REPORT BY THE

Comptroller General

OF THE UNITED STATES

109394

Uses Of National Economic Models By Federal Agencies

At the request of the Joint Economic Committee, GAO surveyed Federal agencies to determine how extensively national economic models are used in economic policy decisionmaking.

The survey indicated that many Federal agencies use large-scale economic models of the United States economy, and that users feel these models have a positive impact on decisionmaking.

5/21 - use job assignment code listed on Form 115 — per Ed Sawyer

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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The Honorable Lloyd M. Bentsen, Jr.
Chairman, Joint Economic Committee
Congress of the United States

TNT 00700

Dear Mr. Chairman:

At the request of the late Senator Hubert H. Humphrey, we examined how Federal agencies use large-scale economic models of the United States for formulating national economic policy. We used two different questionnaires to obtain information on model usage. One questionnaire focused on operations level personnel who used national economic models, and the other focused on policy-level personnel involved in making economic policy decisions. We also interviewed officials at five executive agencies to determine how they viewed the modeling process for economic decisionmaking. (See app. III for the resulting case studies which indicate some current uses of national economic models in the Federal Government.)

The questionnaires focused on the following aspects:

--Identifying agencies which use national economic forecasting models for economic policy formulation, budget determination, and program development.

--Determining the Federal expenditures for using national economic models and the number of employees using these tools.

--Ascertaining the extent to which forecast results influence economic policy decisions.

We coordinated the questionnaires with the Economic Analysis and Policy Machinery Project of the President's Reorganization Project.

USES OF NATIONAL ECONOMIC MODELS

Models of the United States economy serve as a laboratory for studying policy options by projecting alternative outputs of policy choices. An econometric model represents the economy or a particular part of it. The model contains an equation or set of equations. Each equation

describes the relationship between one economic factor and several other factors. These relationships are normally derived from economic theory and historical data. The models are simulated by computer.

Because the economy, or any important sector of it, is so complicated and not fully understandable, the development of one true model is impossible. Models have limitations because the basic model structure itself and input data are often made up of simplified assumptions, estimates, and individual judgments which, when combined, affect the validity, reliability, and accuracy of the model's results. The model builder must use his or her best judgment and focus on key relationships to build a model that approximates the economy. The assumptions and theories used will affect the results.

QUESTIONNAIRE RESULTS

We distributed questionnaires to 25 agencies 1/ that were thought to use large-scale macroeconomic models and that played some role in shaping national economic policies--either directly by having a role in the formulation of national economic policy or indirectly through the impact of agency programs on the national economy. (See app. I for a listing of the agencies.) We supplemented questionnaire responses when necessary with interviews to resolve ambiguities and to obtain missing data. Although in some instances specific offices were asked to respond, each agency determined the type of response and the offices to respond.

Who uses national economic models?

Of the 25 agencies queried, 6 replied that they did not use large-scale models. We received 51 replies from the 19 agencies responding affirmatively to the survey. Of these 51, 20 responses came from policy groups within the agencies and 31 responses came from operations groups. About 20 percent of the respondents said their units had separate, central staffs responsible for using national economic models. This would indicate that in the other units, models are available for anyone to use when needed.

1/The word "agencies" is used in a generic sense to include entities such as the Departments of Agriculture and Defense, as well as the Council of Economic Advisors, located within the Executive Office of the President.

Most users have access to more than one model and can use several models for the same general purpose. Thus, users can cross-check forecasts from one model against forecasts from competing sources or use their own models. Our case studies indicate that large-scale economic models of the national economy are often used as "drivers" to other models; that is, they are used to develop and supply required input data to regional, sectoral, and other model types. (See app. III.)

Which models are most commonly used?

The chart on the next page details the large-scale economic models most frequently identified and their purposes. (The principal models identified appear in app. II.) Clearly, the most frequent use of national economic models is for determining program impact in macroeconomic policy formulation.

What are the resource levels?

