Volume Title: Financial Aspects of the United States Pension System

Volume Author/Editor: Zvi Bodie and John B. Shoven, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-06281-3

Volume URL: http://www.nber.org/books/bodi83-1

Publication Date: 1983

Chapter Title: On Consumption Indexed Public Pension Plans

Chapter Author: Robert C. Merton

Chapter URL: http://www.nber.org/chapters/c6035

Chapter pages in book: (p. 259 - 290)

10 On Consumption Indexed Public Pension Plans

Robert C. Merton

10.1 Introduction

Most economists using a standard life-cycle analysis would probably agree that the primary objective of a pension system is to provide a standard of living in retirement comparable to that enjoyed during the working years. Nevertheless, there is considerable disagreement on how that objective can best be achieved. Broadly, the disagreements are on the appropriate roles for private pension plans and a public pension plan in the pension system and on whether or not the pension system should also be used for redistribution or transfers. The most elegant approach to the problem would undoubtedly be to solve for the optimal overall pension system with a simultaneous determination of the optimal forms for both public and private parts. However, the analysis here is more limited in its scope because its focus is principally on the public part of the system and because it examines only one of the many possible functions that such a system might serve in any real-world implementation. That is, the sole intent of the system is assumed to be the retirement objective and not, for example, also to redistribute wealth. This chapter should thus be viewed as only a prologue to a more complete functional analysis of the overall pension system, including the important issue of the degree of integration between private and public pension plans.

Robert C. Merton is professor of finance at the Sloan School of Management, Massachusetts Institute of Technology, and research associate of the National Bureau of Economic Research.

Aid from the National Bureau of Economic Research and the National Science Foundation is gratefully acknowledged. My thanks to F. Black, S. Fischer, D. Holland, L. Summers, and L. Thurow for many helpful discussions and to L. Summers for providing me with the data for table 10.1. Any opinions expressed are mine and are not necessarily those of my helpful colleagues, NBER, or NSF.

Analysis of the public part of the system is a natural starting place because, whatever form the overall pension system takes, it will surely include a significant public pension plan component. As I shall discuss, there are a number of theoretical arguments to support such a component as part of an optimal system. Moreover, as a practical matter independent of any theoretical welfare arguments that economists might provide to the contrary, the public pension system in the United States, after almost half a century of operating experience, is not going to be eliminated, especially when a significant fraction of the population is not covered by any private pension plan. The current problems with social security do, however, present the possibility for major changes in the structure of the public pension system. It would therefore seem to be somewhat difficult to analyze the optimal design of private pension plans and the associated issue of integration until the structure of the public system is more firmly established.

In theory, the characteristic differences between a public and a private pension system are that participation in a public system is mandatory and that the public system cannot be "custom tailored" to meet the specific preferences of each individual participant. Such a clear distinction is valid if the private system were solely laissez-faire individual saving. However, as the private system has evolved, the operational significance of this distinction, at least at the level of analysis presented here, is less clear. Participation in most existing private pension plans is virtually mandatory. In a typical defined-contribution plan, individual choice of amounts contributed and where the funds are invested is quite limited, and in defined-benefit plans there is typically no choice at all. Therefore, the analysis presented here in the context of a public system is readily adaptable to an organized private pension system.

The arguments for a public pension system with mandatory participation fall into two basic categories: externalities and private market failure. An important example of the former is the utility externality that other people's welfare is one of the arguments of individual utility functions. That is, people care about others and, among other things, will not let them starve in retirement. From this, we get a classical example of the free-rider problem, which cannot be solved by the private markets but can be solved by an appropriately designed mandatory public pension system. A second example is the possibility of economies of scale in information costs. Virtually everyone faces the decision of how much to save for retirement and where to invest those savings during the working years. The marginal cost of obtaining the education and gathering the necessary data to make informed decisions, as well as the time spent implementing these decisions, will vary substantially across individuals as a function of their prior education and their wealth. (Presumably, a professor of finance by virtue of his training would have a lower marginal

cost than a professor of physics.) The cost of buying the service of informed decisions will be lower (as a percentage of wealth) for those who are wealthy than for those of modest means. While such costs could be reduced by pooling, this solution almost assumes away the problem because pooling requires adequate information and opportunity to form a cohesive group.

If, therefore, a pension plan were designed which reasonably approximated the plan which most individuals would choose if they were informed, then by making participation in the plan mandatory the resources used in individual education and data gathering would be saved and the maximum benefits of pooling to reduce operating costs could be achieved. The benefits of such mandatory participation must, of course, be compared to the cost in terms of loss in individual freedom of choice. As already noted, existing private pension plans permit little choice. Although this data point favors the hypothesis that the benefits outweigh the costs, it is hardly a sufficient basis for a policy decision.

The second basic category of arguments for a public pension plan is that the efficiency of risk bearing can be improved. That is, the government can provide diversification possibilities which are not available in the private markets and thereby issue financial instruments, which the private sector cannot. One example would be intergenerational risk sharing, which cannot be covered by private markets (see Fischer 1982). Another would be to use either taxes and transfers (see Merton 1981) or taxes and the issue of securities within the pension system to provide diversification of some of the risks of assets which are not tradable (as is the case for much of human capital).

With these general reasons for a public pension plan as background, I shall summarize briefly the consumption indexed plan to be studied before turning to a formal analysis in the context of a simple intertemporal equilibrium model in section 10.2. In section 10.3, I discuss the merits and feasibility of such plans.

The plan is a mandatory fully funded savings plan of the defined-contribution type wherein required contributions by each member of the plan are a fixed proportion of that member's consumption. As with current private defined-contribution plans, each member has an individual account which is credited with his contributions (less any deduction for operating expenses of the plan).

Contributions and earnings in each member's account are invested in aggregate per capita consumption indexed life annuities, defined to be an instrument that pays a constant fraction of aggregate per capita consumption to its holder (the member) each period, such payments beginning at a prespecified date (the date at which the member begins to receive his benefits) and continuing until the member dies. If the member dies before the commencement date, the annuity is worthless. Benefits, there-

fore, are in the form of a life annuity indexed to aggregate per capita consumption.

The commencement date for benefits is at a specifiied age (e.g., age 60), whether or not the recipient has retired. This provision is to avoid possibly undesirable distortions of the decision to retire. However, provision could be made for delaying the receipt of benefits to a later age. Contributions are mandatory from some statutory beginning age (e.g., age 21) until the commencement date.

One way to administer such a plan would be to create a public corporation which would be responsible for issuing the indexed life annuities to plan members where these annuities would constitute its senior liabilities. The United States government would be the residual liability or equity holder of the corporation and would have unlimited liability. The assets of the corporation would come from member contributions and be invested in the broadest available portfolio of marketable securities.

The number of units of life annuities issued to an account is on a "mark-to-market" basis at the time each contribution is received. That is, the value of a unit of a life annuity issued is determined by current market prices and mortality tables. To make this possible, it would be necessary for the government to issue aggregate per capita consumption indexed bonds of various maturities.

To prevent attempts to circumvent mandatory participation in the plan, retirement benefits are assumed to be neither assignable nor attachable. For similar reasons, integration of private pension plans with the public plan are permitted, but only to the extent that the combined benefits received by the individual are no less than he would have received from the public plan alone.

10.2 A Simple Intertemporal Equilibrium Model

In this section, a continuous-time consumption choice model of the type presented by Merton (1971, 1973) is used to analyze the system of mandatory saving and consumption linked retirement benefits.

Consider an economy where all people have the same lifetime utility of consumption which is given for a person born at time t_0 by

$$(1) \qquad E_{t_0}\left\{\int_{t_0}^{t_0+\tilde{\tau}} \frac{[c(s;s-t_0)]^\gamma}{\gamma} e^{-\rho(s-t_0)}\,ds\right\}, \gamma<1,$$

where $c(t;\tau)$ is consumption at time t of a person of age τ and E_t is the conditional expectation operator conditional on knowing all relevant information available at time t. Each person has an uncertain lifetime where $\tilde{\tau}$ denotes the random variable age of death, and the probability

that the person will die between τ and $\tau + d\tau$, conditional on being alive at age τ, is given by $\lambda(\tau)d\tau$ where $\dot{\lambda}(\tau) > 0$. Each individual acts so as to maximize (1) subject to his initial wealth w_0.

