

Pension Funding in a Dynamic Environment\*

By

James C. Hickman  
University of Wisconsin-Madison

**Abstract**

Concomitant with the industrial revolution, the function of providing old age income shifted from families and local institutions to government social security and private pension plans. The history of this change in the U.K. and U.S. is reviewed. A simple mathematical model provides insights into the role played by three rates (the rate of increase of the working population, the time preference rate, and the rate of real wage growth) in determining optimum funding policy.

**1. Historical Background of Pensions**

A. *Social Insurance*

The idea that government, rather than the immediate family, has an obligation to maintain the income of the elderly has many roots. One of the most interesting is in *The Rights of Man* by Thomas Paine (1737-1809) [10]. Paine was one of the liberal reformers, perhaps to be correct one should call him a revolutionary, of the late eighteenth century. Born in England, he joined the American Revolution and served as a political aide to George Washington. His pamphlet *Common Sense* appeared in January 1776, and urged independence from Great Britain. The pamphlet did a great deal to inspire the revolution. In 1787 he returned to Europe and engaged in a famous dialogue with the conservative Edmund Burke on the merits of the French Revolution.

In 1790 Burke [6] published his *Reflections on the French Revolution* in which he criticized the excesses of the revolution. Paine responded with an extended essay, *The Rights of Man*. Chapter 5 of the work has the comprehensive title "Ways and Means of Improving the Condition of Europe, Interspersed with Miscellaneous Observations." This chapter outlines a broad program

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for social reform in Great Britain. One of the elements of the plan was a government old age income plan.

Looking back over 200 years, Paine's argument remains interesting.

"I now proceed to the case of the aged.

I divide age into two classes. First, the approach of old age, beginning at fifty. Secondly old age commencing at sixty.

At fifty, though the mental faculties of man are in full vigor, and his judgment better than at any preceding date, the bodily powers are on the decline. He cannot bear the same quantity of fatigue as at an earlier period. He begins to earn less, and is less capable of enduring the wind and weather; and in those retired employments where much sight is required, he fails apace, and feels himself like an old horse, beginning to turned adrift.

At sixty, his labor ought to be over, at least from direct necessity. It is painful to see old age working itself to death, in what are called civilized countries, for its daily bread.

To form some judgment of the number of those above fifty years of age, I have several times counted the persons I met in the streets of London, men, women, and children, and have generally found that the average is one in about sixteen or seventeen. If it be said that aged persons do not come much into the streets, so neither do infants; and a great proportion of grown children are in schools, and in the workshops as apprentices. Taking then sixteen for a divisor, the whole number of persons, in England, of fifty years and upwards, of both sexes, rich and poor, will be four hundred and twenty thousand."

Paine continues his informal cost analysis and assumes that only one-third of the 420,000 he estimated to be age fifty years and upward would need income assistance and of these he estimates one-half would be age fifty up to sixty and one-half would be age sixty and upward. His cost estimate is derived from these assumptions. Given that Paine also said that "each generation must be free to act for itself," it is no surprise that his plan used current cost financing. Each generation would be free to change the allocation.

For 1791 Paine derived this estimate,

"Having thus ascertained the probable proportion of the number of aged persons, I proceed to the mode of rendering their condition comfortable, which is,

To pay to every such person of the age of fifty years, and until he shall arrive at the age of sixty, the sum of six pounds per annum out of the surplus taxes; and ten pounds per annum during life, after the age of sixty. The expense of which will be:

Seventy thousand persons at six pounds per annum	£ 420,000
Seventy thousand persons at ten pounds per annum	<u>700,000</u>
	£1,120,000

This support, as already remarked, is not of the nature of charity, but of a right."

Paine's idea did not immediately influence government old age income policy in Europe. In the 1880's Bismarck, the Iron Chancellor, instituted old age benefits in Germany. His motivation was to combat the socialists by taking away one of their most appealing proposals.

