportion to the fall in the saving-income ratio due to the fall in income resulting from reduced labor supply and capital stock. Figure 5.5 illustrates the alternative long-run equilibrium growth paths of the capital stock, income, and labor supply with and without social security for this case.

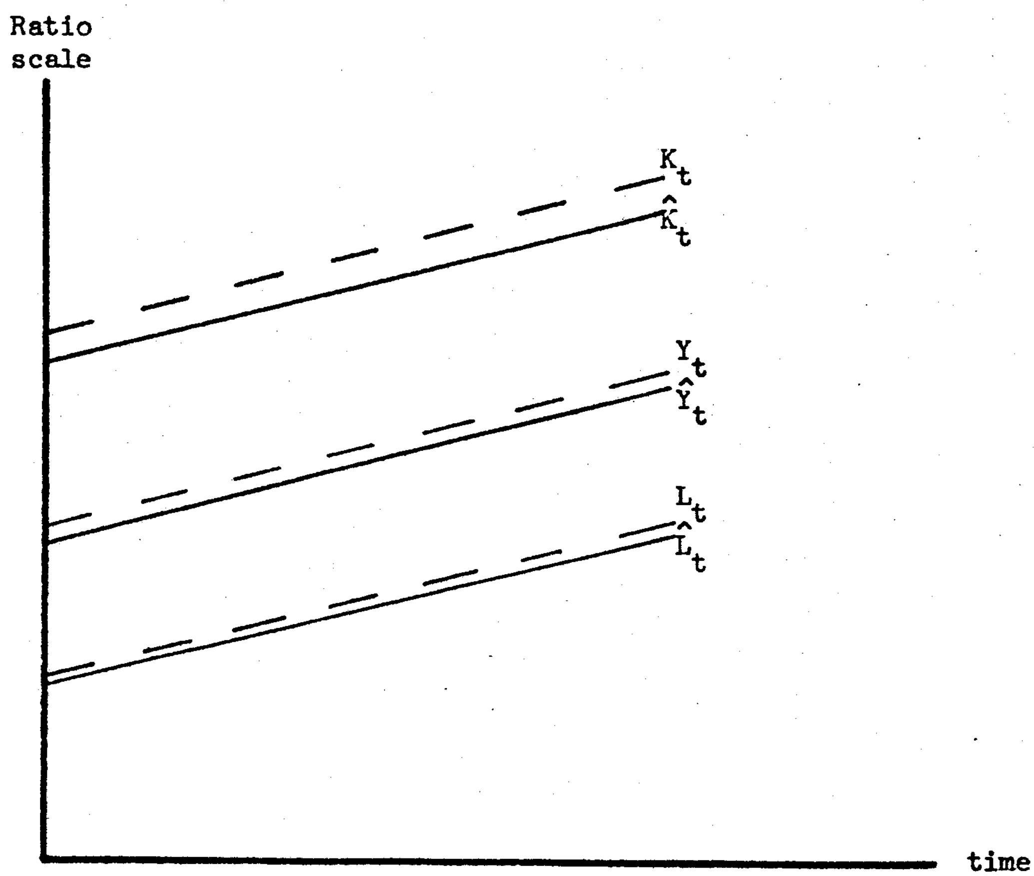
Alternative Closed-Economy Estimated Effects. The formulas derived above can be used to estimate the effects of social security in a closed economy.9/ Unfortunately there is no agreement on the appropriate reductions in labor supply and the saving-income ratio to be used in these calculations. So the calculations must be made for a range of alternative values suggested in the literature.

Estimates of labor force effects. The social security program may affect labor supply both through induced retirement and through change in preretirement labor supply. The limited research to date on labor supply effects has concentrated on estimating the magnitude of the induced retirement effect.