If the event of death is independent of other economic variables, then, along the lines of the proof of Theorem VI in Merton (1971, p. 400), we can rewrite (1) as

$$E_{t_0}\left\{\int_{t_0}^{\infty} f(s-t_0;\,0)e^{-\rho(s-t_0)}\frac{[c(s;s-t_0)]^{\gamma}}{\gamma}ds\right\}, \tag{2}$$

where $f(\tau;\tau')$ is the probability that the person will be alive at age τ conditional on being alive at age τ'. By the definition of $\lambda(\tau)$, f satisfies

$$f(\tau;\tau') = \exp\left[-\int_{\tau'}^{\tau}\lambda(s)ds\right]. \tag{3}$$

By assumption, individuals have no bequest function. Hence it will be optimal for each person to enter into a life annuity contract wherein his wealth goes to the issuer if he dies and he receives a payment if he lives. One such arrangement would be a series of short-term contracts wherein at age τ the individual agrees to bequeath his wealth, $w(t;\tau)$, to the issuer if he dies between τ and $\tau + d\tau$ and the issuer agrees to pay him a dividend $D \cdot dt$ if he lives. If there are enough people in the economy to diversify away completely the risk of individual deaths, and if the contracts (like futures contracts) require no side payments between issuer and purchaser, then the competitive equilibrium dividend will be $\lambda(\tau)w(t;\tau)dt$.

In addition to the annuity contract, the person will choose an optimal portfolio allocation of his wealth. As shown, for example, in Merton (1971), the fractions of his optimal portfolio allocated to the available investments are independent of his wealth or age because his utility function is of the isoelastic form. Therefore, all investors in the economy will hold identical portfolios (except for scale). Hence, without loss of generality, I assume that all people invest in a single security. The rate of return on this security, dM/M, is assumed to follow an Itô process given by

$$\frac{dM}{M} = \alpha dt + \sigma dz, \tag{4}$$

where the instantaneous expected rate of return α and the instantaneous variance of the return σ^2 are constants over time. It follows from (4) that the return on this security is lognormally distributed. Moreover, as a necessary condition for equilibrium, this security must be a market portfolio (i.e., a portfolio which contains all available investments and holds them in proportion to their market values).

The accumulation equation for the wealth of a person of age τ at time t can therefore be written as

$$dw(t;\tau) = \{[\lambda(\tau) + \alpha]w(t;\tau) - c(t;\tau)\}dt + \sigma w(t;\tau)dz \tag{5a}$$

if he does not die between t and $t + dt$ and as

$$dw(t;\tau) = -w(t;\tau) \tag{5b}$$

if he dies between t and $t + dt$.

Along the lines of the derivation in Merton (1971, p. 390), the optimal consumption demand for a person of age τ at time t can be written as

$$c(t;\tau) = a(\tau)w(t;\tau), \tag{6a}$$

where $a(\tau)$ is a solution to the differential equation

$$0 = \frac{\dot{a}(\tau)}{a(\tau)} - a(\tau) + \lambda(\tau) + \mu \tag{6b}$$

with $\mu \equiv (\rho - \gamma\alpha)/(1-\gamma) + \gamma\sigma^2/2$. By inspection, optimal consumption is a function of both wealth and age, and the marginal propensity to consume (out of wealth) will be an increasing function of age if $\dot{\lambda}(\tau) \geq 0$. Similarly, the distribution of a person's wealth who is alive at time $t + s$, given his wealth at time t, will depend, not only on his wealth at time t and the return experience on his portfolio between t and $t + s$, but also on his age at time t.

Using Itô's lemma, we have from (6) that

$$\frac{dc(t;\tau)}{c(t;\tau)} = \frac{dw(t;\tau)}{w(t;\tau)} + \frac{\dot{a}(\tau)}{a(\tau)}dt. \tag{7}$$

Conditional on the person not dying between t and dt, we have by substitution from (5) and (6) that (7) can be rewritten as

$$\frac{dc(t;\tau)}{c(t;\tau)} = (\alpha - \mu)dt + \sigma dz, \tag{8}$$

and, of course, if he dies then $dc(t;\tau)/c(t;\tau) = -1$. By inspection of (8), the dynamic path of a person's optimal lifetime consumption follows a Markov process independent of either his wealth or his age (except for the "stopping point"). That is, given his consumption at time t, $c(t;\tau)$, his consumption (if alive) at time $t + s$ has a lognormal distribution which can be represented by

$$c(t+s;\tau+s) = c(t;\tau)\exp[(\alpha - \mu)s + \sigma\sqrt{s}\,\epsilon], \tag{9}$$

where ϵ is a standard normal random variable. Thus, unlike the percentage change in wealth, which is age dependent, the percentage change in consumption is the same for all people alive. It follows, therefore, that

$$\frac{c(t+s;\tau+s)}{c(t;\tau)} = \frac{c(t+s;\tau'+s)}{c(t;\tau')} \tag{10}$$

for all people alive at time $t+s$ and $\tau,\tau' \geq 0$.

Armed with (8) and (10), we can now proceed to derive the dynamic properties of aggregate per capita consumption, $C(t)$. If $L(t;\tau)$ denotes the number of people of age τ in the economy at time t, then the total population size, $L(t)$, equals $\int_0^\infty L(t;\tau)d\tau$. Therefore, aggregate per capita consumption is equal to

$$C(t) = \int_0^\infty L(t;\tau)c(t;\tau)d\tau/L(t). \tag{11}$$

If the birthrate at time t is given by $b(t)$, then the change in aggregate per capita consumption is given by

$$dC(t) = \int_0^\infty L(t;\tau)dc(t;\tau)d\tau/L(t) - H(t)C(t)dt, \tag{12}$$

where $H(t) \equiv \left\{b(t)[C(t) - c(t;0)] - \int_0^\infty \lambda(\tau)L(t;\tau)[C(t) - c(t;\tau)]\,d\tau/L(t)\right\}/C(t)$.

The properties of $H(t)$ are, of course, dependent on demographic assumptions. However, they also depend on the distribution of consumption per capita. If, for example, the distribution of per capita consumption were uniform—that is, $c(t;\tau) = C(t)$, for all τ—then $H(t) = 0$, independent of demographics. In a stable population $[b(t) = \int_0^\infty \lambda(\tau)L(t;\tau)d\tau/L(t)]$, $H(t) = -\int_0^\infty \lambda(\tau)L(t;\tau)\,[c(t;0) - c(t;\tau)]\,d\tau/[L(t)C(t)]$, and the sign of H will depend primarily on the distribution of per capita consumption between the very young and the very old, where the marginal death rate, $\lambda(\tau)$, is largest. If that distribution is approximately equal—$c(t;0) \approx c(t;\tau)$ for large τ—and the population is growing, then the sign of $H(t)$ will equal the sign of $[C(t) - c(t;0)]$, the difference between the general population per capita consumption and per capita consumption of the very young.

Even without taking into account the interaction between population growth and economic conditions, the analysis of stochastic demographic models is formidable. And, while the death rate (at least in the short run) may be exogenous, the birthrate is surely affected by economic conditions. Therefore, although explicit consideration of the process for $H(t)$ is important for many issues in this paper, no such analysis will be undertaken here. Instead, I simply postulate that $H(t) = 0$.[1]

If $H(t) = 0$, then we have by substitution from (8) that (12) can be rewritten as

$$(13)\qquad dC(t) = \left\{\left[\int_0^T L(t;\tau)c(t;\tau)d\tau\right] \Big/ L(t)\right\}[(\alpha - \mu)dt + \sigma dz]$$
$$= (\alpha - \mu)C(t)dt + \sigma C(t)dz\,.$$

A comparison of (8) with (13) shows that, except for scale, each person's optimal consumption follows a stochastic process identical to the one for aggregate per capita consumption. That is, conditional on being alive at time $t + dt$, $dc(t;\tau)/c(t;\tau) = dC(t)/C(t)$, independent of the person's age τ. Therefore, we have for person j that his consumption (if he is alive) at time t can be written as

$$(14)\qquad c_j(t) = \beta_j C(t),$$

where $\beta_j \equiv c(t_j;0)/C(t_j)$ and t_j is his birthdate.

Consider now a mandatory savings and retirement plan where, beginning at age T_0, each person must contribute at rate δ times his consumption until, at age T_1, the person begins to receive his life annuity retirement benefits. During the accumulation period of length $\tau_a \equiv T_1 - T_0$, each person's contribution is invested in a per capita aggregate consumption linked life annuity contract matched to his age at the time of the contribution.

Let $A(t,\tau;T_1)$ denote the equilibrium price at time t of a life annuity contract which begins its payments at age T_1 and the purchaser is currently age τ. The promised stream of payments is equal to $C(s)$ per unit of time from time $s = t + T_1 - \tau$ until the purchaser dies. Let $P(t;\tau)$ denote the equilibrium price at time t of a consumption linked pure discount bond of maturity τ which pays $\$C(t+\tau)$ at time $t+\tau$. If, as I have assumed, individual death risk can be diversified away, then the competitive equilibrium price for A can be written as

$$(15)\qquad A(t,\tau;T_1) = \int_0^\infty f(s + T_1;\tau)P(t;s + T_1 - \tau)ds$$

where, as previously defined, $f(\tau;\tau')$ is the probability of being alive at age τ conditional on being alive at age τ'.

