August 13, 1997

CHAPTER 3

DYNASIM

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DYNASIM[1]

I. BACKGROUND

The Dynamic Simulation of Income Model (DYNASIM) was the first large scale dynamic microsimulation model of the socioeconomic status and behavior of individuals and families. In 1969 work began on DYNASIM at the Urban Institute under the direction of Guy Orcutt.[2] The first version was completed in 1975 (see Orcutt, et al., 1976). DYNASIM was intended not only for policy analysis but also as a social science research tool. DYNASIM's computer simulation software system, Microanalytic Simulation of Households (MASH) system, was a sophisticated, state-of-the-art technology at that time.

The original model had multiple objectives, including serving as a framework for integrating economic and sociological research on micro entities, forecasting, policy analysis, investigation of the implications of socioeconomic change, and generation of individual and family histories. Early development was supported by the U.S. Office of Economic Opportunity, the Department of Health, Education and Welfare (HEW), the National Science Foundation, the U.S. Treasury Department, and the Ford Foundation. The early model was used to analyze Aid to Families with Dependent Children (AFDC) and Unemployment Insurance issues and to develop long range projections of earnings histories for analysis of social security issues.

Increasing interest in retirement income issues led to an effort to revise and use DYNASIM at the end of the 1970s. Prof. James Schulz at Brandeis University developed a private pension model for DYNASIM (PENSIM), which was completed in 1979. Because of the pension model's complexity, it was never fully integrated with DYNASIM.

To correct substantive shortcomings in the original model and to develop a model which would be less costly to run, a second version of DYNASIM was developed between 1979 and 1983 and renamed DYNASIM2. Development of this version was supported by the U.S. Department of Labor under a contract to analyze the effects of the Age Discrimination in Employment Act (ADEA) and a contract to develop a version of PENSIM for DoL use in-house, and by the Congressional Budget Office (CBO) to do retirement income policy analysis. The development of DYNASIM2 greatly enhanced the model's capabilities to analyze retirement income issues and reduced simulation costs.

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[1] This description draws on Johnson, Wertheimer, and Zedlewski (1983), Johnson and Zedlewski (1982), Hacker and McBride (1989), Orcutt, Caldwell, and Wertheimer (1976), Zedlewski (1984), Zedlewski (1990), Wertheimer et al, (1986), Ross (1991), Zedlewski and McBride (1992), U. S. General Accounting Office (1986), Citro and Hanushek (1997), and discussions with Sheila Zedlewski of the Urban Institute..

[2] Orcutt had first proposed conceptually the development of microanalytic simulation models in 1957 and had developed a prototype microsimulation model in 1961 (Orcutt, et al., 1961).

II. DESCRIPTION[3]

DYNASIM[4] simulates the basic demographic and economic events that determine the socioeconomic conditions of the population. It is an eclectic model, combining elements of both dynamic and static microsimulation.[5] Two of DYNASIM's component models simulate conditions and changes in the characteristics of the population primarily by modeling individual behaviors and events. One submodel directly imputes information to individual records.

Components

DYNASIM has three submodels, each of which simulates different events and uses a different modeling procedure: (1) the Family and Earnings History (FEH) model; (2) the Jobs and Benefits History (JBH) model; and (3) the Cross-Section Imputation Model (CSIM). Figure 3-1 shows the current configuration of the DYNASIM model.

The Family and Earnings History (FEH) model is fully dynamic and simulates demographic and labor force behavior on an annual basis.[6] The basic units of analysis of the FEH model are nuclear families.

The FEH model has 14 modules, grouped in three sectors: (1) the family formation, growth, and dissolution sector; (2) the education, location, and disability sector; and (3) the labor and earnings sector. The sectors are simulated in the order listed. The family formation, growth, and dissolution sector simulates, for each individual, in order, death, birth, first marriage, remarriage, mate matching, leaving home, and divorce. The education, location and disability sector simulates educational attainment, changing residential location, and whether or not disabled (degree of disability is simulated in the JBH model). The labor sector simulates labor force participation, hours in the labor force, wage rate, and unemployment (proportion of the year in the labor force but not working). Table 3-1 lists the behavioral events simulated and shows the variables used to determine each event.

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[3] The basic features of DYNASIM, including sources of data, are summarized in the Summary Description Table in Annex 3-2 at the end of this chapter.

[4] Although the revised model was renamed DYNASIM2, the current model is commonly referred to as DYNASIM. This report follows that practice.

[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.

[6] 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.

