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The Methodology of Planning Models

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Introduction

When a group of us at the Department of Applied Economics started work some four years ago on a computable model of the British economy, we had only vague ideas about the extent to which large econometric models were being built in other parts of the world. From time to time we felt that we ought to try to improve our knowledge, but for one reason or another nothing got done. The stimulus for the present survey came from the invitation to prepare a paper on the methodology of planning models for the 1964 Universities–National Bureau Conference on National Economic Planning.

What follows is an empiricist's reply to this request. It consists simply of a preliminary report on a number of models whose directors were kind enough to complete a questionnaire on their work. At the end of this paper we reproduce a copy of the questionnaire, a list of the directors of the projects reported on, and a selected bibliography. So far we have received reports on thirty-one models, and, from this sample, we have attempted to generalize on a number of methodological questions. We have been promised a number of further replies and intend to produce a final report on the subject in our series *A Programme for Growth.*

The Survey

We should make it clear at the outset that the subject we set out to cover is the methodology of planning models. Accordingly, we did not attempt to examine the vast range of published material on specific economic relationships, demand functions, input-output, production functions and so on, nor did we attempt to cover practical planning methodology which, in many cases, does not involve a model of the economy at all.

Our interest has centered on models directed to forecasting and planning: it is complete models rather than isolated ingredients or practical purposes that are considered here.

Our procedure was to draw up a questionnaire and to send it to research centers which we knew or believed to be engaged in applied economic model building. We enclosed a list of the centers to which our questionnaire had been sent and invited further suggestions. These we received in considerable number, and it is partly for this reason that our survey is not yet completed.

It follows from this that our sample is not representative. If anyone is engaged in purely theoretical large-scale model building, he may well not have been approached. Our personal contacts with model builders were heavily weighted in the direction of work in developed countries. Our invitation to correspondents to suggest further correspondents proved extremely useful but meant that our original intentions were mediated to some extent through our correspondents' interpretation of them. In fact, this does not seem to have led to any distortion.

A few internationally famous model builders found it impossible to reply to our questionnaire and, as a result, their work is not reported here. We sympathize with their difficulties and regret these gaps in our survey. To most readers, however, their models are probably well known.

Our result to date is: a fairly good coverage of Western Europe; a limited coverage of the United States; the socialist countries represented by Czechoslovakia, Hungary, Yugoslavia, and Poland; other areas represented by Argentina, India, Israel, Japan, New Zealand, and models intended for application in Egypt and Turkey; and several models established by international organizations. We expect to increase this coverage in our final report.

The form of our questionnaire was largely based on our own experience and for this reason must have given difficulties to many of our correspondents. Nevertheless the response rate was high, and a warm interest in what we were trying to do was an encouraging feature of many of the replies we received. We should like to take this opportunity of thanking all who have contributed for their cooperation. They have helped to draw a picture of world econometric model building which is perhaps not generally appreciated. The broad outlines of this picture are described in the following sections.

General Characteristics

Questions 4, 5, 6, and 13 in our questionnaire deal with general characteristics and can conveniently be considered together:

Correspondents were invited to say whether their model was theoretical or numerical and, in the latter case, whether it had yet been applied. All the models in our sample are numerical, and about two-thirds of them have already been applied. In general, this application is not a once-and-for-all affair, as has so often been the case with econometric models in the past, but is part of a continuous process of use, checking, refinement, and reuse. The fact that a substantial number of models have come to stay is a comparatively new feature on the economic scene and the best guarantee we could have for solid improvement in the future.

On the question of geographical coverage, most models were national models. Of these very few had, or planned to have, any regional subdivision. Naturally enough the position was different with models constructed by international organizations; here the area covered was the European Economic Community in one case and the whole world divided into three regions in another.

Correspondents were invited to say whether the main purpose of their model was for description, forecasting, or planning. The great majority indicated planning as a use, though in a number of cases this should perhaps be interpreted as economic decision-making in a wide sense. Most model builders indicated a second use, and some indicated all three.

The models in our sample differed widely in their planning horizon—from under one year to infinity. They fell broadly into two groups: one with a horizon of around two years, another with a horizon of around ten years. Twenty-eight models could be classified in this way; of these, eleven were short term (or short to medium term), and seventeen were medium to long term (or long term).

At this point it is convenient to deal with question 13, which asked if the model was static or dynamic. This question was not, perhaps, ideally formulated. Our intention was to find out whether the models involved differences or differentials and so could work out a future path from a given initial state, or whether they depended on data or assumptions to provide a basis for a consistent picture of the future. We did not intend by this question to inquire whether relationships contained residual time trends or whether past estimates of parameters

were modified before application to future conditions. Interpreted as we intended, the answers indicate that rather more than half the short-term models and about one-third of the long-term models should be classified as dynamic.

This result is not surprising. The kind of short-term model that aims at projecting a set of variables from a given initial state until the estimates may be expected to be swamped by the accumulation of residual errors, must, of necessity, be dynamic. At the other extreme, the kind of model that tries to draw up a series of consistent pictures of the future based on a few basic assumptions that can be varied will usually be formulated in static terms.

