

THE IMPACT OF COST OF LIVING AND POPULATION CHANGES ON THE SOCIAL SECURITY SYSTEM

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ABSTRACT

The social security system offers an interesting challenge to modelers. It is probably the only program in the government sector that is essentially a closed system since revenues must equal receipts if the system is to remain self-financed. Furthermore, the program is now tied to changes in the Consumer Price Index (CPI) and average wages rather than to the convenience of legislators. (This is subject to change.) Most features of the system can therefore be modeled from economic and demographic variables alone. To model the system one needs a population sector, estimates for changes in the CPI and wages, and unemployment and labor force participation rates, and information on the relationships between these variables and social security benefits and receipts. This paper presents a model which traces social security receipts and expenditures from 1950 to the present and then projects them to the year 2000. To find the impact on the system, one enters the appropriate unemployment and labor force participation rates, CPI changes, and the rate of increase in average wages. As predicted, tax rates will need to increase if the system is to remain self-financing under anticipated future conditions. One new aspect to this model is the introduction of varying labor force participation rates for women. If female force participation rates increase, projected tax rates can decrease and the changing age structure of the population will not have the anticipated effect at the end of the century.

INTRODUCTION

Since 1950, the Social Security system has evolved from a relatively new and minor program into one constituting a sizable proportion of the federal expenditure and revenue budgets, and involving almost every American. In 1950, payroll taxes—mainly OASDI—comprised 13% of federal government tax receipts. In 1976, they provided 31%, second only to the individual income tax in magnitude. Social security tax liabilities now exceed income tax for most low and middle income families. In 1976, social security taxes usually exceeded income taxes for single persons with incomes of \$13,000, married couples with incomes of \$15,000, and married couples with two children with income of \$17,000.⁴

Modeling the Social Security system from 1950 to 2000 presents special difficulties because the nature and scope the program have changed. In 1950, only 64.5% of workers in paid employment were covered by social security. Today, 90% of the labor force is in covered jobs, 97% if only private industry is considered. In 1950, only 16.4% of the aged population received social security assistance, but by 1974, 88.3% were receiving benefits. This expanded coverage was legislated by Congress and is part of political and legislative design, not economic, social and demographic conditions. Further expansion in coverage is not anticipated. Rather, the high cost is causing a withdrawal of some public employees.

Another basic change in the program occurred in the early seventies. Prior to 1974, increases in benefits and in the income ceiling were legislated by Congress. Now they are tied to increases in the price level and average wages, respectively. As a result, the social security system can now be modeled more easily as part of a closed system, and consequently, our program uses a different philosophy in modeling the twenty five years from 1950 to 1975 than from 1975 to 2000.

Because of legislated and automatic increases in benefits, the real value of benefits to each recipient has risen. A measure of this rise is the replacement rate—the ratio of social security benefits to income in the year immediately preceding retirement. In 1950, the replacement rate for a single male with average taxable earnings was about 30%. In 1975, it had risen to 43.4%. Increases in benefits and replacement rates—prior to 1974 were legislated. They are now automatic and depend on the rate of increase in wages and prices because the program is double or over-indexed, a situation not anticipated or desired by the government. Over-indexing and suggestions for correcting it are explained fully in several articles,^{1,2} but a brief discussion will be helpful here. When the CPI rises by at least 3% benefits increase by the same percentage. Consequently, benefits for any given level of pre-retirement earnings will increase. With today's cost-push inflation, wages tend to rise when prices rise, and when wages rise, the income ceiling and average covered income rise. As a result, future retirees will have greater covered earnings as well as higher benefits for each level of earnings. When price and wage increases occur together, then, future retirees are compensated twice for inflation. If over-indexing remains the Social Security Admin.

estimates that the replacement rate for a single male with average covered earnings will be 98% by 2050 if real wages rise by 1% and prices by 4%.

This paper assumes double indexing will be eliminated by 1980 and the replacement rate will return to where it is today. This is a reasonable assumption since the government is cognizant of the problems and double indexing was an accidental and unwanted occurrence.