Michael Boskin 10/ has carried out a careful analysis of the effects of social security on retirement. His study shows the crucial impact of the very high implicit tax rate in the earnings test in inducing retirement. A naive reading of Boskin's regressions (in which increases in own or spouse's earnings reduce the probability of retirement) would suggest that the labor force participation of the elderly would have increased over time absent social security. However the negative coefficient on own earnings may be due to the operation of the earnings test in the cross-section sample. So Boskin's results

Figure 5.5

COMPARISON OF INCOME, CAPITAL STOCK, AND LABOR SUPPLY WITH AND WITHOUT SOCIAL SECURITY WITH SAVING-INCOME RATIO CHANGE



do tell us that social security accelerated the downward trend in labor force participation of elderly men, but give no reliable indication of by how much.

The recent survey article by Colin and Rosemary Campbell 11/ also found the weight of evidence to support the conclusion that OASI has accelerated the decline in labor force participation of elderly men. However the range of these effects is rather limited. Feldstein calculated that "if the labor force participation rates of those over 65 were at the 1930 values, the labor force in 1970 would be increased by less than 3 percent."12/

I have been unable to find any adequate published study of the effects of social security on preretirement labor supply.13/ The total effect of social security on preretirement labor supply combines four different effects: (1) A negative substitution effect arises because a dollar in social security taxes increases the present value of future benefits by much less than a dollar.14/ So net wages are reduced and leisure is cheaper. (2) To the extent that the lump-sum minimum benefit does not make up for the wealth loss in taxes paid, wealth is reduced and hence leisure reduced and labor supply increased. This positive wealth effect occurs if the real interest rate used in making life-cycle plans exceeds the implicit yield on social security (about 3½ percent per annum). (3) A positive wealth effect also results from the reduced income caused by induced retirement. (4) A positive intertemporal substitution effect may exist in which people substitute leisure during induced retirement for leisure during the preretirement years.

The third and fourth effects would tend to partially offset the reduction in labor supply due to induced retirement, but would leave a residual negative impact. The first and second effects can be thought of as the net effect of a partially lump-sum compensated wage reduction. It is usually argued that the supply of labor is backward-bending with respect to uncompensated wage changes;

that is, lower wages are associated with increased labor supply. The partial lump-sum compensation works in the opposite direction and there can be no presumption of a net decrease or increase in preretirement labor supply from the first two effects combined.

Overall, it would appear that the total labor supply effect of social security is a reduction somewhere in the range from 0 to 3 percent. This range is however subject to some question given the lack of evidence that the net preretirement effect is indeed small.

Estimates of saving-income ratio effects. The range of estimates of the effect of social security on the saving-income ratio range from Barro's 0 to Feldstein's 38 percent reduction. We saw in Chapter 4, however, that Feldstein's estimate went beyond his own figures and should probably have been about 26 percent. Munnell estimated a reduction of about 5 percent.15/ My own time series estimates suggest a reduction from 0 to 20 percent.

The empirical results to date have not come up with any clear cut answer. It appears probable — but not overwhelmingly so — that there has been some reduction in the saving-income ratio. There is almost no evidence to support a 30 to 40 percent reduction a la Feldstein. For the calculations, we will consider the following percentage reductions in σ: 0, 2.5, 5.0, 7.5, 10.0, 15.0, 20, 26, and 38 where the range from 0 to 10 percent is probably the most interesting.

Combined effects. The combined closed-economy effects of labor supply and saving-income ratio reductions for income and the capital stock are given in Tables 5.1 and 5.2 respectively.16/ Table 5.1 indicates that plausible induced reductions in the saving-income ratio have substantial effects on real income in the closed economy case.

These income effects are substantial given that OASI benefits are about 4 percent of NNP. Suppose for example the saving-income ratio falls from

Table 5.1

PERCENTAGE REDUCTIONS IN THE CLOSED-ECONOMY REAL INCOME ON ALTERNATIVE SAVING AND LABOR SUPPLY ASSUMPTIONS

Percentage Reduction in the Saving-Income Ratio	Percentage Reduction in Labor Supply		
	0.0	1.5	3.0
0.0	0.0	1.5	3.0
2.5	0.8	2.3	3.8
5.0	1.7	3.1	4.6
7.5	2.5	4.0	5.4
10.0	3.3	4.8	6.2
15.0	5.0	6.4	7.9
20.0	6.7	8.1	9.5
26.0	8.7	10.0	11.4
38.0	12.7	14.0	15.3

Sources: See text.

