

CHAPTER 7

U. S. SOCIAL SECURITY ADMINISTRATION OFFICE OF THE ACTUARY PROJECTIONS METHODOLOGY

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CHAPTER 7

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The Office of the Actuary of the U.S. Social Security Administration uses a system of assumptions and modeling methodologies to project the finances of the Federal Old Age and Survivors Insurance (OASI) and Disability Insurance (DI) Trust Funds. The Office of the Actuary (OACT) does not have a single, integrated model. Rather, it combines the output of several sets of procedures and algorithms, in order to project variables that are important for the finances of the system and to investigate and project the implications of alternative sets of assumptions. OACT uses the system of projection methodologies to provide input into the annual report to the Congress of the Board of Trustees on the financial and actuarial status of the OASI and DI Trust Funds. In addition, OACT also provides analysis and projections to inform and assist social security policy discussions. For example, OACT provided considerable input to the deliberations of the 1994-1996 Social Security Advisory Council.

Treatment of Uncertainty

Future income and expenditures of the OASDI system will depend on many factors, including the size and composition of the population that is receiving benefits, the level of average benefit amounts, the size and characteristics of the work force covered by social security, the level of workers' earnings, the rate of interest. These factors will depend in turn upon future birth rates, marriage and divorce rates, death rates, migration rates, labor force participation and unemployment rates, disability incidence and termination rates, retirement age patterns, productivity gains, wage increases, inflation rates, and many other economic and demographic factors. All of these factors are characterized by uncertainty concerning their future values.

OACT attempts to reflect the uncertainty in the future values of the factors determining OASDI financial outcomes by providing three alternative projections, reflecting three alternative sets of assumptions regarding future economic and demographic trends, that are intended to span the likely range of future outcomes with regard to the financial soundness of the system. These are designated as alternatives I, II, and III. In alternative I assumptions are selected for the future values of the factors determining OASDI finances that produce relatively low expenditures and high revenues, i.e., an optimistic projection regarding future OASDI finances. In alternative III assumptions are selected that produce relatively high expenditures and low revenues, i.e., a pessimistic projection of finances. Alternative II uses a set of intermediate cost assumptions and is characterized as the best guess projection. OACT does not use stochastic simulation techniques for

¹ This description draws on *1998 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds*, Social Security Administration, Actuarial Study No. 100 (February 1988), Actuarial Study No. 108 (December 1992), Actuarial Study No. 111 (December 1996).

the official projections. No attempt is made to establish confidence intervals for the projections or to indicate the likelihood of individual projections.

Components, Parameters, and Variables

The OACT methodology is a framework for developing explicit assumptions regarding the future paths for key factors determining OASDI financial flows and projecting the implications of those assumptions for the OASDI system, including the number of covered workers, taxable earnings, payroll tax revenues, number of beneficiaries of various types, average benefit amounts, total revenue and expenditures, and trust fund balances. The key parameters and variables can be classified in three groups: (1) demographic, (2) economic, and (3) programmatic, which define three components of the projection system. For each component projections for three sets of assumptions are produced, corresponding to alternatives I, II, and III.

The major components, parameters, and variables of the projection system are the following:

(1) Demographic Projections

Parameters and assumptions

- Total fertility rate
- Age-specific birth rates
- Rate of change of mortality
- Age-specific death rates by cause of death
- Age-specific death rates, all causes
- Total legal and other-than-legal immigration
- Age-sex specific immigration
- Age-specific marriage and divorce rates

Output variables

- Population of the social security area by single year of age, sex, and marital status

(2) Economic Projections

Parameters and assumptions

- Labor force participation rates by age and sex
- Unemployment rates by age and sex
- Ratio of covered workers to employed labor force
- Average hours worked per week
- Average weeks worked per year
- Productivity growth rate
- Ratio of employee compensation to GDP
- Ratio of earnings to compensation
- Ratio of covered earnings to earnings

Ratio of taxable earnings to covered earnings
 Ratio of self-employment income to GDP
 Ratio of covered self-employment income to self-employment income
 Ratio of effective taxable self-employment income to covered self-employment income
 Linkage: annual percent change in productivity to percent change in compensation
 Linkage: annual percent change in compensation to percent change in earnings (wages, self-employment income)
 Consumer price index (CPI) rate of change
 Differential: GDP deflator to CPI
 Real interest rates

Output variables

Labor force by age and sex
 Covered workers by age and sex
 Average wage
 Average self-employment income
 Potential GDP
 Actual GDP
 Total wages
 Covered wages
 Total self-employment income
 Covered self-employment income
 Effective taxable payroll

