INTEGRATING THEORY AND MEASUREMENT

B. Bergmann – G. Eliasson – G. Orcutt

Economic theory must always embody the particular approach that makes it most efficient for handling the chosen decision problem. The all purpose theory is probably impossible by definition and without a decision problem at the back of his (or her) mind the researcher should be at a loss about what to do. It should therefore be considered natural to find – as we do – a multitude of models or theories designed to interpret the same economic phenomena. The particular decision problem chosen determines what is important and what should be deemphasized.

There is, however, one clear restriction that limits the number of possible approaches to economic reality, namely experience and systematic observation. Aspects of a theory that do not pass the test against observation are not allowed to survive in a true scientific environment. In a complex world one should consider it natural to live with many conflicting interpretations of economic reality; but in a world of scientific progress the interpretations should change, old erroneous doctrine should be unloaded and new theory allowed to enter.

The need exists to integrate theory and measurement, in particular by developing theories that incorporate and predict relevant economic behavior and that allow for the most efficient and thorough confrontation with available experience. The basic scientific principle must be to keep ridding the set of suggested explanations of erroneous hypotheses, while simultaneously forming new hypotheses to constantly upgrade our vision of economic reality. This places the requirement on any theoretician in an applied science like economics to add specifications about how to measure his variables. There is no way for the theoretician and the empiricist to live meaningful, separate lives. They should be one and the same person.

This is where the *micro simulation* method enters as a potentially efficient device for organizing scattered versions of theorizing in a consistent manner and on a format that makes efficient confrontation with measurement necessary and feasible as not before, albeit in a somewhat new and unconventional garb.

We believe that micro simulation opens up new possibilities for estimation and analysis based on direct access to the wealth of data that exist at the micro level. The basis rules of empirical inference can be more efficiently put to use. This is why several papers and much comment in this

volume are devoted to measurement and observation techniques in micro simulation models. This was originally the desire of the conference organizers, and even though we recognize that much further work is needed here – not in the least pedagogical –, we think we have made some modest contributions. In fact, the way the distinction between theory and empiricism is blurred is perhaps one of the most useful aspects of economics that are illustrated in this conference volume. Some of the papers and models presented should be regarded as theoretical contributions by conventional standards. All models presented here are, however, based on a much more solid and relevant empirical footing than what is common in theoretical papers in economics. By this we reemphasize again one theme of the conference, namely that a criterion of good theory in economics can only be how well grounded in relevant, empirical facts it is.

The main purpose of the conference, however, was to organize a meeting around the *technique* of large scale (economy wide) micro based modelling. At the time of organizing the conference three more or less complete model systems were in existence – the *Urban Institute – Yale model* project headed by Guy Orcutt, the *U.S. Transactions model* headed by Barbara Bergmann, and the *IUI-IBM Swedish model* project headed by Gunnar Eliasson. These models are all presented in this volume.[1] They illustrate the multitude of approaches that can be taken to economy-wide modelling and how emphasis on different kinds of problems gives rise to different methodologies.

Most questions asked of economists are addressed to typical macro economic phenomena. Macro economic modelling using Keynesian concepts was a first efficient answer that allowed economists to cut through the analytically impossible maze of partial theory existing at the time. The Keynesian revolution was the first true systems approach in economics. It provided the rationale for several grand steps forward in combining theory with measurement (=models) encompassing entire economic systems.

1) Demand driven, national income based *business cycle macro models* have turned out to be quite successful over the last two decades.

[1] At the conference several special reports were given on *other* micro simulation projects in progress. Brief presentations of some of these projects are given in a separate section at the end of this conference volume.

2) Demand driven *input-output, macro sector models* of the Leontief-Keynesian type represent a second major step forward in applied economic theory and several successful models of that type have become operational during the last ten years.

There are at least three serious draw backs associated with these models,

a) a major "element" in economic thinking simply is not allowed to figure explicitly, namely the *market process,*
b) macro modelling deprives us of the efficient use of existing, high quality micro information,
c) it makes it formally and technically difficult to model true dynamic macro economic behavior that is essentially a micro market-macro income determination process over time.

The new methodological development in economic systems modelling, 3) *micro simulation,* solves these three problems simultaneously and also relieves us of the unsound practice of deliberate misspecification to achieve solutions and answers. This is, of course, at the expense of something, most notably easy intelligibility of results. This is, however, largely a beginner's dilemma. Understanding comes with experience. New, sometimes surprising results, and complex problems should not necessarily be easily and immediately comprehended. The black box dilemma of the micro simulation model should always be viewed against the back drop of the full fledged multi-sector macro models currently in use in many institutions, where transparency is no typical virtue.