Toward the end of the Victorian age, with its emphasis on self-reliance and providence, British politicians and scholars rediscovered the aged-poor that Paine had written about a century earlier. In 1891 Booth presented a paper to the Royal Statistical Society proposing a noncontributory tax-supported weekly pension of 5 shillings from age 65. The decade from 1899 through 1908 was marked with several study committees and unsuccessful political initiatives on old age income programs. In 1908 the Asquith government succeeded in enacting an Old Age Pensions Bill. The bill provided for a weekly pension benefit of 5 shillings for a single person or 10 shillings for a married couple for those who had reached age 70. The program was means related in that there was a scale of reductions to offset income from other sources. The program was supported by national general revenue. (This history is reviewed by Waley [13]).

The Social Security Act was passed in the United State in 1935. It was a key element in the program of Roosevelt administration to promote recovery from the economic depression of the early 1930's. The act provided for a system of old age pensions with benefits, based on a beneficiary's wage history. The benefits were to be paid without a needs test on the basis of right created by law and of presumed need. The system was to be self-supporting on the basis of a payroll tax. Until the enactment of Social Security Act, government old age income programs were needs related,

supported by state and local governments and funded from general revenues. (Derthick [7] has written on the history of social security in the United States.)

#### B. *Private Pensions*

Society's institutions adapt slowly to change created by technological and economic advances. With the industrial revolution workers commenced to be employed by large institutions rather than in family farms or shops. Old age income could no longer come from the family enterprise but would have to be supplied by bigger economic institutions. Savings, the excess of production over consumption, now were accumulated as money, rather than as tools, more land or trading stock, and turned over to financial intermediaries. The intermediaries would marshal these savings and invest in the economic development of other large institutions.

Occupational pension plans were relative late arrivals. The East India Company and the Bank of England had formal pensions schemes at an early date. In the United States the American Express Company established an unfunded pension plan for its employees in 1875. Nevertheless, by the beginning of the twentieth century, there were very few occupational pension plans and they tended to be unfunded and have elements of employer discretion. Those plans that did exist were based on a desire for promoting efficiency by removing superannuated employees and by benevolent paternalism.

In the years immediately following World War I, bills were enacted that in both the United States and Great Britain that established a public policy framework for occupational pensions. The British Finance Act of 1921 established the public agenda for pensions. Its main features were:

- (1) Contributions by employers to a pension plan became deductible as a business expense for income tax purposes,
- (2) The investment income of a pension fund became exempt from taxation,

- (3) A set of conditions concerning the communication of benefits to employees and the permanence of the trust holding the money were established, and
- (4) Tax rules permitted an employer to deduct each year as a business expense "normal contributions" and an annual solvency payment "to amortize the initial liabilities of the pension plan."

In the United States features (1) and (2), were enacted in 1921, and feature (4) was enacted in 1928. Feature (3) was established as a result of several acts, especially the Revenue Act of 1938. The dates are not as important as the policy issues which were defined rather clearly during the 1920's. (The history of the British private pension movement is reviewed by Benjamin et al. [2].)

The public recognized that in an industrial age it was desirable for social welfare purposes to encourage employers to establish pension systems. Individual savings and direct investment could no longer provide old age income security in an age of large institutions. At the same time, central governments were turning to the income tax as the main source of revenue. As a consequence, governments had an interest in defining an upper limit for the tax deductibility of pension contributions in order to preserve their tax base. For seventy years governments have had to balance consideration of workers' security, which would motivate large pension contributions, and the need for a broad tax base which would lead to low bounds on tax deductibility.

In the United States and Great Britain, there was an explicit decision to promote worker security and to encourage the efficient allocation of capital through open markets, by encouraging the use of an external trust fund. The alternative would have been to use pension contributions within the firm supporting the plan.

Following World War II, the realities of the industrial age were established. The institutions, labor unions, trust and insurance companies, and laws were in place. Workers adopted secure old age pensions as a major objective and occupational pension systems grew rapidly.