The Accounting Framework

Given our special interest in the accounting aspect of economic models, we sought information on various issues of this kind in question 7:

Part a. Most of our correspondents stated that their models were contained within a social accounting framework. Without exception, correspondents in the socialist countries replied "no" to this question or left it unanswered; they were not alone in this respect.

Part b. The different classes of accounts employed in the various models were not, on the whole, very well specified, and it was impossible in many cases to form a clear picture of the accounting structure underlying the models. The clearest picture emerged for input-output accounts and indicated a tendency toward medium-sized tables distinguishing some twenty to fifty branches of production.

Part c. In only five models was a distinction made between industries and commodities. In one case as many as 2,500 commodities were mentioned.

Part d. As regards capital expenditures, we asked whether gross investment had been subdivided between (i) depreciation and net investment and (ii) replacements and extensions. We received seven positive replies to (i) and (ii); a further seven positive replies to (i) only; and a further five positive replies to (ii) only.

Part e. We asked if a separate set of capital accounts had been established for consumer durables other than housing. In almost every case the answer was "no."

Part f. A distinction between complementary and competitive imports was used in about half the models. Other distinctions were also mentioned, "tropical agriculture" versus "mining products" and "finished" versus "unfinished" being two examples.

Part g. We asked whether a separate subsistence sector appeared in the accounting system. Since most of the models in our sample relate to economically developed countries, most of the answers were "no." The few positive answers probably reflect the fact that imputations are made for a few important nonmarket transactions rather than the existence of a separate subsistence sector.

Part h. We asked our correspondents whether existing national accounts statistics proved adequate for their model-building purposes. About one-third said "yes." Of the two-thirds who said "no," comments ranged from "not entirely" to "of course not!" This somewhat negative state of affairs may explain the small number of detailed accounting frameworks reported and indicates that the importance of close working relationships between economic statisticians and model builders, which already exist in some countries, should be more widely recognized.

Assumptions

The role of assumptions in model building formed the subject of question 8: Assumptions about variables of the kind specified in this question formed an important element in the majority of models, though there were some clear-cut exceptions to this general statement.

Broadly speaking, there were two main reasons for the introduction of assumptions. First, assumptions were made about the dependent variables of potential relationships which had not yet been specified. This category would include assumptions about the rate of growth of the population or of the labor force and about the rate of technical progress. Second, assumptions were made about variables which reflect economic aims. This category would include assumptions about the rate of growth of consumption or of GNP or about the level of the balance of payments in a future year.

Relationships

The extent to which various economic relationships were employed in the model formed the subject of question 9:

Part a. Demand functions for private consumption appear in almost all the models. Similar functions for public consumption were mentioned in a few cases but, as might be expected, reliance is mainly placed on policy projections or known plans. Demand functions for imports appear in about half the models; for exports, in about one-third.

Part b. In most models use was made of current input-output relationships relating either to domestic intermediate production alone or to this plus competitive imports. In a number of cases complementary imports into the branches of production were also determined by similar coefficients.

Part c. Surprisingly little use seems to be made of production functions. Of the few positive replies, two or three mentioned each of the following: Cobb-Douglas, Cobb-Douglas with time trend for productivity growth, and vintage forms. Connections between labor and output and between capital and output by means of coefficients were frequently mentioned.

Part d. We also asked about the use of capital input-output relationships. About three-fifths of the replies were positive; but this should be interpreted to mean that more or less aggregated capital coefficients are much used, not that most models have a matrix of such coefficients classified by using industry and type of equipment.

Part e. About three-fifths of our correspondents indicated that they used price-formation relationships, but it is not clear how this statement should be interpreted. In many cases it would seem to indicate that product prices are calculated from the cost of primary inputs per unit of output by means of a matrix multiplier.

Part f. About a third of our correspondents indicated that they made use of foreign trading relationships. These were usually the same people who had already stated that they used demand functions for both imports and exports. We had intended to isolate by this question models in which imports and exports were sensitive in detail to relative prices and exchange rates; but we have only ourselves to blame for uncertainties of interpretation.

Part g. About a third of our correspondents mentioned the use of explicit saving functions.

Estimation

A number of questions relating to sources and methods of estimation formed the subject of questions 10 and 11: About half the sample mentioned both tabulations of census data and special sample surveys as bases used in estimating parameters. In a few cases only one of these sources was used. About two-thirds of the sample mentioned the use of impressions of outside experts in industry, government, etc. This seems to suggest much more contact with the outside world than used to be

the case in economic model building. If this conclusion is justified it is clearly a good sign.

In almost all cases econometric analysis was mentioned. It is perhaps surprising that there were any exceptions. Almost everyone made use of time series and about half the sample mentioned the use of cross-section data as well. Over two-thirds of the sample used least squares methods of estimation; nearly a quarter mentioned the use of simultaneous equation methods as well. The positive answers to the second question show considerable geographical diversity, and it is perhaps of interest that they are so numerous.

Almost half the sample mentioned that attempts were made to measure changes over time in input-output coefficients; a much smaller proportion said the same thing in respect of coefficients relating to consumers' tastes or preferences.

