SURVEY OF CONSUMER FINANCES: EMPLOYER SPONSORED PENSION BENEFIT PLANS

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Introduction

The role of personal savings in shaping the course of the aggregate economy in the near and longer terms has received much attention in recent years. Personal savings is important as well to the future financial viability of each American family. American families have traditionally reported three major savings motives: to provide reserve funds in case of emergency, illness, or income loss; to finance children's education; and, to provide for retirement. How much is saved by households is also dependent on their entitlements to employer provided benefits and pensions, unemployment compensation, education assistance, social security benefits, health care, and other entitlements. The 1983 Survey of Consumer Finances collected detailed information on household saving and wealth, including the amount and types of financial and nonfinancial investments and liabilities, as well as entitlements to private and public pension benefits. The unique analytic potential of this data set lies in its ability to integrate the several sources of household wealth with private and public entitlements, so as to provide a systematic framework for the assessment of each specific component, and how they interact.

This paper details the overall research design and empirical methodology used to estimate entitlements to employer sponsored pension benefit plans. The following sections describe the sample, research design, measurement model, benefit formulas, plan provisions, and the assumptions required for the estimation of entitlements.

SAMPLE DESIGN

Derived Sample

The sample for the study of Employer Sponsored Pension Benefit Plans was derived in three interdependent stages. The overall research design was based on the use of the 1983 Survey of Consumer Finances to identify, in turn: which households were covered by employer sponsored pensions; which pension providers and plans covered these employees; and which benefit formulas and requirements governed these pension entitlements.

Stage 1: Survey of Consumer Finances. The Survey of Consumer Finances (SCF) was a personal interview survey based on a representative national sample of U.S. households. Detailed information on employment was obtained for the household head and spouse. All respondents or spouses with work experience were questioned about pension coverage on their current job, as well as vested pension entitlements from prior employers. Households that reported pension coverage were asked to identify the provider of the pension—in most cases, their employer. Sections R and S of the SCF questionnaire, which contained the employment and pension information, as well as the questions used to identify and initially verify the name and address of the pension provider are shown in Exhibit A.

As shown in Table 1, there were 1886 households with 2261 people that reported being covered by one or more pension plans. Of these, 1735 households covering 2061 people gave permission and the necessary information to contact their pension provider. Consequently, 91% of all covered employees in the original Survey of Consumers sample were included in the pension study sample base. These 2061 people were covered by a total of 1158 different pension providers, and 1350 different pension plans. Thus, on average, each pension provider covered 1.8 sample members, and the average pension plan included 1.5 sample members.

TABLE 1

RESPONSE RATES ON THE SURVEY OF CONSUMER FINANCES PENSION STUDY

	Sample Base			
	Households	People	Providers	Plans
Eligible for sample	1886	2261		
Permission and name given	1735 (92%)	2061 (91%)	1158	1350
Successful Provider Contact	1609 (93%)	1882 (91%)	995 (86%)	1184 (88%)
Successful Plan Coding	1421 (88%)	1641 (87%)	845 (85%)	1012 (85%)
Overall coverage rate	75%	73%	73%	75%

Stage 2: Survey of Pension Providers. All the pension providers that were identified in Stage 1 were pooled, and a sample listing was generated from the computerized records. Duplicate references to the same provider were combined, and extensive checks were made on the accuracy of the name and address of the pension provider, and the name and telephone number of the appropriate contact person. The sample base of providers was continually revised as new information was obtained—when it confirmed duplicate references to the same provider as well as when previously combined references proved to be different providers.

A telephone interview was conducted with each of the pension providers. The computer generated questionnaire, shown in Exhibit B, automatically had inserted into it all the necessary information on both the pension provider and the households covered. Each pension provider was asked to identify the pension plans that covered workers in a specific occupational classification and work location. Each pension provider was asked for information on one or more members of the original Survey of Consumer Finances sample. Following the initial telephone requests that official plan documentation be mailed to SRC, recontacts by telephone and mail were made as necessary to insure a high response rate.

Stage 3: Survey of Pension Plans. Each pension plan that was identified in the provider survey was eligible for the Survey of Pension Plans. Two kinds of coversheets were used to coordinate the coding of the various plan combinations sponsored by the same pension provider. The first coversheet, generated for each pension provider, details all household IDs covered by each plan or plan combination offered by that pension provider. The second coversheet, generated for each pension plan, gives detailed information on that single plan and the households it covered. These documents are included in Exhibit C. All information requested in the pension plan questionnaires was compiled from official plan documents by a trained staff of specialists. General information on each plan was recorded in Part I of the questionnaire, defined benefit provisions in Part II, and defined contribution provisions in Part III. These questionnaires are included in Exhibit C. Coding guidelines and notation conventions are documented in Exhibit D.

Among all eligible pension providers, 86% were successfully contacted. These providers covered 91% of all eligible sample members, indicating a higher success rate among the providers which covered

multiple sample members. In terms of individual pension plans, 88% were successfully contacted, again indicating that larger providers which offered several different plans were more likely to agree to participate in the study. Once contacted, 85% of the providers provided sufficient information to insure accurate coding. When each of these stages are taken into account, the overall coverage rate was 73% for all eligible sample members, and 73% for all eligible pension providers. The overall coverage rate for household was somewhat higher (75%), as was the coverage rate for all eligible pension plans (75%).

To estimate the dollar amount of pension entitlements held by U.S. households, data on the specific plan provisions and benefit formulas which cover each household member must be combined with that household member's employment and pension information. Such estimates retain the underlying national representativeness of the original Survey of Consumer Finances household sample. Analysts may also shift the primary focus of analysis from the household base to a base defined by the total number of distinct pension providers, or the total number of separate pension plans.

Depending on the objectives of analysis, weights can be devised to insure that each individual provider or plan has an equal probability of selection; or their probability of selection can be made proportional to the total number of persons or households covered by pensions; or proportional to the accumulated size of all vested entitlements. Such weights would use the number of persons or households in each plan, the number of separate plans sponsored by each provider, or a measure of the financial size of the entitlements. The weights would take the form of the inverse of the number of workers covered by each plan, the inverse of the number of plans sponsored by each provider, and so forth. Regardless of which weights or analysis focus is chosen, the underlying representativeness of the derived samples remains anchored at the household level.

RESEARCH DESIGN

Measurement Strategy

Based on considerations of reporting burden, data quality, and analytic flexibility, a two-step procedure was selected to estimate vested entitlements to employer sponsored pensions. The two steps separate the characteristics of pension plans from the characteristics and employment histories of participants. In the first step, benefit formulas are identified for each pension plan in which respondents held vested entitlements. In the second step, the specific characteristics and employment histories of respondents are combined with benefit formulas to produce dollar estimates of vested entitlements.