## 2. Issues in Funding Private Pensions

The growth of private pensions in the industrialized world have created a set of issues. These issues relate to the various constituencies that have an interest in pension funding. These issues have been associated with private pensions throughout this century. They will be presented in outline form. In stating the issues, it will be stipulated that private pension systems can contribute to the general welfare by providing old age income. The issues listed will relate to the decision to accumulate assets over a worker's working career to provide old age income.

### A. *Public Policy Issues*

- (1) Should savings through private pensions be encouraged? In general, savings promote economic growth by facilitating investment. Yet savings through private pensions cannot easily be brought into accordance with a national macroeconomic policy, which at times may emphasize savings and investment and at other times consumption.
- (2) If private pensions are to be funded, should investment within the firm or external investments be encouraged? External investment promote members' security through diversification and the efficient allocation of capital. Internal investment may finance the growth of firms in nations with poorly developed capital markets.

### B. *Employer Issues*

Employers in the nineteenth century may have been motivated by paternalism to establish pension systems. Today, the goal is to secure a stable and motivated work force. The use of a funded pension to achieve this goal is associated with several issues.

- (1) There are many risks and complications in designing and implementing a funded pension plan. In addition, recent years have seen the rise of an individualistic ethic.

Would the goals of the employer be achieved by increasing wages and letting workers make their own retirement plans?

- (2) Worker stability is enhanced if they feel that they have a direct stake in their employer's success and their society. In existing private employer-based pension plans, participants have no mechanism for influencing investment decisions. Would individual retirement plans enhance the feeling of participation?

C. *Accounting Issues*

There are two essential accounting issues related to private funded pension plans.

- (1) How do you allocate pension costs so that they are charged to the year in which the labor was performed and an associated benefit increment earned?
- (2) How do you communicate to the employer some idea of the size of the pension obligation and some sense of the reliance that can be placed on the estimate of the amount of this obligation?

These two issues align with the two fundamental purposes of accounting. These are the definition and measurement of income and assets and liabilities. Accountants have been especially concerned with the definition of annual pension expense. To allow choice in the selection of the budgeting or funding method for allocating pension expense to each year and in the demographic and economic assumptions by which the current value of future pension expenditures is estimated, would reduce the comparability of income statements of different enterprises. The purpose of Financial Accounting Standard 87 promulgated in the United States by the Financial Accounting Standards Board is to improve this comparability by specifying a funding method (projected accrued benefit) and providing some market-based discipline on assumptions.

#### D. *Employee Issues*

Trowbridge and Farr [12] have stated that the two basic reasons for funding private pensions are (1) to enhance the security of employee pension expectations and (2) to assist employers in budgeting pension costs. The second of these reasons is related to accounting but the first concerns employees. For an employee, funding with diversified investments promotes old age income security. On the other hand, the allocation of current pension contributions to build assets to match pension liabilities may reduce the adequacy of income for those now at retirement age.

### 3. **Issues in Funding Social Security**

#### A. *Intergenerational Equity*

At the core of the funding issue in social security is intergenerational equity. If a society has as a basic value that each generation has an inescapable duty to allocate income to the elderly, the issue has been resolved. In modern industrial individualistic societies, this value is not established. Over 150 years ago, one of the most acute commentators on American society, Alexis de Tocqueville [8], wrote that he believed that individualism heightened tensions between generations:

"Amongst democratic nations, new families are constantly springing up, others are constantly falling away, and all that remain change their conditions; the woof of time is every instant broken, and the track of generations effaced. Those who went before are soon forgotten; of those who will come after, no one has any idea: the interest of man is confined to those in close propinquity to himself. As each class approximates to other classes, and intermingles with them, its members become indifferent, and as strangers to one another."

de Tocqueville went on to say: "Not only does democracy make every man forget his ancestors, but it hides his descendants and separates his contemporaries from him; it throws him back forever upon himself alone." Perhaps in other societies the issue of intergeneration equity is resolved at a basic level. The rapid industrialization and democratization of many nations would suggest that the issue will appear outside the United States. Social security systems arose because

of the inability or unwillingness of immediate families or communities to allocate income to the elderly. Will the broader community, the nation, be willing to make such an allocation? Can advanced funding create investment that will increase national productivity so that the burden of social security payments will be relatively lighter?

