COMPARATIVE SIMULATION ANALYSIS OF
SOCIAL SECURITY SYSTEMS*

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Increases in price levels and general standards of living affect the relative positions of those receiving social security benefits. After distinguishing the earnings replacement function of social security from basic income support, the author contrasts the approach taken in the United States with foreign systems. A simulation methodology for examining the effects of formula changes on benefits is then described. A West German type formula is contrasted with that used in the United States social security system, with the former having as an explicit goal for retired individuals, living standards which are currently enjoyed by workers of equivalent status. The simulation findings are then presented and discussed for both systems in terms of retirement benefit levels and their ratios to the average of the last ten years of earnings.

INTRODUCTION

In a recent report by a "task force" studying the economic problems of growing old, the basic retirement preparation problem is succinctly stated:

> Every American—whether poor or rich, black or white, uneducated or college-trained—faces a common aging problem: How can he provide and plan for a retirement period of indeterminate length and uncertain needs? How can he allocate earnings during his working lifetime so that he not only meets current obligations . . . but has something left over for his own old age? (U.S. Senate Special Committee on Aging, 1969.)

This basic economic problem must be dealt with by all persons before the retirement period. Today, older persons in the United States are increasingly likely to find themselves "automatically" retired at a certain age from their regular job, without viable alternative work opportunities. At the same time, over the years that follow their departure from the labor force, they are faced with the prospect of expenditure needs which do *not* decrease very significantly. In the retirement period there usually are rising health expenditures, increased leisure activities, and increased need for supportive services. And there is a continuing desire or need for "regular" goods and services at levels not greatly diminished from preretirement consumption levels.

The aged must also deal with the general rising level of prices which is almost certain to occur throughout the retirement period. Moreover, the retired quickly become aware of the rising living standards of most non-retired families—as these younger families share in the general, long-run economic growth of the country. Such increases no doubt generate a desire among many, if not most, of the aged to "keep up."

All these factors when viewed together indicate that there are strong economic pressures on persons when they retire which make their perceived "needs" *in*

retirement not much different from those just *prior* to retirement. Whether an individual's resources in retirement will be adequate to meet this situation depends on what sort of life style he wants in retirement, but, more importantly, it depends upon the economic preparations which have been made before retirement and which make the desired life style possible.

In recent decades, as many countries have reacted to the widespread poverty among the aged portion of the population, we have seen increased reliance placed upon institutional or collective means of providing economic resources for old age. Collective arrangements are not new, however; people since earliest times have attempted to mitigate or eliminate economic insecurity by banding together in groups—families, tribes, associations, guilds—to "share" income and goods. What is new is the increased importance of industrial and government action in this area. As Kenneth Boulding (1958) has observed:

> It is when the "sharing group" becomes too small to ensure that there will always be enough producers in it to support the unproductive that devices for . . . insurance . . . become necessary. When the "sharing group" is small there is always a danger that sheer accident will bring the proportion of earners to non-earners to a level at which the group cannot function.

For example, during the thirties and the postwar period, significant changes in retirement security provision took place in the United States. Social security eligibility has now been extended (along with higher benefits) to all but a very small minority of the regular work force. At the same time, the number of persons participating in private pension plans has mushroomed to a point where more than 28 million workers are now covered by private pension and deferred profit-sharing plans, about 50 percent of the industrial labor force.

The growth of public and private pension plans has had a significant effect on the incomes of older persons. In terms of the U.S. Social Security Administration's poverty index, the percentage of American aged couples living below the poverty line declined from 30 percent in 1959 to 17 percent in 1969. And the percentage of poor old persons living alone or with non-relatives declined from 66 percent to 49 percent during the same period.

The economic situation of the elderly has improved considerably. But, at the same time, the data clearly indicate that there is still a sizeable number of aged living under serious economic hardship. Moreover, there seem to be increased numbers of persons dissatisfied with the functioning and results of the existing pension mechanisms. And, as a consequence, discussion and analyses continue with a view to developing and perfecting more workable and equitable pension mechanisms.

There now seems to be a general acceptance in the United States that incomes should be raised as soon as possible to an agreed upon poverty level for Americans of all ages who do not adequately share in the Nation's economic abundance. Hopefully, it will not be too long before private and public pension systems— together with supplementary welfare programs where necessary—will insure all the aged a minimum level of income which will be adequate to provide for their most basic needs.

As the United States takes this giant step in providing *minimum* economic security to all Americans, a new look at our economic programs for the retired

aged seems timely. In evaluating present pension systems, it is important to keep in mind the basic economic question of how much income is to be allocated by persons in their younger years, either individually or in groups, for retirement preparation purposes. For example, the United States has accepted in the design of its current social security system the concept that the current generation of workers provides the funds via payroll taxes to provide current retirees with pensions—in return for a promise of similar pension support from future workers. At the same time, there is no political consensus as to what that level of support for various groups of the aged should be.