FIGURE 3-1
STRUCTURE OF DYNASIM

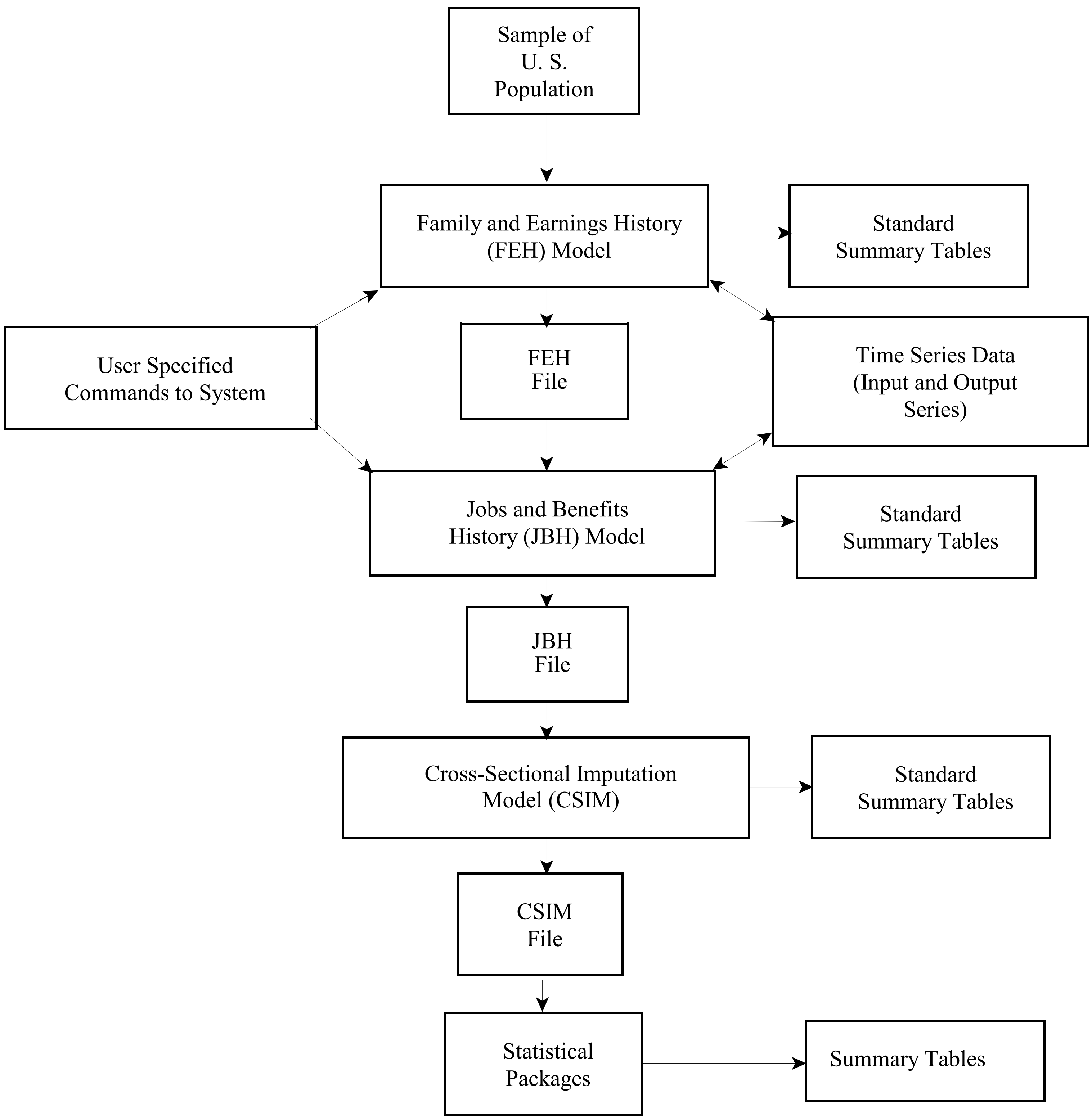

TABLE 3-1

DETERMINANTS OF MAJOR EVENTS SIMULATED BY DYNASIM

Event or Characteristic	Variables Used to Determine Event[a]
Family and Earnings History (FEH) Model	
(1) *Family Demographic Events*	
Death	
Married women 45-64	Age, race, marital status, education, number of children
All others	Age, race, sex, marital status, education
Birth	Age, marital status, number of children, race, education
Multiple birth	Race
Sex of newborn	Race
Marriage	
Age 18-29	Age, race, sex, previous marital status, income, education, region, weeks worked, hourly wage, asset income, receipt of welfare, unemployment compensation
Other ages or ever married	Age, race sex, previous marital status
Mate matching	Difference in age, difference in education
Leaving home[b]	Age, race, sex
Divorce	Distribution over time of expected divorces for this marriage cohort, age at marriage, education, previous marital status, presence of young children, weeks worked, wages
(2) *Education, Location, Disability*	
Education	Race, sex, age, years at current school level, parents' education
Mobility/location	Number of years married, size of family, age and sex of head, education of head, race, region, size of metropolitan statistical area (MSA)
Disability	
Onset	Age, race, sex, marital status
Recovery	Age, race, sex, marital status, education

TABLE 3-1 (continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY DYNASIM

Event or Characteristic	Variables Used to Determine Event[a]
(3) *Labor force events*	
Labor force participation	Age, race, sex, education, region, disability, marital status, student, children, spouse earnings
Hours in the labor force	Age, transfer income, expected wage, disability, marital status, children
Wage rate	Race, sex, age, region, disability, marital status, education, student
Unemployment	Age, sex, race, education, marital status, region, disability, children
Jobs and Benefits History (JBH) Model	
(1) *Job characteristics and pension plans*	
Job change	Age, sex, tenure on current job, industry (probability matrix)
Industry of first job	Sex, education (probability matrix)
Industry of job changers	Sex, previous industry (probability matrix)
Social Security coverage	Industry, program administrative data
Pension coverage on new job	Sex, industry, earnings level (probability matrix)
Pension plan participation	Age, tenure on job, full- or part-time status, sex (probability matrix)
Type of pension coverage (1 of 4 types)	Industry (probability matrix)
(2) *Pension eligibility and benefits*	
Retirement eligibility	Age, industry, years of service (probability matrix)
Vesting	Industry (probability matrix)
Benefit formula type (7 types)	Industry and type of pension coverage (probability matrix)
Benefit plan parameters	Benefit formula type, industry, type of pension coverage (probability matrix)
(3) *Social security eligibility and benefits*	
Retirement benefit eligibility	Age, covered earnings
Primary Insurance Amount (PIA)	Age, calendar year, earnings history, program rules
Benefit	PIA, current earnings, earnings test rules
Disability benefit	Disability status, earnings, covered earnings, program rules
Spouse benefit	Benefit history of head of family, covered earnings, age, program rules
Children's benefits	Parent's eligibility, age, school status

TABLE 3-1 (continued)

DETERMINANTS OF MAJOR EVENTS SIMULATED BY DYNASIM

Event or Characteristic	Variables Used to Determine Event[a]
(4) *Individual retirement accounts*	
Plan participation	Sex, earnings (probability matrix)
Contribution	Assumed to be maximum allowed
Benefit distribution	Retirement determined by private pension model, account balance
(5) *Retirement*	
Probability of leaving job	Age, sex, disability, marital status, pension eligibility and amount, social security eligibility and amount, wage, earnings, social security wealth, pension wealth (logit)
Probability of taking new job	Age, disability, marital status, pension eligibility and amount, social security eligibility and amount, imputed wage, social security wealth, pension wealth (logit)
Cross-Sectional Imputation Model (CSIM)	
Health status/disabilities	
ADL limitations	Age, sex, race, marital status, residential location, region (ordered probit)
IADL limitations	Age, number of ADL limitations (probability matrix)
Institutionalization	Age, sex, marital status, ADL limitations (probability matrix)
Family financial assets	Age, race, sex of head, marital status, health status, region, pension income receipt and level, earnings (tobit)
Home ownership	Age, race, sex and marital status, health status, region, family type, household income (probit)
Supplementary Security Income (SSI)	Age, disability, earnings, financial assets, program rules

[a] Data used for each variable is described in Appendix 3-2

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

Sources: Johnson, Wertheimer, and Zedlewski (1983); Johnson and Zedlewski (1982); Hacker and McBride (1989).