For a program of advanced funding of social security to succeed in promoting national productivity, several conditions must be satisfied:

- (1) The funds must actually be invested in long-term projects that will increase productivity,
- (2) Other savings must not decline, and
- (3) Government must resist the temptation to improve benefits as funds increase.

The economic and political obstacles to meeting these conditions are such that most nations use current cost or, at most, partial funding for social security benefits. The result is that the stability of social security systems results on an informal political compact between successive generations.

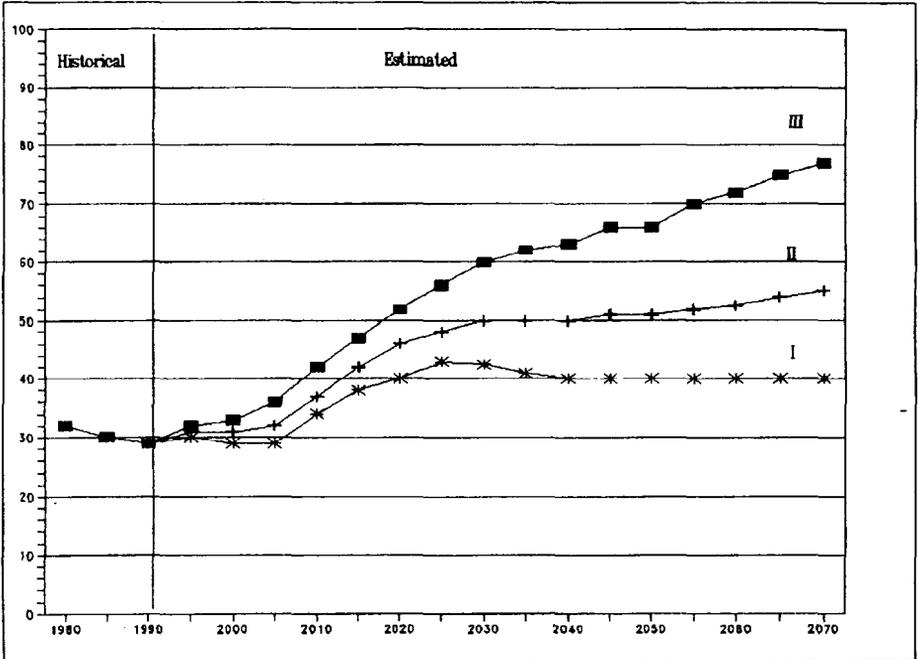
This compact will be strained in industrialized nations in the next century. As a result of demographic realities, the number of social security beneficiaries relative to the number of active workers paying taxes to support the system will increase rapidly in the United States. This is illustrated in Figure 1, taken from the 1992 Report of the Trustees of the Old Age Survivors and Disability Insurance (OASDI) Systems. The labels, I, II, and III denote alternative sets of demographic assumptions. The likely adjustments will be an increase in the tax rates to support the systems and an increase in retirement ages to expand the active work force.

#### B. *Income Redistribution*

In the United States, the federal government has two powerful tools for redistributing income. These are the progressive income tax and the social security system. From its enactment in 1935, the social security benefits have been weighted in favor of low income workers. For

FIGURE 1

RATIOS OF ESTIMATED OASDI BENEFICIARIES PER 100 COVERED WORKERS BY ALTERNATIVE, CALENDAR YEARS 1982-2070



SOURCE: SOCIAL SECURITY ADMINISTRATION (1992)

example, in 1994 the base retirement benefit for a worker retiring at age 65, called the Primary Insurance Amount, is determined by the formula:

$$\begin{aligned}
 & (.90) * (\text{FIRST } \$422 \text{ AIME}) \\
 + & \\
 & (.32) * (\text{AIME BETWEEN } \$422 \text{ AND } \$2545) \\
 + & \\
 & (.15) * (\text{AIME ABOVE } \$2545)
 \end{aligned}$$

In this formula AIME is Average Indexed Monthly Wages. The big point is that much smaller constants, .32 and .15, are applied to higher layers of income than the constant .90 applied to the lowest level of income.