BACKGROUND TO PROGRAM

OASDHI (Old-Age, Survivors, Disability, and Health Insurance) includes three separate programs. OASI provides retirement income for aged workers, their dependents, and survivors. The retirees must have worked in covered employment. It is OASI that is the concern of this paper. The other two programs are DI (Disability Insurance) and HI (Health, Insurance or Medicare).

OASI is financed by a proportional tax on earned income up to an income ceiling that has been steadily increasing. In 1950, the employer and employee each paid 1.5% on the first \$3,000 of each individual's wage or salary income. In 1977, the tax rate became 4.375%, with an income ceiling of \$16,500. The tax rate on self employed workers has been 1.5 times the tax rate on employees, with the same income ceiling. The tax rate on the self employed is temporarily frozen.

To be eligible for retirement income, an individual must have worked a minimum period of time in covered employment. Persons reaching age 62 this year will need six and one half years in covered employment. By 1991, and thereafter, ten years of covered employment will be required. Benefits at retirement depend on the amount of covered earnings during working years. The greater the covered earnings--earnings on which tax is paid--the higher the benefits at retirement. These benefits are not proportional to earnings, however; the program replaces a greater percentage of pre-retirement earnings for low wage and salary earners than high ones.

Retirement benefits are based on average covered wages (ACW). These are calculated by summing covered earnings from the year in which the individual reached age 21 (or 1950 whichever is later) until the year in which he or she reaches age 62. These total covered earnings are then divided by the number of years in the period. (Prior to 1975, men had to include earnings until earned before age 65. The years from 1975 to 1978 are transition years). In calculating ACW, the lowest five years of earnings may be ignored. Years in which an individual did not work average as zero earnings.

Average covered wages determine an individual's Primary Insurance Amount (PIA), which is the monthly benefit a person receives if he or she retires at age 65. Benefits are actuarially reduced for persons retiring between age 62 and age 65. Individuals retiring after age 65 receive benefits higher than the PIA. The minimum PIA for an insured worker in 1976 was \$107.90. For all others, the schedule for calculating PIA in 1976 is as follows:

137.77%	of the first	\$110	of ACW
50.11%	of the next	\$290	of ACW
46.83	of the next	\$150	of ACW
55.04	of the next	\$100	of ACW
30.61	of the next	\$100	of ACW
25.51	of the next	\$250	of ACW
22.98	of the next	\$175	of ACW
21.28	of the next	\$100	of AGW.

As the schedule shows, the system is somewhat income redistributive.

Whenever the CPI rises by at least 3%, the entire benefit schedule is increased by the same percentage as prices. If the cost of living rises by 10%, the first line of the schedule above would become:

151.55%	of the first	\$110	of ACW.
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Spouses and survivors are eligible for benefits under the OASI program. A wife is eligible to receive an amount equal to one-half her husband's benefits if she has none of her own. If a wife has worked and accumulated her own credits, she may elect to receive either her benefits or half of her husband's. Widows become eligible for the entire benefit of the deceased husband. A widow remarrying, however, no longer receives the PIA of her deceased husband; she must choose either one half the PIA of her deceased husband or one half the PIA of her current spouse. Since spring, 1977, husbands and widowers may receive benefits on their wives work experience instead of their own. Prior to that time, husbands had to prove dependency.

METHODOLOGY

The social security system is presented in the DYNAMO computer language. DYNAMO allows for the numerical solution of differential equations that cannot be solved analytically. The DYNAMO simulation language provided the needed numerical integration and also provided convenient printing and graphing capabilities. However, the model will soon be translated into a new computer language called NDTRAN will be used instead of DYNAMO in order to provide even more accurate numerical integration routines and to allow for extended output capabilities. NDTRAN has been developed by Professor W. I. Davisson at the University of Notre Dame.