In addition to the aged who have *always* lived in poverty and the aged who find themselves for *the first time* in poverty because of inadequate pensions, there are many aged families *above* the poverty level whose earnings during worklife allowed them a comfortable living standard but whose retirement incomes have dropped far below their preretirement levels. Their income problem grows out of the cessation of earnings of one or more family members and the failure of their savings and/or private and public pensions to replace a sufficiently large proportion of these earnings.

In the United States, social security old-age benefits are related to prior earnings up to a specified earnings ceiling. Computation of these benefits, therefore, is affected not only by changes in the benefit formula but also by changes in "creditable earnings" ceiling and the period of years of average earnings upon which benefits are based. A recent estimate of the replacement rate or pension-earnings ratio provided by the system has been made by the U.S. Social Security Administration's Office of Research and Statistics (Horlich, 1970). The replacement of earnings in the year before retirement by a social security retirement pension *for a single male full-time industrial worker with average earnings in manufacturing* retiring at age 65 in 1968 was 29 percent. The replacement rate for a similar worker who had a wife who was at least aged 65 and receiving a spouse benefit was 44 percent.

The above rates are based upon preretirement earnings defined as earnings in the year before retirement. If the measure of preretirement earnings is defined to be average earnings during the 1950–1968 period and excluding the 5 years, 1950–1955, of lowest earnings, the replacement rate for a single male worker rises from 29 percent to 38 percent. Such replacement rates differ significantly from the 60 to 75 percent replacement rates necessary to maintain living standards if other financial resources are not available

It can be argued that both private and public pension systems in the U.S. have badly satisfied the relative adequacy standard (i.e., adequate earnings replacement) for the *non-poor* because of three major factors:

1. U.S. pension systems (especially the social security system) are purposely biased in favor of low wage earners.
2. Most U.S. public and private pension systems fail to explicitly take into account the increases in the general level of prices which occur before and after retirement.
3. U.S. pension systems do not provide any formal mechanism for taking account of economic growth and the resulting improved general living standards which result.

Regarding the first factor, the U.S. social security system has a minimum benefit, a benefit formula weighted in favor of low earners, and a creditable earnings ceiling which does not adjust automatically. These features operate with the objective of helping to provide "socially adequate" income to the low income aged. But they also operate, as a consequence, to keep the replacement levels for the non-poor low.

While one cannot generalize about private pension systems as easily because of the large number of independent systems and the wide diversity of provisions, it has been observed by Heidbreder, Kolodrubetz, and Skolnik (1966) that collectively bargained plans tend to provide uniform benefits that vary by length of service but not earnings—thus placing low-paid workers in an advantageous position. Minimum benefit provisions in private plans with earnings-related formulas also tend to favor the below-average wage earner.

Regarding the second factor, adjustment for price increases, U.S. social security benefits *paid in retirement* have been adjusted frequently by Congress to keep pace with price level increases—sometimes, however, after a considerable time lag between the price change and the benefit increase. At the time the *initial* social security benefit is calculated for a retiring employee, however, the benefit is based upon average earnings which include the worker's earlier earnings which were paid at a time when the price level was much lower. Thus, benefits are based upon earnings unadjusted for subsequent price increases.

In the case of private pensions, only a handful of plans currently have a provision for adjusting pensions *during* retirement for price level changes. Many plans in recent years have adjusted periodically the benefit formula used to calculate benefits *at the time of retirement*—raising benefits often more than necessary for compensating for price level changes. While no systematic analysis by government or private researchers has been made to quantify and generalize the extent to which such adjustments are occurring, one would not expect to find a very complete adjustment being made by private pension systems using various *ad hoc* procedures. And certainly we know that many plans, unfortunately, do little or no adjusting at and/or during retirement.

Finally, with regard to the third factor—productivity or economic growth adjustment—the practice of present pension systems is clear. Both the social security system and private pensions have done very little to adjust pension levels *in retirement* to reflect the general improvement in living standards over time.

Thus, the current lack of dynamic adjustment mechanisms in U.S. pension systems promises the continuation of a fundamental retirement problem. Even if aged poverty—as defined, for example, by the SSA poverty index—were to be eliminated, there would still remain the problem of *relative* income adequacy. Past public discussions regarding aged income adequacy (and the adequacy of private and public pension programs) have been dominated by a search for ways of improving the poverty or near poverty incomes of the aged. More attention needs to be given to the question of the desirability of creating pension systems which will not only provide adequate *minimum* old age incomes but which will also provide the elderly with pensions which permit them to maintain or more closely approach their preretirement living standard in retirement and, perhaps, even improve upon it.

112

Whether individuals wish to maintain or improve their standard of living in retirement is, of course, still an open question. It is possible that some people may prefer to reduce their living standard in old age if, as a result, they can live better before retirement. And even for those who do desire to maintain or improve living standards in retirement, there still remains the question as to whether this should be a matter of personal choice (and hence, personal savings) or whether the matter should be handled through the public and/or private pension systems.

In recent years the institutional pension mechanisms (both public and private) in the United States and many other countries have come under heavy criticism. Much of the criticism has centered around the adequacy of benefits realized and the extent to which the pension systems are fulfilling the needs of "social adequacy" at the expense of individual equity and public policy efficiency.