The FEH model simulates all of the appropriate events for each individual in the file each year. All events are simulated sequentially for the first individual, then the second, etc., until all individuals have been processed for one simulation year. Then the model repeats the process for the next year, with the simulated event values for the previous year as inputs. The process is repeated for each year until the final year of the simulation. The output of the FEH model is a file of longitudinal demographic and labor force histories for each person in the sample of the U.S. population, including employment and earnings, plus a cross-section file for the final year of the simulation. (A cross-section file of selected variables can be saved for any other year of the simulation period as well.) Any variable simulated by the FEH model can be saved for all years in a micro time series stored on each person's record.

The FEH output file is the input for **the Jobs and Benefits History (JBH) model**. The JBH model has six submodels. (1) The jobs submodel simulates job change, industry of employment, pension coverage, pension plan participation, and pension plan type (including single- and multi-employer plans and defined benefit and defined contribution plans), and creates a record of all the jobs held by the individual and their characteristics. (2) The employer pension submodel determines benefit eligibility, assigns a benefit formula from a set of seven prototypical formulae types, assigns parameter values to the benefit formulae, computes the benefit for which the worker would be eligible, and stores that information.[7] (3) The social security submodel calculates an entire history of benefits for each person in the population. It determines if a person is eligible for a social security benefit, calculates a primary insurance amount (PIA), adjusts the PIA based on age, and determines if a benefit should actually be assigned, based on current earnings. It calculates retirement benefits, disability benefits, spouse benefits, and child benefits. The social security submodel is highly parameterized to permit simulation of alternative policy scenarios, such as alternative benefit rules, earnings sharing options, alternative survivors benefits, etc. (4) The Individual Retirement Account submodel simulates program participation, account accumulations, and distributions. (5) The retirement submodel is a two equation behavioral retirement decision model, which is implemented for workers age 58 and older. The first stage simulates whether the worker leaves the current job. If the worker leaves the current job, the second stage determines if that worker accepts another job. If so, the jobs submodel simulates job and pension characteristics. If not, the worker is retired. If the worker is simulated to be retired, this overrides the labor force participation and employment determination of the FEH model. (6) The Supplemental Security Income submodel determines eligibility, computes a benefit, and determines participation. The federal tax submodel calculates payroll tax and federal income tax payments. Taxes and SSI payments are determined only for the last year of the simulation.[8]

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[7] DYNASIM does not include a database of pension plans, as does PRISM, so pension plans are built up by simulating each characteristic in turn.

[8] Supplemental Security Income and taxes are in the same submodel.

In the JBH model, in contrast to the FEH model, an entire history of these events is simulated for each person in the sample at one time. Consequently, the JBH model processes the sample only once.

The Cross-Section Imputation (CSIM) model is a static, cross-section model that imputes health status (number of limitations on activities of daily living (ADLs) and limitations on instrumental activities of daily living (IADLs)) and institutionalization for each person age 60 and older, and financial assets, home ownership, and Supplemental Security Income (SSI) for each family. The CSIM model starts with a single cross-section file for a given year generated by the FEH and JBH models and imputes these additional variables only for that year. The CSIM model precesses one family at a time, completing all imputations for each family before preceding to the next family. The asset imputation model assumes that the distribution of assets in a future projection year will be the same as the distribution in 1983.

In addition to these simulation processing capabilities, DYNASIM includes extensive report writing and tabulation capabilities.

Most discrete events in DYNASIM (e.g. death, birth, marriage) are simulated using a *Monte Carlo* technique[9]. That is, the equation for the event determines a probability that the event will occur for each individual. To determine if the event is assigned to occur, the probability is compared to a random number.

Two submodels are of particular relevance for retirement policy -- the employer pension module and the retirement module. Both of these are components of the JBH model.

The employer pension module determines whether a pension benefit should be calculated, whether the worker is eligible for a pension, or whether the worker has a vested benefit. If a worker is eligible for a benefit the model selects a benefit formula type and assigns parameters to the formula. Based on the formula and the worker's earnings history, the benefit is calculated. Whether the worker is covered by a pension plan and participates in the plan and the plan type (single- or multi-employer, defined benefit or defined contribution) has been determined earlier in the jobs submodel.

The employer pension module is called if there is a break in service or if a potential pension benefit must be calculated to determine whether the worker decides to retire. The pension module first determines whether the worker is eligible for a normal retirement, early retirement, or special retirement benefit, probabilistically, as a function of age, years of service, and industry. If a worker is not currently eligible for a pension, vesting status is determined as a function of industry and years of service. If a worker is eligible for a pension (currently or vested), the model assigns a pension formula type, based on industry and single- or multi-employer status. The model assigns one of four broad types of defined benefit plans or a single type of defined contribution plan, which were designed to represent the major types of benefit formulae in use at the time it was developed. The four types

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

of defined benefit plans are: a flat dollar times years of service plan, a non-integrated percent of earnings times years of service type of plan, an integrated percent of earnings type of plan, and a "split earnings" type of plan. Table 3-2 shows the alternative defined benefit formulae types that are assigned in the model. Formula types are assigned probabilistically, based on industry. After the formula type is assigned, parameters are assigned to the formula probabilistically based on industry.[10] Based on the worker's years of service and earnings, a preliminary defined benefit is calculated. These benefits are adjusted to reflect maximum years of service limitations, normal or early retirement, minimum benefit constraints, and survivor's protection reductions, each of which is assigned probabilistically. The defined contribution plan assumes an annual contribution rate of seven percent of salary and a nominal rate of interest of seven percent. At retirement the stock of accumulated contributions plus interest is converted into a life annuity which pays a constant stream of benefits during retirement.

TABLE 3-2

DEFINED BENEFIT FORMULA TYPES

Formula	Specification
	Single-Employer Plan Participant
1	(dollar amount) x (years of service)
2	(percent) x (high 5 of last 10) x (years of service)
3	(percent) x (high 5 of last 10) x (years of service) x (social security offset)
4	(percent_1) x (high 5 of last 10) x (max split) x (percent_2)x (high 5 of last 10) x (over split)
5	higher of formula 1 or formula 2
6	higher of formula 1 or formula 3
7	higher of formula 1 or formula 4
	Multi-Employer Plan Participant
1	(dollar amount) x (years of service)
2	(percent) x (high 5 of last 10) x (years of service)
3	higher of formula 1 or formula 2

[10] The assignment probabilities were initially based on data in the 1974 and 1979 BLS Survey of Defined Benefit Plans and have been updated based on the NBER-DoL EBS-1 Subsample.

