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AN ABSTRACT OF THE THESIS OF John Louis Dobra for the Master of Science in
Economics presented May 22, 1975.

Title: Private Pensions and the Free Market

APPROVED BY MEMBERS OF THE THESIS COMMITTEE.

Richard B. Halley, Chairman

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In light of the retirement phenomena, the development and utilization of private pensions may be viewed as a market response based on individual and collective recognition of the need to plan to finance retirement from the labor force. This market response however, is shown to have produced a profusion of independent differential pension schemes which may vary with respect to their administrative mechanisms, the type and adequacy of benefits paid, the level at which contributions are made to the plan by participants and the basis of these contributions, and the adequacy of funding. As a result, it is not only

difficult to generalize about the nature of pensions, but the response of private pensions to changing market conditions and the nature of factors affecting the stability of private pensions are variable and diverse.

This paper seeks to examine the stability of private pensions in the context of a dynamic market system through the development and examination of two labor force and pension models. The first labor force model considered is that of a stationary labor force which is assumed to be absolutely stable over time with respect to its size and age-composition. The stationary labor force is further assumed to be facing an absolutely stable market demand for its services over time. A private pension plan was designed to provide post-retirement income to retirees of the stationary labor force; and it was found that the stationary labor force's pension plan has an absolutely stable level of liabilities over time. Three funding programs to finance the stationary labor force's model pension plan are presented and assessed. A second labor force model was then developed based upon a case study of the West Coast Longshore industry labor force. This labor force was shown to be shrinking in size and becoming progressively older as a result of changes in the market demand for longshore services. This reduction in the demand for longshoremen is shown to be the result of rapid technological change in the production processes in the industry and the result of the impact on labor force demand of exogenous factors such as wars, fluctuations in general economic activity and the entry of foreign competitors into the market. Without the ability to predict the occurrence of these phenomena and their effects on the demand for longshoremen it is shown that an adequate pension plan to cover the post-retirement income needs of the labor force is not likely to be designed. It is further shown

that even in the event that these uncertainties were predictable, the cost of financing an adequate pension plan would be prohibitive to the establishment of a plan to cover the retirees of a shrinking labor force like the West Coast Longshoremen.

PRIVATE PENSIONS AND THE FREE MARKET

by

JOHN LOUIS DOBRA

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requirements for the degree of

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CHAPTER I

INTRODUCTION

This paper concerns private pension and retirement plans and their application in a market economy. Its purpose is to examine the relevance and characteristics of pensions; to simulate their operation; and to demonstrate through a case study, a central weakness of private pension systems.

Over the past thirty years public interest in pensions has increased sharply with much of this interest developing within the past decade. There are a range of phenomena which have been associated with the public's awakening to the opportunities and problems provided by pensions. Sometimes cited in this regard is the impact of WWII on the supply and demand for labor in the economy; i.e., by increasing demand for labor while wage stabilization policies were in effect, and thereby forcing firms to compete for labor with non-wage benefits such as pensions. Also contributing to the growing public interest in pensions is the increasing prevalence of retirement and early retirement from the labor force. This subject will be dealt with in some detail in a later portion of this paper. Another factor to be noted is the U.S. Supreme Court ruling of 1948 which stated that pensions were "deferred wages" and therefore subject to collective bargaining.

While it is impossible to separate the impacts of these three factors from each other, and from other phenomena to enable us to explain the increasing interest in pensions, it is possible to state in general the cause of the mounting interest. First, there has been increasing reliance upon

the pension instrument throughout the economy; a fact seen in the increasing number of participants in plans and the increasing assets of plans. Secondly, the public has become aware of the use of fund assets; the increasing size of these assets have established large pools of wealth which are neither strictly private nor public and therefore, arouses questions of ownership and control.

Academic and economic interest in so called "life-cycle economics" in which pensions play a significant role, has to some degree been influenced by the growth of gerontology as a multi-disciplinary field involving economists. The role of the economist in gerontology with respect to pensions has been basically three-fold. First, since the pension is a financial instrument, economists are concerned with the mechanics of the plan itself. That is, we may seek to answer questions such as, is a particular plan sound, or are the assumptions upon which it is based valid? Secondly, the economist is concerned with the effect of the plan on the individual. This level of concern contains a range of issues from; the allocation of earnings over the life-cycle as opposed to the individual's work-life, to issues such as the adequacy of the benefits provided by a plan. Finally, the economist investigates the relationships between the pension system and macro-economic variables such as income, consumption, investment, savings, employment, labor force size and composition.

Since the concern of this paper is the application of pensions in the context of a dynamic market system, its focus is essentially in the final set of issues outlined above. This is, we are concerned with the relationship between the operation of pensions and their fundamental assumptions regarding the covered labor force. To succeed in this task, however, requires that

consideration also be given to the first two sets of issues as well. For this reason, this paper has been organized as follows.

The discussion begins with a brief review of retirement, the patterns and trends of retirement, and the fundamental economic consequences of retirement for an individual. The following chapters deal with pensions. In the third chapter a typology of pensions is presented; and in the fourth, three pension funding models are developed. In the fifth chapter the funding models are applied to a model of a declining labor force based upon the west coast longshore industry labor force. In conclusion, the sixth chapter will discuss the application of the funding models and their relevance to the general use of private pensions.

CHAPTER II

RETIREMENT

Underlying the public interest in the financial status of pensions is retirement. Obviously enough, if workers did not retire and continued to work, pensions would have limited usefulness and would be of little interest. There may still be interest in pensions as a means of supplementing earnings in old age when productivity is presumed to diminish, but more than any other single factor, retirement has contributed to the development of the pension system and our present concern for its adequacy.

The increasing prevalence of retirement from the labor force can be seen on Graph 1, which shows the decline in labor force participation among men 65 and over from the year 1900 to 1970. In terms of the corresponding rate of retirement from the labor force, from 1900, when only 36.9% of men 65 and older were retired, retirement has increased steadily with the exception of during the WWII decade, to 74.2% in 1970. The fluctuation in the retirement rate in the 1940-50 decade is attributable to the tight labor market during the war. While retirement did increase slightly in an absolute sense during this decade, 0.8% decennially, this increase is minor relative to the preceding and succeeding periods. During the 1930-40 decade, when the Social Security Act was passed, the decennial increase in retirement was 11.8%, from 46% to 57.8% for the largest decennial increase. From 1950-60 retirement increased 9.2% to 67.7%, and during the 1960-70 retirement

Graph 1
Labor Force Participation for Men over 65 and Life
Expectancy at Birth, Male Caucasians, 1900-1970

increased 6.4% so that 74.2% of men 65 and over were retired in 1970.¹

This increase in retirement rates has resulted from a variety of causes; including legislation such as the Social Security Act and laws establishing mandatory retirement for public employees, and the private actions of firms and unions establishing retirement policies. Underlying these attempts to encourage retirement however, are the declining labor needs of our industrial economy. As a result of the increasing productivity of both labor and capital in our economy, legislating retirement, as in 1935, has become viewed as a means for reducing unemployment. Thus retirement, to some extent, may be viewed as a cosmetic for unemployment.

In industrial economies one result of technological change has been the reduction of the man-hours of labor required to produce a given level of

1. U.S. Bureau of Census, Historical Statistics of the U.S.: Colonial Times to 1957 (Series B19-30, Washington D.C., 1960)p.71. & U.S. Bureau of Census, Statistical Abstract of the United States, 1970 (91st ed., Washington, D.C., 1971) p. 214, Table No. 317.

2

of output. Thus, to maintain full or near full employment it has been necessary to adopt various measures which will distribute the work to be done among as many workers as possible. This has been accomplished through various means, including the shortening of the number of work hours in a normal work day, increasing the number and length of vacations or leisure time, by delaying labor force entry through public education requirements and increasing emphasis on post-secondary education, and by redefining the unemployed³ aged as retired.

For an individual an obvious result of retirement is the reduction of his ability to earn an income. Unless the individual's source of income before retirement is property, in which case the word retirement hardly applies, the individual is faced with limited options. To be able to maintain an adequate standard of living in retirement the individual must either plan or save for a lengthy period of time, he may purchase an insurance policy, or he may participate in a pension plan. In any case the retiree must have anticipated retirement, and it is preferable for the retiree to have done all three of the above.

If the retiree is unable to maintain an adequate level of income there are of course, public income maintenance programs which will give financial aid to the destitute elderly. No public income maintenance program however, including the Social Security Administration's Retirement and

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2. Juanita Kreps, Lifetime Allocation of Work and Income (Duke University Press, 1971) p. 39-41.
 3. Alfred Sauvy, General Theory of Population (Basic Books, New York, N.Y., 1969) p. 148.

Survivors Insurance Benefits, provides or was intended to provide the recipients of its aid with an adequate level of income.⁴ It remains to the individual to provide himself with an adequate level of retirement income.

This situation is partially the result of our Anglo-American heritage, finding its roots in the Elizabethan period when state assistance to the poor⁵ began with the Act of 1563. English settlers in America brought with them the principle that those who could support themselves or secure support from relatives were not eligible for public relief. The present Social Security system in the U.S., and other forms of public relief, notable the Old Age Assistance program and the newer Supplemental Security Income program, were established in recognition of the fact that old age and retirement may prohibit the elderly individual from working to support himself. However, since some elderly individuals are well able to support themselves in retirement, either through the prudent accumulation of income producing assets or by participation in a pension plan or simply saving in anticipation of retirement, or by securing support from relatives, the state has refrained from providing adequate retirement incomes to the elderly in order to maintain incentives for pre-retirement planning by individuals. Thus, it may be said that as a result of traditional attitudes regarding state vis-a-vis individual responsibility for income maintenance, and as a result of the increasing prevalence of retirement, the pension has emerged as the major means available to individuals for providing themselves with an adequate level of post-retirement income.

One important factor augmenting the need for pensions is the increasing life expectancy of the U.S. resident. This trend is also plotted on Graph 1

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4. "Role of Public and Private Programs in Old Age Income Assurance", Old Age Income Assurance (Part 1, 90th Cong., 1st Sess, 1968) p. 45.
 5. Christopher Green Negative Taxes and the Poverty Problem (Brookings Inst.: Washington, DC, 1967) p. 34.

and is measured on the right vertical axis. The life expectancy of white males at birth has increased from approximately 48 years in 1900 to 67 years in 1970, thus indicating that on the average, a white male born in 1970 can expect at least two years of retirement. This fact is somewhat overshadowed by the similar statistic for white females. Although not shown on Graph 1, life expectancy at birth for white females in 1970 was approximately 70 years, indicating that on the average, a white female born in 1970 can look forward⁶ to approximately 13 years of retirement after age 62.

These statistics on life expectancy at birth illustrate the growth of the need for post-retirement income schemes with increasing longevity over almost three-quarters of the 20th century. However, they do not show the necessity of retirement financial planning, this can be seen more clearly by looking at figures for life expectancy at retirement age. A white male retiring at age 65 in 1970 could actuarially expect to live an additional 13 years or until age 78. And a white female retiring at age 62 in 1970, could expect to live an average of 18.8 years or almost until age 81. In addition, over the range of chronological age for which actuarial estimates are accurate, an individual's age-specific life expectancy in years decreases at a rate of less than 1 year for every year a person lives. Thus, if a male aged 65 could expect to live to age 78, at age 66 he can expect to live⁷ until age 78.5, and at age 67 he can expect to live to be 78.9. In other words, on the average, for every year a person ages, their expected age at death is older than it was the previous year.

6. Statistical Abstract of the United States, op. cit., p. 54.

7. Ibid.

Thus, we can see that a combination of these long run trends, that is, increasing retirement rates and increasing longevity have made pre-retirement financial planning a necessity. Especially in light of the fact that the odds are greater than 2:1 at birth that an individual will reach retirement age; and that in that event, depending upon the individual's sex, he or she can look forward to an average of 13 and 18 years of retirement respectively. In financial terms, using the U.S. Bureau of Census' 1969 poverty line budget for an individual, a single male retiring at age 65 will need \$23,400, and a female retiring at age 62 will need \$33,840 for future consumption just to live in poverty. A retired couple, assuming that they retire at the same time, would need \$60,716 for future consumption using the U.S. Bureau of Labor Statistics lower budget for a retired couple in 1972 (\$3,442 per year). To maintain the intermediate budget (\$4,967 per year) will require \$87,617 for future consumption, and a higher budget (\$7,689 per year) will require \$135,633.⁸ In light of the fact that the prospective cost of retirement increases as the retiree ages and the enormity of these sums to members of lower income groups, if left to private savings to provide post-retirement income, it is doubtful that this income could be provided.

The task of providing post-retirement income for the growing number of retired elderly has been approached in several ways in the U.S. On the national level is the Social Security system, a social insurance plan designed to provide a basic, though not adequate, level of benefits to retired workers who have contributed to the insurance fund for at least forty quarters over their work life.⁹

8. "Three Budgets for a Retired Couple", Autumn, 1972, USBLS, USDL 73-367.

9. Individuals born before 1929 have a lower contribution requirement.

Because the coverage of the Social Security system is not, nor was it ever intended to be, universal; categorical assistance programs have been developed to cover those aged who have not participated in the Social Security system. The Old Age Assistance program and more recently, the Supplemental Security Income program have been designed to provide universal financial aid to the elderly poor. The Supplemental Security Income program, the newer federally funded replacement for the locally administered Old Age Assistance programs provides a guaranteed minimum income for all elderly, blind and totally and permanently disabled persons.

None of these attempts by government to provide financial aid to the elderly however, provide an adequate level of retirement income for the elderly, or 60-70% of their pre-retirement income. Thus to secure an adequate post-retirement income the individual must take private actions; actions for which the individual has several options. The first and most obvious of these options is that of personal savings. A second option, and one relied on by many individuals is life insurance. And the third option, that used increasingly, is the pension; which is a combination to some extent of personal savings and insurance.

The outcome of these strategies for providing post-retirement income, social insurance, categorical assistance and the various means available to individuals, is a system in which the individual is assured of basic support but must assume the risks inherent in providing an adequate level of post-retirement income. Consequently, the individual gambles that the means he selects to provide an adequate income twenty to forty years in the future, will work out as planned. This gamble has enormous consequences for the

individual in retirement, for should his plans for the provision of an adequate income fail altogether or in part, the social and psychological impact is substantial. Before turning to the pension in more detail it will be useful to explore these consequences further.

