CHAPTER 4

PRISM

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CHAPTER 4

PRISM[1]

I. OVERVIEW

PRISM (Pension and Retirement Income Simulation Model) is a dynamic microsimulation model designed to simulate the retirement income and long term care utilization and financing of the elderly (age 65 and older) population. It ages a data base of 28,000 adults, which was created by matching the March and May 1979 Current Population Surveys (CPS) with the March 1978 CPS and Social Security earnings records for 1937-1977. It ages the database annually from 1979 through 2030, aligning aggregate outcomes to the projections of the Social Security Trustees report. PRISM depicts the events associated with the determination of retirement income and long term care utilization. It includes a database of 325 retirement plan sponsors and over 475 pension plans. It has detailed models of social security, employer (private and public) pensions, Supplemental Security Income, and Individual Retirement Accounts. It also has a comprehensive model of long term care utilization and financing. Users of PRISM can modify the parameters of the provisions of the pension plans in the plan sponsor database to correspond to changes in laws and regulations, but PRISM does not model plan sponsor behavior.

II. BACKGROUND

The first version of PRISM was developed in 1980 for the President's Commission on Pension Policy and the Office of Pension and Welfare Benefit Programs of the U.S. Department of Labor. Since 1980 PRISM has been substantially revised and enhanced to improve its capacity to model social security and pension policy. PRISM has been used by a number of public and private organizations to analyze a wide range of retirement policies, including changes in social security, pension incomes under alternative revisions to ERISA, taxation of pension accruals, and retiree health coverage provided through pension plans. In 1986 a model of long term care utilization and financing was added to PRISM. The model was extensively refined and updated in 1988 and 1989. PRISM has been used to undertake studies for the U.S. Department of Health and Human Services, the General Accounting Office, the American Council of Life Insurance, the Brookings Institution, the Pepper Commission, the 1991 Social Security Advisory Council, The Commonwealth Fund, the American Association of Retired Persons, and Merrill Lynch.[2]

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[1] This description draws on Kennell and Sheils (1986), Lewin-VHI (1992), Lewin-VHI (1994), Ross (1991), Citro and Hanushek (1997), Wiener, *et al.*(1994), and discussions with Lisa Alecxih of The Lewin Group and David Kennell of Kennell and Associates.

[2] PRISM was developed in 1980 by ICF Incorporated, a Washington, DC based economic consulting and research firm. The long term care financing model was developed in 1986 in a joint project by ICF and the Brookings Institution, and referred to as the Brookings-ICF Long Term Care Financing Model. In 1987 ICF acquired Lewin Associates and PRISM became domiciled at Lewin/ICF, a subsidiary of ICF. In 1991 Lewin/ICF was acquired by Value Health, Inc., and renamed Lewin-VHI. In 1996 Lewin-VHI was acquired by Quintiles, Inc.,

PRISM is designed to analyze retirement income policy. It focuses almost exclusively on the income sources of the elderly population, age 65 and over, their health insurance coverage, and utilization and payment for long term care. PRISM simulations of labor market and family histories are produced to analyze retirement policy, retirement income policy, and long term care policy alternatives. Thus, PRISM has a more narrow focus than DYNASIM or CORSIM, which have been applied to research and policy analysis tasks in a variety of areas.[3] PRISM's development and use have been almost exclusively for policy analysis or for projections of future scenarios to inform policy discussion. It was not designed for broader social science or microsimulation research, as were DYNASIM and CORSIM.

III. DESCRIPTION[4]

PRISM is a dynamic microsimulation model,[5] designed to simulate the economic conditions and income sources and distribution of the elderly population. The basic elements of PRISM are individuals and married couples. PRISM does not depict the behavior of firms, industries, government entities, or other organizations. It simulates the demographic and economic events and states relevant to the determination of incomes of the elderly, for each person and couple in its microdata file on an annual basis. It operates on a database of 28,000 adults, created by matching several Census survey files and social security earnings records. PRISM is usually run over the period 1979 to 2020 or 2030.[6]

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and renamed the Lewin Group. The basic PRISM modeling system and development staff has remained intact during these corporate changes, but the name of the corporate affiliation may differ in various versions of model documentation.

[3] DYNASIM and CORSIM are described in Chapters 3 and 5, respectively.

[4] The basic features of PRISM, including data sources, are summarized in the Summary Description Table in Annex 4-1.

[5] Dynamic and static microsimulation are described in Chapter 2. As described in Chapter 2, a microsimulation model simulates social and economic behavior by depicting events, conditions, and changes in the information recorded on each individual (person or family) record in a large database. A microsimulation model depicts the aggregate conditions of the population by aggregating or tabulating over all the modified individual records. Dynamic means the model simulates events for each individual one year at a time, and the outcome for each event each year depends on current and past year's outcomes for that and other events.

[6] If PRISM ages only persons who were adults in 1979, its effective simulation horizon is 2020. (Individuals age 21 in 1979 reach age 62 in 2020.) To simulate the elderly population to 2030, PRISM assigns completed educational attainment to persons who were younger than 21 in the 1979 data base, assigns them a wage and employment status when they reach age 18, and simulates their employment and retirement income histories. PRISM does not simulate any individual who was not included in the 1979 data base. A simplified method of extrapolating long term care expenditures and potential sources of financing from 2020 through 2050 has also been developed.

Components

PRISM's operations are grouped in four modules, which operate sequentially on a microdata file of persons and married couples. An initial module sets up the macro control totals to which the simulation is aligned. PRISM simulates the life events that ultimately determine retirement income in three stages, each operating in a separate module: (1) person and family demographic events; (2) labor market experience, including pension plan characteristics and benefit acceptance; (3) retirement income sources and levels. PRISM provides the input for a model of long term care utilization and finances, with which it is closely linked. PRISM has two key data bases. The base microdata file of individuals was created by linking four files that have information on the demographic characteristics, incomes, employment and earnings experience, and pension coverage and participation of the same sample of individuals. To simulate the employment-based pensions of the individuals in the data base, persons who are covered by pensions are matched with plan sponsors in a second data base of plan sponsors and their pension plans. The structure and flow of this complete modeling system is shown in Figure 4-1.

PRISM ages almost all variables dynamically. This means that each event or characteristic for each person or couple is determined for each year, one year at a time, with reference to variables representing demographic and socioeconomic characteristics of the person or couple in that year and previous years, including lagged (previous years) values of the variable being determined, and variables characterizing the socioeconomic environment.[7] For example, annual hours worked for each person is determined by a set of transition matrices specifying the probabilities that a person in one of five hours worked classes in one year will be in each hours worked class in the following year. Separate matrices are estimated for individuals classified by age, sex, marital status, education, receipt of retirement income, and hours worked in each of the previous two years (see Table 4-1). Table 4-1 shows the events and processes depicted in PRISM and the variables used to determine each event. The order in which the events are simulated is shown in Table 4-2.

In each module, PRISM simulates all of the events and characteristics included in that module for each individual in the file each year. All of the events/characteristics in the module are simulated sequentially for the first individual, then all are simulated for the second individual, etc., until all individuals and couples have been processed for one simulation year. Then the module repeats the process for the next year, with the simulated event values for the previous year and those already determined for the current year as inputs. The process is repeated for each year until the final year of the simulation period. The output of each module is a longitudinal file for each individual, including all the variables simulated in that module and those simulated in any earlier module. The output file of the first module is input into the second module, and the variables of the second module are then simulated one year at a time for the entire simulation period. The output file of the second

[7] Educational attainment is imputed to individuals who had not completed their education in the initial (1979) data base. Assets are imputed to persons and families at age 65 and adjusted dynamically thereafter. Limitations on activities of daily living and on instrumental activities of daily living are imputed at age 65 and adjusted dynamically thereafter.