The Retirement Module simulates the year in which each person age 58 or over decides to leave his or her current job and then it simulates whether the person takes a new job or withdraws from the labor force. It consists of two behavioral equations. The first equation determines the probability that the worker stays on the same job, as a function of age, sex, disability, marital status, full or reduced pension status, social security eligibility, wage, earnings, social security wealth and its change if retirement is delayed one year, and pension wealth and its change if retirement is delayed one year. If the worker is simulated to leave his or her job, the second equation determines the probability that the worker takes a new job or retires as a function of a similar set of variables. The social security benefit and social security wealth in these equations are calculated from the social security module. Employer pension benefit and pension wealth are calculated from the pension module.

Controls

DYNASIM includes a large array of time series adjustment factors that allow a user to adjust individual outcomes to force the model's annual aggregate predictions to line up to external forecasts. The adjustment factors are fairly detailed, permitting a user to align most demographic and economic events by age, race and sex. After the initial simulation is run for each year, the aggregate result for each variable to be controlled is compared with the control total for that variable for that year, and if they differ, the corresponding results for each individual are proportionally adjusted in order to preserve the distribution across demographic groups while still yielding an aggregate that agrees with the control total.

These adjustment factors permit the user to assure that DYNASIM's aggregate predictions over a historical period accurately track actual events. They also permit the user to align the model's aggregate predictions to other demographic or macroeconomic forecasts. This is designed to encourage broader acceptance of the model's projected individual histories and facilitate simulation of alternative demographic and economic scenarios off of an accepted baseline. The model has often been aligned so that aggregate population projections match those of the U.S. Bureau of the Census or the Social Security Administration Office of the Actuary. The model uses Bureau of Labor Statistics projections to control for employment levels and the proportion of the labor force in each industry over time. External forecasts of the aggregate rate of employment, unemployment, real wage growth, and real interest rates are used to guide the results of the microeconomic operating characteristics. DYNASIM's behavioral equations are used to depict the social-structural effects and distribution of events across demographic groups, while the aggregate results are aligned to external forecasts.

Databases

A household sector microsimulation model starts with a database that provides a sample of the U.S. population and provides information about their demographic characteristics, employment, and incomes. DYNASIM uses the March 1973 Current Population Survey (CPS), which was matched with social security earnings records of the individuals in the survey and federal income tax information.[11] This is the host or base database. This provides for each individual a lengthy record of taxable earnings levels and quarters of social security coverage from 1951 through 1972. In 1997 these data were 25 years old. Although the earnings records simulated for the period from 1973 to the present can be aligned to aggregate historic data, the earnings patterns prevailing in the 1951-1972 data period may not be representative of 1997 and future patterns. The March 1978 CPS was also matched with social security earnings records, but it is not used by DYNASIM. Because of restrictions due to confidentiality concerns no other data sets matching CPS data with social security earnings records have been produced for public use. DYNASIM also used the longitudinal data of the Panel Study of Income Dynamics to estimate several equations. Numerous other data sets used for estimation of behavioral characteristics or parameters or imputation in the model are identified in the summary table in Annex 3-2. These are used to impute the values of variables which were not included in the CPS (such as wealth, limitations on ADLs).

DYNASIM's computer simulation system is "fairly portable (given the complexity of the model)."[12] It is written mostly in FORTRAN.[13] Although it was designed for a mainframe computer with batch processing, it has been modified to operate on a personal computer (PC).

III. APPLICATION TO IMPORTANT RETIREMENT POLICY ISSUES

The policy matrix tables in Annex 3-1 show the types of issues which DYNASIM 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 DYNASIM 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.

DYNASIM's focus is on individual person and family behavior. It can be used to simulate work histories, pension accruals, and retirement behavior. It can analyze policy issues for which information on personal histories is required. Examples of issues suitable for analysis with DYNASIM include social security policy issues such as earnings sharing, pension policy issues such as the effects of changes in participation and vesting requirements on pension benefit receipt and benefit levels, effects of marriage and fertility changes on AFDC, effects of changing schooling on labor force behavior and wages. DYNASIM does not simulate employer or plan sponsor behavior,

[11] The March CPS provides information on the demographic and employment characteristics of individuals surveyed in that month and income and health insurance coverage during the previous calendar year.

[12] Zedlewski (1990).

[13] Some read and write statements are written in machine language.

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 labor supply variables, such as labor force participation, employment, and hours worked, DYNASIM does not depict any aggregate economic behavior, so it cannot analyze effects on the aggregate economy, such as saving, investment, GDP growth, or interest rates.[14]

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 DYNASIM for analysis of each of these illustrative benchmark policy issues.

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

<u>OASI revenues, benefit payments, trust fund balances</u> -- The increase in the Social Security normal retirement age will reduce social security benefits and social security wealth. The DYNASIM retirement module depicts the effects of these variables on the probability of retiring and, through the Monte Carlo simulation process, on the number of persons working and retired. If necessary, the retirement model could be modified to estimate other effects of the change in eligibility age on retirement probabilities. In concept, DYNASIM can be used to calculate effects on OASI revenues, benefit payments, and trust fund balances. It can calculate payroll tax liabilities and social security retirement benefit payments for each person, which can be aggregated. Some reprogramming would be required to estimate total payroll tax collections and benefit payments in each year. Currently, there is no model of the OASI trust fund. Such a model would have to be developed to accumulate revenues, deduct benefit payments and administrative expenditures, estimate interest earnings on the fund, and update the fund from year to year.

<u>DI benefit payments and trust fund balances</u> -- Analysis would require modification of DYNASIM disability module and development of DI trust fund model.

<u>Employer pension accruals and benefit costs</u> -- DYNASIM does not model employer pension plans or employer behavior. Pension accruals and benefit costs are not depicted.

<u>Social security retirement replacement rates and total retirement income replacement rates</u> -- DYNASIM's longitudinal earnings records, employer pension model, and social security model provide the capability to calculate replacement rates. Programming modifications would be required to compare income amounts in different years -- final employment income with initial retirement income -- in order to calculate replacement rates.