Underlying the need for post-retirement income are the human needs for consumption, which obviously do not cease at age 65. Many studies of retired persons, past and present, have been directed at determining life satisfaction among the elderly. Although life satisfaction is an extremely complex variable, dependent upon a range of related variables, one variable or set of variables has been closely correlated to life satisfaction among the elderly, and that variable is socio-economic status. Among the elderly, socio-economic status variables, e.g. education, occupational status and family income, prove to be the most efficient indicators of life satisfaction, with family income being the most efficient among these.¹⁰ Thus, the essential nature of post-retirement income provision and planning becomes clearer still, as does the need for an adequate pension system. In summary, these needs have resulted from declining labor needs in the economy leading to increasing retirement, increasing longevity thus longer period of retirement and finally, the impact of inadequate post-retirement income on the individual welfare of the elderly.

10. John N. Edwards and David L. Klemmack Journal of Gerontology, 1973, Vol. 28, No. 4, pp. 497-502.

CHAPTER III

A TYPOLOGY OF PENSIONS

In the second chapter the development of demand for post-retirement income maintenance programs was traced. It was shown that a number of factors in addition to the increasing incidence of retirement, have stimulated the demand for an adequate retirement income provision system in industrialized economies. The market has responded to this demand with the development of private pension plans, which have grown significantly in the past decades. The growth of private pensions can be viewed in a number of ways; in terms of the number of individuals covered or participating in pension plans, the growth of assets held by private pension plans and the proliferation of pension programs with varying characteristics.

In 1940 slightly more than four million workers were covered by private pensions and almost 1-1/2 million by federal, state and local government employee pensions, yielding a total of 5.5 million employees covered by pensions. Three decades later, in 1970, approximately 8 million government employees were covered and almost 30 million other workers were covered by private insured and non-insured pension plans. Hence the coverage of pensions has increased by more than seven-fold in the thirty years since 1940. In the same period, assets held by private pensions have grown similarly. From a level in 1940 of \$2.4 billion in assets held by private plans, the book value of assets held

by private insured and non-insured plans has increased to over \$137 billion.

With the growth of private pension and retirement plans in terms of coverage and assets held, pensions have been applied to various types of employee groups with numerous modifications. Because of this latter development, it is very difficult to speak in general about pensions, since they may differ with respect to the manner in which the plan is administered, and/or the level of benefits or the manner in which the benefits are paid, and/or the manner in which the plan is financed. Thus, for an assessment of individual pension plans or pension plans in general, it is useful to begin with a definition of the basic element of pensions, and some suggested criteria for evaluation of pensions. The ultimate purpose of this chapter is to develop a typology of pensions to allow for a more explicit assessment of pensions and finally, in Chapter IV, to develop a pension fund model.

The variety of types of plans or financial instruments which are commonly referred to as "pensions" is one aspect of their study that confuses students and baffles laymen when attempting to assess a plan or its soundness. Basic to the understanding of pensions therefore, is a definition of the set of concepts incorporated in pensions; and from this basis, the development of a typology of pensions.

Another result of the diversity of pension plans is that a definition must be very broad to be inclusive of all financial instruments that are called pensions. In general, pensions are simply legal or financial instruments,

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11. Daniel M. Holland, Private Pension Funds: Projected Growth; Occasional Paper 97 (National Bureau of Economic Research, 1966) pp. 2-3; & U.S. Bureau of Census, Statistical Abstract of the United States, 1972, Tables #467, 468, 470, and 471.

which are also organizations, and are evidence of an agreement among two or more parties to provide post-retirement income to individuals designated as beneficiaries under the plan. As such, there are three elements basic to all pension plans. 1) Administration. The plan administrator executes the agreement the participants of the plan. 2) Benefits. The plan administrator pays benefits (monetary or in-kind) to individuals who are beneficiaries under the plan agreement; these are the principle liabilities incurred by the plan. 3) Contributions. Contributions must be paid to the plan administrator to meet the liabilities incurred under the plan agreement. The source of these funds is also specified in the plan agreement.

On the basis of these definitions, the fact that pensions are not complex is easily seen; and to illustrate their basic simplicity they maybe compared to a sink or a bathtub. Imagine a sink with water flowing into it while its drain is open. In terms of this analogy, contributions to the plan are represented by the water flowing into the sink through the faucet, and benefits are represented by the water flowing out of the sink through the drain. Further, the function of the plan administrator is to regulate the inflow of contributions and the outflow of benefits.

Some plans, as it will be discussed, specify that the outflow of benefits and the inflow of contributions be equal. In this case, in terms of the analogy, the inflow of water equals the outflow and no water is stored in the sink. In real terms, this situation indicates that the plan has no fund. On the other hand some plan agreements specify, or the age structure of the covered labor force may necessitate, that contributions paid to the plan be greater than the benefits paid by the plan at some point in time. In this case, in terms of the

analogy the inflow of water from the faucet into the sink is greater than the outflow of fluid through the drain, and hence the sink becomes a reservoir or fund to be released as benefits in the future.

The first plan discussed above, where contributions are equal to benefits paid is the simplest pension in our typology. Called an "unfunded pension" or sometimes a "pay-as-you-go plan" for obvious reasons, participants in unfunded plans have no security in the plan other than the administrator's (generally the employer's) promise to pay a specified benefit in the future. Hence in the past, "pay-as-you-go" plans have been notorious for involving higher risks of failure when employers other than government have been involved.

Distinguished from unfunded plans are funded plans, and obviously enough, they are called funded plans because beneficiaries of the plan have claims on specific assets in addition to the plan administrator's promise to pay. A primary distinction between funded plans or pension funds is the degree of funding each plan has. That is, some plans are fully-funded, while other are partially-funded. The principle difference between fully- and partially-funded plans is that the fully-funded plan is fully capable of meeting its future financial obligations to beneficiaries on the basis of the contributions that have been made to the fund by or on the behalf of the beneficiaries. Whereas, a partially funded plan is not capable of meeting its obligations to beneficiaries on the basis of past and current contribution levels, and hence, will require a subsidy to pay full benefits in the future. This subsidy is likely to be paid by future participants of the plan, employers or employees or both; and hence, the fulfillment of the plan agreement will require an inter-generational transfer of income, that is, between the working population and the retired population.

In developing a typology of pensions, it is with funded plans (both fully-and partially funded) that confusion is frequently encountered. Hence, before proceeding with the typology, several criteria will be suggested for use in discriminating between the various forms of pensions. These criteria relate to the three principle elements of pensions defined previously, and will be presented in that framework.

With respect to the administration of the plan, the primary criteria for distinguishing between plans is the control of the plan and fund. Inherent in this line of inquiry are the issues of control of the plan and fund; fund investment policies, the establishment of beneficiary eligibility requirements, i.e. service and contributory obligations, the ability of parties to the plan agreement to interpret the plan and rule on disputes arising over interpretation the plan agreement. Generally, control over the fund will go to the group in the plan who finance it or contribute to the fund.

Related to benefits are several criteria useful for distinguishing between types of plans and for evaluating the status of the fund, that is, whether it is fully- or partially-funded. The first criteria related to benefit payment to be examined is the manner in which benefits are paid by the plan. Benefits may be paid by a plan to a retiree in a "lump-sum" benefit, or the plan may transfer a lump-sum to an insurer on the retiree's behalf for the purchase of an annuity. Or finally, the plan may pay a specified benefit per unit of time, generally a month, for the rest of the retiree's life; this type of benefit is the most common and will be the type discussed here.

Another variable related to benefit payment by a pension plan is the basis used by the plan administrator to determine the level of benefits paid by the plan to beneficiaries. This is also an important variable in evaluating the financial status of the plan. With respect to the basis for determining

the level of benefits is the plan agreement itself. Generally a flat rate, or fixed benefit level will be specified and due to the participant upon completion of the service and/or contributory requirement of the plan.

In plans with variable benefit levels, the level of benefits paid by the plan is also based upon the plan agreement. However, rather than specify a benefit level, by establishing a benefit formula, the plan agreement will relate the level of benefits due to retirees to one or more variables. One fairly simple type of variable benefit plan would be one in which the level of benefits is based upon years of service over the minimum specified for eligibility under the plan agreement. For example, a plan may pay a benefit of \$200 per month to retirees who have satisfied the minimum service requirements of the plan, 20 years of service. In addition, the plan may pay increased benefits to retirees with more than the 20 years of service required for eligibility under the plan; that is, the plan may pay an additional \$10 monthly benefits per years of service over the minimum. Thus, a retiree with 21 years of service may expect a monthly benefit of \$210, a retiree with 22 years of service would expect a monthly benefit of \$220, etc. Although only a partial list, the common methods for determining variable benefit levels include formulae which adjust benefits to a price index, industry or labor force productivity, employee contributions, an employee's pre-retirement salary or wage, or to an employer's profits.

Most of the criteria associated with evaluating contributions to a plan or fund are closely related to the criteria used for evaluating benefits paid to beneficiaries. Likewise, these criteria are also useful for assessing the financial status of the plan's fund; that is, whether it is fully- or partially-

funded. However, a primary consideration to be made with respect to contributions to the plan, which is more closely related to issues of fund control rather than financial status, is the determination of the source of contributions. That is, which party or parties to the plan agreement contribute to the fund?

If we were considering a plan in which the beneficiaries make contributions to the plan, the plan would be said to be a "contributory" plan. And, on the other hand, if beneficiaries make no contributions to the fund, the plan would be said to be "non-contributory". Categorizing on the basis of the source of contributions to the plan, contributory plans are more prevalent than the non-contributory variety.

However, in a larger sense, that is in terms of the micro-economic theory of the distribution of income to factors of production, it may be successfully argued that an employer's contribution to an employee's pension fund is a labor cost and therefore part of the employees' wage. Thus, following this line of reasoning, all plans are contributory, that is, the employees or beneficiaries pay the cost of the plan either in the form of contributions to the fund or forgone wages.

This line of reasoning finds its principle usefulness in bargaining between the parties of the plan, and for analyzing the savings aspect of the plan. In the final instance, we are concerned with the rate of savings the contributions to the plan implies and what return on investment does the plan yield to its participants.

Using the basic elements of pensions discussed above, the first type of funded plan which may be distinguished is the insured plan. Although uninsured

plans are more common in terms of coverage, with approximately 20.4 million covered participants to 9.3 million participants in insured plans¹²; the latter type of plans tend to be used more frequently by small plans and retirement plans for the self-employed. Insured plans provide an opportunity to these groups to reduce the risks of participation in a pension plan by purchasing the financial and investment expertise of the insurance carrier. Hence in spite of the fact that insuring a pension plan or private savings plan involves higher costs, for individuals or small groups lacking the necessary skills or the resources to hire full time pension management, the insured plan is an attractive alternative.

The major contrast of insured plans to the uninsured varieties is the administration of the respective plans. In the case of the insured plan, the plan administrator, or the insurer controls the fund and its disposition in accordance with the plan agreement, and also controls the investment of the funds' assets absolutely. Contributions to the insured plan are made as premiums, which are paid entirely by the insurance purchaser at whatever rate is required to provide the benefit level desired in retirement. Whether the rate of contribution is determined by a desired benefit level or the benefit level is determined by a desired rate of contribution; the levels of contributions and benefits are based upon the length of the period of participation in the plan, and the insurance carrier's experience ratings of such plans. Hence, with regard to the financial status of insured plans, they are always fully-funded.

In uninsured plans, in contrast to insured plans, administrative responsibilities and control over the fund rest in the hands of either an

12. U.S. SSA, Soc. Sec. Bull., April, 1972.

employer, a group of employers, or a group of employees. While the insurer collects premiums, invests funds and pays benefits in the insured plan, these responsibilities are the obligations of the participants of the plan, or individuals appointed to undertake the responsibilities of fund administration and management. These individuals, called trustees, exercise control over the fund by virtue of proxies from the participants of the plan, either the employer, the employees or both. Hence, the degree of control which the purchaser of the pension has over the characteristics of the plan and over the administration of the plan varies widely and is the primary basis upon which funded pensions are categorized.

In the terms of the criteria suggested earlier for the evaluation of funded pension plans, perhaps the simplest funded plan with regard to organization and control, is the "unilateral" plan. In this type of plan, administrative responsibilities and control over the characteristics of the plan and the disposition of the fund rests entirely with one party to the plan agreement, and that is generally the employer. Unilateral plans are most commonly found in small businesses and in industries employing white-collar occupational groups; particularly where there are no unions to bargain over the plan.

Typically, in an employer controlled unilateral plan, the employer either administers the plan directly or indirectly through trustees who manage the fund. In addition, the employer establishes contributory and service eligibility requirements; rules on disputes and establishes benefit and contribution formulae. Therefore, an employee participants in an unilateral plan has no control over the characteristics of the plan or its administration; decisions

on matters such as these are entirely the perogatives of the unilateral fund administrator.

Distinct from unilateral plans in our typology are the most widely publicized type of plans, the "bargained" or "negotiated" plan. There are several popular types of bargained plans, but all are basically variations on the funded plans discussed heretofore. Perhaps the simplest variation in light of the discussion above is the "employer administered bargained plan". Such a plan could be identical to that discussed above as a unilateral plan with the exception that the characteristics of the plan are determined through two-party negotiations. The employer, in this case, would remain responsible for the administration and management of the fund; although the employer's control and interpretation of the plan would likely be subject to the review of a bargaining unit representing the employees.

Similar to the employer administered bargained plan is the "jointly administered bargained plan" which, as the name suggests, is a plan jointly administered by employees and employer. The joint administration of the plan is arranged through one of several means, either by establishing a representative board of trustees where the trustees would be elected or appointed by the memberships of each bargaining unit to represent their respective interests in the fund's decision and management processes; or, the trustees could also be elected or appointed unilaterally but subject to the review of the other side.

Another variation on the theme of bargained plans are union administered plans which are basically similar to the two other types of bargained plans

discussed above. The typical union administered plan is one in which a single employee group bargains with a multi-employer group. One such plan, that of the International Longshoremen and Warehousemen's Union (ILWU) which is bargained over with the Pacific Maritime Association (PMA) will be discussed in Chapter IV in some detail.

The preceding analysis has been an attempt to systematically categorize different types of pension plans in order to compare and contrast the various types of plans. Diagram 1, below, summarizes the categorization of pension plan types with regard to funding, administration and control, and the special characteristics of the plans.

Diagram 1

Categorization of Pension Plans

CHAPTER IV

THREE PENSION FUNDING MODELS

Thus far the analysis of pension has been limited to the broader institutional and organization aspects of the wide variety of financial instruments falling under the general heading of pensions. These discussions have attempted to relate pensions, particularly their development and proliferation, to U.S. economic institutions.