Over half the sample indicated that the results of their calculations were modified subjectively before use.

Computation

The methods used in carrying out the calculations formed the subject of question 12: About four-fifths of the sample indicated that they used electronic methods. A wide range of equipment was reported. The name of IBM was mentioned in many cases, and the name of Elliott occurred a few times. In about one-quarter of the sample the program was written in stages, the maximum number mentioned being eleven. In about one-quarter of the sample iteration was said to play an important part.

Size and Scope

Plans for increasing the size and scope of the models formed the subject of questions 14 and 15:

Almost all our correspondents had plans for increasing the size of their models. Interestingly enough, only a small proportion, under one-quarter, proposed to do this simply by increasing the size of the model, keeping the form the same. A little over one-third said that they proposed to develop submodels. About one-third planned to adopt both methods.

About half the sample had plans for extending the scope of their models in various directions. All who had such plans mentioned their intention to explore the demand for labor skills. About one-third also

intended to examine the role of education and training in satisfying these demands. About one-fifth intended to work on the role of research and development.

Organization

The size and composition of the staff employed and the nature of sponsorship and support formed the subject of questions 16 and 17:

In most cases our correspondents informed us about the size of the staff they employed. Although there are exceptions to this generalization, professional staffs tended to lie in the range six to twelve, clerical staffs in the range three to six. In making this statement we took account as far as possible of indications about part-time work. What we could not allow for was the range of activities undertaken by the model-building team: How far, that is to say, they could call on government departments or others for assistance.

In all cases where a classification of professionals was given, economists formed a substantial element but frequently not the majority of the professional group. Statisticians, mathematicians, and programers were all represented in most cases. Sociologists and other professionals were mentioned in a few cases.

In the great majority of cases a government or other public body was connected in one way or another with the model. In about one-fifth of the sample the work was undertaken at a university; in a rather larger proportion, by an independent research institute. In a few cases these two types of organization combined. The majority of models were built by government or international organizations. Other institutions were mentioned mainly in connection with finance.

Conclusions

This completes our preliminary survey, and it seems to us that the picture that emerges is distinctly encouraging.

In the first place, there is ample evidence of a large amount of model-building activity all over the world. As far as our results go to date, this is largely concentrated, as one would expect, in the economically advanced countries. The models are all intended for application and in most cases have been applied. In general they are not of the single-shot variety but are being maintained and improved. As time goes on they will provide a great deal of experience, the most needed ingredient in building better models.

In the second place, the models show considerable variety in terms of form and aim. They range from short-term forecasting models, which measure the future in quarters and try to look at the economic scene up to one or two years ahead, to long-term planning models, which measure the future in quinquennia and try to draw up balanced pictures of the economy from five to twenty-five years ahead.

In the third place, the survey shows the considerable strides that have been taken in recent years in systematic data processing and in the application of theory and statistical methods to economic phenomena. No one engaged in these processes can feel that he has reached the end of the road, but there are indications of a number of developments that may be expected to bring him perceptibly nearer. One is the increasing professionalization of business managements and the recognition that this often fosters the potentialities of model building. As a consequence, econometricians who seek practical help from industry receive, on the whole, a much more positive response than they did in the past. This widening of the range of communication is almost a *sine qua non* of successful model building. A second interesting development is that even when governments do not build models themselves, they are usually associated in one way or another with the model-building activity of others. Third, we can detect an increasing concern with social as opposed to purely economic phenomena; and particularly with questions of labor skills and the system of education and training in which they are learned. There is no need to believe that education exists simply to supply economically useful skills in order to welcome this development.

Finally, we see that all models in our survey are computable models generally making use of large, high-speed computers. It can fairly be said that without the development of the computer they could not exist. Yet, in spite of the immense number of calculations now required in solving the equation system of a large model, it is probably the general view of model builders that computing capacity does not and in the future will not provide any restriction on their activities. One great difficulty of the past has been overcome. We are now free to concentrate on our particular responsibilities as economists and statisticians: accurate model building, data processing, and closer contacts with the practical world whose help and approval are alike needed if today's efforts are to bear fruit.

Appendix 1

UNIVERSITY OF CAMBRIDGE
DEPARTMENT OF APPLIED ECONOMICS

AN INTERNATIONAL SURVEY
OF
THE METHODOLOGY OF PLANNING MODELS

Questionnaire

1. Name and address of Director of project

2. Full title of project

3. Short name, if any, of project and/or model

4. Is the model
   a. Purely theoretical
   b. Numerical and intended for application
      If so,
      (i) Has it yet been applied
      (ii) To what country or region has it been or will it be applied
      (iii) Does it contain or will it contain a regional subdivision

5. Is the model intended primarily for
   a. Description
   b. Forecasting
   c. Decision-making (planning or programing)

6. What is the planning or forecasting horizon of the model

7. Has the model a social accounting framework
   If so,
   a. How many classes of accounts do you distinguish in it
   b. What is the name of, and number of accounts in, each class
   c. Do you make a distinction between industries and commodities
      If so,
      (i) Are there more commodities than industries
      (ii) What classification do you adopt for each category
   d. Do you divide gross investment into
      (i) Depreciation and net investment
      (ii) Replacements and extensions
   e. Do you divide imports into
      (i) Complementary and competitive