For the economy of this section, an explicit formula for the $P(t;\tau)$ can be derived by competitive arbitrage. From (13), $C(t+\tau) = C(t)$ exp $[(\alpha - \mu + 1/2\sigma^2)\tau + \sigma\int_t^{t+\tau} dz(s)]$. Therefore, the realized return on the discount bond between t and $t+\tau$ is $C(t+\tau)/P(t;\tau) = C(t)e^{-\mu\tau}/P(t;\tau)$ exp $[(\alpha - 1/2\sigma^2)\tau + \sigma\int_t^{t+\tau} dz(s)]$. However, from (4), the return per dollar from investing in the market portfolio between t and $t+\tau$ is exp $[(\alpha - 1/2\sigma^2)\tau + \sigma\int_t^{t+\tau} dz(s)]$. Therefore, to avoid arbitrage, $P(t;\tau)$ must satisfy

$$(16)\qquad P(t;\tau) = C(t)e^{-\mu\tau}.$$

It follows from (16) that the instantaneous rate of return on the bond, $dP/P = \alpha dt + \sigma dz$, is the same as on the market. Substituting for P from (16), we can rewrite (15) as

$$A(t,\tau;T_1) = C(t)e^{-\mu(T_1-\tau)}\int_0^\infty e^{-\mu s} f(s+T_1;\tau)ds. \tag{17}$$

Moreover, it is straightforward to show that, for $\tau < T_1$,

$$\frac{dA}{A} = [\alpha + \lambda(\tau)]dt + \sigma dz \tag{18}$$

if the owner of the contract is alive at $t + dt$ and $dA/A = -1$ if the owner dies between t and $t + dt$.

Let $V(t;\tau)$ denote the value of the accumulated retirement account for a person of age τ at time t. Under this retirement plan, with accumulations in units of a consumption-linked life annuity, the value can be expressed as

$$V(t;\tau) = N(\tau)A(t,\tau;T_1), \tag{19}$$

where $N(\tau)$ equals the number of units accumulated at age τ. By Itô's lemma, $dV = N(\tau)dA + \dot{N}(\tau)Adt$ if the person lives to time $t + dt$ and $dV = -V$ if he dies between t and $t + dt$. Under the mandatory saving plan, $\dot{N}(\tau)A(t,\tau;T_1) = \delta c(t;\tau)$ and $N(T_0) = 0$. From (14), $c(t;\tau) = \beta C(t)$, and if the retirement plan is designed to provide fraction $\eta\,(0<\eta\leq 1)$ of the person's optimal retirement period consumption, then δ should be chosen so that at retirement the number of units accumulated, $N(T_1)$, equals $\eta\beta$.

If the retirement plan is fully funded and actuarially fair, then at age T_0 the present value of the person's future contributions should be equal to the present value of the annuity payments to be received during retirement. Under the terms of the mandatory saving plan, the person will contribute at the rate $\delta c(t;\tau) = \delta\beta C(t)$ (as long as he is alive) until he reaches T_1. Therefore, at age T_0, the present value of his future contributions, $F(t;T_0)$, is given by

$$\begin{aligned} F(t;T_0) &= \int_0^{T_1-T_0} f(s+T_0;T_0)[\delta\beta P(t;s)]ds \\ &= \delta\beta\int_0^{\tau_a} f(s+T_0;T_0)P(t;s)ds. \end{aligned} \tag{20}$$

If the plan is to provide $N(T_1) = \eta\beta$ units in retirement, then the present value of these retirement benefits at age T_0 is $\eta\beta A(t;T_0;T_1)$. Therefore, δ

must be chosen such that $F(t; T_0) = \eta\beta A(t, T_0; T_1)$, and from (15) and (20) we have that

$$\delta = \frac{\eta \int_0^\infty f(s + T_1; T_0)P(t; s + \tau_a)ds}{\int_0^{\tau_a} f(s + T_0; T_0)P(t; s)ds}. \tag{21}$$

Substituting for P from (16), we can rewrite (21) as

$$\delta = \frac{\eta e^{-\mu\tau_a} \int_0^\infty f(s + T_1; T_0)e^{-\mu s}ds}{\int_0^{\tau_a} f(s + T_0; T_0)e^{-\mu s}ds}. \tag{22}$$

By inspection of (22), the required contribution fraction does not depend on endowments or the individual contributor's age. It does, of course, depend on the statutory retirement age, T_1; the accumulation period, τ_a; and the target fraction of retirement period consumption provided by the plan, η. Therefore, δ can be kept constant over time and still meet the objectives of the plan. The only changes required would be in response to large cumulative changes in the mortality tables, f or μ, and these would probably be infrequent. Moreover, because the plan is fully funded and accumulations earn a fair market return, such changes in f or μ as might occur will cause no significant distortions even if δ were not adjusted over time.

To provide a crude estimate of the magnitude of δ, I assume (1) that the accumulation period $\tau_a = 45$ years; (2) that during the accumulation period the mortality rate is a constant, λ, equal to .0138 per year; and (3) that during the retirement period the mortality rate is a constant, λ, equal to .0666 per year and in no event will anyone live longer than 30 years after retirement. The average rate of growth of aggregate per capita real consumption from 1947 to 1981 is approximately 2% per year. If the expected real rate of return on all wealth in the economy, α, is taken to be 4%, then from (13) we derive an estimate for μ of 2%. Substituting these numbers into (22), we have that

$$\delta = .10\eta. \tag{23}$$

That is, to provide for all of retirement consumption ($\eta = 1$) would require about 10% contribution rate. While such a rate may seem large (requiring contributions of the order of $200 billion in 1981), 10% is a common contribution rate (on income) in many existing private defined-contribution plans, and the current maximum contribution rate for Keogh plans is 15%. To provide further perspective, I would also note that the combined employee-employer contributions to social security in the fourth quarter of 1981 were at an annual rate of $245 billion. It is, of course, unlikely that a public pension plan would be expected to provide for all retirement consumption, and therefore the necessary contribution rate would be considerably less than 10%.

10.3 On the Merits and Feasibility of a Consumption Indexed Public Plan

While the analysis in the previous section demonstrates a consumption indexed public retirement plan, it is presented within the context of a model where such plans are redundant. That is, with perfect markets for both assets and annuities, no utility externalities, and rational and informed people, there is no need for such public intervention. From this base, however, imperfections can be introduced to provide at least a qualitative analysis of the benefits of the plan for comparison with alternative plans if, and when, such intervention were deemed appropriate.

For example, a significant feature of this plan is that contributions be invested in aggregate consumption linked life annuities. If important assets within the economy, such as human capital and real estate, are either nontradable or not available in divisible lots, then even a broad-based portfolio of tradable assets will not provide a fully efficient diversified portfolio. However, an individual's consumption is likely to be strongly correlated with his wealth (or permanent income) whether that wealth is tradable or not, and therefore a security whose return is perfectly correlated with aggregate per capita consumption is likely to represent a better diversified holding than a portfolio containing only marketable securities. Moreover, even when all securities are traded, Breeden (1979) has shown that all efficient portfolios will be perfectly correlated with aggregate consumption.

If there are systematic differences among large segments of the population as to the types of nontradable assets they hold, then it is possible to improve diversification efficiency still further. For example, the young in the economy may be forced to hold too large a fraction of their wealth in human capital because it is not tradable while the old hold too small a fraction in human capital because they cannot buy it. As I have shown elsewhere (1981), risk bearing can be improved by a system that taxes wages and pays wage linked retirement benefits. However, as that analysis amply demonstrates, such further diversification gains are earned at the expense of having a pay-as-you-go retirement system with a risk of significant distortions from the associated taxes and transfers.

Diamond (1977) has suggested that one reason for a social security system is the absence in the private markets of "real" or "indexed" investments by which people of normal means can accumulate savings for retirement. However, "real" fixed-income bonds would only protect such savers against the uncertainties of inflation. They would not protect the saver against the risk of real increases in the standard of living. As shown in table 10.1, real per capita consumption in the United States has increased at an average rate of 1.96% per year from 1947 to 1981.