The two-step procedure insures that clearly identified and consistent methods are used to estimate entitlements across all the various types of pension plans. The two-step procedure also expands the range of research designs that can be accommodated, since it allows the use of derived representative samples of all pension providers or plans, as well as all participants. Potential changes in benefit amounts can be investigated by using the observed set of benefit formulas with simulated changes in the characteristics and employment histories of the participants. Or, the observed characteristics and employment histories could be used along with simulated changes in benefit provisions, or both types of changes could be simulated to investigate potential developments.

Entitlements as Wealth

An important measurement objective of the 1983 Survey of Consumer Finances was to develop an estimate of wealth held by American households. The SCF used a "balance-sheet" approach to systematically assess the various types of assets and liabilities held by households, with each component monetized at its current market value. Unlike most assets held by households, vested pension benefits do not represent ownership of an asset "stock," but rather an entitlement to a "flow" of future benefits. This

issue is not limited to defined benefit plans, since the difference between defined benefit and defined contribution plans refers to how benefit amounts are determined, not when and how benefits are paid. Both types of plans often make benefits payable only after a certain age, and may exclude the option of "lump-sum" withdrawals at any time.

Entitlements to benefit flows can be converted into stocks of wealth by discounting the expected stream of future benefits to their present value. The present discounted value of the pension entitlement is the amount of money needed today to purchase an annuity contract which would provide for periodic payments of a certain amount over some given time period beginning at a specified future date.

Economic assumptions. The present discounted value calculations require assumptions regarding real rates-of-return on investments. In addition, because of how some benefit formulas are structured, separate assumptions concerning nominal interest rates, inflation, and income growth over the relevant time horizons are often required. Rather than fixing all present value calculations with a single set of assumptions, benefit formulas have been constructed using these assumptions as "exogenous" variables. This enables the manipulation and control of these crucial economic assumptions, and thus supports a wider range of analysis designs.

Behavioral assumptions. A second set of assumptions involves the personal and employment characteristics required to calculate vested entitlements for individual respondents. These assumptions are required because pension entitlements are defined only in reference to the actual date the individual retires or terminates active participation in the pension plan. Consequently, the exact dollar value of vested benefits depends on future decisions about job change and retirement. Some analysts may prefer the "quit tomorrow" assumption for wealth analysis—generally, this would yield the minimum estimate of expected pension wealth. Other analysts may want to compare this amount to that calculated under the assumption that the participant remained with the same employer until retirement —an indicator of the opportunity cost of changing employers. More generally, analysts can vary these assumptions depending on the characteristics of the participant, for example, with the likelihood of remaining with the same employer increasing as the participant nears retirement age.

Differences in these behavioral assumptions can be organized under the following retirement circumstances:

1. Normal retirement.
2. Late retirement.
3. Early retirement.
4. Employment termination prior to retirement.
5. Disability retirement.
6. Death and survivor benefits.

The underlying reason to isolate the above retirement circumstances is that the dollar value of the vested entitlement often depends on these differences in retirement circumstances. In general, different entitlement formulas apply to each of the six circumstances outlined above. In many cases, pension plans specify actuarial adjustments to the normal retirement formula for earlier or later retirement, but some plans add penalties or supplements, and some specify minimum and maximum benefit amounts.

This focus on retirement circumstances is reflected in the overall organization of the questionnaire for the Survey of Pension Plans. The major sections of Part II of the questionnaire determine the plan definitions, formulas, and other provisions, in turn, for each retirement circumstance listed above (see Exhibit C). Using a standardized format, the same type of questions were asked across all retirement circumstances. Each section begins with the identification of the variables the plan uses, and how these variables are defined in terms of the employment characteristics of the respondents. In the middle of each section, the component formulas used to calculate benefits are recorded, grouped by

common requirements and provisions. The third part of each section identifies the requirements and circumstances under which these benefits would be paid. The last question in each section integrates the various component formulas along with their requirements and provisions into one final "decision" formula.

The circumstance under which participants eventually claim vested benefits can be viewed as a probabilistic outcome. The expected pension entitlement would then be equal to a weighted sum of the probabilities and associated benefits that would accrue if: the employee terminates prior to retirement, the employee works until normal retirement, becomes disabled, chooses early retirement, and so forth. The "quit tomorrow" assumption means the probability of immediate employment termination is assumed to be 1.0, and all other probabilities are assumed to equal 0.0. More generally, any set of probabilities can be chosen, based on theoretical considerations, historical evidence, or respondent characteristics and preferences.

Institutional assumptions. The third set of assumptions involves the current and future financial viability of the pension plan itself, as well as how overall public policy and government regulation will affect these plans in the future. Vested participants face a risk that the pension plan will be unable to meet its financial commitments when their entitlements are due. Developments in government policies, such as funding standards or benefit guarantees, also influence the type and extent of risk faced by participants. Moreover, since benefits from employer sponsored pensions are often integrated with Social Security payments, future changes in Social Security benefit provisions would have an important impact on benefit amounts from private pensions.

MEASUREMENT MODEL

Benefit Formulas

A major objective of the Survey of Pension Plans was to identify and quantify plan provisions and benefit formulas using a standard format. The standardization involves the transformation of benefit formulas into equations that used a limited number of respondent characteristics. Although the specific form and content of the resulting formulas may differ widely, all the formulas share the same set of exogenous variables. These formulas can then be combined with respondent information to estimate the specific benefit amounts under the various types of retirement circumstances. In general, each formula was constructed as a function of a base amount plus benefits depending on the participants length of credited service, earnings, age, and so forth. The actual future payment of the entitlements may also be viewed as dependent on the financial viability of the plan itself, and other associated factors.

The general form of the pension entitlement formulas can be written as a function of the pension plan variables, and the exogenous household variables as follows:

$$(1) \quad PE_{ijkt} = F_{jk}(PPVARS_{ijkt})$$

$$(2) \quad PPVARS_{ijkt} = H_{jk}(HHVARS_{ijkt})$$

where the subscripts indicate:

i = 1,...,n, the total number of respondents
j = 1,...,m, the total number of pension plans
k = 1,...,6, the six retirement circumstances
t = time index, with t = 0 defined as the date of interview

and the variables are defined as:

PE_{ijtk} = Value of entitlements for the i^{th} respondent under the *j*th pension plan, with benefits calculated as of time *t* under the k*th* retirement circumstance.

F_{jk} = Benefit formula for the *j*th pension plan under the k*th* retirement circumstance.

$PPVARS_{ijkt}$ = Pension plan variables which determine benefit amounts.

H_{jk} = Variable definition for the *j*th pension plan under the k*th* retirement circumstance.

$HHVARS_{ijkt}$ = Participant's income and employment characteristics available from the Survey of Consumer Finances household survey.