For example, in a well-reasoned critique of the American social security system—Pechman, Aaron, and Taussig (1968) have argued:

> The basic dilemma in considering reform of the social security system is that the United States has attempted to solve two problems with one instrument—how to prevent destitution among the aged poor and how to assure to people, having adequate incomes before retirement, benefits that are related to their previous standard of living. The earnings replacement function calls for benefit payments without an income test. Basic income support, on the other hand, can be carried out most efficiently if payments are confined to households with low income.
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> Two separate systems are needed to accomplish the two functions at the lowest cost. The earnings replacement function should continue to be performed by a social security system. Social security would become strictly wage-related, with the replacement rate roughly the same at all earnings levels between subsistence and the median earnings level. The income support function should be transferred to a negative income tax system or to a comprehensively reformed system of public assistance. With a good negative income tax, dependents' allowances would be unnecessary under social security. The payroll tax might be retained, but it should be used only as a withholding mechanism for the individual income tax.

It is time that a broad review of the U.S. retirement income maintenance system was undertaken and serious thought given to the requirements of providing adequate retirement incomes for *the future aged*. Present trends indicate we must be prepared to deal with the economic implications of (a) ever increasing living standards in the working years, (b) retirement at earlier ages, (c) longer life, and (d) changing retirement life-style expectations.

COMPARATIVE ANALYSIS OF SOCIAL SECURITY SYSTEMS

In recent years there have been numerous calls for research to evaluate and build upon the social security experiences of various foreign countries in the old age income maintenance area. As early as 1963, Margaret Gordon wrote that "a promising method of inquiry that has been almost totally neglected is comparative analysis of the impact of various types of welfare programs, including old-age insurance programs, on the economy in various countries."

More recently, the 1967 U.S. Social Security Advisory Committee commented as follows:

> A good deal of light could be shed on the issues involved through analysis of the rather wide variety of relationships among income-maintenance systems that have been developed in other industrial countries. There, income-conditioned pensions and payments not related to income, such as universal old-age pensions and family allowances, exist in varying combinations with social insurance and public assistance systems . . .

Concurrent with these calls for research, another important development has occurred. There have been developed and implemented in a number of industrialized countries a variety of highly innovative social security systems. These new systems have been in large part motivated by dissatisfaction with the existing programs of old age income maintenance in each country and have attempted to overcome many of the existing problems. Public pension developments in Austria, West Germany, Sweden, and Canada, for example, have been watched with increasing interest.

There have been a few articles and books which discuss the social security systems of various countries. In general these studies have concentrated on describing the laws guiding past and present social security systems and in highlighting the major historical developments and issues surrounding these evolving systems. There is little in the literature, however, to indicate how these new systems are working: the extent to which they are meeting objectives; the economic effects on income distribution and savings; their effects on private pension systems; and the general satisfaction or dissatisfaction with them.

Important exceptions to this lack of study of foreign systems are the works of Gordon (1963), Aaron (1967), Pryor (1968), Kreps (1968), and Rimlinger (1968). Gordon studied eighteen industrial countries and found a significant correlation between the date of establishment of an old-age pension program for a sizeable segment of the population and the level of average benefits measured as a percentage of national per capita income. Aaron also studied industrialized countries and found age of programs a major factor determining the size and adequacy of social security outlays, and similar findings are reported by Pryor. Kreps makes international comparisons of labor force activity and variations in leisure-time patterns. Finally, a comparative analysis of the *historical* development of the social security systems in Germany, Russia, France, Great Britain, and the United States has been recently published by Rimlinger.

In most countries with highly developed social security systems (including the United States), at least five broad concerns have dominated recent discussions with regard to developing satisfactory public systems of old-age income maintenance. First, there is the question of the appropriate public-private pension mix and the effect of developing public pension systems on personal and private institutional income provision for old-age. Second, there is the problem of how to insure adequate incomes for the aged poor while maintaining the "integrity" of income maintenance programs for all income groups (i.e., maintaining a program which is equitable, financially viable, and without major economic disincentives). Third, there has been increasing interest in providing for middle-income groups public pension benefits which (with or without other income

sources) would permit retired families to maintain a standard of living in old age which was very similar to that achieved during the later years of the workers' earnings period. Fourth, there is the question of the desirability of automatic public pension adjustments and the search for suitable adjustment mechanisms. Finally, there is the question of what is the best way to finance a public income maintenance program for the aged.

With regard to the question of pension adequacy, there has been a shift in thinking away from accepting as the sole role of pensions the prevention of poverty through providing minimum levels of benefits—the so-called "floor of protection." Whether individuals can effectively and efficiently handle the major part of their retirement income planning is open to serious doubt, given historical experience and the nature of the problem. Even assuming a new individual awareness of the need for retirement preparation, a look at the uncertainties the individual has to deal with reveals the magnitude of the problem:

1. He does not know with certainty his time of death (or the time of death of his spouse). Hence, he must assume the worst and presumably save for age 100 (or more) or decide to go on public assistance (or perhaps seek help from relatives) at a certain age. Thus arises one reason for public and/or private retirement insurance. By pooling this risk, the cost of protection from uncertainty is decreased.