This is a reflection of the ongoing political compromise between "social adequacy" and "individual equity" that has always been part of the U.S. system. Without weight given to "social adequacy" there would seem to be small justification for a government-sponsored program.

#### 4. Actuarial Issues on Pension Funding

##### A. General Dynamic Model

In a set of three papers, Bowers, Hickman and Nesbitt [3][4][5] developed a comprehensive mathematical model of pension funding. The model includes components for changes in salary attributable to changes in productivity across time, changes in salary attributable to individual merit and experience as a function of age, investment income, post-retirement benefit adjustments, and changes in the rate of entry into the plan. It would be impossible to summarize the model in a few paragraphs. As an alternative, we will study a general pension plan income allocation equation that is derived from the model. The equation will yield several business and public policy implications.

$$\begin{aligned}
 \text{Pension Fund Income} & & = & & \text{Allocation of Pension} \\
 \text{Rate at Time } t & & & & \text{Fund Income at Time } t \\
 P(t) + \delta V(t) & = & B(t) + & \frac{dV(t)}{dt}
 \end{aligned}$$

In this equation

- $P(t)$  = the rate of normal cost (contributions) at time  $t$ ,
- $V(t)$  = the present value of future pension payments to participants covered by the plan at time  $t$  as defined by a specified funding method,
- $B(t)$  = Benefit payment rate at time  $t$
- $\delta$  = The force of interest

The equation can be interpreted as

- Normal Cost Rate at Time ( $t$ ) + Interest Income Rate at Time  $t$  =
- Benefit Payment Rate at Time  $t$  + Rate of Change in Pension Liability at Time  $t$

All pension funding plans can be interpreted using this equilibrium equation. For example, current cost or pay-as-you-go funding satisfies the income allocation equation.

$$P(t) = B(t).$$

We will simplify the model by assuming that the dynamic elements involve constant annual rates of change (increase or decay). We will assume that the rate of entry of new participants is changing at an annual continuous rate  $\alpha$ , the rate of salary payment is changing continuously as a result of general productivity changes at an annual rate  $\gamma$  and following retirement at age  $r$  members can expect benefits to increase continuously at an annual rate,  $\beta$ . These simplifying assumptions are probably never exactly realized, but they do lead to insights. Exponential rates of change are used in cost estimates of the OASDI system in the United States.

Under these exponential change assumptions, the income allocation equation becomes

$$P(t) + (\delta - \alpha - \gamma) V(t) = B(t).$$

The immediate conclusions are as follows:

- (1) If the rate of interest ( $\delta$ ) exceeds the sum of the rate of change in the rate of entry and the rate of change across time in the rate of salaries ( $\alpha + \gamma$ ), then the normal

cost rate  $P(t)$  will be smaller than the rate of benefit payment  $B(t)$ . That is, if  $\delta > \alpha + \gamma$ , then  $P(t) < B(t)$ .

- (2) If the rate of interest ( $\delta$ ) is less than the sum of the rate of change in the rate of entry, and the rate of change across time in the rate of salaries ( $\alpha + \gamma$ ), then the normal cost  $P(t)$ , will be larger than the rate of benefit payment  $B(t)$ . That is, if  $\delta < \alpha + \gamma$ , then  $P(t) > B(t)$ . In this case, current cost funding will result in the lowest contribution rate.