The simulation approach to modeling was used in this case instead of simultaneous multiple regression analysis primarily because observations on some of the important variables were available only at five year intervals and in some cases for only ten year intervals. Consequently, simultaneous regression analysis would have been less than satisfactory due to the large number of missing values for several of the important variables and, therefore, the resulting small effective sample size and small number of degrees of freedom. Needless-to-say data for explanatory variables for years 1976 to the year 2000 were not available. In addition the complicated structure and feedback relationships in the social security system made the properties of simultaneous regression estimates intractable.

The simulation approach, on the other hand, models the interacting relationships of the system variables such as population, income, social security benefits, etc. and projects this model into the future on the basis of the system's own inertia. This inertia is generated by lags and feedbacks for example in the maturation and aging of the population as reflected in the changing age-earnings profile.

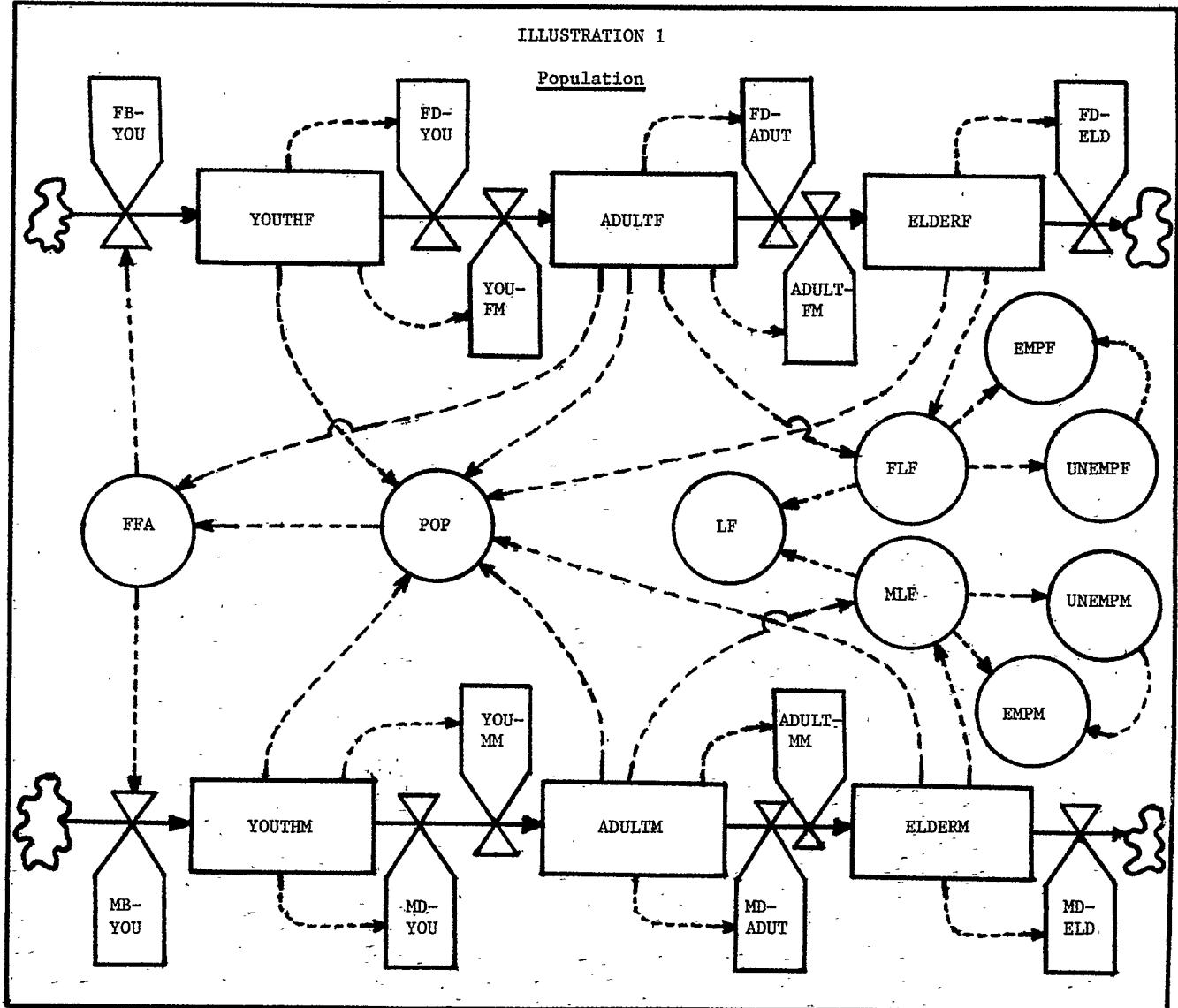
are given in Table 1.