2. He does not know with certainty what his future income stream will be. He must protect himself from such hazards as ill health, cyclical economic fluctuations, and job obsolescense. Again, a case for public and/or private insurance arises (unemployment, disability, and medical insurance).

3. He does not know what his retirement needs will be. He cannot predict, for example, his state of health throughout the retirement period. Not only does his health have a direct influence on medical costs, but it also affects retirement mobility—influencing recreation and transportation expenditures.

4. He does not know when he will retire. Although the individual has some control over this, increasingly the decision is becoming institutionalized with (1) the growth of mandatory retirement rules, (2) the growth of early retirement options (often accompanied by management and/or union retirement pressures), and with (3) the continued existence of age discrimination practices in hiring.

5. He cannot easily predict the future rate of inflation which, if it occurs, will depreciate the value of his retirement assets and retirement income from sources which do not adjust fully for this happening. Furthermore, he cannot easily predict the rate of economic growth—which is likely to affect his economic position *relative* to the working population.

Thus, as a result of these problems and others, private and public institutions have been created to assist and in some cases to force changes (Musgrave, 1968) in the individual's consumption-saving pattern. And with the development of pension institutions and mechanisms has come the development of the concept of an "adequate pension." Many countries now have public pension systems which not only relate pension benefits to prior earnings but seek to guarantee through these benefits a relatively high level of earnings replacement at retirement. The

115

trend seems to be toward developing public (and also private) pension systems which will be adequate enough to permit the retired population to at least maintain a level of living which approximates that which they enjoyed during their working years.

Social security benefits in the United States do not currently achieve this objective. Nor have past discussions and debates about future benefit increases explicitly dealt with the role of earnings replacement in determining the appropriate pension formulas. Thus, the 1971 Advisory Council on Social Security observed and recommended:

> While past and proposed legislative actions have approximately achieved the goal of maintenance of purchasing power, the replacement rates have shifted over time and between different levels of average wages. There has been insufficient analyses of public discussion of the role of replacement rate in prescribing the benefit formulas. If policy were formulated in relation to replacement rates, the method of calculating the rate should be stated precisely. A replacement rate derived from the relationship between the benefit and the average wage over the entire period of an individual's participation in the labor market will differ markedly from a ratio of the benefit to his average wage in the 5 year period immediately preceding retirement. Careful study and serious consideration should be given before establishing a specific policy about replacement rates. However, the policy should be explicit and not implicit as is inherent in the use of the level wage assumption.

THE SIMULATION METHODOLOGY

If we seek to change the social security system (or private pension system) of any country, an important policy question arises: How will various changes in the pension mechanisms affect not only the size of benefits but also the distribution of benefits? Policy discussions of such questions are usually based upon highly aggregate projections of pension benefits and the total cost of such reforms. Utilizing the computer and simulation techniques, however, the effects of pension mechanism changes can be estimated at a micro-level—permitting a much wider range of policy questions to be examined, including the distributional effects of such changes. In an earlier study (Schulz, 1968), for example, a model was developed to simulate U.S. public and private pensions as they existed and were developing in the late 60's. That study was able to look at whether the economic circumstances of the retired population in the United States would improve significantly in the near future as a result of the improvements in these pension systems during the post-World War II period. The effects of increased coverage, benefit formula changes, private pension vesting provisions, and other factors were investigated.

Using a simulation model, it is possible to take any proposed change in a pension system and subject it to extensive analysis. There are currently before the U.S. Congress literally dozens of bills which seek to change private and public pensions in some basic way. Using simulation techniques, the results of most of these changes can be examined and comparisons can be made. The Office of Research and Statistics of the U.S. Social Security Administration is currently

developing a more detailed version of the model referred to above, to be used for just such purposes.

A related use for simulation analysis in the aged income maintenance area is analysis of a set of alternative pension mechanisms, such as they currently exist in a particular country. Valuable insights can be gained by studying the systems of other countries. A project is currently under way at Brandeis University to examine the economic implications for the United States of its adopting pension reforms similar to those in other countries. Currently simulation analysis is being utilized to analyze West German, Swedish, and Canadian-type social security systems.

The simulation model used for this purpose is a modification of the model developed by Schulz (1968) for simulating the U.S. pension system. The basic data for the simulations are from a sample of the U.S. population in 1960. This sample, called the "one-in-a-thousand sample," is on a set of tapes produced by the U.S. Bureau of the Census and contains separate records of characteristics of a 0.1 percent sample of the U.S. population as recorded in the 1960 census. Each record contains 40 coded characteristics about an individual—including certain demographic, work force, income, and family characteristic information.

From this sample are taken: (a) all married couples where the husband is between 45 and 60 years of age (inclusive), and (b) all unmarried individuals where the individual is between 45 and 60 (inclusive). These persons constitute the basic population which is "aged" into retirement.

In order to project pension income and assets of the retired aged, it is necessary to construct a "life process" model which will permit those activities of individuals to be simulated which have an important influence on pensions and assets. These activities can be divided into the following four categories: (a) demographic, (b) work force and earnings, (c) pension status, and (d) asset accumulation.

