Demographic Changes and Funding for Pension Plans

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Many sectors of the economy have felt the impact of the dramatic decline of birth rates from the post-World War II level that began about 1960. Among the first was our education system. New schools were built and more teachers were trained in response to increases in demand for schooling when birth rates were high. Now the decline in school age population has left many school buildings empty and trained teachers unemployed. The havoc created by the demographic shift has awakened many planners to the need for closer attention to population changes and to raising their time horizon to decades ahead.

Economic planners have rarely looked more than five years ahead. There are several explanations for this lack of long-term planning. First, forecasting with any precision for a long time ahead is impossible. The actual outcome will not likely be realized exactly as forecast. Some conditions can be reasonably projected for the future, while others are open to large errors and much less confidence can be placed on them. However, demographic shifts can be projected with some accuracy for the existing population base.

The yearly increments and decrements to the population have little effect on the demographic composition in any given year. It is their cumulative impact that matters. The population base is large in proportion to any change that occurs in one year. The factors which increase the population — fertility rates and immigration — do not show their cumulative effects until years later. The same can be said for the elements that reduce the population — mortality rates. During the initial period when rates of fertility, mortality, and immigration are fluctuating, their full impact on the demographic composition would not be clear unless the population is examined when it reaches a stationary condition. Yet the life cycle is of such length that it requires 50-75 years to reach the stationary state. Therefore, any analysis of the economic impacts arising from demographic shifts has to look into the distant future. While there are great uncertainties in long-range projections, nevertheless they can provide some indications as to what the future might be if certain predictions based on current trends are realized.

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Pension funds are a significant part of the capital market. At the end of 1975, total assets accumulated by private pension plans were estimated to exceed $250 billion. The implications of demographic shifts since World War II on pension plans — social and private — are examined in this study. Changes in the birth rates have already affected pension funding in the mid-1970s. Their total cyclical impact will last the next 50 years; in the absence of other new demographic shifts, an equilibrium state will be reached in the 2020s.

Two major systems of pensions are in existence today. Social Security provides the largest part of retirement income in the United States. In addition, private pensions play a significant role in the provision of income to retired persons. The role of private pensions will increase with time because more workers are being covered and vesting provisions have been strengthened. As a result, more workers will be eligible for private pensions and for greater amounts.

Pensions, social or private, alter the savings behavior undertaken directly by individuals. Various studies[1] have examined the economic effects of Social Security, and private pension plans. Recent econometric studies tend to show that the net impact of Social Security induces workers to reduce their private savings. Meanwhile private pensions also supplant direct savings by individuals. Their effect on the capital market depends on the funding methods adopted for Social Security and private pension plans. The aggregate savings over time is determined in part by the demographic composition. The potential economic effect resulting from the demographic shift is the subject of this analysis.

Demographic Shift

Like economic conditions, the U.S. population is also ever-changing. Besides migration, there are two major factors that cause population statistics to change. First, the reproduction rate. The statistical method used to measure reproduction is called the fertility rate, which expresses for a given calendar year the number of children that a woman of child-bearing age can expect to have throughout her child-bearing years if the birth rates then currently apply to her and she survives those years. A fertility rate of 2.1 is necessary if a mature population is to remain at the zero population growth.

[1]See Phillip Cagan, "The Effects of Pension Plans on Aggregate Savings: Evidence from a Sample Survey," National Bureau of Economic Research Occasional Paper 95 (New York: Columbia University Press, 1965); Alicia Munnell, *The Effects of Social Security on Personal Savings* (Cambridge, Mass.: Ballinger Publishing Company, 1974); Alicia Munnell, "Private Pensions and Savings: New Evidence" (paper presented at the National Bureau of Economic Research Conference, May 19-20, 1975); Martin Feldstein, "Social Security, Induced Retirement and Aggregate Capital Accumulation," *Journal of Political Economy*, Vol. 82 (September/October 1974).

Since 1900, when reasonably accurate population statistics began to be collected, the fertility rate of the United States has declined steadily. This trend was halted after World War II. After an aberrational bulge which lasted until the end of 1950s, the fertility rate resumed its historical downward course. Table 1 shows that the fertility rate reached the bottom of its trough in 1950, then turned upward dramatically and sustained an upward rate of change until 1957. Since then, the fertility rate has declined sharply. Many demographers had expected the fertility rate to bottom out around the end of the 1960s and remain level thereafter. However, the downward trend continues. Currently the rate is about 1.75, below the replacement rate for zero population growth in the absence of migration.

Undoubtedly the decline in the fertility rates reflects better birth control methods, legalized abortion, the changing role of women, better public education and attention given to family planning, and other changes in life styles.

On the other hand, economic studies published by Richard Easterlin[2] show a "wave" phenomenon in fertility rates. Furthermore, the demand for children by household is a function of economic cycles.