In Chapter IV, we will turn to an analysis of the pension as a financial instrument for providing post retirement income. This will entail the establishment of a pension model to examine the actuarial aspects of the implementation and operation of pension funds.

One pension model has already been introduced, that being the simple analogy of a pension fund to a sink. Recall that water flowing into the sink from the faucet represented benefits paid by the plan, and the volume of water in the sink represented the assets of the fund. While this model clearly illustrates the principle functions of a pension plan, it does not lend itself easily to a more rigorous quantitative measurement and analysis of pension funding. In short, a more effective model, which will allow a more extensive examination of the actuarial and financial aspects of pension funding is preferable.

There are however, other considerations both theoretical and practical, relevant to the problem of designing a pension model. In addition to the

practical considerations of the need for quantitative applications of the model; specifications of assumptions related to the institutional setting, organizational form and the character of the plan's participants and beneficiaries is required.

Turning to the practical issue first; based upon its prospective applications, the plan should be designed as simply as possible, both for the sake of clarity and to facilitate its use as a standard of comparison. In this regard, the principle purpose of the model building exercise is to develop and analyze a financial instrument capable of providing post-retirement income to a group of individuals or beneficiaries to be specified later. There is no attempt at this point, to simulate any plan in particular or any particular type of plan. Rather, the strategy for developing the pension model is to illustrate a general pension model which, while it is unique in its "generalness" of design, coverage, etc., at the same time illustrates the functions of pensions and will thus serve as a basis of comparison.

To begin the construction of such a model it is appropriate to begin with assumptions and data related to the plan's covered participants. This point of departure is appropriate because it is for the purpose of maintaining this group's post-retirement income, and at their expense that the fund has been established and benefits actually paid. Beyond propriety however, assumptions concerning the population to be covered by the plan, their age, sex, income, the conditions of their employment and labor force turnover are the bases upon which the plan is established and operated. These variables are essentially demographic in nature and hence, it is apparent that the basis

of the pension model is a demographic model of the plan's participants.

This demographic model is developed using the method of "potential
¹³
 demography" in which a survival table showing the age specific mortality rates of an assumed or empirically determined population with specified size and age-composition, is used to project the size and age-composition of the population at some point in the future. From the information obtained from the "potential demography" projection we can calculate how many of the plan's participants are expected to reach the age of retirement, and, given that event, how long retirees are expected to live and collect benefits. Thus, the demographic model of the plan's participants, once benefit levels and eligibility rules have been specified, is the basis for determining the liabilities the fund will incur over time.

In their initial derivation and use, the variables of both the demographic model and pension model will be assumed to be fixed over the projection period. This will be done to establish, and then examine a stable population and pension system. Thus, the initial demographic assumptions will be used to develop a model of a stable sized labor force with a constant age-composition. In other words, the labor force will be a "stationary population" ¹⁴ which Lotka has ¹⁵ demonstrated will occur given constant age-specific mortality and birth rates. Since the stationary population concept was developed with respect to an entire population, (i.e., containing individuals of all ages, from infancy to old age) certain assumptions in addition to Lotka's conditions concerning birth and

13. A. Sauvey, op. cit., p. 304.

14. Ibid., p. 4.

15. Alfred J. Lotka; Theorie Analytique des Associations Biologiques; (Hermann, Paris, 1936); English Edition: Elements of Mathematical Biology (N.Y., Basic Books, Inc., 1969).

mortality rates are required to adapt the population model to a labor force model.

First among these adaptations will be the dropping of assumptions regarding birth rates. For the purposes of the pension fund model we are not concerned with births to members of the labor force, but rather, additions to the labor force through the hiring of new members. Therefore, the "stationary labor force" is established with constant age-specific mortality rates and stringent assumptions concerning labor force entry and exit.

Since our model labor force is assumed to be stable with respect to its size and age-composition, it follows that the number of entrants in any given year must be exactly equal to the number of withdrawals from the labor force. If it is further assumed that there is no labor force turnover, then we may deduce that the number of entrants per year is equal to the number of mortalities since under the assumption of no turnover, death is the only means of withdrawing from the labor force.

Further adaptation of the "stationary population" model to a "stationary labor force" model requires an additional assumption relating to the age of entrants to the labor force. Just as entrants to a stationary population have a specified age, or at the very least, the average age of entrants at entry should be determined and held constant over the projection period. (Averaging the age of entrants, as opposed to specifying a uniform age at entry interjects an error into the "potential demography" projection because of the non-linearity of age-specific mortality rates. The error will vary in proportion to the standard deviation of the age of entrants around the mean age at entry.) Thus, there are two principle assumptions related to labor force entry: 1) the number

of entrants to the labor force in any given year is equal to the number of entrants in any other year, and further, is equal to the number of mortalities in that, and any other year; 2) the age of entrants at the time of entry is assumed to be twenty years of age.

In addition to the above, the labor force is assumed to be all male, both to avoid using two sets of age -- specific mortality rates and two retirement ages as well. The impact of women on the pension fund model, under normal assumptions would be to increase costs slightly as a result of a longer life expectancy and an earlier retirement age. The extent to which costs would increase if women were covered participants in the plan is undeterminable however. It has not been conclusively demonstrated that women would have significantly higher life expectancies than men under similar occupational conditions, and thus, it may be inappropriate to follow normal assumptions and utilize two sets of age-specific mortality rates even if women were included in the demographic model. The mortality rates used in the potential demography projection of the stationary labor force are for male caucasians. ¹⁶

The assumptions above, particularly those related to labor force entry, the age of entrants and labor force turnover are highly restrictive in the sense of the extreme improbability of finding a labor force such as that described. In addition, it is highly unlikely that in the event such a labor force were found, that the conditions set forth could be maintained over a period of time comparable to the projection period which is to be under consideration.

16. Statistical Bulletin (Metropolitan Life Insurance Co.; Vol. 51, August, 1970) pp. 9-11.

With regard to the no-turnover assumption, there are arguments for and against its inclusion in the model. If, as we have heretofore implicitly assumed, the stationary labor force is a single industry or employer labor force, then the no-turnover assumption seemingly implies that the stationary labor force is also a slave labor force. This implication is derived from the fact that mortality is the only means of labor force exit. However, in a somewhat rare case¹⁷ the no-turnover assumption has been approximated in the real world. This, of course, is an insufficient rationale for the inclusion of the no-turnover assumption in a general pension model. The only point intended is that a non-slave labor force which exhibits virtually no labor force turnover is an observable phenomena.

A more extensive examination of the implications of the no-turnover assumption reveals the usefulness of the assumption in light of the prospective applications of the pension plan model. A group of beneficiaries (not necessarily a single industry or employer labor force) which exhibit the behavior of never leaving the group once they enter may indicate that the pension system is universal or fully portable. That is, if labor force members are not assumed to be members of the same industry labor force, but simply members of the same population or group of beneficiaries; then individuals may be entering and exiting from various industry labor forces at any turnover rate without affecting the size or age composition of the population of beneficiaries. What would be affected in this instance would be the earnings of the covered labor forces, which would fall due to the periods of

17. The West Coast longshore industry labor force.

unemployment between jobs.

In spite of the lack of realism in certain aspects of the model and its related assumptions, it nevertheless remains a useful conceptual tool. Furthermore, this usefulness is, to a certain extent, based on the same factors contributing to the atypicality of the model. It is the long run stability of the covered labor force and the pension designed for them which makes the general model a suitable basis of comparison with less stable populations and pensions. And this same long run stability is the direct consequence of the highly restrictive assumptions related to the size, the age composition, and the entry and exit rates of the labor force.

A Demographic Model of the Stationary Labor Force

Thus far the description of the stationary labor force has proceeded in general terms. The foundation has been laid however, for a quantitative illustration and investigation of the size and age composition of the labor force. Graph 2, "Age Composition of the Stationary Labor Force" is the first step in this direction. This graph is a population pyramid depicting the relative size of each five year cohort of labor force members. As a result of the no-turnover assumption, the diminishing size of each successively older cohort is solely the consequence of mortality. It can be noted from Graph 2 that cohort size diminishes absolutely with age, and thus, relatively with an assumed stable sized labor force, the rate of decline in cohort size is not constant. Thus, the population pyramid on Graph 2 exhibits a relatively uneven stair-step effect. This variability does not violate the stationary population assumptions since it merely reflects the variable rate of increase

COHORTS

Graph 2

Age Composition of Stationary Labor Force

TABLE I

STATIONARY LABOR FORCE & COHORT SIZE

COHORT	ACTIVE	RETIRED	TOTAL
Over 85		150	150
80 - 84		240	240
75 - 79		420	420
70 - 74		480	480
65 - 69		510	510
60 - 64	650		650
55 - 59	740		740
50 - 54	830		830
45 - 49	830		830
40 - 44	830		830
35 - 39	840		840
30 - 34	870		870
25 - 29	870		870
20 - 24	<u>870</u>	<u> </u>	<u>870</u>
Total	8,200	1,800	10,000

in age-specific mortality rates with increasing age.

Closely associates with Graph 2 is Table 1 "Stationary Labor Force and Cohort Size," which is derived from Graph 2 and based on an assumed labor force membership of 10,000 individuals. In addition to labor force and cohort size, Table 1 differentiates between the active and retired segments of the labor force. Labor force members over the age of 65 are assumed to be retired; these members with a retired work status number 1,800 or 18% of the total. Thus, the remaining 8,200 individuals or 82% of the entire labor force membership are under 65 years of age and assumed to be working and earning an income. These proportions, i.e. the ratio of retired to active labor force members, are also assumed to be fixed for the stationary population as a result of the assumptions concerning labor force entry, turnover and mortality.

Before turning to the problem of developing a pension plan to cover the stationary labor force, the income of the group remains to be specified. The initial assumption will be that the average annual net earnings of working members of the stationary labor force is \$10,000. Thus, given the size of the active work force from Table 1, the net annual earnings of the labor force is \$82 million. Further assumptions regarding the income of the labor force will be required for the establishment of the pension plan to cover the stationary labor force. In particular, the distribution of income within the labor force with respect to age. However, these assumptions will be specified while developing the benefit formulae in the next section.

Financial Aspects

Pensions have been discussed as financial instruments, yet at this point the model plan has no financial components. Thus far, attention has been

focused on the general demographic elements of the model. The labor force's size and age composition have to be specified, as well as certain behavioral characteristics and the general institutional setting. This brings to the fore the next step in the pension design process; that of developing a financial instrument capable of providing post-retirement income for members of the hypothetical stationary labor force. In this regard, the ultimate goal is to define benefit and contribution formulae consistent with the post-retirement income needs of the labor force members, and their capacity to finance the plan.

One of the first considerations to be made in this regard is on what rate of earnings replacement constitutes an adequate post-retirement income. This question has been dealt with widely in the literature; yet no single standard of adequacy has, or is likely to emerge as being universally acceptable and applicable. The improbability of the establishment of a single standard of adequacy is the result of numerous economic, social psychological and idealogical factors associated with the meaning of adequate and the context of its use. Thus, adequacy standard have developed in the literature as a function of the purposes they have been intended to perform. There are however, two general patterns or strategies in the development of retirement income adequacy tests, and both are associated with particular types of studies and research.

One type of income adequacy standard, usually associated with poverty studies and which are regularly produced by governmental agencies, is the

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budgetary standard. These types of measures define adequacy with respect to poverty line or some market basket of goods and services representative of a somewhat arbitrary standard of living for a household of specified characteristics.

The other type of adequacy standard, based on specified rates of earnings replacements, is more often associated with theoretical studies of consumption functions and forecasting.¹⁹ When using an earnings replacement standard,

post-retirement income adequacy is defined relative to the worker's pre-retirement earnings, or more generally, an index of earnings. Commonly used indexes of earnings are the worker's average annual income, the worker's highest annual income or an average of the highest years, but more frequently used as an index are the worker's earnings in the years immediately preceding retirement.²⁰

Once this earnings base is established, an adequate income is defined as a fraction of that base; generally a replacement rate between 50 and 80% is used.

One such standard that was adopted by the American Association of University Professors (AAUP) in its "Statement of Principles on Academic

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18. BLS Bulletin 1570-6, Three Budgets for a Retired Couple in Urban Areas of the U.S., 1967-68, which is regularly supplemented by the U.S. Department of Labor is one example, another, Three Standards of Living for an Urban Family of Four Persons (Sp., 1967), BLS Bulletin 1570-5.
 19. Schulz & Carrin, "The Role of Savings & Pension Systems in Maintaining Living Standards in Retirement", Journal of Human Resources (Vol. VII, No. 3, Summer 1972) p. 349; and Schulz, James, "Economics of Aging", Chapt. IV "Research and Development Goals in Social Gerontology -- A Report of a Special Committee of the Gerontological Society", printed as special volume of The Gerontologist (9, Winter 1969), pp. 65-79; and Juanita Kreps, op. cit., Chapters 8-11, are examples of research following the earnings replacement standard method of determining post-retirement income adequacy.
 20. Schulz & Carrin, op. cit., p. 349.

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Retirement and Insurance Plans" specifies "that a person's benefits (be) equivalent in purchasing power to approximately two-thirds of the yearly disposable income realized from his salary . . . during the last few years of full-time employment." In addition to specifying an earnings base and replacement rate, the AAUP in its statement of principles has defined adequacy in real terms, i.e. "purchasing power". Thereby incorporating the necessity of providing means of offsetting inflationary forces which diminishes purchasing power absolutely, and economic growth, which diminishes purchasing power relative to other (non-retired) economic groups. These latter two considerations, inflation and economic growth, may in the long run have a greater impact of the adequacy of benefits than the replacement rate; and hence, are important considerations in developing a long-run pension projection.

If, for example, an individual is receiving retirement benefits equal to 75% of his pre-retirement income of \$10,000 or \$7,500 in benefits annually, and the price level in the economy rises, then in real terms, the replacement rate becomes less than 75%. If, over this period of time, prices rise by 25% than in real terms, the \$7,500 in annual benefits represents only a 60% replacement rate. Further price increases would deteriorate the adequacy of benefits more in the same fashion. Economic growth has a similar effect on benefit adequacy, but is more closely related to the problem of maintaining an equitable distribution of income between working and retired groups. It is generally assumed that the earnings of workers will reflect increases in their own productivity, and to a lesser extent, productivity gains in allied industries and general economic growth. Thus, if we assume that members of the stationary labor force increase their output per unit of other outputs, then their earnings

21. AAUP Bulletin 55, pp. 9-69, 386-389.

can be expected to increase relative to other groups of workers, ceterus paribus. However, with regard to the allied problems of maintaining benefits at an adequate level and an equitable distribution of income within the stationary population, the increases in the earnings of the working labor force members improves their position relative to retired members, and conversely, deteriorates the financial position of retired workers relative to workers. Furthermore, if the productivity and earnings increases are representative of trends in the outside economy, then retirees will suffer a loss in financial status relative to all working groups in the economy. Hence, these two variables have a critical and direct impact on benefit adequacy in the long run, and need to be incorporated into the pension model projection. This will be accomplished by means of the assumptions used in establishing the benefit formula. First however, as a basis for determining an adequate level of benefits some additional assumptions regarding labor force earnings are in order.