The model tracks social security receipts and expenditures from 1950 to the year 2000. It is assumed that over-indexing will be eliminated by 1980 and the replacement rate will remain constant after that. Potential tax payers and beneficiaries come from a population sector which is broken into male and female youth, adults, and elderly. Youth are under age 18; adults are individuals aged 18 thru 64; the elderly are age 65 and over. The adult population contributes to the social security system. The elderly draw benefits. A representation of the population sector is seen in Illustration 1. Projections into the future are based on medium range growth and

TABLE I
POPULATION PROJECTIONS BY AGE AND SEX
(in millions)

Year	1980	1985	1990	2000
Male Youth	32,859	32,999	33,704	35,999
Female Youth	31,661	31,705	32,321	34,456
Male Adults	63,899	68,121	72,489	80,889
Female Adults	67,491	71,341	74,906	81,846
Male Elderly	9,814	10,386	11,041	12,423
Female Elderly	14,946	15,985	17,221	19,452

ILLUSTRATION 1



REVENUE MODEL

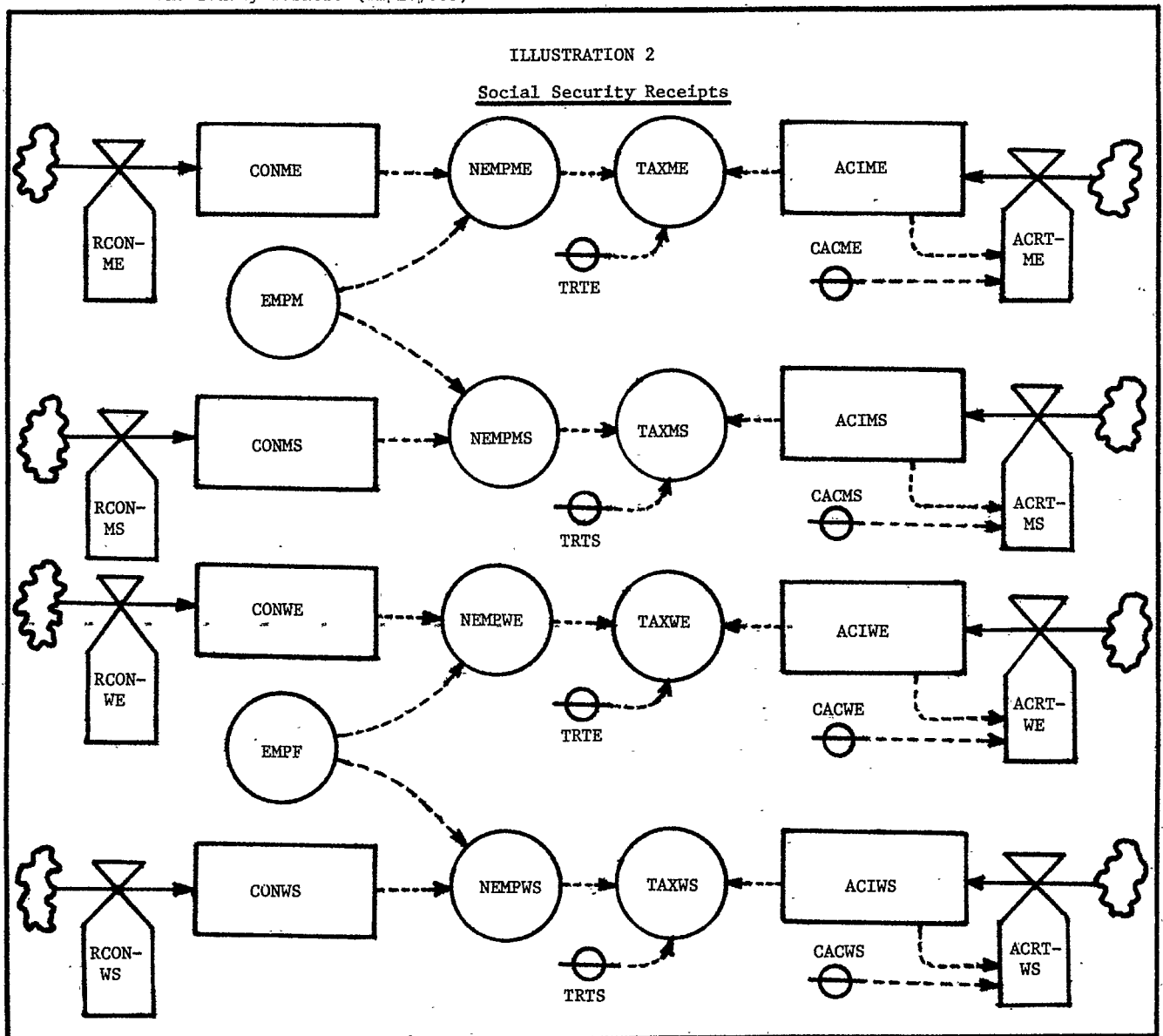
Taxpayers are separated into four groups: male wage and salary workers; female wage and salary workers; male self-employed; and female self-employed. Wage and salary workers are separated from self-employed since the total tax rate on the two groups differs. The taxpayers are separated by sex because women have lower average wages and therefore lower average covered wages. Total revenue in any year is given by the following:

