Microsimulation and Public Policy: A Synopsis of Developments in Modeling and The Role of Policy Analytic Needs

Final Report

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<table>
<thead>
<tr>
<th>Chapter</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>INTRODUCTION ............................................. 1</td>
</tr>
<tr>
<td>II</td>
<td>MICROSIMULATION AND PUBLIC POLICY: A DEVELOPMENTAL HISTORY ............... 5</td>
</tr>
<tr>
<td></td>
<td>A. THE FOUNDATIONS OF MICROSIMULATION ................. 6</td>
</tr>
<tr>
<td></td>
<td>1. Guy Orcutt and Dynamic Microsimulation ............. 6</td>
</tr>
<tr>
<td></td>
<td>2. The Introduction of Microdata into Social Policy Analysis ........ 7</td>
</tr>
<tr>
<td></td>
<td>B. SEMINAL APPLICATIONS OF STATIC MICROSIMULATION ...... 12</td>
</tr>
<tr>
<td></td>
<td>1. Income Maintenance Reform, 1968-1969 ............... 12</td>
</tr>
<tr>
<td></td>
<td>3. Tax Policy ........................................... 15</td>
</tr>
<tr>
<td></td>
<td>C. DEVELOPMENT OF TRIM, MATH, AND DYNASIM ............. 16</td>
</tr>
<tr>
<td></td>
<td>1. Development of TRIM .................................. 16</td>
</tr>
<tr>
<td></td>
<td>2. MATH and Food Stamp Program Reform ................ 18</td>
</tr>
<tr>
<td></td>
<td>3. DYNASIM: Dynamic Simulation Revisited ............... 19</td>
</tr>
<tr>
<td></td>
<td>D. FURTHER INITIATIVES IN HEALTH AND WELFARE POLICY IN THE 1970s .......... 20</td>
</tr>
<tr>
<td></td>
<td>1. National Health Insurance ............................ 21</td>
</tr>
<tr>
<td></td>
<td>2. Labor Supply Response to a Negative Income Tax ....... 24</td>
</tr>
<tr>
<td></td>
<td>3. Carter Administration Welfare Reform ................ 24</td>
</tr>
<tr>
<td></td>
<td>E. RETIREMENT INCOME POLICY, 1975-1982 ................. 26</td>
</tr>
<tr>
<td></td>
<td>1. Development of DYNASIM2 ............................. 26</td>
</tr>
<tr>
<td></td>
<td>2. The ICF Pension and Retirement Income Model .......... 28</td>
</tr>
<tr>
<td></td>
<td>3. Additional Modeling of Social Security ............... 29</td>
</tr>
<tr>
<td></td>
<td>F. MICROSIMULATION IN THE 1980s ........................ 30</td>
</tr>
<tr>
<td></td>
<td>1. Modeling with Program Data .......................... 31</td>
</tr>
<tr>
<td></td>
<td>2. Impact of OBRA ...................................... 32</td>
</tr>
<tr>
<td></td>
<td>4. New Data Collection .................................. 34</td>
</tr>
<tr>
<td></td>
<td>5. New Models ........................................... 36</td>
</tr>
</tbody>
</table>
CONTENTS (continued)

Chapter                                                                 Page

G. DEVELOPMENTS IN THE EARLY 1990s ........................................ 39
   1. New Modeling with SIPP ............................................. 39
   2. Movement to the Microcomputer .................................... 40
   3. Health Care Reform .................................................. 41

III SIMULATING POLICY INITIATIVES: SOME ILLUSTRATIONS
BEARING ON MODEL DESIGN .................................................. 43

IV CONCLUSION ................................................................. 53

REFERENCES ........................................................................... 55

APPENDIX: A REVIEW OF THE DRAFT REPORT .............................. 61
I. INTRODUCTION

Microsimulation is an analytical tool which enables the user to estimate the aggregate and distributional implications of a policy or status change by first simulating outcomes at the "micro" level—for example, persons, households, or establishments—and then aggregating these outcomes with appropriate weighting to reflect the entire population. Microsimulation has been used in policy analysis for nearly 30 years. Microsimulation modeling capabilities developed rapidly after the pioneering applications in the late 1950s and early 1960s, but progress since the mid-1970s has been comparatively slow. Now, however, there are factors which may spur renewed efforts to improve microsimulation capabilities:

- the issuance in 1991 of a report by the National Research Council (NRC) criticizing aspects of the current state of such modeling
- a policy environment in which entirely new approaches to persistent social problems will receive increasing attention
- continuing improvements in computer hardware and software, providing easier access to powerful computing at very low cost
- the wider availability of true panel data and the recognition of its critical importance in answering many research questions, which may strengthen the behavioral science underlying microsimulation

To evaluate important policy initiatives which have been advanced in recent years, and many others which are likely to come forth in the near future, requires modeling capabilities which are not well developed in the current generation of microsimulation models. In particular, so-called second-round effects, depending on behavioral changes or "responses," are becoming critical to the success—if they are not the actual focus—of policy initiatives in the areas of social welfare, social insurance, and health care. This includes, among other things, acknowledgment of the vital role to be played by person- and family-level decision making and behavior in strategies to address major problems in the social welfare arena.
In response to these developments, the Division of Family and Community Policy in the office of the Assistant Secretary for Planning and Evaluation (ASPE), Department of Health and Human Services (DHHS), formed a Committee on Microsimulation Model Design to explore issues related to the design of a model that could simulate the processes of family formation and dissolution and family functioning (and dysfunctioning), including their relationship to policy variables. A feasibility study conducted in 1992 recommended that the first phase developmental effort focus on defining the specifications for a model to project household and family composition from the processes that determine household and family formation and dissolution (Zill et al. 1993). While essentially demographic in nature, this model is intended to be a source of policy-relevant information for the debates that may develop around family-related policy issues over the next several years. To accomplish this objective the model design must incorporate determinants and outcomes of family demographic behavior that will provide linkages to these future policy debates.

This report, which constitutes the first product of the microsimulation design study, provides a synopsis of the historical development of microsimulation as a tool in the policymaking process, primarily in the area of social welfare. The report also discusses the way in which microsimulation models translate formulations of prospective policy initiatives into empirical estimates of the potential consequences of their enactment. This report is addressed to an audience of policy analysts and is intended to stimulate speculation about the substance and information requirements of future policy debates in the social welfare area--more specifically, those for which household and family formation, dissolution, and composition are particularly relevant. To further the ultimate objectives of this project--namely, the design of a microsimulation model of family formation and dissolution--the information requirements for these debates must be anticipated with sufficient clarity and depth to enable us to define the structure and components of a microsimulation model capable of producing the needed information. We have prepared this report with the hope that it will assist policy analysts.
in expressing their thoughts about future policy issues in terms that will enable us to specify the key requirements of this future microsimulation model.

The heart of this report is divided into two chapters. Chapter II provides an interpretive history of the development of microsimulation as a tool in social policy analysis. Reflecting our mandate, this history focuses on the way in which model development has been influenced by emerging policy analytic needs. Chapter III discusses in both general terms and with concrete examples what is required to simulate a policy initiative at the micro level. The discussion includes illustrative examples based on four generic policy initiatives. Finally, Chapter IV draws some lessons from this history of microsimulation with the hope that they will be applied to ASPE's model design effort.

\footnote{As David Betson suggests (see the Appendix), the more interesting question may be: "how has microsimulation influenced public policy?" While this report includes some examples of policy decisions that ensued from applications of microsimulation, the specified scope of our effort did not permit the more extended treatment that this topic would require.}
II. MICROSIMULATION AND PUBLIC POLICY: A DEVELOPMENTAL HISTORY

In writing a brief history of the development of microsimulation and its relation to public policy, we have chosen to highlight several episodes which tell important stories about the interaction (and sometimes the lack thereof) between policy analytic needs and modeling advances. We have not attempted to cover the entire history of microsimulation; nor, to our knowledge, has anyone else. There are several accounts, however, which provide more thorough treatment of particular phases or aspects of this history—among them Greenberger et al. (1976, pp. 107-115), Orcutt et al. (1980), Kraemer et al. (1987), and Citro and Hanushek (1991, especially pp. 109-114 and 194-230). The material which we present reflects our interpretation of key developments that illustrate to varying degrees the influence of policy issues.

We find it helpful to divide this discussion, which covers developments from the mid-1950s through the present, into the following segments:

- Foundations of microsimulation
- Seminal applications of static microsimulation
- Development of TRIM, MATH, and DYNASIM
- Further initiatives in health and welfare policy in the 1970s
- Retirement income policy, 1975-1982
- Microsimulation in the 1980s
- Developments in the early 1990s

These segments, which overlap chronologically to some degree, are differentiated by the nature of the model development which they encompass and by the policy concerns which stimulated or at least influenced these developments.
A. THE FOUNDATIONS OF MICROSIMULATION

The laying of the foundations of microsimulation can be traced through two distinct but interweaving lines of development. The first involves the work of Guy Orcutt, who conceived the idea of dynamic microsimulation and built the first model in the late 1950s, trained an influential cadre of researchers, and went on to head a research team on dynamic microsimulation at the Urban Institute. The second involves the introduction of microdata into social policy analysis. Orcutt’s early efforts reflected his own academic interests and were little influenced by events in the policy arena whereas the first uses of microdata in social policy analysis represented a direct response to policy research needs, coupled with developments in computing technology that made the analysis of large microdata files possible.

1. Guy Orcutt and Dynamic Microsimulation

A classically trained economist and econometrician and colleague of Leontief at Harvard, Orcutt became discouraged with the limited data that underlay the macroeconomic models of his day and what he felt was a serious loss of information due to aggregation (Greenberger et al. 1976, p. 110). While on sabbatical at the University of Michigan Survey Research Center in 1955 he became impressed with the analytical potential offered by data being collected by sample surveys on the consumption activities of individual households—the most basic decision units of the economy. Time series analysis of the behavior of these units appeared to offer a more effective way to predict macroeconomic outcomes than traditional macroeconomic forecasting. He laid out his initial ideas in a 1957 paper (Orcutt 1957) and began working on a demographic simulation model of the U.S. economy through the decade of the 1950s. The initial runs of this dynamic microsimulation model were made in 1958, and an account of this seminal research effort was published a few years later (Orcutt et al. 1961).

Orcutt left Harvard in 1958 to join the University of Wisconsin, where he was instrumental in securing a shared facility to house the university’s social science departments. In the late 1960s
Orcutt joined the Urban Institute and resumed work on the task of modeling the U.S. economy. At the Urban Institute he found an environment wherein microsimulation activities included not only his own dynamic modeling but the static microsimulation that was then growing out of its infancy.

It is noteworthy that Orcutt’s research did not develop from a policy stimulus. Policy applications emerged during the 1970s, as we relate below, but the impetus for Orcutt’s work was a more academic interest in improving the modeling of phenomena of the national economy. The development of dynamic microsimulation at the Urban Institute is discussed in Section C.3.

2. The Introduction of Microdata into Social Policy Analysis

During the 1960s, growing needs and a growing appreciation of the value of microdata to support policy analysis stimulated four developments: (1) the production of microdata files from ongoing surveys, censuses, and administrative data; (2) early ventures into static microsimulation, supported by microdata from administrative records; (3) the expansion of item content by the initiation of special purpose surveys and exact matching of survey data to administrative data; and (4) the development of methods of synthesizing data by statistical matching and imputation.

a. Early Microdata

During the 1960s, as the number of social welfare programs multiplied, there developed an increasing demand for estimates of caseloads and costs as well as statistics on beneficiaries. With the expansion of the War on Poverty programs interest grew in evaluating their impact, as well as measuring trends among the poverty population. The limitations of existing data and the shortcomings of the available analytical tools hampered efforts to satisfy these new demands, however (Kraemer et al. 1987).