The micro simulation model in fact offers itself as a great didactic instrument if one understands how to use it properly. Assumptions not only can be stated correctly but also more intelligibly, whereas macro theory forces us to a high level of abstraction in this respect. Dynamic processes can be described one at a time in quite easy language and we never have to resort to traditional but awkward constructs like forcing the economic world to be in perpetual equilibrium – an absurd construct to say the least. The problem is understanding the whole economic machinery at work simultaneously, but it is not altogether clear that a human brain (and eye) should be capable of seeing through such a system at a glance. On the other hand one can learn and become familiar with the properties of a theory (a model) and learn to put it to efficient use to enhance one's understanding of empirical phenomena. This is something that has long

been recognized in natural sciences.

The many uses of the term micro simulation often confuse more than they reveal. Before we proceed it is appropriate to state what we think the term means.

Micro simulation represents a numerical method of dealing with more complex versions of conventional theoretical structures. It represents a method of coordinating large volumes of numerical information.

It takes testing and estimation down to basic behavioral assumptions at the micro level and relieves the researcher of an unsound overreliance on goodness of fit criteria at the macro level.

It represents, by freeing one of the confines of the "analytical paradigm" of economics, a new and extremely rich language of theoretical expression. This is no longer new in many other sciences.

It offers a new "cognitive" way of handling more realistic, and hence more complex, thought about the ways society works, much in the same way that various branches of mathematics have done a lot of good to many applied sciences. One example is the possibility of integrating market price theory with income determination theory in an empirically relevant fashion.

In fact, the listing above simply describes a method of integrating theory and measurement, and any theory pretending to be relevant should have that aspect well developed.

The description given also emphasizes that micro simulation is a theoretical and empirical method combined, as it should be. The set of papers presented in this conference volume illustrates this well. The papers represent various theories on how a national economy works, shaped in a micro simulation framework. The common denominators are two, namely, that they all deal with behavior (decision) units at the micro (firm, household, etc.) levels and that they all aggregate up to large parts or all of the national economy.

THE THREE MODELS

The Urban Institute – Yale (Orcutt) model is primarily concerned with behavior in the household sector, which is enclosed in an outline of a production system with few feedbacks. The U.S. Transactions (Bergmann) model places more emphasis on the production system, which is a semi-macro construct with each cell in the input-output matrix representing one firm. The firm behaves on the basis of expectations drawn from

past experience and is guided by a mark-up pricing system. The household sector has a full micro presentation in a reduced scale U.S. economy consisting of 800 households of different wealth, income, marital, occupational, etc. status. The overriding emphasis, however, is on the financial side where all volume transactions are traced financially from week to week.

The IUI-IBM (Eliasson) model on the other hand places *most* emphasis on the production and supply side, where a large number of individual firms (most of them being representations of real Swedish firms) appear as decision makers in an *explicit* market process. An explicit feedback at the micro market level from profits via investment and capacity growth to the supply decision in effect means that market price theory has been merged with income determination theory.

The *U.S. Transactions model* works by having each of the actors represented in the model follow a weekly schedule of economic decisions and consequent activities, in the course of which interactions with the other actors occur. The major decisions for households (job search, home and auto acquisition, other expenditure, debt and portfolio management) for the non-financial firms (production, employment and hours setting, price and wage setting, acquisition of capital goods, debt and portfolio management) and of the non-financial firms (interest rate setting, loan rationing, port-folio management) are all based on the position of the variables at the moment the decision is contemplated. The weekly period is short enough so that no simultaneity need be allowed for, which greatly simplifies the task of running the model and modifying it to reflect policy changes whose impacts are being evaluated. The structure allows for policies to be represented in a great deal of naturalistic detail, with such elements as "triggers" and other nonlinearities easily incorporated.

The *Urban Institute – Yale model* described in this volume is a member of the Urban institute DYNASIM class of microanalytic models. It is implemented in a new microanalytic simulation system called MASS.

The DYNASIM models have been and are being developed for use in the analyses of United States public welfare and social security policies and so are strongly focused on individual and family behavior, income, and income maintenance. They represent a useful step toward development of models which successfully relate outcomes to policies concerned with unemployment, inflation and inequality as well as income maintenance and poverty.

The core of the model presented consists of program modules which determine the probabilities that various events will occur to an individual or family, and which assign quantitative values to person and family characteristics. In addition to the micromodel a simple macromodel of the economy is also included. The key steps involved in using the model for policy analysis are:

1. An initial population is specified. Currently, samples of ten to twenty thousand drawn from the 1960 or 1970 decennial census are used.
2. For each person and family unit in the population the probability of occurrence of an event that would change an individual or family characteristic of concern (e.g., marriage, death, entrance to the labor force, unemployment) is computed.
3. Assignment of changes in status to some of the individuals in the population are made to provide a fully specified set of attributes for each individual and family which will generate the simulated population sample for the next year.
4. For some events, a quantitative amount is assigned, such as hours in the labor force, wage rate, or amount of social security benefits. In the case of transfer payment income, the quantities are calculated by applying administrative rules.
5. In conducting policy analyses, changes in government programs are introduced. Their impact is then predicted taking into account predicted induced effects as well as direct effects.