Because respondents often had entitlements to benefits from more than one pension plan, the total benefit amount represents the sum of the separate plan benefits under each of the retirement circumstances.

$$(3) \quad TPE_{ikt} = \sum_{j=1}^{m} PE_{ijkt}$$

where

TPE_{ikt} = Value of the sum of entitlements due to the i*th* respondent from all pension plans under the k^{th} retirement circumstance.

Finally, the overall summary measure of pension entitlements represents the present value of the weighted sum of expected benefits under each of the retirement circumstances.

$$(4) \quad WTPE_{it} = V_t\left[\sum_{k=1}^{6} (PROB_{ik} * TPE_{ikt}), BEND_{ijk}, DEATHD_{ik}, RATE_t, PRICE_t, RISK_{jt}\right]$$

where

$WTPE_{it}$ = Weighted present discounted value of all pension entitlements for the i^{th} respondent.

V_t = Formula to calculate present discounted value of all entitlements as of time *t*.

$PROB_{ik}$ = Probability that the i*th* respondent retires under the k*th* circumstance.

$$\text{Note that:} \quad \sum_{k=1}^{6} PROB_{ik} = 1.0$$

$RATE_t$ = Nominal interest rate over the relevant time period for benefit calculations made at time *t*.

$PRICE_t$ = Inflation rate over relevant time period for benefit calculations made at time *t*.

$RISK_{jt}$ = Risk factors associated with the j^{th} pension plan at time *t*.

$BEND_{ik}$ = Participant's age at the time benefit payments begin under the k^{th} retirement circumstance.

$DEATHD_{ik}$ = Participant's age at the time of death, given retirement occurred under the k^{th} retirement circumstance.

Questionnaire Notation. Instead of using the index *k* to identify the retirement circumstance, the questionnaire used separate notation for each retirement circumstance. The term NR was used for the normal retirement formulas, LR for late retirement, ER for early retirement, VD for vested deferred retirement, DR for disability retirement, and DS for death and survivor benefits. The two sets of notation are related as follows:

$$\begin{aligned} PE_{ijkt} &= NRT_{ijt} \text{ , for } k=1 \\ &= LRT_{ijt} \text{ , for } k=2 \\ &= ERT_{ijt} \text{ , for } k=3 \\ &= VDT_{ijt} \text{ , for } k=4 \\ &= DRT_{ijt} \text{ , for } k=5 \\ &= DST_{ijt} \text{ , for } k=6 \end{aligned}$$

Up to eight component formulas were coded for each of the retirement circumstances. In order to calculate the final benefit amount across the separate formulas, a "decision" rule, which specifies how the component formulas are combined, determines the functional form f_{jk} in the equations below:

$$NRT_{ijt} = f_j(NR\#1_{ijt}, \ldots\ldots, NR\#8_{ijt})$$

$$LRT_{ijt} = f_j(LR\#1_{ijt}, LR\#2_{ijt})$$

$$ERT_{ijt} = f_j(ER\#1_{ijt}, \ldots, ER\#5_{ijt})$$

$$VDT_{ijt} = f_j(VD\#1_{ijt}, \ldots, VD\#5_{ijt})$$

$$DRT_{ijt} = f_j(DR\#1_{ijt}, \ldots, DR\#5_{ijt})$$

$$DST_{ijt} = f_j(DS\#1_{ijt}, \ldots, DS\#5_{ijt})$$

Plan Provisions

In general, the variables included in benefit formulas were related to the employment tenure and income history of the participant. Some plans also included variables which determined a Social Security offset or some other type of reduction to basic benefit amounts. Defined contribution plans also required

variables that defined the sources and amounts of annual contributions. For each of the pension plan variables, pension plan formulas frequently specified several different definitions. Most often, separate definitions were required by the different retirement circumstances, although many plans used several definitions in one or more formulas for the same retirement circumstance. The questionnaire allowed from 3 to 18 separate definitions of the plan variables. Although the questionnaire allowed space for three definitions within each of the questionnaire sections, once defined, the plan variables could be used in any of the formulas. Volume 2 of the accompaning documentation contains the dictionary and codebook for the pension plan survey instrument.

The plan variables specified were as follows:

ASY#: Actual Service Years
PSY#: Potential Service Years
FAP#: Final Average Pay
SS#: Social Security Offset
RED#: Reduction factor
MAN#: Mandatory contributions by participants
MMAN#: Employer matching of mandatory contributions
VOL#: Potential voluntary contributions by participants
MVOL#: Employer matching of voluntary contributions
CTE#: Employer contributions to plan
COE#: Employer contributions to participants
CLS#: Lump sum contributions at retirement

Actual Service Years (ASY). The vast majority of plans used the length of credited service to determine benefits. Just 7 percent of all plans did not include any ASY term, primarily defined contribution plans. Nearly half of all plans used two or more ASY terms in benefit formulas. Due to a wide variety of plan provisions, the use of four separate questions was required to define each ASY term. The major variations involved eligibility requirements, the unit of accumulation, maximums, and date restrictions. Each of these components of ASY were defined in terms of the participant's age, date of hire, work hours, and the date when employment terminates.

Accumulation rule. Plans differed on the number of work hours required per year to accumulate each unit of service credit. Approximately one-third of all plans did not include any minimum work-hour requirements. Another third required a minimum number of work hours per year to qualify for each unit of service credit, with no provisions for partial credit for part time employment. A prorated credit for less than full time employment was given in about one-quarter of the cases. Although the vast majority of plans limited the accumulation of service credit to one unit per year, a few plans allowed the accumulation of more than one unit per year.

Accumulation eligibility. Most plans defined ASY to include all years of employment. One-third of the plans, however, required that before accumulation of service credit could begin, the participant must have reached a certain age, or have completed a minimum number of years of employment, or both.

Maximum accumulation. Over half of all plans limited the total number of service years that could be accumulated for benefit credit. These limitations usually set a maximum age after which the participant could no longer accumulate service credit. Less frequent were direct limitations on the total ASY that could be accumulated, and limitations that depended on a combination of age and ASY.

Date restrictions. About 40 percent of the ASY terms covered only a specific calendar time period. Service credit accumulated under a prior version of the plan often followed different rules than at present. In addition, ASY terms used to determine supplemental benefits were also often subject to date restrictions.

Potential Service Years (PSY). Rather than accumulate a certain benefit amount for each year of employment, about one plan in six prorates benefits depending on the potential length of employment, given the participants date of hire. When used in benefit formulas in conjunction with ASY, the ratio of actual to potential service years can range from 0.0 to 1.0, and was used to prorate benefits. Three separate questions were used to define each PSY term, specifying the accumulation of the potential total service years, maximums, and date restrictions. Each of the components of PSY were defined in terms of the participants date of hire, date of birth, and date of termination of employment.

