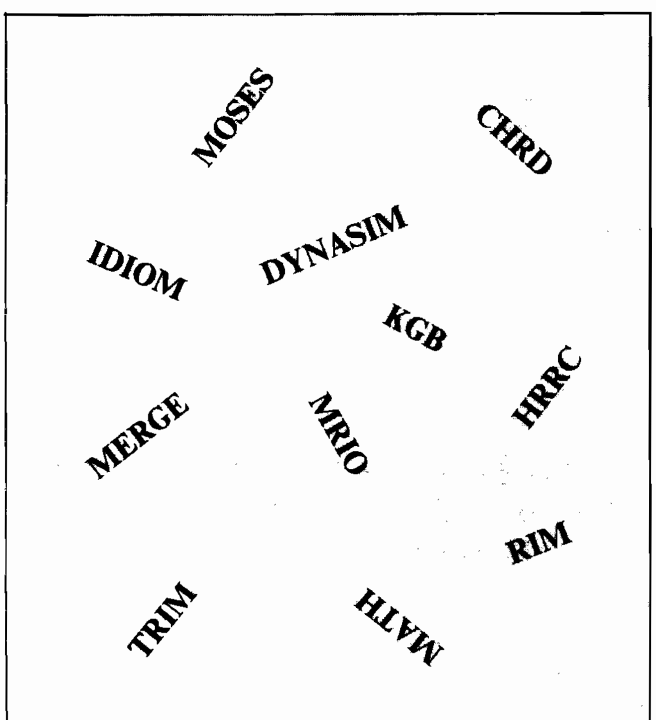
# The "modern miracle" of microsimulation modeling

Struggling through an undergrowth of acronyms, even the informed reader may well be forgiven his impatience with the language of the miscrosimulation modelers. CHRDS and MATH, TRIM and DYNASIM, HRRC and IDIOM—it is not immediately apparent how to pronounce them, and it is even less immediately apparent what their function is. Yet microsimulation modeling is rapidly becoming an indispensible tool; one practitioner has called it, only half in jest, a "modern miracle." When policymakers formulate new economic and social policies or reform old ones, critical questions always are—Who gains, and who loses? And by how much? Policy changes may be stalled while officials and legislators wrestle with such difficult questions. Increasingly, it is the use of the microsimulation models that contributes to answering them.

Microsimulation modeling involves, in essence, the creation of computer models that are designed to simulate the effects of proposed policy changes at very disaggregated levels—individuals, families, firms, industries, and regions. Use of these models enables policymakers to examine the full distribution of the effects of particular combinations of policies, instead of working with averages and broad generalizations.

The two volumes that constitute *Microeconomic Simulation Models for Public Policy Analysis* offer the first systematic review of the major advances in a relatively new, highly promising field of policy analysis. The range of subjects considered is very wide: housing policy and health care, welfare reform and energy, tax and transfer policies. Each model and its data base are explained, and the application to a particular policy issue with notable distributional consequences is demonstrated. Here, rather than describing the models—the details of their structure are complex and constantly in flux, as changes and refinements are introduced—we shall examine some examples of their ability to provide useful forecasts of the consequences of particular actions in two areas: (1) *In reform of existing systems,* especially in accurately and realistically estimating what the government—the taxpayer, ultimately—will have to pay for new programs and what groups will benefit the most. The particular issues to be examined below are the reform of the Food Stamp Program, and the current efforts for welfare reform.




(2) *In formulating new policies.* Given profoundly different and perhaps incompatible courses of action, what are the respective effects of these courses likely to be? The effect of new energy policies on the poor is a classic example where the choices may be very difficult, and some options are discussed.

## Reform

### The Food Stamp Program

Between 1971 and 1976 Food Stamps grew from a relatively little-noticed program distributing $1.5 billion in benefits to a major income-maintenance program costing $5.3 billion. In 1976, 1 in 11 Americans received food stamps; almost as many others were eligible. The great bulk of this expansion came in a very short period—participation increased by one-third between September 1974 and May 1975, and long lines developed at food stamp offices in many cities. States were unable to respond quickly to the crushing increase in workload (many came close to running out of stamps).