FIGURE 4-1

PENSION AND RETIREMENT INCOME SIMULATION MODEL FLOW DIAGRAM

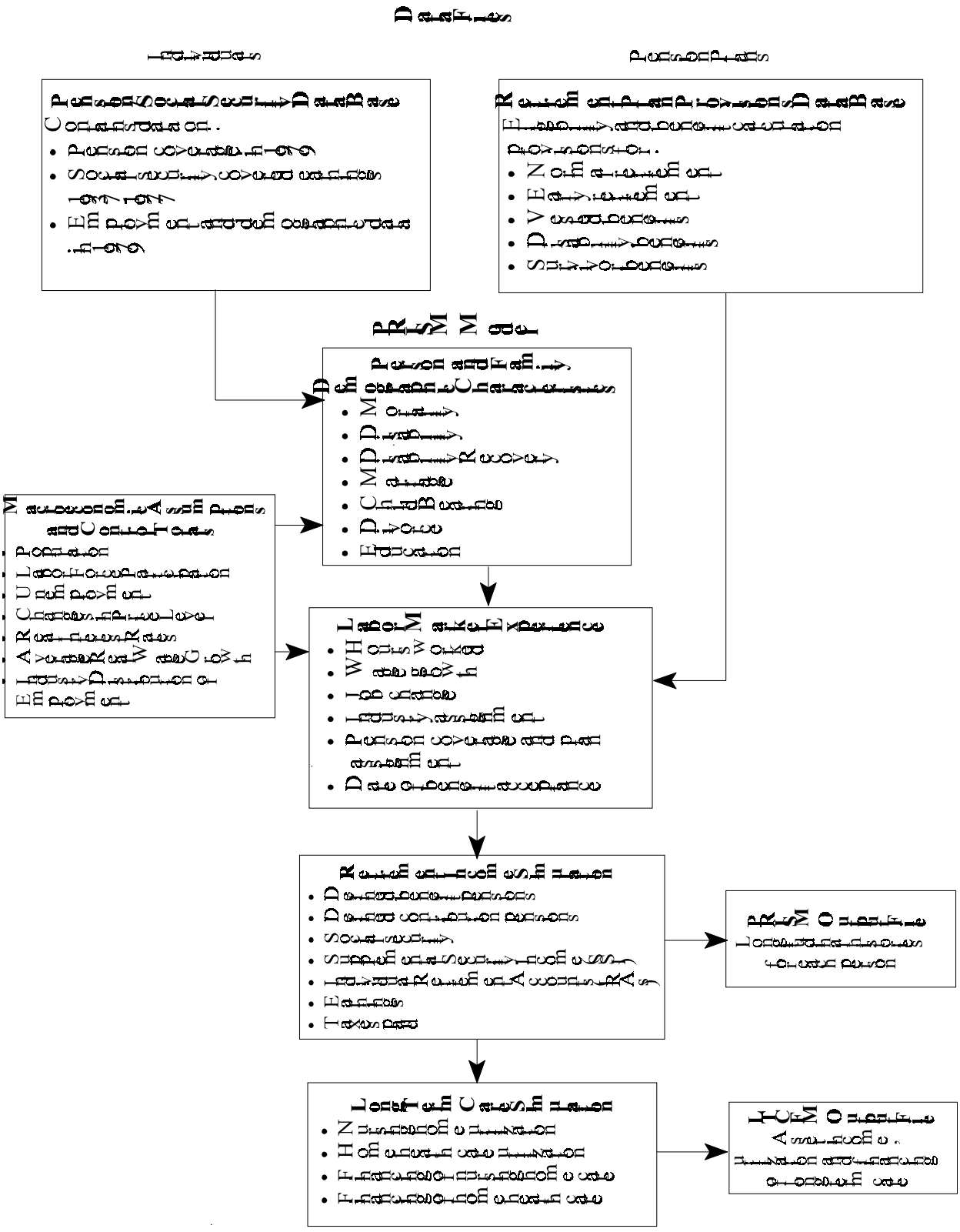

TABLE 4-1

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Person and Family Demographic Characteristics	
(1) *Family demographic events*[b]	
Death	Age, race, sex, disability status, years of disability, year
Birth	Age, race, marital status, number of children, employment status
Marriage	Age, sex, marital status (never married, divorced, widowed)
Mate matching	Age, education, race, of male and female
Divorce	Age of husband and wife
Immigration	Not simulated
(2) *Education, Location, Disability*	
Education (grade completed)	Assigned to one of four categories by race, sex
Residential location	State of residential location in initial data base (1979 CPS) remains constant - no migration
Disability (incidence)	
Onset	Age, sex (constant over time)
Recovery	Age, sex, years since becoming disabled (constant over time)

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Labor Market Experience	
(3) *Labor force events and earnings*	
Annual hours worked	Age, sex, marital status, presence of children of various ages, hours worked in each of previous three years, education, female bearing child during the year, female becoming divorced during the year, female becoming widowed during the year, receipt of social security or pension income, labor force participation of age-sex group (transition probability matrix for five hours worked categories)
Entry wage rate	Age, race, sex, education, wage in initial data base (if employed) (statistical match)
Wage growth	Age, sex, education, whether changed jobs during year, employment status
Income from employment	Product of wage times hours worked
Job change	Age, full-time/part-time status, job tenure, hours worked in current and previous years, proximity of eligibility for early retirement or vesting, (special treatment of women who have children)
Industry for new entrants or re-entrants	Age, sex, education, full-time/part-time status
Industry for job changers	Age, sex, industry of prior job (separate transition probability matrices for eleven industries)
Labor force participation	Not explicit Zero hours worked could indicate out
Unemployment	Not explicit of labor force or unemployed all year.

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
(4) *Pension characteristics*	
Social security coverage	
Pre-1978	Covered quarters in initial Pension/Social Security Data Base, 1937-1977
1978 and later	Assume all private sector workers covered, federal workers who began after 1984, selected state and local government workers
Pension coverage (availability)	Industry, full-time/part-time status, age, real wage rate
Pension plan assignment	Industry, firm size, social security coverage, union status, multi/single employer plan status, hourly/ salary worker status, plan characteristics reported in initial data base (participation, vesting, contribution requirements, supplemental plan)
Pension plan participation	Determined by provisions of pension plan assigned and individuals age, tenure, full-time/part-time status
Defined contribution thrift/savings/ 401(k) plan participation	Wage, employer match rate
Vesting	Determined by provisions of pension plan assigned and individuals age, tenure, full-time/part-time status
(5) *Retirement benefit acceptance (date)*	
Social security benefit acceptance	Age, sex, disability status, unemployment status, private pension receipt (conditional on eligibility)
Pension benefit acceptance	Age, sex (conditional on eligibility)

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Retirement Income Levels	
(6) *Social security benefits*	
Average Indexed Monthly Earnings and Primary Insurance Amount (PIA)	Age, calendar year, coverage and earnings history, program rules, average wage growth
Retirement benefit level, Actuarial adjustment for early/late retirement, earnings test	PIA, coverage and earnings history of both worker and dependent, age, current earnings, earnings test rules, timing, year
Spouse benefits	Benefit of primary beneficiary, covered earnings, age, program rules
Survivors Insurance benefit level	PIA of deceased spouse and of survivor, earnings, timing and age at receipt of retirement and survivors benefit, year
(7) *Employer pension benefits*	
Defined benefit plans	Age, eligibility, vested status, plan benefit formulae,
Normal retirement	earnings history, tenure
Early retirement	
Disability retirement	
Separated vested benefit	
Survivors benefits	Plan provisions, marital status, size of benefit, joint and survivor determination
Benefit indexing	Type of plan (Federal Civil Service, state and local government, private), inflation
Defined contribution plans	
Contributions	Plan type, employer contribution rate, wages or salary
Participation in savings/thrift plans	Hourly wage rate, employer match rate
Accumulations	Contributions, interest rate assumptions
Benefit	Age, size of balance (lump sum payment), annuity, joint and survivor determination
(8) *Retirement health insurance*	
Coverage	Defined benefit pension coverage, industry, firm size
Dependents coverage	Industry, firm size
(9) *Individual Retirement Accounts (IRAs)*	
Adoption	Age, family income, pension coverage status
Contribution probability	Family income, pension coverage status

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Contribution amount	Age, family income, sex, marital status (constrained not to exceed statutory maximum
Retirement benefit amount	Balance converted to life annuity at social security or pension acceptance
(10) *Assets of elderly (age 65 and older)* (Simulated in Long Term Care Financing Model)	
Financial assets, Housing equity	
Ownership and value	Age, marital status, non-pension income, pension income (statistical match to 1984 SIPP)
Net saving/dissaving in retirement	Marital status, ever had children
Asset transfers at death	All to surviving spouse, less expense deduction
Divorce	Rule-based: split equally
Bequests and inheritances	Rule-based: only to spouse
Asset income	Assumed interest rate applied to non-housing assets
(11) *Supplemental Security Income (SSI) (aged, disabled)*	
Eligibility	Age, marital status, disability status, financial assets, income
Benefit entitlement and level	Marital status, age of spouse, earnings, asset income, pension and social security income, living arrangements (own/others home), state
Participation	Marital status, family income, size of potential benefit
(12) *Taxes on income*	
Federal income tax	Family earnings, family asset income, defined benefit pension income, defined contribution annuity income, IRA annuity income, social security income, age, number of dependents, tax rules, year
State income tax	Family income, individual state income tax rules and rates
FICA	Covered earnings, year

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Long Term Care Financing Model	
Disability level (age 65 and over)	Social security disability status at age 62, age, marital status, previous year disability level
No disability	
Requires help with at least one IADL[d]	
Requires help with one ADL[e]	
Requires help with two or more ADLs	
Institutionalization	
Nursing home entry, disabled	Age, marital status, disability level, previous nursing home admission (regression model)
Nursing home entry, nondisabled	Age, sex, marital status, previous nursing home admission (regression model)
Discharged dead or alive	Age at admission, marital status
Length of stay	Age at admission, marital status, type of discharge (alive/dead)
Mortality (age 65 and over)	
Institutionalized	Date and type of discharge (determined when institutionalized based on age, marital status)
Noninstitutionalized	Age, sex, disability level
Utilization and financing of non-institutional care (home care)	
Utilization by nondisabled	Age, sex, marital status
Utilization by disabled	Sex, disability level
Disability status of home care users	Age, marital status
Length of use for disabled	Distribution of number of months for disabled
Number of visits, disabled	Disability level
Number of visit covered by Medicare	Distribution of number of visits
Medicare coverage for nondisabled	Age, sex
Length of use of Medicare home health care	Distribution of number of months
Home care financing from other sources (Medicaid, out-of-pocket, other)	Disability status, type of service, income (poverty status)

TABLE 4-1 (Continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY PRISM

Event or Characteristic	Variables Used to Determine Event[a]
Nursing home care financing	
Nursing home charges (daily rate)	Source of payment, assumed inflation
Acute care costs	Assumed same for all
Available income	Social security, pension, IRA, asset income, marital status, poverty level
Available assets	Non-housing assets, length of stay
Medicaid coverage	Available income and assets
Medicare coverage	Length of stay
Home care financing	
Price per visit	Source of payment, assumed inflation
Expenditures	Number of visits, price per visit
Source of payment	Medicare coverage, income, marital status, assets

[a] Data used for each variable are described in Annex 4-1.

[b] Events/characteristics are grouped into categories by the author. Categories and order of presentation in this table do not indicated logical relationships in the model or solution order.

[c] People leaving home for reasons other than marriage, birth of a child, divorce, or death.

[d] Instrumental activity of daily living (doing heavy work, doing light work, preparing meals, shopping, getting around inside, walking outside, managing money, using the telephone)

[e] Activity of daily living (bathing, dressing, eating, getting in/out of bed, toiletting)

Sources: Kennell and Sheils (1986), Lewin/ICF (1992), Lewin-VHI (1993), Ross (1991), Citro and Hanushek (1997), Wiener, Illston, and Hanley (1994).

module is then input into the third module and the variables of the third module are simulated for each year. The final output of the PRISM model is a file of longitudinal demographic and socioeconomic histories for each person in the sample of the U.S. population, including annual hours worked, earnings, job characteristics, pension coverage, participation, vesting and benefit accruals, individual retirement account contributions and accruals, and retirement benefit receipt.