The office of ASPE in what was then the Department of Health, Education, and Welfare (DHEW) became interested in evaluating alternative ways to use Federal programs to address the poverty problem. Analysts wished to evaluate the impact of alternative policy initiatives such as a
negative income tax, a universal child allowance, aid to the working poor, and a federal takeover of welfare. Outcomes for which estimates were desired included the effects on employment and on program costs and caseloads. A key staff member at ASPE was Alice Rivlin, who had coauthored with Orcutt and others the 1961 book that detailed the first dynamic microsimulation modeling efforts. ASPE persuaded the Census Bureau to provide access to microdata from the Census so that ASPE staff could prepare their own analyses rather than relying on tabulation requests, which afforded only very limited research potential and which required an inordinate amount of time for completion (Kraemer et al. 1987). With these data, ASPE analysts were uniquely positioned to address some of the important policy information needs of that time.

b. The Origins of Static Microsimulation

In the early 1960s Joseph Pechman and Benjamin Okner at the Brookings Institution applied accounting relationships to a sample of 100,000 tax returns from 1960 to estimate the first-round revenue implications of proposed changes to the tax code (Greenberger et al. 1976). Using variations on this same basic methodology, which involved simulating the application of the tax code to a sample of microdata records, they conducted a series of studies of the tax system, extending into the mid-1970s (see Section B.3 for a discussion of microsimulation as applied to tax policy analysis).

While Pechman’s methods were, without doubt, the antecedent of later tax policy modeling in Washington, Orcutt credits Harvey Brazer with developing the first, crude microsimulation model for tax and transfer analysis (Orcutt et al. 1980). This model, described by Brazer (1968), who was at the University of Michigan Survey Research Center during Orcutt’s important 1955 visit, demonstrated to at least some observers the potential contributions of microsimulation as an analytical methodology even when the underlying data were seriously limited.

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2 The 1960 census was the first for which public use microdata files were produced. Research teams have since created public use files for the 1910, 1940, and 1950 censuses.

3 This seminal work was reported by Pechman (1965).
c. Special Purpose Surveys and Exact Matching

To answer or even begin to address some of the policy questions that emerged in the late 1960s required microdata containing sets of items that had never been collected in the same survey—if at all. One response to this problem was to design and field new surveys with the explicit purpose of addressing policy analytic needs. The Survey of Economic Opportunity (SEO) was conducted in 1967 as a special supplement to the March Current Population Survey (CPS), which routinely collects information on household income and family composition—at that time for a sample of about 18,000 households. The SEO included a supplemental sample of 12,000 households drawn from largely nonwhite, low income areas and collected additional, detailed data on assets and liabilities, items which had rarely been included in government surveys but which were becoming important for the analysis of social welfare issues (Wilensky, 1970).

Another response to the data shortage was to pool items from multiple sources by matching one agency’s administrative records to another agency’s records as well as to national sample surveys. Under the direction of its Chief Mathematical Statistician, Joseph Steinberg, the Social Security Administration (SSA) undertook research on the matching of survey and administrative data. SSA conducted the 1963 Pilot Link Study, which involved the matching of March 1964 CPS data to income tax returns and SSA earnings records (U.S. DHEW 1973). The resulting file combined the rich IRS and SSA data with the extensive demographic and income data collected in the March CPS supplement. SSA’s research on exact matching continued through the end of the 1970s and demonstrated both the difficulties and the potential benefits of the methodology. As this work was proceeding, however, a growing fear of the risks that federal record linkages posed to the
confidentiality of personal data largely ended such research. Nevertheless, some of the models discussed below still use exact match data.

d. Statistical Matching and Imputation

By creating a need for datasets with items too diverse or too numerous to be collected in a single survey, microsimulation stimulated the use and further development of statistical techniques for synthesizing datasets with the desired item content. Such techniques became part of the stock set of procedures employed in preparing a database for microsimulation.

Statistical matching was developed as an alternative or substitute for exact matching in circumstances where there are no unique identifiers to permit exact matching, or where the samples contain different individuals. Statistical matching provides a mechanism for linking microdata records from one file to records from another file on the basis of their resemblance with respect to variables that appear in both files. The files that are being statistically matched must represent the same population (or substantially overlapping populations) but need not contain the same individuals. Typically the procedure utilizes a distance metric to define the degree of resemblance between pairs of records in the two files. A record from the first file is matched to the record it most closely resembles in the second file.

The exact match files available from SSA suppressed too much tax return detail to be useful for detailed tax policy modeling (Minarik 1980). Consequently, researchers at the Brookings Institution

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4The most comprehensive and successful exact match study was the 1973 effort, which, like the pilot study, combined March CPS data with IRS and SSA data. There have been few significant exact match projects since then. The Census Bureau attempted to create a 1978 CPS-IRS-SSA exact match file, but this effort met with only limited success, and the file has not been released to the public. The PRISM model constructed by ICF and discussed below uses an exact match of March and May 1979 CPS data with the CPS-SSA portion of the 1978 exact match file. Since the passage of the Privacy Act of 1974, proposed linkages of microdata records collected by different federal agencies have been subject to very strict guidelines, which effectively prohibit further construction of exact match files of the scope of the 1973 effort. More limited matching of survey and administrative data is being carried out primarily for the purposes of evaluating the survey data, although some in-house efforts intended to serve policy analytical purposes still occur (see, for example, Vaughan and Wixon 1991). A National Academy of Sciences panel is currently completing a study on data confidentiality.
used statistical matching to create datasets for their tax policy simulations. The matched files were far more satisfactory than either the tax files or CPS files separately. The original, 1966 "MERGE" file was a match of the 1967 SEO (reporting 1966 calendar year income) and a sample of 1966 IRS tax returns. This data file became the basis of the first comprehensive study of the U.S. tax system based on microdata, reported by Pechman and Okner (1974).\(^5\) By some accounts this methodology is no longer widely used (Michel and Lewis 1990, p. 17). However, the Treasury Department and the Joint Committee on Taxation (JCT) of Congress continue to rely on statistical matching to construct microdata files for tax policy modeling (see Sections B.3 and F.4.b for a further discussion of such modeling).

Statistical matching is one form of imputation--a term which encompasses a variety of "techniques for filling in a (plausible) value for a specific data item for which the response is missing, or rejected as unusable" (Panel on Incomplete Data 1983, p. 58). In fact, the method of imputation used most commonly by the Census Bureau--the "hot deck" method--involves matching records with missing items to other records in the same dataset with complete data (for the items in question plus a set of matching variables). For all intents and purposes, this is a statistical match.\(^6\)

An alternative method of imputation that has been used to combine data from two or more files is "model-based" imputation. The procedure involves the use of a statistical model to predict the values of variables that were not collected for any observations in a dataset, based on relationships that can be estimated from another dataset. As with statistical matching, variables shared by the two datasets are critical to the procedure. In applying model-based imputation, researchers use the second dataset to estimate equations predicting the values of the variables that they wish to add to

\(^5\)Okner (1972a, 1972b) addresses the ability of statistical matching to generate plausible joint distributions of the variables that are not common to the two files being matched. Smeeding (1980) critiques these conclusions. For a more recent discussion and critique of the methodology of statistical matching see Cohen (1991).

\(^6\)Hot decking would be classified as a method of imputation using internal data whereas statistical matching utilizes external data.
the first dataset, using as predictors the (relevant) variables that are common to both datasets. The predictive equations are then used to calculate predicted values in the first dataset. Random error may be added to the predicted values to reflect the imperfect nature of the prediction and to ensure that important statistical properties of the variables are preserved across the two datasets.\(^7\) The first microsimulation models developed for tax policy analysis utilized databases constructed with statistical matching and (model-based) imputation.\(^8\)

B. SEMINAL APPLICATIONS OF STATIC MICROSIMULATION

The information needs generated by a succession of social welfare policy debates beginning in the late 1960s were instrumental in spurring the development of microsimulation modeling capabilities. In this section we discuss developments related to income maintenance reform in the late 1960s and the Nixon administration’s proposed Family Assistance Plan in the early 1970s. We also discuss the application of microsimulation to tax policy analysis from the mid-1960s through the mid-1970s.

1. Income Maintenance Reform, 1968-1969

In 1968 President Johnson established a Commission on Income Maintenance Programs with a mandate to evaluate existing and proposed programs and recommend a new income maintenance system to better serve the nation (Tell 1970). At issue was the individual and collective effectiveness of the array of social welfare programs established or strengthened during the Great Society years. A major obstacle to the commission’s work was the lack of adequate data on multiple benefit receipt. To address this problem, the commission funded development of what became the Reforms in Income Maintenance (RIM) microsimulation model (Webb et al. 1989).

\(^7\)If the prediction is not particularly strong, the imputed values will consist largely of this random error, but they will have appropriate means and variances and will exhibit appropriate covariances with the predictors—conditional on the model.

\(^8\)Other, simpler forms of imputation also have been used to fill in missing variables in databases created for microsimulation.
The development team wanted a model that could provide estimates of:

- joint program eligibility
- the distributional impacts of individual programs and all programs working together
- the potential impact of changes in one program on other programs
- the program costs and distributional effects of a negative income tax scheme, which would provide a cash allowance as an alternative to eligibility for public assistance

Measures of the potential impact of a negative income tax that interested the commission included the number of families that would choose the cash allowance, the net change in income among families below the poverty line, and the aggregate cost (Kraemer et al. 1987).

The model developed for the commission utilized the 1967 SEO sample of 30,000 households. To reduce the model’s computational requirements, only those items viewed as most important to the analysis were retained in the database. To provide estimates of future impacts, the data were aged to 1975. The model then calculated each sample household’s cash allowance and tax liability as well as the public assistance benefits for which it was eligible. The model did not take into account the behavioral influence of the cash allowance on "family formation or dissolution rates, individuals’ work efforts, or the positive tax liabilities needed to finance the program" (Kraemer et al. 1987, p. 39). In November 1969 the commission issued its executive summary, which included a proposal for a negative income tax.

2. Family Assistance Plan, 1970-1971

In early 1970 the Nixon administration and Congress began work on the development of a Family Assistance Plan (FAP) that would provide a guaranteed income and eliminate several existing welfare programs (in particular, AFDC and Food Stamps). The RIM model used by the Commission was modified at the Urban Institute and used to simulate alternative versions of FAP. Separately,

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9For a description of the model see Wilensky (1970).
Dorothy Projector’s staff in the Office of Research and Statistics (ORS) in SSA made their own extensive changes to RIM and ultimately produced most of the administration’s estimates relating to FAP and the alternative proposals it stimulated (Greenberger et al. 1976, p. 114).

The Urban Institute’s revisions to the RIM model represented a response to both the developing policy debate and the new requirements of modeling in the policy environment (Webb et al. 1990, pp. 36-37). The major reform proposals all made use of eligibility factors in addition to income, and RIM was modified to include such additional eligibility screens. As the policy debate continued, new elements were added to the proposals, making it necessary to modify RIM further to include such features as different filing units, additional programs, and state-specific benefit determination. As the number of alternative proposals multiplied, the modeling requirements strained the capabilities of RIM, which had neither the flexibility nor the speed to satisfy these demands. Because RIM was designed without modules and user-specified parameters, slight changes in the features of a program being simulated required modifications to the RIM computer code. New requests had to be programmed independently of prior requests. This not only made it difficult to implement new program features; the numerous ad hoc modifications made it impossible to determine what features had been simulated on what run. It became apparent that the overall software framework, designed to produce a particular set of numbers quickly, was inadequate for the broader task which it was being called upon to address. RIM was retired in 1971 after the administration abandoned its FAP efforts, and the Urban Institute undertook the development of an entirely new model.

During this same period, Dorothy Projector’s staff developed the Simulated Tax and Transfer System (STATS) model, thereby providing ORS with in-house static microsimulation capabilities. This developmental effort was motivated by a growing recognition of the serious shortcomings of their attempts to evaluate policy proposals with grouped data (Wixon et al. 1987). As noted above, estimates from STATS played a key role in the FAP debate. The primary motivation for the model development effort, however, was to enable the ORS staff to evaluate the distributional impacts of
alternative social security policies. In this capacity STATS provided estimates that were central to the debates that culminated in the establishment in 1972 of the Supplemental Security Income (SSI) program (Citro and Hanushek 1991, p. 110).\textsuperscript{10}

3. Tax Policy

The NRC panel observed that "the earliest, most continuous, and perhaps most widespread use of microsimulation modeling has been in the area of tax policy analysis," quite possibly because "the complexities of the federal individual income tax code, coupled with the diverse economic circumstances of the U.S. population, virtually require that tax policy analysis be conducted at the micro level" (Citro and Hanushek 1990, p. 219).