The administration, then preparing the budget for fiscal 1976, responded with hasty and, many believed, ill-conceived proposals for cuts that would have affected the elderly and the poorest most severely. These were blocked by near-unanimous vote of Congress. Thus the impetus was given to reform, and the kinds of criticism directed at the government's demolished proposals made it clear that the potential distributional effects of any future policy would come under intense scrutiny. It was at this point that the office responsible for drafting new proposals, the Food and Nutrition Service, began to look very closely at the potentialities of a sophisticated microsimulation model for answering questions such as: How many families would lose eligibility; how many would gain? What kinds of families would bear the brunt of change? How would program costs change?

The model used was a variant of the MATH system. In addition to straightforward questions like the ones above, it was asked to answer very complex questions about interlocking program effects that would have been difficult if not impossible to answer in its absence. What would happen to Food Stamp costs, for instance, if a federal minimum benefit, set at 75 percent of the poverty line, were to be established for all state AFDC programs (a real possibility)? AFDC participation—and hence participation in Food Stamps—would very likely increase, but the higher AFDC rates in those states which currently had very low rates would reduce each individual's food stamp bonus.

One of the most important questions put to the model had to do with substituting a standardized deduction for the individual, itemized deductions whose administrative burden had aroused many state complaints. Obviously, program costs and impacts on recipients would be very sensitive to the level of deduction chosen. For instance, the analysts had intuitively favored a deduction that increased with family size, but the model demonstrated that this would have caused large reductions in existing benefits to one- and two-person families, which included most of the elderly. A flat deduction, however, would preserve the favored treatment of the elderly that was part of the existing system. Thus the model was clearly influential in establishing the details of the reform proposal—indeed, the congressional committee considering the proposal sometimes delayed votes on particular provisions until a model estimate of that provision could be run. Its influence, furthermore, extended beyond the narrower confines of Food Stamp reform. P. Royal Shipp, a senior official of the Congressional Research Service, comments, "It appears certain that never again will changes be made in welfare programs without . . . simulation of the impacts of change on current recipients" (Vol. 1, pp. 77-78).

That this is indeed the case seems evident from the central role played by microsimulation modeling in the course of the administration's current efforts toward welfare reform.

### Welfare reform

Any change in the government's tax and income transfer policies will have substantial effects on the way people behave—how they allocate their resources of time or cash, how much they work, what their living arrangements are. These effects, moreover, will not be confined only to the immediate recipients of benefits. If, for instance, the income of higher-income people falls because they must pay higher taxes needed to support more generous federal transfers, then there will very likely be unfavorable effects on those sectors in which high-income people concentrate their marginal spending—for example, travel, finance, insurance and consumer luxuries. Not only are these behavioral effects pervasive, they are often unpredictable. (For example, consider the unexpected increase in divorce and marital separation rates among two-parent families in the Seattle-Denver Experiment to test out the effects of a negative income tax.)

Clearly, it is of the highest importance for all who are currently concerned with welfare reform to be able to predict the likely behavioral responses. Increasing concern with problems of work incentive, labor supply, and productivity, as well as with the expanding size and costs of the current welfare program, has led to a new stress on work programs, especially in the form of guaranteed jobs, as a major component of any new welfare package (see FOCUS, Fall/Winter 1979). If the government establishes a large public employment program, which people—and how many of them—are likely to participate, and for how long?

In the administration's welfare reform efforts since 1976, microsimulation has been an integral part. The model most frequently used was developed within the former HEW (now HHS, Health and Human Services); it has proved able to predict not only the effects of substantial changes in both cash assistance programs and the positive tax system, but also the effects of introducing a relative unknown—a large public jobs segment. Outside the confines of the administration's defunct Program for Better Jobs and Income, which it was originally designed to explore, the model has proved its usefulness over and again. It has most often, and probably most effectively, been used to inform policymakers of the costs of marginal changes of a single element in a general welfare program, and has been instrumental in determining basic benefit levels, benefit reduction rates, effects of state supplementation of benefits, and wage rates in a public employment program.