While it is impossible to make accurate predictions of fertility rates for the future, it is difficult to believe that the United States would, in the long run, permit the fertility rate to remain at a level below the zero population growth. The resulting effects such as disrupted social structures, unfulfilled economic expectations and fractured institutions would be so great that public law may well be enacted to remedy the decline in total population. Among the policy instruments which can reverse the downward population trend are immigration policies, child allowances, free child care, etc.

The other major factor that determines the demographic composition is the mortality rate. Mortality rates changed significantly in the 1950s when death rates were declining for infants and for adults over age 50. That decreasing trend leveled off in the early 1960s. Since then the mortality rate has remained relatively level for most age groups. Recently there have been moderate improvements for infants in the South and in other low income areas, and also a slight improvement for older ages. However, without a major conquest of cancer or cardiovascular diseases, mortality rates are unlikely to show any significant improvements.

Funding of pensions is affected by population in two ways. First, the aggregate amount of a pension fund is determined by the number of covered workers. Second, the change in the demographic composition greatly affects the payroll tax rates that are needed to finance the Social Security program. This brings up the question of intergeneration equity. Moreover,

[2]Richard Easterlin, "Does Human Fertility Adjust to the Environment?" *American Economic Review, Papers and Proceedings,* 61:399-407, May 1971. Also Richard Easterlin, *Population, Labor Force and Long Swings in Economic Growth* (New York: Columbia University Press, 1968).

Table 1

FERTILITY RATES OF THE UNITED STATES
1948-1975

Year	Fertility Rate	Year	Fertility Rate
1948	3.11	1962	3.47
1949	3.11	1963	3.33
1950	3.09	1964	3.21
1951	3.27	1965	2.93
1952	3.36	1966	2.74
1953	3.42	1967	2.57
1954	3.54	1968	2.48
1955	3.58	1969	2.46
1956	3.69	1970	2.48
1957	3.77	1971	2.28
1958	3.70	1972	2.02
1959	3.71	1973	1.90
1960	3.65	1974	1.81*
1961	3.63	1975	1.75*

*Based on preliminary data from the U.S. Vital Statistics Report.

Source: U.S. Department of Health, Education and Welfare, Social Security Administration, *Actuarial Study No. 72,* U.S. Government Printing Office, Washington, D.C. 1975.

the shift in the age distribution of the population also alters the total amount of private pension funds.

The demographic shift is illustrated in Table 2. The fertility rate is likely to be the most significant and volatile factor in changing the population composition. Three different fertility rates are used in projecting the population. The first one, assumption A, uses an ultimate fertility rate of 2.1 that will maintain zero population growth. Under this assumption, the population projection shows a continuing increase in the total population of the United States because of the rising number of child-bearing age women and an increase in the fertility rate from the present rate of 1.7 to 2.1.

One very important effect of the low fertility rate is its impact on the retirement dependency ratio — the ratio of people age 65 and over to the working age population. In 1975 that ratio was 0.18. In other words for every 100 people between the age of 18 and 64, there were 18 persons age 65 and over. The retirement dependency ratio will increase steadily over time, but reach a stable level by the early 2020s. By then the ratio is projected to reach 0.27, an increase of 50 percent from 1975. This demographic shift with its drastic change in the retirement dependency ratio is a cause for concern. The implication for pension funding will be discussed in a later section of this paper.

The sensitivity of the fertility rate assumption is illustrated in Table 2. A higher fertility rate of 2.7 would increase the total population by a significant number. Under this assumption, the population would rise sharply. By the year 2025, the total population would increase by 80 percent. Meanwhile the retirement dependency ratio would increase by a moderate amount from 0.18 to 0.23.

Another fertility rate assumption that is used in the sensitivity analysis is the 1.7 rate which closely approximates the current experience. With this rate the retirement dependency ratio increases sharply while the total population rises only slightly.

Demographers have illustrated the change in the demographic composition graphically. The age cohort pyramids for two time periods, superimposed on each other, provide a visual picture of the shift in age composition in the population. If there is little change in the fertility and mortality rates between age cohorts, the pyramid would take the expected triangle shape where the largest group of persons is between age 0-4, then the number of persons will decrease according to the mortality rates. However, the U.S. fertility and mortality rates have been unstable. With the fluctuations in these rates even by year 2025 the population would not have reached a stationary number. The pyramid for year 2025 still has a slight bulge from age 5 to 44. This phenomenon arises from the change in fertility rates. Figure 1 is based on a set of projections which assumes that fertility rates will rise from the current low level to an ultimate rate of 2.1. As the number of women increase and attain child-bearing age, the number of second generation babies will increase. However even by year 2025,