Most events in PRISM (e.g. death, birth, marriage, hours worked) are simulated using a *Monte Carlo* technique.[8] That is, a table or matrix for the event determines a probability that the event will occur for each individual, based on that individual's characteristics. To determine if the event is assigned to occur, the probability is compared to a random number.

Almost all simulated events and characteristics in PRISM are determined by tables that assign probabilities of the event occurring to individuals in a large number of categories based on demographic and economic characteristics or states, or transition matrices that assign probabilities to individuals in various states or categories that they will be in each of various states or categories in the following year. The model begins each simulation with a nationally representative sample of 28,000 adults. To reduce random variation, the data base is run through the model twice.

Person and Family Demographic Characteristics. PRISM first simulates demographic events/characteristics experienced by each individual each year: mortality, disability, recovery from disability, change in marital status, child bearing, and educational attainment. For each demographic event, the probability for each individual is equal to the incidence rate of that event for all individuals with similar characteristics. These incidence rates are estimated from historic data or are based on assumptions or projections. For example, base case mortality is simulated using the mortality rates assumed for the Social Security Trustees Report.[9] The Trustees Report mortality rates vary by single year of age, sex, disability status, and years since becoming disabled. These rates are adjusted by race based on mortality rates used in Census Bureau projections of the U.S. population. Mortality rates vary during each simulation year reflecting improvements in mortality projected by the Social Security Office of the Actuary. For persons age 65 and over, mortality rates are further adjusted to reflect differences in mortality between institutionalized and noninstitutionalized and disabled and nondisabled persons.

Probabilities of becoming disabled and of recovering from disability are also based on disability rates and recovery rates developed by the Social Security Office of the Actuary for the Trustees Report. For persons age 65 and over disability rates are estimated from data from the 1982-84 National Long Term Care Survey. Child bearing is simulated using fertility rates based on analysis of CPS data for 1987-1991. Probabilities of marriage and divorce are based on marriage and divorce rates from National Center for Health Statistics *Monthly Vital Statistics*. Ultimate educational attainment is assigned to individuals based on the education they had completed in the 1979 CPS and data on educational attainment in the March 1991 CPS.

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[8] Monte Carlo simulation is discussed in Chapter 2, p. 2-5.

[9] *Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds.* PRISM currently uses assumptions from the 1991 Trustees Report.

Labor Market Experience. PRISM simulates each individual's employment history from 1979, or the date of entry into the labor force, if later, through 2030, including wage rates (and shadow wage rates for those not employed), hours worked, job change, industry of employment, pension coverage, pension plan characteristics, and acceptance of social security and pension benefits. Labor market simulations begin with each individual's labor market status in 1979. Those not working in 1979 are assigned a shadow wage of individuals of similar characteristics. Individuals' labor market status in future years, including job change, industry, and hours worked, is determined by sets of transition probabilities estimated based on CPS data.

Pension coverage and participation data are included in the base year (1979) data base. Coverage for new entrants and job changers in future years is assigned based on industry, full-time/part-time status, age, and wage rate, based on 1979, 1983, and 1988 CPS pension supplement data. Covered workers are assigned to an actual plan sponsor in the PRISM Retirement Plan Provisions Data Base. This is a data base of 325 plan sponsors, including private and public employers, for profit and non-profit organizations, with the provisions of more than 475 actual pension plans.[10] Workers are assigned to plans based on fairly tight criteria: similar industry, firm size, social security coverage status, union coverage status, multi/single employer plan status, hourly/salary worker status. Workers are assigned to plan sponsors in proportion to the number of individuals actually covered by that type of plan sponsor. In the base year, workers are assigned to plans that are consistent with characteristics of the plan that the individual reported in the May 1979 CPS.

PRISM simulates the acceptance of early, normal, and late retirement benefits from both pension plans and social security. Social security benefit acceptance rates are derived from social security benefit receipt data by age and sex. Eligibility for employer pension benefits is determined by the provisions of the plan to which the individual is assigned. Pension benefit acceptance rates for eligible workers are based on analysis of Census Bureau data. Individuals who are vested and leave their job prior to eligibility for retirement receive a deferred vested benefit. These benefits go into effect when the individual reaches the plan's normal retirement age.

Retirement Income Simulation. PRISM simulates elderly incomes from six sources: earnings, social security, employer pensions, Supplemental Security Income (SSI), Individual Retirement Accounts (IRAs) and other individual retirement savings arrangements, and other financial assets. PRISM also simulates federal and state income taxes and payroll taxes. Social security retirement and survivors benefits are estimated based on the worker's retirement age and earnings history and program rules. Employer pension benefits are simulated using the provisions of the plan(s) in the Retirement Plan Provisions Data Base to which the worker was assigned. Defined benefit formulas are indexed to projected changes in prices or wages corresponding to historical experience. Provisions of the plans in the 1984 data base have been revised when the model is updated to be consistent with changes in laws and regulations that occurred after the data

[10] Some sponsors have more than one pension plan.

were collected,[11] including changes in participation and vesting requirements and integration with social security. For simulations of future years plan provisions can be assumed to remain constant (after indexing for inflation) or specified changes or trends can be simulated.

Individual retirement account (IRA, Keogh) adoption and contribution probabilities are simulated for workers, based on age, family earnings, and pension coverage. Contribution amounts are simulated based on family income, age, sex, and marital status, constrained not to exceed the maximum allowed by law.

Housing and financial assets are assigned to each family unit age 65 and over in the base year (1979) from the 1984 Survey of Income and Program Participation (SIPP). Asset records are similarly assigned to individuals who turn 65 after 1979. At the time assets are assigned, individuals and couples are also assigned to one of three asset accumulation/decumulation classes (financial assets increase at a constant annual rate, remain constant, or decrease at a constant annual rate) based on marital status and whether a couple has had children. Individuals remain in the same class for the remainder of the simulation. Income from non-housing assets is calculated based on a specified interest rate.

PRISM simulates benefits from Supplemental Security Income (SSI) by determining which couples and individuals are eligible for SSI benefits using the SSI assets test, estimating the annual benefit they would be entitled to receive from both federal and state SSI programs, given their simulated countable income and state of residence, and estimating which eligible couples and individuals participate in the program.

The **Long Term Care Financing Model (LTCFM)** takes output from the PRISM longitudinal family demographic, labor market, and elderly income histories and simulates events and attributes related to utilization and financing of long term care. The LTCFM simulates additional disability detail for individuals age 65 and over (limitations on Activities of Daily Living and Instrumental Activities of Daily Living). The model then simulates institutionalization (nursing home entry, discharge, and length of stay) based on disability level, age, sex, and marital status. The model also simulates the utilization of non-institutional care by the disabled and non-disabled elderly. The model simulates the financing of nursing home care and non-institutional care from various sources of payment, including income, assets, Medicare, Medicaid, and other sources.

Controls and Alignment

PRISM aligns virtually every simulated variable to correspond to external controls. PRISM adjusts the simulated probabilities of demographic and economic events and changes applied to individuals to replicate external estimates of historic and projections of future aggregate and group values. For many events the initial individual probabilities are set equal to group-specific incidence or prevalence rates estimated or assumed by external sources. In its current base case, PRISM uses many of the incidence rates assumed by the Social Security Administration Office of the Actuary

[11] These include the Retirement Equity Act (REA) of 1984, the Tax Reform Act (TRA) of 1986, and the Age Discrimination in Employment Act (ADEA) of 1986.

for the projections of the OASDI trust funds for the annual OASDI Trustees Report.[12] PRISM uses the OASDI Trustees Report assumptions for mortality rates (adjusted for race), disability rates for persons under age 65, and recovery from disability. Fertility rates are estimated from CPS data and are aligned to match total fertility rates assumed for the Trustees Report. Marriage and divorce probabilities and mate matching are based on *Vital Statistics* data and aligned to match control totals from the Trustees Report. Employment levels are controlled to be consistent with actual labor force participation and unemployment rates for past years and projections of labor force participation and unemployment rates from the Trustees Report. Individual wage growth is controlled to actual average wage growth for past years and average wage growth projections of the Trustees Report. Industry of employment transition probabilities are estimated from CPS data, and the distribution of employment over industries is controlled to be consistent with Bureau of Labor Statistics (BLS) projections. In general, alignment to external control totals is achieved by aggregating the individual outcomes of an initial microsimulation over groups for which external control totals are available, comparing the initial simulated aggregate outcomes with the external control values, and proportionally adjusting the event probabilities to produce outcomes that match the controls.

PRISM has previously been controlled to the ICF Macroeconomic-Demographic Model of the U.S. Retirement Income System (MDM). The MDM forecasts population by single year of age, sex and race; and labor force participation, employment, weeks and hours worked, and compensation per hour for each of 22 age-sex groups, modeling the supply and demand for labor of various age groups and capital, and economic growth simultaneously.[13] This permitted PRISM to produce estimates of individual employment, hours worked, and wages and demographic-group-specific outcomes in the microsimulations that were consistent with general equilibrium model forecasts of age-sex group labor market behavior and wages that take into account aggregate economic growth and other macroeconomic variables and demographic trends, and forecast changes in social security and employer pension variables.

Databases

PRISM uses two databases to simulate the distribution of retirement income: a representative sample of persons with information about their demographic characteristics, earnings and employment, and pension coverage, participation, and plan characteristics; and a representative sample of retirement plan sponsors, with detailed information on plan provisions.

The **Pension/Social Security Data Base** provides employment, income, pension, and demographic data for a representative sample of 28,000 adults in 1978-1979. This data base is useful for analysis of pension and social security benefits because it provides information on current (1979) and historical pension plan participation and a history of coverage and covered earnings under the social security system for each individual in the data base. ICF Incorporated developed

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[12] The current base case projections use the Alternative II assumptions from the *1991 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds*. These are relatively easy to update to the most recent Trustees Report.