(ii) Other categories (please specify)

f. Do you treat consumers' durables as capital goods
If so, please give categories

g. Do you cover a subsistence sector in addition to the monetized economy

h. Do you find the national accounts of your country or region adequate

8. If basic assumptions form part of the model, do these relate to
   a. The rate of growth of the gross national product or similar total (please specify)
   b. The rate of growth of consumption
   c. The rate of growth of the population
   d. The rate of growth of the labor force
   e. The rate of technical progress
   f. The supply of domestic saving
   g. The balance of payments (surplus or deficit)
   h. Other variables (please specify)

9. Does the model include
   a. Demand functions for
      (i) Private consumption
      (ii) Government consumption
      (iii) Exports
      (iv) Imports
   b. Current input-output relationships for
      (i) Domestic intermediate product
      (ii) As above *plus* competitive imports
      (iii) Complementary imports
   c. Production functions of type
      (i) Cobb-Douglas
      (ii) As above with residual time trends for productivity growth
      (iii) Vintage
      (iv) Other (please specify)
   d. Capital input-output relationships
   e. Price-formation relationships
   f. Financial relationships relating to
      (i) Saving functions
      (ii) Preferred portfolio patterns
      (iii) Other (please specify)
   g. Foreign trading relationships
   h. Other relationships (please specify)

10. If estimates of parameters have been made, are they based on
    a. Tabulation of census data

b. Special sample surveys
c. Impressions of outside experts in industry, government, etc.
d. Econometric analysis
e. Other sources (please specify)

11. If estimates are based on econometric analysis
    a. Is the information derived from
        (i) Time-series
        (ii) Cross-section data
    b. Is use made of
        (i) Least squares methods
        (ii) Simultaneous equations methods
        (iii) Other methods (please specify)
    c. Is an attempt made to measure changes over time in
        (i) Input-output coefficients
        (ii) Preference coefficients
        (iii) Other coefficients (please specify)
    d. Are the results of the calculations modified subjectively before use

12. Are the calculations carried out by
    a. Electronic methods
       If so,
        (i) Is the program written in stages
        (ii) How many stages does it contain
        (iii) Does iteration play an important part
        (iv) What type or make of equipment do you use
    b. Other methods (please specify)

13. Is the model
    a. Mainly static, alternative solutions depending on initial assumptions
    b. Mainly dynamic

14. If you are planning to increase the size of the model, do you intend to
    a. Simply increase the number of variables, without altering the form of the model
    b. Develop submodels for different branches of production or sectors of the economy, such as transport, power, education, etc.
    c. Combine both methods

15. If you are planning to extend the scope of the model, do you intend to explore
    a. The demand for labor skills now and in the foreseeable future
    b. The role of education and training in satisfying this demand
    c. The role of research and development

d. Human adaptability
e. Other socio-economic phenomena (please specify)

16. How large is the staff you employ in terms of
    a. Economists
    b. Statisticians
    c. Mathematicians
    d. Programers
    e. Sociologists
    f. Other professionals
    g. Clerical and computing staff

17. Is the project sponsored and supported by
    a. A university
    b. An independent research institute
    c. Government or some other public body
    d. Some other institution (please specify)

18. Do you publish your results in
    a. A special series (please give bibliographical details)
    b. Other publications (please give bibliographical details)

Remarks

Appendix 2. A List of Correspondents

Area of Application	*Director of Project*	*Title of Project*
1. Argentina	Dr. Oscar Varsavsky, Instituto de Calculo, Peru 272, Buenos Aires	A Simulation Model for the Argentine Economy
2. Belgium	Monsieur Jean Waelbroeck, 49 rue du Chatelain, Bruxelles 5	Modele de croissance de l'économie belge
3. Britain	Professor Richard Stone, Department of Applied Economics, Sidgwick Avenue, Cambridge	Cambridge Growth Project

Area of Application	*Director of Project*	*Title of Project*
4. Czechoslovakia	inž. Jiři Skolka, Econometric Laboratory, Economic Institute, Czechoslovak Academy of Sciences, Politických vězňů 7, Praha 1	Long-term optimal plan
5. France	Professeur A. Nataf, Directeur du CERMAP, 19 rue de Passy, Paris 16e	Essai de variante formalisée pour l'élaboration du Ve Plan
6. Germany, West	Dr. G. Gehrig, Ifo-Institut für Wirtschaftsforschung, 8 München 27, Poschingerstrasse 5	Forschungsvorhaben "Langfristige Projektion" des "IFO-Instituts"
7.	Professor Dr. Wilhelm Krelle, Direktor des Institutes für Gesellschafts- und Wirtschaftswissen-schaften der Universität Bonn, Bonn, Liebfrauenweg 5	Prognosemodell für die Bundesrepublik Deutschland
8.	Professor Dr. H. Langelütke Ifo-Institut für Wirtschaftsforschung, 8 München 27, Poschingerstrasse 5	Disaggregated growth model to be constructed by means of input-output analysis and regression analysis
9.	Professor Günter Menges, Institute for European Statistics, Saar University, Saarbrücken 15	Econometric Analysis for Short-term Forecasting