Table 2

PROJECTION OF THE U.S. POPULATION BY BROAD AGE GROUPS

Year	Population (in thousands) as of July 1				65 and Over		Ratio of Persons
	Under Age 18	18-64	65 and Over	Total	Percent of Total	Ratio to Age 18-64	Under Age 18 to Persons Age 18-64
Assumption A— 2.1 Fertility							
1975	66,273	124,847	22,330	213,450	10.5	0.18	0.53
2000	71,079	160,815	30,600	262,494	11.7	0.19	0.44
2025	74,857	176,751	48,105	299,713	16.1	0.27	0.43
2050	78,701	188,448	51,247	318,396	16.1	0.27	0.42
Assumption B— 2.7 Fertility							
1975	66,273	124,847	22,330	213,450	10.5	0.18	0.53
2000	91,152	165,255	30,600	287,007	10.7	0.19	0.55
2025	121,054	212,852	48,105	382,011	12.6	0.23	0.57
2050	158,987	283,767	56,575	499,329	11.3	0.20	0.56
Assumption C— 1.7 Fertility							
1975	66,273	124,847	22,330	213,450	10.5	0.18	0.53
2000	57,322	157,176	30,600	245,098	12.5	0.19	0.36
2025	49,938	152,378	48,105	250,421	19.2	0.32	0.33
2050	44,146	135,532	47,024	226,702	20.7	0.35	0.33

Source: U.S. Bureau of Census, Current Population Report, Series P-25, No. 601, "Projections of Population of the United States: 1975-2050."

not all child-bearing age women would have completed their planned family size. Figure 1 also shows that the low birth rates in the 1930s have been responsible for the small number of people between ages 35-45 in 1975.

But the important point brought out by Figure 1 is that the total number of persons over age 25 is expected to increase between the year 1975 and the year 2025. People over age 65 are projected to increase at a higher rate than persons between ages 25-64. While the retirement dependency ratio is expected to increase, the ratio of dependent children to the working population is expected to decline.

Funding of Pension Systems

Among the important factors which influence the fund development of the pension system are (1) the funding approach that system adopts (2) the changes in the benefit structure and (3) the shifts in the age distribution of the covered population. Besides these elements which affect the funding levels of a matured pension system,[3] the fund of a retirement program is also greatly influenced by transitional changes. Between the time when a pension plan begins to operate and the time it reaches maturity, the proportion of covered older persons to younger persons will increase because of the omission of some of the current aged who are already retired at the start of the program. In addition the benefit amount per retiree, on a constant dollar basis, will rise over the transitional period because benefits are largely based on the length of time contributions are made.

There are, of course, almost an infinite number of variations that can be used to fund a pension system. One common method is the "pay-as-you-go" arrangement. Under this approach, the revenue collected each year is just sufficient to finance that year's expenditures. Frequently, this method is modified slightly by making the contribution schedule slightly larger in order to accumulate a small fund. This fund is used to even out fluctuations in the flow of funds due to economic cycles and unevenness in the time of payments.

However, one actuarial cost method used frequently in funding private pension plans is the entry age normal cost method. Under this approach, the present value of the accrued benefit for each worker is estimated, assuming that each worker enters into the pension system at a fixed age such as age 30. The present value of accrued benefits is calculated with a projection of increases in real wages along with rate of inflation and discounted by the rates of interest, death, disability and rates of termination from employment. Then the funding of the retirement

[3]A matured pension system is defined as one in which the benefit structure has remained relatively unchanged for a long period of time and where the system has been in operation for at least four decades thereby most of the workers have been covered under the pension plan for their working lifetime.

benefits for that individual worker is spread out evenly throughout the expected working life-time of the worker. Under an entry age normal cost method, the funding for a mature pension system will be largely affected by the rise in nominal wages, changes in interest rates, and changes in the age composition of the covered workers.

Funding patterns for a pension system during its transitional period — the date of inauguration to maturity — are seriously influenced by the rapid rise in the benefits being earned and by the approach used to finance the accrued liability for services performed before the inception of the plan. As the number of years that workers contribute to the pension program increases, the benefit earned by new retirees becomes larger. The benefits will grow, in the absence of any revision of benefit structure, until the system reaches a point when most workers have been covered by the plan for their full working lifetime. Similarly, the funding for pension plans will increase under the "pay-as-you-go" method.

During the transitional period, a significant financial liability arises for a young pension plan. Usually benefits are based on the number of years of service that the workers have with the employer. For instance, if a plan provides a retirement benefit that equals 2 percent of the final year's salary times the years of service up to 30, a person who is age 63 and has been employed by that company for 28 years at the inception of the plan would be eligible for retirement pay equal to 60 percent of his final salary. Under an entry age normal funding arrangement, the total benefit for a young worker under age 35 would be financed over a 30-year period. The funding would begin when the worker reaches age 35. Yet for this worker age 63, there would be an initial unfunded past service liability equal to 28 years of contributions accumulated with interest rates and probability of survival until age 63. Many private pension plans amortize this initial liability over a period of 25 to 40 years when they inaugurate a new program. But many other pension plans do not fund this liability. In 1974 Congress passed the Employee Retirement Income Security Act which mandates the funding of the initial past service. The maximum period for amortizing the liability is 30 years (40 years for multi-employer plans and plans established before January 1, 1974).