The *Swedish model* is complete, in the sense of covering the entire economic system and being equipped with all the necessary feedbacks on a quarterly basis. For the time being, everything outside the manufacturing sector is a conventional Leontief-Keynesian macro model. Micro to macro contact is established through (explicity modelled) labor, product and money market processes. Interaction runs across markets as well as over time through price-quantity adjustments. As in the U.S. Transactions model, expectations figure importantly in the decision machinery. Wage income by individuals working in the production system are added and transformed into taxes, savings and various consumption items in the household sector, represented by a nonlinear expenditure system with saving and durable goods stock demand being determined simultaneously with other spending categories.

The money and financial system is explicit but much more crude. An important link is the quarterly feedback through market price-quantity determination via profit formation and investment decisions in individual firms to capacity growth. Growth may be said to be endogenous under an exogenous upper technology constraint. In this sense the IUI-IBM Swedish model combines market price theory with income generation theory in a dynamic fashion not often found in current theorizing. It makes the model very market-oriented and capable of investigating the allocative efficiency-market stability trade off pattern of an economic system which was one of the ambitions of the model venture to begin with.

The micro simulation approach thus allows us to break the analytical confines of equilibrium theory and develop a true numerical disequilibrium framework of analysis. The explicit feedback loops at the micro level between market pricing, profit generation, investment, capacity growth and the supply decisions of each firm gives the total model system a spectrum of "new" properties that so far have received strong support in empirical testing of the model. Several papers on this are included in this conference volume. It has been demonstrated throughout the hundreds of experiments performed so far that micro market disturbances that cannot easily and rapidly be learned and adjusted for by decision makers invariably tip the economy on to a lower, long-term growth path.

The disequilibrium approach is carried further in the Nichols micro simulation model that is exclusively concerned with the labor market. In fact, a positive, frictional unemployment rate that is efficient in the sense of maximizing output probably needs the disequilibrium characteristics of the microsimulation approach to be established.

The more complete full economy model of Yndgaard, on the other hand, is designed in the Arrow-Debreu tradition, in the sense that the system, when disturbed from an equilibrium position if stable, is forced to return it to the same fix point by some time path.

Nichols' results are particularly interesting to compare with the IUI-IBM model. He begins with a random distribution of variously talented workers on jobs requiring various talents. He then allows the model market to reallocate the workers on new jobs. Over some ranges he finds that misallocated labor is such a severe handicap that GNP actually increases from a reallocation even if unemployment also increases. There seems to exist a particular rate of turnover in the labor market that is

efficient in a macro economic sense. An interesting collary would be to see if the reallocation mechanism itself is so fast that it disturbs the market signalling function and hence hampers growth in the longer run through profit and investment feedback, as in the Swedish model.

In all three full economy models rigid distributed lag specifications from econometric models are replaced by a sequential decision machinery and frequent feedback loops through the entire economic system. Some would argue that this way of reducing the number and importance of fixed coefficients in the model system and making the hierachical ordering of decisions more important is the true and relevant way of representing an economy. From a qualitative time ordering of decisions and a period specification that conforms approximately with decision times, a quantified time pattern of responses can be derived. As illustrated in the price transmission study on the Swedish model (see p. 281 ff) distributed lags will appear as expected. They will, however, often not be invariant to the impulse being transmitted and more perilious, even if invariant, the traditional inertia interpretation of the distributed lag will be erroneous.

By this we want to emphasize again that there is no meaningful dividing line between theory and empiricism. All econometric models used for, say, forecasting are a mix of assumption and measurement. So are all the models presented in this volume. There is no basic difference between Yndgaard's and Nichols' truly *"principles"* model on the one hand and the Orcutt model, based on very extensive measurements on the other. They all tell us something about an economy in a particular decision context. They differ with respect to the extent and character of quantitative measurement entered.

As stated by both Orcutt and Klevmarken in their methodological papers the micro simulation method allows efficient partial testing and estimation of the model and the piecewise integration of more empirical information into a relevant theoretical system. In principle this makes the micro simulation approach potentially very useful for comparing different economic systems. The micro simulation modelling technique is still too new for this to have been done at an empirical level. However Albrecht has loaded the Swedish model with "synthetic data" adding up to a closed

U.S.-like economy allowing him to study the effects of inflationary expectations on two differently structured economies.

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Barbara Bergmann
University of Maryland

Gunnar Eliasson
IUI

Guy Orcutt
Yale University