Table 10.1 **Levels and Growth Rates of U.S. Aggregate Real Consumption and Over-Age-16 Population, 1947–81**

	Aggregate Consumption (Billions/1972 $)		Population (Millions)		Per Capita Consumption (Thousands/1972 $)	
Year	Level	% Change	Level	% Change	Level	% Change
1947	305.8	—	103.4	—	2.957	—
1948	312.2	2.1	104.5	1.1	2.987	1.0
1949	319.3	2.3	105.6	1.0	3.023	1.2
1950	337.3	5.6	106.6	1.0	3.163	4.6
1951	341.6	1.3	107.7	1.0	3.171	0.3
1952	350.1	2.5	108.8	1.0	3.217	1.5
1953	363.4	3.8	110.6	1.6	3.286	2.1
1954	370.0	1.8	111.7	1.0	3.313	0.8
1955	394.1	6.5	112.7	1.0	3.496	5.5
1956	405.4	2.9	113.8	1.0	3.562	1.9
1957	413.8	2.1	115.1	1.1	3.596	1.0
1958	418.0	1.0	116.4	1.1	3.592	−0.1
1959	440.4	5.4	117.9	1.3	3.736	4.0
1960	452.0	2.6	119.8	1.6	3.774	1.0
1961	461.4	2.1	121.3	1.3	3.802	0.7
1962	482.0	4.5	123.0	1.3	3.919	3.1
1963	500.5	3.8	125.2	1.8	3.999	2.0
1964	528.0	5.5	127.2	1.7	4.150	3.8
1965	557.5	5.6	129.2	1.6	4.314	3.9
1966	585.7	5.1	131.2	1.5	4.465	3.5
1967	602.7	2.9	133.3	1.6	4.521	1.3
1968	634.4	5.3	135.6	1.7	4.680	3.5
1969	657.9	3.7	137.8	1.7	4.773	2.0
1970	672.1	2.2	140.2	1.7	4.794	0.5
1971	696.8	3.7	142.6	1.7	4.887	1.9
1972	737.1	5.8	145.8	2.2	5.056	3.5
1973	768.5	4.3	148.2	1.7	5.183	2.5
1974	763.6	−0.6	150.8	1.7	5.063	−2.3
1975	780.2	2.2	153.4	1.7	5.084	0.4
1976	823.7	5.6	156.0	1.7	5.279	3.8
1977	863.9	4.9	158.6	1.6	5.448	3.2
1978	904.8	4.7	161.1	1.6	5.618	3.1
1979	930.9	2.9	163.6	1.6	5.689	1.3
1980	935.1	0.5	166.2	1.6	5.625	−1.1
1981	958.9	2.5	168.6	1.4	5.688	1.1
Average growth rate		3.44%		1.45%		1.96%
Standard deviation		1.75%		0.32%		1.68%

Source: Consumption data are taken from U.S. Department of Commerce, Bureau of Economic Analysis, *National income and product accounts of the United States*, table 1.2. Noninstitutional population 16 and over data are from U.S. Department of Labor, Bureau of Labor Statistics.

Moreover, the annual standard deviation of that growth rate is 1.68%. Hence, if a person's sense of economic well-being depends not only on the absolute level of his consumption but also on its level relative to those around him, then the risk in utility terms of a price level linked investment can be considerable, especially over a long accumulation period. A consumption linked investment protects against both inflation and real changes in the standard of living. It has the further practical advantage of avoiding the index problem because it is not necessary to distinguish between nominal and real changes.

In another context, Fischer (1982) argues that the government should issue bonds linked to wage income. While it is likely that such bonds would be a superior to price level linked bonds for most saving plans, at least in theory, they may not be as efficient as consumption linked bonds. One reason is that changes in wage income capture the returns to only one segment (albeit an important one) of national wealth, while consumption changes depend on all segments. A second reason is that wage income is more likely to have a significant transient component than is consumption since, by the life-cycle hypothesis, consumption depends on permanent income or wealth. How important the difference would be between wage income and consumption linked bonds is, of course, an empirical matter, and one that warrants further study.

There are relatively limited opportunities in existing private markets to accumulate savings in life annuities, and none where those savings are invested in consumption linked investments. In the absence of such instruments, the individual may be forced to save too much relative to his bequest motive. By investing contributions in life annuities, the proposed plan permits a person to accumulate adequate amounts for retirement with smaller contributions. The additional available funds from this reduced contribution rate can be used either for more current consumption or to purchase life insurance or other saving instruments to meet bequest motives. This feature is especially important in a *mandatory* saving plan because, for the *same* target level of retirement benefits, it reduces the welfare loss of the plan to those in poor health or those who have no bequest motive.

A second significant feature of the plan is that retirement benefits are linked to aggregate per capita consumption. The arguments in favor of consumption linked benefits are essentially the same as those given for consumption linked accumulations. So, for example, while a number of people, including Diamond (1977), have argued for real or price indexed fixed annuities for retirement benefits, per capita consumption linked benefits are likely to dominate such annuities because they protect the retiree against both uncertainties in the inflation rate and changes in the standard of living.

The success of a consumption indexed plan (whether public or private) depends critically on the existence of per capita aggregate consumption

linked bonds. In their absence, administrators of the plan would be required to estimate the fair market value of such bonds in order to determine how many units to credit to each account during the accumulation period and to determine how much to pay in benefits during retirement. I need hardly mention the extreme difficulties associated with making these appraisals, especially when such instruments have never traded. Moreover, for a public plan, there would likely be times when strong political pressure would be brought to bear on the administrators to "adjust" their appraisals. Even if such pressure were in fact resisted, the mere prospect of a potential conflict of interest could taint the entire system.

In theory, the private sector could create a market for per capita aggregate consumption linked bonds and provide consumption linked life annuities through financial intermediaries. Indeed, some might argue that the fact that such instruments have not been created is strong evidence in favor of the hypothesis that there is no need for them. However, if this hypothesis is correct, then close surrogates for these instruments must already exist in the market, since—as suggested, for example, by Breeden's (1979) analysis—there is a strong theoretical foundation for the belief that an aggregate consumption linked security would be widely demanded. I know of no such combination of available securities.

There is, of course, the alternative hypothesis that the nonexistence of such instruments is an example of private market "failure." That is, even though there would be a demand for these instruments, there is insufficient incentive for investment bankers, for example, to undertake the costs of educating both purchasers and issuers, especially when the latter have no assets that are naturally matched to this type of liability. Similarly, in the absence of a "thick" market for consumption linked bonds, financial intermediaries probably would be reluctant to issue such annuity liabilities because there is no asset which can be purchased to hedge these liabilities. Of course, some intermediaries might be induced to take some limited amount of risk without being hedged, but this limited amount would surely be inadequate for the scale required for pension plans. On the other hand, it appears that the government is a "natural" intermediary to issue consumption linked bonds because it has the power to tax expenditures. That is, the government could institute a consumption tax proportional to the number of consumption linked bonds outstanding and the revenues from the tax would exactly match the required liability payments. Moreover, there appears to be no significant social cost to the government's issuing consumption linked bonds, and there may be social benefits from the government's financing the deficit in this form.[2] While the principal reason for discussing the creation of such bonds here is their essential role in pension plans, I believe that, independent of pension

plans, consumption linked bonds would be an ideal investment instrument for private saving generally. If this belief is correct, and if the government did issue such bonds, then it is likely that private financial intermediaries would introduce consumption linked annuities and corporations would issue consumption linked liabilities. The existence of such private sector financial instruments would serve to make consumption indexed pension plans more efficient by providing better pricing information for the plans' annuities and a broader base of securities in which to invest the plans' assets.

Even if the private sector could efficiently provide consumption linked bonds and life annuities, as I noted in my introduction, private pension plans alone cannot handle either information cost or utility externalities. While it is difficult to measure how other people's welfare enters into an individual's utility function, I believe that it is likely to do so in a relative fashion. That is, we are less inclined to worry about or make transfers to those who have a relatively high standard of living. Among those with the same current standard of living, we are more sympathetic toward those who have fallen on "hard times" and experienced a decline from their past standard. If this assessment is correct, then a public plan along the lines discussed here appears to efficiently handle this utility externality for people in retirement. By requiring individuals to make contributions proportional to their consumption during their working years and investing these contributions in per capita consumption linked life annuities, the plan ensures an accumulated amount sufficient to support a retirement consumption path for individuals at a level (relative to aggregate per capita consumption) similar to that which they enjoyed during the working phase of their life. Linking benefits to per capita aggregate consumption provides for a continuation of their standard of living throughout the retirement years. Thus, a plan with these features meets the objective of ensuring an appropriate relative standard of living in retirement for everyone and it also handles the free-rider problem.