Demographic Changes and Social Security Financing

Social Security is by far the largest system in the United States that provides income to retired persons. In 1975, more than $40 billion was paid to retirees in benefits.[4] About 90 percent of people age 65 or over received benefit payments.

[4]Social Security Administration, *Social Security Bulletin* Vol. 39, No. 9 (September 1976) Table Q-15, p.90.

Since the 1939 Amendment, the Social Security system has been financed by a "pay-as-you-go" scheme. The revenue collected from the payroll tax each year is intended to equal total expenditures plus a small amount to develop a contingency fund. Currently, the goal is to maintain a fund whose average size is about one year's outlay.

The financing of Social Security depends on an implicit social compact between generations of covered workers. Present workers pay a tax to finance the current benefits paid to retired people. When these workers retire, the next generation of workers will finance the necessary benefits by paying a payroll tax adequate to meet the expenditures then. The inter-generation transfer nature of such a financing scheme can be clearly illustrated by examining the initial past service liability of the system. This valuation is based on a "closed group" concept, under which the program would be continued for present participants but there would be no new entrants and no employer contributions in respect to new entrants. At the end of 1975, the present value of future benefits and expenses for this generation of people over the next 75 years is estimated to exceed the present value of future taxes over the same time period by approximately $4 trillion.[5]

In other words, a large portion of the benefits that will be received by the present "closed group" of people will not be financed and paid by the same group. Instead, these unfunded obligations will be financed by taxes collected from the generation of persons that is yet to be born.

The "pay-as-you-go" payroll tax schedule that is necessary to finance the present Social Security program would be distorted by a flaw in the current program:

The present Social Security benefit formula, legislated in 1972, adjusts benefits automatically to reflect changes in the Consumer Price Index. In addition, the automatic provisions cause the taxable earnings base to rise as average wages under covered employment increase. However, the automatic provisions suffer from an overindexing flaw which will increase benefits to future beneficiaries disproportionately in relation to price and wage increases. According to the Report of the Consultant Panel on Social Security to the U.S. Congress,[6] the outlook is for benefits that will be erratic, a tendency that will be accentuated during periods of high inflation.

There is widespread agreement that this technical flaw in the present benefit formula must be corrected. Although there is no political consensus as to an acceptable alternative, the benefit formula proposed by President Ford in June 1976[7] to correct the overindexing does provide a base by which the impact of demographic shifts on the financing of Social

[5]Data obtained from *Special Analyses, Budget of the U.S. Government, Fiscal Year 1977.*

[6]*Report of the Consultant Panel on Social Security to the Congressional Research Service,* Joint Committee Print., 94th Cong., 2nd Sess., August, 1976.

[7]For details see the "Social Security Benefit Indexing Act," H.R. 14430, June 17, 1976.

Security can be brought out clearly. President Ford proposed that for each age cohort of retirees, their initial retirement benefits replace approximately the same ratio of preretirement wages as applies for a worker who retires in 1976. Under this proposed benefit structure, the changes in the payroll tax rates necessary to finance the retirement and survivor program (excluding disability) will be largely determined by demographic shifts.

The change in the Social Security payroll tax shown in Table 3 is largely due to the shifts in the age distribution in our population. When the retirement dependency ratio increases by 50 percent, then the financing of retirement benefits under a "pay-as-you-go" arrangement would follow that pattern. Meanwhile the portion of our resources allocated to retirement income can be expected to be slightly less for the years 1995-2005. The abnormal decline in fertility rates during depression years will result in fewer retirees at the end of the twentieth century. Accordingly, the projected payroll tax rates for that period would be slightly less than what a stationary population would produce.

Undoubtedly, the economic impact of an increasing Social Security payroll tax arising from demographic shifts will reduce disposable income. According to the projected tax rates in Table 3, the rates may increase by 6-7 percent in absolute terms over the next 50 years. The increase is most pronounced during years 2010 to 2030. If we assume that the marginal utilities of both disposable income and leisure are monotonically decreasing and payroll tax is viewed as another tax,[8] then the effects from reduction in net wage rates depend on the trade-off between the marginal utility of disposable income and the marginal utility of leisure. Although an increase in the payroll tax rate reduces net wages, there is no *a priori* reason to expect that that increase will either decrease or increase the labor supply. Such an effect depends upon the shape of the preference function. Little is known empirically about labor responses to a change in the Social Security payroll tax. Much empirical investigation is necessary.

[8]It is interesting to examine people's beliefs about Social Security which influence their economic behavior. Of course, economists usually treat these factors as exogenous in economic models. Nevertheless it is important to consider consumer beliefs and social values in any economic analysis with public policy implications. Workers generally believe that they have earned their Social Security benefits through their contributions. The system is a forced savings program where the government makes it compulsory for workers to set aside a portion of their wages for retirement. A recent survey (Goodwin and Tu, "The Social Psychological Basis for Public Acceptance of the Social Security System," *American Psychologist*, September 1975, pp. 875-883) reported that in home interviews of a sample of 615 households, most workers believe paying into Social Security is like buying an insurance policy against need in their old age. If the results of this survey are valid, then workers may view the payroll tax not as a tax, but rather as a deduction from wages after taxes, similar to deductions for private pension contributions, health insurance premiums, or other contributions, etc. Accordingly, the way in which workers perceive the Social Security tax can have an important influence on labor supply.