In the preceding section the average annual net earnings of working members of the stationary labor force was specified at \$10,000. Based upon the size of the labor force, the net annual earnings of the entire labor force was then calculated to be \$82 million. As a basis for establishing an adequate level of benefits for retirees from the stationary labor force, it will be assumed that incomes of the individual members of the stationary labor force, range between \$5,000 and \$20,000 net annually, depending upon seniority and position. It will further be assumed that the average net annual earnings of working labor force members who are aged 60 and over is \$15,000. This figure

will be used as the pre-retirement earnings rate to be replaced at a fixed proportion by the model plan. By basing the level of benefits paid to all retirees on the average earnings of currently working labor force members aged 60 and older, we provide a major hedge against possible deterioration of benefit adequacy by economic growth and/or inflation. Retirees will thus benefit from cost-of-living wage increases and productivity related wage increases earned by active workers.

The pre-retirement earnings rate of replacement used in the model plan will be 60%. Hence, a retiree member of the stationary labor force receiving 60% of \$15,000, or \$9,000 is assumed to have an "adequate" post-retirement income. The \$9,000 annual income is above the total budget costs of a "higher" standard of living for a retired couple in the urban U.S. as reported by the BLS for Autumn, 1972. Thus, this retirement income is quite adequate by these standards as well.

Thus far, the consideration of earnings and income has run in terms of these amounts net of taxes. Therefore, it has been implicitly assumed that workers have been paying payroll taxes for Social Security benefits, and will receive them upon retirement. If the potential sources of post-retirement income are limited to include only Social Security benefits and benefits paid from the model plan, then the problem of determining a benefit formula becomes one of supplementing individual's Social Security benefits to bring their total
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income up to the level determined to be adequate.

If Social Security is assumed to provide an annual benefit of \$3,600, then the balance of the \$9,000 or \$5,400 must be supplemented by the model

22. Sometimes called an "envelope" formula. Marples, Act. Aspects, p. 30.

plan. Thus, we have defined the plan's benefit formula as $Y_b = (.6 Y_e) - Y_{ss}$. Where the retirement benefit paid by the plan (Y_b) is equal to 60% of the income earned by workers aged 60 - 65 (Y_e) less benefits received from Social Security (Y_{ss}). This formula, along with the demographic characteristics of the stationary labor force discussed, provide the basis for projecting the potential liabilities of the plan in the future.

Although the period of projection has not been specified yet, under the assumptions of the stationary labor force, the length of the period is of little consequence to the computation of potential liabilities. Since the labor force, whether viewed as a pyramid as in Graph 2, or in absolute terms as in Table I, will remain identical to the beginning population over a 10, 20, 30, 40 year planning period by virtue of its stationary status. However, while it makes no difference with regard to the demographic variables what projection period is used, one must be specified to develop an estimation of actuarial costs over that period. Hence, the planning or projection period to be used will be arbitrarily set at 40 years. The problem projecting the liabilities of the fund over a 40 year period becomes elementary given the life-table of the stationary population and the benefit formula of the plan. Since we know both the number of labor force members who will retire each year, how long retirees are expected to live and how much they will receive in benefits in each year of retirement, the calculation of the plan's potential liabilities becomes rather mechanical. Particularly when, as in this case, all of the so-called "variables" are constants given the characteristics of the stationary labor force. As Table I illustrates, the demographic variables affecting the

plan, i.e., the respective size of the worker and retired groups, are absolutely constant with respect to time.

Graph 3, "Projected Size of Labor Force by Work Status," depicts the results of the potential demography projection of labor force size and age composition with respect to work status. (Chart 1 would represent the age-composition by cohorts for both the beginning and ending of the projection period.) The total stationary labor force, represented by line t, has 10,000 members and includes, 8,200 active and 1,800 retired members, represented by lines "a" and "r" respectively.

This projection of the size of both segments of the labor force is the basis for determining the actuarial costs of the prospective plan. Under the conditions established, there are the same number of retirees in each and every year of the projection, therefore the liabilities incurred by the plan will have the same time pattern. Hence, with 1,800 retirees collecting benefits of \$5,400 annually, the total annual liability of the plan in the first, or any year of its operation is projected to be \$9.72 million. Graph 4, "Projected Labor Force Earnings and Pension Liabilities," illustrates the time pattern of the plan's projected liabilities; as well as projected earnings. These levels of earnings and liabilities have been projected on the basis of no inflation and/or economic growth, and/or market change. However, by virtue of automatic benefit escalators built into the benefit formula, earnings and liabilities are presented in real terms. Thus, we can expect liabilities over time to remain a constant proportion of labor force earnings. So that in the event earnings are escalated to maintain or raise the real income of the active labor force, there will be a parallel shift upwards in the liabilities

Graph 3

Labor Force Size by Work Status

Graph 4

Projected Labor Force Earnings (E)
And Pension Plan Liabilities (L)

of the plan.

The determination of the actuarial costs of the plan principally involves determining the present value of the stream of future liabilities depicted on Graph 3. The present value of the sums of money due to beneficiaries in each year of the projection is the product of three factors, two of which have already been discussed. The first requirement is an estimate of the amount of money to be paid, or liabilities to be incurred in each year. This has been specified at \$5,400 per beneficiary, per year or \$9.72 million per year for the benefits for all retirees. Secondly, an estimate of the probability of payment, or of incurring liabilities in each year is required. This is defined by the life table of the stationary population. The final variable, the ²³ interest factor or discount rate has yet to be specified.

The choice of an interest or discount rate is a conceptually difficult one and, in the end is arbitrary. In this case however, the choice is not particularly crucial since variations in the discount rate have no impact on the model other than expressing a differential rate of time preference. That is, since the present value calculation expresses the value of a future income stream to a beneficiary or future expenses to the plan in terms of current income or liabilities, if two otherwise identical plans have two different discount rates, the plan with the higher rate simply values current income more than the plan with the lower rate. This situation will give rise to the plan with a higher discount rate to assign a lower present value to its

23. Marples, Actuarial Aspects of Pension Security (Pension Research Council, Wharton, etc.) p. 50.

expected liabilities than the other plan, even though their expected liabilities are assumed to be equal.

In this case, the discount rate that will be used is 5%. Thus, the present value of the projected liabilities of the plan, expressed in general form as:

$$\sum_{n=0}^{39} \ln / (1 + .05)^n ;$$

where n represented each year of the projection period, and ln represents the plans liabilities in each year.

Substituting \$9.72 million into the above equation and expanding so that the projected liabilities for each year may be discounted yields:

$$\sum_{n=0}^{39} \$9.72 \text{ m} / (1 + .05)^0 + \$9.72 \text{ m} / (1 + .05)^1 + \$9.72 \text{ m} / (1 + .05)^2 + \dots + \$9.72 \text{ m} / (1 + .05)^{39} = \$172 \text{ million}$$

This figure is the standard of the cost of the pension plan since it evaluates the stream of future liabilities shown by line L of Graph 4 in terms of current income or currently held assets. Hence, it is the basis of cost comparison among alternative benefit formulae, and is also useful in the computation of contribution rates.

Financing the Plan

While little specific attention has yet been paid to the problem of financing or funding the pension plan, a number of factors having influence upon the general approach to the issue have been either specified or implied.

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What remains is to define a funding program, that is, to define a time pattern

and rate of contribution which will provide the plan with assets with which it may pay its liabilities.

The funding program of a plan is described in the plan agreement itself and establishes rules concerning the ". . .receipt, accumulation and disbursement of benefit funds."²⁵ Thus, the funding program establishes the degree of advance funding which is agreed upon by the plan's participants. And it is this factor which will determine the time pattern and rate of contribution relative to that time pattern, necessary to finance the model plan. Thus, the problem of computing a contribution formula is entirely dependent upon the assumptions adopted concerning the funding program.

In establishing a funding program there are an almost unlimited number of options available, all of which would be able to provide the model plan with assets with which to pay its liabilities. Obviously, all of these alternative programs cannot be analyzed; and there would really be no need for such analysis since the difference between each would be only marginal. In view of wide choice of funding program alternatives and the problematic nature of various existing funding programs, the choice of a program should rest upon the characteristics, needs and financial capacity of the group of beneficiaries. Thus, rather than replicate an existing program or type of program, effort will be made to design an adequate program of funding. Hence, the criteria of choice between alternative funding programs is the workability and adequacy of the program, and not conformity to some existing standard. While the funding program chosen will conform to some standard or fall into a certain category

25. Marples, op. cit., p. xviii.

of funding programs, this is only because the universe of pension plans have all been categorized to some degree.

In this analysis, three funding programs will be presented. Each varying with respect to the degree of benefit security it provides, and therefore, they will also vary in their respective contribution formulae. These programs will be presented in the order of the complexity, cost and security they provide, starting with Funding Program I.

Funding Program I. Given the projected liabilities of the model plan shown on Graph 4 by line L, the task of designing a contribution formula may be reduced to its absolute simplest if the plan were to fund its current liabilities only. Or in other words, if the funding program were established as a "pay-as-you-go" plan. This type of funding program could provide the plan with assets to meet its liabilities in the year of contribution. That is, we will match the time pattern and level of contributions to the time pattern and level of benefits to be paid as shown on Graph 4 by line L. Thus, the time pattern and level of contributions would look like Line L of Graph 4, which is at a constant annual level of \$9.72 million.

At the above rate of contribution, the active members of the stationary labor force would be forced to pay a tax, in effect, of approximately 8.4 per cent on their real income. This tax is in addition to payroll taxes paid by the labor force members of OASDHI; and, at the base year price level, represents an average reduction in net annual earnings of \$840 per worker.

This brings forward the question of what happens to the plan if at some time the active workers of the stationary labor force decide not to, or refuse to pay the tax? At this point it can only be presumed that the plan liabilities

will not be paid and retirees from the labor force will lose the substantial share of the post-retirement income they had expected.

This possibility illustrates the major drawback of this, and other "pay-as-you-go" plans. The lack of advance funding gives potential beneficiaries little, if any, security. Plans lacking full advance funding, of which "pay-as-you-go" plans are an extreme case, are not surprisingly, the most susceptible to failure.

Funding Plan II. While Plan I would provide an adequate level of funding for the model plan, the issue of the security of current and future retirees' benefits remains problematical. Thus, it is useful to design another funding program, but in this case, a funding program which will provide the beneficiaries of the model plan with a greater degree of security. This, in turn, will require assumptions concerning advance funding, and in this regard there are two issues of importance. First, since the problem is to design a plan with advance funding, the initial consideration should be, how far in advance should liabilities be funded? This question could be phrased as "how big should the fund be?" This is easily computed, given time patterns and level of liabilities shown on Graph 4, using the present value determination of costs. Thus, if we assume, for Funding Program II, that liabilities will be funded twenty years in advance, then the required size of the fund can be calculated from the following equation:

$$F = \sum_{t=0}^{19} \frac{1}{(1 + .05)^t} = \frac{1}{(1 + .05)^0} + \frac{1}{(1 + .05)^1} + \dots + \frac{1}{(1 + .05)^{19}}$$

The size of the fund in the first year of the period (F_0) which is required to meet the liabilities of the fund projected over 20 years (0-19), is equal to those liabilities discounted by an assumed 5% annual return on the assets of the

26. Beier, Emerson, "Termination of Pension Plans: Eleven Years Experience", Monthly Labor Review (June, 1967). pp. 26-30.

of the fund. Plugging the value of liabilities projected for years 0-19 into the right hand side of the equation, and summing yields \$127,190,622.

Once the problem of specifying the desired degree of advance funding is resolved, the problem of determining an appropriate contribution formula is at hand. Unlike the contribution formula of Funding Program I which was simply an 8.4% tax on the net real income of active labor force members, the contribution formula of Funding Program II consists of two formulae. That is, since the model plan is new, there will be of necessity a period in which the fund accumulates assets to build a fund of the desired size to cover its unfunded liabilities from past service. What is required is the establishment of a²⁷ "benchmark", or the designation of a point in time at which the fund is designed to become fully-funded with respect to its 20 year projected liability. If we assume that the benchmark will be 10 years from the establishment of the fund, the next step will be to compute the necessary pre- and post-benchmark contribution formulae.

Of immediate interest is the pre-benchmark contribution formula; which, while it will take the form of a proportional tax on net real income, it will also represent a higher rate of taxation than that used in Funding Program I. This situation is required by the asset accumulation program of the plan in addition to contributions required to meet current liabilities since the plan is assumed to begin paying benefits in its first year of operation. Thus, the pre-benchmark contribution formula must contain the 8.4% tax to discharge the plan's responsibilities to retirees, and an additional tax on earnings to allow the fund to reach the desired level of advance funding.

27. Marples, op. cit., p. 97.

Before calculating the required contribution rate to finance Funding Program II, certain assumptions concerning the management of the plan's assets are required. In this regard we are particularly interested in the rate of return on investment the fund will earn up to the benchmark. However, since it is extremely difficult if not impossible to predict the movement of market interest rates and yields on investments in the market even if given precise data on investments and market conditions, a simple 5% rate of return will be assumed. Studies of long-run market interest rates have shown that the real rate of return in the market, that is, the nominal rate less the rate of inflation has averaged 3%.²⁸ In light of this, the 5% rate of return on the pension plans assets may be regarded as the 3% rate of return with the implicit assumption of a 2% average annual rate of inflation.