Area of Application	*Director of Project*	*Title of Project*
10. Germany, West	Professor Dr. Alfred E. Ott, Institut für Angewandte Wirtschaftsforschung, Tübingen, Biesingerstr. 25	Quarterly Model of the Federal Republic of Germany
11. Hungary	Dr. J. Kornai, Computing Center of the Hungarian Academy of Sciences, Budapest, V, Nádor u. 7	Macroeconomic programing, 1966–70
12.	Dr. T. Morva, National Planning Board, Budapest, V, Nádor u. 11	
13. India	Dr. S. Chakravarty, Presidency College, Calcutta	Research Project on Development Planning Methods
14. Ireland	Dr. R. C. Geary, The Economic Research Institute, 73 Lower Baggot Street, Dublin 2	An Input-Output Decision Model for Ireland
15. Israel	Dr. Michael Bruno, Research Department, Bank of Israel, Jerusalem	Linear Programing Model for Israel
16. Italy	Professor Vera Cao-Pinna, "Centro di studi e piani economici," Roma, Via Piemonte, 26	Econometric Model of Growth and Geographical Distribution of Resources in Italy
17.	Dr. Siro Lombardini, Ires via Bogino 18, Torino	A Model for National Economic Planning with Three Regions

Area of Application	*Director of Project*	*Title of Project*
18. Japan	Dr. Tsunehiko Watanabe, Economic Research Institute, Economic Planning Agency, Government of Japan, Chiyoda-ku Kasumigaseki, Tokyo	Methodology of Long-term and Medium-term Planning
19. Yugoslavia	Dr. Branko Horvat, Jogoslavenski Institut za Ekonomska, Istrazivanja, Beograd, Savska broj 35	A Simple Model for the Preparatory Stage of a Medium-term Economic Plan
20. New Zealand	Dr. C. A. Blyth, N. Z. Institute of Economic Research, 26 Kelburn Parade, Wellington	Long-term target making for the New Zealand economy
21. Norway	Dr. Odd Aukrust, Central Bureau of Statistics, Dronningensgth 16, Oslo	1) Modis I 2) Modis II
22. Poland	Dr. Józef Pajestka, Zaklad Badań Ekonomicznych Komisji Planowania, Warszawa, Plac Trzech Krzyzy 5	Structural Analysis for 1970
23. Portugal	Dr. Joao Salgueiro, Presidencia do Consello, Secretariado Tecnico, 51 Rua Alexandre Hermlano, Lisbon	Global Programing Project for III Plan of Portugal

Area of Application	*Director of Project*	*Title of Project*
24. Sweden	Professor Ingvar Svennilson, Stockholms Universitets Nationalekonomiska Institution, Oddengatan 61, Stockholm	The Royal Commission for Long-term Planning
25. United Arab Republic, Turkey	Professor Jan Tinbergen, Haviklaan 31, The Hague, Holland	Formulating the Optimum Method of Development Planning for Developing Countries
26. United States	Mr. Jack Alterman, Division of Economic Growth, Bureau of Labor Statistics, U.S. Department of Labor, Washington 25, D.C.	Interagency Growth Study Project
27.	Professor Lawrence Klein, Department of Economics, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia 4, Pa.	Econometric Model Project U.S.A.
	INTERNATIONAL ORGANIZATIONS	
28. European Economic Community (member countries)	Dr. J. Paelinck, Secretary's office: EEC, rue d'Arlon, Bruxelles 4	Economic Development Prospects in the EEC from 1960 to 1970

Area of Application	*Director of Project*	*Title of Project*
29. International Monetary Fund (39 countries)	Dr. Jacques J. Polak, Director, Department of Research and Statistics, International Monetary Fund, 19th and H Streets, N.W., Washington 25, D.C.	Monetary Analysis of Income and Imports
30. I.M.F (Canada)	Dr. Rudolf R. Rhomberg, Chief, Special Studies Division, International Monetary Fund, 19th and H Streets, N.W., Washington 25, D.C.	Model of the Canadian Economy with Special Emphasis on the Balance of Payments
31. I.M.F (three world regions)	Dr. Jacques J. Polak and Dr. Rudolf R. Rhomberg, Department of Research and Statistics, International Monetary Fund, 19th and H Streets, N.W., Washington 25, D.C.	World Trade Model

Appendix 3. A Selected Bibliography

(Items concluding with a reference number are associated with a project listed in Appendix 2)

Alterman, Jack, *First Stage—Demand, Production, Employment, Capital Projections,* U.S. Bureau of Labor Statistics, 1963. Project 26.

———, *Research Program of Economic Growth Studies,* U.S. Bureau of Labor Statistics, 1962. Project 26.

———, *Research Projects to be Used in Growth Studies Programme,* U.S. Bureau of Labor Statistics, 1964. Project 26.