The pioneering work of Pechman and Okner at Brookings was described earlier. Following the successful work in creating and analyzing the 1966 MERGE file, Brookings staff created a second MERGE file with 1970 data (see Minarik 1980). The files were extremely expensive to create, however--both in terms of computer time and programming and research effort. Furthermore, the time lag between the data year and the file completion was quite long. Accordingly, it was determined that future data files should be created as much as possible through projection of existing files. A 1973 MERGE file was created in this manner, using 1973 IRS and March 1974 CPS data to project the 1970 MERGE file. Imputation was also used in producing this file.\textsuperscript{11} The outcome

\textsuperscript{10}During the 1970s, ORS staff made extensive use of the STATS model in preparing a series of reports on the impact of taxes and transfers on the distribution of family units by income (see, for example, Projector and Murray, 1978). Major topics included estimates of program eligibility and participation and analysis of the factors affecting the participation decision. On occasion this research also extended to examining the potential effects of proposed changes in various elements of the tax and transfer system.

\textsuperscript{11}The database used by the Treasury Department for tax modeling includes imputations for items which are present on some but not all returns. For example, if a taxpayer did not itemize, then no information on potential deductions is present. If the analyst wishes to evaluate a tax reform proposal which might increase the number of itemizers, then the analyst needs to know the potential deductions for all taxpayers in the database. The only way to obtain this information for nonitemizers is by imputation. Other such items include social security income, which is taxable only for higher income taxpayers and not always reported when it is not taxable.
of this effort was a file that was at the same time comprehensive and consistent with the national
income accounts with respect to household income, expenditure, and taxes.

As early as 1962 Orcutt had recommended that the Department of the Treasury consider
building a microsimulation model of the tax system. For a variety of reasons there was little
immediate response. Some years later, however, the Brookings research provided impetus for
Treasury to initiate similar work (Galper 1980). The Office of Tax Analysis (OTA) hired an
economist with computer experience and assigned this person the task of developing a model to
analyze files of tax returns (Kraemer et al. 1987, p. 36). This effort gave birth to the Personal
Income Tax Model, the first, primitive version of which was completed in the mid-1960s. Results of
the first extensive analyses utilizing statistically matched data were published in 1977 (see U.S.
Department of the Treasury 1977). Treasury staff have improved upon the matching methodology
so critical to the model (see Barr and Turner 1978, 1980). The tax model, later renamed the
Individual Income Tax Simulation Model, has been modified numerous times since that initial effort
and remains the centerpiece of Treasury's tax modeling methodology.

C. DEVELOPMENT OF TRIM, MATH, AND DYNASIM

The 1970s have been recognized as something of a golden age of microsimulation, principally
because of the development of three models whose successors and descendants are still among the
major players in the field of microsimulation. The development and early applications of these three
models--known by the acronyms TRIM, MATH, and DYNASIM--are discussed here.

1. Development of TRIM

The experience with modeling the FAP alternatives demonstrated the inadequacies of the RIM
software framework for responding to policymakers' information needs. In developing the Transfer
Income Model (TRIM), staff at the Urban Institute recognized that an effective microsimulation
model of income transfers would have to satisfy all of the following requirements:
• simulate a wide variety of tax and transfer programs, by means of modules

• simulate programs with different filing units

• provide impact estimates for highly disaggregated population groups (implying adequate sample size and micro-level simulation with flexible tabulation capability)

• permit comparison of alternative versions of a program and examination of program interaction

• provide sufficiently current estimates

• provide flexibility in specifying simulations, implying extensive parameterization of program characteristics

• be comprehensible to analysts and programmers

• provide quick turnaround, implying ease of use as well as computational efficiency

• facilitate modification to meet changing demands, implying modular and well-documented code

The design solutions that were achieved in trying to satisfy these requirements included a flexible modular structure, extensive parameterization, a common data file structure distinguishing required data fields from potentially useful supplemental fields, the use of status definition variables, extensive technical documentation, a more efficient computational structure, and integration of the computer and research staffs (Webb et al. 1990, pp. 40-46). The first version of TRIM was completed in 1973.

Using TRIM, and with support from the Urban Institute, ASPE staff worked on a welfare reform plan, the Income Supplement Program, that they hoped would win more political support than the administration's earlier FAP. They performed numerous simulations to explore the impact of alternative benefit guarantees and filing unit definitions. The proposal itself was derailed by Nixon's

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12 A feature introduced to address one of the many shortcomings of the earlier RIM model was the use of a common file format to enable the substitution of more recent data without requiring any changes to the model code (Webb et al. 1990). This was achieved by the conceptually simple procedure of reformatting the CPS file to match the format of RIM's original base dataset, the 1967 SEO. This made it relatively easy to update the model's data base with each new CPS file. This design feature has been incorporated into later generations of simulation models.
resignation, but the developmental research informed the Carter administration’s own welfare reform efforts, discussed below (Webb et al. 1990, pp. 46-47).\textsuperscript{13}

2. MATH and Food Stamp Program Reform

Between 1971 and 1976 the cost of the Food Stamp Program (FSP) increased nearly four-fold. Program enrollment grew by one-third in one six-month period starting in late 1974. These developments, combined with concern about whether the program was serving the most needy persons, generated a far-reaching debate over reform of the FSP (Beebout 1980; Shipp 1980). To evaluate the many alternative reform proposals, including small changes to relatively obscure provisions, the Food and Nutrition Service (FNS) felt that it needed estimates of the following for each reform proposal:

- the number of eligible families and the change from the current program
- the number of participating families, their total food stamp bonus value, and the change in cost from the current program
- the number and characteristics of participating families with increased bonuses or reduced bonuses
- the extent to which benefits are concentrated in target groups such as families with incomes below the poverty line

To meet these requirements—particularly the measurement of distributional impacts—called for detailed modeling of program eligibility and the participation decision. The complexity of the eligibility and benefit determination formulas, together with the fact that FNS wanted to focus attention on specific components of the income deductions and on the treatment of students and of workers involved in labor disputes, demanded far more data than was available in any one source. Addressing the data needs and modeling participation presented the greatest challenges; the modeling of eligibility was relatively straightforward, given suitable data (Beebout 1980).

\textsuperscript{13}The Income Supplement Program is described in U.S. Department of Health, Education, and Welfare (1974).
In 1974 Mathematica Policy Research (MPR) had developed its own static microsimulation model, the Microanalysis of Transfers to Households (MATH) model. To address the unique modeling requirements generated by the food stamp reform debates, MPR did the following:

- constructed a database by
  - aging the most recent March CPS file
  - statistically matching administrative data on several types of income deductions
  - imputing countable assets
  - simulating public assistance, social security, and payroll taxes

- constructed a detailed food stamp module for the MATH model

- specified code to write both the pre-reform and multiple sets of simulated outcome values onto each sample household record, thereby permitting simultaneous evaluation of multiple alternative reforms

- created as part of the model output a set of "gainer-loser" tables, which provided breakdowns by income, type of household, geography, and other characteristics

Estimates from the MATH model played an important role in shaping the reform bill that was signed into law in 1977. During the two years preceding the bill's passage, MPR simulated more than 200 variations (Citro and Hanushek 1991, p. 110). The way in which the estimates were presented (specifically the gainer-loser tables) brought the impacts on recipients to the fore of the debate and influenced subsequent policy analysis (Shipp 1980).

3. DYNASIM: Dynamic Microsimulation Revisited

With Orcutt joining the Urban Institute staff the development of the Dynamic Simulation of Income Model (DYNASIM) began in 1969 and was completed in 1975. In keeping with Orcutt's earlier work, DYNASIM was intended as a general social science research tool rather than simply a policy model. One of the goals of DYNASIM was to serve as "a receptacle for the best behavioral equations developed by social scientists around the country" (Zedlewski 1990, p. 130). The model development was not driven by specific policy needs although the model was expected to reap policy
benefits. With few exceptions, however, this did not occur. Early applications of DYNASIM were designed more to demonstrate the model's potential than to address pressing policy questions (see Orcutt et al. 1976).

The first application to solve a policy problem arose as Congress and the administration grappled with what had emerged as an error in the social security cost of living adjustment mechanism which Congress had passed in 1972. There was a need to evaluate the long-term implications of alternative benefit formulae and indexing schemes. ASPE awarded the Urban Institute a grant to develop long-range projections of earnings histories. In response, the Institute used DYNASIM to simulate the 40-year experience of a cohort of persons who were in their early 20s in 1960. The data files created by the simulations were used for a number of policy analyses in addition to those which led to the 1977 Social Security Amendments.\(^\text{14}\)

More extensive policy applications were limited by the serious constraints placed upon DYNASIM by the contemporary computing environment. Even with the small samples forced on it by necessity, DYNASIM still had enormous computing time requirements. DYNASIM also used a data file (from the 1970 census) that was six years out of date by the time the model was completed; consequently, the model had to simulate several years just to bring the data up to the present, much less extend the data into the future. As an alternative or even a complement to TRIM for the analysis of welfare policies, DYNASIM was unable to generate much interest (Zedlewski 1990, p. 116).

D. FURTHER INITIATIVES IN HEALTH AND WELFARE POLICY IN THE 1970s

As the 1970s progressed, major national policy initiatives in the areas of health care and income maintenance were introduced and debated. These policy activities stimulated the development of additional microsimulation modeling capabilities to address policymakers' needs. Here we discuss the developments in modeling accomplished in response to policy activity--actual or anticipated--in three

\(^{14}\)For a discussion of several of these applications, see Orcutt et al. (1980, pp. 97-100).
areas: (1) national health insurance, (2) a negative income tax, and (3) welfare reform under President Carter.

1. National Health Insurance

When the Medicaid program was created in the 1960s, the first year expenditures were more than double the projected costs, and the expenditures proceeded to grow rapidly. With this as a backdrop, DHHS undertook in 1972 the development of a model to provide policymakers with cost estimates of alternative reform proposals that might be generated during the anticipated debate over national health insurance. The National Health Insurance Modeling Group was chartered and financed as a joint venture by ASPE and SSA to build a model that could estimate the impacts of the many health insurance bills that were circulating through Congress at the time (Turek-Brezina 1988).

Development of the model proceeded through several distinct stages over the course of the decade, reflecting an interaction with the policy process (U.S. DHHS 1981, pp. 210-213). The initial modeling team was assembled in SSA. Beginning with an econometric model developed by Martin Feldstein of Harvard University, the team made numerous revisions but did not change the model’s basic nature, which proved to be not well suited to providing input to the policymaking process. In 1975 the team undertook an entirely new approach, utilizing a combination of microdata, cell means, and aggregates. The new model did not produce final cost estimates, however; instead, the desired results had to be calculated outside the model, by the application of actuarial methods and other techniques to the model outputs as well as other information. Shortly thereafter the cost estimation methodology was incorporated into a separate actuarial model, which proved particularly useful in preparing cost estimates for certain kinds of national health insurance proposals.\(^\text{15}\) The capabilities of this model were too limited for wide applicability, however. For example, the model could not deal with catastrophic coverage, nor could it estimate the impact of bad debts, fee upgrades, costs controls,

\(^{15}\text{In 1977 the modeling team was disbanded following the emergence of a reorganized Health Care Financing Administration. Not long afterwards, however, the team was reconstituted in DHHS/ASPE.}\)
or changes to regulations. Furthermore, the model could not allocate expenditures to income classes and categories of insurance program eligibility.

A new model, which combined the microdata methodology of the earlier model with the expenditure analysis capabilities of the actuarial model, was designed to satisfy the following objectives:

- Assess the impact of policy changes on the economic resources used to provide health services
- Assess impacts of policy changes on federal, state, and local governmental budgets, on taxpayers, on health care providers, private health insurers, and on the total economy
- Assess financial gains or losses to various population groups, classified by income, family composition, health status, and other relevant characteristics
- Produce accurate estimates of costs and identify the impacts of policy changes on existing programs, such as Medicaid and Medicare
- Produce estimates in a timely, responsive manner

In view of the model’s policy planning role, both accuracy and timeliness were paramount in importance (U.S. DHHS 1981, pp. 1-2).