These features do not, of course, solve the redistribution problem for those whose relative standard of living is too low during their working years. However, a reasonable argument can be made that it is more efficient to make the necessary transfers by other, more direct means at the time when they are needed (during the working years) instead of attempting to do so indirectly by redistributing future benefits within the retirement plan. There are other good economic arguments for keeping the transfer system and the retirement system separate, but that is not the focus of this paper. I would note, however, that the plan analyzed here would automatically handle much of the redistribution problem for people in their retirement years if a proper transfer system were devised for people during their working years. Transfers received and consumed during the working years will increase future retirement benefits pro-

portionately because the required contributions to the plan are proportional to consumption. Transfers in the form of a total or partial credit for the individual's required contribution to his retirement account would work in a similar fashion, provided that the cost of this transfer is not borne by the retirement plan itself.

Having reviewed the merits of a consumption indexed pension plan, I now turn to the issue of its feasibility. Although the idea of investing accumulations in consumption linked life annuities is new, the basic structure of the plan is simple and is essentially the same as a standard defined contribution pension plan. It is therefore a relatively easy plan to explain and understand. Its format also has the attraction of stability in the sense that neither its basic structure nor the parameters of the structure (such as the contribution rate or the period of accumulation) would require much change over time, even in the face of significant variations in economic conditions. It does, however, require that an appropriate measure for aggregate per capita consumption be chosen.[3] To select the proper measure would require further study to determine how consumer durable purchases should be treated and whether or not to include items such as leisure time which are not normally included in measures of consumption. There is also the issue of what population measure to use. While investigation of these issues is beyond the scope of this chapter, their resolution is not an insurmountable problem. With this measurement problem solved, there does not appear to be any major difficulty with the government's issuing consumption linked bonds and using their prices to determine the value of consumption linked life annuities.

The main feasibility problems with a public plan as described here are likely to be associated with the method of collecting the required contributions and the maintenance of the individual accumulation accounts. Though I have not investigated in detail the amount of computation and record keeping required in the current social security system, it appears likely that the amount required for individual account maintenance would not be significantly larger for a consumption linked plan. However, the collection in such a plan would probably be more difficult than for current social security because the base is consumption rather than income. As outlined, the plan requires that the amount of each contribution be indentifiable in the same way that individual federal income tax payments are identified. Therefore, the method of collection necessary for its implementation would probably be like that of the income tax, with consumption determined as the residual from a cash flow analysis. The feasibility of such a collection system is currently a topic of considerable discussion among economists, principally in the context of the feasibility of an individual expenditure tax (see Aaron and Boskin 1980; Pechman 1980). Although I will not undertake a serious analysis of feasibility here,

I would note that there is an important difference between an expenditure tax and the mandatory contribution part of a fully funded retirement plan. Because it is a defined-contribution plan and accumulations earn a competitive rate, cheating is less of a problem to the extent that people treat contributions as saving and not as a tax. Indeed, the rich, high-income, and well-informed people who might be thought to have the greatest incentive and opportunity to cheat on a tax are probably the most likely to view such contributions as saving, since these are the people who now voluntarily enter into deferred compensation and Keogh plans. In general, those who cheat on contributions are primarily cheating themselves. However, one slight modification which might make the collection part of the plan more effective would be to have withholding of the required contribution based on income, as is currently the practice for social security, and then to have refunds or additional contributions based on the computation of consumption made in conjunction with the filing of federal income tax returns.

A more radical modification of the plan described here was suggested to me by Lester Thurow. The collections for the plan would be done at the aggregate level by a value-added tax. The aggregate amount collected would then be distributed as contributions to individual accumulation accounts in proportion to the amount of income reported on the individual's federal tax return. The administrative benefits of this modification depend on the relative costs of collection for a value-added tax versus a residual cash flow computation on the income tax return. It does have the attractive feature that those who cheat by underreporting income on their federal tax will lose some of their retirement benefits (which they presumably paid for through the value-added tax). The principal disadvantage of this modification is that the aggregate contributions will now be treated as a consumption tax, which can distort the labor leisure decision. However, the credit to individual retirement accounts based on income will act as a subsidy to wage income, which may offset this distortion at least in part.[4] This modification would become considerably more attractive if the government chooses to use a value-added tax to finance general government expenditures.

In summary, although the method of collecting contributions poses the principal feasibility problem for such a public plan, a number of different methods would seem to serve as close substitutes provided that it remains essentially a defined-contribution plan which earns a fair rate of return on accumulations and pays benefits indexed to consumption.

If a policy decision were made to adopt a public pension plan with a basic structure like the one analyzed here, there would still be the further critical policy decision of what fraction of retirement period consumption should be the target for the plan. Presumably, those who are most concerned about the plan's success in dealing with information cost and

utility externalities would advocate a high fraction and those who are most concerned about preserving individual choice would advocate a low fraction. The correct policy decision will surely depend on the amount of other retirement saving that people are likely to make, especially in housing and private pension plans. The resolution of this policy issue, therefore, requires an analysis of the overall pension system. Since that was the note on which I began, it seems an appropriate place for me to end.

Notes

1. On the matter of the assumed stability of $H(t)$, I note that because $c(t; 0)$ depends strongly on the initial endowments of the very young, $c(t; 0)/C(t)$ is likely to be larger when the value of human capital relative to other factors of wealth is larger. It also seems reasonable that the birthrate will be higher when the relative economic value of children is high. However, if $c(t; 0)/C(t) < 1$, then comparative statistics reveal that these two effects work in opposite directions on $H(t)$ in a stabilizing fashion.

2. Fischer (1982) discusses a number of social benefits from the government's issuing wage income linked bonds, including possible intergenerational risk sharing that private markets cannot provide. Many of the same benefits would come from consumption linked bonds, and indeed, if a consumption tax is less distorting than a wage tax, then the consumption linked bonds may be superior.

3. It is, of course, not true that every model of lifetime consumption choice will lead to an efficient allocation of retirement consumption which depends only on aggregate per capita consumption. For example, Breeden's (1979) important theorems on this matter will not apply if utility of consumption is state dependent.

4. As I have shown elsewhere (Merton 1981), the distortion of the labor-leisure decision of a consumption tax can be offset by linking future retirement benefits to current wage income.

Comment Paul A. Samuelson

Not long ago social security was judged to be the most valuable legacy of the New Deal. Now social security is supposed to be in crisis, and people are worried whether they will receive in the end the retirement benefits promised to them. But what does the crisis consist of? Is it the case that taxpayers have reached some ceiling on their ability to finance the scheduled out-payments? No. Many nations tax themselves much more than we do. And, properly measured, America's affluence is still the greatest of any country on earth.

The crisis consists merely in the unresolved debate on how rapidly payroll tax rates should be raised and on whether or not general revenue

Paul A. Samuelson is Institute Professor, Massachusetts Institute of Technology.

sources should be utilized to cover part of social security expenditures. At the deeper philosophical and class-struggle level, the debate is over how redistributive between affluent and poor the public retirement program should be. As a result of recent inflation and certain inadvertent technicalities of indexing, during the 1970s older Americans were given a step-up in their share of the total social pie. Since this result was never explicitly deliberated and decided on by the electorate, now that the size of the social pie has ceased to grow and in view of the present conservative resurgence it is natural that there are second thoughts about the generosity of the social security program.

What is happening in the realm of social security is of course much the same political struggle that is going on in general fiscal policy.[1] Deficits of over $100 billion are in no sense consequences of ceilings on taxable capacity. Conservatives whose central goal is to reduce the weight of government expenditure in the gross national product are not irrational to believe that the ploy of starving the government for tax revenue will in the end force liberal acquiescence in cutting down on transfer and public goods expenditure. The ploy is not irrational, but it is a form of Russian roulette. Contriving or countenancing crises is a tactic that must run the risk that you will go over the abyss before you force the opposition's capitulation short of the brink itself.

Robert Merton's valuable mechanism of a consumption indexed public pension plan sidesteps most of these controversial aspects. Although he abjures consideration of redistributive social security for the most part, his mechanism could adapt to it. He takes for granted full actuarial funding, something which would have to be taken for granted by any voluntary private pension insurance scheme but which has to be argued out in any social contract with respect to mandatory social insurance. In an epoch when most social contracts are hardly worth the paper they are written on, full funding has the virtue that reneging on promises is least likely to be politically feasible.

To obviate argument with those whose major preoccupation is with the Pareto optimality that perfect markets might achieve, Merton bases his case for a public system on "market failure." In particular, he has in mind the many reasons why there are not perfect Arrow-contingent markets for each person's human capital. If you are not able to spread the risks to which your earning power is intrinsically subject onto existing human capital markets, then even the zealots who concentrate on Pareto optimality concede that laissez-faire will lead to deadweight loss that might be ameliorated by various mandatory public schemes.