It appears that the economic desirability of pension funding is sensitive to the relationship between the interest rate ( $\delta$ ) and the sum of the rate of change in the rate of entry into the plan plus the rate of change in productivity ( $\alpha + \gamma$ ). Because it is the difference  $\delta - (\alpha + \gamma)$  that is critical, adding an inflation component to  $\delta$  and to  $\gamma$  would not affect the conclusion. That is, our conclusions hold independently of whether  $\alpha$  and  $\gamma$  are stated in real or nominal terms.

#### B. *Current Cost Financing of Social Security*

A theorem on social security funding that is closely related to the results just stated has been studied by Samuelson [11], Aaron [1] and Hickman [9]. Despite simplified and unrealistic assumptions, the theorem provides insights into the economic and political forces that influence decisions on social security.

##### (1) Assumptions and Notation

###### (i) Demographic

$s(x)$  = a survival function that yields the probability of survival to age  $x$ . This function does not change over time.

$ne^{\alpha t}$  = rate at which new entrants join the working force at time  $t$  and age  $a$ .

$r$  = uniform age of retirement.

(ii) Economic

$\delta$  = continuous average rate of time preference for present goods rather than future goods.

$w(x)$  = average annual rate of wage payment at age  $x$ . This measures individual merit and promotion effects.

$e^{\gamma t}$  = increase factor in average wages at time  $t$ . This function measures changes in real wages, such as productivity changes, that are a function of time. A life age  $x$  at time  $t$  can expect to earn wages at the rate  $w(x)e^{\gamma t}$ .

(iii) Social Security Plan

$f$  = constant fraction of average final real wages paid as a social security benefit. The benefits are adjusted for post-retirement increases in average wages ( $\gamma$ ).

$\pi(t)$  = payroll tax rate applied to all wages at time  $t$  to fund benefits paid at time  $t$  on a current cost basis.

(2) Preliminary Results

$$\begin{aligned} W(t) &= \text{rate of total wage payments at time } t. \\ &= \int_a^r [ne^{\alpha(t-x+a)}s(x)] [w(x)e^{\gamma t}] dx \\ &= \int_a^r [\text{number of survivors}] [\text{wage rate}] dx \end{aligned}$$

$$\begin{aligned} B(t) &= \text{rate of total benefit payments at time } t \\ &= \int_r^\infty [ne^{\alpha(t-x+a)}s(x)] [fw(r)e^{\gamma t}] dx \\ &= \int_r^\infty [\text{number of survivors}] [\text{benefit rate}] dx \end{aligned}$$

By the current cost funding method, we have

$$\pi(t)W(t) = B(t).$$

We can demonstrate that  $\pi(t)$  does not depend on  $t$  and

$$\pi = \frac{f_{r-a} | \bar{a}_a w(r),}{\bar{a}_a^{(w)} | \frac{r-a}{r-a}}$$

where each of the contingent annuities is valued at interest rate  $\alpha$ , and  $\bar{a}_a^{(w)} | \frac{r-a}{r-a}$  is determined using the special "survival function"  $s(x)w(x)$ .

(3) Is This Social Security System a "Good Buy?"

At age  $r$ , the age of retirement, and at time  $t$ , the average participant's position can be summarized by two expressions.

Accumulated value of payroll tax

$$T(t) = \pi \int_a^r [e^{\delta(r-x)}] [e^{t-(r-x)}] \gamma w(x) [s(x)/s(r)] dx$$

$$= (\text{Payroll Tax Rate}) \int_a^r \left[ \text{time preferences} \right] * \left[ \text{average wages} \right] * \left[ \text{survival accumulation} \right] dx$$

Present value of future income benefits

$$I(t) = f \int_r^\infty [e^{-\delta(x-a)}] [e^{t+(x-r)}] \gamma w(r) [s(x)/s(r)] dx$$

$$= (\text{fraction of real wages paid}) * \int_r^\infty (\text{time preference})(\text{wages})(\text{survival}) dx$$