Table 3

PROJECTED EXPENDITURES FOR RETIREMENT AND SURVIVOR INSURANCE UNDER PRESIDENT FORD'S PROPOSAL, JUNE 1976[1]
(Excluding Disability Insurance)

Year	Expenditures as Percent of Taxable Payroll (in percent)
1980	9.17
1990	9.83
2000	9.84
2010	10.35
2020	13.23
2030	15.90
2040	15.84
2050	15.69

[1]Each 1 percent of payroll equals approximately $7 billion in 1977. These projected payroll tax rates are derived with various economic and demographic assumptions. For the short run, the projected rates of inflation and rates of growth in nominal wage rates are those contained in the 1976 President's Budget. For the long run, it was assumed that beyond year 1981, the rate of inflation will be 4 percent per year and wage growth will be 5 3/4 percent per year. The fertility rate is assumed to increase gradually from the present level to an ultimate rate of 1.9 by year 2005 and remain level thereafter. The mortality rate will improve slightly for the next 25 years and then remain stable.

Source: Data in this table are supplied by the Office of the Actuary, Social Security Administration, Baltimore, Maryland, August 1976.

Although the discussion of Social Security and savings is also limited by a scarcity of empirical data, two recent studies[9] indicate that Social Security reduces aggregate savings. Social Security influences savings in two ways. First, the promised benefits of Social Security supplant the need for individuals to save for their own retirement. This substitution effect could reduce savings. Second, Social Security could increase saving through the retirement effect by inducing workers to retire earlier which increases their rate of saving. While these empirical studies differ sharply on how much Social Security has depressed savings in the past, they both agree that the net impact is a reduction in savings and they agree even more on the impact in the future. It is likely that Social Security will reduce savings more drastically in view of the recent large benefit increases and the slowing of the decline in the retirement age. Martin Feldstein's paper, which is included in this volume, provides an analysis of the implication of the "pay-as-you-go" approach to fund Social Security on capital formation in the United States.

Demographic Changes and Private Pension Funding

Changes in the funding of private pensions will be determined largely by three factors: (1) expansion of the number of covered workers, (2) changes in funding requirements mandated by law, and (3) changes in the composition of the population.

Partly because of tax incentives, pension plans have expanded rapidly. They have become important institutional investors in the capital market. Table 4 illustrates the past trend in the growth of pension plans for private employers. Even without ERISA legislation, there is no reason to believe that the rate of growth in pension funds will change significantly from the past.

The number of workers covered by private employer pension plans increased at an average annual rate of 3.4 percent per year since 1960. Of course, this rate of growth is influenced by the size of the labor force. As the working age population increases more rapidly in the future because of the demographic shift plus the continuing upward trend in the female labor participation rates, the number of workers covered can be expected to increase even more rapidly than the past.

Between the years 1960-1970 the assets held by the plans grew at a 10.2 percent rate annually. Meanwhile, the contributions increased 9.8 percent per year while benefit payments rose by 15.6 percent per year. Although the benefit payments are increasing more rapidly than contributions, the net cash flow — contributions minus benefit payments —

[9]See Martin Feldstein, "Social Security, Induced Retirement, and Aggregate Capital Accumulation," *Journal of Political Economy*, Vol. 82, September/October 1974, pp. 905-926 and Alicia Munnell, *The Effects of Social Security on Personal Savings.*

Table 4

PRIVATE EMPLOYER PENSION PLANS,
ESTIMATED COVERAGE, CONTRIBUTIONS,
BENEFIT PAYMENTS AND ASSETS, 1940-1974

Year	Number of Workers Covered (in thousands)	Contributions (in millions)	Benefit Payments (in millions)	Assets (in billions)
1940	4,100	$ 310	$ 140	$ 2.4
1945	6,400	990	220	5.4
1950	9,800	2,080	370	12.1
1955	14,200	3,840	850	27.5
1960	18,700	5,590	1,720	52.0
1965	21,800	8,460	3,520	86.5
1970	26,100	14,000	7,360	137.1
1975	29,800	25,020	12,930	191.7

Source: Data obtained from Alfred M. Skolnik, "Private Pension Plans 1950-74," *Social Security Bulletin,* June 1976, Social Security Administration, Washington, D.C.

is still positive. The explanation lies in the fact that in absolute dollar terms the contributions are still greater than benefits. The assets are increased by the positive net cash flow and by the investment earnings on the assets. Between 1970-1974, in spite of a higher rate of increase in contributions, the rate of increase in total assets slowed down to an annual rate of 8.7 percent, probably caused largely by the drop in stock prices. While net cash flow improved, total assets did not experience more accelerated rates of increase. Thus capital appreciation and investment return on the capital have recently increased at a lower rate than in the period between 1960-1970.