Avoiding the esoteric Itô-Wiener calculus of instantaneous probabilities, we can understand Merton's results by contemplating a minimally simple model. Each of us works in two periods of life, youth and prime ages, and lives in retirement in a third period. In our first youthful

working period we all earn much the same zero-variance wage. As a result of what each of us is then and of what we each do by way of training, there is a stochastic spread of our prime period's earnings. But it is not possible to actuarially borrow on our different human capitals, for a variety of reasons having to do with market imperfections and incompletenesses. (As one example there is the familiar problem of moral hazard: if an insurance company had lent on my brilliant prospects when I was a Harvard Junior Fellow, I might later have refused to write my successful textbook out of the knowledge that the insurance company would be cashing in on the harvest of my efforts; therefore, so the argument goes, I had too little to spend when young and was unable to lay off some of the risks of not writing a best-seller by investing some of my capitalized prospects in a broad index of common stocks, bonds, and real property.)

Aside from the interpersonal stochastic variations in relative earning power, this simplest model will presumably want to postulate that society's aggregates of consumption and capital formation are subject to stochastic variation both in totals and in sectoral parts. As the quasi rents of capital goods fluctuate stochastically, the capitalized values of the securities denoting their ownership will likewise fluctuate, with only some of the dispersions being capable of being diversified away. The resulting overlapping-generations three-period model might be called a Samuelson-Diamond-Merton, or S-D-M, model in consequence of the series of papers (Samuelson 1958, 1967, 1968, 1975*a*, 1975*b*, 1976, 1979; Diamond 1965, 1977; Merton 1971, 1975, 1981, 1982).

Some questions suggest themselves.

1. Why does an S-D-M model lead to consumption indexed pension insurance contracts? We must read Merton's lines closely to understand why.

2. Robert Merton makes skillful use of constant relative risk aversion utilities on the part of the people in his system. Maximizing functionals that are sums of independent period utilities, each of which are the same power of the period's consumption, is known to lead to nice linear simplifications. Suppose life utility $= U(c_1) + (1+R)^{-1} U(C_2) + (1+R)^{-2} U(C_3)$, where $U(C)$ is $\log C$ or C^γ with $1 > \gamma = 0$. Then optimal consumption and wealth decisions at each stage of life are known to involve simple proportionalities. With instantaneous Wiener probabilities, the constancy of relative risk aversion can be dispensed with.

How robust is this simplifying paradigm? I ask not to record doubt but to applaud Merton's statement that his chapter is "only a prologue to a more complete functional analysis of the overall pension system."

* * *

Rather than linger on the analytical complexities of Robert Merton's schemata, I can best use this limited space to reproduce my original

conference reactions to his proposal. Then, finally, I can usefully elaborate on two of the points made there: the reservations that must be made to the notion that real people have consistent life-long intertemporal preferences, in terms of which they deliberate ex ante, on which they decide in midstream, and on which they look back with agreement; and the lack of optimality content of the laissez-faire solution even when no market failure is present.

Spontaneous Reactions

Robert Merton's excellent public pension plan, though he never knew it, is the answer to an ancient prayer of mine. In public lectures, I used to complain that two out of the three features that I wanted in a retirement pension were just not available.

1. Not knowing just when I should die, I wanted an *annuity for life*. This, my friendly Prudential agent had long been glad to sell me. (But still I had the impression that, at least until recently, because of moral hazard and lack of popularity, the actuarial loadings and terms of annuity contracts were not all that feasible for the ordinary person outside the field of education.)
2. Not knowing what the future price level would do, I wanted a *real* annuity for life. This was just not available; however, in 1952, when TIAA set up CREF and when we were all still under the innocent illusion that a portfolio of common stocks provided a good hedge against inflation, it looked as if it was possible to begin to meet this second requirement.
3. Noticing that the average real level of consumption was rising in the modern mixed economies, and realizing that my unhappiness increases when I see myself moving down the scale of real income and consumption relative to the people of all ages I live with, my final unreasonable demand was for an annuity that would leave me for life at the same *percentile* level of the working age population's real living as I had become accustomed to.

There was no way I could get these three wishes. And indeed, I suspected that if somebody invented that better mousetrap and beat a path to my door, I would not be able to afford the cost of that mousetrap and would have to scale down my hankerings.

At this point, I did what we all do when we have an itch that we're not able to scratch out of our own resources. I thought of the government. It knows we are all going to die, and when on the average that will happen. So it can reduce variance to zero in working out actuarial annuity terms by merely operating on a pay-as-you-go basis. (So help me, it was Aaron Director, in my first University of Chicago elementary economics course in 1932, who said: "Everyone is going to die; be born; quit work at an average age lower than the average age of death. Why have insurance companies that have to hire salesmen and keep records on each client

when the government can simply and cheaply provide for everyone by law and mandatory taxes what we all are going to need?" I have forgotten many things Director taught me, but not those words of pre-Beveridge wisdom.) I do not know whether government can control inflation. But it can tax the nominal fruits of inflation. So it can offer us a *real annuity*.

At this point, the embryo of my 1958 pure consumption model of overlapping generation was kicking in the womb. Government, I realized, has a tax hold on the fruits of Hicks-neutral technical change and every other kind of technical change. So when I am old, it can tap the enriched harvests produced by my contemporary juniors and let me share in what science and technology have brought to the system even without my having stinted myself in my prime years out of prudential forethought for the future.

By this time I was shameless. With the numerosity of my own six children, future taxpayers all, before my eyes, I realized that government could build into the real annuity account that was implicitly accruing on my behalf the *biological interest rate* equal to the steady-state rate of population growth.

One more goody you may think might have occurred to me. Adam and Eve, the very first generation born into an already going concern, Eden, had an opportunity no later generation could enjoy. Adam and Eve could bite into the apple. Doing this enjoyable thing had to be made a sin so that such an irreversible act wouldn't again occur. You may think I am referring to the possibility that my generation, not being able to take it with us, proposed to use it up (*it* being the capital stock built up since the industrial revolution) in our single retirement years. I have nothing so crass and simple in mind as eating up the apple or the milling lathes. What I have in mind is *something for nothing*!

The first generation of social security requirements can get a free ride in an overlapping generation system with a positive Harrod natural rate of growth of population and of neutral technical change. That (almost!) free ride is often the political factor that sells the idea of social security to the democracy. So it happened in FDR's America and in Scandinavia in the late 1950s.

However, there is only one free ride. And along with the free ride of the initial generation, who reap what they never had to pay anything for—namely, social security—there exists the one final gouging of the terminal generation. Particularly when the population growth rate has turned negative and when younger workers begin to ask, "What have our parents done for us lately?" the voters may disavow the promised benefits that everyone had been able to count on.

By now you will realize that Merton deduced by a stochastic optimal-control maximum that I was right to want my three-pronged pension. And his analysis shows that, on a fully funded basis, much of this could be

provided for ourselves in each generation by US INCORPORATED—the government—or, in the absence of externalities, moral hazard, and market failure for informational and transaction-cost reasons, a perfect competitive market of like situated persons can recreate for each of them what omniscient benevolent government can create for all of them.

Lingering Questions

Because Merton has put down a concrete plan, we can use it to bring out major issues that a post-1982 social security system must face. Here are a few nonsystematic questions that his plan made me think about.

1. Our tax system keeps track of our respective incomes, not our consumptions. If not impossible, it would still, I suspect, be difficult for us to go over to a consumption tax system—particularly if it is to be graduated. *After* we have seen an *expenditure* tax system, Merton's consumption tax for pension purposes will be just one more aspect of it (and, as he points out, a part that is more self-enforcing than the rest). But I have to wonder whether, before we have such a general system, it will be administratively feasible for so limited an objective. I hope he or someone will work out how much distortion there will be if surrogates (such as income) are used for his consumption targets.

2. As an academic exercise, one can and should separate social security from "redistribution." However, it is a central feature of the welfare state that democracies want to perform much of their redistributions by means of their life-cycle taxes and benefits. The equality that matters is lifetime equality. Social security, properly, tempts egalitarians to use it.

3. There is the further point that redistribution between generations (overlapping and disjoint) is the very essence of any social security discussion. Samuelson-Diamond-Merton models do *not* deduce as theorems that the laissez-faire solution is the optimal one. Although Merton's exposition puts stress on the case of fully funded public pension schemes, the reader must not think that there is something right about fully funded public pension systems. The bargain that full-funding overlapping generation models arrive at between me and my posterity or forebears is only one such bargain, albeit one which is likely to be politically honored. (I elaborate on the nonoptimality of full funding and laissez-faire later.)

4. Having lived in the world before and after social security, I believe that *myopia* is an essential ingredient present in the private and voting behavior equations of the people we are talking about. Much that a steady-state public system accomplishes could have been contrived privately. But it wasn't. And the voters are at least partially aware of their own imperfections. Models that ignore this miss an important point of the problem.