[13] The Macroeconomic-Demographic Model of the U.S. Retirement Income System is described in Chapter 7 of this report.

this data base by merging four data files which provided information for a common subset of individuals: the March 1979 Current Population Survey (CPS), May 1979 CPS Special Pension Supplement, March 1978 CPS, and Social Security Administration (SSA) earnings history records for the same individuals in the March 1978 CPS. The characteristics of these data bases and the merge are shown in Figure 4-2.

The Current Population Survey is collected by the Bureau of the Census each month. In 1978 and 1979 about 60,000 households were interviewed, with about 140,000 persons. In March of each year detailed information on income, from about 30 sources, and employment experience in the previous year is collected. The Social Security Administration and Census Bureau had matched SSA administrative records with data on quarters of coverage earned annually for 1937-1977 and annual taxable earnings for 1951-1977 to the records of 107,000 adults in the March 1978 CPS. In May 1979 a special supplement to the CPS collected detailed data from workers on employer-provided pension coverage, years of service with employer, type of pension plan, vested status, 401(k) type plans, IRA contributions, and other pension data for 54,000 adults. The March 1979 CPS collected demographic, employment, and income data for these same persons. ICF merged the records for the same individuals in the March and May 1979 CPS. Of these individuals, 28,000 were included in the 1978 CPS-SSA matched data. ICF merged the records of these same 28,000 individuals from the March-May 1979 CPS and the March 1978 CPS-SSA data to create a data base of 28,000 adults with the information shown in Table 4-3.[14]

The **Retirement Plan Provisions Data Base** contains detailed eligibility and benefit formula information for a representative sample of 325 public and private retirement plan sponsors. This data base is a representative sample of all plan sponsors, with benefit and eligibility information current as of January 1984. The plan sponsors include both single and multi-employer plan sponsors from all industries, including the public sector. The data base contains information on the defined benefit and defined contribution plans that each of these representative sponsors maintained for hourly and salaried employees. Because the data base contains data on the primary and supplemental plans of each of the 325 sponsors, it includes 475 separate pension plans.

The sample of plan sponsors is stratified on the basis of industry, single/multi-employer type of sponsor, and sponsor size, to include sponsors of all industries and all sizes. The sample of private single employer sponsors was obtained from a data base of all single employer plans which filed Form 5500 reports in 1981. The sample of public employer plans was selected from a 1982 data base of all public employer plans with more than 200 participants. The sample of multi-employer plans was selected from a data base of private sector multi-employer plans which filed Form 5500 in 1981.

[14] About 20,000 records had complete information for each question. ICF used statistical techniques to impute responses to one or more questions on about 8,000 records. For 7,000 records the social security earnings history data were imputed by statistical matching.

FIGURE 4-2

DATA SOURCES USED TO CREATE THE ICF PENSION/SOCIAL SECURITY DATA BASE

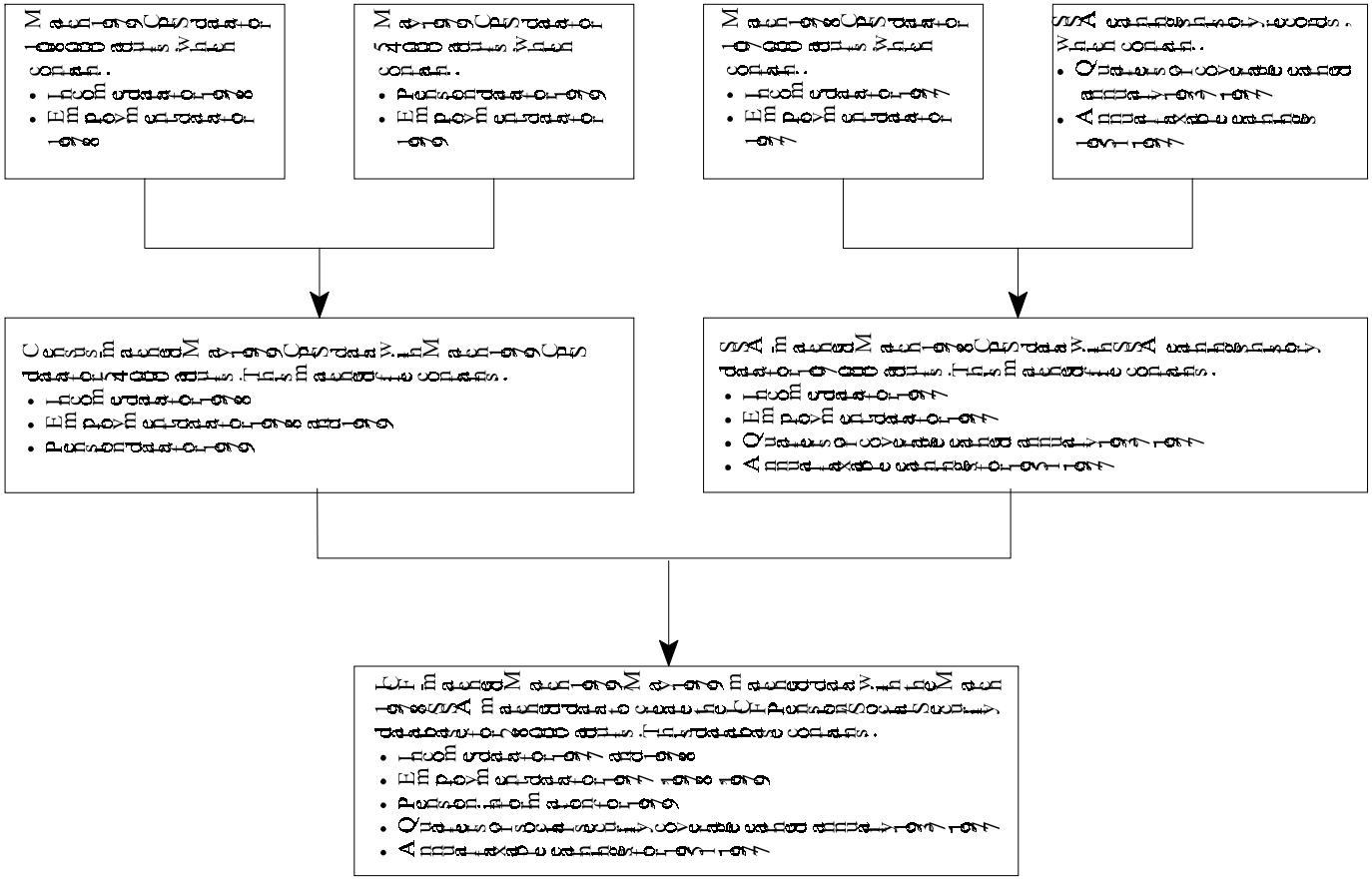

TABLE 4-3

DATA IN THE PRISM PENSION/SOCIAL SECURITY DATA BASE

Pension plan information
- Coverage status in 1979
- Participation status in 1979
- Vested status in 1979
- Years participating in the plan before 1979
- Multi/single employer plan coverage status in 1979
- Whether eligible for a vested benefit from a previous plan
- Whether participating in a supplemental plan

IRA/Keogh status
- Whether contributing to an IRA or Keogh account in 1979
- Whether maintaining an inactive IRA or Keogh account

Social Security coverage
- Covered earnings in each year between 1951 and 1977
- Quarters of coverage earned in each year between 1937 and 1977

Employment data
- Industry of employment in 1977 and 1978
- Years on current job
- Size of firm
- Wage rate
- Union coverage status
- Hourly/salary status
- Occupation

Demographic and income information
- Age
- Sex
- Marital status
- Education
- Presence of children
- Age of children
- Income from all sources during 1977 and 1978
- Disability status in 1977 and 1978

Source: Kennell and Sheils (1986)

Information on the provisions of plans sponsored by each sponsor in the data base was obtained from Summary Plan Descriptions (SPDs) filed with the Department of Labor or directly from the plan sponsor. Information in the sample was updated through February 1984 for each sponsor which was willing to provide new data. Each plan sponsor in the data base is weighted to reflect the number of workers that the sponsor represents.

The plan sponsor data base contains information for each plan on type of workers covered; participation requirements; vesting requirements; service crediting rules; eligibility for normal retirement benefits, early retirement benefits, separated vested benefits, survivors benefits, and disability retirement benefits; benefit formulae; and integration with social security. The data base contains data for defined contribution plans, including money purchase, profit sharing, savings/thrift, and stock bonus plans.

The use in PRISM of a sample of actual plan sponsors and plan provisions contrasts to the approach used in DYNASIM[15] and the approach proposed for the CORSIM private pension model.[16] Those models use a series of random processes to assign to covered individuals parameterized pension plan provisions, such as participation and vesting standards, benefit formula type, benefit accrual rates, and benefit eligibility. This approach may be limited in its ability to capture interrelationships between benefit provisions and other plan provisions that prevail among actual plan sponsors, and the joint distributions of primary plans and supplementary plans.

Both the PRISM Pension/Social Security Data Base of individuals and the PRISM Retirement Plan Provisions Data Base of plan sponsors contain considerable information that is useful for modeling retirement income and represent a significant strength of PRISM. However, both data bases are old. The data in the Pension/Social Security Data Base is 18 years old in 1997. PRISM simulates individual employment, earnings, social security and pension coverage, participation, benefit accrual and benefit receipt for the period 1979-1996, aligning the outcomes to historic group and aggregate data. The data in the Retirement Plan Provisions Data Base are 13 years old in 1997. Plan provisions in the data base have been adjusted for changes in laws and regulations that have occurred since the plan provisions data were collected, and some benefit provisions have been indexed for inflation, but there is no assurance that the data base reflects important changes and trends in employer pension provisions that have occurred since 1984, such as the trend toward defined contribution plans and the expansion of 401(k) type plans. Updating the Retirement Plans Provisions Data Base would require a new survey of plan sponsors, which would be a significant project. Updating the individual Pension/Social Security Data Base may be a greater challenge. No individual social security covered employment and earnings history data have been made available to the public since the 1978 match with the CPS, and current law prohibits making such data available. Finding a substitute or a source of comparable longitudinal data that provides recent data is a major challenge for future microsimulation modeling of pensions and social security.