Table 5.2

PERCENTAGE REDUCTIONS IN THE CLOSED-ECONOMY CAPITAL STOCK ON ALTERNATIVE SAVING AND LABOR SUPPLY ASSUMPTIONS

Percentage Reduction in the Saving-Income Ratio	Percentage Reduction in Labor Supply		
	0.0	1.5	3.0
0.0	0.0	1.5	3.0
2.5	3.3	4.8	6.2
5.0	6.6	8.0	9.4
7.5	9.8	11.2	12.5
10.0	13.0	14.3	15.6
15.0	19.2	20.5	21.7
20.0	25.3	26.5	27.6
26.0	32.4	33.4	34.4
38.0	45.9	46.7	47.5

Sources: See text.

0.111 to 0.100 due to social security, a 10 percent reduction. This would imply a fall in income of 3.3 to 6.2 percent and a fall in total and per capita consumption of 2.3 to 5.2 percent. The latter calculation takes into account the higher (private and government) consumption implied by the lower saving-income ratio. Partially offsetting the reduction in consumption would be the value of the "forced" leisure represented by the induced reduction in the labor supply.

As can be seen in Table 5.2, the interaction of reductions in income, capital stock, and labor supply result in rather larger reductions in capital stock than would be predicted from looking at the fall in the saving-income ratio alone. Plausible values of social security effects yield substantial reductions -- say 5 to 20 percent -- in the closed-economy capital stock, but these reductions are rather smaller than Feldstein's original estimate.

The Case of a Small Open Economy

The other polar case is that of the small open economy in which capital flows freely to and from the rest of the world. For the world as a whole the neo-classical growth model would be applicable with only minor modifications. That is, the world saving-income ratio, growth rate of labor, and aggregate production function would determine an equilibrium capital-labor ratio. Capital would flow from countries with relatively high saving-income ratios to those with relatively low saving-income ratios so as to equate the returns to capital and labor (measured in efficiency units) throughout the world. 17/ The amount of capital used in any country would be proportional to the amount of labor there.

Now consider the effects of social security in a small open economy in such a world. 18/ The country is small and so any reduction in its saving-income ratio would have a negligible effect on the world supply of saving or the capital-labor ratio. So the capital stock within the country would fall only in proportion to the induced fall in labor supply. The effect of any reduction in the saving-income ratio would be to reduce the amount of capital owned by residents of the country whether that capital is located at home or abroad. A sufficient fall might change the nation from net creditor to net debtor status, for example.

A Formal Analysis. It is necessary to distinguish between (1) the output produced by factors located within the country regardless of by whom owned or net domestic product (NDP) and (2) the income received by the country's residents regardless of where earned or net national product (NNP). Continue to denote total income (NNP) by Y_t but output (NDP) will be denoted by Q_t. Y_t differs from Q_t by the yield on net foreign securities held or rF_t. 19/

The ratio of output to labor is fixed in this case by the constant world capital-labor ratio. 20/ So the introduction of social security would reduce long-run equilibrium capital and output in proportion to the fall in labor supply regardless of any saving-income ratio effects.

(11) $\hat{K}_t = \lambda K_t.$

(12) $\hat{Q}_t = \lambda Q_t.$

The long-run equilibrium level of income and the total amount of capital $(K_t + F_t)$ owned by the country's residents would be affected further if the saving-income ratio fell. Again using μ for the ratio of income per labor unit with social security to income per labor unit without social security, 21/ the combined effect on owned capital and income is given by:

(13) $\hat{K}_t + \hat{F}_t = \frac{\hat{\sigma}}{\sigma}\mu\lambda(K_t + F_t);$

(14) $\hat{Y}_t = \mu\lambda Y_t.$

Summing up, the capital stock used and output produced in the economy fall only in proportion to any induced fall in labor supply in the small open economy. The capital stock owned and income received by residents of the country fall further, however, if the saving-income ratio is reduced by social security.