But the model has not been effective merely in answering specific questions. Within the context of the debate between those who would maintain a cash only program, and those who would guarantee households both jobs and

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cash, microsimulation results have made it clear that significant trade-offs are involved. A cash only program will most effectively reduce poverty, but also diminish work incentives for recipients. Guaranteeing jobs will engender greater work effort, but reach less of the poverty population. And either alternative will reduce private-sector earnings among low-income persons. The choice before Congress will ultimately be a moral or judgmental one. But the ability of microsimulation modeling to clarify the costs of moral choices has made a substantial contribution to the debate.

## Energy

### Two ways to go

Rapidly rising energy prices, energy supply shortages, and severe winters have focused increasing attention on the plight of energy consumers—particularly low-income consumers—many of whom are faced with physical discomfort from inadequate heat or financial hardship from mounting fuel bills. The incidence of hardship has been very uneven. Shortages strike users of specific fuels in particular states or regions; financial hardship is concentrated among the low-income population, which already spends more of its income on energy than other groups, and has little flexibility to alter consumption patterns.

Concern that all segments of the community be equitably treated has repeatedly surfaced in congressional discussions of energy, and is one of the stated principles of the administration's National Energy Policy (NEP), promulgated in 1977. Since most proposed energy policies involve a trade-off between equity and efficiency, assessment of their distributional effects on American families is a matter of high priority. Such assessment is very complex, given the intimate involvement of energy, in various forms, in our daily lives; besides, much necessary information on residential energy use is simply not available. A model has, however, been developed to estimate first-round direct effects of proposed energy policies on households. It is designed to answer such questions as the following: If the price of gasoline were raised by 25 percent, what would be the impact on families at different income levels? How much energy would be saved by a policy that subsidized increased insulation for houses more than 15 years old, and who would benefit most?

Many aspects of a comprehensive national energy policy have not yet been determined, and there are, abstractly considered, a number of different ways the government might choose to go. Two possibilities, one directed at encouraging individual conservation measures, the other manipulating the energy market, are discussed in these volumes: the "Conservation Scenario" and the "Rebate Scenario."

The Conservation Scenario includes a number of actions that are assumed to affect demand for energy; in the energy market, business as usual prevails. Automobile fuel efficiency standards are tightened; a national van pool program changing many commuters' travel patterns is instituted; new thermal efficiency standards for appliances and for buildings are established, and gas pilot lights eliminated; tax credits are given for insulation of existing buildings. The Rebate Scenario in contrast, attacks the problem within the energy marketplace: It resembles rather more closely an early version of the NEP, and includes uniform pricing of natural gas and sharply reduced industrial and utility use of that fuel; a crude oil equalization tax; and a standby gasoline tax.

Effects of these two policies were simulated for 1985, and measured against figures derived from a base that simply extended to 1985 the conditions of demand and supply prevailing in 1975, without introducing major technological improvements or conservation measures, or any new regulations.

### The conservation scenario

A complex set of practical measures had to be simulated; they are described in detail in the book. Eliminating gas pilot lights in favor of electric starters, for instance, might well result in decreases in total gas consumption of 37 percent for stoves, 22 percent for water heaters, and 7 percent for furnaces in return for far smaller increases in electrical usage. The model was also able to simulate a complex series of home insulation policies—caulking only, caulking plus storm windows, wall insulation, or ceiling insulation—and a number of changes in commuter patterns, including distance from work, existence of a van pool, and income.

Such measures, according to the results of the simulations, would result in energy savings of around 20 percent over the base scenario. Fuel savings for all households were so large that the percentage of disposable income spent on energy fell to the 1974 level, despite the higher energy prices that were assumed to hold in 1985 and the higher real standard of living (associated with wider ownership of appliances and less drafty homes) that was also assumed.