With this final assumption we have defined three of the four variables of a payment annuity program. Given, 1) the number of contribution and interest-earning periods, (10); 2) the desired level of funding to be attained, (\$127,190,622); and 3) the rate of interest (5%); then there is only one rate of contribution which will compound to the desired level in the allotted time. That rate is \$10,112,200 annually, which is assumed to be contributed and deposited or invested on the last day of the year for which it is contributed, and at the same time at which interest on funds' assets is paid. As mentioned above, this \$10,112,200 annual contribution is required in addition to a \$9.72 million annual contribution needed to discharge the current liabilities of the plan during the pre-benchmark period. Thus, during the initial phase of

28. Monetary Trends (St. Louis Federal Reserve, Sept. 19, 1973). p. 12.

Graph 5

Size of Fund Under Three Funding Programs

Graph 6

Required Rates of Contribution
Under Funding Programs I, II & III

TABLE II

A COMPARISON OF CONTRIBUTIONS AND
FUNDING UNDER THREE PROGRAMS

Funding Program	Advance Funding	Annual Contribution	Contribution As a % of Real Net Earnings
I	None	\$9.72	8.4
Pre-Benchmark II	N.A.	19.83	20.7
Post-Benchmark II	20 years	3.32	4.0
Pre-Benchmark III	N.A.	12.31	8.8
Post-Benchmark III	40 years	1.11	1.4

N.A. - Not Applicable

Funding Program II, the required rate of contribution is the sum of these, or \$19,832,200. This pre-benchmark contribution level is shown on Graph 6 as line C2.

The accumulation of assets in the fund of the model plan will proceed at the rate shown on Graph 5, "Size of the Model Fund Under Three Funding Programs", by line F2. On this same graph, the horizontal axis would depict the level of the fund under Funding Program I, which of course is a fund with assets equalling zero. Thus, Funding Program II, with full, twenty year advance funding has a great deal more to offer members of the stationary labor force in terms of security. However, the near prohibitive costs of the initial ten years of Funding Program II reduces its attractiveness enormously. Funding Program II would required a 20.7% tax in the pre-benchmark period. Before examining these costs more extensively, the post-benchmark contribution rate has yet to be determined.

Once the desired level of funding has been accumulated by the plan, the rate of contribution can be adjusted downward as the plan enters the post-benchmark phase of its operations. At this point, to maintain the fund's size while meeting its liabilities to retirees the yearly contribution required will be equal to the difference between the plan's liabilities and the yield on the fund's assets. Again assuming a 5% return on investment, the annual return on assets equalling \$127,190,622 is \$6,396,859. The required rate of contribution must therefore be \$3,323,141, which will bring the plan's annual income, from earnings and contributions to the level of projected liabilities. This post-benchmark contribution rate is shown on Graph 6 as line C2.

As seen from Graph 6, this contribution rate is significantly lower than that of the initial ten years of the funding program. And, in addition, it is substantially lower than the contribution rate of Funding Program I. In real terms however, the post-benchmark contribution rates for Funding Programs I, II, and III are identical. Although the labor force need not contribute approximately \$6.4 million because of interest earned on the assets of the fund, when these earnings are used to meet the liabilities of the plan, labor force members are sacrificing income. Thus, the actual level of contribution to the pension plan in the post-benchmark period for Funding Programs II and III is \$9.72 million. However, since the labor force members are required to impose a tax of only 4% on their real net earnings in the post-benchmark period, this contribution rate may be perceived to be less of a burden by labor force members. Table 2, "A Comparison of Contributions and Funding Under Three Funding Programs" provides a basis for comparing the three alternate plans in terms of their contribution rates, the tax on earnings each contribution rate implies, and the degree of advance funding.

It can be seen from Table 2 that the pre-benchmark contribution rate of Funding Program II imposes a substantial financial burden on labor force members relative to the other alternative funding programs. And on this basis, Funding Program II may be undesirable because of the prohibitive costs of establishing the fund in the allotted ten years. However, it is clear that Funding Program II would provide adequate coverage for plan participants, as well as offer a great deal more security than Funding Program I. Thus, it would be beneficial to examine Funding Program III which has been designed to incorporate the security of Program II with the relatively lower cost of Program I.

Funding Program III. This final funding program has been designed to improve on Program II by; 1) increasing the degree of advance funding by establishing a fund equal to the present discounted value of liabilities projected for forty years, and 2) reducing the cost of establishing the fund. Hence, the required fund size, calculated as the present value of liabilities projected for forty years is \$172,114,147. Since this fund is larger than that designed for Funding Program II, and the objective in Program III is to reduce contributions under the Program II levels, an adjustment in the time allotted to build up the fund is required. Therefore, in contrast to the ten-year benchmark of Program II, Funding Program III will establish its benchmark as shown on Graphs 4 and 5, thirty years from the beginning of the plan.

Once again we have defined three of the four variables in a payment annuity program; and the fourth variable, the amount of payment required per period is easily determinable. Given: 1) the number of periods in which to build the fund (30); 2) the desired amount in the fund at the end of the periods (\$172,114,147); and, 3) assuming a 5% return on investment; 4) the required contribution per period is \$2,590,570.

Because these contributions must be made in addition to contributions to pay benefits to retirees in the pre-benchmark period, the total required contribution to the fund in the pre-benchmark period is \$12,310,570. This figure is the sum of the contribution required to establish forty year advance funding (\$2,590,570), and the amount required to pay benefits to retirees in the pre-benchmark period (\$9.72 million).

This contribution rate is represented on Graph 6 as line C3, and is also shown on Table 2 as being approximately 8.8% of net labor force income. The

resulting accumulation of assets by the plan will proceed as shown on Graph 5 by line F3.

As with Funding Program II, the contribution rate under Program III falls after reaching the funding benchmark. The post-benchmark contribution rate for Program III is calculated in the exact same manner as for Program II, and is shown on Table 2 in absolute terms as \$1.11 million, in relative terms as 1.4% of the labor force's net income, and on Graph 6 as line C3.

A Comparison of Three Funding Programs. In the preceeding section three funding programs were presented; all of which were shown to be capable of providing members of the stationary labor force with an adequate post-retirement income. There are however, significant differences in terms of the security they provide future retirees, their costs and the distribution of the financial burden of establishing the fund. While some of the issues were considered in designing the funding programs, a closer look is necessary for a more thorough examination and comparison of these aspects of the funding programs. Table 2, "A Comparison of Contributions and Funding Under Three Funding Programs", presents some basic information on the advance funding of the respective programs, their annual costs, and the effort required by the active labor force in terms of the percent of their net income which they must sacrifice to finance the plans. This table provides a starting point for a comparative analysis of the three funding programs.

One important criteria for comparing the alternative funding programs is the benefit security provided by the funding program. Funding Program I is a "pay-as-you-go" type program and thus has no advance funding. This factor was noted as a drawback to implementing Funding Program I when it was presented, since the "pay-as-you-go" type of plan has proven to be the most susceptible to

failure. In contrast, Funding Programs II and III incorporate advance funding into their funding programs. Funding Program II offers twenty years advance funding and Funding Program III provides forty year advance funding at their respective benchmarks as shown on Table 2. This indicates that upon reaching their benchmarks, Funding Program II will provide one hundred percent advance funding of liabilities projected for twenty years, and Funding Program III fully funds projected liabilities of the plan for forty years.

All other things being equal, it could be asserted that Funding Program III is clearly preferable to the other two funding programs in terms of the security provided to future retirees of the stationary labor force. Unfortunately in this instance, the case is not so clear since the greater degree of security attainable through Funding Program III is not realized until significantly later in the projection period. As shown on Graph 5, the fund under Funding Program III is built up at a slower rate than under Funding Program II. This is the result of the lower pre-benchmark contribution rate and the longer pre-benchmark period in Funding Program III. While Funding Program II reaches its fully funded status by year ten of the projection period, Funding Program III does not reach a fully funded status until year thirty. Furthermore, as shown on Graph 5, Funding Program III does not reach a level of funding comparable to the post-benchmark level of Funding Program II until year twenty-six of the projection period. Thus, the preference of Funding Program III on the basis of the greater degree of security offered to future retirees of the stationary labor force is a long-run consideration. The comparison of the three funding programs on the basis of the advance funding is inconclusive. However, we are able to say that on the basis

of this criterion Funding Program I is clearly inferior, and that in the long run Funding Program III is to be preferred over the other two funding programs.

A comparison of the costs of the three funding programs must necessarily include short run, intermediate and long-run considerations. The immediate short run factor to be considered in this regard is the per cent of net labor force earnings required to finance the respective plans. In the pre-benchmark period, Funding Program II requires an annual contribution of \$19.83 million which represents 20.7% of the labor force's net real income. Although these costs are reduced sharply to \$3.32 million and 4% of net real labor force earnings after ten years when the benchmark is reached, the initial costs are likely to be prohibitive, and particularly in comparison to Funding Program III. In the pre-benchmark period of Funding Program III the required level of contribution per year is \$12.3 million. In relative terms this amounts to 8.8% of the net real earnings of the labor force; a self-imposed tax of only 0.4% more than that required to fund Funding Program I. Moreover, the rate of contribution required in the pre-benchmark period of Funding Program III is 11.9 per cent of labor force earnings less than the comparable figure for Funding Program II. Thus in the short run, Funding Program III imposes substantially less of a burden on the stationary labor force.

It is useful to examine the sacrifice required as a result of undertaking either of the two funding programs in terms of family budgets. This analysis will show the impact of participating in the respective funding programs on the standard of living of active labor force members. Earlier it was assumed that the average net income of labor force members, that is the income available for consumption, is \$10,000. This figure is approximately

12% below the cost of total family consumption under the higher budget for four-person urban families in 1970, and approximately 22% above the intermediate budget figure for total family consumption.²⁹

If it were assumed that the stationary labor force uses Funding Program II to finance its pension plan, then the average net real income of active members of the labor force in the pre-benchmark period would be reduced by 20.7%, or to \$7,930. Relative to the U.S. Bureau of Labor Statistics budgets for four-person urban families, using Funding Program II would reduce the real net income of labor force members to a full 30% below the consumption costs for the higher budget, and 3% below the consumption costs for the intermediate budget. Hence, it is apparent that under Funding Program II, labor force members must take a substantial cut in their standard of living; from slightly below the higher budget level to slightly below the intermediate budget level.

In contrast to the sacrifices required by Funding Program II, the sacrifice required to finance Funding Program III is slight. In the pre-benchmark period of Funding Program III the average net income of active labor force members would be reduced by 8.8% or from \$10,000 to \$9,120. Relative to the consumption costs for four-person urban families prepared by the Bureau of Labor Statistics, the average net income of the labor force members after contributing to Funding Program III would be almost 20% below the consumption costs for the higher budget, and slightly more than 11% above the consumption costs for the intermediate budget. Hence, it is clear in terms of the standard of living of labor force members that Funding Program III would reduce that standard of living but

29. USDL, BLS. Three Standards of Living for an Urban Family of Four Persons. (Bulletin 1570-5, 1972). p. 3.

significantly less than the adoption of Funding Program II.

The respective funding programs may also be compared with respect to their costs over time, and in this regard two time periods will be considered: an intermediate run which is defined for this analysis as the forty year projection period; and a long run defined as the beginning of the projection period to perpetuity.

One standard method of comparing the costs of the three funding programs is accomplished by calculating the present discounted value of projected contributions under each funding program. Using this criterion of comparison the preferred funding program would be that which had the lowest present value of projected costs. This calculation has been made for both the intermediate and long run periods, and the results of these computations are shown on Table III, "Present Value of Contributions Under Three Funding Programs: Intermediate and Long Run".

TABLE III

PRESENT VALUE OF CONTRIBUTIONS UNDER THREE
FUNDING PROGRAMS: INTERMEDIATE AND LONG RUN

<u>Funding Program</u>	<u>Present Value of Contributions (Millions)</u>
I	
Intermediate run	\$172
Long run	204
II	
Intermediate run	193
Long run	207
III	
Intermediate run	200
Long run	204

As shown on the table, the greatest differences in the cost of the three funding programs exist in the intermediate run; that is, when only the forty year projection period is considered. In this time frame, Funding Program I has the lowest present value of projected contributions, Funding Program II has the second lowest present value of projected contributions and Funding Program III is the most expensive plan using this criterion. The present value of contributions under Funding Program I is 89 percent of the comparable figure for Funding Program II, and 86 percent of the present value of contributions under Funding Program III.

Since the model stationary labor force pension plan is designed and assumed to be capable of providing benefits to retirees from the labor force indefinitely, the present value of the contributions under the three funding programs carried to perpetuity are also shown on Table III. These costs are identified as the long run present value of contributions, and they show little difference between the programs. The present value of contributions under Funding Programs I and III are the same in the long run and are only 1-1/2 percent less than the present value of contributions under Funding Program II in the long run. Thus, in comparing the cost differentials between the three programs on the basis of the present value of contributions, little difference was found. Certainly the intermediate and long run cost differentials are less significant than short run cost differentials.

A comparison based strictly on costs is inadequate in itself since it only shows one side of the picture. That is, the analysis above does not allow for a comparison of the benefits received under each funding program. Thus, to examine the benefits received under each program relative to contributions,

the present value of net benefits received under each funding program have been calculated using the formula:

$$PV = \sum_{t=0}^n \frac{B_t - C_t}{(1 + .05)^t}.$$

The results of these computations are shown on Table IV, "Present Value of Net Benefits Under Three Funding Programs: Intermediate and Long Run", which, like Table III, shows the present value for an intermediate and a long run period.

TABLE IV

PRESENT VALUE OF NET BENEFITS UNDER THREE
FUNDING PROGRAMS: INTERMEDIATE AND LONG RUN

Funding Program	Present Value of Net Benefits (Millions)
I	
Intermediate run	0
Long run	0
II	
Intermediate run	-\$18
Long run	0
III	
Intermediate run	- 25
Long run	0

As with the comparison of the present value of contributions, the greatest differentials in discounted net benefits of the three funding programs exist in the intermediate run. Within this time frame the present value of the net benefits from Funding Program I is 0, and is greater than the net benefits under Funding Programs II and III which are negative. As shown on the table, Funding Program I has the highest discounted net benefit in the intermediate run, the discounted net benefits of Funding Program II are second, and the

discounted net benefit of Funding Program III is the lowest. Thus, within the intermediate run time frame, Funding Program I is to be preferred on the basis of the criterion of the net benefit of the funding programs.

In the long run however, this is not the case; and as with the comparison of the present value of contributions, there is no significant difference between the funding program in terms of the present value of net benefits. As shown on Table 4, the present value of net benefits under all three funding programs is zero, indicating that in the long run, benefits received under the three funding programs are equal to contributions made under the three funding programs. This comparison of intermediate and long run costs and net benefits has shown no significant differentials between the three funding programs; particularly when long run costs and net benefits are considered. By far the most significant cost differential between the funding programs are found in the short run costs of implementing the respective funding programs.