The respondents reported fiscal year 1977 fixed contract costs for having access to the services of these national models of $340,000 and variable costs for using the models of $653,000. These data generally do not reflect all the costs of using economic forecasting services, just those connected with actual model usage. Some additional services provided by these vendors are statistical analyses packages, historic time series data, data base management, and packages to solve agencies' models on agency or vendor data bases.

For example, one agency reported a fiscal year 1977 total of $37,233 for using all national economic models and, at the same time, paid three commercial forecasting firms $445,600 for their other services. Corresponding figures for a second agency were $41,280 and $183,700. Those agencies reporting the largest expenditures for national economic models were Commerce, Labor, and Health, Education, and Welfare, respectively.

Regarding staff sizes, agencies reported the equivalent of 83 full-time persons involved with national economic models. The agencies having the largest staffs were Commerce, Treasury,

Questionnaire responses indicating model use for:	Data Resources Inc.	Chase Econo-metrics	Wharton (short term)	Bureau of Economic Analysis (short-term) (note a)	Other	Total
Macroeconomic policy formulation:						
Monetary	7	4	3	2	3	19
Taxing	11	9	6	3	1	30
General spending	10	7	9	3	1	30
Program impact	13	13	8	2	5	41
Other (note b)	8	3	4	1	5	21
Budget formulation	4	4	1	-	-	9
Program development	7	6	4	1	3	21
Other (note b)	12	4	4	-	10	30
Total	72	50	39	12	28	201

a/The Bureau of Economic Analysis model is operated by the Department of Commerce. The other models represent private concerns.

b/The responses varied. Some uses given were: agricultural policy, inflation analysis, defense requirements and production, social security, international economic policy, world energy markets, and reviews of the state of the economy.

and Transportation, respectively. The Federal grade levels ranged as follows:

GS level	Number of staff
7	4
9	6
11	13
12	11
13	16
14	13
15	16
16 or above	4

One question examined the level of responsibility for model usage. Operations personnel identified the individuals most responsible for using economic model outputs. The responses indicate that responsibility is placed at the upper Federal grade levels, primarily at the GS-15 level and above.

How are the results used?

We asked the respondents to estimate--in situations where models might be used--how frequently models (1) figure in the agencies' decisionmaking process and (2) should be applied. The responses follow.

Figure in process		Should be applied	
Response	Percent	Response	Percent
Sometimes	35	Sometimes	35
Generally	54	Generally	56
Almost always	7	Almost always	9
Do not know	4	Do not know	-
Total	100		100

Most respondents apparently feel that models play a role in the agency decisionmaking process and are reasonably comfortable with the present level of model usage. Specifically, when asked the impact models have on the current agency decisionmaking process, most policy respondents (88 percent) thought models have a positive impact. The remainder thought the models have little, if any, impact. Half of the respondents thought the models should have about the same impact in the future as in the present. The other half thought their impact should increase.

About half of the policy personnel thought their modeling efforts were underused. The principal reasons given to explain the underuse of models were (1) usefulness of models is not appreciated and (2) time constraints. Those who felt their modeling efforts were overused suggested that (1) model results are not as reliable as other techniques and (2) models are too easily available.

We asked operations personnel if they had a standard mass distribution of their output. If so, the respondents were asked to identify the users and the method for communicating output. Seventy-five percent of the respondents said there is no standard widespread distribution of their modeling work. The other 25 percent tended to distribute modeling results to between 40 and 80 recipients. It appears that models are used for specific projects or tasks as needed.

We asked how much confidence the respondents have in the control forecasts and how much they have after the results are interpreted by their staff. Approximately 70 percent of the respondents have either moderate or major confidence in the control forecasts. After staff adjustments of the results, the confidence level increased to 93 percent. The policy and operations personnel responses were almost identical.