One provision in the Employee Retirement Income Security Act (ERISA) requires the funding of initial past service liabilities. Undoubtedly this will provide an abnormal increase in the amount of contributions to pension funds. Since the accrued benefits for which the contributions are being made are not payable until these workers retire, the aggregate pension funds will rise by these additional contributions by ERISA. This bulge in funding patterns may continue for the next 20-30 years.

The baby boom of the post World War II era has already begun to make its dent in the labor force. Between 1975 and 1985, the number of people between age 18-64 is expected to increase from 125 million to 143 million. This demographic shift towards a higher proportion of people in the working age group will swell the labor force. If the industries provide pensions to their workers and increase their employment at the same rate as the total economy, then workers covered by private pension plans will experience a surge in number with a corresponding increase in contributions. This demographic shift will boost the growth rate of aggregate pension funds.

Yet as the age cohort groups born between 1950-1960 reach retirement age in year 2015 and after, the pension funds will pay out the accumulated funds as benefits. Meanwhile, with the expectation that the lower fertility rate we have experienced will continue, the proportion of active workers will decline. Accordingly, the aggregate contributions are likely to decrease. It seems highly probable therefore that the balance of pension funds will be depressed because the net cash flow — contributions minus benefit payments — may be negative.

Conclusion

A sharp cyclic change in fertility rates since post World War II will have profound effects on the funding of Social Security and private pension plans in the years ahead. This paper discusses two major economic considerations resulting from the demographic shift: intergeneration equity and capital formation.

The fertility rate in the United States halted its steady decline in the late 1940s. The post World War II baby boom is now a well-known fact. The fertility rate reached an asymptotic point in the late 1950s and then again continued on its historical downward trend. Currently the fertility

rate is around 1.75, well below the replacement rate for zero population growth. Over the next decades, this demographic shift will produce a dramatic change in the age composition of our population. Initially the proportion of the retired population to the working population — the retirement dependency ratio — decreases. However, by the turn of the century the retirement dependency ratio will rise rapidly. Its ultimate level is likely to be 50 percent higher than in 1976.

The Social Security program is funded on a "pay-as-you-go" basis. It is a social compact between generations of workers that the present workers will pay a tax sufficient to finance the Social Security benefits for the retired population. When these workers retire, the next generation of workers will finance their benefits by paying a sufficient amount of payroll tax. This method of funding has two serious consequences: inter-generational equity and capital formation.

Under a "pay-as-you-go" funding scheme, a shift in demographic composition has a direct impact on the tax rate required to fund the program. When the retirement dependency ratio is low, the tax rates can be low. And when the retirement dependency ratio increases, the tax rates have to be increased proportionally. For the generation of workers born during the baby boom, the payroll tax rates that they have to pay during their working lifetime are relatively low. But when they reach retirement age, the tax rates required to finance their benefits will have to increase significantly, perhaps by more than 50 percent. These higher tax burdens are borne by the next generation of workers. The inequity between generations is self-evident. It may impair the long-term stability of the Social Security program.

Empirical works by Martin Feldstein and Alicia Munnell tend to show that the retirement benefits provided by Social Security change savings behavior. People tend to save less. Meanwhile, with a pay-as-you-go financing arrangement, the Social Security program does not accumulate a reserve fund that substitutes for the reduction in private savings. Therefore, Social Security affects capital formation in the United States. The demographic shift further aggravates the problem. The current workers save less than they would otherwise save. When they retire, a larger portion of our Gross National Product has to be allocated for their income support because of an increased retirement dependency ratio.

Funding for private pension plans is very different from the one used for the Social Security program. An approach frequently employed is to fund the retirement benefit of workers over their working lifetime. Therefore a reserve fund is accumulated while a person is working and the fund is spent over his retirement years. When the United States experiences a demographic shift, the pension funds would rise while the working population is increasing. However, the proportion of savings provided through private pensions will likely decline when this large working population reaches retirement age.

Discussion

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In pension funding with actuarial reserves, such as are offered by private insurers, each person's discounted prospective contributions are equal to his discounted benefits (less office loading), so that each person pays for himself. The sense in which any one individual pays for himself is not that his deductions are equal to his benefits, but rather that expected values are equal, and for large bodies of policy-holders this is what counts. In particular the cohort of people of a given age will come close to balancing deductions and benefits. The next cohort can be much larger or much smaller without this making any difference; as long as the insurer holds the calculated reserves and remains solvent, no problem of equity among cohorts or among generations can possibly arise.

Each cohort gains from the fact that the insurer can put the reserve out at interest, and the interest is for most ages of much more consequence than the gain through some members of the cohort dying before they can collect. The community benefits by having the funds for long-term investment.