Over the course of the decade, the policy focus evolved, inducing changes in the modeling requirements. Originally the modeling was directed at broadly defined social insurance schemes, whereby the federal government would provide uniform benefits to large segments of the population. A key objective of the modeling effort was to simulate the reduction or elimination of cost-sharing. In 1974 the Nixon administration introduced a rather different proposal, which made private employers and state governments responsible for the better part of the expanded coverage. Cost estimation became centered on the expenditures in particular segments of the population—hence the redesign of the model to make use of microdata. The Carter administration sought to target specific subgroups—for example, pregnant women and infants, inner-city and rural residents, and low income, unemployed single persons. This increased the need for detailed population data. Late in the
decade, however, the policy focus shifted away from such targeting toward attempts to alter the
competition between health care providers and insurers--thus requiring new model components.

The Health Financing Model combined microsimulation of population characteristics with a
predominantly "cell-based" simulation structure. Cell-based models (and models with major, cell-based
components) have been used more widely than full microsimulation models in health care policy
simulation because data relating to many of the key elements of health care service utilization and
cost are most readily available only in an aggregate form--with some subgroup disaggregation.

In the Health Financing Model the population module provides a vehicle for calculating the
aggregate impact of policy changes, whose effects are estimated initially at a microaggregate level--
that is, in terms of altered health care utilization or expenditures within population subgroups
identifiable in the database. The version of the model described in the DHHS report utilizes a
population database developed from the SIE and the Survey of Institutionalized Persons, conducted
in the same year.\textsuperscript{16} With its sizable state level samples the SIE enables the model to take advantage
of some of the aggregate statistics compiled by states. Indeed, the Health Financing Model includes
a state module, which serves as a reservoir of state level data--both cross-sectional and longitudinal.
Impacts measured at the cell level can be aggregated by utilizing as weights the population estimates
corresponding to each cell. The model also makes use of data drawn from numerous administrative
sources.

To develop a "present law profile" the model tabulates the database at the person level by five
characteristics (family income, employment of adult family members, primary insurance coverage,
person type, and family size), yielding a maximum of 4,368 cells. To develop a hypothetical "future
law profile the characteristics that define the cells can be varied to distinguish subgroups that would
be treated differently under the new law.

\textsuperscript{16}In addition, data on health care utilization, not reported in the SIE, were obtained from the
Health Interview Survey and matched to cells defined by combinations of variables present in both
surveys.
The model (in its different incarnations) received extensive use during the 1977 to 1981 debates over the structure of a national health insurance program and, again in 1981, over the form of a tax cap (Turek-Brezina 1988).

2. Labor Supply Response to a Negative Income Tax

As the debate concerning income maintenance and welfare reform progressed, it became apparent that a critical component was absent from all of the models—namely, a means of estimating the cost implications of the labor supply response. To gather relevant data the government had launched first the New Jersey Negative Income Tax Experiment and the Gary Experiment, followed by the Seattle and Denver Income Maintenance Experiments. Anticipating the importance of incorporating these research findings into the microsimulation modeling framework, where the labor supply response could be linked at the micro level to the income changes that would be induced by alternative reform proposals, both MPR and the Urban Institute worked on labor supply response modules for their microsimulation models (see, for example, Maxfield 1980). Before these efforts could reach full fruition, however, the policy debate shifted away from the negative income tax concept, and further development of these modules was curtailed.

3. Carter Administration Welfare Reform

Shortly after President Carter assumed office his administration launched a major welfare reform effort built around a job training and employment package, the Program for Better Jobs and Income (Citro and Hanushek 1991, p. 111). ASPE found that it could not use TRIM to evaluate the new welfare proposals. The current-law bias and rigid structure of TRIM did not lend itself well to simulating the combination of a substantial public employment component with a cash component (Webb et al. 1990, p. 50; Betson et al. 1980, p. 154). Moreover, there were no analysts left at ASPE who understood TRIM well enough to even attempt to use the model. Rather than try to adapt
TRIM, staff at ASPE undertook to develop their own model, a preliminary version of which was completed in about five weeks.

This new model, named the KGB model after its developers Richard Kasten, David Greenberg, and David Betson, incorporated three components that were not available in any other model at the time the developmental effort was started: (1) "a methodology for predicting whether particular individuals would participate in guaranteed employment programs," (2) "a set of reliable behavioral parameters that can be used to predict adjustments in work effort that individuals would make in response to changes in their wage rate and income levels," and (3) "a random-sample survey of the nation’s households that is large enough to provide reliable information at a state level and that provides accurate (sic) data on individuals' wage rates, hours of work, and numerous other variables" (Betson et al. 1980, p. 154). Greenberg (1978) developed the methodology for the first of these components. The second component became available when MPR and SRI developed a MATH subroutine to simulate the labor supply response using data collected in the Seattle-Denver Income Maintenance Experiment (see Maxfield 1977). This subroutine was modified by the ASPE team and adapted for use in the KGB model. Finally, the 1976 Survey of Income and Education, which was designed to produce statistically precise estimates of children in poverty at the state level, provided the needed sample data (Betson et al. 1980, p. 155).

While the welfare reform policy modeling at ASPE relied almost exclusively on the KGB model, the Labor Department contracted with MPR to develop new modules for the MATH model to simulate two types of response to the new jobs program: acceptance rates for the program and induced labor supply. Both the KGB and MATH simulations contributed to the policy debate, which produced a proposal acceptable to the President but which Congress ultimately failed to enact (Citro and Hanushek 1991, p. 111). It is noteworthy that by 1980 Kasten, Greenberg, and Betson had all left ASPE, and the model developed to meet ASPE's immediate needs in 1977 had come to the end of its useful life.
E. RETIREMENT INCOME POLICY, 1975-1982

In the mid to late 1970s several developments in the area of retirement and social security policy combined to create an expanded need for modeling of long-range consequences of policy action in this area. These developments included, among others:

- In 1974 Congress passed the Employee Retirement Income Security Act (ERISA), which established new requirements for pension administration and funding and marked a policy shift toward an employee security orientation (Greenough and King 1976).

- The solvency of the Social Security trust fund was threatened by an unintentionally generous cost of living adjustment formula while demographic projections indicated additional, serious long-range problems.

- Congress passed the Age Discrimination in Employment Act (ADEA), which raised the minimum mandatory retirement age from 65 to 70.

In response to these and other developments, President Carter appointed a commission to investigate issues and explore options regarding retirement income policy. At the same time, some of the major providers of pension financial services established the Employee Benefit Research Institute (EBRI) with goals that included the use of microsimulation to estimate the long-range consequences of the commission’s recommendations and alternative proposals.

In this subsection we discuss two models—DYNASIM2 and PRISM—that were developed in large part in response to policymakers’ need to evaluate retirement income issues at long range. We also discuss some additional modeling focusing on the Social Security program.

1. Development of DYNASIM2

By the late 1970s the tightness of research funding ruled out significant investments in general model improvement. Instead, funding was targeted to immediate policy needs. The earlier DYNASIM applications had demonstrated the utility of dynamic microsimulation in the analysis of issues relating to retirement and aging. Three separate contracts made possible the development of DYNASIM2 (Zedlewski 1990, p. 119). In 1979 the Urban Institute was awarded a contract from the
U.S. Department of Labor to evaluate the implications of the ADEA. One area of interest was the long term impact of the ADEA on retirement behavior. The contract included provision for simulation of these long-range effects and facilitated the development of a specialized retirement model for DYNASIM. A second Labor Department contract provided funding for software development that would permit the agency to bring in-house a private pension model which James Schulz had created for DYNASIM with National Science Foundation funding. This pension model, which had an explicit policy focus, had not been integrated into DYNASIM; instead it used the simulated earnings histories generated by the model and calculated both social security and pension benefits outside the model. The third contract, from the Congressional Budget Office (CBO), requested revisions that would enable analysis of general retirement issues. These revisions included developing a "more complete policy-relevant social security model and the integration of Schulz's PENSIM model" (Zedlewski 1990, p. 119).

DYNASIM2 was developed with a more limited focus and much simpler computer software than the original DYNASIM (Zedlewski 1990). The mainstay of DYNASIM2 consists of policy applications requiring long-run projections of demographic and labor force behavior. DYNASIM2 was designed to provide a detailed representation of the retirement income system and an ability to support analyses requiring projections of individual life histories. This included not only earnings histories and other income streams but also family composition, as children provide an important, alternative source of support for the elderly. Indeed, a number of early policy applications involved projection of the future elderly population's need for long-term care services, taking into account the diminishing number of children available to provide such care and the health status of the future elderly population under alternative mortality scenarios (Zedlewski 1990, pp. 128-129). Another application--to an issue affecting social security--is discussed below.
2. The ICF Pension and Retirement Income Model

Needing a means to evaluate alternative proposals for integrating the public and private pension systems, the President's Commission on Pension Policy contracted with ICF to develop a simulation model that could project retirement income from both public and private sources through the year 2020 (Citro and Hanushek 1991, p. 112). With additional funding from the Office of Pension and Welfare Benefit Programs, ICF constructed in a three-month period a preliminary version of the Pension and Retirement Income Simulation Model (PRISM). Over the next few years ICF developed the model much further, using its own funds as well as support from several government agencies plus EBRI and other private organizations. Policy issues to which PRISM was applied included changes to the social security program that were considered and ultimately enacted by the Reagan administration, revisions to the vesting requirements mandated by ERISA, taxation of pension accruals, and provision of health coverage to retirees under private pension plans (Citro and Hanushek 1991, p. 112; Kennell and Sheils 1990, p. 144).

In its current form, PRISM simulates the distribution of retirement income from both public and private sources among elderly families through the year 2025 (Kennell and Sheils 1990, p. 137). PRISM uses as its database an exact match of three files: (1) the May 1979 CPS supplement, which collected information on private pension coverage, (2) the March 1979 CPS annual income supplement, and (3) a separate exact match of March 1978 CPS and social security earnings history data for the years 1951-1977 and quarters of coverage annually from 1937 (Kennell and Sheils 1990, pp. 139-142). Income sources simulated by the model include social security benefits, private and public pensions, earnings, individual retirement accounts, and SSI. PRISM also simulates asset holdings and taxes paid. In a joint effort with the Brookings Institution, ICF added a Long-Term Care Financing Model, which simulates long-term care expenditures and their sources of payment.17

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17For an overview of the complete model see Kennell and Sheils (1990). For a more detailed description of PRISM see Kennell and Sheils (1986).
3. Additional Modeling of Social Security

During the early 1980s, issues involving revenue and taxation came to command significant attention at SSA. The STATS model, described earlier, was modified to simulate payroll and income taxation and then used for a number of studies involving the taxation of social security benefits and the incidence of the payroll tax (Wixon et al. 1987). Of particular interest to Commissioner Robert Myers was the number of families whose payroll taxes exceeded their annual income taxes. During this time SSA also considered a proposal to eliminate the retirement earnings test. To model the implications of such a policy required estimation of the labor supply response, which was crucial to the impact of such a change because net growth in work effort could generate new income taxes and payroll taxes and help pay for the increased benefits. This represented one of the few times that ORS analysts attempted to take account of behavioral effects in their modeling efforts.

In 1985 there developed a policy debate around alternative proposals to enable husbands and wives to share the social security earnings credit from their combined earnings while married. This was an attempt to address the financial hardships endured by retired women who had reduced their labor force participation while married, thus lowering their eventual social security entitlements, and then later divorced. To evaluate these proposals required a longitudinal database which included an earnings history for each sample member plus the earnings of any spouse during the time that the two were married. For this modeling the SSA utilized a dynamic model, MICROSIM, which Cindy McKay had developed from the Microanalytic Simulation System (MASS) created by Orcutt and James Smith during the time that DYNASIM2 was under development.

Using MICROSIM, analysts at SSA projected a simulated population to the year 2030--more than 40 years after the hypothetical enactment of earnings sharing--along with individual marriage

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18 Findings related to this question are reported by Bridges (1981).