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[15] See Chapter 3.

[16] See Chapter 5.

The Bureau of the Census and the Social Security Administration have matched March 1994 CPS records with social security earnings records. That data base is not available to the public. Staff at the Department of Health and Human Services are exploring the possibility of using that data base to update PRISM.

In addition to these two simulation data bases created by ICF for PRISM, several other data bases were used to estimate parameters for the model or to control the simulation results. PRISM uses pension coverage and participation data from the May 1983 and May 1988 CPS Employee Benefit Supplements, as well as the May 1979 CPS supplement, to estimate coverage trends and IRA contribution trends; family assets data from the 1983 Survey of Consumer Finances (SCF) and the 1984 Survey of Income and Program Participation (SIPP); and data on disability levels and nursing home utilization from the 1982-1984 National Long Term Care Survey and the 1985 National Nursing Home Survey (NNHS).

Documentation

The 1986 documentation of PRISM[17] provides a reasonably complete, clear, and thorough description of the model methodology, data, and assumptions. In 1997 this document is 11 years old and parts are out of date. This documentation has been updated somewhat in 1992 and 1994 with descriptions of the assumptions used for PRISM simulations.[18] The Long Term Care Financing Model is described in an appendix to a Brookings Institution study of long term care policy published in 1994.[19] No users guide or technical documentation for PRISM is available.

Computer Hardware, Software, and Portability

PRISM was developed to run in batch mode on a mainframe computer. In 1997 the model was converted to run on a Pentium based IBM-compatible Personal Computer (PC) with at least 24 MB of RAM. The model is coded in Lahey 90 Fortran.[20] The computer run costs on the mainframe are moderate. The marginal computer costs on a PC are essentially zero. The run time for a full sample (28,000 records processed twice) from 1979 through 2030 is about one hour. The model is portable in its entirety between compatible computer platforms, but has not been installed outside its home organization (currently The Lewin Group). The satellite Long Term Care Financing Model is a separate model. A 1989 version of the LTCFM has been installed on a VAX computer outside The Lewin Group and is available through the National Technical Information Service (NTIS).

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[17] Kennell and Sheils (1986).

[18] Lewin-VHI (1992, 1993).

[19] Wiener *et al.* (1994).

[20] Lahey 90 Fortran is a DOS based version of Fortran.

IV. APPLICATION TO RETIREMENT POLICY ISSUES

PRISM was designed to analyze retirement policy and retirement income. It can be applied to numerous issues that require projections of the incomes of the elderly. The policy matrix tables in Annex 4-2 indicate the types of issues which PRISM is suitable to address. There is a table for each of six major areas where changes in retirement income policy could have important implications. The rows, which are the same for each table, list several important areas where policy changes could occur. The columns, which differ in each table, show aspects which are relevant or of concern in each of the major areas. Entries in each table show areas where PRISM is suitable for analysis of the impacts of the types of policy changes indicated in the rows on the aspects of the pension system indicated in the columns.[21]

PRISM models individual person and family behavior. It can be used to simulate retirement income related variables for individuals: work histories; social security contributions, social security benefits receipt and amounts; employer pension coverage, participation, plan characteristics, and benefit receipt; Supplemental Security Income; and long term care utilization and financing. PRISM can model retirement policy issues for which information on personal histories is required.

PRISM has extensive detail on a large representative sample of employer pension plans, concerning how these plans relate to participants. The provisions of these plans can be modified to simulate the affects of changes in laws and regulations that affect plan provisions, and in turn, how these changes may affect workers. However, PRISM does not model the operations or funding of pension plans, so it does not simulate how changes may affect plan funding, or how plan funding may affect other pension provisions, such as benefits levels. PRISM does not model plan sponsor behavior, so it cannot simulate how plan sponsors' behavior will react to changes in laws, regulations, or other aspects of the pension environment.

Examples of issues suitable for analysis with PRISM include the effects on individual incomes of social security policy issues such as earnings sharing, changes in benefit formula and indexing, and adoption of individual accounts; effects of changes in pension participation and vesting rules on retirement income levels and distribution; effects of changes in employer pension integration with social security; effects of changes in pension benefit indexation; effects of changes in individual retirement savings eligibility rules and contribution levels. Although PRISM includes considerable detail on employer pension plans and can show how specified changes may affect these plans and the benefits they provide, the model does not simulate employer or plan sponsor behavior, so it does not have the capability to analyze the effects of policy measures on employers or on their offering of pensions or other benefit plans. It does not depict the behavior of producers or industries, so it cannot be used to analyze industry outcomes. Other than very simple labor input variables -- individual hours worked and wages -- PRISM does not depict any aggregate economic

[21] Annex 4-2 can be compared to Annex 3-2 for DYNASIM and Annex 5-2 for CORSIM.

behavior, so it cannot analyze effects on the aggregate economy, such as saving, investment, GDP growth, or interest rates.[22]

Benchmarks

Appendix C describes seven illustrative policy issues that can be used as benchmarks to assess and compare the suitability of various models for analysis of retirement income policy in various areas. This section reviews the suitability of PRISM for analysis of each of these illustrative benchmark policy issues.

1. Effects of increase in Social Security Normal Retirement Age on:

OASI revenues, benefit payments, trust fund balances -- PRISM can simulate the effects of change in social security normal retirement age (NRA) on workers. The effects of the 1983 Social Security amendments raising the normal retirement age are currently depicted in PRISM. Change in the age of eligibility for OAI full retirement benefit and changes in the early retirement reduction change the retirement benefit amount at each retirement age. PRISM does not have a behavioral retirement model.[23] To simulate the effects of the 1983 amendments increase in the normal retirement age on benefit acceptance at various ages, assumptions about changes in retirement prevalence rates were made, and the corresponding changes in benefit acceptance incidence rates and labor force participation were calculated. While the assumptions used by PRISM appear to be plausible, they are, nevertheless, arbitrary and *ad hoc*.[24] PRISM provides a detailed simulation system that permits analysis of the implications of a variety of assumptions. However, it does not model the behavior of employers. In existing simulations, the provisions of employer retirement plans have not been modified to respond to changes in the social security NRA. Potential social security or pension benefit amounts and how they may change are not explicit factors in the model's determination of workers' benefit acceptance rates. Therefore, PRISM does not model the behavioral responses of workers or employers to changes in the normal retirement age. Given assumptions about benefit acceptance behavior, PRISM can be used to calculate the effects of changes in normal retirement age on individual social security benefits and payroll tax liabilities. PRISM does not model aggregate OASI revenues and benefit payments nor trust fund balances, however.

DI benefit payments and DI trust fund balances -- PRISM does not estimate social security benefits for persons younger than age 62, so it does not have a DI model. The social security model assumes

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[22] The two labor input related variables --annual hours worked and wages -- are modeled as functions of socioeconomic characteristics of the person, e.g. age, sex, race, education, marital status, etc., and aggregate age-sex labor force participation rates. No labor demand-related factors are included.

[23] PRISM assigns employer pension benefit acceptance rates (probabilities) to eligible individuals based on age and sex, estimated from analysis of CPS data on pension benefit recipients in the 1980s. PRISM assigns social security retirement benefit acceptance rates to eligible individuals based on age and sex, calculated from Social Security Administration data for 1980.

[24] PRISM documentation describes virtually all the assumptions used for simulations of the model. It does not provide justification of the particular assumptions used to simulate the effects of increase in the normal retirement age, for example with reference to other studies of retirement behavior.

that DI benefit receipt rates for persons age 62-65 increase as the NRA is increased under the 1983 law. (The methodology is not documented.) Accurate analysis may require additional research. Currently, all DI beneficiaries convert to OAI at age 65. DI receipt rates are not estimated for persons age 65 and 66, since there are no historic data for DI receipt at ages 65 and 66. There is no DI trust fund model.

Employer pension accruals and benefit costs -- PRISM depicts the effects of increase in the NRA on employer pension benefit payments to individuals, for specified assumptions about changes in benefit acceptance rates. The documentation does not indicate clearly how PRISM simulates the effects of the change in social security NRA on employer pensions. It appears that currently, PRISM implicitly assumes that employer pension benefit acceptance rates change corresponding to the changes in social security retirement benefit acceptance rates. The difference between the simulated number of social security retirement benefit recipients with a higher NRA and the number if the NRA had not changed is assumed to be added to the labor force. PRISM could use alternative assumptions. However, since PRISM does not have a retirement (benefit acceptance) model, it simulates changes in retirement rates only if the user inputs new assumptions. PRISM does not model plan sponsors behavior or employer behavior. Employee pension accruals are modeled, for specified assumptions about pension accrual rules.[25] Given specified funding assumptions, effects on benefit costs could, in concept, be estimated.

Social security retirement replacement rates and total retirement income replacement rates -- PRISM's longitudinal earnings records and retirement income model provide the capability to calculate social security and employer pension replacement rates, for specified assumptions about retirement behavior. The family asset assignment model does not depict effects of changes in retirement behavior or expectations on assets. Consequently, PRISM could not analyze effects on asset income.

2. Means testing of Social Security benefits.

PRISM could be used to estimate the effects of means testing of social security benefits on OAI benefit payments and total retirement income. It depicts earnings, employer pensions, and asset income. It currently depicts the effects of the social security earnings test on individual social security benefits and means testing of SSI. PRISM does not have behavioral models of DI or OAI benefit receipt (that is, models that depict decisions relating to OAI and employer pension benefit acceptance in the context of decisions relating to earnings, saving, and asset income). Assumptions about the effects of means testing on benefit receipt behavior and on earnings and asset accumulation behavior would be required. For given assumptions about behavioral effects, effects on income replacement rates could be simulated. In concept, the effects of means testing on total social security retirement (OAI) benefit payments could be estimated. PRISM does not model DI benefits. PRISM does not model the OASDI trust funds. PRISM can be used to depict employer pension accruals. For given assumptions about pension funding, effects on employer costs could be estimated.