[14] All the labor supply related variables -- labor force participation, hours in the labor force, wage rate, unemployment -- are modeled as functions of socioeconomic characteristics of the person, e.g. age, race, education, region, etc. No labor demand-related factors are included.

2. Means testing of Social Security benefits.
In concept, DYNASIM could be used to estimate the effects of means testing of social security benefits on total benefit payments. It currently depicts the effects of the social security earnings test on individual benefits. A trust fund model would have to be developed to estimated the effects on trust fund balances. DYNASIM does not depict all sources of income, so additional income imputations would be required. Effects on income replacement rates could be simulated. DYNASIM does not depict employer costs, so the effects on employer costs could not be simulated.

3. Mandatory minimum employer pension.
DYNASIM could be used to estimate some of the effects on workers of a mandatory employer pension, under the assumption that employer behavior did not change, or specified assumptions about changes in employer behavior in response to the mandatory pension. DYNASIM could not simulate the effects on employers or the potential changes in other pensions, wages, or employment. DYNASIM could show the effects on individual workers' fund balances of a mandatory money purchase plan, but it would not depict employer pension accruals. The potential effects on individual future pension benefits and replacement rates could be estimated. By aggregating over all workers, DYNASIM could show potential effects on aggregate national retirement saving and aggregate annual pension benefit payments, assuming that other saving behavior, pension benefits, employer behavior, and labor market behavior did not change. These would be strong assumptions.

4. Expansion of individual retirement account eligibility.
In concept, DYNASIM's individual retirement account model could be used to estimate some of the effects of expansion in eligibility. It is based on data on participation collected during a period of limited eligibility (1979, 1993), so the effects of eligibility changes would have to be specified or modeled. DYNASIM assumes that all individual retirement account participants contribute the maximum, which is naive and unsuitable for analysis of a significant increase in the contribution ceiling. A contribution model would have to be developed.[15] With these (significant) modifications, DYNASIM could simulate the effects on individual contributions, account balances, benefit payments, and retirement replacement rates, assuming no other changes. Individual contributions, balances, and benefits could be aggregated to estimate effects on total contributions, balances, and benefits. Potential effects on individual and total federal tax revenues could be estimated, assuming no other changes in individual behavior, macroeconomic activity, or federal fiscal behavior. Because DYNASIM does not depict saving behavior or macroeconomic effects, it could not estimate the effects on total retirement savings, personal savings, national savings, capital formation, or GDP. It does not depict federal expenditures, deficits, or debt. With the same qualifications and limitations, DYNASIM could analyze a "back-loaded" IRA.

5. Effects of value added tax on pension contributions and accruals.
DYNASIM is not suitable to address issues concerning the effects of taxes on pension offerings, contributions, or accruals. The model does not depict the effects of taxes on individual or firm

[15] Existing research suggests that development of an adequate individual retirement account contribution model would not be easy or straightforward.

behavior. It does not depict the behavior of corporations or other employers, so it does not depict pension plan sponsors.

6. Effects of construction industry benefit accrual rates on funding.
DYNASIM is not suitable to analyze issues concerning the condition or behavior of employer pension funds. DYNASIM does not model employers, industries, sponsors, or pension funds.

7. Effects of alternative macroeconomic scenarios on social security and employer pensions.
DYNASIM in general is not appropriate for analysis of effects of alternative macroeconomic scenarios on other aggregates, such as pension and social security fund balances. Because individual labor market behavior and outcomes in each period, such as employment, hours worked, and wages, can be controlled to align to alternative macroeconomic scenarios, DYNASIM can 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 pension and social security receipt and benefit levels. In this way DYNASIM can be used to depict some of the effects of alternative macroeconomic scenarios on various socioeconomic or demographic groups, including the effects on pension participation, vesting, and benefit receipt. DYNASIM does not depict employer pension fund balances or accruals.

IV. ACCESSIBILITY AND EASE OF USE

DYNASIM was developed largely with public funds and is in the public domain. The Urban Institute does not, as a matter of policy, maintain proprietary models. The source code of the model is mostly FORTRAN. Some input-output routines are coded in machine language. These could be recoded to use modern database software. The Urban Institute will provide the computer code for the model on request without charge.

The model is not user friendly. To use the model, either internally at The Urban Institute or externally, would require significant input of time of Urban Institute staff familiar with the model, which would be costly. Users unfamiliar with the model could not use it without significant investment of time and effort.

While the basic features of DYNASIM are described in several publications, the detailed documentation is old and out of date (Johnson, Wertheimer and Zedlewski, 1983; Johnson and Zedlewski, 1982; Hacker and McBride, 1989).

The model of the household sector is comprehensive. It would be feasible for The Urban Institute to add modules pertaining to individual and family economic behavior, if they are consistent with current model structure and simulation outputs. DYNASIM does not provide information about employers, occupational changes, or determinants of compensation and benefit offerings. In concept, modules depicting other sectors, such as employer or plan sponsor behavior, could be linked to DYNASIM, but the undertaking would be very difficult, costly, and the outcome would be uncertain. Assessment of the costs and prospects for any particular enhancement of DYNASIM would require a detailed specification of the desired enhancements. It would be possible for the Society of Actuaries to contract with the Urban Institute to use the existing model for analysis, or to update, modify, or augment the model. Updating and augmenting the model would be difficult and costly.

V. CRITIQUE

DYNASIM simulates a broad range of demographic, social, and economic events, giving it great flexibility and broad application. For many retirement policy issues, the longitudinal employment and earnings histories that dynamic microsimulation produces are very useful. DYNASIM includes formal models of labor market behavior and an interesting and well-articulated behavioral retirement model, which models the effects of pension eligibility and benefit changes on the retirement decision.

The model has great flexibility in providing parameters that can be changed to analyze a variety of social security and retirement income policies and alternative demographic and economic scenarios.

The major structural shortcoming of DYNASIM arises from the efforts which were made to reduce simulation costs. Under the current structure, most policy changes do not generate either labor market or demographic behavioral responses. This is because most of the events relating directly to retirement income -- including job choice and tenure, pension coverage and characteristics, social security benefit rules, retirement saving -- are simulated after the longitudinal demographic and employment histories are created. The JBH model, which includes employer pension characteristics and social security benefit determination, as well as industry, job tenure and characteristics, is run after the FEH model creates the longitudinal earnings and employment histories, and it does not influence employment, hours worked, or earnings. This structure makes it impossible for policy changes or job or pension characteristics to affect demographic or labor market events. (The exception is the retirement decision, which is simulated in the JBH model and takes into account potential pension and social security benefit levels and how those levels change if the worker retires or works another year. This overrides the employment history simulated in the FEH model for workers age 58 and older.) This structure limits the ability of the model to analyze the full range of long term responses to policy changes, which may affect labor market and demographic behavior in the future.