19 MASS provided a streamlined computer implementation of DYNASIM. For a discussion of MASS see Orcutt et al. (1980, pp. 102-106). MASS was applied to analyses in a number of different policy areas, with a particular focus on wealth accumulation, especially through intergenerational transmission (Smith and Orcutt 1980; Smith 1986).
and earnings histories. Researchers then evaluated who would gain and who would lose under the earnings sharing proposals being ascertained at the time, using one percent higher or lower benefits relative to current law to assign persons to either (or neither) group. The SSA team also used the model to examine 24 alternative options for achieving some of the same objectives that earnings sharing was intended to address but without the major redesign of the social security benefit structure that earnings sharing would entail. The SSA study also evaluated alternative phase-in provisions—including a no-loser guarantee that would award each recipient during the transition period the higher of the two alternative benefits.

Using its own version of the DYNASIM model, CBO evaluated the SSA findings and analyzed some additional options. Key points of departure between the CBO simulations and those of SSA were the duration of spells of disability and the levels of mortality experienced by disabled persons (CBO employed longer spell lengths and higher mortality rates). CBO also incorporated somewhat different equations to predict divorce (CBO 1986).

Finally, the Urban Institute was able to use DYNASIM2 to prepare some additional simulations of earnings sharing options under still other assumptions (Zedlewski 1990, p. 128).

F. MICROSIMULATION IN THE 1980s

The initiation of the Reagan administration in 1981 marked a turning point of sorts in the development of microsimulation modeling. Funding for general model development, which had become thin during the Carter years, became almost nonexistent during the early 1980s. At the same time, the major thrust of policy activity shifted to efforts to scale back the transfer programs that had been introduced in the 1960s and greatly expanded in the 1970s. This had an immediate impact on both the nature of the modeling that was performed and where it was performed. As the 1980s progressed, however, policy emphases changed, and the debates turned toward new ways to address

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20This summary of the earnings sharing modeling is based on CBO's review of the SSA effort and discussion of findings from its own modeling (CBO 1986). The SSA findings are reported in a Congressional subcommittee print (U.S. House of Representatives 1985).
the problems of income inadequacy and unemployment that had given rise to the War on Poverty programs in the 1960s. Models were called upon to do new things, and research resources were directed to new ventures or to refinements of older models with new data.

1. Modeling with Program Data

During the early 1980s the combination of limited research budgets and a policy orientation toward scaling back programs provided an incentive for federal agencies to develop their own simple microsimulation models based on microdata from their program administrative records. While the reliability of such data is often high, the representation of key variables is generally spotty, and the population coverage is limited to current program participants. With proposed reforms focusing on cutbacks in benefits or eligibility, generally, the coverage limitations of program data became relatively unimportant. Several agencies—including ASPE and FNS—constructed "benefit-calculator" models with which they could estimate the impact of reductions in benefit levels or eligibility (Citro and Hanushek 1991, p. 112). The ability to do more modeling in-house had considerable appeal as well. What such models could not do, however, was address the implications of multiple program eligibility upon the participation decision among eligibles. While a reduction in benefits or eligibility had clear first-round implications, persons who lost their eligibility for one program might choose to participate in another program for which they had been eligible but had found insufficient incentive to participate. By neglecting this aspect of the problem, one could easily overestimate the potential savings that would accrue from changes in the eligibility and benefit determination formulas.

One example of policy analysis with a benefit-calculator that did achieve some measure of success—but not in the intended direction—involves efforts at FNS to design simplified eligibility rules.

21Since the early 1960s, tax policy analysis has relied heavily on the data provided in tax returns filed by individuals and corporations. In the case of these administrative data, however, the "program" covered a very large proportion of the adult population, and the data were extremely rich with respect to the items needed to define key policy outcomes—namely, the potential tax liability of taxpayers under alternative reform proposals. Even here, however, supplementing the program data has been a key part of tax policy modeling since the mid-1960s.
for the Food Stamp Program. FNS used both MATH and its own model based on program data to try to devise a set of eligibility rules that were significantly simpler than the current rules but which would not significantly reduce the eligibility of current beneficiaries. Ultimately, the modeling demonstrated that it was impossible to satisfy both sets of criteria, and the simplified eligibility procedures failed in Congress (Citro and Hanushek 1991, p. 113).

2. Impact of OBRA

In 1981 Congress passed the Reagan administration's Omnibus Budget Reconciliation Act (OBRA), which included sizable cutbacks in a number of welfare programs. A few years later the Census Bureau recorded a rise in the poverty rate, and there arose concern that the welfare program cuts may have contributed significantly to the increase in poverty. With the nation in a recession, however, the independent impact of the welfare cuts was not easy to disentangle. The House Ways and Means Committee requested from the Congressional Research Service (CRS) "an analysis of the relative importance of the recession, budget reductions, and other factors on the recent increases in the poverty rate" (U.S. House of Representatives 1984, p. iii). Of particular interest were the effects of the changes made to the AFDC program.

CRS contracted with MPR to apply microsimulation to the problem of sorting out the program effects from the economic effects. The research design developed by MPR and CRS permitted analysis of both the combined and individual effects of the OBRA welfare changes and the onset of the recession on the poverty rate. This effort did not require development of any new capabilities in MATH although the income projections and unemployment rate adjustments that were part of the economic aging of the base year sample file were given particularly careful attention. The methodology involved simulating two alternative economic scenarios—the recession as it occurred versus a stronger economy—with and without the OBRA welfare cuts. By comparing the four sets of outcomes MPR was able to estimate the independent contributions of the OBRA cuts and the
economic downturn to the observed rise in the poverty rate. The Executive Summary of MPR’s report highlighted two important contributions of the study:

- First, we demonstrate that microsimulation models can yield results helpful to decisionmakers as to the impact of complicated policy changes.

- Second, we are able to separate the effects of two complex factors affecting poverty simultaneously. In this case we find that OBRA increased poverty by 2 percent and the weak economy increased poverty by 6 percent—for a combined increase of 8 percent (U.S. House of Representatives 1984, p. xii).

Thus the unique capabilities of microsimulation were demonstrated once again—an outcome that was especially important given the reductions in research funding generally and of microsimulation model development in particular.


The Family Support Act (FSA), passed by Congress and signed into law by President Reagan in late 1988, was a major welfare reform initiative that included a number of features that were new to welfare programs, among them child support provisions, a jobs and training component, and transitional assistance. The FSA also extended the previously optional AFDC Unemployed Parent (UP) program to all states. Agencies potentially affected by the FSA were caught by surprise by the emergence of this policy debate and had little opportunity to perform the new research and extensive revisions to their models that would have been required to adequately evaluate the cost implications of many of the new provisions that were under discussion. For example, while several states had experience with the UP program, these states were very different from those that did not (virtually all of the experienced states were in the south, for instance). Moreover, their UP programs had been in effect for many years, and their welfare caseloads had already adjusted. It was difficult to find a satisfactory basis from which to infer what the impact of AFDC-UP in northern industrial states might be. With respect to the child support provisions, data on the absent parent in one-parent families
were virtually nonexistent, making it exceedingly difficult to utilize microsimulation to develop credible estimates of the potential gains from these new provisions. Similarly, no existing model could simulate the transitional support services and jobs and training programs that were central provisions of the legislation (Citro and Hanushek 1991, p. 47).

In response, policy analysts in both Congress and the affected agencies had to piece together estimates of the implications of FSA provisions with limited data and strong assumptions—a not very satisfying outcome in light of the earlier heavy reliance on microsimulation models and their ability to provide detailed estimates of costs and benefits. The NRC panel suggests that there is a lesson here on the merits of building flexibility into policy models, but models also depend on good data and solid research—both of which suffered during the early 1980s.

4. New Data Collection

While the early 1980s saw a scaling back of federally-sponsored data collection for social policy analysis, this situation eased as the decade progressed. Two developments with implications for microsimulation were the initiation of the Survey of Income and Program Participation and the expansion of administrative data processing for tax policy analysis.

a. Survey of Income and Program Participation

The launching of the Survey of Income and Program Participation (SIPP) in 1984 was an answer to many of the needs of policy analysts for improved data for policy modeling and research.22 In contrast to the March CPS, the cornerstone of static microsimulation in the social welfare area, SIPP provided data on program eligibility factors and participation on a monthly basis, matching the accounting period used by many of the transfer programs in their determination of eligibility and

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22SIPP was the culmination of a multi-agency research effort, the Income Survey Development Program (ISDP), which was started under the Carter administration and terminated by the Reagan administration, temporarily stopping SIPP, which was reborn under the full authority of the Census Bureau. The ISDP fielded pilot surveys in 1978 and 1979, which supported some policy applications of microsimulation, paving the way for later modeling applications of SIPP.
benefit amounts. SIPP also captured asset data and more detailed income information and provided true panel data, if only for periods of two-and-a-half years. Some of the item content of SIPP was developed—in direct response to agency requests—to enable more detailed simulation of program eligibility.

SIPP promised to benefit microsimulation in three distinct ways. First, it provided better measures of program eligibility, which analysts could use to improve the imputations in their existing, CPS-based models. Second, the panel feature of the survey provided valuable data for behavioral research, opening up the possibility of improving simulations of both first-round and second-round behavioral responses. Third, SIPP could serve, potentially, as the actual base file for a microsimulation model. Later in this section and the next we discuss two such models.

b. Tax Data

Microsimulation model estimates of the revenue and distributional implications of alternative tax reform packages were instrumental to the policy debates that culminated in the enactment of the Tax Reform Act of 1986. Between them, OTA and the JCT prepared hundreds of model estimates. Variations in the specifications from one run to the next often focused on small changes in prospective reform provisions, underscoring the importance of large samples.

Despite the importance of the tax models' contributions to the policy debate, the analysts were made all too aware of the limitations of their procedures—particularly with regard to the behavioral changes that might be induced by the changes in the tax structure.23 Efforts to improve the tax data that underlay the model estimates were launched a year later (Czajka and Walker 1989). One outcome of these efforts was the initiation of a 90,000 filing unit panel in the annual Statistics of Income (SOI) sample of individual tax returns. With panel data, analysts would have a better basis

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23 The OTA model does not account for behavior responses to changes in the tax code except for tax-minimizing choices like the decision to itemize. Occasionally analysts may define a behavioral response to a particular change in the tax code. This was done, for example, in applying price and income elasticities to estimate the level of charitable contributions after the significant change in tax rates embodied in the Tax Reform Act (Cilke and Wyscarver 1990, pp. 1-3 to 1-4).
for estimating behavioral responses. Moreover, as Ralph Bristol (1985) has observed, the number of tax provisions involving longitudinality is growing, thus increasing the need for panel data to simulate just the direct effects of new law. Another change in SOI data collection capitalized on the requirement introduced in the Tax Reform Act that taxpayers list the social security numbers of their dependents. Provision was made to collect data from the returns of all dependents of sample members, making it possible to construct "tax families" and reduce the heavy reliance on statistically matched CPS data. Finally, in view of the importance of capital gains as an issue in the 1986 and later tax policy debates, OTA and JCT are working to take advantage of a small panel started in 1985 with a focus on capital gains transactions (Hollik et al., 1989).