An examination of post-benchmark contribution rates under the three funding programs reveals an additional factor relevant to the comparison of the funding programs. In absolute terms the post-benchmark contributions rate under Funding Program II is \$3.32 million as compared to \$1.11 million under Funding Program III. In relative terms, the post-benchmark contributions rate of Funding Program II requires a sacrifice of net real earnings of 4% as opposed to 1.4% under Funding Program III. This cost differential is clearly not as significant as the differences in the pre-benchmark contribution rates. However, this differential does illustrate an important long run aspect and advantage of Funding Program III; that is, its self-financing capacity.

It was noted earlier that although Table 2 shows differentials in the post-benchmark contribution rates under the three funding programs under consideration, these contribution rates are actually the same. While Funding Programs II and III require a post-benchmark contribution rate of \$3.32 million and \$1.11 million respectively and Funding Program I requires a contribution rate of \$9.72 million, the differences are solely due to interest earned on the assets of the fund. However, as noted earlier, earned interest applied to the payment of benefits to retirees represents a loss of income to labor force members. Hence, in terms of opportunity costs the cost of all three funding programs is the same if we include earnings from assets sacrificed along with earnings from workers which are sacrificed.

There is however, a distinction to be made between the contribution rate of Funding Program I and the post-benchmark contribution rates under Funding Programs II and III. This distinction concerns the capacity of the respective funding programs to generate revenues and finance themselves. While this factor is somewhat illusory given the analysis of opportunity costs, it is nevertheless an important consideration and closely related to the security of the funding programs. Comparison of the three funding programs on the basis of their self-financing capacities yields the same results as the previous analysis of security. That is, by virtue of the greater fund size and hence greater earning power, Funding Program III is to be preferred.

The comparison of the three funding programs has thus far included consideration of the security offered by each program; short run, intermediate and long run costs; net benefits received from each program in the intermediate

and long run; and the self-financing capacity of each program. While none of these criteria are conclusive with respect to showing which of the funding programs is best suited to the needs of the stationary labor force, this determination is possible when these criteria are considered concurrently.

The comparison of the security offered by each funding program showed that Funding Program I is clearly inferior to the other two programs. As a "pay-as-you-go" program, Funding Program I provides no advance funding while the other programs offer advance funding and hence, greater security.

Although the criteria of long run costs and net benefits showed no significant differentials between the funding programs, the comparison of short run costs did reveal an important difference. On the basis of the short run costs of implementing each program it was shown that Funding Program II is clearly less desirable than either Funding Program III or I.

When the self-financing capacity of each program was considered it was shown that Funding Program III incorporates a greater capacity for generating revenues by virtue of the larger fund size under that program. Hence, on the basis of this criterion, Funding Program III is to be preferred.

As a final consideration the equity of the three funding programs should be examined. Clearly, Funding Program I is the most equitable since the same contribution is projected for each year of the program's existence. In contrast, under Funding Programs II and III the relatively high pre-benchmark contribution forces individuals working and contributing to the fund in that period of time to bear a larger share of the burden of building up the fund than workers in the post-benchmark period. This is particularly true under Funding Program II where the fund is established in a ten year period. As discussed earlier,

pre-benchmark contribution rates under Funding Program II were prohibitively high, and for this reason Funding Program II is the least equitable of the three programs.

In the preceeding discussion it has been shown that Funding Programs I and II are clearly inferior programs on the basis of at least one of the evaluation criteria. Furthermore, the preferability of Funding Program III over Funding Program II can be seen in four factors: 1) by virtue of its forty year advance funding, Funding Program III offers participants a greater degree of security; 2) as a consequence of a longer pre-benchmark period, a smaller contribution before and after the benchmark is required to finance Funding Program III; 3) interest earned on the fund is greater in Funding Program III as a result of the larger fund size. Hence, Funding Program III has a greater self-financing capacity; and, 4) Funding Program III is less severe in terms of apportioning the costs of establishing the pension plan over time. Thus, Funding Program III is more equitable.

CHAPTER V

THE IMPACT OF CHANGES IN LABOR FORCE SIZE ON PRIVATE PENSIONS: A CASE STUDY

In the previous chapter, three pension funding programs were developed to provide post-retirement income to retirees from a model stationary labor force. The stationary labor force model was established with explicit assumptions regarding labor force size, age-composition, exit and entry; and implicit assumptions concerning the market conditions affecting these variables. When projected over time there was no change in the size or age-composition as a result of the assumptions establishing the model, and hence, the liabilities incurred by the model pension plan were absolutely stable over time.

In this chapter, the three funding programs designed to provide retirement benefits to retirees from the stationary labor force will be applied to a labor force with certain dynamic features. This second labor force model is constructed on the premise that the labor force is shrinking in size largely because of technological change, and to a lesser extent market changes in its industry. In addition, the age-composition of the labor force is shifting so that the median age is becoming older. In short, it is a labor force facing decreasing demand for its services over time. The model labor force used will be adapted from a demographic model of the West Coast longshore industry labor force, members of the International Longshoremen and Warehousemen's Union (ILWU). This labor force will be used as a case study of a declining or shrinking labor force to examine the impact of changes in the supply and demand for labor on pension

funding programs.

At the outset, it is fairly obvious that a labor force which is shrinking in size and becoming older on the average, will be unable to pay a level of benefits to its retirees equal to benefits received by retirees from the stationary labor force with a level of effort equal to that of the stationary labor force. It is also obvious that a pension plan designed to pay benefits to retirees from the declining labor force would necessarily be designed with significantly different assumptions than those used in designing the pension model of Chapter IV. Thus, in this sense this exercise could be described as setting up a straw man. However, in an attempt to examine the impact of changes in labor force size and age-composition on the pension funding programs, the three funding programs developed in Chapter IV will be applied to the longshore labor force model. Under the conditions established in Chapter IV, the three funding programs were shown capable of providing retirement benefits to the stationary labor force. Thus, the inadequacy of the model funding programs when applied to the longshore labor force will be solely the result of changes in the supply and demand for labor in the industry.

Before turning to the application of the funding programs the factors affecting the supply and demand for longshoremen and the labor force's response to these factors will be discussed. A demographic model of the longshore labor force will then be presented, followed by the application of the model funding programs.

Background

That technology, or the "systematic application of scientific or other
³⁰
 organized knowledge to practical tasks" has had an immense impact on the

30. Galbraith. The New Industrial State (Houghton Mifflin Co., Boston, 1967).

character of the American labor force is an understatement. And while technological change in production processes has had a variety of implications for the labor force with respect to the size of the labor force in various sectors of the economy, the mix of skills possessed by the members and the stability of employment in various occupational sectors, a less well known implication of this phenomena is the difficulty in funding a pension plan for a shrinking labor force.

The analysis of this less well known implication of technological change will be accomplished through the use of a case study of a labor force in an industry which has exhibited rapid and drastic technological change in the manner in which production is organized and conducted. This industry is the longshore industry and the labor force are longshorement from the West Coast of the United States who are members of the International Longshoremen and Warehousemen's Union (ILWU). The following is a brief historical sketch of the labor force, the market conditions and production techniques in the West Coast longshore industry.

The history of longshoring on the West Coast is a colorful one, and from the early 1800's to the present, enormous changes have occurred. The changes in the character of the labor force and the concomitant changes in longshoring techniques are of principle interest here.

In early frontier days, longshoring activity provided members of the local labor force with casual employment. When a ship came to port to load or unload cargo, runners were sent out calling "attention men along the shore" to recruit a labor force. The only requirement of these workers, who later came to be called longshoremen, was the ability to physically carry cargo onto, or off of

the ship. When the ship was loaded or unloaded and ready to leave port the
31
work force was paid and disbanded.

The policies for hiring longshoremen and cargo handling did not change appreciably during the 19th Century. Although mechanical aides were being slowly introduced on the waterfront, the fundamental quality of the work was not altered and efforts to organize the longshoremen were ineffective until the 1930's.

Before 1934, attempts to organize West Coast longshoremen had all ended in disasters such as the shooting deaths of working men and violent confrontations between organizers and strikebreakers, police, etc., which the workers lost. Many tactics were used successfully by employers to restrain longshoremen from unionizing; government restraints, hired strikebreakers, company labor unions, as well as police and national guard assistance when needed to end strikes effectively. It was not until 1933, during the depth of the Great Depression that longshoremen were able to overcome employer group opposition to unionize and become a cohesive labor force and bargaining unit under the International Longshoremen's Association (ILA).

From this point the character of the longshore force has changed appreciably. Through a union controlled hiring hall, longshoring activity relied less on casual labor and more on full-time, regularly employed union members. Despite several work stoppages, jurisdictional disputes (West Coast longshoremen split with the ILA in 1937 to form the ILWU), and political fights (the ILWU was expelled from the CIO for alleged communist activities), the longshore force succeeded in protecting their jobs, their union and the work rules which had

31. The ILWU Story: Three Decades of Militant Unionism (ILWU, San Francisco, 1964).

evolved in practice and which they had established by contract.

The next noteworthy change in the West Coast longshore industry began with an expansion of the industry in the Post World War II period. With the Korean War, Pacific coast shipping was stimulated; and within the three year period, 1948-51, coast-wide tonnage tripled. However, the cease-fire in Korea and the subsequent reduction in U.S. military involvement there, along with general economic slowdown brought an end to the West Coast shipping boom in 1952. Dry-cargo tonnage in foreign trade dropped by 25% from 1952-53, and continued at that low level through 1954 until it began to rise slowly in 1955. Aside from the general lack of trade, American-flag shippers began to face severe competition from the Japanese, the Norwegian and others after they had recouped their war-time losses. In spite of the general lack of activity on the Pacific Coast waterfronts, the union continued to dispatch full eight-man work gangs on jobs that sometimes required as few as two men to complete. The old waterfront work gang procedure of "four-on-four-off" eventually degenerated into "two-on-six-off" and resulted in some bizarre and fantastic example of "feather-bedding".³² As a result of union malpractices, the industry wide cost-squeeze and allegations that Pacific Coast ports were being passed by because of their high loading and unloading costs, the Pacific Maritime Association (PMA), the ILWU's employer group, brought pressure against the ILWU through "Conformance and Performance" programs. The employers sought conformance to standardized, non-duplicative work procedure rules and greater productive performance. These programs however, ended in failure because of the unwillingness

32. Ibid.

33. Hartmen, Paul T. Collective Bargaining and Productivity, The Longshore Mechanization Agreement, (Univ. of California, 1969). pp. 74-80.

of local stevedores to force compliance on PMA ships while relaxing restrictions on other ships.

TABLE V

CRUDE INDEX OF AVERAGE PRODUCTIVITY, ³⁴
PACIFIC COAST LONGSHORING, 1948-1965. (1953=100)

Year	Tonnage per Longshore Hours ^a	Tonnage per Total Hours ^b	Year	Tonnage per Total Hours ^b
1948	95.7	---	1957	117.5
1949	105.3	---	1958	96.3
1950	94.1	---	1959	97.7
1951	100.2	---	1960	110.2
1952	106.4	106.5	1961	118.2
1953	100.0	100.0	1962	121.4
1954	94.7	90.2	1963	136.1
1955	---	98.6	1964	145.7
1956	---	107.5	1965	156.5

a. Total coast-wide tonnage divided by longshoremen hours.

b. Total coast-wide tonnage divided by total longshore, clerical, and supervisory man-hours.

Table V shows a crude index of labor productivity for the industry. The years 1953-54 and 1955 have the lowest index of productivity. Over the two year period 1956-57, tonnage on the West Coast increased substantially by approximately 25%, while man-hours increased by only .07 of 1%; hence, the average productivity increases during that period were a result of expanding output where a substantial amount of excess capacity existed. In spite of significant increases in average productivity in the industry the PMA continued to press the union for waterfront work-procedure reforms and the average

34. Hartman. op. cit., p. 111.

productivity decreases during the next two year period (1958-59) intensified PMA-ILWU negotiations on those reforms and culminated in the signing of the Modernization & Mechanization (M & M) Agreement on October 18, 1960.

The union gained many new benefits and additional security for its members as a result of the signing of the M & M Agreement; a guaranteed income, no layoffs, easier, cleaner, safer work, early retirement and increased retirement funds. The employer group, the Pacific Maritime Association was to create a fund in order to provide these benefits. The employers on the waterfront were then able to mechanize waterfront activities and gradually reduce the work force as automation and mechanization reduced needed employees. The ILWU, in a pamphlet explaining the contract, stated that workers who smashed machines in the past ". . . were not trying to hold up progress, (but) were hitting back at a system which denied them any benefits from the new machines and from
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Progress."

A Demographic Model of the Longshore Labor Force

Based on the discussion of pension funding in Chapter III and the short history of the longshore industry above, this section will draw these concepts together and examine the feasibility of providing post-retirement income to the longshore labor force with the funding models presented in Chapter III. However, since the funding programs of Chapter III were designed to cover a stationary labor force and the longshore labor force is obviously a shrinking labor force, there is little question about the feasibility of the three funding programs. That is, these funding programs will prove to be inadequate. Yet, in spite of

35. Information and Union Comment on the 1960 Mechanization and Modernization Agreement (ILWU, San Francisco, 1960), p. 3.

this inadequacy, by promoting compatibility between the assumptions of the demographic models of the longshore and stationary labor forces, with the specific exceptions of the age-composition and labor force entry assumptions, the performance of the funding programs can be simulated and examined to determine the impact of these alternative assumptions.

Graph 7, "Age Composition of the Longshore Labor Force, 1964" shows the relative age distribution of active longshoremen, ship clerks and walking bosses among age cohorts shortly after the M & M Agreement went into effect. A quick comparison of Graph 7 with Graph 2, "Age Composition of the Stationary Labor Force", illustrates the substantial differences in the age compositions of the two labor forces. In the case of the stationary labor force, the age composition shown on Graph 2 was determined by the age specific mortality rates of the population given constant rates of cohort entry. The age composition of the longshore labor force on the other hand, is the result of the actual patterns of hiring and hiring in the industry and the age of longshoremen at entry. Thus, a close examination of the age structure of the longshore labor force in light of the preceeding discussion of industry growth and productivity changes will therefore provide a basis for inferences concerning the relationship between labor force size, age composition and productivity in the longshore industry.

The age composition of the longshore labor force as shown on Graph 7 is the result of a variety of factors, and as we shall see, represents a problem of inordinate magnitude for the labor force members. As Hartman notes, the age structure problems of West Coast longshoremen has as its root the situation
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caused by World War II and the immediate post-war period. Moreover, because Graph 7 represents active survivors in 1964 and not initial entrants, the

36. Hartman. op.cit., p. 166.

Graph 7

Age-Composition of the Longshore Labor Force, 1964

Source: Hartman, op. cit., p. 166.

magnitude of wartime expansion is understated by Graph 7.