For example, not everyone in 1960 between 45 and 60 can be expected to live at least 20 years. Hence the first life process activity considered in the simulation model is death. A probability of death for each particular year is specified for individuals based on their sex, race, and age. A random drawing from the associated probability distribution is used to determine whether an individual will die or live that year. Similarly, probabilities are specified for other possible occurrences built into the model: labor force exit and entry, job change, pension coverage, vesting and unemployment.

Each possible "occurrence" specified in the model is treated in a manner similar to the live-die occurrence—each person being considered in turn. By sequential handling of the various occurrences, it is possible to make the consideration of any one occurrence dependent upon occurrences which were handled before it. For example, one possible occurrence for a person in the work force is a change of job. The consideration of this occurrence in the computer for a particular individual is made conditional on the outcome of the "leave work force" occurrence considered before it. If the individual "left" the work force, obviously there is no need to consider whether he has changed jobs.

Once one year's simulation is completed, the individual, if he survives, is aged another year and the process immediately repeated. This continues until the year 1980 is reached (that is, completion of 20 "passes" in the computer).

Another individual is then considered, and the whole simulation process repeated. After all individuals are processed, the resulting sample population represents most of the future aged population, since the surviving individuals are now 65 to 85 years of age.

During the simulation, earnings histories are kept for each individual. Individuals in the simulation who work full-time during a particular year and do not change jobs are given an employment equal to their "wage level." Females who work part time receive earnings equal to 50 percent of their "wage level."

Individuals (full or part time) in the simulation who change jobs in any particular year are subject to a reduction of earning because of possible time lost between jobs. In the simulation, a random number is generated each time a worker changes jobs. The probabilities of losing (a) no time, (b) 1 to 4 weeks, (c) 5 to 10 weeks, (d) 11 to 26 weeks, or (e) more than 26 weeks are estimated using Bureau of Labor Statistics data. Using the earnings histories generated by the simulation process described above, pension benefits can then be calculated. Account is taken of trends in pension coverage, private pension vesting, and public and private pension levels.

Social security and private pension benefit levels are assumed to rise at various designated rates which can be varied to test the sensitivity of the pension income distributions to such assumptions. In the current simulations, social security benefits are assumed to increase in the future at an average annual rate of 4 percent. This assumption is quite liberal. It is a higher rate of increase than has been voted by the Congress in the past.

The type of analysis being undertaken in the project can be illustrated by describing the simulation of the set of mechanisms used in the West German social security system.

SIMULATING A WEST GERMAN TYPE SOCIAL SECURITY SYSTEM

The present system was introduced in West Germany in 1957 when the pension laws then operating underwent fundamental change. The changes which occurred in the "pension reform of 1957" were not small incremental adjustments to the old system; in effect the existing system was replaced by a radically different one.

The basic aim of the reform was "to avoid too great a decrease in the standard of living of insured persons at the end of their working lives." The amount of pension payable, therefore, is no longer dependent on the actual contributions paid during the insurance life, but on the earnings of the individual during his working life in relation to average earnings, as well as to the level of wages and salaries at the time the pension becomes "payable." (Zollner, 1970).

This dynamic principle which underlies the new system is probably the system's most interesting feature. The goal is to allow the retired individual to have a living standard roughly equivalent to that which is being enjoyed by a current worker of equivalent status. Equivalent status refers to a worker with current earnings which bear the same relationship to mean national earnings as do the retired worker's lifetime average earnings to average national mean earnings (over the same period). Thus, a worker who on average received earnings

which were, say, one and a half times mean national earnings would receive a pension at retirement which was equal to the earnings of the "equivalent" current worker (reduced by the appropriate replacement percentage). Given that earnings over one's worklife tend to increase for many workers at a rate greater than national mean earnings—the resulting pension calculated by this mechanism would often be lower than a pension based on earnings just prior to retirement.

The second basic feature of the West German system is that the system is based upon the principle that pension benefits are deemed "adequate" to maintain prior living standards only if they replace a high proportion of preretirement earnings. Thus, the German system explicitly recognizes the need for adequate earnings replacement, not just that pension benefit levels should be related to earnings (or taxes paid). To this end, the pension formula is set up so that regular workers will receive between 60 and 75 percent of preretirement earnings adjusted for national price and productivity increases.

The third feature of the system is that benefit levels are further adjusted in relation to the number of years worked. Unlike the U.S. system and most other systems where the relationship between benefit amount and years worked is minimal once the worker meets the minimum coverage qualifications—the German system benefit size is directly related to the number of years worked, so that a worker with only half as many years of work coverage receives a pension which is one-half as large as another worker who is equal in all other respects.

The fourth feature of the German system worthy of note is the fact that no spouse benefits are paid. Wives who work get a pension based upon their earnings and number of years worked. But families without working wives, which were exclusively dependent before retirement on the earnings of one bread-winner, receive a pension for retirement based upon his earnings alone. This is consistent, of course, with the basic principles of the system and is possible without creating extreme hardship for couples because of the relatively high pension levels. Here, and in other ways, the Germans have attempted to clearly separate traditional welfare/redistributive objectives from pensions based on the "self-help principle."