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[25] Data on employer pension funding rules are not included in the Retirement Plan Provisions Data Base.

3. Mandatory minimum employer pension.
PRISM's ability to estimate effects on workers and employers of a mandatory minimum employer pension after the year 2000 is limited. In concept, PRISM could identify the plans in the Retirement Plan Provisions Data Base which do not meet the specified minimum standards and estimate the effects on retirement income and employer pension accruals of requiring all employers to offer a pension meeting the specified standard. PRISM was used to analyze the effects of a mandatory minimum pension to be implemented in 1982, for the Presidents Commission on Pension Policy in 1980. PRISM could not simulate the effects on employer behavior or the potential changes in other pensions, other employee benefits, wages, or employment that could result from mandating a minimum pension. For given assumptions about the effects on employer and worker behavior, PRISM could estimate the effects on total pension payments, total retirement income and replacement ratios through the year 2030. The effects on aggregate retirement saving could not be estimated for years after about 2000. PRISM does not simulate all new entrants to the labor force after 2000, so it cannot estimate accurately pension accruals. Even if all workers were represented in the model, estimates of the effects on pension accruals and retirement saving would require assumptions about employer behavior, worker behavior, asset accumulation, and pension funding, which would be considerable and are beyond the range of issues PRISM is designed to address. PRISM is not an appropriate model to estimate effects on aggregate national saving.

4. Expansion of individual retirement account eligibility.
PRISM could be used to estimate effects of changes in IRA eligibility and tax deduction rules on individual IRA contributions and accruals. PRISM does not have a behavioral model of IRA contributions or family asset accumulation. Assumptions about the effects of changes in IRA eligibility and contribution limits on IRA adoption and contributions would have to be specified. Given such assumptions, effects on individual annual IRA contributions could be estimated. Total IRA contributions cannot be estimated accurately after the year 2000, because PRISM does not represent the total labor force after 2000. PRISM does not model individual or national saving behavior.[26] For specified assumptions about other savings and asset accumulation and employer pension changes, effects of changes in IRAs on individual retirement savings could, in concept, be estimated. These assumptions would be considerable. PRISM does not model total personal savings, national savings, or macroeconomic effects. It could not estimate any policy effects on total personal savings, national savings, capital accumulation, or GDP. PRISM cannot estimate the effects of changes in IRA eligibility and contributions on federal tax revenue after 2000. PRISM does not depict federal expenditures, deficits, or debt. For specified assumptions about IRA contribution behavior, PRISM could be used to estimate similar effects, and would have the same limitations, for "back-loaded" IRAs.

[26] PRISM assigns housing and non-housing assets to persons at age 65. No assets or savings behavior is modeled for persons under age 65.

5. Effects of value added tax on pension contributions and accruals.
PRISM cannot address issues concerning the effects of taxes on pension offerings, contributions, or accruals.[27] The model does not depict the effects of taxes on individual or firm behavior. It does not depict the behavior of corporations or other employers, so it does not depict pension plan sponsor behavior.

6. Effects of construction industry benefit accrual rates on funding.
The construction industry is one of 11 industry groups to which workers are assigned in PRISM. The Retirement Plan Provisions Data Base includes several construction industry pension plans. PRISM could simulate the effects of some industry-specific pension benefit provisions, including benefit accrual rates. With suitable assumptions it could simulate industry pension accruals. Simulations of total industry accruals would become progressively more inaccurate after the year 2000, because PRISM does not simulate the total labor force after that year. PRISM does not depict funding rules or funding status of plans, so it is not suitable to analyze issues concerning the condition or behavior of employer pension funds. This capability could possibility be added. This would require considerable additional model development, and the validity may be uncertain.

7. Effects of alternative macroeconomic scenarios on social security and employer pensions.
PRISM in general is not appropriate for analysis of effects of alternative macroeconomic scenarios on other aggregates, such as social security fund balances. PRISM simulations are controlled to be consistent with specified macroeconomic scenarios. Individual labor market outcomes in each period, such as hours worked and wages, are controlled to align with external data and projections of aggregative and group-specific variables, such as labor force participation rates, employment rates, and wages. PRISM could be used to develop alternative simulations to correspond to alternative macroeconomic scenarios. PRISM could in this way be used to simulate longitudinal earnings and employment histories under alternative macroeconomic scenarios. These longitudinal earnings and employment histories are inputs into the determination of social security receipt and benefit levels and pension benefits. In this way PRISM can be used to depict some of the effects of alternative macroeconomic scenarios on social security and pension outcomes for individuals in various socioeconomic or demographic groups. PRISM cannot estimate aggregate labor market outcomes after the year 2000.

V. ACCESSIBILITY AND EASE OF USE

PRISM is a proprietary model owned by The Lewin Group, a Washington, D.C. based, for-profit consulting firm, which is a subsidiary of Quintiles, Inc. It has been used widely by The Lewin Group (and its predecessor firms) to undertake studies and consulting projects for clients. The model has not been made available to other organizations. The model was not designed to be easily portable nor to be used by others. It does not have a user-friendly interface nor a user's guide. The code is written in Lahey 90 Fortran. PRISM could be made available to outside organizations, but

[27] PRISM has been used to analyze the effects of treating pension accruals as taxable income to the employee (assuming such treatment has no effects on employee or employer behavior).

any outside organization or individual acquiring the model would require assistance initially from PRISM programming staff, which could be provided at reasonable cost.

The full documentation of the model, written in 1986, is comprehensive and reasonably complete (242 pages), but parts are now out of date. It provides the reader a clear and fairly complete description of how the model works and its capabilities and limitations. There is no user's guide or technical (programmer's) documentation.

PRISM may provide a platform with potential to add modules of interest to the Society of Actuaries. The PRISM Retirement Plan Provisions Data Base has extensive detail on a large, representative (in 1984) sample of pension plans, to which individuals simulated in the model are assigned. That data base is now out of date. The Society of Actuaries may consider participating in a new survey and development of a new plan sponsors data base, which could include features and capabilities of interest to the Society.

Apart from the Retirement Plan Provisions Data Base, PRISM does not provide any representation of firms, employers, government entities, industries, or other organizations. Industry, firm size, labor union coverage, and pension plan characteristics are attributes of individuals in the model, which can be controlled as part of the simulation process. The behaviors of employers or plan sponsors are not modeled.

An updated and augmented Retirement Plan Provisions Data Base could provide a basis for incorporating plan sponsor behavior, and potentially for development of a microsimulation model of plan sponsors.

PRISM has been used in a joint project with the Brookings Institution to develop a model of Long Term Care Financing. PRISM provides longitudinal socioeconomic, employment and earnings, and retirement income histories, which are used as the basis for simulations of utilization and financing of institutional and non-institutional long term care. The Lewin Group currently has a contract with the U.S. Department of Health and Human Services to update the Long Term Care Financing Model, which could potentially include elements of PRISM.

Contracting with The Lewin Group to conduct specific studies, add modules or capabilities to PRISM, or provide the model and assistance in its use would be feasible.

VI. CRITIQUE

PRISM is a simulation model specifically designed to analyze retirement income policy. It begins with two detailed and comprehensive data bases developed for the model. The Pension/Social Security Data Base of individuals has the economic and demographic data, pension coverage and characteristics, and social security coverage and earnings histories required to provide the basis for analysis of current and simulation of future pensions and retirement income. The Retirement Plan Provisions Data Base contains detailed information on all the pension plans of a representative sample of 325 plan sponsors. PRISM ages the data base of individuals using Monte Carlo simulation, assigning probabilities of events to individuals, primarily using probability tables

and transition matrices based on incidence rates derived from published data or projections. PRISM simulation studies often involve significant input by the analysts doing the studies, in terms of simulation rules, adjustments, and assumptions. These typically have been well documented. PRISM simulations are aligned closely to projections done by the Social Security Office of the Actuary for the annual OASDI Trustees Report, by the Bureau of Labor Statistics, and by the Census Bureau. PRISM projections have also drawn heavily on input from the Macroeconomic-Demographic Model of the U.S. Retirement Income System (MDM).[28] PRISM incorporates considerable actuarial input.

A major strength of PRISM derives from its use of the two comprehensive pension data bases. The Pension/Social Security Data Base, matching social security coverage and earnings histories for 1937-1977 with comprehensive demographic, economic, employment, pension, and individual retirement saving information for 1978 and 1979 for a representative sample of 28,000 individuals, provides a powerful basis for simulation of individual retirement income sources and levels. The Retirement Plan Provisions Data Base provides information on the pension plans offered by 325 representative plan sponsors, including both primary and supplemental plans, a total of 475 actual plans. The data include rules on coverage, participation, vesting, benefit eligibility, and benefit formulae. This data base is designed to capture interrelationships between the benefit and other plan provisions, and between the primary plan and secondary plans of various types of sponsors. Typical methodologies used in other pension simulation models, of simulating plan characteristics by assigning parameters of prototypical plans to individuals, may not capture these important interrelationships.

Both of these data bases are old. The Pension/Social Security Data Base dates from 1979. The last year a match of SSA coverage and earnings records and CPS records was made available to the public was 1978. Current law prohibits releasing such data. PRISM must simulate employment, earnings, social security, and pension information for 1979-1996. The data in the Retirement Plan Provisions Data Base was last updated for 1983. Although the simulated individual employment, earnings, and pension data for 1979-1996 have been extensively aligned to historic group and aggregate data, and the retirement plan provisions have been modified to correspond to statutory and regulatory changes since they were collected, it is unlikely that the data bases capture all of the important trends and changes in joint distributions that have occurred since the data were collected.[29]

The most recent Employee Benefits Survey supplement to the CPS was done in April 1993. These data could be matched to the March 1993 CPS, which includes the same individuals. As stated earlier, the Bureau of the Census and the Social Security Administration have matched March

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[28] The Macroeconomic-Demographic Model of the U.S. Retirement Income System is described in Chapter 7.