In addition to the rapid influx of workers into the industry, another change occurred in the early 1940's which also contributed to the top heaviness of the longshore work force's age structure. Because men with longshoring experience were given preference in hiring in the 1940's, and also because of the general lack of younger men in the civilian labor force during the war, entrants to the longshore work force during that period tended to be middle-aged. Hartman reports that the median age of entrants to the longshore labor force increased significantly over the period from 1935 to 1945. The age of workers entering the longshore work force increased from a median of 29 years in the period 1935-39, to a median of 35 years at entry in the succeeding five
37
year span. Thus, the combined effect of these two phenomena occurring simultaneously in the early 1940's explains the disproportionate size of the cohort of workers age 50-59 on Graph 7. This cohort represents slightly more than 30% of the entire longshore work force, and on the basis of the data above it can be said to be comprised of two principle groups of workers; men who entered the longshore work force in the early 1930's, and in all likelihood were part of the original longshore registration with the ILWU in 1935, and men who entered the work force in the early 1940's at an older age.

In the immediate post-war period, 1945-49, entry into the longshore labor force was restricted somewhat, but picked up again slowly in the following decade. Table VI, "Entry Into the Longshore Labor Force, 1935-64," shows entry into the longshore work force by quintennial periods, and illustrates the rapid increase in the size of the work force in the 1940-44 period and the decrease

37. Hartman, op.cit., p. 167.

TABLE VI

ENTRY INTO THE LONGSHORE LABOR FORCE, 1935-64

<u>Period</u>	<u>Entry</u>	<u>Median Age of Entrants</u>
1935-39	790	29
1940-44	3,278	35
1945-49	1,930	35
1950-54	2,397	35
1955-59	2,931	32
1960-64	1,923	28

Source: Hartman, op. cit., p. 166 ff

in entry in the post-war period.

Table 7, "Size and Age Composition of the Model Longshore Labor Force" shows the size of the model longshore labor force, and its component age cohort groups which is shown on Graph 7 in relative terms. Excluded from this table are longshoremen who were retired in 1964. While the actual size of the active longshore work force in 1964 was approximately 15,500 members,³⁸ the size of the model labor force has been scaled down to 10,000 members, or to the size of the model of the stationary labor force. Thus the demographic model of the longshore labor force differs from the stationary labor force only with respect to its age composition and the assumption concerning labor force entry discussed below.

Given the size and age composition of the longshore labor force, we are prepared to project the population through time once assumptions concerning labor force entry and turnover have been specified. It has been noted that the size, age composition, entry and turnover assumptions, used in projecting stationary labor force and the projection that population through time, were established at sizes and rates which would allow for the maintenance of these variables as constants over the projection period. Thus, establishing a demographic model which exhibited stable size and age composition, and leading to the design of a pension plan with stable liabilities over the projection period. In designing the model of the longshore labor force however, additional criteria were used to establish these assumptions.

In the case of the model longshore labor force these assumptions are based in part on actual data from the industry, and in part on the desire to promote

38. Hartman. op. cit., p. 166.

TABLE VII

SIZE OF MODEL LONGSHORE LABOR
FORCE BY AGE COHORTS

<u>AGE</u>	<u>COHORT SIZE</u>
65-69	700
60-64	770
55-59	1,625
50-54	1,505
45-49	1,423
40-44	1,123
35-39	928
30-34	804
25-29	568
20-24	<u>554</u>
Total	10,000
Active	9,300
Retired	700

Source: Extrapolated from Hartman, op.cit., p. 282.

compatibility between the two model labor forces and pensions. The assumptions of the longshore labor force model which are related to the age composition fall into the first group, as do, to some extent, the assumptions concerning labor force entry and turnover. That is, the demographic model of the longshore labor force shown on Graph 7 and Table 7 shows the influence of turnover and entry in the industry prior to 1964. Hence, all that remains is to establish turnover and entry assumptions for the projection period (post-1964) which are consistent with expected trends in the industry.

The history of entry into the longshore labor force has been discussed in some detail earlier, and it has been shown that entry has fluctuated widely in response to a number of exogenous factors such as World War II, the Korean Conflict, entry of new foreign competition into the market, and major business cycles. Events such as these are uncertainties, which are distinguished from risks in that the former cannot be predicted on the basis of statistical computations. Thus, in spite of the possibility of the occurrence of similar events in the future, neither the events themselves nor their impact on entry can be reasonably predicted if exogenous factors are assumed to have as much influence on entry in the future as they have shown in the past. The alternate assumption of course, is that labor force entry will not be affected by economic uncertainties as it has in the past; and on the basis of recent trends in the industry this assumption has considerable merit.

It may be argued that the combination of a number of factors; the signing of the M & M Agreement in 1960, subsequent innovations in work procedures, the introduction of more and better capital equipment, an upturn in the economy in the early 1960's, and steady demand for West Coast shipping and longshoring services resulting from the war in Southeast Asia, have in short, provided an

ideal environment for the technological transformation of the industry. Containerization and bulk handling of dry goods are obvious examples of this trend. Thus on the basis of the quality of the changes occurring in the industry, i.e., the increasing use of capital relative to labor inputs, it is reasonable to expect increases in the capacity of the industry to be accomplished primarily by additions to capital equipment and the redistribution of labor among tasks. It may therefore be hypothesized that even in the event of the occurrence of uncertainties of the type and magnitude of those discussed above, labor force entry is likely to be largely unaffected.

The validity of this hypothesis is dependent upon the extent to which innovations in production techniques have enabled the industry to respond to future changes in demand and increase output without increasing manhours or labor usage. This seems quite plausible in light of historical evidence of excess capacity in the industry in the mid-1950's, as well as the technological changes mentioned. Thus, on the basis of the industry's need for labor inputs it is highly improbable that the longshore labor force will experience any increase in entry, ceteris paribus or even in the event of the occurrence of major economic uncertainties.

This however, does not imply that a no-entry assumption would be more appropriate. On the contrary, given the changes occurring in the industry it is probable that additions to the longshore labor force may continue to be necessary. Since changes in production processes are likely to introduce demand for specialized labor skills not found in the present mix of skills in the longshore work force, it is equally likely that there will be a need for hiring planners, managers, technicians and equipment operators to increase or perhaps even maintain performance. Thus, because of the introduction of more

sophisticated capital equipment in the industry new labor skill will be required, and therefore either entry or retraining of workers will be necessary.

While entry into the longshore work force may be expected to continue, on the basis of the evidence above it does not appear likely entry will continue at a rate comparable to that experienced prior to the signing of the M & M Agreement. Furthermore, because of increasingly specialized nature of the skills of labor force entrants over time, as these skills join the work force they will presumably decrease the required labor input for a given level of output, through greater utilization of existing and new capital equipment, and by achieving greater output. In short, since it is assumed that the work force will become more specialized and therefore increase the capital/labor input ratio in the industry over time, the need for entrants may also be expected to decline. Therefore, while entry into the longshore work force may be expected to continue, it is also likely that the rate of entry will diminish over time.

For the purposes of formulating entry assumptions to use in projecting the longshore labor force's size and age composition over a forty year period the analysis above will be followed. More specifically, it will be assumed that in the initial year of the projection period there are 100 entrants into the work force. It is further assumed that in each succeeding year, the number of entrants will decrease by 2; so that entry could range from the initial high of 100 entrants per year to 20 entrants per year at the end of the projection period.

The actual historical data on the age of entrants into the longshore work force is shown on Table 6, "Entry Into the Longshore Labor Force, 1935-64."

This table reveals the increase in the median age of entrants during the 1940's, and which was noted earlier. Also to be seen on the table and not mentioned earlier is the decline in the median age of entrants beginning in the second half of the 1950's.

In contrast to the actual experience of the industry, for the projection period it will be assumed, as it was with the projection of the stationary labor force, that entrants are age 20 in the year of labor force entry. To the extent that it is likely to understate the age of actual entrants, this assumption will overrepresent younger cohorts in the projected age composition of the labor force.

Given the age composition of the longshore force and assumptions concerning labor force entry, all that is required to begin the projection are assumptions concerning the two means of labor force exit; mortality and turnover. In the case of mortality, the same age-specific mortality rates as those used in the stationary labor force projection will be used for the longshore labor force members. There are undoubtedly some differences in the actual longshore age-specific mortality rates from those which will be used, which represent national average age-specific mortality rates.³⁹ Nevertheless, and in spite of the fact that longshoring activity can often require difficult manual labor, the national average age-specific mortality rates will be used since the mortality rates for longshoremen are not available.

As for assumptions pertaining to labor force turnover to be used in the projection, an assumption of no turnover will be both compatible with the stationary labor force model and realistic. On the basis of the package of

39. Statistical Bulletin, op. cit.

welfare benefits gained by longshoremen as a result of the signing of the M & M Agreement, the rather lax requirements for maintaining membership and eligibility rights, the existence of a guaranteed minimum wage in spite of actual hours worked, and the advanced age of the labor force members it is highly unlikely that a longshoreman would quit, and it is even more unlikely that he would be fired. Hence, longshoremen enjoy a high degree of job security and under current arrangements at least, labor force turnover is⁴⁰ improbable. Thus, it is reasonable to expect that if turnover occurs in the labor force, it is likely to have an insignificant effect on the size and age composition of the longshore work force in the foreseeable future. It is also reasonable to expect that whatever turnover will occur will involve younger workers, and thus, will augment the trends in the labor force which increase the age of the labor force over time.

With the age composition of the labor force shown on Graph 7 and Table VI, and assumptions regarding entry, mortality and turnover, we are prepared to project the future size and age composition of the labor force by the potential demography method. The projection period will be forty years, and correspond to the period from 1964 to 2004. To compare the beginning and ending labor force sizes and age composition refer to Graph 7 and Table VII, which represent the labor force at the beginning of the period, and Graph 8 and Table VIII, representing the labor force at the end of the period.

Looking at the latter set of Graphs and Tables, the results of the projection can be summarized. In terms of absolute size, the labor force

40. In addition, in an interview which was conducted with Al Owen, past Pres., Local 8 of the ILWU in 1972, it was Mr. Owen's assessment that turnover in the longshore work force had been negligible since the signing of M & M Agreement.

Graph 8

Age Composition of the Longshore
Labor Force: End of Projection Period

TABLE VIII

SIZE OF LONGSHORE LABOR FORCE BY AGE COHORTS
AND LABOR FORCE STATUS: END OF PROJECTION PERIOD

<u>AGE</u>	<u>SIZE</u>	<u>% OF TOTAL</u>
90 & over	187	3.98
85	162	3.44
80	229	4.87
75	326	6.93
70	390	8.29
65	468	9.95
60	464	9.87
55	442	9.40
50	410	8.72
45	377	8.02
40	338	7.19
35	293	6.23
30	252	5.36
25	207	4.40
20	<u>158</u>	<u>3.36</u>
Active	2,941	62.53
Retired	1,762	37.47
Total	4,703	100.00

Graph 9

Projected Size of the Active and Retired
Components of the Longshore Labor Force

shrank considerably, declining 53% from 10,000 members to 4,703 members at the end of the period. Of the 10,000 members at the beginning of the projection period, 9,300 were active and 700 retired (assuming a retirement age of 65). A comparison of these figures with similar ones from the end of period labor force yields a clear picture of the change in the age composition which occurred over time. Of the actual 4,703 labor force members at the end of the projection period, 2,941 are active and 1,762 are retired. Thus, in relative terms, the labor force goes from a situation in which 93% of the longshore labor force are active, to one in which 63% are active and 37% are retired. Graph 9, "Projected Size of the Active and Retired Components of the Longshore Labor Force" depicts the change in the absolute and relative size of the model labor force over the projection period.

Because of the decline in the size of the active labor force, the funding programs designed for the stationary labor force will obviously be inadequate. Before turning to the model longshore pension plans however, assumptions regarding the earnings of the active labor force must be considered. As with certain assumptions used in the labor force model, the earnings assumptions used for the pension model are designed to be compatible with those used in the stationary labor force and pension models. Thus, it will simply be assumed that the net real earnings of the active longshore labor force averages \$10,000 per year per member.

Using this assumption and the labor force projection shown on Graph 9, we may construct Graph 10, "Projected Earnings of the Model Longshore Labor Force." This Graph plots the total net real earnings of the model labor force over the forty year projection period. The net earnings shown on Graph 10 are based on

Graph 10

Projected Net Earnings of the
Longshore Labor Force Model

the assumed average income of active labor force members and the number of labor force members under age 65 in each year of the projection period. As seen on the graph, projected net real earnings decline from an initial high of \$93 million to a low of \$29.4 million at the end of the projection period.

Model Longshore Pension Plans

Before turning to the problem of applying the three funding programs developed in Chapter III to the model longshore labor force, a number of observations on the labor force and pension projections are in order.

The results of the projections are tentative and based on assumptions which range from reasonable to questionable. Thus, it could be correctly said that the projection is probably wrong. The validity of the model however, is aside from the central purpose of this exercise. The problem at hand is that of covering a shrinking labor force with a secure pension system. The longshore work force was chosen only as a model of a shrinking labor force, and it is useful only to the extent that it exhibits certain characteristics. The acuity of the model in projecting the actual size and age composition of the longshore work force is of secondary importance.

The purpose of the exercise is to examine the implications of economic growth and technological development on the viability of private pensions. By utilizing the longshore model it is possible to compare the performance of the longshore pension models with the stationary labor force pension models. Since these two labor force models differ only with respect to their age composition and entry assumptions, and these in turn, have been attributed to the patterns of growth and technological change in the industry, the differential performance of the pension programs may be interpreted to be solely the result of the patterns of growth and change in the industry.

The next step in this comparative analysis is to establish benefit levels for the pension plan by which the liabilities of the pension plan may be projected. As with the assumptions concerning labor force income, benefit levels used in the longshore pension model will be those utilized in the stationary population model. Hence, it will be assumed the retired longshoremen receive a pension benefit of \$5,400 annually or \$450 per month in real terms. As in the case of the pension benefits received by retired members of the stationary labor force, the longshore pension benefits are assumed to be adjusted in accordance with changes in the income of active labor force members.

Using the above assumption and the labor force projection depicted on Graph 9, Graph 11, "Projected Liabilities of the Model Longshore Pension Plan," may be constructed. The procedure for deriving Graph 11 is parallel to that used in producing Graph 10. The line on Graph 11 plots the product of the number of longshoremen over the age of 65 and the level of real benefits paid by the plan to retirees. As seen on the Graph, the projected real liabilities of the model longshore pension plan arises from an initial level of \$3.78 million to a high of \$15.276 million in year 21 of the projected period; and then declines steadily to \$9.51 million in year 39, or at the end of the projection period.