Atkinson, L. Jay, "Long-term Influences Affecting the Volume of New Housing Units," *Survey of Current Business,* November 1963. Project 26.

Beld, C. A. Van der, and P. de Wolff, *Exercise in Medium-term Macroforecasting for the Netherlands Economy,* Centre International d'Etude des Problemes Humains, Monaco, 1964.

Bénard, Jean, "Reseau des échanges internationaux et planification ouverte," *Economie Appliquée,* 1963, pp. 249–76.

Benard, Jean, and D. L. Phan, "Elements d'une projection du commerce exterieur Francais en 1970," mimeo., CEPREL (Centre d'Étude de la Prospection Économique à Moyen et Long Termes), Paris, 1964. To be published in vol. 3 of ASEPELT, Amsterdam.

Blyth, C. A., and G. A. Crothall, *Alternative Policies for Economic Development: A Pilot Policy Model and Its Sensitivity Analysis,* New Zealand Institute of Economic Research, Wellington, 1962. Project 20.

———, "A pilot programming model of New Zealand economic development," *Econometrica,* January 1965. Project 20.

———, "A programmed model of the New Zealand economy." Paper presented at fifth annual conference of New Zealand Association of Economists, Wellington, February 1963. Project 20.

Brady, Dorothy, and F. Gerard Adams, *The Diffusion of New Products and Their Impact on Consumer Expenditures,* Philadelphia, 1962. Project 26.

Bruno, M., *Interdependence, Resource Use, and Structural Change in Israel,* Jerusalem, Israel, 1962. Project 15.

———, "Some Applications of Input-Output Techniques to the Analysis of the Structure and Development of Israel's Economy," *Structural Interdependence and Economic Development,* London, 1963. Project 15.

———, "The Use of a National Accounting Framework for Economic Policy and Development Forecasting: A Survey of Israel's Research Experience 1958–61," *Income and Wealth,* Series X, London, 1964. Project 15.

Cambridge University, Department of Applied Economics, *A Programme for Growth,* London, Project 3: No. 1, *A Computable Model of Economic Growth,* 1962; No. 2, *A Social Accounting Matrix for 1960,* 1962; No. 3, *Input-Output Relationships, 1954–1966,* 1963; No. 4, *Capital, Output, and Employment, 1948–1960,* 1964; No. 5, *The Model in Its Environment: A Progress Report,* 1964; No. 6, *Exploring 1970: Some Numerical Results,* 1965.

CERMAP, *"Un Modele d'étude de Variantes d'un Plan,"* mimeo., Paris, 1962. Project 5.

Chakravarty, S., and R. S. Eckaus, "An Appraisal of Alternative Planning Models," mimeo. Project 13.

———, "An Approach to a Multisectoral Intertemporal Planning Model," mimeo. Project 13.

———, "Choice Elements in Intertemporal Planning," mimeo. Project 13.

Chenery, H. B., and M. Bruno, "Development of Alternatives in an Open Economy: The Case of Israel," *Economic Journal,* March 1962. Project 15.

de Leeuw, Frank, "Financial Markets in Business Cycles: Simulation of an Aggregate Model." Paper presented at meeting of the Econometric Society, Boston, 1963. Project 27.

Duesenberry, James S., Gary Fromm, Lawrence R. Klein, and Edwin Kuh, *The Brookings Quarterly Econometric Model of the United States*, Chicago, 1965.

Eisner, Robert, "Forecasting investment spending," *Proceedings of the Eleventh Annual Conference on the Economic Outlook*, Ann Arbor, Mich., 1963. Project 27.

———, "Investment plans and realizations," *American Economic Review*, May 1962, pp. 190–203. Project 27.

———, "Overall View of the Model." Paper presented at meeting of the American Statistical Association, Cleveland, 1963. Project 27.

———, "Realizations of Investment Anticipations in a Quarterly Econometric Model of the United States Economy." Paper presented to CIRET conference, Vienna, 1963. To be published in *IFO-Studien*. Project 27.

European Economic Commission, *Economic Development Prospects in the EEC from 1960 to 1970*, Brussels, 1962. Project 28.

Ferber, Robert, and Harold W. Guthrie, *Factors Influencing Consumer Saving Behavior*, 1964.

Fisher, Franklin M., "Dynamic Structure and Estimation in Economy-wide Econometric Models," mimeo., 1963. Project 27.

Friedman, Charles, "Stocks of Passenger Cars: Postwar Growth and Distribution," *Survey of Current Business*, September 1963. Project 26.

Fromm, Gary, "Forecasting, Structural Analysis and Policy Evaluations: the Brookings-SSRC Model of the U.S. Economy." Paper presented at international meeting of Institute for Management Sciences, New York, 1963. Project 27.

Geary, R. C. (ed.), *Europe's Future in Figures*, North-Holland for ASEPELT, Amsterdam, 1962.

Geary, R. C., "Towards an Input-Output Decision Model for Ireland," *Journal of the Statistical and Social Inquiry Society of Ireland*, Dublin, 1964. Project 14.