$$\text{TOTREV} = (\text{NEMPME} \times \text{ACIME} + \text{NEMPWE} \times \text{ACIWE})\text{TRTE} + (\text{NEMPMS} \times \text{ACIMS} + \text{NEMPWS} \times \text{ACIWS})\text{TRTS} \quad (1)$$

where ACIME = average covered income of male wage and salary workers (employees)
 ACIWE = average covered income of female wage and salary workers (employees)

- ACIMS = average covered income of male self-employed workers
- ACIWS = average covered income of female self-employed workers
- NEMPME = number of covered male wage and salary workers
- NEMPWS = number of covered female wage and salary workers
- NEMPMS = number of covered self-employed males
- NEMPWS = number of covered self-employed females
- TRTE = total OASI tax rate on wage and salary income
- TRTS = OASI tax rate on self-employed income.

A flow diagram of receipts is given in Illustration 2.



The number of employed in each of the four categories (NEMP) is given by the social security administration for the years 1950-1975. In our model, though, NEMP comes from the number of adult and elderly males and females, labor force participation rates for the four groups, and male and female unemployment rates. Eventually unemployment rates will be broken down by age as well as by sex. The formula for number of employed males is as follows:

$$\text{NEMPME} = (\text{ADULTM} \times \text{LPAM} + \text{ELDERM} \times \text{LPEM}) \times (1 - \text{UNEM})\text{CONME} \quad (2)$$

where ADULTM = adult men (age 18 - 64)
 ELDERM = elderly men (age 65 and over)
 LPAM = labor force participation rate of adult men
 LPEM = labor force participation rate of elderly men
 UNEM = male unemployment rate
 CONME = proportion of employed men working in wage and salary occupations.

calculations for NEMPWE, NEMPMS, and NEMPWS follow the same procedure.

The formula tracks well from 1950 to 1975 (1951 for self-employed) and is used for projections to 2000. Actual unemployment and labor force participation rates are used for the period 1950 to 1976. From 1980 to 2000, the male unemployment rate is assumed to be 6% and female is 6.5%. The latter is possibly a bit low. Later simulations will show the effect of varying unemployment rates on the trust fund.