Potential accumulation rule. The definitions of PSY differ from ASY in that they count "backwards" from some specified age when the accumulation process must end. In addition, about one-quarter of the plans specified a minimum number of years of employment before which the accumulation of service credit could not begin.

Maximum limitations. Approximately one-fifth of the PSY definitions included a specific limitation on the maximum level of PSY that could be used in benefit formulas, regardless of the age and work history of the participant.

Date restrictions. Approximately 7% of the PSY terms applied to a specific calendar time period, usually to account for transitions in plan provisions and formulas.

Final Average Pay (FAP). Two-thirds of all benefit formulas depended on the income of the participants. Plans differed widely on how income was defined. In general, the various definitions of FAP required information on the participant's income history. Given an age-income profile for each participant, these definitions specified which age-income observations were used to define FAP.

Averaging rule. Most plans specified a certain time period over which wages and salaries had to be averaged for use in benefit formulas. Although the time periods ranged from one month to the participant's entire income history, plans usually focused on the last one to ten years of employment. Some plans required averaging over consecutive years, while others allowed the highest average of any combination of years during the specified time interval. Rather than using some fixed period of employment, in one-fourth of the cases the time period was defined by when the highest income level was achieved.

Date restrictions. Plans sometimes specified specific calendar time periods that wages and salaries could be earned for the calculation of FAP variables—in about one-fifth of the cases. These restrictions applied mainly to prior plan provisions and supplemental benefits.

Maximum limitations. Half of all plans placed limitations on FAP when it was used in benefit formulas. Two types maximums were specified. The most common type of involved a maximum age after which any wages or salaries that were earned could not be used in the calculation of FAP. The least common type was a direct limitation on the maximum level of wages and salaries that could be used in the calculation of FAP.

Social Security Offset (SS). One-third of the plans included an offset for social security benefits. The offset provisions differed depending on the retirement circumstances under which benefits were paid, and on the age of the participant at the time of retirement, and on how future Social Security entitlements were estimated.

Social security offset definition. Most plans that used offsets defined the offset in terms of the Social Security benefit amount. Only about one-fourth of the SS terms were defined by the Social Security wage base. For plans that used the SS benefit amount, formulas differed in whether this amount was the unreduced benefit payable at 65 or the reduced benefit payable at 62; and whether the benefit amount was based on the participant's own work history or whether it included spouse earnings and any additional amounts paid for dependents.

Date restrictions. Only 5 percent of the SS terms had date restrictions, most commonly when the offset was defined by the annual wage base.

Maximum limitations. One-third of the plans had maximums on the total amount of the SS offset that could be used in benefit formulas. These offset maximums took two forms: a maximum percentage of the Social Security benefit amount, and maximums on the participant's age or credited service years that could be used to calculate the SS offset.

SS estimation methods. For participants that terminate employment before they are eligible to receive Social Security benefits, plans differed in how the offsets were estimated. Major differences involved assumptions about the age at which the participant would begin receiving benefits, and whether the participant would work in the future.

Reduction Factor (RED). Almost all defined benefit pension plans included a "reduction factor" that was used to lower normal retirement benefit amounts to account for other retirement circumstances, usually for early retirement, but also for disability and deferred vested retirement. Two types of reduction factors were commonly used. The first type was defined as an actuarial reduction, meant to leave benefits equivalent in economic value to those which would have been received at some later date. The second type involved a fixed dollar or percentage reduction depending on the participant's age or credited service years at the time of retirement.

Mandatory contributions (MAN). For plans that required contributions from participants, the provisions that governed these contributions were measured, including the amount of the annual mandatory contribution, withdrawal rights, and the time period and rate of interest accrual.

Amount of contribution. The most common type of mandatory contributions took the form of a fixed percentage of wages or salaries. In a few plans, the percentage varied by income level, age, and service years.

Withdrawal rights. This variable specifies the conditions under which a participant that terminates employment can withdraw mandatory contributions prior to the time the participant would have been eligible to receive regular pension benefit payments. Some plans had minimum age and service year requirements for withdrawals.

Rate and period of Accrual. Some plans included specific guidelines on how the rate of accrual on past contributions was determined, and some plans set restrictions on the length of the accrual time period. Age and service year requirements were sometimes used to determine whether any accrued interest would be paid, and when the accrual period would begin.

Matching of Mandatory contributions (MMAN). This variable specifies whether and how employers match participant's mandatory contributions. Plan provisions varied in how matching amounts were determined, maximums on matching amounts, and whether matching was limited to participants that met some special requirement.

Matching rule. Although the most common practice was to match the exact amount of the participant's mandatory contribution, some plans provided less in matching funds for each dollar contributed by participants, while other plans provided more. In a few plans, the rate of matching varied by the age or service years of the participant.

Vesting of Matching Contributions. Although all of the participant's contributions are immediately 100% vested, the matching contributions of the employers are subject to plan defined vesting schedules.

Voluntary contributions (VOL). The measures of plan provisions which govern voluntary contributions are similar to those for mandatory contributions. The major difference is that voluntary

contributions can vary at the discretion of the participant, and thus the plan provisions are usually defined in terms of allowable ranges for contributions.

Matching of Voluntary contributions (MVOL). These measures are comparable to those for matching mandatory contributions. The major difference is the more frequent use of maximum limits on the amount of the employer's matching voluntary contribution.

Employer contributions to plan (CTE). Two distinct types of procedures were used to determine the dollar amount of the employer's contribution. Under one procedure, the total amount of the employer's contribution to all plan members was determined first, and then this fixed total was allocated among plan participants. The other procedure was to first determine the amount due each participant, and then the sum of these individual contributions determined the total employer contribution. The variable CTE represents employer contributions that were determined using the first procedure, while the variable COE represents employer contributions determined using the second procedure.

Plans that first determined the total amount of the employer's contribution (CTE) specified both a rule for determining the total contribution, as well as a rule to allocate this fixed total among plan participants.

Total contribution amount. For plans that first determined the total size of the employer's contribution, the contribution amount often depended on the economic performance of the company, as measured by profits, or change in net worth. These rules often included a minimum and maximum annual contribution amount.

Allocation of total. Once the total contribution is determined, rules for the allocation of these contributions among participants are needed. Some plans divided the total employer contribution among participants in proportion to wages or hours worked; other plans varied the contribution depending on the participant's age or number of service years. In addition to minimums and maximums on the total employer contribution, plans also frequently specified limits on contributions to individual participants.

Employer contributions to participants (COE). Under this procedure, the rule for determining the annual contribution to each participant was measured by the variable COE. The contribution rule frequently depended on the participant's wages or workhours, and the amount often varied by the number of service years or age of the participant.