Gehrig, Gerhard, "Eine ökonometrische analyse des Konsums von 1925 bis 1938 und 1950 bis 1957," *Schrifteneihe des IFO-Instituts*, 1952. Project 6.

———, "Ein makroökonomisches Modell für die Bundesrepublik Deutschland," *ibid.*, 1956. Project 6.

———, "Forschungsplan für die Erstellung eines disaggregierten Wachstumsmodells mit Hilfe von Input-Output und Regressions Analyse," *IFO-Studien*, 1962. Project 8.

———, "Gross National Product and Private Consumption in the Federal Republic of Germany in 1960 and 1970," in Jan Sandee (ed.), below. Project 6.

Horvat, Branko, "A Restatement of a Simple Planning Model with Some Examples from the Yugoslav Economy," *Sankhya,* 1960. Project 19.

———, "Methodological Problems in Long-term Economic Development Programming," *Industrialization and Productivity,* 1962. Project 19.

———, *Primjena Medusektorske Analize U Planskom Bilanciranju Privrede,* Jugoslavenski Institut za Ekonomska Istrazivanja, Belgrade, 1963. Project 19.

Houthakker, Hendrick, and Lester D. Taylor, *Projecting Personal Consumption Expenditures in 1970,* Parts 1, 2, 3 and 4, U.S. Bureau of Labor Statistics, 1963–64. Project 26.

———, "Recent Empirical Experience with Dynamic Demand Functions." Paper presented at meetings of the Econometric Society, Boston, 1963. Project 26.

Hungarian Academy of Sciences, *Input-Output Tables: Their Compilation and Use,* Budapest, 1962. Project 12.

———, *Commonwealth Program, 1966–70,* Budapest, 1964, Project 11.

IFO-Institut, *Bezug von Input-Output Tabellen für die Bundesrepublik mit vorläufigen Ergebnissen für 1961,* Berlin-Munchen, 1964. Project 8.

IRES-ITALCONSULT-SEMA, *Struttura e Prospettive Economici di Uno Regione,* Milan, 1962. Project 17.

Ivanović, Branislav, *Primena metode I—odstupanja u problemima Odredivanja stepena ekonomiske razvijenosti.* Project 19.

Jorgenson, Dale W., "Capital Theory and Investment Behavior," *American Economic Review,* May 1963, pp. 247–59. Project 27.

———, "The SSRC Econometric Model Project of the United States Economy." Paper presented at meetings of the Econometric Society, Copenhagen, 1963. Project 27.

Klein, Lawrence R., "A Postwar Quarterly Model: Description and Applications," mimeo., NBER, 1963. Project 27.

Kornai, J., and Th. Liptak, "Two-level planning," *Econometrica,* January 1965.

Krelle, Wilhelm, "Angewandte Wachstums- und Konjunkturtheorie: Ein Modell zur Wachstums- und Konjunkturprognose," mimeo. Project 7.

———, "Das Prognosemodell: I, II and III," mimeo., 1962. Project 7.

Lefeber, Louis, "*A Simple Optimizing Planning Model,*" mimeo. Project 13.

Leser, C. E. V., *A Further Analysis of Irish Household Budget Data 1951–52,* Dublin, 1964. Project 14.

———, *Demand Relationships for Ireland,* Dublin, 1962. Project 14.

———, "The Pattern of Personal Expenditure in Ireland," *Journal of the Statistical and Social Inquiry Society of Ireland,* 1963–64. Project 14.

Maisel, Sherman J., "Fluctuations in Residential Construction Starts," *American Economic Review,* June 1963, pp. 359–83. Project 27.

———, "The SSRC Econometric Model Project: Examples of Relationships." Paper presented at meetings of the Econometric Society, Copenhagen, 1963. Project 27.

Marimont, Martin L., "GNP by Major Industries," *Survey of Current Business,* October 1962. Project 26.

Marris, R. L., "The Development of Global Planning in Portugal," *Planeamento e Integracão Economica,* Lisbon, January 1964. Project 23.

Massé, Pierre, "Les principes de la planification francaise," *Weltwirtschaftliches Archiv,* 1964.

———, "The French Plan and Economic Theory." Paper read to meeting of the Econometric Society, Boston, 1963.

Moore, Frederick T., "Models for economic development." Paper presented at a NATO conference, 1963.

Morva, T., "The Role of the Balance of Social Product in the Price Changes of the Plan 1959 and Further Possibilities of Its Use," *Közgazdasági Szemle,* Budapest, 1960. Project 12.

Moustacchi, A., "The Interpretation of Shadow Prices in a Parametric Linear Economic Programme," *Econometric Analysis for National Economic Planning,* London, 1964.

Nataf, A., "Essais de formalisation de la planification," *Economie Appliquée,* 1963, pp. 277–97. Project 5.

Nerlove, Marc, *A Survey of Macro-Econometric Time-Series Models,* Netherlands School of Economics, 1963.

Netherlands Central Planning Bureau, *Central Economic Plan, 1961,* The Hague, 1961.

Norway, Central Bureau of Statistics, *Input-Output Analysis of Norwegian Industries, 1954,* Oslo, 1960. Project 21.