(3) Programmatic Projections

Parameters and assumptions

Employee, employer, and self-employed payroll tax rates
 Proportion of benefit payments subject to income tax
 Benefit prevalence rates, incidence rates, and termination rates for 10 types of retired worker, dependent, or survivor beneficiaries, and four types of disabled worker and dependent beneficiaries
 Average awarded Primary Insurance Amounts (PIAs)
 Ratios of average benefits by type to PIAs

Output variables

Average benefit amounts by type of benefit
 Number of beneficiaries by type of benefit
 Benefit payments by type of benefit
 Lump-sum death payments
 Administrative expenses
 Payroll tax revenues
 Income from taxation of benefits

Interest earnings on trust funds
Trust fund balances

Projection Methodologies and Assumptions

1. Total Population

Population projections start with a base population, the population of the Social Security Area by age and sex, based on data from the U.S. Bureau of the Census, adjusted to correspond to the Social Security Area.² This population is then projected using assumed rates of birth, death, marriage and divorce, and assumed levels of immigration. Age-specific birth rate assumptions are developed to be consistent with alternative assumptions regarding the future total fertility rate (TFR). Future fertility rates are expected to remain close to recent relatively low levels. The TFR in 1996 was 2.03. The 1998 Trustees Report assumed the ultimate TFR would be 2.2, 1.9, and 1.6 children per woman for alternatives I, II, and III, respectively. For each alternative, the TFR is assumed to reach its ultimate level in 2021.

To project future death rates, OACT projects rates of improvement (decline) in death rates by age, sex, and cause of death, from a recent base year (1996). The age-sex adjusted central death rate is assumed to decline at rates of 0.2 percent, 0.6 percent, and 1.0 percent between 1996 and 2072 for alternatives I, II, and III, respectively.

OACT develops three sets of assumptions regarding future levels of net immigration by age and sex, considering recent trends and changes to immigration laws. In 1996 and 1997, net legal immigration is estimated to be 683,000 and 660,000 persons per year, respectively. In addition, net other-than-legal immigration is estimated to be about 300,000 persons per year. Net immigration for the year 2000 and later is assumed to be 1,150,000, 900,000, and 750,000 persons per year for alternative I, II, and III, respectively. Of these 700,000, 600,000, and 550,000, respectively, are assumed to be legal, and the remaining immigrants are assumed to be other-than-legal.

2. Covered Population

The number of covered workers in a year is the number of persons who, at any time during the year, have OASDI taxable earnings. Projections of the number of covered workers are made by applying projected coverage rates to the projected Social Security Area population. Coverage rates – the number of covered workers in the year as a percentage of the population by age and sex – were

² The Social Security Area population is the population of the fifty states plus D.C., adjusted for net census undercount, plus other entities and groups whose populations participate in the U.S. Social Security System. The territorial components of the Social Security Area are the fifty states and D.C., armed forces overseas; civilian residents of Puerto Rico, Virgin Islands, Guam, American Samoa, Palau, Northern Mariana Islands; federal civilian employees overseas, dependents of armed forces and federal employees overseas, crew members of merchant vessels, other citizens overseas. In 1995 the population of the fifty states and D.C. and armed forces overseas (census population) was 263,036, while the population of the Social Security Area was 272,918.

determined based on projected labor force participation rates and unemployment rates, and their historical relationships to coverage rates. Labor force participation rates were projected by age and sex, taking into account the percentage of the population that is married, the percentage of the population that is disabled, the number of children, the level of retirement benefits, and the state of the economy. Age-sex specific unemployment rates are projected to be consistent with assumed aggregate unemployment rates. The unemployment rate averaged 5.9 percent during 1987-1996. The ultimate total unemployment rate is assumed to be 5.0, 6.0, and 7.0 percent in alternatives I, II, and III, respectively.

3. Average Earnings

Increases in average nominal earnings are projected separately for wage and salary workers and for self-employed persons. Each of these increases in nominal earnings is divided into increases in real average earnings and increases in the CPI. Real increases in the average covered wage are sometimes expressed as “real wage differentials,” the percentage increase in the average nominal wage minus the percentage increase in the CPI. Assumed ultimate rates of change in average real earnings are based on analysis of trends in productivity change and the factors linking productivity change with increases in average real earnings. Table 1 shows trends over recent periods in these variables and the assumptions for alternative I, II, III.