But the benefits of the conservation policies were not evenly distributed among all households. The absolute fuel savings for low-income and poor households (that is, households with incomes under $10,000) were about 20 percent, but those for households with incomes above $10,000 were nearer 25 percent. Clearly, low-income households have less opportunity to benefit from conservation measures: They own fewer appliances, and those appliances tend to be older; they often live in older houses and are thus less likely to benefit from thermal efficiency standards; finally, they are less likely to own those houses, so that tax-incentive programs for insulating owner-occupied houses are irrelevant to them.

Gasoline savings from the higher levels of fuel economy mandated for automobiles were dramatic, but the same pattern prevailed—the largest increases in gas expenditures over 1974-75 were experienced by low-income families, who tend to drive older, larger autos purchased second-hand. The smallest increase was paid by middle-income families, who tend to own relatively new, small, or medium-sized autos.

Note, too, that these figures estimate only savings from conservation measures. When one begins to compute the costs of such changes, including perhaps higher prices for more energy efficient autos and appliances, it is clearly the poorer families who are once again at a disadvantage and find themselves spending larger fractions of their incomes.

### The energy rebate scenario

Under this scheme the energy tax revenues resulting from the market policies outlined above would be redistributed to the public. Different rebate redistribution schemes were simulated. All families obviously would benefit to some degree by a check in the mail, but the method chosen would dramatically affect the amount of benefit that poorer families received. Redistribution through a federal income tax credit would be of little use to the many poor families who pay no taxes. Establishing in addition an "energy bonus" payable through the Food Stamp program would be a much more effective mechanism for spreading the gains more widely and equitably, although many who are eligible to receive food stamps choose not to participate. Whatever the merits of any particular choice, however, it is clear that microsimulation models can provide much pertinent information as policymakers ponder alternatives.

### Some caveats

There are, inevitably, difficulties with any new methodology, and microsimulation modeling has its share. They are succinctly laid out in the introduction and final overview chapter of these volumes, and are more fully discussed throughout. These volumes, indeed, constitute a "state of the art"—a review and evaluation that should become essential reading for those who make use of such tools, or who must rely upon the figures they generate.

Because such models are very complex, their construction, operation, and updating require very large research, computer, and survey costs. The potential for programming and calculating errors is large, and because of their cumulative, linked nature, minor restructuring or respecification at early stages may require massive reprogramming and recalculating all along the line.

Moreover, the collection of data for such models is still very imperfect. Many existing data sets are inadequately detailed, or tooled for other purposes; they need much manipulation to fit the demands of a particular simulation model. The data contain many weaknesses—misreporting, or inadequate sample size. Besides, the information available for simulation must be very frequently updated so that cost and impact estimates remain accurate under rapidly changing economic circumstances.

To point out these and other difficulties, however, is not to detract from the promise held out by these new tools, or to call into question their ultimate validity. With each generation these models become increasingly sophisticated, their potential wider. ■

## Work in progress
## Preparation of public use sample tapes: The 1940 and 1950 Census of population

Public use samples from the 1960 and 1970 censuses have proved major sources of data on the levels and trends of poverty and other forms of social and economic inequality; on the geographic, racial and social incidence and distribution of poverty; and on market, life-cycle, and family factors that cause poverty. These data are used extensively by social scientists and policy analysts.

The creation of similar samples from the 1940 and 1950 censuses will provide social scientists with the opportunity to trace and describe in unprecedented detail the processes of social and economic change in the United States from the Great Depression to the present day—a period that covers transitions of extraordinary magnitude. The files will also offer an opportunity to construct models of change, and to investigate the way in which changes are interrelated.

Institute researchers Halliman Winsborough, Karl Taeuber, and Robert Hauser head this extensive project funded by the National Science Foundation. An archival record (transcription) of very large (N1/100) samples of person-records from the 1940 and 1950 U.S. Censuses of Population and Housing and a public use sample (or samples) of persons and households will approximate the design and content of the 1960 and 1970 Public Use Sample of the U.S. Bureau of the Census and will be distributed by that agency. ■