5. New Models

The mid- to late 1980s witnessed significant investments in new microsimulation models or submodels designed to address new problems or extend the technological frontiers of microsimulation methodology. The major focus of new modeling was the health care area—a trend that has continued through the beginning of the Clinton administration. Other types of models were developed, however, and we identify some of them first.

a. Multi-Regional Policy Impact Simulation

ASPE made a major investment in a model designed to simulate second-round effects of policy changes on regional markets (Citro and Hanushek 1991, p. 113). The Multi-Regional Policy Impact Simulation (MRPIS) model, developed at the Social Welfare Research Institute at Boston College, was designed to simulate at the state level the employment and income distributional effects of changes in tax and transfer policy. The model is an intellectual descendant of an earlier model developed at the University of Wisconsin to estimate the changes in consumption spending that would be induced by a proposed policy (FAP is one example the Wisconsin model was used to evaluate) and to trace the effects of these changes through the economy (Golladay and Haveman 1977). The
MRPIS model utilizes not only microsimulation but both cell-based and input-output estimation (Citro and Hanushek 1991, p. 113). The model never achieved its full ambitions, however, and despite the large investment the policy applications have been few.

b. Targeting Employment and Training Programs

One of the most significant shifts in the welfare policy debate during the 1980s was the acceptance of the idea that welfare mothers with small children might be permitted, even encouraged, to work. In an effort to break the long cycles of dependency that panel-based research had documented, policymakers began to explore in a serious way the addition of employment and training components to supplement the income support provided by welfare programs. The first microsimulation model to simulate the long-term impact of such components, using data from experimental evaluation programs, was developed at MPR with ASPE support (see Maxfield and Rucci 1985). While fairly limited in purpose (the model's objective was to assist policymakers with the targeting of employment and training), the model provided estimates of the potential benefits of investment in such programs and the length of time over which varying degrees of benefits were realized.

c. FOSTERS--A SIPP-Based Model

MPR developed the FOSTERS (Food Stamp Eligibility Routines) model with data from the 1984 and 1985 SIPP panels (Doyle and Beebout 1990). FOSTERS was designed, originally, as a set of routines to simulate the food stamp eligibility of households with a greater approximation of program rules than was possible with the CPB-based MATH model and to calculate participation rates utilizing this simulated eligibility status. With its more rigorous simulation of eligibility, FOSTERS was used to study participation in the Food Stamp Program. FOSTERS was used to assess a number of Congressional proposals that would have raised the ceiling on the asset value of

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24 The model has since been updated with data from 1988 and 1989.
vehicles that households could own without losing their eligibility for food stamps. Adoption of any such relaxation of the vehicular asset limit was deterred by the estimated high costs, as measured by increased eligibility and participation (Citro and Hanushek 1990, pp. 113-114). In response to a growing demand for analyses utilizing the richness of SIPP data, MPR developed FOSTERS into a more complete model. For example, a participation algorithm was added, enabling simulation of changes in overall participation in response to changes in eligibility.

d. Models of the Health Care System

Unlike many of the entitlement programs or the tax system, the health care system lacks the explicit program rules and benefit (or cost) formulae that microsimulation models can replicate to such good effect. Furthermore, the health care sector lacks a sample survey or administrative data system that can provide on a regular basis the measures and population coverage which the March CPS, SIPP, and SOI tax data provide for transfer and tax models. For these reasons, microsimulation has not played anywhere near the major role in health care policy development that it has for social welfare and tax policy.

Nevertheless, there were a number of developments in the modeling of health care in the 1980s. The Urban Institute made significant revisions to the Medicaid module of TRIM2, which can be used to simulate the effects of expanding Medicaid coverage (see Holahan and Zedlewski 1989). The Department of Labor also funded work to enable TRIM2 to simulate the health insurance benefits provided by employers. The long-term care module which Brookings and ICF added to ICF's PRISM model in 1986 was mentioned earlier. Rivlin and Wiener (1988) provide a detailed discussion of numerous applications of this long-term care model to explore policies related to caring for elderly persons with disabilities. Toward the end of the decade ICF/Lewin developed

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25The NRC panel report includes a discussion of the use of microsimulation in health care policy research historically and makes recommendations regarding the course of future development (see Citro and Hanushek 1991, pp. 195-212). Chollet (1990) provides a recent assessment of the state of microsimulation modeling in health care policy research.
the Health Benefits Simulation Model (HBSM) to simulate health care utilization and financing at
the household level. Described as the first major microsimulation model designed expressly to analyze
the effects of alternative health care policies at the household level, HBSM utilizes the 1980 National
Medical Care Utilization and Expenditures Survey as its database and simulates impacts on health
insurance coverage, health services usage, sources of payment, and total health care spending (Chollet
1990).

G. DEVELOPMENTS IN THE EARLY 1990s

Even setting aside the ASPE activity which this report serves, there is evidence that the 1990s
will witness significant new investment in microsimulation methodology. Here we highlight three
recent developments: (1) new modeling with SIPP as the base file, (2) movement away from the
mainframe to the personal computer (PC) as the platform of choice, and (3) model construction to
support national health care reform.

1. New Modeling with SIPP

Staff at SSA have constructed an SSI program model using two waves of the 1984 SIPP panel
(Vaughan and Wixon, 1991). Operating under a joint agreement, SSA and the Census Bureau have
matched the SIPP records to earnings and benefits data from two SSA files: the Summary Earnings
Record and the Master Beneficiary Record. There are short term plans to link data from the
Supplemental Security Record to the SIPP files in order to facilitate more accurate identification of
SSI participants among SIPP respondents and to permit analytical usage of actual benefit amounts.
Over the longer term, SSA hopes to extend the model to include all components of social security,
which will enable improved modeling of proposals to integrate the SSI and OASDI programs. With
the matched data utilized in the model, current confidentiality restrictions may very well limit access
to the model to authorized employees of SSA.
While SIPP data provide the base files for the SSA model and MPR's FOSTERS model, discussed earlier, both are static models, and neither model utilizes the longitudinally of the SIPP panel other than as a source of richer data. Indeed, as Michel and Lewis (1990, p. 11) point out, all of the dynamic and static models utilize cross-sectional surveys for their base files. While it might make intuitive sense in a dynamic model to utilize the dynamics of prior years to age the sample several more years, this is very difficult to do. Michel and Lewis cite a number of problems with the use of panel data for base files, among them the assignment of appropriate weights, and they predict that cross-sectional surveys will continue to dominate as input files—even for dynamic models (Lewis and Michel 1990, p. 13).

2. Movement to the Microcomputer

With the shifting of investment in new computer technology from the mainframe to microcomputers, it was inevitable that microsimulation modeling would move to the microcomputer as well. Microcomputers lower the processing costs very substantially while recent technological advancements provide greater computing power than the mainframes of a decade ago. Here we discuss PC versions of both static and dynamic models.

a. MATH and TRIM2 for the PC

Both MPR and the Urban Institute have developed PC versions of their bread and butter models, MATH and TRIM2. The MATH PC model includes a user-friendly interface—a feature which did not exist in the mainframe version. The interface makes it possible for an analyst to perform simulations without the assistance of a programmer. The model is able to provide the analyst with results much more quickly and at a substantially lower cost than the earlier mainframe version. Database development still occurs on the mainframe, but this last vestige of mainframe use is expected to be eliminated in the next two years. The conversion of TRIM2 to the PC has progressed more slowly than MATH PC development but with similar long-term objectives.
b. CORSIM: A PC-Based Dynamic Model

Steven Caldwell, a member of the original DYNASIM team, undertook development of a new version of his earlier CORSIM (Cornell Simulation Model), a PC-based dynamic microsimulation model. The earlier model was essentially a scaled down version of DYNASIM. The new model is substantially more powerful, is designed to handle files of the size of the CPS (in terms of the number of observations), and includes basic modules to simulate demographic processes, education, labor force behavior, transfer payments, wealth accumulation, taxes, and consumption. With funding from different sources, Caldwell and his team have added modules to simulate voting, consumption behavior, and dental events (which entails simulating each tooth of a sample member).

3. Health Care Reform

The most recent, major development in the application of microsimulation to health care policy research is the construction of a model--by the Agency for Health Care Policy and Research (AHCPR)--to assist in the development of a national health care reform proposal. Building on the experience of staff members who were major contributors to TRIM and MATH, the agency has designed and constructed the AHCPR Healthcare Simulation (AHSIM) model, with the objective of simulating how proposed changes to the health care industry might affect such outcomes as insurance coverage, costs of care, and the apportioning of payments for health care services (Doyle 1993, Moeller and Witter 1993). This household-based model will also be able to simulate the responses of both employers and health care providers. The initial version of this model was programmed in SAS for the mainframe, but a microcomputer version is currently under development. Undoubtedly this and other simulation models will play a vital role in the upcoming health care reform debate.
III. SIMULATING POLICY INITIATIVES:
SOME ILLUSTRATIONS BEARING ON MODEL DESIGN

We have seen how key policy issues of the day played an important role in stimulating and shaping the development of microsimulation as an analytic tool. The project for which this report was prepared seeks to influence the further development of microsimulation at ASPE by first identifying the major policy issues and types of policy initiatives that will emerge in the social welfare arena over the next several years--specifically as they relate to the family--and then developing a model design that gives expression to these same issues and initiatives. The task of designing a microsimulation model to address issues related to family formation and dissolution demands not only that we anticipate key areas of policy activity over the next several years but that we fully understand what capabilities are required for modeling possible initiatives in these areas. We suggest that the task of specifying the modeling requirements should not be separated very far (if at all) from the task of identifying the issues themselves. In this chapter we discuss how the operational goals and content of a policy initiative can be translated into terms that define the modeling requirements for a microsimulation analysis aimed at estimating the prospective outcomes that would ensue upon the implementation of that initiative. If the policy analysts who will help to identify the future policy issues in this area can also lay out at least some of the implied modeling requirements, they increase the likelihood that the model design produced later in this project will turn out to be quite useful--even if the analysts' guesses about issues prove to be somewhat off target.

We suggest that the following aspects of policy issues bear directly on their modeling requirements:

- outcomes of interest
- policy variables--that is, what is being changed?
- population of interest
• relevant characteristics of population members
• behavioral responses (in particular, their role in producing the outcomes of interest)
• time horizon for outcomes (including phase-in considerations)
• administrative control over the program being adopted/modified

By defining these aspects of an issue or initiative, the policy analyst provides the information needed to define the modeling requirements.

To flesh out how these different aspects of policy issues or initiatives affect their modeling requirements, we have prepared four figures. These figures provide summary descriptions of the simulation requirements of four generic policy initiatives dealing with means-tested transfer programs and more broadly inclusive entitlement programs. The four initiatives are:

1. a marginal change in the benefits/eligibility formula of a means-tested program
2. elimination of the social security retirement earnings test
3. the provision of transitional child care and Medicaid services to AFDC recipients leaving the rolls
4. institution of a social insurance program to cover the use of long term care services

For each initiative the corresponding figure lists the outcomes of interest, the time horizon over which estimates of program impacts are desired, and the modeling capabilities that exist currently, with references to models discussed in Chapter II. Then for each population of interest the figure indicates what should be simulated to generate a "status quo" scenario and what should be simulated to generate the "reform" scenario that would ensue upon enactment of the initiative. Simulations are differentiated according to whether they require: (1) little more than the application of program rules, (2) estimates of behavioral responses to program changes, or (3) estimates of the probability of events that occur independently of program changes. The figures do not depict benefit
calculations explicitly or indicate any aggregation across micro units. It should be understood that such aggregation follows from the specification of outcomes of interest.

Let us consider the simulation shown in Figure III.1. This figure represents what is perhaps the most common type of microsimulation exercise conducted in the welfare policy arena: some aspects of the benefit formula of a means-tested program are modified, and the simulation model helps predict the effect of the reform on outcomes such as program expenditures, the size of eligible and participating populations, and the distribution of gains and losses among those receiving benefits. The horizon over which outcomes are considered is in this case very short, typically the fiscal year following enactment of the reform.

As in most policy simulations, the model must first simulate the "status quo" scenario: the essential components are described in the left-most part of Figure III.1. Using a representative sample of households, the model must determine which households are eligible, which are participating in the program, and what amount of benefits they are entitled to receive. Therefore, simulation of the status quo requires mainly the application of program rules to the sample of households, as if they were applying for benefits.