TABLE 1
PRODUCTIVITY CHANGE AND REAL EARNINGS CHANGE,
SELECTED PERIODS: 1957-1996

Period	Productivity Change	Change in Average Real Earnings	Difference: Productivity Change and Real Earnings Change	Change in Average Real Wage in Covered Employment
1957-66	3.1	2.3	-0.8	1.8
1967-76	2.0	0.5	-1.5	0.7
1977-86	1.1	-0.1	-1.2	0.6
1987-96	0.6	0.6	0.0	0.5
1957-96	1.7	0.8	-0.9	0.9
Alternative I	1.6	1.4	-0.2	1.4
Alternative II	1.3	0.9	-0.4	0.9
Alternative III	1.0	0.4	-0.6	0.4

4. Consumer Price Index (CPI)

Assumptions about future increases in the CPI are based on review of historic experience, weighted more heavily toward more recent experience. In the 1998 Trustees Report, the assumed ultimate rates of increase in the CPI were 2.5, 3.5, and 4.5 percent, in alternatives I, II, and III, respectively. The difference in the rate of increase in the CPI and the GDP deflator was assumed to decline from 0.2 percentage points in 1997, to the ultimate assumed difference of 0.1 percentage point by 2007.

The ultimate increases in average annual nominal wages in covered employment equals the sum of the assumed annual percentage increase in the CPI and the assumed real wage growth. These are assumed to be 3.9, 4.4, and 4.9 percent, for alternatives I, II, and III, respectively.

5. Interest Rates

Assumed future real interest rates are developed based on examination of historical experience. The assumed ultimate real interest rate on the government securities held by the Social Security trust funds are 3.5, 2.8, and 2.0 percent for alternatives I, II, and III, respectively. The nominal interest rate is equal to the real interest rate times the rate of inflation.

6. Taxable Payroll

Taxable payroll is that amount which, when multiplied by the combined employee-employer tax rate, yields the total amount of taxes due from employees, employers, and the self-employed. Estimates of taxable earnings for employees, employers, and self-employed are developed from estimates of total earnings in the U.S. economy, using factors which adjust for differences in these measures. Total earnings are projected in two ways: (1) based on projections of aggregate economic parameters and variables, such as total labor force, potential and actual GDP, total compensation, and the relationship between total compensation and total earnings; and (2) based on projections of average economic parameters and variables, such as average real earnings, and the number of covered workers. Estimates of taxes collected are developed from the estimates of taxable earnings by applying the employee, employer, or self-employed tax rate, taking into account the lag between the time the tax liability is incurred and the time the taxes are collected.

7. Insured Population

Projections of the percentage of the population that is fully insured under social security are made by age and sex, from estimated distributions of workers by accumulated quarters of coverage, based on past and projected coverage rates and amounts of earnings required for quarters of coverage. Projections of the percentage who are also disability insured are made by age and sex, based on past and projected coverage rates, the requirements for disability insured status, and their

historical relationships. The fully insured and disability insured populations were developed from the projected population by applying the appropriate percentages.

8. Beneficiaries

Old-Age and Survivors.

There are 10 categories of OASI benefits. The number of OASI beneficiaries is projected for each type of benefit separately, by the sex of the worker on whose earnings the benefits are based, and the age and sex of the beneficiary. For some benefits, the number of beneficiaries is also projected by marital status.

(1) Retired workers. For the short-range projections, the numbers of retired worker beneficiaries are projected by applying award (incidence) rates (retirement rates), by sex and single year of age, to the aged fully insured population less those already entitled to a benefit, and by applying termination rates to the number of persons receiving retired-worker benefits. The fraction of entitled beneficiaries that would actually receive benefits is also projected. The number of retired worker beneficiaries at the end of the calendar year is projected, by single year of age, by adding the retired worker awards (newly retired workers) during that year to the number of retired workers at the end of the previous calendar year, and applying termination rates. Termination rates are projected based on historical trends and on the projected mortality rates of the aged population.

For the long-range projections, the number of retired-worker beneficiaries is projected by applying prevalence rates – as a percentage of the exposed population -- to the aged fully insured population less persons entitled to a disability or widow(er)s benefit. Prevalence rates for ages 62 through 69 are projected based on historical and projected short-range trends. The number of retired worker beneficiaries by age and sex is projected as a proportion of the total population not disabled (or converted from a disability benefit) and not receiving a widow(er)s benefit. As the normal retirement age increases after 2001, the number of retired workers as a percentage of the exposed population is adjusted downward at each age 62 through 69.