Combined open-economy effects. Total (and per capita) output and capital stock used fall in proportion to the induced reduction in capital stock. This was estimated above at between 0 and 3 percent.

Total (and per capita) income and capital stock owned falls further as indicated by equations (13) and (14) above. Tables 5.3 and 5.4 compute the approximate effects implied by various combinations of induced labor supply and saving-income ratio reductions. The calculations are based on U.S. values of the parameters and an assumed real interest rate of 3 percent per annum. 22/

Table 5.3

PERCENTAGE REDUCTIONS IN THE SMALL-OPEN-ECONOMY REAL INCOME ON ALTERNATIVE SAVING AND LABOR SUPPLY ASSUMPTIONS

Percentage Reduction in the Saving-Income Ratio	Percentage Reduction in Labor Supply		
	0.0	1.5	3.0
0.0	0.0	1.5	3.0
2.5	0.3	1.8	3.3
5.0	0.5	2.0	3.5
7.5	0.8	2.3	3.8
10.0	1.1	2.6	4.0
15.0	1.7	3.1	4.6
20.0	2.3	3.8	5.2
26.0	3.2	4.6	6.1
38.0	5.2	6.6	8.1

Sources: See text.

Table 5.4

PERCENTAGE REDUCTIONS IN THE SMALL-OPEN-ECONOMY OWNED CAPITAL STOCK ON ALTERNATIVE SAVING AND LABOR SUPPLY ASSUMPTIONS

Percentage Reduction in the Saving-Income Ratio	Percentage Reduction in Labor Supply		
	0.0	1.5	3.0
0.0	0.0	1.5	3.0
2.5	2.7	4.2	5.7
5.0	5.5	6.9	8.3
7.5	8.2	9.6	10.1
10.0	11.1	12.3	13.6
15.0	16.4	17.7	18.9
20.0	21.9	23.0	24.2
26.0	28.3	29.4	30.5
38.0	41.2	42.1	43.0

Sources: See text.

Table 5.3 indicates that income would be reduced somewhat less than under similar conditions in a closed economy. For example a 10 percent reduction in the saving-income ratio reduces income per unit of labor by 1.1 percent versus the 3.3 percent reduction indicated in Table 5.1 for the closed economy case. Further, this result is dependent on the interest rate used. At 3 percent per annum, the fall in income due to a lower owned capital stock is relatively trivial. At higher interest rates the loss is higher. For example, the same 10 percent reduction in the saving-income ratio would cause a 4.1 percent reduction in open-economy income at a 9 percent interest rate. Of course higher interest rates imply smaller values of net social security wealth and therefore smaller reductions in the saving-income ratio.

The fall in the owned capital stock is also smaller than the fall in the owned (and used) capital stock in the closed economy case. Continuing our numerical example, the open-economy reduction in owned capital per unit of labor is 11.1 percent versus 13.0 percent for the closed economy case. Again the results are dependent on the interest rate used, since the same 10 percent reduction in the saving-income ratio would cause a 13.7 percent fall in the open-economy owned capital-labor ratio on a 9 percent interest rate. Again a higher interest rate would be associated with a smaller saving-income ratio reduction, however.

Summing up the Combined Effects for the U.S.

The United States falls somewhere between the two polar cases of a closed economy and a small open economy. The capital stock used and output produced in the United States therefore would fall more than in proportion to the induced fall in the labor supply if the saving-income ratio is also reduced. But this fall would be less than the reduction in the capital stock owned by and income of U.S. residents because part of the effect of the saving-income ratio fall is to reduce net U.S. holdings of foreign securities.

The combined effect of social security on the owned capital stock probably lies in the range of a 5 to 20 percent reduction. The used capital stock is arguably not reduced at all, but a decrease up to 15 percent would not be implausible. The corresponding reductions in income and output range from 7 to 2 and 0 to 4 percent, respectively. These broad ranges reflect the inconclusive state of empirical research on social security.

FOOTNOTES TO CHAPTER 5

1/ For more complete expositions of this model, see Robert M. Solow, Growth Theory: An Exposition (Oxford: Oxford University Press, 1970), pp. 1-38; or Michael R. Darby, Macroeconomics: The Theory of Income, Employment, and the Price Level (New York: McGraw-Hill Book Co., 1976), pp. 112-21.