In pay-as-you-go there is no reserve beyond a small buffer for smoothing year-to-year operations, and no one pays for himself. Each cohort pays for cohorts that are older than it is. There is no contract between the generations, as there is for holders of the national debt, but each one hopes that when it reaches retirement it will be covered as it covered its predecessors. There is a kind of moral claim: as we paid for our predecessors so our successors ought to pay for us. I shall later make the point that the moral claim will prove tenuous under demographic pressure and we should not lean too heavily on it.

There being no appreciable reserve in pay-as-you-go, there can be no contribution of interest to lighten the load on the scheme. Instead there is something else: a benefit from population increase. By a simple piece of algebra it can be shown that the premiums for pay-as-you-go in a population increasing at rate 100r percent will be identical with the premiums on a reserve scheme with interest at 100r percent, given the same life table, retirement ages, etc. Each individual gains exactly as much on the average from there being $1 + r$ as many individuals the year after on pay-as-you-go as he gains from the fact that the reserve increases in the ratio $1 + r$ on the reserve scheme. I will relegate the algebra to another place, but the result is important; for a population increasing rapidly, say at 2 or 3

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percent per year, the two methods might be chosen indifferently, while for the stationary population the reserve scheme might be preferable. Since the span of years between payment and benefit can be up to 35, interest or population increase could multiply early contributions by a factor as high as four.

It is a shift from an increasing to a stationary population that we are now undergoing in the United States. The change had to come sometime, since nothing can keep rising forever. If we study the table of birth rates provided by Dr. Hsiao, we see that the peak was reached in 1957 and has since been falling. More directly relevant is the absolute number of births, whose peak was reached in 1961. In that year there were 4.3 million births; by 1973 the number was down 3.1 million. If the births had continued upward from 1961 to 1973 at a modest 0.7 percent per year, then we would have had 4.7 million births in 1973, or just 50 percent more than actually occurred. It is the fact that the survivors among the 3.1 million births are going to have to pay pensions of the 4.3 million (or the shadow 4.7 million) that is causing the trouble now so much discussed.

To find the proportion of covered wages that are required at any time on pay-as-you-go is much easier than to calculate reserves. All one need do, in principle, is divide the total pension bill for the given year by the total wages that are taxable. An index of this that is sufficiently accurate to show the demographic aspect is found by taking year by year the ratio of persons over age 65 to persons aged 21 to 65. We should in principle weight according to wages for the working group, and according to pension for the older one, but the unweighted ratio of the table shows the main tendency. It uses the median estimate of the Bureau of the Census and comes to about the same conclusion as Dr. Hsiao.

Evidently the big jump of the past was during the 1950s, when the high births of the late nineteenth century, plus the high immigration around World War I, were factors. Between 1970 and 2000 the rise is slow. A further very large jump of costs comes in the twenty-first century. The peak births of 1961 reach pensionable age in 2026, so that at this time the ratio of pensionables to workers would be at an all-time high and would subsequently decline slightly. The variation over three-quarters of a century is great: a doubling between 1950 and 2025.

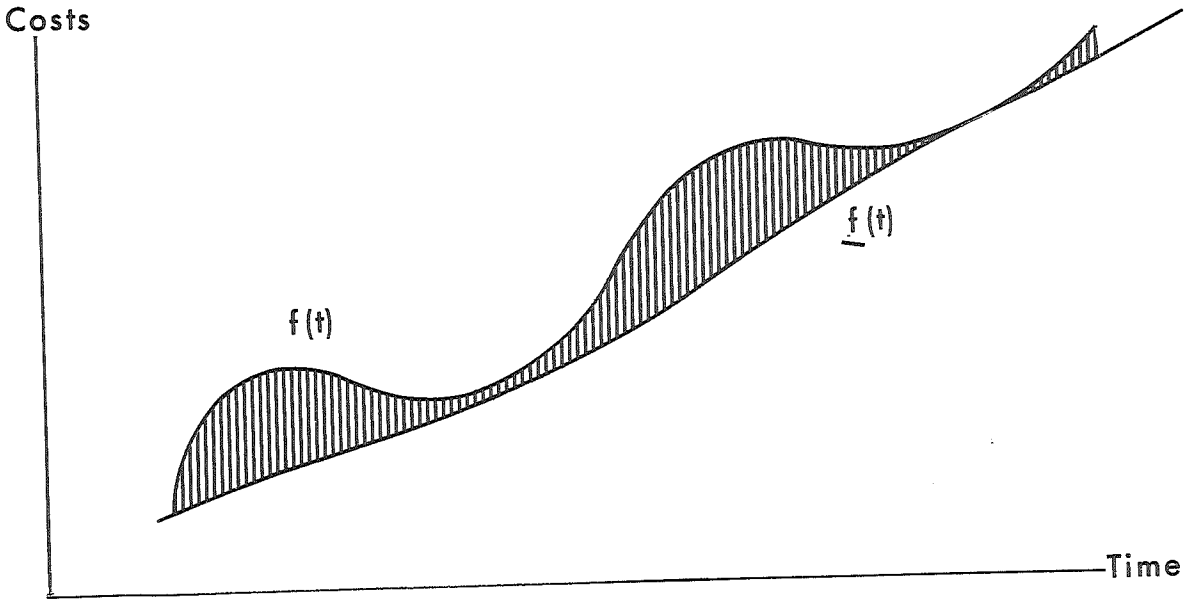
The situation is that of a chain-letter scheme, in which the first receivers of the letter faithfully send their dollars in the hope of recouping later from others, but not enough people can be found to continue the process. The mathematical analogy between pay-as-you-go and the chain letter can be elaborated to cover the case where the body of contributors does not increase fast enough.