Lump sum contributions at retirement (CLS). In addition to regular annual contributions, some pension plans provided for lump sum contributions to the participant's account at the time of retirement. Plans varied in how the amount of this additional contribution was determined, and whether the participant had to meet any special requirements.

Eligibility Requirements

Aside from the requirements imposed by the plan variables, pension plans also set specific conditions under which participants become eligible for particular benefit payments. For each type of eligibility condition, up to 15 separate definitions were coded. The requirements and conditions of payment were defined as follows:

RAS#: Required age and service
ROT#: Other requirements
DAT#: Date restrictions
BEG#: When payments begin
LEN#: Length of payment period

Required Age and Service (RAS). The vast majority of pension plans had age and service requirements which the participant had to satisfy to be eligible for benefits. These requirements differed depending on the retirement circumstance, with the most restrictive requirements being for normal retirement benefits. Typically, there was a set of alternative combinations of age and service years, and if the participant satisfied any one of the combinations, then they were eligible for the benefit payments.

Other Benefit Requirements (ROT). Besides age and service year requirements, pension plans often had other requirements which the participant had to satisfy to receive benefits, especially when the benefit was a supplement or an alternative to the basic benefit.

Date Restrictions on Benefit Payments (DAT). Formula date restrictions apply to the time period when the benefit payments begin. These specific calendar time periods often applied to special supplements, or to changes in basic benefit levels over time.

Date Payments Begin (BEG). Although most benefits begin at the time of retirement and continue for the life of the participant, some benefit formulas determined amounts that start at some time after retirement. In addition to vested deferred benefits, disability and survivor benefits were often timed to begin at some later date depending on the availability of other company provided disability income or the age of the beneficiary. To account for these differences, the earliest time that payments could begin under each benefit formula was coded.

Length of Payments (LEN). Each benefit formula was also coded as to the length of time the payments would continue. Most often payments are made for life, however some benefit formulas determined amounts that would be paid for a fixed number of years or until a certain age. In some cases, early retirement supplements were only paid until the participant became eligible for Social Security benefits. Lump sum payments at the time of retirement were coded here as one time only payments.

Complete Entitlement Formulas

The overall system of entitlement formulas, written in terms of the exogenous household information and the required behavioral, economic, and institutional assumptions, is as follows:

$$WTPE_{it} = V_t\left[\sum_{k=1}^{6} (PROB_{ik} * TPE_{ikt}), BEND_{ijk}, DEATHD_{ik}, RATE_t, PRICE_t, RISK_{jt}\right]$$

$$TPE_{ikt} = \sum_{j=1}^{m} PE_{ijkt}$$

$$PE_{ijkt} = F_{jk}(ASY\#_{ijkt}, PSY\#_{ijkt}, FAP\#_{ijkt}, SS\#_{ijkt}, RED\#_{ijkt}, MAN\#_{ijkt}, MMAN\#_{ijkt}, VOL\#_{ijkt}, MVOL\#_{ijkt}, CTE\#_{ijkt}, COE\#_{ijkt}, CLS\#_{ijkt}, RAS\#_{ijkt}, ROT\#_{ijkt}, DAT\#_{ijkt}, BEG\#_{ijkt}, LEN\#_{ijkt})$$

$$ASY\#_{ijkt} = \alpha_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, WKHRS_{ijt})$$

$$PSY\#_{ijkt} = \beta_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, WKHRS_{ijt})$$

$$FAP\#_{ijkt} = \gamma_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, WAGE_{ijt})$$

$$SS\#_{ijkt} = \delta_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, WAGE_{ijt}, BEND_{ij}, SSWB_t, SSBA_t)$$

$$RED\#_{ijkt} = \epsilon_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, WAGE_{ijt})$$

$$MAN\#_{ijkt} = \eta_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, WAGE_{ijt})$$

$$MMAN\#_{ijkt} = \psi_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, WAGE_{ijt})$$

$$VOL\#_{ijkt} = \theta_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, HHVOL_{ijt}, WAGE_{ijt})$$

$$MVOL\#_{ijkt} = \iota_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, HHVOL_{ijt}, WAGE_{ijt})$$

$$CTE\#_{ijkt} = \kappa_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, HHVOL_{ijt}, WAGE_{ijt}, WKHRS_{ijt})$$

$$COE\#_{ijkt} = \lambda_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, HHVOL_{ijt}, WAGE_{ijt}, WKHRS_{ijt})$$

$$CLS\#_{ijkt} = \mu_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, HHVOL_{ijt}, WAGE_{ijt}, WKHRS_{ijt})$$

$$RAS\#_{ijkt} = \nu_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, WKHRS_{ijt})$$

$$ROT\#_{ijkt} = \xi_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij}, QUAL_{ij})$$

$$DAT\#_{ijkt} = o_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij})$$

$$BEG\#_{ijkt} = \pi_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij})$$

$$LEN\#_{ijkt} = \rho_{jk}(BIRTHD_i, HIRED_{ij}, QUITD_{ij}, BEND_{ij})$$

ESTIMATION ASSUMPTIONS

Household Data

Based on information from the Survey of Consumer Finances and other sources, the following household variables are required for the estimation of pension entitlements.

$BIRTHD_i$: Date of birth.

$HIRED_{ij}$: Date/age hired.

$QUITD_{ijk}$: Date/age terminate employment.

$BEND_{ijk}$: Date/age retirement benefits begin.

$DEATHD_{ik}$: Date/age at death.

$PROB_{ik}$: Probability of retirement circumstance.

$QUAL_{ij}$: Participant's special qualifications.

$WKHRS_{ijt}$: Hours worked per year.

$WAGE_{ijt}$: Rate of pay per year.

$HHVOL_{ijt}$: Participant's voluntary contributions.

Birth Date (BIRTHD). The month and year of birth for each plan participant is available from the Survey of Consumer Finances.

Hire Date (HIRED). This variable defines the date the individual was hired by the employer for which the pension plan applies. The date of hire is obtained from the SCF. This date is in general different from the date of initial participation in the pension plan, as some plans allow participation only after a certain age or years of service. However, even when plan participation did not commence on the date of hire, plans often included all years of service in the benefit formulas. These differences in plan provisions are incorporated in the formulas and variable definitions specified above, for each of the j pension plans and k retirement circumstances.

Date Terminate Employment (QUITD). Unlike the birth and hire dates, for the vast majority, the date of employment termination had not yet occurred at the time of the household interview. For most all respondents, this date must be estimated. Information from the SCF includes the age at which the respondent expects to stop working: at their current job, at any full time job, and at any part time job.

Since pension entitlements from both current and past employers were included in the study, some respondent had already terminated employment, but had not yet begun to receive benefit payments. For these cases, the date of employment termination is available from the SCF. In the case of disability and death benefits, this date refers to the date of death or onset of the disability.