We should point out that a great deal of complexity hides behind the apparent simplicity shown in the left-most part of Figure III.1, due to the fact that the survey data used in microsimulation typically do not contain all the information needed to apply the existing program rules. The missing information must be added to each sample record, using a number of different techniques, including imputation and statistical matching, discussed in Chapter II. Moreover, the status quo that the model simulates does not refer to a past year, but to a future year. This requires "aging" the sample using aggregate projections of demographic and economic trends to the chosen future year. (It is legitimate to use the term status quo, because what is simulated for a future year is the situation that would prevail under current legislation).
**FIGURE III.1**

<table>
<thead>
<tr>
<th>Policy initiative</th>
<th>Marginal change in the benefits/eligibility formula of a means-tested program</th>
</tr>
</thead>
</table>
| **Outcomes of Interest** | • Total program expenditure  
                           • Size of population eligible for the program and population participating in the program  
                           • Distribution of benefits among households participating in the program |
| **Time horizon for outcomes** | Usually the fiscal year following the reform: phase-in considerations are typically ignored (they are important only for those behavioral responses that depend on the diffusion of information about program changes) |
| **Existing modeling capabilities** | The static models most widely used for welfare policy (*MATH* and *TRIM2*) can simulate the status quo scenario as described below, but only part of the reform scenario described below |

<table>
<thead>
<tr>
<th>Population of interest</th>
<th>What should be simulated to generate the status quo scenario</th>
<th>What should be simulated to generate the reform scenario</th>
</tr>
</thead>
</table>
| All households         | ☑ Whether they are eligible for the program on the basis of their characteristics (observed or imputed) | ☑ Whether they become eligible for the program under reform law, holding their characteristics and behavior constant  
                        |                                                            | ☒ (If they become eligible) Whether they decide to participate  
                        |                                                            | ☒ Whether they change their behavior (e.g., their labor supply and living arrangements) in response to the change in benefits  
                        |                                                            | ☒ Whether they become eligible for the program under reform law after their behavior has changed |
| Households eligible for the program | ☑ The benefits they are entitled to receive under existing law  
                                      △ Whether they participate in the program | ☑ The benefits they are entitled to receive under reform law  
                                      ☒ (If they are not already participating) Whether they join the program in response to higher benefits |
| Households participating |                                                           | ☒ Whether they leave the program in response to lower benefits |

☑ This simulation requires mainly the application of program rules.  
☒ This simulation requires estimates of behavioral responses to program changes.  
△ This simulation requires estimates of events that occur independently of program changes.
In some instances, simulating the status quo requires more than the application of existing program rules. For example, whether a given household participates in the program depends on that household’s choice, not merely an administrative decision. If the information on program participation is not (reliably) collected by the survey, simulating the status quo will require simulating, for each household, whether or not the household participates in the program. It should be noted that this decision might be affected by the household’s characteristics, as well as by existing program rules, but not (for the status quo simulation) by the proposed change in program rules.

The right-most part of Figure III.1 describes the simulations that generate the "reform scenario." The application of modified program rules is an important component of the simulation exercise: under new program rules, households might become eligible or lose eligibility, and they might gain or lose benefits. However, the new program rules might also induce households to change their behavior: for example, reduced benefits might induce some households to leave the program, because the costs of participation now outweigh the benefits, whereas increased benefits might induce some households to modify their living arrangements or work behavior to take advantage of the program’s greater generosity. Simulating these second-round effects requires information of a very different nature: the model must incorporate estimates of the likely behavioral response to the proposed policy change. This information can be gathered either by directly observing responses to similar policy changes implemented in the past, or by observing differences in behavior across households facing different program implementations.

Figure III.2 represents another essentially static simulation exercise, that pertaining to the elimination of the social security retirement earnings test. Simulation of the status quo scenario requires both the application of current programs rules (to determine the amount of social security benefits received given a sample member’s prior earnings history, amount of income and payroll taxes paid) and the simulation (if not directly observed) of labor supply choices on the part of the beneficiary. In simulating the reform scenario, application of modified programs rules is still
FIGURE III.2

<table>
<thead>
<tr>
<th>Policy initiative</th>
<th>Elimination of the Social Security Retirement Earnings Test</th>
</tr>
</thead>
</table>
| **Outcomes of interest** | ⚫ Social security payments  
|                     | ⚫ Payroll/income tax revenues  
|                     | ⚫ Labor force participation among older workers  
|                     | ⚫ Duration of unemployment among younger workers |
| **Time horizon for outcomes** | The years immediately following the elimination of the test |
| **Existing modeling capabilities** | The Social Security Administration's STATES model, with the addition of ad hoc estimates of labor supply response, is capable of simulating both status quo and reform scenarios as described below, with the exception of the second-round effects on the non-beneficiaries |

<table>
<thead>
<tr>
<th>Population of interest</th>
<th>What should be simulated to generate the status quo scenario</th>
<th>What should be simulated to generate the reform scenario</th>
</tr>
</thead>
</table>
| Social security beneficiaries | ☑ Social security benefits they receive  
|                          | △ Whether they work while receiving benefits | ☰ Whether they start working in response to the lower marginal tax rate  
|                          |                                             | ☰ (If they start working) Hours, weeks of work, and earnings  
|                          |                                             | ☰ Payroll and income taxes they pay when working |
| Social security beneficiaries who work | △ Hours, weeks of work, and earnings  
|                                      | ☑ Amount of benefits withheld  
|                                      | ☑ Payroll and income taxes paid | ☰ Increase in SSA benefits following elimination of the test, holding constant work behavior  
|                                      |                                             | ☰ Whether they work more hours, to take advantage of higher marginal net wages (substitution effect)  
|                                      |                                             | ☰ Whether they work fewer hours, reflecting higher disposable income (income effect)  
|                                      |                                             | ☰ Changes in payroll and income taxes following change in work behavior |
| Non-beneficiaries | △ Probability of finding a job upon labor market entry or reentry | ☰ Whether their probability of finding a job is affected by the higher participation rate among the elderly |

☒ This simulation requires mainly the application of program rules.  
☐ This simulation requires estimates of behavioral responses to program changes.  
△ This simulation requires estimates of events that occur independently of program changes.
important, but here the behavioral response to the reform (i.e., the elimination of the test) plays a crucial role. Without credible labor supply responses, the results of the entire simulation exercise become questionable.

Figure III.3 depicts a type of policy initiative (in this case the provision of transitional services to AFDC recipients leaving the program) that requires a radically different modeling approach, one that is not implemented in any of the existing models. The application of program rules plays a very minor role in simulating both status quo and reform scenarios. Simulation of the status quo scenario involves reproducing the dynamics of entry and exit from the program under existing conditions, while simulating the reform scenario requires estimating how such exit and entry behavior changes when the incentives to stay on and off the program are modified by the provision of transitional services.

Finally, Figure III.4 illustrates the simulation of a social insurance program to cover the use of long-term care services. As in the preceding example, the application of program rules plays a very minor role. Given the exceedingly long time horizon over which the outcomes of interest are to be simulated, constructing even the status quo scenario (that is, what will occur if current policies remain unaltered) involves simulating the future path of earnings, savings, disability, and service usage for a sample of individuals over a long period of time. Constructing the reform scenario involves simulating how these earnings, savings, disability, and service use histories will change if a social insurance program is created.

Our hope in presenting these illustrative figures is that policy analysts thinking about future policy issues to which family formation and dissolution are relevant will use the figures as a guide and give consideration to the information requirements that future policy issues will create.
FIGURE III.3

<table>
<thead>
<tr>
<th>Policy initiative</th>
<th>Provision of transitional child care and medicaid services to AFDC recipients leaving the rolls</th>
</tr>
</thead>
</table>
| Outcomes of interest | - Expenditure for program benefits  
- Expenditure for transitional services  
- Rates of program entry, exit, and recidivism |
| Time horizon for outcomes | The medium-term period following enactment: phase-in considerations are crucial, as program costs can accumulate early after enactment and reductions in program expenditures might materialize later |
| Existing modeling capabilities | None of the existing models is currently able to simulate this type of policy initiative |

<table>
<thead>
<tr>
<th>Population of Interest</th>
<th>What should be simulated to generate the status quo scenario</th>
<th>What should be simulated to generate the reform scenario</th>
</tr>
</thead>
</table>
| Families receiving AFDC in period t | △ Whether they leave the program in period t+1  
△ How long they stay off the program after leaving | ☑ Whether they qualify for transitional services if they leave the program in period t+1  
❖ Whether they leave the program in period t+1 given that they qualify for transitional services  
❖ How long they stay off the program after leaving given that they use transitional services |
| Families not receiving AFDC in period t | △ Whether they enter the program in period t+1 | ❖ Whether they enter the program in period t+1, given that transitional services are available upon exit |

☒ This simulation requires mainly the application of program rules.  
❖ This simulation requires estimates of behavioral responses to program changes.  
△ This simulation requires estimates of events that occur independently of program changes.
FIGURE III.4

<table>
<thead>
<tr>
<th>Policy initiative</th>
<th>Instituting a social insurance program to cover the use of long term care service (with 10 percent coinsurance and two-year waiting period to qualify for benefits)</th>
</tr>
</thead>
</table>
| Outcomes of interest | • Public expenditure for long term care (LTC) services  
• Tax burden to finance the social insurance program  
• Total demand for LTC services |
| Time horizon for outcomes | Any time period in the future during which a given cohort of individuals reach old age |
| Existing modeling capabilities | A dynamic model (the Brookings-ICF Long Term Care Financing Model) has been built with the purpose of simulating alternative solutions to financing of long term care use |

<table>
<thead>
<tr>
<th>Population of interest</th>
<th>What should be simulated to generate the status quo scenario</th>
<th></th>
<th>What should be simulated to generate the reform scenario</th>
</tr>
</thead>
</table>
| Adult population reaching old age during the chosen future time period | △ Labor force participation from present to retirement  
△ Savings from present to retirement  
△ Income sources during retirement  
△ Disability and mortality rates  
△ Use of nursing home and home care services  
△ Receipt of care by informal providers  
△ Financing of LTC service use under current options (Medicare, Medicaid, out-of-pocket expenditure) | | □ Payroll tax paid to finance the program  
△ Decision to buy private insurance to cover the coinsurance and the two-year deductible period  
△ Decision to reduce private savings  
△ Decision to use formal rather than informal care |
| Potential informal care givers | △ Provision of informal care  
△ Labor force participation | | △ Decision to reduce informal care giving  
△ Decision to increase labor force participation |
| Private insurers | △ Supply of private insurance contracts under current financing options | | △ Supply of private insurance contracts to cover the deductible period and coinsurance |

□ This simulation requires mainly the application of program rules.  
△ This simulation requires estimates of behavioral responses to program changes.  
△ This simulation requires estimates of events that occur independently of program changes.
IV. CONCLUSION

Recalling the purpose of this report, we may draw several observations from the material that we have presented:

- **Dynamic and static microsimulation developed separately and have rarely been applied to the same problem.** Clearly any effort to employ dynamic microsimulation to any great extent in evaluating a welfare reform or tax reform proposal would be breaking new ground.

- **Assembling a database with the required characteristics is often the biggest and most important task in using microsimulation.** For static models, preparation of the base year file and aging it to the model years is a considerable undertaking involving numerous steps, many of which could stand methodological improvement. For dynamic models, much of the actual simulation consists of constructing the (longitudinal) database; the subsequent analysis is often a small part of the total effort. The fact that no single data source can obtain all of the variables required for effective simulation underscores the importance of statistical techniques for combining the information present on two or more data files--techniques that include exact matching, statistical matching, and other forms of imputation. Aging the database must be considered an essential requirement as well.

- **The behavioral content of microsimulation models remains weak.** Despite a history exceeding two decades, microsimulation models contain only limited representation of behavioral responses to policy changes, and most of what is present is not well grounded in research findings. The importance of behavioral research to effective policy simulation cannot be overstated.

- **Modelers remain dependent on empirical research to define the relationships which drive their models.** Parameter values and behavioral response functions depend on prior research. At the same time, there will always be a need to initiate special studies to address some of the unique elements of policy initiatives, evidenced by the experimental evaluations that contributed to the policy debates on income maintenance.

- **Specialization has dominated generalization in model development.** While Orcutt’s original goal was to develop a general simulation model of individual economic behavior, policy demands and maintenance costs have worked to produce many specialized models. Even models that started out with general objectives—including DYNASIM, TRIM, and MATH—became focused upon particular policy areas while other capabilities atrophied.

- **There are drawbacks to basing models on nonrecurring data collection.** There can be little question that the predictive ability of models diminishes as their data become increasingly out of date. This is more true of static models than long-term dynamic models, generally, because the starting point of a long-term dynamic
Simulation is less important than that of a short-term static model. Models built around exact match data are particularly vulnerable to developing obsolescence because their data sources are the most difficult to regenerate.

- There is very little experience with the successful modeling of second-round effects. While this suggests caution in proceeding with such modeling efforts, second-round effects are becoming more important to resolving policy debates in certain areas. They grow more significant as policymakers grapple with "big picture" initiatives such as health care reform and welfare reform.