The question of whether this social security system is a good buy for the average worker will be determined by examining

$$T(t) \stackrel{>}{\stackrel{<}{\approx}} I(t).$$

This is reduced to

$$\pi \bar{a}_a^{(w)} | \frac{r-a}{r-a} \stackrel{>}{\stackrel{<}{\approx}} f w(r)_{r-a} | \bar{a}_a,$$

which is equivalent to

$$\left. \frac{r-a}{a} \frac{\bar{a}_a}{(w)} \right|_{a: |r-a|} \alpha > \left. \frac{r-a}{a} \frac{\bar{a}_a}{(w)} \right|_{a: |r-a|} \delta - \gamma$$

If  $\alpha = \delta - \gamma$ , then  $T(t) = I(t)$ . That is, if  $\delta = \alpha + \gamma$ , the average rate of time preference is equal to the sum of the rate of increase in the rate of new entrants and the rate of increase in real wages, then for the average participant the actuarial value of payroll taxes equals the value of benefits at retirement.

If we can show that  $\alpha > \delta - \gamma$  implies that  $T(t) < I(t)$ , then social security will be a good buy when the rate of increase in new entrants plus the rate of increase in productivity exceeds the average time preference rate. This conclusion follows from a lemma.

**Lemma:**

The function  $H(\theta)$  is a general form of the fraction that enters our comparison, where

$$H(\theta) = \frac{\int_r^\infty e^{-\theta(x-a)} s(x) dx}{\int_a^r e^{-\theta(x-a)} s(x) w(x) dx}$$

Then  $H(\theta)$  is a decreasing function of  $\theta$ .

**Proof:**

$$H'(\theta) = \frac{\left[ - \int_r^\infty x e^{-\theta x} s(x) dx \int_a^r e^{-\theta x} s(x) w(x) dx + \int_r^\infty e^{-\theta x} s(x) dx \int_a^r x e^{-\theta x} s(x) w(x) dx \right]}{\left[ \int_a^r e^{-\theta x} s(x) w(x) dx \right]^2}$$

We seek to show that the numerator of the expression for  $H'\theta$  is negative.

This follows from the facts that

$$a < \int_a^r x [e^{-\theta x} s(x) w(x)] dx / \int_a^r e^{-\theta x} s(x) w(x) dx < r < \int_r^\infty x [e^{-\theta x} s(x)] dx / \int_r^\infty e^{-\theta x} s(x) dx,$$

and then

$$- \int_r^\infty x e^{-\theta x} s(x) dx \int_a^r e^{-\theta x} s(x) w(x) dx + \int_a^r x e^{-\theta x} s(x) w(x) dx \int_r^\infty e^{-\theta x} s(x) dx < 0.$$

We summarize our results as a theorem.

**Theorem:**

Using the assumptions stated in (1), if  $\alpha > \delta - \gamma$ , then  $T(t) < I(t)$ , if  $\alpha = \delta - \gamma$ , then  $T(t) = I(t)$  and if  $\alpha < \delta - \gamma$ , then  $T(t) > I(t)$ .

**Proof:**

The result follows from the observation in (3) and the Lemma.

In simple terms, this theorem tells us that a social security system paying a constant fraction of current real wages to retired lives and funded on a current cost basis by a flat payroll tax is a good bargain for the average participant if the time preference rate ( $\delta$ ) is less than the sum of the rate of growth of the population of participants ( $\alpha$ ) and the rate of growth of real wages ( $\delta$ ). These conditions were met in many of the industrialized nations in the years following World War II. The

growth of the working population and real wages were rapid. The result was strong political support for a current cost social security system. Today, the rate of growth of the working population and real wages has slowed, resulting in predictable political strains on social security systems funded on a current cost basis.

In Section 3.A, it was indicated that the current issue in the U.S. is whether the rate of growth in the number of participants should be increased by raising retirement ages or productivity increased by government investments derived from a funded social security system.