2/ Note that government and private accounts are consolidated so that σ is the fraction of income available to finance investment.

3/ Note that $Y_t/L_t = f(K_t/L_t, 1)$ so the $(K/L)^* \equiv 1/(L/K)^*$ determines a unique equilibrium income-labor ratio $(Y/L)^*$.

4/ Such a ratio or logarithmic scale has the convenient property that variables growing at a constant proportional rate are depicted as straight lines.

5/ This growth rate is indicated by the (identical) slopes of the variables' growth paths. Note that per-capita income grows to the extent that the growth rate of labor measured in efficiency units exceeds the growth rate of population.

6/ That is, the labor-capital ratio will rise.

7/ For small changes in σ, a given growth path of labor, and denoting labor's share of total income as α, it can be shown: (1) that the capital stock falls by x/α percent if the saving-income ratio falls by x percent ($\frac{d \log K}{d \log \sigma} = 1/\alpha$); and (2) that real income falls by $x(\frac{1}{\alpha} - 1)$ percent if the saving-income ratio falls by x percent ($\frac{d \log Y}{d \log \sigma} = \frac{1}{\alpha} - 1$). For the United States α is about 0.75; so a 10 percent decline in σ (say from 0.10 to 0.09) would cause the capital stock per labor unit to fall by about 13 1/3 percent and real income to fall by about 3 1/3 percent.

8/ Carrying forward the argument of footnote 7 above, μ would be approximated by $1 + \frac{\hat{\sigma} - \sigma}{\sigma} (\frac{1}{\alpha} - 1)$ for small changes in σ. If in fact $\hat{\sigma} = \sigma$, $\mu = 1$ and equations (9) and (10) reduce to equations (7) and (8)

9/ A degree of approximation is introduced by computing μ as indicated in footnote 8 above for other than small changes in σ. This would not seem to be a serious problem since the U.S. aggregate production function seems to be well approximated by the Cobb-Douglas form $Y = A\, K_t^{(1-\alpha)}\, L_t^{\alpha}$ where labor's share α is constant and about 0.75.

10/ Michael J. Boskin, "Social Security and Retirement Decisions," Economic Inquiry, vol. 15 (January 1977), pp. 1-25.

11/ Colin D. Campbell and Rosemary G. Campbell, "Conflicting Views on the Effect of Old-Age and Survivors Insurance on Retirement," Economic Inquiry, vol. 14 (Sept. 1976), pp. 369-88.

12/ Feldstein, "Social Security and Capital Accumulation," p. 924. Since the elderly appear to have below the population average in labor efficiency units per capita, this is probably a doubly safe upper limit on the reduction in labor supply due to induced retirement.

13/ Michael Boskin, Michael Herd, and Lawrence Lau of Stanford are presently engaged in a major study of labor supply effects of social security, but no results are yet available.

14/ This results from the large welfare element in the minimum benefit which is received by everyone who pays a trivial amount of taxes for forty quarters.

15/ Munnell, "Impact on Personal Savings," p. 562. Munnell estimated a \$2.9 billion reduction in personal saving for 1969. It is assumed that this reduction is reflected in private saving of \$53.4 billion for 1969.

16/ For these calculations it is assumed that labor's share α is 0.75.

17/ Saving-income ratios however are presumably based on income inclusive of returns on foreign investments or net of foreign loans. This complicates the determination of the equilibrium as the world saving-income ratio is endogenous.

18/ References on growth in open economies are James A. Hanson and Phillip A. Neher, "The Neoclassical Theorem Once Again: Closed and Open Economies," American Economic Review, vol. 57, (September 1967), pp. 869-79; and Phillip A. Neher, Economic Growth and Development: A Mathematical Introduction (New York: John Wiley & Sons, 1971), pp. 257-82.

19/ If the nation were a net debtor, F_t would be negative and income would be less than output due to net interest payments to foreigners.

20/ See note 3 above.