How this date is estimated for those who were working at the time of the interview is a matter of analytic objectives. For some research objectives the quit date could be set to the date of the interview; or or it could be assumed that all participants work until some certain age, like 62 or 65; or the stated intentions and preferences of respondents about retirement could be used; or a more general model of decisions to retire could be employed, estimating differential retirement dates depending on the occupational, economic, demographic, and preference data available in the SCF.

Benefit Payment Date (BEND). This variable defines the age at which actual benefit payments begin. Although for normal and early retirement, the date of employment termination is often the same as the date when benefits begin, for other retirement circumstances these dates often differ. Since all cases included in the sample represented future entitlements, this variable must be estimated for all respondents. In most cases, the age at which benefit payments begin under each type of retirement circumstance is stipulated in the pension plan. In some cases, however, the participant can choose among alternative starting dates, especially in the case of vested deferred retirement. The SCF contains information on when the respondents expects to begin receiving benefits.

Probability of Retirement Circumstance (PROB). For each respondent, a zero or some positive probability of occurrence can be assigned to each of the six retirement circumstances outlined above. This variable is not independent from the other information on termination and benefit dates; rather, it is designed to be used in combination with this information so as to allow greater analytic flexibility. When the age at which employment terminates is defined separately for each of the retirement circumstances (e.g. 65 for normal, 62 for early, 55 for disability, current age for vested deferred, etc.), a weighted sum can be estimated using the probabilities assigned to each circumstance. In addition to the available SCF data on the respondent's future work plans, and expected retirement and benefit dates, the SCF included a self-assessed overall health status measure, and occupational and demographic information that could be used to estimate differential risks of disability and death.

Special Qualifications (QUAL). Special qualifications are often required for special or supplemental benefit payments. The most common type of special requirements involve the type of work (e.g. special benefit provisions for police), eligibility to receive other benefits (e.g. other benefits provided by the employer for disability, eligibility for Social Security), whether the respondent was employed during specific calendar time periods, and presence or absence of spouse. Most of this information can be obtained from the SCF. Some information, however, must be assumed, such as whether any potential disability qualifies for Social Security, whether the injury occurred at the work place, and so forth.

Work Hours (WKHRS). Unlike the above household variables which require an estimate of a single date or qualification, information on the number of annual work hours is sometimes needed for all years employed. Information in the SCF documents the "average" number of hours worked per week, and the number of weeks worked in a "normal" year. Depending on the objectives of analysis, the reported "average" could be used for all years, or only for years prior to the interview, with estimates of the years following based on expressed preferences about full and part time employment to take account of child rearing and pre-retirement years.

Wage Rate (WAGE). Although most benefit formulas require information on the income history of the participants, information in the SCF gives only wage and salary data for the current year. Estimates of annual wages both prior to and following the date of the interview are required. For estimates of past trends in wages, historical data on aggregate wage trends within industry or occupation groups can be used in conjunction with the SCF data. Estimates of the future annual growth rate in nominal wages can be divided into three major components: a factor which represents cost-of-living adjustments; factors which represent productivity increases in the general economy, and for specific industries or occupational groups; and, factors related to the growth in wages due to the accumulation of skills and experience by individual workers. Using the participant's birth date, date of hire, and current wage and salary data, the required income history can be described by the the average annual rate of growth, and whether the growth rate is rising or falling within specific age-tenure ranges. Assumptions regarding wage inflation and productivity gains could then be combined with age-tenure related gains. This procedure would help insure the consistent use and clear identification of the underlying assumptions about nominal wage growth.

Voluntary Contributions (HHVOL). For defined contribution plans, the voluntary contributions made in each year that respondents participated in these plans is needed for entitlement estimates. The information in the SCF documents the current annual rate of voluntary contributions made by the respondent, as well as the respondents estimate of the current accumulated account total.

Economic Assumptions

The major economic assumptions involve the real discount rate used in present value calculations, as measured by the difference between estimated nominal rates of return on investments and the corresponding estimated inflation rates. The composition of pension portfolios can be used as a guide for the selection of the appropriate rate of return. The variables used in the above equations are:

$RATE_t$ = Nominal rate of return over the relevant time period for benefit calculations made at time *t*.

$PRICE_t$ = Inflation rate over relevant time period for benefit calculations made at time *t*.

$GWAGE_t$ = Average overall growth in wages over relevant time period for benefit calculations made at time *t*.

Institutional Assumptions

The major institutional assumptions involve the future financial viability of the individual pension plans, and prospective changes in Social Security and other federal programs and regulations. The risk associated with the eventual payment of entitlements can be conceptualized in the form of a probability of non-payment ranging from zero to one. Estimated benefit amounts could then be adjusted by this risk factor. Information on the funding status of the individual pension plans included in this study is available from the 5500 forms required to be filed under ERISA regulations. Since Social Security offsets are frequently used when calculating private pension benefits, estimates of future changes in the wage base as well as benefit amounts are needed. And since Social Security benefits reflect earnings levels, differential estimates are needed which are consistent with the participants' assumed tenure and wage history. The notation for the variables used in the above equations is as follows:

$RISK_{jt}$ = Risk factors associated with the j^{th} pension plan at time *t*.

$SSWB_t$ = Social Security wage base at time *t*.

$SSBA_t$ = Social Security benefit amount at time *t*.

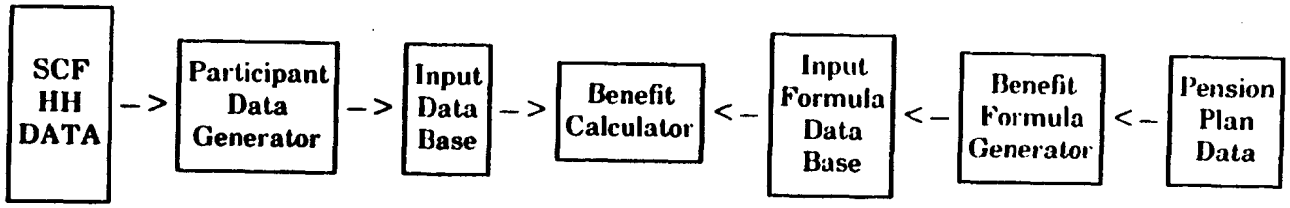
DATA ANALYSIS SYSTEM

The overall measurement strategy requires that the benefit formulas be combined with respondent data, along with behavioral, economic, and institutional assumptions, to estimate pension entitlements under each of the six retirement circumstances. This strategy is depicted in Chart 1. At opposite ends, the two raw data bases—the Survey of Consumer Finances and the Survey of Pension Providers—represent the starting points. Each of these raw data bases need to be transformed to a standard format and notation, as indicated by the two "generator" programs; one to transform the participant data, and the other to transform the pension plan data. These two standardized data bases are then used by the "calculator" program to estimate pension entitlements. The calculator program, shown in the center of the Chart, then produces estimates of pension entitlements, under the specified assumptions. Three major computer programs are necessary: one to transform the participant data, one to transform the pension plan data, and one to estimate pension entitlements using information from both data bases.