Two projections of labor force participation rates are used. The first comes from the Department of Labor. The second utilizes the same rates for men but assumes higher rates for women than the official projections. These are given in Table 2.

YEAR	1980	1985	1990
OFFICIAL PROJECTION			
ADULT MALE	84.5	85.5	85.7
ELDERLY MALE	19.1	17.3	16.1
ADULT FEMALE	55.9	58.6	60.7
ELDERLY FEMALE	7.6	7.3	7.2
ALTERNATIVE PROJECTIONS			
ADULT FEMALE	58.0	61.5	65.0
ELDERLY	7.6	7.4	7.3

SOURCE: Official projections are from data published by Department of Labor, Bureau of Statistics, Monthly Labor Review, December, 1976.

Raising the labor force participation rates for women results in increases in revenue relative to receipts if the increase results in a decrease in the ratio of nonworking married women to all women.

Married women whose husbands are covered are eligible for benefits whether or not they contribute to the system. When such women enter the labor market and find jobs, they contribute as much to the system as men with equal incomes, but the net cost to the system is less. The net cost in benefits for a married woman dually entitled is the difference between her benefits and her entitlement on her husband's experience. (If this difference is negative, the net cost is zero.)

Average Covered Income (ACI) in the model and in the economy increases whenever wages increase from inflation or productivity. In the past, legislated changes in the income ceiling also increased ACI, but now the income ceiling is indexed to average wages and rises at the same rate. In the present model, wages in the future are assumed to increase at 6%. The model can handle varying wage increases, however.

EXPENDITURE MODEL

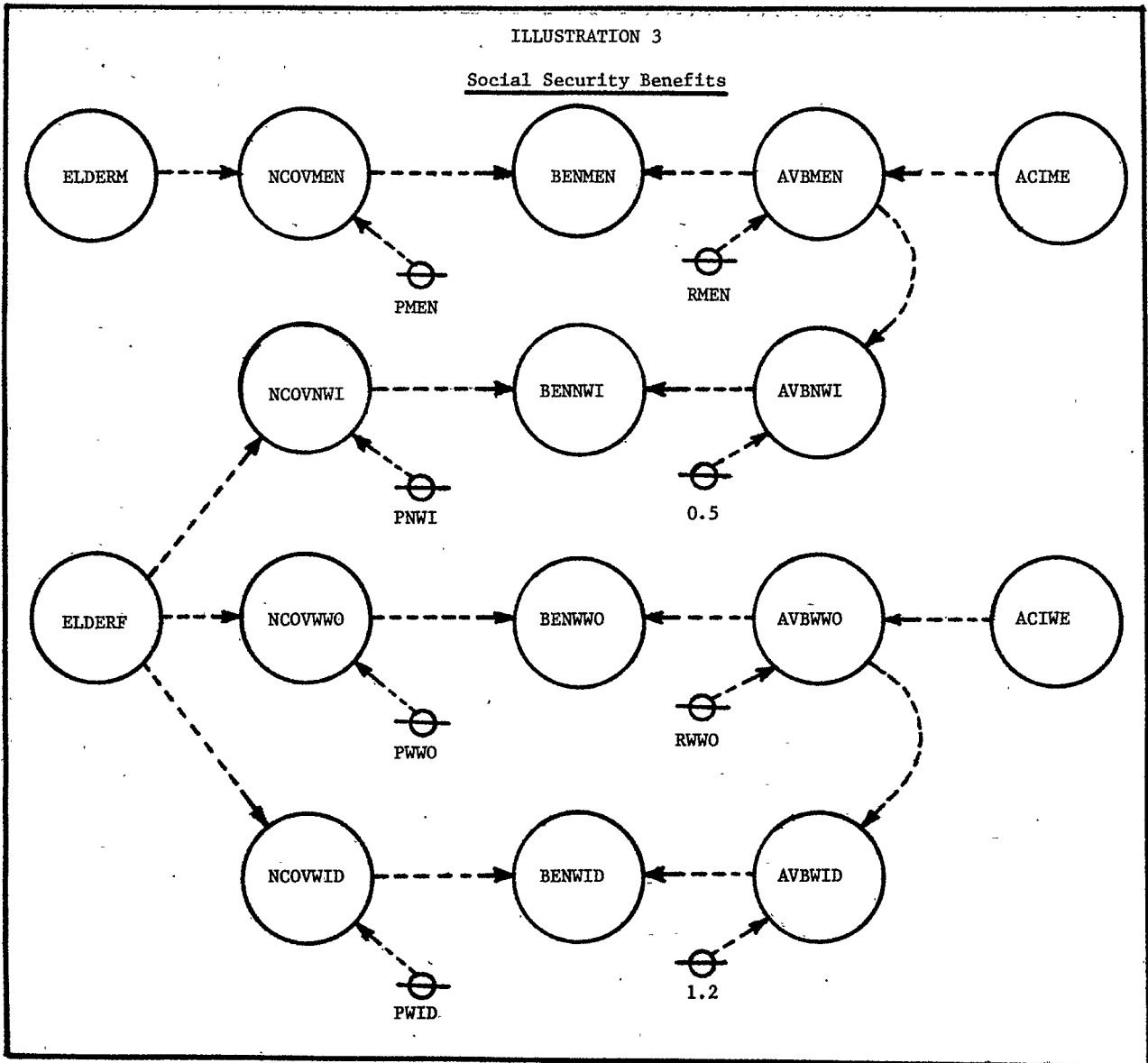
Receipts are more difficult to model than revenue for two reasons. First, benefits depend on ACW for each individual, not for the nation as a whole. Because of the redistributive nature of the program, total covered income for the nation can remain the same and total benefit payments will decline if covered wages are distributed more evenly. Second: expenditures depend on the proportion of dually covered married women in the work force and on the ratio of each wife's own benefits to her half of her husband's. (The same situation is applicable for husband's collecting benefits on their wife's entitlement, but this group is considerably smaller. In the model such husbands are included with wives.)