21/ For small changes in σ and a given growth path of labor it can be shown: (1) that the owned capital stock falls by $x(1 + \frac{\sigma r}{g-\sigma r})$ percent if the saving-income ratio falls by x percent $(\frac{d\log(K+F)}{d\log\sigma} = 1 + \frac{\sigma r}{g-\sigma r})$; and (2) that real income falls by $x\frac{\sigma r}{g-\sigma r}$ percent if the saving-income ratio falls by x percent $(\frac{d\log Y}{d\log\sigma} = \frac{\sigma r}{g-\sigma r})$. If we take g as .0325 per annum and σ as about 0.1, then a 10 percent decline in σ would cause owned capital to fall by 11.0, 12.3, or 13.8 percent according to whether a 3, 6, or 9 percent per annum interest rate r is assumed. The corresponding reductions in income are 1.0, 2.3, or 3.8 percent respectively.

22/ That is, g is assumed to be 0.0325, $\hat{\sigma}$ is approximated by 0.10 (government and private saving rates thus taken as equal, and σ is implied by the assumed percentage reduction. The value of μ is calculated as $\mu = 1 - \frac{\sigma-\hat{\sigma}}{\sigma}(\frac{\bar{\sigma}r}{g-\bar{\sigma}r})$ where $\bar{\sigma} = (\sigma + \hat{\sigma})/2$.

From Michael R. Darby, The Effects of Social Security on Income and the Capital Stock. Not for quotation without the author's permission.
D 1: July 7, 1977

Chapter 6

CONCLUSIONS

The research reported in this monograph emphasizes the complex nature and uncertain magnitudes of the effects of social security on the capital stock and income. Nonetheless some substantial progress has been made.

First we have seen that the zero-bequest life-cycle model is inadequate to explain aggregate saving and capital holdings. The bulk of capital is held and net saving made in anticipation of bequests. Saving for bequests, relative to income, falls due to social security only to the extent that the forced "purchase" of a life annuity is in excess of what would otherwise be purchased and so reduces the precautionary value of bequest assets.

Social security however may also have had a sufficiently large effect on life-cycle saving that total saving (for a given income) is reduced by a significant amount. In fact, the largest possible reduction in life-cycle saving is rather large relative to total saving -- some 23 to 12 percent depending on the interest rate -- although rather less than Feldstein's original 38 percent reduction. This maximum reduction would be offset by effects of induced retirement, the low effective yield on social security, and uncertainty of benefits.

Since the retirement effect alone would apparently swamp any reduction in bequest saving relative to income, it is likely that the reduction in the private saving-income ratio is no more than 10 to 20 percent. Time series estimates of the effect of social security on saving imply a reduction ranging from 0 to about 25 percent, including Feldstein's own regressions on reexamination. The higher estimates are dependent however on the functional form and time period used in estimation in a way which suggests upward bias. So it is concluded that the range from 0 to 10 is more plausible than 10 to 20 percent for the actual reduction in the saving-income ratio due to social security.

A second finding of this study is that the relatively internationally open U. S. capital market requires distinction between the capital stock owned by U. S. residents wherever located and that used in the U. S. by whomever owned. Similarly the income of U. S. residents (NNP) must be distinguished from U. S. output (NDP). In long-run equilibrium, capital owned and income received by U. S. residents are more greatly reduced by reductions in the saving-income ratio and labor supply than are capital used and output produced in the U. S., respectively.

Calculations of the long-run equilibrium effects suggest that owned capital is reduced from 5 to 20 percent and used capital from 0 to 15 percent. The corresponding reductions in income and output range from 2 to 7 and 0 to 4 percent, respectively.

In 1974, OASI taxes and benefits were a bit less than 5 percent of NNP. Therefore the estimates suggest a total tax plus lost income burden of $1.40 to $2.40 for each dollar of OASI benefits. Offsetting this excess burden would be any value of the increased leisure implicit in the induced retirement and rise in consumption relative to income.