A quick comparison of Graphs 4 and 11 will illustrate the significant difference in the level and time pattern of liabilities incurred by the stationary labor force and longshore model pension plans. With respect to the level of liabilities incurred under each plan, the stationary labor force model plan begins with a higher level of liabilities (\$9.72 million as opposed to \$3.78 million). However, by the seventh year of the projection period, the

Graph 11

Projected Liabilities of the Model
Longshore Pension Plan

liabilities accruing to the longshore model plan surpass those accruing to the stationary labor force's model plan, which of course, are constant over the projection period. From the seventh year of the projection period to the last year of the period, liabilities under the model longshore plan are higher than those under the stationary labor force model plan. Thus, as it is expected, the longshore plan will have a higher actuarial cost than the stationary plan. Using a five percent rate of discount, the present discounted value of the stream of liabilities depicted on Graph 11 is \$192.19 million, which is approximately \$20 million more than the discounted value of liabilities under the stationary model plan.

We are now prepared to assess the three funding programs discussed in Chapter III with respect to their capacity for providing adequate financing for the model longshore plan. Because, as it is noted above, the model longshore plan is more expensive than the model stationary pension plan, the longshore plan will obviously require greater effort on the part of the active longshoremen if adequate funding is to be realized. Thus, it may be said from the outset that if the contribution rates used to finance the stationary plan are followed in the model longshore plan, the latter plan will be insolvent. Hence, there is no point to asking if these contribution formulae will adequately fund the plan. Rather, the problem has resolved itself to examining the degree of contribution formulae inadequacy, and the effort that will be required to finance the longshore plan.

To depict the results of using the three funding programs to finance the longshore plan, and address the issues raised above, Funding Programs II and III will be presented first. Funding Program I will then be applied and

subsequently lead to a discussion of the issues of the degree of funding inadequacy and the effort required to finance the plan.

Funding Program II. Table 2, "A Comparison of Contribution and Funding Under Three Programs" shows the contribution rates as a percent of net real income for each funding program. For the purposes of this analysis the contributions to the model longshore fund will be calculated as a constant percent of projected net real labor force earnings. Thus, in the pre-benchmark period, contributions to the longshore fund will be 20.7% of net real labor force earnings; and in the post-benchmark period (years 10 through 39) contributions will be 4% of projected real net labor force earnings. Hence, under Funding Program II, in the first year of the projection period contributions to the fund will amount of \$19.25 million, or 20.7% of \$93 million in labor force earnings. In year ten, or the first year of the post-benchmark period, contributions will be approximately \$2.9 million, or 4% of net real earnings which are projected to be \$72.59 million.

Graph 12, "Projected Contributions and Fund Size under Funding Program II: Longshore Model," depicts the operation of Funding Program II with the model longshore labor force. As it can be seen from Graph 12, contributions (line C) decline in both the pre- and post-benchmark periods. This is the result of the declining labor force earnings shown on Graph 10. Projected fund size, line F on Graph 12, is the summated difference between contributions and liabilities in each year of the projection period, plus interest (calculated at 5% as in the stationary pension plan models) earned on the fund's assets in each year.

During years 0-9 of the projection, or the pre-benchmark period, the

Graph 12

Projected Contributions (C) and Fund Size (F) Under Funding
Program II: Longshore Model

size of the fund increases rapidly from the initial level of zero, to approximately \$131 million. Beginning with year ten, the fund begins to be depleted rapidly as a result of the significantly lower rate of contributions shown on the graph, and rising liabilities shown on Graph 11. By the beginning of year 27 of the projection period, the fund has been completely exhausted and shows slight negative balance. It is important to note that with respect to the operation of Funding Program II using the longshore labor force model, the longshore labor force expends the same relative effort as the stationary labor force under Funding Program II. Obviously, greater relative effort is required if the longshore labor force model is to maintain their pension fund's solvency. Given the age structure of the longshore work force and the projected level of liabilities, the contributions to the plan in the post-benchmark period must increase over the 4% of net real earnings used in the model.

Funding Program III. In the earlier discussion of Funding Program III, it was noted that with respect to the stationary labor force model, Funding Program III was superior to either of the two alternative model funding programs. In the case of the longshore work force pension model, however, this is decidedly not the case. This may be seen from Graph 13, "Projected Contributions (C) and Fund Size (F) under Funding Program III: Longshore Model," which has been constructed in a manner parallel to the methods used for Graph 12.

Going back to Table II, "A Comparison of Contributions and Funding Under Three Programs," we see that in the pre-benchmark period, years 0-29 of the projection, contributions amount to 8.8% of real net income under Funding Program III. Using this rate of contribution and the projected labor force earnings from Graph 10, we may plot line C of Graph 13. As with contributions under

Graph 13

Projected Contributions (C) and Fund Size (F)
Under Funding Program III: Longshore Model

Graph 14

Contribution Rates Under
Funding Program I: Longshore Model

Funding Program II, under Funding Program III contributions decline over the projection period because the projected level of total labor force earnings also decline.

Line F on Graph 13, representative of the size of the model longshore pension fund under Funding Program III, is the summated difference between projected liabilities and contributions. Contributions decline and liabilities increase over the projection period; hence, as it was the case with Funding Program II, using Funding Program III the longshore model pension fund is unable to remain solvent. As shown on Graph 13 by line F, the model longshore fund accumulates funds at a decreasing rate until year five of the projection period. During the succeeding four years of the period, the fund is depleted at an increasing rate until year ten, the last year shown on Graph 13, at which time the fund shows a deficit of approximately \$1.8 million.

Under Funding Program III the model fund becomes insolvent much earlier in the projection period than was the case under Funding Program II. This fact is the result of the significantly lower pre-benchmark contribution rate, which in turn is the result of a much longer pre-benchmark period. The rates of contribution as a percent of real net income under Funding Programs II and III in the pre-benchmark periods are 20.7% and 8.8% respectively. The length of the pre-benchmark period in the respective plans are ten years for Funding Program II and 30 years under Funding Program III. Thus, while neither funding program discussed with respect to the longshore labor force model has proven to be adequate, it may be said that Funding Program II is less inadequate. The initial high rate of contributions under Funding Program II is more in line with the needs of the longshore labor force. However, an increase in the rate

of contributions in the post-benchmark period under Funding Program II, if it were of sufficient magnitude, would provide the longshore pension model with adequate funding.

Funding Program I. In the previous discussion and application of Funding Program I, a constant 8.4% of real net income was found to be necessary to adequately fund the stationary labor force pension model. The invariability of the rate of contributions under Funding Program I, which is the unfunded or "pay-as-you-go" model, was in that case solely the result of the assumptions establishing the stationary labor force model. Hence, given the assumptions underlying the longshore labor force model, it is obvious that the contribution rate in the model longshore plan will not be constant. As a result of the combined effects of diminishing labor force size and earnings, and the increase in the proportion of labor force members who are retired, the required rate of contribution will rise over most of the projection period.

Since Funding Program I is a "pay-as-you-go" plan, contributions in any given year of the plan's operations will be equal to the plan's liabilities. Thus, the annual contributions required to fund the model longshore pension plan under Funding Program I are represented by Line L on Graph 11; "Projected Liabilities of the Model Longshore Pension Plan".

As it can be seen from Graph 11, contributions would rise from an initial level of approximately \$3.8 million, approximately \$15.3 million in year 21 of the projection period. During the balance of the projection period, contributions would decrease steadily to \$9.5 million in year 39. Unlike the relatively stable levels of contributions under Funding Programs II and III, the level of contribution increases over four-fold in the first

half of the projection period, to decrease by 38% in the second half.

While the plan becomes less expensive to operate in the latter half of the projection period in an absolute sense, with respect to the longshore labor force's projected earnings, the plan will actually require a greater proportion of earnings in the second half of the projection period. Line L/E on Graph 14, "Contribution Rates Under Funding Program I: Longshore Model," represents the ratio of projected liabilities to projected net real labor force earnings, from Graphs 11 and 10 respectively. The liabilities/ earnings ratio increases from slightly over 4% initially to 27% in year 19. In the second half of the projection period, the liabilities/earnings ratio increases to 32% by year 27, to 32.4% in year 33 at its highest, and then fluctuates between those levels for the balance of the period. Thus, Funding Program I becomes more expensive, in terms of a percent of real net labor force earnings, as we move farther into the future. The average annual required rate of contribution in the second half of the projection period (years 20-39) is 31.7% as opposed to 15.8% in the first half of the period.

When applied to the model longshore work force, Funding Program I gives the clearest indication of the impact of the age-composition and entry assumptions used in constructing the model longshore labor force. Whereas in the stationary labor force pension model the required rate of contribution was 8.4% of net real labor force earnings per year, when applied to the longshore labor force model, Funding Program I would require an average annual rate of contribution of 23.5% of real net labor force earnings. Thus, the impact of the age-composition and entry assumptions on the cost of the plan relative to labor force earnings is clear.

CHAPTER VI

SUMMARY AND DISCUSSION

In the preceeding chapter a basis for assessing the effectiveness of private pensions in a dynamic market system has been established. This has been accomplished through a comparison of the operations of three model funding programs when applied to a stationary labor force model and a declining labor force model. The results of this exercise are presented in the previous chapter. In Chapter VI, these results will be summarized and lead to a discussion of a central weakness of private pension programs in the context of post-retirement income maintenance systems.

The first chapter presents an introduction to the problem under analysis. The second chapter is concerned with the development of demand for post-retirement income maintenance programs. The retirement phenomena is discussed along with its economic impact and implications for the retiree. In addition, the means of providing post-retirement income available to individuals were addressed briefly. It was observed that to obtain an adequate level of retirement income, the individual must take the initiative and save in anticipation of retirement, and/or participate in an insurance program, and/or participate in a pension plan.

In Chapter III definitions for the basic elements of pension plans are provided along with some criteria for categorizing and evaluating pensions. It was shown that while the pension is a relatively simple mechanism, wide

differences among plans have developed as the pension has come to be utilized increasingly.

In Chapter IV, the focus of the discussion was shifted from the demand for, and applications of pensions in our market economy, to the construction of a model pension plan. The model plan was designed to provide an adequate level of retirement income benefits to retirees of a model stationary labor force. In developing the pension plan and funding programs for the stationary labor force, model demographic and market factors having potential impact on the assumptions used in the projection of the labor force were assumed to be constant. The results of this assumption, as shown in Chapter IV, is an absolutely stable pension system with respect to the level and time pattern of liabilities incurred or benefits paid.

Market conditions were assumed to be constant for the construction of the demographic model of the stationary labor force, its pension plan and funding programs; however, in the fifth chapter changing market conditions are the basis of the discussion. In that chapter a demographic model of a declining labor force based on a case study of the West Coast longshore industry work force was presented. In constructing the longshore labor force model, assumptions concerning rates of labor force entry, exit and turnover, as well as the age-composition of the labor force were based on the experience of the work force. Other characteristics of the longshore labor force model were established to promote comparability between the longshore and stationary labor force models; the labor forces were assumed to have the same earnings and total size.

The pension plan and funding programs were developed for the stationary labor force model and subsequently applied to the longshore labor force model

to compare the ability of the two labor forces to finance the model pension plan. Two of the funding programs developed for the stationary labor force, Funding Programs II and III, were found to be totally unworkable for the longshore labor force model. Funding Program I, the "pay-as-you-go" type program, proved to be workable, however, it was shown that the cost of implementing Funding Program I was prohibitive. The cost of implementing the "pay-as-you-go" program was projected to be approximately one third of projected net real labor force earnings in the second half of the forty year projection period. This is compared to a projected cost of less than one tenth of net real labor force earnings under Funding Program I when applied to the stationary labor force model. Since the difference in the labor force models are known, it follows that the discrepancies in the operations of the funding programs in their respective applications is the sole result of changes in market conditions affecting the demand for labor in the longshore industry.

In presenting the longshore labor force model in Chapter V, two observations were made at the outset. First, because the pension plan and funding programs were designed to cover a stationary labor force, and the longshore labor force is declining, the funding programs would prove to be inadequate. This observation was verified by the exercise in Chapter V. Secondly, it was noted that if a pension plan and funding program were to be designed to cover the declining longshore labor force it would necessarily incorporate different assumptions than those used in designing the funding programs for the stationary labor force. While this statement is true on its face, to design a pension for the longshore labor force with the proper assumptions assumes that the market conditions affecting the industry are either known or can be predicted

with accuracy for a forty year projection period.

In constructing the longshore labor force model a number of factors affecting the demand for longshoremen were discussed. However, these discussions were post facto analysis of the demand for longshoremen, and it was noted that factors such as technological innovations, wars, entry of foreign competitors into the market, and general economic instability are generally unpredictable. The point may then be made that the demand for labor is also unpredictable. Therefore, any assumptions used to design a pension plan and funding program are suspect.

This brings the vulnerability of private pension plans clearly into focus. Because the participants in a given pension plan are either employees of the same firm, or in the same industry, conditions in the market affecting either their firm or industry affect all of the plan's participants. Thus, risks posed by economic uncertainties become uninsurable because all members of the group are affected. In the case of the longshore industry model, this would indicate that the pension mechanism is not a viable option for providing post-retirement income to retirees from the labor force. Rather than participate in a pension program covering their industry, members of the longshore labor force would be better advised to either purchase an insurance policy which may be converted to an annuity upon retirement, or simply save in anticipation of retirement.

On the basis of the previous discussions, the role of pensions in a system for providing post-retirement income maintenance is clarified. Retirement from the work force is necessitated by a combination of factors, including the changing labor needs of our industrial economy and the deterioration of work

skills in later life. The prevalence of retirement has given rise to a private pension system which in conjunction with private insurance, individual savings and social insurance forms the retirement income maintenance system. Of the four elements of this system, only social insurance provides near universal coverage for the members of the labor force. However, because benefits paid by the social security system in the United States provide a basic, and not an adequate level of retirement income, individuals facing the inevitability of retirement are forced to take the initiative if they are to have an adequate retirement income. The individual must choose one, and preferably more than one of the other elements of the retirement income maintenance system to supplement their social security benefits.

Given this situation, the private pension has come to be utilized increasingly and in most cases has proven to be a sufficient means of providing an adequate post-retirement income. However, as the exercise involving the model longshore labor force indicates, reliance upon the pension instrument is a mistake in some instances.

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