Total benefits are calculated by the following formula:

$$\text{TOTEXP} = \text{NCOVMEN} \times \text{ABBNMEN} + \text{NCOVWVO} \times \text{AVBNWVO} + \text{NCOVNWI} \times \text{AVBNNWI} + \text{NCOVWID} \times \text{AVBNWID} \quad (3)$$

where NCOVMEN = number of covered, retired men
 NCOVWVO = number of covered women collecting on their own records
 NCOVNWI = number of non-working wives covered on their husbands' records
 NCOVWID = number of covered widows receiving benefits on their husbands' records
 AVBNMEN = average benefits of men
 AVBNWVO = average benefits of women
 AVBNNWI = average benefits of wives covered on their husbands' records
 AVBNWID = average benefits of widows.

At present, because of data restrictions the category NWI--nonworking wives--includes wives who have worked but who elect to receive benefits on their husband's entitlement rather than their own. Working wives whose benefits are less than one half their husband's fall into this category. Ideally, these women should form a fifth group. When they are placed in a separate group it will be easier for the model to handle internally any changes in average wages and labor force participation rates of married and single women. A diagram of the expenditure model as it exists now is given in Illustration 3.



AVBMEN and AVBWWO are calculated from the variables ACIME and ACIWE from the revenue side of the model. The ratio of average benefits and average covered income in the model is related but not equal to the replacement rate of social security. During the years from 1950 to 1969, when the replacement rate was virtually constant--there was a slight secular rise--the ratio of AVBMEN to ACIME and AVBWWO to ACIWE showed the same relationship. Since this model assumes the system will be decoupled (over-indexing eliminated), the ratios of AVBMEN to ACIME and AVBWWO to ACIWE remain constant from 1980 to 2000.

Average benefits for non-working wives and working wives receiving benefits on their husband's entitlement (AVBNWI) are approximately equal to AVBMEN. This is to be expected since a wife is entitled to

one half her husband's PIA. AVBNWI is not equal to exactly one half AVBMEN because average benefits of married and single men differ and because wives more often than husbands elect to receive benefits early. The latter situation has the most effect.