The retirement submodel in the JBH model, which runs after labor force participation and employment has been determined in the FEH model, may introduce bias and inconsistency. Presumably, the prediction of labor force participation and employment in the FEH model is unbiased -- that is, the expected value for each individual, given his/her demographic characteristics, is equal to the mean probability. If these unbiased outcomes are revised by the JBH model, and the revisions are not unbiased, the overall outcome will be biased.

Even within the JBH model, there is limited interaction among job characteristics, job tenure, and pension characteristics. For example, the probability of job change is not related to pension coverage, participation, vesting, or pension benefit formula. The pension model, which assigns pension eligibility, vesting status, and benefit formula, is called only if there is a break in service, or in conjunction with the retirement decision model to calculate a potential pension benefit, should the worker leave his/her current job.

There appears to be no interaction between the assignment of degree of disability in the CSIM model and the assignment of a Disability Insurance benefit in the social security model or job change or retirement in the JBH model.

These problems are examples of a pervasive problem of microsimulation models. Because of their detail and complexity and the large number of computations required for each individual, it is practically impossible for a microsimulation model to solve for many variables simultaneously. In practice, microsimulation models are constrained to utilize for the most part a recursive solution structure, solving sequentially for each variable one at a time for each individual. This makes it impossible to capture feedbacks of variables solved for later in the solution sequence on those solved for earlier. Consequently, the order of solution is important in determining the outcomes and in determining which policy effects can be analyzed.

Similarly, in microsimulation models it is practically impossible to capture the effects of the aggregation of individual behaviors on those behaviors themselves. For example, the model may predict an increase in labor force participation and hours worked for an individual with given characteristics. That may be an accurate prediction for an individual, if no other labor market conditions change. However, it may not be possible for all individuals to increase hours worked at the same wage, if labor demand conditions or employment opportunities do not change.

While DYNASIM's employer pension model was a significant state-of-the-art contribution when it was developed in 1979, it now appears to be rudimentary and out-of-date. It assigns only one plan to each worker, and therefore does not capture the role of supplementary plans, which have become significant over the past 15 years. The model assigns all workers in defined benefit plans to one of four types of benefit formulae. It assumes that all workers in defined contribution plans have the same fixed contribution rate and receive the same rate of interest every year. At retirement all defined contribution balances are converted into a life annuity which pays a constant stream of benefits.

CSIM is a static imputation model, imputing the values of several variables in a single period based on values of other variables in that period alone. However, several of the variables it imputes -- institutionalization, assets, and home ownership -- are highly dynamic, in the sense that their current period values are highly correlated with their values and other variables in earlier periods. These dynamic aspects are ignored.

A deficiency of the current version of DYNASIM is that much of the data used to estimate or derive parameters and characterize the population are old, including the initial population database, which is based on the March 1973 CPS. Before the model could be used for current policy analysis, it should be updated and many of the behavioral equations should be re-estimated. The cost of required updates would be substantial. Estimates of costs of specific tasks could be provided by the Urban Institute. A major challenge would be to find a replacement or substitute for the 1973 CPS data on income, employment, and demographic characteristics, which includes earnings and employment histories for 1951-1972. The only current source of earnings histories for years since 1972 in DYNASIM are the imputations for 1973 to the present, which are based on earlier data.[16] Updating the model would require use of a recent CPS file and would require imputations of earnings histories.

The current documentation of the model is also old and out-of-date. The only detailed descriptions of the FEH and JBH models were written in 1982 and 1983 and do not reflect updates to the model which were done in the mid-1980s.

DYNASIM is based on a powerful conceptual framework and has provided an organizing framework for the integration of fruitful empirical research and many sources of information. The advances in computational power and efficiency that have occurred over the past 15 years, since the last major revision of DYNASIM, make it possible to achieve significant improvements in the basic tasks the model was designed to perform.

The required changes in model structure and simulation procedures and the required updating of behavioral equations and databases would be costly. Moreover, analysis of many important retirement income policy issues requires information about behavioral responses of participants which are not represented in DYNASIM, such as employers and plan sponsors, information about long term responses in labor market and saving behavior, and information about the macroeconomic feedbacks from changes in retirement income and asset accumulation. It does not appear likely that, in the near future, the data, research, and simulation capabilities will be sufficient to incorporate these requirements in a microsimulation framework.

VI. ACTUARIAL ASPECTS OF DYNASIM

DYNASIM is a microsimulation model. That means, inter alia, that projections are made for individual cells, and then these are aggregated to produce totals (such as the total of employees covered by retirement plans). The projection of individual cells is similar to the process used in a pension valuation system of an actuarial consulting firm.

A key question to ask about a model is the source of and validity of data that are included in the data base. The validity of a model's results depend on the validity of the data input on the important variables that determine those results.

[16] The PRISM model, described in Chapter 4, uses the 1979 matched CPS-social security earnings records, and imputations for 1979 to the present.

The primary source for the DYNASIM data base is the March 1973 Current Population Survey (CPS) matched with Social Security earnings records for the individuals in the CPS data base. The basic unit is the nuclear family. The information from the original data set included the following for each individual in the family that are relevant for retirement analysis:

Age
Race
Sex
Family Size
Education
Marital status
Income
Spouse income
Tenure on current job
Industry of employer
Annual hours worked category

The original data base has been linked with other data sources to build the current data base. Two important additional data sets were retirement plan characteristics and family asset distribution. The retirement plan characteristics were obtained from four data sources compiled between 1974 and 1988 (see Annex 3-2). The data on retirement plans include benefit eligibility rules, benefit formulae, early retirement reductions, and survivors benefit protection. These data were used in the JBH model to simulate the pension eligibility rules and the benefit formulae characteristics and parameters in the employer pension module.

The family asset distribution data were obtained from the 1983 Survey of Consumer Finances. These data include values of various types of financial assets, including Individual Retirement Accounts and Keogh Accounts, home equity, business equity, debt, as well as demographic characteristics, income and employment. The data were used in the CSIM model to impute family financial asset levels and home ownership.