Decisions regarding the type and structure of these programs were guided by their flexibility and ease of use. A major purpose of this data analysis system is to facilitate the comparison of benefit entitlements under a variety of simulated or assumed circumstances. Thus the participant data, as well as the behavioral, economic, and institutional assumptions, need to be under the control of each individual analyst. This meant that the programs that generate the participant data, and the program that controls the assumptions underlying the calculations, must be flexible to accommodate a wide array of analytic interests, and yet be easily accessible to users without the need to learn a completely new software

Chart 1

Data Analysis System



system. In contrast, the program that generates the pension formula data base, and the program that calculates the estimated entitlements, are not subject to change depending on the analytic objectives, as they represent a fixed system of equations defined by the pension plans. Thus the pension formula generator and calculator programs, while "user friendly", were designed as self contained units, using an highly structured and efficient computational approach.

Participant Data Generator. This program is necessary to prepare the participant's employment and demographic characteristics in a standard format. The output from this program is the participants' input data base. The requirements for this data base are few: each line in the data file includes the employment and demographic characteristics for one participant; the values for the specified variables must be entered in a fixed order, separated by blanks. Most standard analysis software programs are capable of listing the data in this manner. Thus, OSIRIS, SPSS, SAS, or any other analysis package usually used by the analyst, is suitable to transform the raw survey data on participants' characteristics. As such, users will not have to learn a new system, and the data transformation commands already available in these packages can be used to simulate any desired combination of behavioral assumptions.

It should also be noted that some analysts may prefer completely synthetic characteristics so as to compare the benefits various pension plans provide for a standard set of characteristics. For example, the calculation of normal retirement benefits under all pension plan for a fixed set of employment and demographic characteristics. In such a design, pension benefits could be compared among plans, holding constant participant characteristics.

Users do not necessarily need to generate new data on participant characteristics, as a default data base will be made available. It is expected, however, that most users would generate new data bases in accordance with the hypotheses of interest. Indeed, this is the strength of this analytic system, as it allows an unlimited number of variations in participant characteristics. All that is required is that for each participant—whether actual or simulated—all the data values be entered in a fixed order on one line.

Pension Formula Generator. The purpose of this program is to transform the raw survey data into a integrated set of standardized equations. The output from this program is an equation data base, with a separate set of equations for each pension plan. The set of equations defines the benefit entitlements under the six retirement circumstances for each pension plan. Three types of equations were generated for each plan: equations which defined the employment characteristics used to determine benefits; equations that defined how the benefit amounts were determined; and equations that defined the requirements participants needed to satisfy to receive these benefits.

The pension formula generator program was written in Pascal, a widely used and efficient programing language. The source code for this program is included in Volume 4, which accompanies this report. The input formula data base, which this program produces, is shown in Volume 3. The set of equations generated for each pension plan is identified by its ID variables which identify each of the j pensions plans. The number of equations generated for each plan depended on the complexity of the provisions. Some plans required a dozen or less equations, while others required up to eight dozen separate equations; the average plan included 28 equations. The order in which the equations are listed is of importance, as the set of equations for each pension plan represent a recursive system. Each equation must be estimated in the sequence shown, from top to bottom, since the variables defined in the initial equations are used in subsequent equations in the sequence.

The following example can be used to clarify the structure of the equations. Suppose a pension plan had the following provisions for normal retirement: the annual pension would equal 1 1/2 percent of final salary for each year worked, and would be paid when the participant reached age 65 with 10 or more

years of service. The formulas that determine normal retirement benefits for the *j* pension plan at time *t* can be expressed as follows:

FAP1 = WAGE(QUITD)
ASY1 = QUITD − HIRED
NR1 = 1.5% * FAP1 * ASY1
RAS1 = AGE>=65 & ASY1>=10
NRQ = RAS1 -> NR1

The first equation defines FAP as the participants final wage, expressed as the annual wage at the time of employment termination. The second equation expresses the plan provision that all years of employment are counted in the determination of pension benefits. The third equation gives the plan formula that determines normal retirement benefits. The fourth equation states the age and service requirements necessary to be eligible for normal retirement benefits, which in this example is the dual requirement that the participant be 65 or older and have 10 years service credit. Finally, the last equation in the sequence is a conditional statement that tests whether the participant meet the qualifications necessary for normal retirement benefits. This equation is read as follows: if the participant meets the requirements as defined by RAS1, then the NRQ variable will equal the normal retirement benefit (NR1), otherwise it will be set equal to zero. It is thus the NRQ variable that is used as the final estimate, since it gives the benefit amounts only for participants that qualified for these entitlements.

When the data on WAGE, BIRTHD, HIRED, QUITD for the *i* th participant are inserted into these equations, the benefit amount can be estimated. For example, if the participant's final wage was $20,000, was born in 1920, hired in 1955, and retired in 1985, the above equations would indicate the participant qualified for an estimated benefit of $9,000, since the participant meet the age and service requirements.

Of course, most plan provisions were much more complex than the simple example given above. For example, the RAS variable often included multiple sets of qualifications, such as age 65 and at least 10 years service, or age 60 and 25 years service, or any age with 30 years of service. These multiple requirements were expressed in formulas as follows:

RAS1 = AGE>=65 & ASY1>=10 | AGE>=60 & ASY1>=25 | ASY1>=30

The vertical bars in this formula indicate that if participants meet any one of the three conditions, they would qualify for benefits.

Pension plans typically included several alternative benefit formulas depending on the participants age and service record. For example, one formula may be used for participants with 30 or more years of service, and another formula for those with less than 30 years. Two different sets of requirements were expressed as follows:

RAS1 = ASY1>=30
RAS2 = AGE>=65 & ASY1>=10 | AGE>=60 & ASY1>=25

Suppose the two different normal retirement formulas were:

NR1 = 1.5% * FAP1 * ASY1
NR2 = 1% * FAP1 * ASY1

Then equations that determine the final normal retirement pension for which the participant was qualified would be expressed as follows:

```
NR1Q = RAS1 -> NR1
NR2Q = RAS2 -> NR2
NRT  = MAX(NR1,NR2)
NRQ  = MAX(NR1Q, NR2Q)
```

The third equation listed above gives the rule for combining the two different formulas, and the last equation restates this rule including the necessary qualifications. If the participant did not meet the 30 year requirement (RAS1), but did meet the other set of requirements (RAS2), NR1Q would be set to zero, NR2Q would be set to the value of NR1, and the maximum of these two amounts would always be NR2Q. If the participant meet both sets of qualifications (RAS1 and RAS2), then the maximum of NR1Q and NR2Q would be assigned as the final benefit amount, which in this case would be the NR1 formula.