The fifth feature of special interest is the dynamic adjustment of German pension levels during retirement. Initially, these adjustments were not adjusted automatically but instead by annual legislative review after the recommendations of an advisory council were announced. In reality, the pensions of retired persons have been adjusted by the legislature every year by the process specified in the social security law—a time lagged wage index. Therefore, it is generally agreed by pension experts in Germany today that the system is and will be adjusted (for all practical purposes) in an automatic fashion. Certainly the pension adjustment process in no way resembles the *ad hoc* process in use in the United States.

The effect of the German features described above are investigated by projecting the individual pensions, pension distributions, and pension-earnings ratios which would result in the U.S. if the West German system of social security were introduced in place of the current OASDI program. The pension system for Americans is simulated using the West German old age pension mechanisms.

The results of the German simulation (a census of all sample individuals) are stored on tape in a manner that will permit retrieval in a flexible manner. In this way, all basic output data are available on one tape for future tabulation and

119

analysis purposes. In addition, a set of basic tables are tabulated and stored on another tape. In the German case, these tables represent the various possible combinations (2,016 tables) of the key variables listed below:

1. Three alternative measures of preretirement earnings.
2. "Social security pensions only" or "all pension income" (public and private).
3. Alternative German formula constants (0.015 or 0.0011).
4. Three alternative definitions of "work history."
5. Present U.S. versus German-type pensions.
6. The total U.S. population or only the nonagricultural population.
7. Couples, widowed women, single men, and women "never married."

A set of 53 of these tables were selected and have been printed for the initial analysis phase. As the project progresses and further questions or areas of inquiry arise, additional tables can easily be retrieved and printed.

SIMULATION FINDINGS

What would the distribution of social security old-age pension look like in the year 1980 if the West German system were used in the United States? Table 1 summarizes the simulation estimations for units age 65 or more who are *totally* retired from the work force.

Looking at Table 1, one is immediately struck by the very high pensions which would be paid by this type of system. In every category except that for women who never married, the pensions paid are two to four times higher than social security benefits currently paid. In the case of couples, 70 percent of the units are projected to have benefits of $5,000 or more; furthermore, 20 percent are projected to have social security benefits exceeding $10,000. The distribution for single men and widowed women indicates a lower proportion of relatively high pensions, but even among these units, there are about half with pensions equal to or greater than $5,000.

As was explained previously, the current German social security old-age pension system does not have a minimum benefit provision. Poverty problems are dealt with by a separate system administered primarily by state and local governmental units. Therefore, it is not surprising to find some very low pension recipients in Table 1. For example, 18 percent of the couples and 35, 32, and 84 percent of single men, widowed women, and women who never married (respectively) are projected to have social security benefits under $3,000. The large proportion of "never married" women without benefits or with very low benefits is explained by the fact that many have little or no work history which would qualify them for a large pension. One must remember that the West German system pays pensions whose amounts are directly related to the number of years worked.

Using the simulation projections, we can compare social security pensions for the U.S. population (based upon the West German system) with projected benefits of the *current* U.S. system. The U.S. OASDI system as it currently exists is used to make the comparative simulation projections, with the following exceptions and assumptions:

120

TABLE 1
PROJECTED SOCIAL SECURITY INCOME FROM A GERMAN-TYPE
SOCIAL SECURITY SYSTEM, 1980
[percentage distribution]

Income	Couples[1]	Single Men[2]	Widowed Women	Women Never Married
Total percent	100	100	100	100
Less than $2,000	13	29	26	74
$2,000–2,999	5	6	6	10
$3,000–3,999	6	6	7	6
$4,000–4,999	7	7	9	4
$5,000–5,999	9	8	11	3
$6,000–6,999	13	14	10	2
$7,000–7,999	10	8	9	1
$8,000–8,999	10	6	6	1
$9,000–9,999	8	6	5	(3)
$10,000–11,999	14	10	7	1
$12,000 or more	6	2	5	0

[1] If wife retired, pension is sum of husband and wife's pension; if wife not retired, husband pension only is used; if husband not retired, unit excluded from calculation.
[2] Never married or widowed men.
[3] Less than 0.5 percent.

1. In the simulation, it is assumed that all men qualify for OASDI pensions *in terms of time*; women, however, are tested for pension eligibility based upon their stimulation and pre-stimulation work histories.
2. "Creditable" earnings for pension calculation purposes was assumed to be similar to the West German system (two times the average national earnings of the three previous years) and were not assumed to be limited by the lower ceiling schedule of the current U.S. law.
3. The earnings histories for the years before 1959 are based upon estimates described in Appendix A.
4. Social security benefits are assumed to rise at an average rate of 4 percent per year in the future as a result of various *ad hoc* increases authorized by the Congress and the President.
5. Widows' benefits are calculated as 100 percent of their husbands' earned benefits.

Table 2 presents a comparison of the projected 1980 U.S. and German-type social security pension distributions for couples, single men, and widowed women. The table gives a dramatic comparison of the generally static American social security system with low earnings replacement goals versus a system with higher replacement goals and adjustment features which take into account the dynamic factors of both price level changes and real economic growth in calculating benefits at retirement.