Since pensions with actuarial reserves are immune to demographic changes, why not use them? Two difficulties stand in the way. An actuarial reserve scheme makes no provision for those who retire at the start of the scheme, and inadequate provision for those who are well into their working careers. These would be an initial one-time expense that no one

PERSONS OF WORKING AND PENSIONABLE AGES
IN THE UNITED STATES, 1950-2050
MEDIAN ESTIMATE

Year	Age 21-64	Age 65+ (in thousands)	Percent 65+/21-64
1950	85,944	12,397	14.42
1960	92,181	16,675	18.09
1970	103,939	20,085	19.32
1974	110,579	21,815	19.73
1980	122,115	24,523	20.08
1985	131,495	26,659	20.27
1990	137,500	28,933	21.04
2000	148,589	30,600	20.59
2025	146,645	45,715	31.17
2050	147,635	45,805	31.03

Source: *Statistical Abstract of the United States,* 1975, p. 6.



Costs of pensions divided into two parts, shaded $f(t) - \underline{f}(t)$ covered by reserve scheme, $\underline{f}(t)$ by pay-as-you-go.

wants to face. Secondly, it does not seem possible in the presence of inflation so to invest reserve funds as to guarantee a positive real rate of interest. This is a problem that the private insurance companies have struggled with. They know that inflation makes profits in the short run because interest rates received are quicker to take account of inflation than interest paid out, but they also know that enough inflation would destroy them in the long run because people would cease to buy insurance or annuities. No insurance company can be sure enough of its investment skills to offer a contract in real terms, say indexed on consumer prices. Reserve schemes, private or governmental, cannot be affected by demographic change, but they are sensitive to changes in the value of money. Pay-as-you-go is largely proof against inflation, but has demographic troubles.

The main pressure in the United States will come after the end of the century, with a rise of 50 percent over the years from about 2010 to 2020. The only thing that could prevent this is a large increase of births before the year 2000 that would raise the twenty-first century labor force, and this seems unlikely. The weighted calculation cited by Martin Feldstein shows the 30 retirees per 100 workers of today rising to 45 per 100 in 2030. This is the same as the 50 percent increase shown in the table from 1974 to 2025.

The Social Security scheme can be seen as a way of borrowing from future generations, like the national debt. Besides lacking a contractual character, it differs from the national debt in being five times as large. Martin Feldstein shows that the scheme reduces private savings: people do not save as much because they are implicitly promised support by the next generation when they are old. But at the same time their smaller savings mean smaller investment than would otherwise occur, so the incomes of the next generation will be less than with private savings for retirement or an actuarial reserve scheme. Our children's having to pay us larger benefits out of incomes that are smaller than they otherwise would be because of our failure to save may seem reasonable enough to us. After all, we paid for their education, which cost $110 billion for the year 1975 alone, or over $1.2 trillion for those with the average of 11 years of schooling. But with the pensions plus national debt at about $2.4 trillion, fully twice the cost of schooling, the intergenerational exchange may seem unfair to those who come after us.

Since unlike the national debt no legal contract exists between generations, and the Social Security scheme can be changed at any time and in any degree by Act of Congress, one wonders whether our attempt to live off the next generation will ultimately be successful. Whether Congress reduces benefits depends on its calculus of the votes of taxpayers versus the votes of retirees, actual and impending. A scheme that depends on such a calculus is not the most secure that can be devised.

If this is a correct diagnosis of the Social Security demographic problem, the solution is perfectly clear. To anticipate future waves in population, a reserve is needed large enough to equalize the burden on successive generations. Suppose that f(t) is the amount of claim on each dollar

of premium collected, and that it takes on a wave form. Suppose also that a smooth, very slowly rising exponential $\underset{\sim}{f}(t)$ is tangential to its bottom points. Then the part of the claims constituted by $\underset{\sim}{f}(t)$ could be fairly transferred between generations, by which each would pay for the preceding. The excess of prospective claims above $\underset{\sim}{f}(t)$ should be paid for by the generation that is going to benefit from them. For this part each cohort would build an actuarial reserve to cover itself.

Such a scheme would combine pay-as-you-go for the demographically stable part with an actuarial reserve for the demographically variable part. The effect is short of the full reserve, and without more detailed calculation I cannot say whether it would be one-third of the actuarial reserve or more or less. But it would have a major effect on the moral claim of the large cohort to subsequent benefits, and hence on the durability of the Social Security scheme.