The DYNASIM model begins with a projection of the demographic and basic labor market status of each individual in each year in the projection period under consideration produced by the Family and Earnings History (FEH) model (see Table 3-1). The industry, pension coverage and characteristics, and retirement status of each individual in the projection file are then simulated through the Jobs and Benefits History (JBH) model by reference to the projected demographic and labor market status of the individual in each year. This process is explained in detail in the Model Description section II of this chapter. While the DYNASIM model provides dynamic projections of demographic characteristics and labor force participation, employment and wages of individuals, a major limitation is that there is no mechanism to feed back information from the JBH results to the projection of the labor market status and behavior of each individual.

The model results can be aligned with external annual aggregate predictions for each year of the projection. The adjustment factors include aggregate subtotals by age, race and sex for birth rates, death rates, population counts, migration, marriage rates, counts by marital status, divorce rates, labor force participation rates, weekly unemployment rates, annual unemployment rates, labor force, mean earnings, wage rates. The aggregate controls are obtained from the Office of the Actuary of the Social Security System (central birth rates, central death rates, labor force participation rates, unemployment rates, average wage growth), the Bureau of Labor Statistics, and Vital Statistics.

Actuarial Critique

The strengths of DYNASIM are summarized in the first two paragraphs of the chapter's Critique in section V. These include a well-articulated ability to estimate the effects of retirement pension eligibility and benefits design on the retirement decision. The model can analyze the effect of a wide variety of Social Security and retirement income policy changes on retirement income levels and distribution.

The primary limitations on the use of the model for analyzing pension policy issues are the absence of a feedback mechanism from changes in pension policy and structure to labor market outcomes, and lack of information about plan sponsors in the data base and the absence of any representation of plan sponsor behavior in the model. The primary data validity problem is that the original data source is now a quarter of a century old.

Attempts to strengthen the model through the introduction of important feedback mechanisms or addition or updating of data would require considerable effort and expense. The model documentation is old and out-of-date. The last major updating of the model occurred in 1987, and the last update of the documentation was in 1989. Although the model is in the public domain, only an expert in the program and data base could modify the model. The Urban Institute originally built the model, and they would be willing to undertake changes, but the cost would be considerable.

DYNASIM is not able to analyze important areas and facets of retirement policy that may be of interest to policy makers and to members of the Society of Actuaries, and the analysis it can undertake currently may not be relevant because of the age of the data bases. For DYNASIM to provide useful, accurate, and reliable analysis of major retirement income policy issues in 1997 would require addressing the two major shortcomings described above: (1) the absence of feedback from changes in pension and retirement income policy and institutions onto labor market and saving behavior, and (2) the fact that the basic income and demographic data and equations are out-of-date. Solving these two problems would require major revision and re-estimation of the model and would be time-consuming and costly.

ANNEX 3-1

DYNASIM

SUMMARY DESCRIPTION

ANNEX 3-1

DYNASIM

Summary Description

Subject: U.S. person and family socioeconomic conditions and behavior
General Objectives of Model
■ Policy Research and Analysis: project future socioeconomic state and conditions of U.S. population for policy planning; simulate implications of alternative conditions and alternative policy measures for transfer income, social insurance, and pension policy.
Specific Purposes 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 for which work and life histories are significant, such as retirement income, long term care policy.

Period of historical analysis: 1951-1972 (1973 CPS-SER file; also selected data from 1980, 1983, 1984, 1986, 1988)
Forecast/simulation horizon: 1973-2030
Frequency: Annual
Base year: 1972
Simulation technique: Dynamic microsimulation
Solution algorithms and structure: Sequential/recursive, solution of single equations, application of transition matrices
Unit(s) of analysis: Nuclear families (unmarried individuals, married couples with natural and adopted children)
Cell structure: Individual person and family records from CPS, weighted to represent U.S. civilian non-institutional population

<u>Databases</u>
Base Year Database: March 1973 Current Population Survey (CPS) matched with Social Security earnings records for 1951-1972. CPS has 60,000 person records.
Population/demographics: 1960, 1970, 1980 Decennial Census; March 1971, March 1973, May 1983 CPS; 1968-1984 PSID; 1986 Vital Statistics Life Tables
Individual/family/household characteristics: March 1971 CPS, May 1983 CPS, PSID
Employer characteristics: None
Industry characteristics: None (industry of employment from CPS)
Retirement plan coverage, participation: May 1979, May 1993 CPS
Retirement plan vesting: 1976 EBS-1
Retirement plan characteristics: 1974 and 1979 BLS Surveys of Defined Benefit Plans; 1983 NBER-DoL-EBS1 Subsample; 1986 tax act rules; 1988 Abstract of government pension rules
Individual Retirement Account (IRA) participation: May 1979, May 1993 CPS

Supplemental Security Income (SSI) participation: 1975 Survey of Income and Education; March 1988 CPS; Administrative program data

Family assets: 1983 Survey of Consumer Finances (SCF)

Home ownership: 1983 SCF

Macroeconomic data: None analyzed or simulated. Macroeconomic controls provided exogenously.

Labor market data: January 1973 CPS, BLS data (job change, industry), PSID (wages, participation, hours), May 1983 CPS, BLS projections

Retirement Behavior: Retirement History Survey

Taxes: Tax model based on tax rules

Health conditions: Activities of Daily Living (ADLs) data from the 1984 National Health Interview Survey/Supplement on Aging (NHIS/SOA), 1984 Long Term Care Survey, and 1985 National Nursing Home Survey (NNHS)

Health insurance coverage: None

Data Quality

Completeness: Complete

Accuracy: Basic employment and earnings data are for period 1951-1972. Many other data sets pertain to period of mid-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 -- 1973 CPS-SER -- is out of date. Synthetic earnings histories are based on data through mid-1980s.

Currency: Much of the data are out-of-date.

Applicability to other contexts: DYNASIM is very comprehensive and can be applied to many different issues and contexts.

Gaps: No earnings histories data after 1972.

Applicability of other private/consulting firm data: Data on employer pension plans could potentially improve the DYNASIM pension module.

Characteristics, activities, behaviors that are modeled

Demographic characteristics: birth, death, marriage, divorce, leaving home, education, mobility and location, disability

Economic activity: Not modeled. Controls provided exogenously.