Of course, the difference in the cost of the two systems is equally dramatic. To estimate the relative costs, the individual pensions amounts making up the pension distribution were aggregated. It was found that the West German system costs would be 2.2 times greater than the costs of the U.S. system. However, if the replacement level goal of the present West German system were lowered (by

TABLE 2

Projected Social Security Income for U.S. Pension Recipients
based upon the U.S. and West German Systems, 1980
[percentage distribution]

Income	Couples[1] U.S.	Couples[1] German	Single Men[1] U.S.	Single Men[1] German	Widowed Women U.S.	Widowed Women German
Total percent	100	100	100	100	100	100
Less than $2,000	23	13	52	29	47	26
$2,000–2,999	28	5	39	6	46	6
$3,000–3,999	27	6	9	6	6	7
$4,000–4,999	17	7	0	7	0	9
$5,000–5,999	6	9	0	8	0	11
$6,000–6,999	(2)	13	0	14	0	10
$7,000–7,999	0	10	0	8	0	9
$8,000–8,999	0	10	0	6	0	6
$9,000–9,999	0	8	0	6	0	5
$10,000–11,999	0	14	0	10	0	7
$12,000 or more	0	6	0	2	0	5

[1] See footnotes 1 and 2 of Table 1.
[2] Less than 0.5 percent.

reducing the constant used in the benefit calculation formula), the costs would drop accordingly.

REPLACEMENT RATES

If we assume that earnings prior to retirement is a good proxy for a family's level or standard of living *before* retirement—then the ratio of a family's pension income to preretirement earnings is one useful indicator of retirement income adequacy. Using this measure, one can get a good indication of the extent to which pensions, in this case social security pensions, replace earnings lost by retirement and, therefore, of the amount of supplemental effort required by the individual in order to maintain a standard of living similar to the one experienced before retirement.

In another paper, I have discussed extensively various measures of the "pre-retirement standard of living" (Schulz, 1971). The amount of financial resources required varies considerably, depending upon the *measure* of the preretirement standard used. Three basic types of measures are embodied in various different social security programs today: (a) the average of lifetime earnings, (b) the average of a certain number of the *best* years of earning, and (c) an average of a certain number of the *last* years worked. In this study, the latter method, which uses the final work years as the measure of the standard of living, is used. Three different sets of projections are made—using the *last* year, the last *five* years, and the last *ten* years before retirement, respectively. Only the projections using the "last ten years" measure are discussed in this paper.

Table 3 presents the pension-earnings ratio distributions for the various demographic groups. It is important to note that in addition to the fact that the ratios were calculated using an average of the last ten years of earnings in the

TABLE 3

Ratio	Couples[3]	Single Men[3]	Widowed Women[4]	Women Never Married
Total percent	100	100	100	100
Less than 0.20[2]	2	0	19	19
0.20 to 0.29	2	1	5	17
0.30 to 0.39	4	1	7	19
0.40 to 0.49	6	2	12	12
0.50 to 0.59	12	4	15	7
0.60 to 0.69	21	12	16	5
0.70 to 0.79	29	32	14	3
0.80 to 0.89	17	31	9	2
0.90 to 0.99	4	12	3	2
1.0 or more	3	6	1	14

[1] Average of ten years prior to retirement.
[2] Includes persons receiving no pension but with some earnings in the relevant years.
[3] See footnotes 1 and 2 of Table 1.
[4] Ratio based upon dead husbands earnings (if appropriate) and own earnings (if any).

denominator, the pension used in the numerator is the simulated pension received by each individual in the first year of retirement (between 1960 and 1979) and not the 1980 pension (which is higher because of the 4 percent annual benefit increase assumed in the study). As in the previous tables showing the projected distribution of income, only social security old-age pensions are included. Estimates which include projected private pensions were also made but are not discussed.

In evaluating the results presented in Table 3, we can use two benchmark measures: (a) the proportion of units with a pension-earnings ratio below 0.50 and (b) the proportion of units with a ratio above 0.60. These benchmarks are used because "in the United States, some social planners currently speak of an assured flow of income of probably 50 percent of the earnings of recent years—not the lifetime earnings—for a single worker and 66⅔–70 percent for a couple" (Horlich, 1970). In the case of couples, nearly three-quarters (74 percent) are projected as having a ratio of 0.60 or higher. Only 14 percent receive pensions amounting to less than 50 percent of their earnings and, as we will show below, most of these couples have very high earnings (probably above the social security earnings ceiling). The proportion of single units with a ratio of 0.60 or more varies from a high of 93 percent for single men to a low of 26 percent for women who never married—with female widows being in-between with 43 percent.

Of course, any pension system can provide very high benefits with the appropriate formula specification. What is unusual and, I would argue, desirable about the German system (and certain other European systems) is that its formula explicitly embodies a *relative* concept or definition of income adequacy by guaranteeing long term workers a relatively high earnings replacement rate consistent with historical price level changes and rising real earnings levels— *irregardless of what those changes might be in the unforeseen future.*

123

Contrast the pension-earnings ratio resulting from a German-type system with those resulting from the current U.S. system. Whereas the German-type system results in very few couples with a pension-earnings ratio below 0.50—the current U.S. social security system will result in almost all of the same couples receiving a social security pension at retirement which will be less than 50 percent of their prior average earnings.