A Cautionary Note. It is deceptively easy to look at the implied reductions in capital and income and conclude that something must be done to the social security program. This involves two giant steps over unresolved questions: (1) Is the reduction in capital and income good or bad? (2) If it is bad, are changes in the social security program the best way to eliminate these reductions? This study does not provide answers to either of these questions although it might be used in their analysis.

Martin Feldstein has rightly pointed out that the welfare implications of capital stock reductions induced by social security cannot be analyzed in isolation. 1/ The central issue is whether the aggregate capital stock is too small or too large. Whether social security reduces the capital stock is of interest primarily as to whether it is a possible policy tool to increase (or decrease) a presently too small (large) capital stock.

Proposals to fund the social security system over a short period of time are nothing more than proposals to run a large government surplus and so induce "forced saving." 2/ There is no obvious reason why this surplus -- if desired -- should be tied to social security or why doing so would in any way alter its effects on the amount available to finance investment in capital goods.

Policy tools alternative to a government surplus are available to encourage private saving and investment. Tax law changes would be an example of such alternatives which would have to be considered in an analysis of policy aimed at increasing the capital stock.

It would seem that other issues -- such as the effect on the economic well-being of the elderly, the burden of the taxes, the forced participation, and induced retirement -- are basic to any evaluation of the social security system.

Footnotes to Chapter 6

1/ Martin S. Feldstein, "Does the United States Save Too Little?," American Economic Review, Papers and Proceedings, vol. 67 (February 1977), pp. 116-121.

2/ The idea is that if private saving falls by less than the increase in taxes to finance the surplus, the amount available to finance private investment will increase. It is not a settled issue in the literature whether this does or does not occur in fact.

BIBLIOGRAPHY

Aaron, Henry. "Social Security: International Comparisons." In Studies in the Economics of Income Maintenance, edited by Otto Eckstein. Washington: The Brookings Institution, 1967.

Ando, Albert, and Modigliani, Franco. "The 'Life Cycle' Hypothesis of Saving: Aggregate Implications and Tests." American Economic Review. March 1963, 53: 55-84.

Barro, Robert J. "Social Security and Private Saving -- Evidence from the U.S. Time Series." unpublished paper. University of Rochester, April 1977.

______. "Are Government Bonds Net Wealth?" Journal of Political Economy. July/August, 82: 1095-1117.

Blinder, Alan S. "Intergenerational Transfers and Life Cycle Consumption." American Economic Review, Papers and Proceedings. May 1976, 66: 87-93.

Boskin, Michael J. "Social Security and Retirement Decisions." Economic Inquiry. January 1977, 15: 1-25.

Browning, Edgar K. "Social Insurance and Intergenerational Transfers." Journal of Law and Economics. October 1973, 16: 215-37.

Campbell, Colin D. and Campbell, Rosemary G. "Conflicting Views on the Effect of Old-Age and Survivors Insurance on Retirement." Economic Inquiry. September 1976, 14: 369-88.

Cass, David, and Yaari, Menahem E. "Individual Saving, Aggregate Capital Accumulation, and Efficient Growth." In Essays on the Theory of Optimal Growth, edited by Karl Shell. Cambridge: MIT Press, 1967.

Darby, Michael R. "The Consumer Expenditure Function." Explorations in Economic Research, forthcoming.

______. Macroeconomics: The Theory of Income, Employment, and the Price Level. New York: McGraw-Hill Book Co., 1976.

______. "Review of The Effect of Social Security on Personal Saving by Alicia Haydock Munnell." Journal of Finance. March 1976, 31: 186-87.

______. "Postwar U.S. Consumption, Consumer Expenditures, and Saving." American Economic Review, Papers and Proceedings. May 1975, 65: 217-222.

______. "The Permanent Income Theory of Consumption -- A Restatement." Quarterly Journal of Economics. May 1974, 88: 228-50.

David, Paul A., and Scadding, John L. "Private Savings: Ultrarationality, Aggregation, and 'Dennison's Law'." Journal of Political Economy. March/April 1974, 82: 225-49.

Eisner, Robert. "Capital Shortage: Myth and Reality." American Economic Review, Papers and Proceedings. February 1977, 67: 110-15.