Pension plans also had more complex provisions governing the determination of the service years (ASY) and income (FAP) used in benefit formulas. Plans often defined service years to include only those years worked after the participant attained age 25, excluding the first year of employment. For situation such as this, the ASY variables were defined as:

```
ASY1 = QUITD - MAX(HIRED+1, BIRTHD+25)
```

If in addition, there was a maximum on the amount of service years that could be used in the formulas, say 30 years, the term would be expressed as:

```
ASY1 = MIN(30, (QUITD - MAX(HIRED+1, BIRTHD+25))
```

Needless to say, there were many variants in how the ASY term was defined, as shown in the actual formulas included in Volume 3.

Variations in the plan definitions of the income term used in the formulas were handled in a similar fashion. Because the calculations were often defined over a specific time period, two addition terms were added to the program: the start and ending dates of the period over which FAP is calculated. For example, if the FAP term was defined as the average annual wage over the final five years of employment, the following equations were generated by the program:

```
SDFAP1 = QUITD - 5
FDFAP1 = QUITD
FAP1   = AVG(WAGE, SDFAP1, FDFAP1)
```

The first two equations determine the start and ending dates, respectively. The last equation calculates FAP1 and the average annual wage over the period determined by the start (SDFAP) and finish dates (FDFAP). Alternatively, if the plan called for using the highest year during the last five years of employment, the final equation would be:

```
FAP1   = PEEK(WAGE,SDFAP1,FDFAP1)
```

Another common complication of the benefit formulas was how benefit amounts varied depending on the actual values of ASY or FAP. For example, a normal retirement benefit formula may differ depending on whether FAP was below or over a certain amount, or the benefit accrual rate varied with the length of service. In such cases, the formulas were expressed with the restrictions within brackets, as follows:

```
NR1 = 1% * ASY1 * FAP1[FAP1<=15000] + 1.5% * ASY1 * FAP1[FAP1>15000]
```

Or:

NR1 = 1% * ASY1[ASY1<=15] * FAP + 1.5% * ASY1[ASY1>15] * FAP1

If, for example, FAP1 equaled $25,000 and ASY1 equaled 35, the first equation would yield a value of 1%*35*15000 + 1.5%*35*10000, or $10500. The second equation would be evaluated as 1%*15*25000 + 1.5%*20*25000, or $11250. This format was also used for plans that used maximums on ASY or FAP which were built directly into their benefit formulas. For example:

NR1 = 1% * ASY1[ASY1<=15] * FAP1 + 1.5% * ASY1[15<ASY1<=30] * FAP1

In this example, only up to 30 years of service credit is used in the formula to determine benefits. Using the same participant characteristics as above, the formula would be evaluated as 1%*15*25000 + 1.5%*15*25000, or $9375.

Variations in benefit amounts depending on the level of the participant's income were often designed to reflect the Social Security wage base, and thus incorporate an implicit offset for the employer's contributions to Social Security. Other pension plans made this an explicit part of the benefit formulas. For example:

NR1 = 1%*ASY1*FAP1[FAP1<=SS1] + 1.5%*ASY1*FAP1[FAP1>SS1]

In other pension plans, the Social Security benefit amount, rather than the wage base entered into the formulas. A typical example of this was the deduction of half of the Social Security benefit amount, as shown below:

NR1 = 2%*ASY1*FAP1 − 50%*SS2

The terms SS1 and SS2 were defined according to the plan provisions which governed each benefit formula. The general form of the notation used to define the Social Security term is as follows:

SS# = (TYPE, DATE)

The first parameter indicates the type of Social Security—whether it is the Social Security wage base, or the normal, early, disability, or survivors benefit amounts. The second parameter defines date the benefit starts. For example, the formula:

SS1 = (1, BIRTHD+65)

This formula defines the Social Security term as the primary benefit amount the participant would receive at age 65. A special form of the equation was needed for the Social Security wage base to take into account both beginning and ending date of the calculations. For example, when formulas were based on the accumulated sum of wages than exceeded the sum of the wage base across all years employed, then the following notation was used:

SS1 = SUM(SSBASE, HIRED, QUITD)

Pension Benefit Calculator. This program uses three sources of inputs to calculate pension entitlements: the data on participants' employment and demographic characteristics; the pension formula data base; and assumptions regarding future growth in wages and prices, and the assumed discount rate for present value calculations. The participant and pension formula data is produced by the generator program described above, while the calculator program before estimating entitlements, first prompts for user input regarding the selected assumptions. In addition, the calculator program allows for two different analytic strategies. The first matches each participants' data with the relevant set of plan

formulas; the second uses a fixed set of participants' characteristics to determine entitlements under all pension plans.

The calculator program is written in Pascal, and is shown in Volume 4. The executable program includes the pension formula data base as part of the object code, and thus this input data does not need to be read into the program each time it is used. This results in a time saving, highly efficient computational routine, as well as simplicity, as the typical user will never need to run the pension formula generator program. The program prompts include: the option to reset the default assumptions concerning wages, inflation, and interest rates; the choice of whether to use actual participant or simulated data; the specification of the file containing the input data; the specification of the file to which the benefit entitlements will be written, and the required format; and the option to select one of several different standard reports detailing the results.

If the program is directed to estimate benefits using actual participant data, benefits will be estimated by matching each participant's data line in the input file with the corresponding plan formulas. The input file may contain one line for a single participant, or as many lines as there are participants in the full sample, or any subsample desired.

If the program is directed to use simulated data, from one to five simulated data cases can be estimated. Of course, the program can be rerun as many times as necessary if more than five simulated circumstances are desired. For each simulated case, the program will estimate pension benefits from every plan included in the data base. Since no matching of participants and plans occur with this option, the ID variables for participants and plans are not needed in the input data base. The output data base includes for each simulated case, the pension plan ID variable, and the estimated benefit amounts.

In addition to the choice of actual or simulated data, the program allows the analyst to specify the use of a single estimate of each participant's quit date, or the use of all potential quit dates for each participant. The program calculates the pension entitlements due from each type of retirement circumstance—normal, early, vested deferred, disability, and death—for each year from the time of the interview to when the participant reaches age 80. If the participant was eligible for more than one type of retirement benefit at any given age, the program automatically selects the one which yields the highest benefits. Using this data base would allow more detailed models which specify the probability of each retirement circumstance, and allow those probabilities to vary over the life of the participant.