Merit Want Aspects of Social Insurance

In the following amplifications of my Amelia Island oral remarks, I begin with the central feature of the New Deal social security genesis, of which Robert Merton and all the speakers at this National Bureau conference have taken little notice. Democracies introduce upon themselves social security precisely because the voters realize that they are prone to act in too myopic a way in their private spontaneous capacities as consumers and savers.

Americans in the century before 1937 were the richest people on earth. But still it was the case that most people died broke and lived their declining years as charges on their children and on the meager resources of private and public philanthropy. Of course, people had the capability to consume less in their working years and consume more at the older ages. But in fact the extent to which the majority did so was judged by that majority to be deficient.

We have here a clear case of what Richard Musgrave (1959) calls "merit wants." Democracies vote universal conscription in time of war even though (and precisely because) any one person may not volunteer in a regimen where it cannot be assured that others will volunteer. Democracies regulate availability of therapeutic and other drugs, distrusting the revealed preferences and indifference curves of their own citizenry. And often this is not a matter of some ruling elite or bureaucracy telling the consumer herd what is or is not good for them; but, rather, it is a case where most of us do not wish to entrust to our day-to-day impulses the supply-and-demand deployment of these economic items.

The road to Hell is admittedly paved with good intentions. Likewise the descent to tyranny is festooned with rationalizations for merit-want interferences with personal economic liberties. So always the burden of proof has to be against the overruling of each of our indifference curve preferences. Only when the case is made in a strong way are merit wants to be promulgated in the good society.

Where life-cycle rationality is concerned, a prima facie case for merit wants has always been recognized. Precisely where judgments are concerned about the future, particularly the far future, each of us realizes that we do not possess consistent ex ante and ex post preferences. We are prone to sow wild oats we later come to regret. Faced with the fact that most cigarette smokers acquired as teen-agers the dishygienic habit they wish they could get rid of, only a crackpot libertarian could regard as ethically optimal all behavior patterns that arise under voluntarism.

Maurice Allais (1943), Robert Strotz (1956), A. C. Pigou (1944), Oskar Lange (1936-37), and a host of philosophers have elucidated the problem of human myopia where the passage of time is concerned. Even sociobiology, which recognizes that our genetic propensities to react with

respect to intertemporal trade-offs were evolved during eons when the caveman's opportunity sets and life expectancies were very different from what they are in modern economic life, militates against the notion that there is something sacrosanct in the representative person's indifference curves between different time-of-life consumptions.

I must emphasize that the point to which I am calling attention is something deeper than the "externalities" point, according to which we introduce compulsion to make sure you save for your old age—because otherwise you would be tempted to save too little under the correct knowledge that the rest of us will be so uncomfortable at the sight of your poverty that we shall be effectively blackmailed into supporting you. Even if there were no such sympathy or envy, if each of us was prone before the 1937 birth of social security to consume more in our working years than on reflection we conceive to be ("ethically") desirable, we could rationally mandate on ourselves a social security system. And even if it were fully funded, there is no realism to the notion that people will in fact undo rates of positive saving by acts of private borrowing or of equivalently reducing the tax-enforced reduction in consumption during the working years. It is precisely because of the existence of myopia—or discrepancy between what one thinks about ex ante and what one's judgments are ex post—that the general run of the citizenry escape realization that they have the power to undo privately what they have voted governmentally on themselves.

It will be no refutation of the fundamental logical and factual point I am making if now, almost half a century after the New Deal debates about social security began, the de facto existence of a social security and widespread corporate pension system should have reduced substantially the irrational element of myopia in the citizenry's overt preference structure. Use develops a muscle. Once each of us lives in an environment where virtually all of us engage in explicit life-cycle savings—voluntary and mandatory—our consciousness is raised. Like the forms into which cement for a cathedral is poured, which have done their duty even though they can later be dispensed with, the social security system must be credited with contributing toward the restructuring of American minds in the direction of much more explicit rationality in making life-cycle consumption saving decisions.

How Unfull Should Funding Be?

There is much reason to believe that the 1937 inception of social security would never have been politically achievable if there had to be an insistence on full funding of the new social insurance scheme. The electorate persuaded itself to create social security only because the first beneficiaries, those with all or part of their working years already behind

them at the system's inception in 1937, could be given benefits *their* in-payments never earned at a perceived burden that could appear to be light for many years ahead.

Most legislators and journalists never understood the real financing of social security. But one who did understand it—for example, Marion Crawford Samuelson, whose job as a research assistant on Seymour Harris's project at Harvard was to study the economics of social security—could rationally favor the underfunding of the system on the well-founded grounds that any engineered increments of public thriftiness would in the Great Depression days of mass unemployment and near-zero marginal rates of interest merely have increased the unemployment rates in the 1937–41 prewar period. When markets do not clear in the fashion presupposed by naive neoclassicism or supersophisticated modern rational expectationism, an increase in thriftiness can in fact reduce achieved capital formation and ex post total saving. If Franklin Roosevelt's right hand had taxed to make the social security system fully funded, in all probability his left hand would have been forced by the resulting increment of unemployment to engage in offsetting deficit spending so as to abort the purpose of full funding. During World War II itself, private consumption was indeed restrained by rationing and enforced unavailability of durable goods, but the exigencies of war did not allow increments of capital formation to occur in the interests of later generations of retirees.

Once the postwar achievement of conditions near to full employment had been achieved, undoubtedly an increase in social security tax rates could have been used to increase the total of United States capital. Easier Federal Reserve monetary policy would then be implied to offset any deflationary effects of the fiscal surpluses. However, if it were deemed good public policy to promote capital formation—whether to prepare for a surge of retirees later or for whatever reason—quite without regard to the social security accounts there remained the opportunity for the government to engineer a *general* budgetary surplus: an increase in public saving, other things being equal, could by means of accommodating monetary ease contrive a lower ratio of consumption to capital formation at full employment levels.[2]

Democratic Resolution of Thrift Decisions

So far I have been taking for granted that our unfunded social security system does not conduce to the optimum mix of United States capital formation and current consuming. But, as I have already stated, economic theory does not conclude that the social optimum is achieved by full funding. On the contrary, even if intralifetime myopia or market imperfections were ignorable, and people were all alike, it would still not be the case that the good society would want to entrust to laissez-faire

saving decisions or—what is then the same thing—to full-funded social security the task of determining how much capital formation there is to be in the steady state and in the transient approach to it.

To appreciate that there is nothing optimal about laissez-faire saving decisions, consider the recent discovery of oil in North Sea Norwegian waters. None of the political parties is content to leave it up to the current generation of Norwegian savers to determine how fast this exhaustible resource should be used up in the interests of Norwegians now alive as against the interests of Norwegians still to come. Both conservatives and social democrats would reject the shibboleth proposed by Milton Friedman for disposition of Alaskan windfall oil assets, namely, that each present-day Alaskan be given sellable securities that signify each person's pro rata shares. If Alaskan Eskimos and Caucasians wish to go on a glorious binge, then Friedman would argue that this should be allowed to happen. Or, if they wish to bequeath some of their windfall to later generations, then in whatever degree they choose to do so, that is ipso facto the correct outcome. Nothing in economic science or in the calculus of freedom for the individuals who will exist in the stream of history sanctifies such a solution—except the shibboleth that laissez-faire is right whatever are its consequences.

I am not suggesting that some Plato ought to dictate to the Norwegian people how successive generations shall relatively fare, doing so through decisions being made about social security rates and oil exploitation rates. My point is that the Norwegian electorate have the right to second guess by legislation what they believe will occur if they leave the decision to laissez-faire Walrasianism.

My concluding section draws on the analytical studies of steady-state equilibria in overlapping-generation models. Such Modigliani-Turgot models—or, what is the same thing, Samuelson-Diamond-Merton models—generate equilibria which have no necessary proximity to golden rule states.[3] They provide no economic justification for the present fad glorifying full funding of social security, leaving that proposal only with the defense that full funding is the only mode of operation which can be terminated or expanded without losses or profits.

Paradoxes of Exponential Growth

1. The faster a population's (permanent) exponential growth rate, the more workers there will be to support each older retiree (Samuelson 1958). However, the greater the population growth, the more will be the subtractions from per capita production that must be withheld from consumption in order to keep capital widening in step with labor-supply growth (Diamond 1965; Samuelson 1975*a*, 1976). The two-part golden rule requires that, in a population growing forever at the percentage rate of 100 R per year, the lifetime utility of each generation's representative

person will be at its maximum only if capital's net product equals the biological interest rate of R and if people's intralifetime consumption decisions are made taking into account that same R opportunity cost of successive periods' consumptions (Samuelson 1968). Warning: All technical change is ignored here; production is considered to obey a one-sector neoclassical production function à la Solow (1956); bequest motivations are ruled out. Meade-Lerner total utility considerations, which are not addressed here, also do not sanctify laissez faire's full funding.