- **Short-run/cyclical:** exogenous
- **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 of labor supplied, unemployment (% of hours), wage, job change, industry, retirement decision. No labor demand equations nor supply-demand interaction.

Capital markets: none

Retirement plan characteristics: Benefit eligibility rules (normal, early retirement), benefit formulae, early retirement reduction, survivors benefit protection
Retirement behavior: yes (two-stage logit)
Savings and asset accumulation: No savings behavior; individual/family financial assets imputed in specified cross-sections (not dynamic, not annual)
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: income tax rules, payroll taxes
Public retirement income programs: Rules affecting individuals; no aggregate behavior of programs.
  OASDI: tax rules and benefit rules
  SSI: benefit rules
Government employee pension programs
  Federal civil service: yes (1988 abstract of rules)
  Military: no
  State and local government, types: yes
Private pensions: Seven representative plan types. Rules and benefit formulae are parameterized. Pension plan or plan sponsor behavior not represented.
  Defined benefit: single employer, multi-employer
  Defined contribution: single employer, multi-employer
  Supplemental: none
Individual retirement saving arrangements (IRA, Keogh, etc.): yes
Public sector health care finance programs none
  Medicare: no
  Medicaid: no
  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: no
Employer/plan sponsor behavior: Plan eligibility rules and benefit formula are represented. No sponsor behavior.
Worker behavior: Complex modeling of worker behavior (participation, hours, wage, retirement behavior); Labor market propensities represented as prevalence rates, statistically estimated probability models, and transition probabilities.
Health care provider behavior: none
Insurer behavior: none
Institutionalization: yes

<u>**Assumptions, Parameters, Methodology**</u>

Key Assumptions: Future will be like the past, in the sense that reduced form descriptive functions can continue to characterize relationships. No effect of retirement plans or government policy changes on labor market behavior of workers under age 58.

Types of Parameters, Decrements, Transition Rates/Probabilities

Experience considered, origins of decrements: Largely based on analysis and tabulation of survey data bases (CPS, PSID, RHS). Econometric equations representing demographic and economic behavior estimated from cross-section and longitudinal survey data bases.

Consistency with other experience and other assumptions of model: Generally consistent. Most individual equations and operating characteristics estimated individually.

Internal consistency: Model is internally consistent. Most relationships estimated as reduced form single equations. No interaction of pension or social security changes on labor market behavior of workers under age 58. (Earnings history model runs separately from jobs and pension model. Potential interactions not represented.) Pension and social security provisions and prospective benefits affect retirement decision of workers over age 58.

Methodology used to estimate parameters and relationships

Econometric/statistical: OLS, logit, probit, tobit

Actuarial: Specification of program rules, demographic, disability, retirement probabilities

Judgmental: yes

Economic/actuarial literature, studies done by others: yes

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 aging of cross-section, static imputations

Policy levers: Social security benefit computation rules, tax rules, EITC provisions, employer pension regulations

<u>**Economic/demographic feedbacks**</u>

Employer costs and behavior: none

Labor market behavior: Labor force status affects some demographic behavior in following period. Social security and pension provisions affect retirement decision.

Taxes, government deficits, etc.: none

Capital accumulation: Individual wealth accumulation is not modeled.

Interest rates: exogenous, no feedbacks

Employment, productivity, economic activity, GDP: exogenous

Sensitivity Analysis: Simulations can be done with alternative parameter values, but this is costly because of computational burden and complexity of each simulation.

Model Validation Procedures: Various studies. Simulations of 1973-1995 period can be compared with actual data. Simulated earnings history files for 1976-1982 were compared with PSID, indicating shortcomings in early version of model.

Computer implementation

Hardware requirements: Mainframe, VAX, PC
Software: Fortran, SAS
Computer costs: Low-medium on mainframe; marginal, if run on microcomputer
Transportability: limited, because of complexity of model

Applications

Effects of mandatory retirement through 2000; U.S. Dept. of Labor, 1981.
Effects of teenage childbearing on welfare costs; N.I.C.H.D., 1982.
Forecasts of private pension system through 2020 under different scenarios, U.S. Dept. Of HHS, Brookings Institution.
Long range effects of 1983 Social Security Amendments; 1983, consortium of foundations.
Earnings sharing alternatives in Social Security System; 1984, women's advocacy groups, private foundations.
Long range effects of private pension rule changes in Tax Act of 1986; 1988, Rockefeller Foundation and National Senior Citizens Law Center.
Needs of elderly in 21st century; 1989, Administration on Aging.

Contact Person: Sheila Zedlewski, The Urban Institute

ANNEX 3-2

DYNASIM

POLICY MATRICES

DYNASIM -- POLICY MATRIX

1. Effects of Policy Measures on Employer Pensions

Outcome Variable Policy Input	Offerings	Types of plans and provisions	Costs of plans	Funding	Contributions and benefits
Tax Policy					
Pension					
General					
Social Security					
Retirement age					
Benefit structure					Benefits only[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.
DYNASIM simulates only the effects and responses of individuals and families.
[1] In plans integrated with social security only.

DYNASIM -- POLICY MATRIX

2. Effects of Policy Measures on Employees

Outcome Variable **Policy Input**	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		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.

Alternative policies may effect employees in DYNASIM through effects on pension benefit formulae and effects on retirement functions through changes in social security wealth and pension wealth.

DYNASIM -- POLICY MATRIX

3. Effects of Policy Measures on Retirees

Outcome Variable **Policy Input**	Payouts	Funded levels of plans	Retirement income	Replacement rates	Poverty levels	Health care costs and insurance	Retirement age and labor market outcomes	Inflation protection	Auxiliary benefits
Tax Policy									
Pension			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					x				
Trust fund investment									
Individual accounts			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		

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

DYNASIM -- 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 DYNASIM. DYNASIM shows effects only on individuals.

DYNASIM -- POLICY MATRIX

5. Effects of Policy Measures on Aggregate Economy

Outcome Variable **Policy Input**	GDP growth	Saving and capital accumulation	Equity investment	Investment efficiency	Interest rates	Productivity	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 DYNASIM.

DYNASIM -- 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				
General	x			
Social Security				
Retirement age		x		x[1]
Benefit structure		x		x[1]
Indexation		x		x[1]
Payroll tax	x	x		
Trust fund investment				
Individual accounts		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.

[1] Social security benefit payments only.

Government finances are not modeled in DYNASIM.