[29] In fact, of the three major U.S. microsimulation models reviewed in this report, PRISM uses the most recent data base. DYNASIM uses the 1972 CPS-SSA match file. CORSIM uses a 1960 Census file and no SSA earnings records, simulating employment, earnings, and social security coverage for the 1960-1996 period. DYNASIM does not include data on actual retirement plan sponsors or plans. The CORSIM pension model was in the design stage in 1997. At that time the proposed design for the CORSIM pension model was more similar to that of DYNASIM.

1994 CPS records with social security earnings records, but this data base is not available to the public. Staff at the Department of Health and Human Services are exploring the possible availability of these data. As with the 1978 and 1979 CPS data used in PRISM, there is a 50 percent overlap between the March 1993 and the March 1994 CPS samples. If the 1994 CPS-SSA matched data were available, they could be matched to the 1993 CPS-EBS data to provide a more recent data base comparable to the current PRISM data base.

PRISM includes very few behavioral equations and relationships.[30] In particular, PRISM does not include a behavioral retirement decision model nor a behavioral savings model. Changes in pension or social security levels, accrual rates, or other characteristics do not influence labor market behavior, retirement, or saving behavior.[31] Consequently, there is no feedback of changes in social security or pension policy on labor market, saving, or pension participation or acceptance behavior. PRISM generally simulates the effects of policy changes through *ad hoc* adjustments performed by the model user.

There is no representation of employer behavior or plan sponsor behavior. Pension plan provisions are represented in some detail. Plan provisions can be modified by the model user in the specification of a particular simulation to depict a behavioral trend or response on the part of sponsors, but sponsor behavior is not depicted by the model itself.

Almost all of the events in PRISM are determined using probability tables and transition matrices based on tables of incidence rates assumed or projected by others (such as the Social Security Office of the Actuary) or tabulations of historic data bases. This is a relatively low-cost method of developing (and updating) these relationships, and may ensure that PRISM simulations reflect relationships that are consistent with other widely accepted projections (such as those in the Social Security Trustees Report). PRISM incorporates relatively little original research in formulating and estimating these relationships.[32]

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[30] In this context, behavioral refers to equations or relationships that reflect individual decisions and incorporate variables that may be considered in decision-making and that may be affected by the outcome of the decision. For example, a retirement probability determined by variables such as current and expected wage, assets, current social security and pension benefits if retire this year, social security and pension benefits if delay retirement one year, may be considered a behavioral relationship. Specifying that retirement rates are related only to age, sex, race, based on past observed patterns, would not be considered a behavioral relationship. A behavioral model is generally more difficult to develop, and may not provide more accurate simulations.

[31] Changes in retirement eligibility rules determine benefit acceptance from pension plans because PRISM will not simulate a worker to accept a retirement benefit unless he/she is eligible.

[32] Of the three major U.S. dynamic microsimulation models discussed in this report, PRISM relies almost entirely on tables of rates published by others or tabulations of cross-section data to develop event probabilities. CORSIM appears to rely most heavily on estimated discrete choice equations. DYNASIM uses a mixture of the two. There has been little research or discussion concerning which approach may be preferable for given applications. One advantage of statistical estimation of equations is that the estimation process provides a statistical measure of the standard error of the estimate and tests of statistical significance of the estimated coefficients of each equation. These statistics are rarely used in the simulations, however.

PRISM is highly specialized -- designed to analyze retirement income policy and related policy areas (such as long term care financing). It has more pension detail, both for individuals and plans, than other models, but is less flexible and provides less information related to other socioeconomic behaviors and other policy issues. For example, PRISM assigns educational attainment to individuals in the 1979 CPS who had not completed their education to correspond with patterns observed in that cross-section and a later cross-section (the 1991 March CPS) in order to more accurately assign hours worked and wages, rather than to model educational attainment. PRISM assigns births to women in the 1979 data base in order to determine family structure and labor market histories, but it does not age individuals who are born after the beginning of the simulation. PRISM provides limited information on the population younger than age 62, primarily information related to the later determination of retirement income. For example, PRISM does not simulate social security disability or SSI benefits for persons younger than age 62. PRISM does not model family assets or home ownership for persons younger than age 65.

PRISM ages the population sample of the March 1979 CPS. It does not age any individual born after March 1979. Consequently, it does not simulate new entrants to the labor force after about the year 2000, so it cannot accurately estimate variables related to aggregate labor market outcomes after that year, such as total income tax revenues, payroll tax revenues, IRA contributions, and employer pension costs.[33]

PRISM is not user-friendly. There is no programmer's technical documentation nor users guide.

In summary, PRISM provides a powerful simulation system to analyze retirement income. It makes use of two rich data bases with considerable pension and social security detail. PRISM demonstrates the implications of applying the assumptions and projections adopted by the Social Security Office of the Actuary and the Bureau of Labor Statistics, and trends and patterns in several historic data bases, to individuals in the 1979 CPS-SSA pension/social security sample and projecting them into the future. Its strengths derive from its integration and use of considerable pension and social security data, and the fact that its development and use for numerous projects incorporates considerable research and experience in the actual operations and interactions among the programs and processes that determine retirement income. Its major weaknesses are that the data bases are old and the relationships internal to the model lack significant behavioral elements.

[33] For specific studies, PRISM staff have developed a separate modeling system to estimate aggregate payroll tax revenues for years after 2000.

ANNEX 4-1

PRISM

SUMMARY DESCRIPTION TABLE

PRISM

Summary Description

Subject: Retirement Income of U.S. persons and married couples
Purpose and Objective of Model

- Dynamically age a sample of the U.S. population;
- Create synthetic cross-section database representing future U.S. population;
- Create longitudinal files with socioeconomic histories for individual members of a sample of the U.S. population, including work histories, pension accruals, pension benefit receipt;
- Analyze public policies concerning retirement income, long term care, for which work and life histories are significant.

Period of historical analysis: 1951-1979 (1978 CPS-SSA Earnings History Records file (CPS-SER), 1979 CPS), 1986-1991
Forecast/simulation horizon: 1979-2030
Frequency: Annual
Base year: 1979
Simulation technique: Dynamic microsimulation
Solution algorithms and structure: Sequential/recursive, application of transition matrices
Unit(s) of analysis: Nuclear families (unmarried individuals, married couples)
Cell structure: Individual person and family records from CPS, weighted to represent U.S. civilian non-institutional population

Databases
Population/demographics: March 1978 CPS-SSA Earnings History file; March-May 1979 CPS; NCHS Vital Statistics; 1991 Social Security Trustees Report population, fertility, mortality, marriage
Individual/family/household characteristics: March 1978 CPS, March-May 1979 CPS
Employer characteristics: None (size of employer from CPS)
Industry characteristics: None (industry of employment from CPS)
Retirement plan coverage, participation: May 1979, May 1988 CPS
Retirement plan vesting: 1983 ICF Survey of Retirement Plan Sponsors, Federal Employee Retirement System (FERS) provisions
Retirement plan characteristics: 1983 ICF Survey of Retirement Plan Sponsors, Federal Employee Retirement System (FERS) provisions; 1986 tax act rules
Individual Retirement Account (IRA) participation: May 1979, April 1983, May 1988 CPS
Supplemental Security Income (SSI) participation: March 1978 CPS; Administrative program data
Family assets: 1984 Survey of Income and Program Participation (SIPP)
Home ownership: 1984 SIPP
Macroeconomic data: None analyzed or simulated. Macroeconomic controls provided exogenously; 1991 Social Security Trustees assumptions
Labor market data: March 1978 CPS, BLS data (job change, industry), BLS projections
Retirement Behavior: SSA data; CPS; ICF Survey of Retirement Plans. Model determines early, normal, or late retirement based on: eligibility for Social Security benefit, eligibility for

Social Security survivors benefits, employer pension benefit acceptance, and eligibility for deferred vested benefits.

Taxes: Tax model based on federal and state tax rules

Health conditions: Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) data from the 1984 National Long Term Care Survey, and 1985 National Nursing Home Survey (NNHS)

Health insurance coverage: Retiree health insurance coverage only.

Data Quality

Completeness: Complete. Data on pension characteristics of persons and characteristics of pension plans.

Accuracy: Basic employment and earnings data are for period 1955-1978. Many other data sets pertain to period of mid to late 1980s, and may not accurately represent current conditions, e.g. private pension plan data are for 1983.

Representative: Government collected data sets are designed to be representative of the U.S. population. However, the underlying database – 1978-79 CPS-SER -- is out of date. Synthetic earnings histories are based on data through mid to late 1980s.

Currency: Much of the data are out-of-date; last partial update in 1991

Applicability to other contexts: Very comprehensive and can be applied to many different issues and contexts related to income and welfare of elderly; output data serves as input to the Long-Term Care Financing Model (LTCFM)

Gaps: No individual earnings histories data after 1978, no data on IRA adoptions after 1988.

Applicability of other private/consulting firm data: Data on employer pension plans could potentially improve the pension module; considering using 1997 Hay Huggins pension data for medium and large firms

Characteristics, activities, behaviors that are modeled

Demographic characteristics: birth, death, marriage, divorce, education, disability

Economic activity: Not modeled. Controls provided exogenously.

Short-run/cyclical: Economy is exogenous; usually no cyclical activity

Long-run growth, productivity: exogenous

Inflation: exogenous

Industrial sector detail: industry of employment provided on person records

Open or closed economy: NA

Labor market behavior: For individuals, supply side variables --labor force participation, hours worked, unemployment (zero hours worked), wage, job change, industry, retirement benefit acceptance. No labor demand equations nor supply-demand interaction.