Some persons concerned with the Federal Government's development and use of economic models have proposed some type of centralized control over economic model usage. When asked about their preference for centralized control versus individual agency control of model use, 75 percent responded that individual agency control (as presently operated) is better. 1/ A number of persons indicated they would not object to centralized control as long as it did not impede their access to currently available services.

Observations

The questionnaire results and interviews with various agency officials indicate the Federal agency users of large-scale economic models of the United States economy are satisfied with the results. They feel that models have a positive impact on agencies' decisionmaking. Also, they point out

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1/As used here, centralized control means that the user does not directly interact with the models. The simulations are run by some other group.

that models have improved and reflect (1) new technological contributed capabilities, (2) innovations in statistical techniques, (3) better understanding of the economic system, and (4) experience gained from using econometric models. Agency officials believe economic modeling will expand in the future. However, since each model uses different assumptions, perspectives, and data bases, it is unlikely that different models will make the same forecast for a particular situation. Yet, there is a general feeling that these models provide valuable input into economic policy decisionmaking. In appendix III, we use case studies to further enhance the questionnaire results.

As arranged with your office, we are sending copies of this report to the heads of the agencies discussed in the case studies and to other cognizant congressional committees. Copies will also be available to other interested parties who request them.

Sincerely yours,

Comptroller General
of the United States

APPENDIX I

AGENCIES THAT RECEIVED QUESTIONNAIRES

Macroeconomic models used	Macroeconomic models not used
Agriculture	Agency for International Development
Commerce	Arms Control and Disarmament Agency
Council of Economic Advisers	Central Intelligence Agency
Council on Wage and Price Stability	Civil Aeronautics Board
Department of Defense Department of the Air Force Department of the Army (note a)	Federal Trade Commission
Energy	Securities and Exchange Commission
Environmental Protection Agency	
Federal Reserve System	
General Services Administration	
Health, Education, and Welfare	
Housing and Urban Development	
Interior	
Interstate Commerce Commission	
Labor	

a/We received positive responses from groups located in the Offices of the Comptrollers of the Army and the Air Force but not from any of the offices asssociated with departmental management.

APPENDIX I

Macroeconomic models used (continued)

Office of Management and Budget

State

Transportation

Treasury

Special Representative for
Trade Negotiations

PRINCIPAL LARGE-SCALE

NATIONAL ECONOMIC MODELS IN USE

Data Resources, Inc. (DRI)

Chase Econometric Associates, Inc.

Wharton Econometric Forecasting Associates, Inc.
Short- and Long-term Models

Bureau of Economic Analysis (BEA), U.S. Department of Commerce

University of Michigan Econometric Model

Federal Reserve Bank of St. Louis Econometric Model

Federal Reserve--University of Pennsylvania--Massachusetts Institute of Technology Model

Project LINK, Wharton Econometric Forecasting Associates, International Model

Interindustry Forecasting Model of the University of Maryland

Bureau of Labor Statistics (BLS), U.S. Department of Labor

Jorgenson Energy Model, Harvard University

Mathematics Computation Laboratory (MCL), U.S. General Services Administration

APPENDIX III

CASE STUDIES

This appendix discusses the present use of economic modeling at five agencies. The case studies are based on interviews with agency officials who described their responsibilities and their use of economic modeling in decision-making.

DEPARTMENT OF AGRICULTURE

The Economics, Statistics and Cooperatives Services (ESCS) of the Department of Agriculture is responsible for developing economic forecasts related to the agriculture sector of the national economy. These forecasts have historically been developed by in-house staff, primarily agricultural economists, with expertise in fields such as specific commodities and foreign agriculture, using traditional methods. In recent years, these traditional methods have been supplemented by using both in-house microeconomic models and commercially available macroeconomic model services.

On the microeconomic level, both the commodity models and the mechanism for forecasting price linkages among the commodities employ output from the commercially available national economic model, which include such factors as income, wage rates, consumer price index, and consumption expenditures. ESCS economists and modelers have found the agriculture components of the commercial national economic models insufficiently detailed. For this reason, they have built their own aggregate model of the agricultural sector and merged it with the Wharton model to measure the impact of the agricultural sector on the general economy.