(2) Aged-spouse beneficiaries. The number of aged-spouse beneficiaries is estimated from the population projected by age and sex. In the short-range projections, a regression equation is used to project the number of aged-spouse beneficiaries, as a proportion of the aged uninsured female or male population. For long-range projections, aged-spouse beneficiaries are estimated from the population projected by age, sex and marital status. A series of factors are applied to the number of spouses aged 62 and over in the population, representing the probabilities that the spouse and the wage earner meet all of the conditions of eligibility. To the resulting number of eligible spouses was applied a projected prevalence rate to calculate the estimated number of aged-spouse beneficiaries. The same factors were applied to the number of divorced persons aged 62 and over in the population, with modifications corresponding to the treatment of divorced persons.

(3) Children under age 18 and students, dependents of retired workers. The projected numbers eligible for benefits as children of retire-worker beneficiaries are based on the projected number of children in the population. In the short-range projections, the number of entitled children is projected by applying incidence rates to the number of children in the population where both parents are alive, and by applying termination rates to the number of children already receiving benefits. The number of children of retired workers receiving benefits at the end of each calendar, by single year of age, is projected by adding the new child benefit awards during the year to the number of child beneficiaries at the end of the previous calendar year, and applying termination rates.

In the long-range projections, the number of entitled children is projected separately by sex of the wage-earner parent by applying prevalence rates to the number of children in the population, reflecting the probability that a parent is receiving a retired-worker benefit. The number of child of retired worker beneficiaries each year, by age and sex, is projected as a proportion of the population of that age and sex.

(4) Disabled dependent children of retired-workers, aged 18 and over is projected from the adult population. For short-range projections incidence (award) rates are applied to the population, and termination rates are applied to the number of disabled children already receiving benefits. For long-range projections, disabled children are projected using prevalence rates, similar to that for children under 18.

(5) Young spouse beneficiaries, mothers of dependent children of retired workers. For short-range projections, the number is projected by applying award (incidence) rates to the number of awards to children of retired workers, and by applying termination rates to the number of young-spouses already receiving benefits. For long-range projections, young-spouse beneficiaries are projected as a proportion of the projected number of child beneficiaries of retired workers.

(6) Aged widow(er) beneficiaries are projected from the population by age and sex. For short-range projections aged-widow(er) beneficiaries are projected concurrently with the retired-worker beneficiaries, using regression equations, as a proportion of the uninsured aged female or male population not receiving any type of benefit. For the long-range projections, aged-widow(er) beneficiaries are projected from the population by age, sex, and marital status, applying prevalence rates to the number of widow(er)s in the population, and to the number of divorced persons.

(7) Disabled widow(er) beneficiaries. For short-range projections the number is estimated as a proportion of the uninsured female or male population aged 50-64. For long-range projections, the number is projected for each age 50 through 64 as a percentage of the widowed and divorced populations.

(8) Children under 18 and students eligible for benefits as survivors of deceased workers are projected based on the projected number of children in the population whose mothers or fathers are deceased. For short-range projections, incidence (award) rates are applied to the number of orphaned children, and termination rates are applied to the number of children already receiving benefits. For

long-range projections, the number of child-survivor beneficiaries is projected similarly to that for child beneficiaries of retired workers, where the prevalence rates reflect the probability that the parent is deceased.

(9) Mother-survivor and father-survivor beneficiaries. For the short-range period the numbers are projected by applying award (incidence) rates to the number of awards to child-survivor beneficiaries, and by applying termination rates to the number of mother-survivors and father-survivors already receiving benefits. For the long-range period mother-survivor and father-survivor beneficiaries are estimated from the number of child-survivor beneficiaries, taking into account projected changes in average family size.

(10) Parent-survivor beneficiaries are projected based on the historical pattern of the number of such beneficiaries.

Disability

There are four types of disability benefits. The number of DI beneficiaries is projected for each type of benefit separately, by the sex of the worker on whose earnings the benefits are based, and the age of the beneficiary.