- While modeling has suffered from the need to evaluate proposals for which the existing models were ill-equipped, and to do so in a short time frame, history suggests that the need to develop estimates on short notice will not disappear. It is difficult to anticipate all of the issues that will arise and then design a model that can handle them. Models need to be designed with the flexibility to allow analysts to address new initiatives with fairly limited changes. Design principles that are important in achieving this capability include modular construction and extensive parameterization.

On this last point, an observation by the NRC panel bears quotation:

> Although there are many sources of information that can help agencies anticipate future policy proposals, there is no crystal ball that will furnish them with infallible forecasts for guiding their investments in policy analysis tools. The difficulties of predicting the policy agenda underscore the importance of investments that are aimed at improving the overall capabilities of microsimulation models (and other policy analysis tools) for flexible, timely, and cost-effective responses to changing policy concerns. To achieve this goal . . . models need to follow good design principles and practices, and agencies need to find ways to further fruitful interactions between policy research and modeling (Citro and Hanushek 1991, p. 195).

We would add that to build sufficient flexibility into the design of policy models, it is absolutely essential that the modelers understand what kinds of information will be most helpful to policymakers in evaluating policy initiatives and contributing to policy debates. Policy analysts can help to foster this understanding by carefully considering and communicating their needs. At the same time, however, we should not underestimate the importance of recognizing potentially emerging issues. History provides too many examples where the unexpected emergence of an initiative left too little time for the necessary research and development, and microsimulation made no contribution to a debate for which good forecasts were desperately needed.
REFERENCES


Review of
"Microsimulation and Public Policy: Debates and Developments that Shaped a Methodology"

As the title suggests, this paper reviews the historical development of microsimulation as an analysis methodology. Its documentation of policy debates and events surrounding the development of microsimulation is both accurate and quite complete. With this characterization, my comments on the specifics of this report are quite limited. However, I have taken some time to jot down some remarks and thoughts that were sparked by this telling of the history of microsimulation. The comments which follow don't reflect any order of priority or importance.

Policy and Modeling

The title of the report indicates that the authors believe that policy debates and other events have shaped the microsimulation methodology. The existence of micro data and the increasing speed of computers have had an important influence and can be said to have made microsimulation possible. Policy concerns in the welfare and social insurance have shaped the methodology for numerous reasons if not for the single reason that significant amounts of money were made available to construct the models.

But the more interesting question is, "Has microsimulation shaped policy?" This is not a frivolous question. I recall being interviewed by a team from GAO. The primary question that they kept asking was "How did the KGB model determine welfare policy?" One clearly got the impression that they believed that one ran the model and out came a welfare policy. While this is clearly not what a model accomplishes, it does produce information that can be utilized in the decision making process. What is the impact of this information on the political process? In my more skeptical moments, I believe that the information produced by these models has had only a negative impact on policy in the sense that it tended 'kill' legislation. In my more upbeat moments, I believe that information plays a very positive role in the political process. To the extent that numbers and information are believed and used, the policy discussions can focus on the important factors that divide the participants.

The authors make an interesting observation when they note that dynamic and static models have rarely been applied to the same problem and have been developed separately.
The obvious question is why is this the case? I think that it is important to remember that the first microsimulation models were dynamic and were built by academics. It was Orcutt's dream that these models would become the organizing framework that would integrate the work of economists, sociologists, demographers, and anyone else who could contribute to a better understanding of society. The richness of these models were displayed in the large range of life events and individual decisions which were modeled and not in the detail that they modeled government programs such AFDC or OASDI. When compared to the static models such as MATH and TRIM, these models are quite crude in their modeling of the government sector. I make this observation not in order to criticize these models but because I believe this level of attention betrays the real primary focus of these models: understanding the social economy from an academic perspective.

While I have never directly used a dynamic model, it is my understanding that these models are rarely used for policy analysis. Rather it is the output of these models which are utilized as the input for other models. For example, consider the fourth policy simulation discussed in the report which pertains to the institution of a social insurance program to cover the use of long term care. In this simulation, a dynamic model would be used to generate a series of cross-section data bases covering a specified future period of time. This data would be dynamic in the sense that there would exist direct links between the cross-sections based upon individuals and households. This data would represent the status quo, in other words, our best guess about what the future would look like if there was no change in policy. For all practical purposes, another model would then be used to estimate the likely impacts of the implementation of the 'new' government program. This model would not have to be an integral part of the original dynamic model. It very well could be a stand alone model which utilizes the data and some modules from the original dynamic model. Its structure would most likely resemble that of a static model. A comparison between the output from this second model and the original data would form the basis to analyze the impact of the long term care program.

This description leads one to the conclusion that perhaps the primary purpose of dynamic models is to 'age' the data to some future period of years. It is Steve Cadwell's (CORSIM model) position that all aging of data for microsimulation models should be done by a dynamic model. The actual analysis would performed by another model utilizing this data in very much the same fashion that a static model would by examining yearly cross sections of the data one year at a time. I have begun to believe that it is more useful to talk about these models as being cross-sectional rather than static models.
Modeling Behavioral Responses to Policy

The authors conclude that "there is little experience with successful modeling of second order effects." I found this statement problematic. First, I am not sure that authors intended to use the term, "second-order." I believe that the more appropriate term to use would be "second round" implying an individual or market wide response to the implementation of a program. Now it is true that in some cases, the responses may be of a second-order magnitude when compared to initial and direct impact of the program. However, I don't believe that is what the authors had in mind when they use this term.

The next part of the statement that troubles me is the claim that we have little experience in this area. But clearly all models have some behavior in them. Even static models such as MATH and TRIM have a program participation 'decision' in them. Now some might argue that these participation decisions are no more than allocation routines aimed at getting the data to line up with other published data and probably there is truth to the claim. But when these routines are used to simulate alternatives to the current programs then I would argue they are simulating behavior. With respect to other behavioral responses such as labor supply and family formation, it is true there is much less experience with these models.

Now the next key word in the statement is "successful." I am not sure whether we have had any successful experiences since there has never been any validation studies of the models' second round estimates. We just don't know if they are accurate or not. Perhaps the most accurate statement would be, "While there has been numerous attempts to model second-round effects of policy, whether or not they have been successful is an open question."

This discussion of the second-round policy effects is interesting since the authors seem to imply that we should move in this direction with caution. I must admit that I have always found quite puzzling the belief that since there is great uncertainty surrounding the magnitude of the second round effects, we should not incorporate them in any estimate of the impact of the policy. The only possible rationale for this belief would have to be made on a mean squared error comparison of estimates. I would argue that by including a behavioral response, the model will produce a less biased estimate but given the uncertainty of our knowledge of the true response, there will be an increase the variance of the estimate. Thus on a mean squared criteria, we might be better off ignoring the response. But this rationale clearly assumes that while others don't have a strong preference for
unbiased estimates and are willing to put up with bias to decrease the variability of our estimates. I guess I just have a strong preference for unbiased estimates and am more comfortable with being on average "right" rather than being on average "wrong."

Having stated this preference for modeling behavioral responses, I want to discuss an dimension which I feel has not be given much attention. Microsimulation is based upon the belief that the population is quite diverse and this diversity is important to our understanding of society and how governments can affect the well-being of households and individuals. Yet when we model any behavioral response in our models, we assume that all individuals with the same observable characteristics will respond in a similar fashion. For example, consider a policy which increases hours worked in a population of identical individuals by 10%. In the current microsimulation models, all individuals would be assumed to increase their work effort by 10% even though the true distribution might be where 10% of the population doubled their work effort and remaining 90% of the population didn't alter their hours of work.

Now this could have a dramatic impact upon our perception of the policy especially if we are concerned with a discrete policy outcome such as the percent of the population remaining in poverty. In this example, let us assume that a 10% increase in work effort would be sufficient to raise a individual out of poverty. By imputing the same response to the entire population, we would estimate that the entire population would work their way out of poverty. However, if it is the second distribution of work outcomes that is true then only 10% of the population will exit poverty. The distribution of responses among identical individuals may prove to be rather important as this hypothetical example attempts to demonstrate.

Data

The authors' observation that the data base used by any microsimulation model is often the biggest and most important task is understated. It is always the biggest and most important task. The quality of data is the single foremost important component of a microsimulation model or of any model. Two sayings come to mind. "You can't make a silk purse out of a pig's ear." "Garbage in, Garbage out." Good data while not sufficient is clearly necessary for a good model.

I feel that much more effort should be devoted to thinking about the data to be used in microsimulation models. I don't think there ever will be a 'silver bullet' data set that will comprise the perfect data. Some have suggested that SIPP is such a data base, I guess I
still need some convincing. My feeling is that there will always be a need to create data for these models by merging data from many different sources. For example, an interesting policy question would be, "How much of the proposed energy tax is being offset by the expansion of the EITC?" Or "How regressive is a VAT which excludes food expenditures?" Clearly to answer these questions in the MATH or TRIM framework, consumption data from the CEX would have to imputed to the CPS data base.

While we are on the topic of appending data from one source to another, I would like to offer the observation that statistical matching and imputation are statistically the same procedures. In statistical matching, we append actual records from the one data base (the original data) to another by trying to match records on the basis of observed characteristics. How different is this procedure from using regression techniques to construct a statistical picture of the original data conditional on a set of observable variables common to both data bases and using this statistical picture to impute variables to the second data base? If we construct our statistical picture correctly there should be no difference between the two procedures.

Investment in Microsimulation Modeling

The report concludes with a quote from the NRC microsimulation panel report which suggests that there exists "no crystal ball which will yield infallible forecasts for guiding investments in policy analysis tools." Since I was a member of the panel, I guess I have to agree with the statement. However, an example in this report suggests that there exists one area of modeling which we should have been investing in and we didn't. The third example in the report discusses a simulation of the provision of transitional child care and Medicaid services to AFDC recipients leaving the rolls. Now it is not like this is a new policy that has never been discussed. Nor can it be argued that the policy addresses a new policy concern. The length of stays on welfare and welfare dependency have long been a policy concern and an area of policy research. Yet as the report indicates, "None of the existing models are currently able to simulate this type of policy initiative." I would like to add that none of the current models are well suited to simulate transitions on and off of welfare nor are they easily adaptable for these simulations. I think that there will have to be some serious consideration given to the possibility that a radically different model from MATH or TRIM will have to be constructed. I don't think that moving MATH or TRIM to a SIPP data base will be the solution. Some creative discussions will have be undertaken before we can determine the desired strategy. However, I feel the model of duration of life events and the corresponding transitions represent the greatest current needs in policy today. The time to react to these needs is now and not later.
While I believe that we should be investing in building models to simulate durations on welfare, the need for models such as MATH and TRIM will still exist. I believe that it is foolish to believe that ever will be the grand model capable simulating everything of policy interest. My vision is more based upon a concept of boutique models which specialize in a specific policy area or type of analysis. To efficiently produce these models, standardization in the constructions of software modules will be needed to be achieved. Greater flexibility and speed of model construction can be realized if there existed a "toolbox" of modules and data which was common to all users. Why should we build models from the ground up or lock ourselves into old models? Recycling plastics and aluminum is the thing to do, so why shouldn't we consider recycling software? It is here that the government can play an important and appropriate role in policy modeling: the creation and enforcement of software and data standards.

Quality of Models

I want to conclude with another NRC recommendation that wasn't discussed in the paper. The quality of simulation output needs to be examined. In the press of trying to answer numerous requests, analysts tend to focus upon the single number produced by the simulation and fail to consider the amount of the uncertainty present in the estimate. In doing so, we fall into the potential trap of believing too much in the simulation results and possibly believing there exists important differences in the effects of alternative policies when none truly exist. Attempts to quantify this uncertainty and to validate models needs to be undertaken. This recommendation pertains not only to microsimulation models but also to spreadsheet models used in policy analysis. Those who use this latter form of analysis shouldn't feel that they can avoid specifying the quality of their estimates.

Suggestions for Revisions

A good paper is characterized by the amount of reactions it stimulates. By the amount of comments that this report generated for me, I would have to give it a high grade. My only suggestions for rewriting the paper would be to first decide which of the observations you feel are the most important to stress and then rewrite the history with those observations in mind. For example, are four policy examples really necessary? I am not sure. My suggestion for possible addition to the paper would be the following. I would think it would really be interesting to hear more about what the authors feel has been the impact of microsimulation models on policy debates.