CONCLUDING OBSERVATIONS

To a large extent, pension benefit levels in the past and the increases in these levels have been stimulated not so much with the purposeful intent of tapping a greater part of the nation's rising national product for old people but rather as a secondary result of attempts to deal with the severe and potentially explosive hardship problems facing many older people. In consequence, these past efforts have been aimed primarily at raising the economic status of the aged to some minimum standard or subsistence level in the face of rising prices.

What has been proposed by some, however, is to develop mechanisms which allow the retired aged to share in the growing productivity and output of the nation—to share in some of the "harvested fruits." What this no doubt requires is the development of means to permit an orderly, equitable *but substantial* transfer of income from the working to the retired population in order to improve the latter's relative economic status. The national dialogue and debate over such a change of focus with regard to developing better retirement income programs is just beginning.

Simulation analysis provides a flexible tool for evaluating various important economic implications of alternative social security reform proposals. Its usefulness in American policy discussions is reflected in the widespread interest which the results of the Orcutt, Pechman, and Schulz simulations have generated among American politicans, government analysts, and academics working in the income maintenance field. It is no accident that the Office of Economic Opportunity, the U.S. Treasury, and the Social Security Administration have cooperated and encourage these projects.

Simulation as a tool of policy analysis is appropriate even in countries where existing data are scarce. Simulation makes it possible to remain at the microeconomic level and bring to bear on the questions under consideration a wide variety of data from many different sources—data available at different levels of aggregation. As Orcutt (1964) has observed, "selection of a probabilistic approach to predicting the behavior of micro components does not reflect any particular philosophical position about the nature of causation or about the meaning or existence of free will." Such an approach is chosen in order that the limited data that exists can be utilized in investigating problems for which non-stochastic models do not seem feasible. The whole area of social welfare economics presents many such problems.

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124

1. *Age of Entering the Labor Force (AGENT) in the German System*

In previous simulations, AGENT was assumed to be 20 years of age. In this simulation, the age was kept variable with the years of schooling received. The relationship between the years of schooling and the age is as follows:

AGENT	*Type of schooling received and completed*
15	High school, grade 10, or less schooling
16	High school, grade 11
17	High school, grade 12
19	College, three years, or less college
21	College, for years, completed
25 + N	College, five years, or more.

In the case of five or more years of college, a normally distributed random variate was generated and added to the value 25 of AGENT. The variate N had a mean of zero and a standard deviation of one. Consequently, the average age generated was 25 years, and approximately all cases generated 99.7 percent fell within the interval of 22 years to 28 years. The "type of schooling" used for estimating was based upon the 1960 census information.

2. *Wage History of Individuals (WAGE)*

In the absence of a detailed knowledge of wage histories of individuals in different trades and occupations, a method was developed to generate these wages for the years 1940 to 1959—based on the individuals' recorded wages for 1960.

Using national wage averages, a linear regression line was fitted according to the least squares criterion. The slope of the regression was found to be $144.5 per year. In the simulation an individual's recorded wage for 1960 was successively reduced by this amount to give his deflated wages for the years 1959 to 1940.

In order to introduce variation, a normally distributed random variate N with mean zero and standard deviation of 5.8 was added to the deflated value; consequently, almost all variations (99.7 percent) ranged between −17.4 and 17.4. In other words, the 1960 recorded wage of an individual was successively reduced by an amount normally distributed within the limits of $127.1 and $161.9 per year.

In the above scheme, the minimum wage permissible was $500 per year, and the maximum was not allowed to exceed a value twice the average of the last three years of the national wage averages. In addition to the 1960 recorded wage, the status of employment and the last year of work were known. Accordingly, the annual wage was set to zero when an individual had not worked.

3. *German Pensions (GP)*

The calculation of German pensions can be readily understood by following these steps:

(a) At the year of retirement, the general earnings base (GB) is defined as the average of the prior three years of average national wages.

(b) Departing from the practice in Germany, three factors to adjust the general earnings base were calculated. These factors are defined as the average of the prior ten, twenty, or lifetime ratios of an individual's annual earnings to the national wage averages. In Germany, the average of all (i.e., lifetime) ratios of wages to national wave averages are calculated.

(c) Given these three factors, the general earnings base is multiplied to form three (as opposed tone) personal earnings bases (PB10, PB20, and PBLIFE).

(d) Given the personal earnings base—the number of years worked and the age at retirement minus the age of entering the workforce were determined.

(e) In this simulation two legal constants (LCON) were used to give weight to the number of years worked. Presently in Germany this constant is 0.015 for every year worked. In the simulation the constant 0.0111 was also used.

(f) Given three personal earnings bases and two legal constants, six different pensions were calculated. These pensions were obtained by multiplying the personal earnings base with the number of years worked and with the legal constant.

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