Feldstein, Martin. "Does the United States Save Too Little?" American Economic Review, Papers and Proceedings. February 1977, 67: 116-121.

______. "Facing the Social Security Crisis." Harvard Institute of Economic Research Discussion Paper. Number 492, July 1976.

______. "Social Security, Induced Retirement, and Aggregate Capital Accumulation." Journal of Political Economy. September/October 1974, 82: 905-26.

______. "Social Security and Private Savings: International Evidence in an Extended Life Cycle Model." Harvard Institute of Economic Research Discussion Paper. Number 361, May 1974.

______. "Social Security and Saving: The Extended Life Cycle Theory." American Economic Review, Papers and Proceedings. May 1976, 66: 77-86.

Friedman, Milton, and Schwartz, Anna J. A Monetary History of the United States, 1867-1960. National Bureau of Economic Research Studies in Business Cycles 12. Princeton: Princeton University Press, 1963.

Ghez, Gilbert R., and Becker, Gary S. The Allocation of Time and Goods over the Life Cycle. New York: National Bureau of Economic Research, 1975.

Greville, Thomas N. E. United States Life Tables and Actuarial Tables 1939-1941. Washington: U. S. Government Printing Office, 1946.

Hanson, James A., and Neher, Phillip A. "The Neoclassical Theorem Once Again: Closed and Open Economies." American Economic Review. September 1967, 57: 869-79.

Heckman, James J. "A Life-Cycle Model of Earnings, Learning and Consumption." Journal of Political Economy. March/April 1974, 84: S11-S44.

Kendrick, John W. Productivity Trends in the United States. National Bureau of Economic Research General Series 71. Princeton: Princeton University Press, 1961.

Kochin, Levis A. "Are Future Taxes Anticipated by Consumers?" Journal of Money, Credit, and Banking. August 1974, 6: 385-94.

Kotlikoff, Laurence J., Chamby, Christopher, and Pellechio, Anthony. "Social Security and Private Wealth Accumulation." unpublished paper. Harvard University, November 1976.

Leijonhufvud, Alex. "Effective Demand Failure." Swedish Journal of Economics, No 1(1973), 75: 27-48.

Long, Clarence D. The Labor Force Under Changing Income and Employment. National Bureau of Economic Research General Series 65. Princeton: Princeton University Press, 1958.

Modigliani, Franco. "The Life Cycle Hypothesis of Saving, the Demand for Wealth, and the Supply of Capital." Social Research. June 1966, 33: 160-217.

______, and Brumberg, Richard. "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data." In Post Keynesian Economics, edited by K. E. Kurihara. New Brunswick: Rutgers University Press, 1954.

Munnell, Alicia H. The Effect of Social Security on Personal Saving. Cambridge: Ballinger Publishing Co., 1974.

______. The Future of Social Security. Washington: The Brookings Institution, 1977.

______. "The Impact of Social Security on Personal Savings." National Tax Journal. December 1974, 27: 553-67.

Neher, Phillip A. Economic Growth and Development: A Mathematical Introduction. New York: John Wiley and Sons, 1971.

Pechman, Joseph A., Aaron, Henry J., and Taussig, Michael K. Social Security: Perspectives for Reform. Washington: The Brookings Institution, 1968.

Samuelson, Paul A. "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money." Journal of Political Economy. December 1958, 66: 467-82.

______. "The Optimal Growth Rate for Population." International Economic Review. October 1975, 16: 531-38.

______. "Optimal Social Security in a Life-Cycle Growth Model." International Economic Review. October 1975, 16: 539-44.

Smith, James P. "Assets, Savings, and Labor Supply." Economic Inquiry. forthcoming.

Solow, Robert M. Growth Theory: An Exposition. Oxford: Oxford University Press, 1970.

Thompson, Earl A. "Debt Instruments in Both Macroeconomic Theory and Capital Theory." American Economic Review. December 1967, 57: 1196-1210.

Tobin, James. "Life Cycle Saving and Balanced Growth." In Ten Economic Studies in the Tradition of Irving Fisher, by William Fellner et al. New York: John Wiley and Sons, 1967.