Paelinck, J., and J. Waelbroeck, "Étude empirique sur l'évolution de coefficients input-output," *Économie Appliquée,* 1963, pp. 81–111. Project 2.

Polak, J. J., "Monetary Analysis of Income Formation and Payments Problems," *IMF Staff Papers,* 1957–58, pp. 1–50. Project 29.

Polak, J. J., and L. Boissonneault, "Monetary Analysis of Imports and Its Statistical Application," *IMF Staff Papers,* April 1960, pp. 349–415. Project 29.

Polak, J. J and R. R. Rhomberg, "Economic Instability in an International Setting," *American Economic Review,* May 1962. Project 31.

Portugal, Presidencia do Conselho, *Projecto de Plano Intercalar de Fomento para 1965–1967,* Lisbon, 1964. Project 23.

Pyatt, Graham, "A production functional model," *Econometric Analysis for National Planning,* London, 1964.

Rhomberg, Rudolf R., "A Model of the Canadian Economy Under Fixed and Fluctuating Exchange Rates," *Journal of Political Economy,* 1964. Project 30.

———, "Canada's Foreign Exchange Market: A Quarterly Model," *IMF Staff Papers,* April 1960. Project 30.

Rhomberg, Rudolf R., "The Foreign Sector." Paper presented at meeting of the Econometric Society, Pittsburgh, 1962. Project 27.

Rhomberg, R. R., and L. Boissonneault, "Effects of Income and Price Changes on the U.S. Balance of Payments," *IMF Staff Papers,* March 1964, pp. 59–124. Project 31.

Roma, Centro di Studi e Piani Economici, "Modello econometrico di sviluppo e di ripartizione territoriale nell' economia italiana," *Modelli Econometrici per la Programmazione,* Project 16, Florence, 1965.

Ryan, W. J. L., "The Methodology of the Second Programme for Economic Expansion," *Journal of the Statistical and Social Inquiry Society of Ireland,* 1964. Project 14.

Sandee, Jan, "An Experimental Phase Sector Model for the Netherlands," *Modelli Econometrici per la Programmazione,* Florence, 1965.

——— (ed.), *Europe's Future Consumption,* North-Holland for ASEPELT, Amsterdam, 1964.

Sevaldson, Per, "An Interindustry Model of Production and Consumption for Economic Planning in Norway," *Income and Wealth,* Series X, London, 1964. Project 21.

Stone, Richard, "A Framework for Economic Decisions," *Moorgate and Wall Street,* London and New York, 1964, pp. 5–24. Project 3.

———, "British Economic Balances in 1970: A Trial Run on Rocket." *Econometric Analysis for National Planning,* London, 1964.

———, "Private Saving in Britain, Past, Present and Future," *Manchester School,* 1964, pp. 79–112. Project 3.

Stone, Richard, Alan Brown, and D. A. Rowe, "Demand Analysis and Projections for Britain: 1900–1970," in J. Sandee (ed.), above. Project 3.

Stone, Richard, *et al., Economic Growth and Manpower,* Report of Spring Conference of British Association for Commercial and Industrial Education, London, 1963. Project 3.

Suits, Daniel B., "Forecasting and Analysis with an Econometric Model," *American Economic Review,* 1962.

Tübingen, Institut für Angewande Wirtschaftsforschung, "Arbeitsbericht über die Versuche zu einem ökonometrischen Modell für die Bundesrepublik Deutschland 1950 bis 1960," mimeo., 1962. Project 10.

U.S. National Planning Association, *Long Range Projections for Economic Growth: The American Economy in 1970,* Washington, D.C., 1959.

U.S. Department of Labor, "Economic Growth Studies," *Manpower Report of the President,* March 1963. Project 26.

Varsavsky, Oscar, "Modèle financier et physico-financier," CERMAP, mimeo., 1964. Project 1.

Verdoorn, P. J., and C. J. van Eyk, *Experimental Short-term Forecasting Models,* The Hague, 1958.

Verdoorn, P. J., and J. J. Post, "Capacity and Short-term Multipliers." *Econometric Analysis for National Economic Planning,* London, 1964.

COMMENT

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This survey of planning models should be very useful when it is completed. The preliminary results given here are so sketchy, however, that they only serve to whet the appetite. Although we are given a few generalizations from thirty-one answers to the authors' questionnaire, it is impossible to determine how representative they may be of planning models actually in use. From the studies on this list with which I am familiar, I would guess that the sample consists mainly of models being tested for methodological purposes rather than those used for decision-making.

The authors' summary of the responses gives little indication of the relations among the various characteristics which they tabulated. For example, the typical model is apparently built around some type of input-output framework. This in itself accounts for such features as reliance on cross-section rather than time series data, the form of production functions used, and the absence of price relationships. In their final report, perhaps Stone and Leicester may be able to give us a typology of models with typical features for each rather than separate generalizations for individual characteristics.

The most useful feature of this survey is its bibliography. The evidence which it gives of diversified activity on a broad scale is quite impressive. Whatever the deficiencies of the present sample of planning models, it provides a starting point from which it should be possible to build up a more representative inventory of the state of the art.