(11) Disabled-worker beneficiaries. The number is estimated from the existing stock of disabled worker beneficiaries at the beginning of the projection period by adding new entitlements and subtracting terminations. The starting number is estimated by age, sex, and duration of disability status. The number of new entitlements each year is projected by applying assumed age-sex specific disability incidence rates to the projected disability insured population, excluding those already entitled to disabled-worker benefits. The number of terminations is projected by applying assumed termination rates to the disabled-worker population. In the short-range period, the number of terminations is projected by applying assumed termination rates by reason – death, recovery, and all other – and by age and sex, to the entitled disabled-worker population. In the long-range period, the number of terminations is projected by applying assumed death rates and recovery rates, by age, sex, and duration of entitlement, to the entitled disabled-worker population. Disabled-worker beneficiaries are converted to retired-worker beneficiaries at the normal retirement age. The projection of incidence and termination rates is based on historical trends. The projections are adjusted to reflect the scheduled increase in the normal retirement age, upward for individuals who reach age 62 in 2000 or later. In the short-range period, the age-sex specific termination rates are projected by reason – death, recovery, and all other. In the long-range period, the death rates and recovery rates are projected by age, sex, and duration of entitlement.

(12) Children under age 18, students aged 18, and disabled children aged 18 and over. In the short-range projections, the number of children who are eligible for benefits as children of disabled-worker beneficiaries, are projected by applying incidence (award) and termination rates, based on the number of awards to disabled-worker beneficiaries. In the long-range period, the projected numbers of minor child and student beneficiaries are projected by applying prevalence rates

to the projected number of children in the population by age, reflecting the probability that either of their parents is insured and disabled.

(13) Young-spouse beneficiaries are projected in the short-range period by applying award (incidence) and termination rates, based on the number of awards to child beneficiaries who are either under age 16 or disabled. In the long-range period, the number of young-spouse beneficiaries is projected as a proportion of the projected number of child beneficiaries under age 16 or disabled, taking into account projected changes in family size.

(14) Aged-spouse beneficiaries are projected in the short-range period by applying award and termination rates, where awards are based on the number of awards to disabled-worker beneficiaries. In the long-range period, the number of aged-spouse beneficiaries is projected as a proportion of the number of disabled-worker beneficiaries, allowing for projected changes in marriage rates.

9. Average Benefits

Average benefits are projected by type of benefit based on recent historical averages, projected average Primary Insurance Amounts (PIAs), and projected ratios of average benefits to average PIAs. Average PIAs are calculated from projected distributions of beneficiaries by duration from year of award, average awarded PIAs, and increases since the year of award. For the 1998 Trustees Report average awarded PIAs were calculated from projected earnings histories, which were developed from actual earnings in a sample of awards made in 1996. For retired-worker, aged-spouse, and aged widow(er) benefits, projected ratios of average benefits to average PIAs are based on projections of age distributions of beneficiaries at initial entitlement.

10. Benefit Payments

For each type of benefit, benefit payments are calculated as the product of the number of beneficiaries and the average benefit. Lump-sum death benefits are calculated as the product of the number of such payments, based on the assumed death rates, the projected fully insured population and the percentage that would qualify, and the amount of the lump-sum death payment (\$255, not indexed).

11. Administrative Expenses

Projection of administrative expenses is based on assumed increases in average wages, increases in the CPI, and increases in the number of beneficiaries.

12. Income from Taxation of Benefits

The OASI and DI Trust Funds are credited with the additional income taxes attributable to the taxation of the first 50 percent of OASDI benefit payments, for recipients with income above a specified threshold. For the short-range projections income to the trust funds from such taxation is

estimated by applying factors for the percentage of benefit payments that is taxable and the average tax rate applicable to those benefits. For the long-range projections income to the trust funds from such taxation was estimated by applying projected ratios of such income to total OASI and DI benefit payments. Because the income thresholds above which benefits are taxable are constant in nominal terms in the future, their values relative to future incomes and benefit levels will decrease. Consequently, the percentage of total benefit payments that is taxable is projected to increase, and ratios of income from taxation of benefits to the amount of benefits are projected to increase.

13. Other Transactions

Projections are also done of the financial implications of several other programs and benefits, including an annual financial interchange between the Railroad Retirement Fund and the OASI and DI funds, the payment of special cash benefits to certain uninsured persons, and adjustments for military service transfers. The latter two have no effect on long-range projections, and the Railroad Retirement interchange has a small cost (0.05 percent of taxable payroll).

14. Interest Earnings on Trust Fund Balances

The OASDI trust funds are invested in special U.S. government securities. Interest earnings on the trust funds are calculated by applying the assumed (nominal) rates of interest on these securities to the projected level of assets in the trust funds.

15. Trust Fund Balances

The level of trust fund balances at the end of the year is calculated as the level of assets at the end of the previous year, plus total revenues to the trust funds, including payroll tax revenues, revenues from income taxes on benefit payments, and interest earnings, less total expenditures, including total benefit payments, administrative expenses, and other net transfers.