2. Laissez-faire life-cycle saving and fully funded social security will lead, under certain rather artificial but often invoked conditions, to precisely the one and the same equilibrium—as private industries cease to save privately exactly the amount that the mandatory public social security system saves on their behalf (Samuelson 1975*b*, theorem 2).

3. The resulting equilibrium will, in general, deviate forever from the two-step golden rule optimum (Samuelson 1975*b*, p. 540). However, by appropriately gauged nonfunded social security, society can be swung into the two-step golden rule configuration (Samuelson 1975*a*, theorem 1).

4. In the singular case where the rate of population growth is the most golden of all rates—in the sense of yielding maximum lifetime utility forever of the representative person of each generation—fully funded social security (which is the same as no *social* security at all!) would by the Serendipity Theorem achieve the two-step golden rule (Samuelson 1976*b*, fig. 1*b*).

5. There are some realistic reasons why the most golden population growth rate might involve negative growth rates (Deardorff 1976; Samuelson 1976). To the degree that this is so, the present era of incipient population decline may perhaps be near the optimum. And then, redistribution and myopia aside, the case may be stronger today for fuller funding than it was when the social security system was adopted in 1937.

6. To the degree that the present income tax system leads to too little capital formation (and to deadweight loss), more than full funding of Merton's social security might be desirable. People are forced to pay in more than they will ever perceive themselves to be getting back in their old age. As the public debt is reduced by the overall government surplus, the Federal Reserve's optimal interest rate policy is one low enough to keep employment full with a high ratio of investment to income.

* * *

Finally, I should call attention to the writings of Meade (1956), Dasgupta (1969), and Gigliotti (1983*a*, 1983*b*). These are in the ancient Sidgwick-Edgeworth utilitarian tradition that wishes to maximize the product of population and per capita lifetime utility, a view emphasized

by A. P. Lerner (1957) and Asimakopulos (1967) in discussion of Samuelson (1958, 1959). The "most golden state" by this utilitarian criterion is not realized by laissez faire's full funding—as the Norwegian oil case well shows.

Notes

1. The fact that the intrinsic rate of population growth has dropped since 1960 is the only genuine new factor that creates a problem for the U.S. social security program. All things considered, steady population decline probably expands society's capacity to afford generous retirement benefits to its elderly. (A partial offset to the implied fall in the ratio of workers to retirees is the drop in the ratio of dependent minors to workers. The decline in the net reproduction rate is itself in good part a consequence of the increased propensity of women to be in the *taxable* labor market, which is another favorable offset. Finally, a declining population requires less *widening* of capital, thereby releasing more for the consumption of each person of any age. See Samuelson [1975*a*, 1976] for discussion of these crosscurrents.) But even if the population decline is on balance a favorable factor, it admittedly exacerbates the element of deadweight loss involved in financing those benefits by high taxes on the working ages.

2. I have always found it odd that a Martin Feldstein, who registered concern that social security displaces private saving by being unfunded and thereby undermining capital formation, should at the same time play down in policy discussions the Tobin-Samuelson proposals for fiscal surpluses–cum–central bank ease. Feldstein's legitimate concern over the wedge between before-tax and after-tax returns for capital by no legitimate syllogism of logic can serve to rationalize that inconsistency. The fact that chocolate is good does not negate the fact that honey is good.

3. Such equilibria are admittedly Pareto intertemporally optimal. But so too are an infinity of other contrived equilibria. And there is no reason to infer that one Pareto-optimal point is ethically better than all non-Pareto-optimum points.

References

Aaron, H. J., and Boskin, M. J., eds. 1980. *The economics of taxation.* Studies in Government Finance. Washington, D.C.: Brookings Institution.

Allais, M. A. 1943. A la recherche d'une discipline économique. Vol. 1. Paris: Private circulation.

Asimakopulos, A. 1967. The biological interest rate and the social utility function. *American Economic Review* 57 (March): 185–89.

Breeden, D. T. 1979. An intertemporal asset pricing model with stochastic consumption and investment opportunities. *Journal of Financial Economics* 7 (September): 265–96.

Dasgupta, P. A. 1969. On the concept of optimum population. *Review of Economic Studies* 36 (February): 295–318.

Deardorff, A. 1976. The optimum growth rate for population: Comment. *International Economic Review* 17 (June): 510–15.

Diamond, P. A. 1965. National debt in a neoclassical growth model. *American Economic Review* 32 (December): 289–98.

———. 1977. A framework for social security analysis. *Journal of Public Economics* 8: 275–98.

Fischer, S. 1982. Welfare aspects of government issue of indexed bonds. Hoover Institution, January (unpublished paper).

Gigliotti, G. A. 1983*a*. Total utility, overlapping generations, and optimal population. *Review of Economic Studies*, in press.

———. 1983*b*. Total utility, overlapping generations, and optimal social security. Submitted to *Journal of Economic Theory*.

Lange, O. 1936. On the economic theory of socialism, pts. 1–2. *Review of Economic Studies* 4 (October-February): 53–71, 123–42.

Lerner, A. P. 1957. Consumption-loan interest and money. *Journal of Political Economy* 67 (October): 437–41.

Meade, J. E. 1965. *Trade and welfare*. Oxford: Oxford University Press.

Merton, R. C. 1971. Optimum consumption and portfolio rules in a continuous-time model. *Journal of Economic Theory* 3 (October): 373–413.

———. 1973. An intertemporal capital asset pricing model. *Econometrica* 41 (September): 867–87.

———. 1975. An asymptotic theory of growth under uncertainty. *Review of Economic Studies* 42 (July): 375–93.

———. 1981. On the role of social security as a means for efficient risk-bearing in an economy where human capital is not tradable. Chapter 12, this volume.

———. 1982. On consumption indexed public pension plans. Chapter 10, this volume.

Musgrave, R. A. 1959. *The theory of public finance*. New York: McGraw-Hill.

Pechman, J. A., ed. 1980. *What should be taxed: Income or expenditure?* Studies of Government Finance. Washington, D.C.: Brookings Institution.

Pigou, A. C. 1944. *Socialism versus capitalism*. London: Macmillan.

Samuelson, P. A. 1958. An exact consumption-loan model of interest with or without the social contrivance of money. *Journal of Political Economy* 66 (December): 467–82. Reprinted in *Collected scientific papers of Paul A. Samuelson*. Vol. 2. Cambridge: MIT Press, 1966.

———. 1959. Reply [to Abba P. Lerner, Consumption-loan interest and money]. *Journal of Political Economy* 41, pt. 1 (May): 183–84. Reprinted in *Collected Scientific Papers of Paul A. Samuelson*. Vol. 1. Cambridge: MIT Press, 1966.

———. 1967. A turnpike refutation of the golden rule in a welfare-maximizing many-year plan. In *Essays on the theory of optimal economic growth*, ed. K. Shell. Cambridge: MIT Press, 1966. Reprinted in

Collected Scientific Papers of Paul A. Samuelson. Vol. 3. Cambridge: MIT Press, 1972.

———. 1968. The two-part golden rule deduced as the asymptotic turnpike of catenary motions. *Western Economic Journal* 6 (March): 85–89. Reprinted in *Collected Scientific Papers of Paul A. Samuelson*. Vol. 3 Cambridge: MIT Press, 1972.

———. 1975*a*. The optimum growth rate for population. *International Economic Review* 16 (October): 531–38. Reprinted in *Collected scientific papers of Paul A. Samuelson*. Vol. 4. Cambridge: MIT Press, 1977.

———. 1975*b*. Optimum social security in a life-cycle growth model. *International Economic Review* 16 (October): 539–44. Reprinted in *Collected scientific papers of Paul A. Samuelson*. Vol. 4. Cambridge: MIT Press, 1977.

———. 1976. The optimum growth rate for population: Agreement and evaluations. *International Economic Review* 17 (June): 516–25. Reprinted in *Collected scientific papers of Paul A. Samuelson*. Vol. 4. Cambridge: MIT Press, 1977.

———. 1979. Land and the rate of interest. In *Theory for economic efficiency: Essays in honor of Abba P. Lerner*, ed. H. I. Greenfield, A. M. Levenson, W. Hamovitch, and E. Rotwein. Cambridge: MIT Press.

Solow, R. M. 1956. A contribution to the theory of economic growth. *Quarterly Journal of Economics* 70 (February): 65–94.

Strotz, R. 1956. Myopia and inconsistency in dynamic utility maximization. *Review of Economic Studies* 23: 165–80.

This Page Intentionally Left Blank