### C. *Inflation*

Price inflation has made long-term planning risky for governments, corporations and individuals. One of the most powerful reasons for a national program of social security is the absence of a private annuity product that will provide security of real income. Governments, with their power to tax current income for transfer purposes, have a better chance of providing lives at least partial protection from inflation. In the U.S., social security payments are indexed to the Consumer Price Index, with annual adjustments made in benefit amounts.

Sponsors of private pension plans are seldom willing to accept the full risk of indexing benefits to a price index. A practical, but not perfect, alternative is to exploit the fact that real interest rates tend to be more stable than nominal rates. If liabilities for retired lives are valued at the approximately real interest rate, inflation-induced earnings in excess of this rate can be used to increase benefits. The correlation between the excess of investment return over the assumed real investment return and inflation is not perfect. In practice, however, the use of this method in the United States has provided good inflation protection.

There are two models. The first is the variable annuity developed by the College Retirement Equity Fund (CREF). The retirement income varies directly with the total income, dividends and price changes, of a supporting fund of assets. Retirement benefits can both increase and decrease.

The supporting fund can, in theory, be invested in any set of assets. CREF is invested in common stocks.

The second alternative is to leave to a governing board's judgment the granting of benefit increases based on investment performance better than that assumed. The assumed interest rate is typically set equal to an estimate of the real interest rate. The responsible board, in order to avoid unpopular negative benefit adjustments, follows a rather conservative approach in awarding the increases.

The United Presbyterian Church in the U.S.A. has followed this second alternative in administering the pension plan for its employees. Table 1 shows the effect of the program of investment-based benefit increases compared with increases in the Consumer Price Index (CPI). Note that, except for participants retiring in 1965 and 1966, all retired lives have had an increase in real benefits since retirement. In this example, the assumed interest rate is currently 4.5% per year. Investment earnings above this rate and other deviation between actual experience and the valuation assumption are used to increase benefits.

## **5. Summary Observations**

If political stability exist to validate financial claims, funding private pensions has desirable consequences from several viewpoints.

- (a) Accounting. The full costs of current production are more completely recognized.
- (b) Employees. Old age income is more secure because of the existence of assets, especially if these assets are diversified.
- (c) Public. Savings through pension funds may promote investment and productivity.

If real interest rates are greater than the rate of increase of real wages, then funding has economic advantages to an employer committed to providing old age income to retired employees. In this case, post-retirement benefit adjustment costs can be managed.

The issues in deciding on funding social security systems are more complex. Governments can compel participation in social security and these systems are often viewed as tools of social and economic policy. The social adequacy of the benefit structure must be balanced with the individuals equity of the system. This balance is struck by a political process. High rates of growth of population and real wages tend to lead to current cost funding. When these rates decline, current cost social security systems tend to have less support.

Table 1

Compound Growth in the Pension Benefit of the United Presbyterian Church (USA) Plan and the CPI from Each Year of Potential Retirement, 1964 through 1992

Year of Retirement 12/31/	Percent Increase Through 12/31/92	
	UPUSA	CPI
1964	384.5%	359.4%
1965	345.3%	353.9%
1966	345.3%	345.5%
1967	345.3%	330.8%
1968	345.3%	318.3%
1969	306.5%	299.5%
1970	306.5%	276.5%
1971	306.5%	256.9%
1972	248.0%	245.2%
1973	248.0%	233.8%
1974	214.0%	208.8%
1975	214.0%	173.5%
1976	214.0%	155.6%
1977	214.0%	143.9%
1978	185.4%	128.3%
1979	185.4%	109.5%
1980	185.4%	84.9%
1981	146.1%	64.5%
1982	146.1%	51.0%
1983	123.7%	45.4%
1984	113.0%	40.1%
1985	90.2%	34.7%
1986	69.8%	29.7%
1987	55.8%	28.3%
1988	31.0%	22.9%
1989	24.8%	17.7%
1990	16.6%	12.6%
1991	8.0%	6.1%
1992	8.0%	2.9%

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