CONDITIONS FOR A SELF FINANCED SOCIAL SECURITY SYSTEM

Presently, expenditures are a contractual obligation determined by the number of elderly and their former employment experiences, the current number of elderly who are employed, and the rate of inflation. Receipts must be adjusted to equal expenditures. On the receipt side, the social security administration and Congress can control the tax rate, the income ceiling, or both. The social security administration cannot directly control the size of the labor force and unemployment rates since these are under the influence

of more general economic and demographic conditions. Receipts can be increased or decreased by raising or lowering the tax rate and/or income ceiling. Since the income ceiling is already appropriately and automatically linked to the economy, tax rates are the discretionary adjustment mechanism in this model. (Admittedly, the government can control the size of the labor force and the unemployment rate by appropriate monetary and fiscal policies. In terms of adjusting receipts to benefits, however, adjusting unemployment through changes in social security tax rates would be self defeating. Changing the social security tax rate and income ceiling therefore, are the only appropriate methods for adjusting receipts.)

There are two basic philosophies for managing a self financed public pension system. First, the program can be viewed in a lifetime framework, with revenues for each generation of workers entering a trust fund to be used for that generation's retirement. Under this approach, the program would more closely approximate a true, pension system. Second, the program can be viewed as an intergenerational transfer from the current working aged adults to the elderly.

When social security was first introduced in 1935, use of the first approach was anticipated, but the government began abandoning it as early as 1939. When coverage of social security was expanded in the 1950's, newly covered workers were allowed to receive full benefits with only a very few number of years in covered employment. This moved the program further away from a lifetime framework. Under a lifetime framework, a changing age structure would have little effect on the system, but under such a procedure, it would be impossible for benefits to increase with the cost of living for those already retired. Regardless of the advantages or disadvantages of this approach, the lifetime framework is not feasible at present (a large trust fund would need to be established), and it will not be modeled.

Under the second approach, the program can be balanced every year or over the business cycle. If balanced every year, tax rates would rise and fall with the unemployment rate. This runs contrary to standard stabilization policy. If the system is cyclically balanced, a tax rate is chosen that will result in an increase in the trust fund when unemployment is high and a subsequent, equal drain on the system during the unemployment phase. A modification of this, suggested by several economists and recently endorsed by President Carter, would provide for general revenue financing of the deficit financing of the deficit created by high unemployment. Under President Carter's proposal, when unemployment exceeds 6%, social security would be reimbursed from general revenue funds for the difference between actual collections and those that would occur at an unemployment rate of 6%.

RESULTS

With this model, these various approaches can be simulated under varying unemployment rates, levels of inflation, and wage changes. Anticipated conditions can be entered into the model and the tax rate necessary to balance the system and the deficit or surplus under existing tax rates can be determined. The relationship between receipts and benefits is shown in Illustration 4.

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Using the conditions described above, the program begins incurring a deficit in 1974 (a little sooner than actual experience) and remains at a deficit. The situation eases somewhat in 1980 by which time we anticipate decoupling. With decoupling tax rates necessary to balance the system are not formidable if the government either maintains a high level of employment or subsidizes through general revenues in periods of high unemployment.

The burden on low income individuals should probably be relieved through expansion of the earned income credit or a similar measure.)

The unique feature in this model is the changing labor force participation rate of women. When the labor force participation rate increases, the deficit decreases, or, alternatively, the rise in the tax rate will be less. (The relationship between changing labor force participation rates and the size of the deficit is somewhat lagged.)

CONCLUSION

This model has demonstrated the effect of the changing age profile on the social security system as population flows through the youth, adult, and elderly sectors. The implications of the elimination of double indexing have been considered at length and incorporated into the model as anticipated for the near future. This paper has also explained the alternative methods for financing the social security system through the year 2000.

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ILLUSTRATION 4
Social Security Fund