Capital markets: none

Retirement plan characteristics: Participation rules, vesting rules, benefit eligibility rules (normal, early retirement), benefit formulae, early retirement reduction, survivors benefit protection, defined benefit, defined contribution, contribution rates, and benefit accruals

Retirement behavior: Social security and pension benefit acceptance rates

Savings and asset accumulation: Assign asset levels at age 65 and then specify saving rates, dissaving rates, and maintenance of wealth

Government behavior: none

Federal budget: not represented
OASDI and HI trust funds: Income and benefit payments can be aggregated from individual records; trust funds not represented.
Regulations: ERISA and tax rules applied to pensions
Taxes: Federal and state income tax rules, payroll taxes

Public retirement income programs: Rules affecting individuals; no aggregate behavior of programs.
OASDI: tax rules, coverage and benefit rules
SSI: eligibility and benefit rules

Government employee pension programs
Federal civil service: yes
Military: no
State and local government, types: yes

Private pensions: Provisions of 475 actual individual plans, 10 plan types, 325 plan sponsors
Defined benefit: Final pay, career average salary, flat percentage of final average, percent of employer contribution, and unit benefit – use separate distributions for single employer, multi-employer, and public sector plans.
Defined contribution: Money purchase, profit sharing, stock bonus, level cents-per-hour contribution, and savings or thrift -- use separate distributions for single employer, multi-employer, and public sector plans.
Supplemental: yes

Individual retirement saving arrangements (IRA, Keogh, etc.): yes

Public sector health care finance programs: none (Medicare, Medicaid, and other public programs for long term care in LTCFM)
Medicare: no (long term care only)
Medicaid: no (long term care only)
Military/CHAMPUS: no
Veterans: no
Indian Health Service and others: no

Private sector health care finance programs none

Private health insurance, especially retiree health insurance: Retiree health insurance only. Large employers based on the 1984 Level of Benefits survey. Estimated small employer insurance coverage from HIAA data (differentiation by industry based on that for large employers). Estimated state and local plan coverage using data from the Martin E. Segal survey of health plans and the Mercer/Meidenger survey of health plans. Assume that only defined benefit plans offer retiree health coverage.

Employer/plan sponsor behavior: Plan eligibility rules and benefit formula are represented for 475 plans. No sponsor behavior.

Worker behavior: Participation, hours worked, wage, social security and pension benefit acceptance. Labor market propensities represented as prevalence rates and transition probabilities. No statistically estimated equations or behavioral models.

Health care provider behavior: none

Insurer behavior: none

Institutionalization: yes

Assumptions, Parameters, Methodology

Key Assumptions: Probability tables based on historic data and projected trends can characterize future behaviors. No effect of retirement plans or government policy changes on labor market behavior[a] or savings behavior.

Types of Parameters, Decrements, Transition Rates/Probabilities

Experience considered, origins of decrements: Incidence rates projected by Social Security Office of the Actuary, Vital Statistics, analysis and tabulation of survey data bases (CPS).

Consistency with other experience and other assumptions of model: Generally consistent. Individual event probability tables are estimated separately. Little interaction among event probabilities.

Internal consistency: Model is internally consistent. Most relationships specified as independent probability tables or transition matrices. No interaction of pension or social security changes on labor market behavior[l] or savings behavior. (Labor market model runs before retirement income model. Potential interactions not represented.) Pension and social security eligibility affect retirement decision.

Methodology used to estimate parameters and relationships

Econometric/statistical: minimal

Actuarial: Demographic, disability, labor market (hours, wages, job change, industry), pension coverage, participation, and retirement rates and probabilities based on Social Security Office of the Actuary and other sources. Specification of program rules.

Judgmental: yes

Economic/actuarial literature, studies done by others: yes (SSA OACT projections)

Simulation Methodology: dynamic microsimulation, cross-section imputation

Stochastic Properties: Monte Carlo simulation

Feedback Phenomena: limited

Microsimulation Adjustment (Aging) Methodology: mixed -- dynamic aging of individual states and events, static reweighting of cross-sections to match controls, static imputations

Policy levers: Social security eligibility, benefit, and indexation rules; SSI eligibility and benefit rules; tax rules; EITC provisions; employer pension regulations

Economic/demographic feedbacks

Employer costs and behavior: none

Labor market behavior: Minimal: labor force status affects birth probability in following period; vesting status can affect job change; social security and pension eligibility can affect retirement decision. Actual or potential social security and pension benefit levels, IRAs, and other assets do not affect labor market behavior.

Taxes, government deficits, etc.: none

Capital accumulation: none (Assets and asset income assigned in LTCFM after completion of PRISM simulation.)

Interest rates: exogenous, no feedbacks

Employment, productivity, economic activity, GDP: exogenous

Sensitivity Analysis: Simulations can be done with alternative parameter values.

Model Validation Procedures: PRISM has previously been integrated with the ICF Macroeconomic-Demographic Model of the U.S. Retirement Income system. Outputs are controlled to Social Security Trustees Report projections.

Computer implementation

Hardware requirements: IBM Mainframe or Pentium PC with at least 24 MB of RAM
Software: Lahey 90 Fortran
Computer costs: Low-medium on mainframe; marginal, if run on microcomputer
Transportability: moderate

Applications

"The Estimated Cost of a Proposed Home Care Program," prepared for The Commonwealth Fund Commission on Elderly People Living Alone, May 1989.

"Future Financial Resources of the Elderly" prepared for the Social Security Advisory Council, October 1991.

"The Financing and Delivery of Long-Term Care Services: A Review of Current Problems and Potential Reform Options," A Report of the Advisory Council on Social Security, December 1991.

Studies of future economic welfare of Baby Boom cohorts, American Association of Retired Persons, 1992 and 1994

Contact Person:; Lisa Alecxih and John Sheils, The Lewin Group, Fairfax, Virginia; David Kennell, Kennell and Associates, Fairfax, Virginia.

[a.] PRISM does simulate the effect of the Retirement Equity Act (REA) on women's decisions to rejoin the workforce after childbirth.

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ANNEX 4-2

PRISM

POLICY MATRICES

PRISM -- POLICY MATRIX

1. Effects of Policy Measures on Employer Pensions

	Offerings	Types of plans and provisions	Costs of plans	Funding	Contributions and benefits
Tax Policy					
Pension					
General					
Social Security					
Retirement age					
Benefit structure					X[1]
Indexation					X[1]
Payroll tax					
Trust fund investment					
Individual accounts					
Funding and Guarantees					
PBGC premium					
Funding rules					
Pension Regulation and Policy					
ERISA/IRS					
Employer plans					
Pension and saving incentives/mandates					

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.
PRISM simulates only the effects on and responses of individuals and families.
[1] In plans integrated with Social Security

PRISM -- POLICY MATRIX

2. Effects of Policy Measures on Employees

	Job availability	Portability	DC accumulations, investments, earnings	Benefit accruals	Wage and non-wage compensation levels and mix	Incidence and timing of retirement
Tax Policy						
Pension			x	x		x
General						
Social Security						
Retirement age			x	x		x
Benefit structure			x	x	x	x
Indexation			x	x	x	x
Payroll tax				x		?
Trust fund investment						
Individual accounts						
Funding and Guarantees						
PBGC premium						
Funding rules						
Pension Regulation and Policy						
ERISA/IRS		x		x		x
Employer plans		x	x	x	?	x
Pension and saving incentives/mandates			x			?

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.

PRISM -- POLICY MATRIX

3. Effects of Policy Measures on Retirees

Outcome Variable **Policy Input**	Payouts	Funded levels of plans	Retire-ment income	Replace-ment rates	Poverty levels	Health care costs and insurance	Retirement age and labor mkt outcomes	Inflation protect-ion	Auxiliary benefits
Tax Policy									
Pension			x	x			x		
General			x	x					
Social Security									
Retirement age	x		x	x	x		x		
Benefit structure	x		x	x	x		x	x	x
Indexation	x		x		x		x	x	
Payroll tax									
Trust fund investment									
Individual accounts	x		x	x	x				
Funding and Guarantees									
PBGC premium									
Funding rules									
Pension Regulation and Policy									
ERISA/IRS	x		x	x	x		x		x
Employer plans	x		x	x	x		x	x	x
Pension and saving incentives/mandates	x		x	x	x		x		

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.

PRISM -- POLICY MATRIX

4. Effects of Policy Measures on Industry Outcomes

Outcome Variable **Policy Input**	Financial strength of plans, sponsors, insurers	Labor costs	Profits	Competitiveness
Tax Policy				
Pension				
General				
Social Security				
Retirement age				
Benefit structure				
Indexation				
Payroll tax				
Trust fund investment				
Individual accounts				
Funding and Guarantees				
PBGC premium				
Funding rules				
Pension Regulation and Policy				
ERISA/IRS				
Employer plans				
Pension and saving incentives/mandates				

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.

Industries are not modeled in PRISM. PRISM shows effects only on individuals.

PRISM -- POLICY MATRIX

5. Effects of Policy Measures on Aggregate Economy

Outcome Variable **Policy Input**	GDP growth	Saving and capital accumu-lation	Equity invest-ment	Invest-ment efficiency	Interest rates	Produc-tivity	Inflation	Labor mobility and labor market flexibility
Tax Policy								
Pension								
General								
Social Security								
Retirement age								
Benefit structure								
Indexation								
Payroll tax								
Trust fund investment								
Individual accounts								
Funding and Guarantees								
PBGC premium								
Funding rules								
Pension Regulation and Policy								
ERISA/IRS								
Employer plans								
Pension and saving incentives/mandates								

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.
Aggregate economy is not modeled in PRISM.

PRISM -- POLICY MATRIX

6. Effects of Policy Measures on Government Finances

Outcome Variable **Policy Input**	Tax revenue	Expenditures by program	Deficits and debt	Social Security and Medicare
Tax Policy				
Pension	x			
General	x			
Social Security				
Retirement age		x		x
Benefit structure		x		x
Indexation		x		x
Payroll tax	x	x		x
Trust fund investment				
Individual accounts		x		x
Funding and Guarantees				
PBGC premium				
Funding rules				
Pension Regulation and Policy				
ERISA/IRS				
Employer plans				
Pension and saving incentives/mandates				

Blank cell indicates that the effects of the policy issue or input on that outcome cannot be simulated in this model.

Government finances are not modeled in PRISM.