National economic models are used in two aspects of their work. The first of these is the regular monthly agricultural outlook forecast. The analysts use the in-house model output as one of several inputs, including weather and their general knowledge of the industry, in formulating these forecasts. The monthly outlook includes a forecast for the sector as a whole and the impact of the sector on the general economy.

About 4 percent of the gross national product is from agriculture (excluding processing), so that, in general, the direct immediate impact of agriculture sector changes on the rest of the economy are small. Even though the particular estimating relationships used in the in-house model may differ

greatly from tne agriculture sector relationships used in the commercial national models, the immediate impact of the differences is small. In certain instances--for example, a massive increase in the level of agricultural exports--the sector will have a major impact on the general economy. In those cases, efforts are made to modify national economic forecasts to take into account the results of the in-house agriculture sector model.

The national economic models are also extensively employed in simulating the general economic impact of major shifts in Government agricultural policy. The models are considered particularly useful for these exercises; Department of Agriculture analysts have more confidence in each model's comparative results from alternative scenarios than they do in the general base case forecasts of the vendors.

The best recent example of this involved the various legislative proposals to increase Government supports, including the use of 100 percent parity. In such cases, ESCS arranges with the model vendors to provide forecasts based on alternative scenarios developed by the Department. The output from the vendors is then compared with the projections made by ESCS analysts using the in-house model results and more traditional analytical tools. This use of the national economic models is limited to complicated scenarios for which there is sufficient time for vendor analysis. In those cases where the proposed changes are relatively simple or where time is severely limited, ESCS will rely solely on in-house resources.

ESCS has used the Wharton model in this manner for several years and recently has subscribed to both Chase Econometric Associates, Inc., and DRI. Since the staff has worked much less with the DRI and Chase models and lacks sufficient staff resources for rapid in-house manipulation of all three models, some scenarios have been sent out to vendors as special studies. ESCS is presently trying to increase its modeling staff so that in the future they can rely more on in-house capabilities.

The "what if" scenarios come to the ESCS from the Office of the Secretary through the Director of Economics, Policy Analysis and Budget. The analysts dealing with commodities, foreign agriculture, and the aggregate agriculture sector provide the further refinements necessary for the simulations. Detailed results of these simulations are presented to the Director of Economics, Policy Analysis and Budget, who in turn presents results to the Secretary.

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For the routine monthly forecasts, the modeling technicians work closely with the analysts to provide relevant external variables. The results of these modeling efforts are given to the various analysts and constitute only one component of the final product, which is presented to the Director of Economics, Policy Analysis and Budget. The analysts' familiarity with and confidence in the models influence how often the modeling results are used in the monthly forecasts. It also affects the feedback the analysts give to modeling technicians on the accuracy and validity of the modeling results.

The Director of Economics, Policy Analysis and Budget's perceived need for model forecasting and his ability to understand and use the results of those forecasts constitute the main reason for the Department's increased reliance on models. While there is continuing internal evaluation of the costs and benefits of using the three individual modeling services, Agriculture feels that in the future, analysts and policymakers will rely more on these tools.

DEPARTMENT OF COMMERCE

One of the responsibilities of the Chief Economist of the Department of Commerce is to be a primary source of information about current business circumstances and to keep the Secretary informed of all major developments, trends, and forecasts in this area. Similarly, the Assistant Secretary for Policy has the lead in exploring the implications of proposed policies and in developing possible alternatives, within the broad framework set by the administration. Since it appears that these two individuals have a more immediate input to deliberations about economic policy than do many other groups within the Department, this section will focus on their modeling activities and uses. Thus, this should not be taken as descriptive of the Department as a whole because it does not discuss the many other groups within the Department using national economic models.

The most common use of the models is to make forecasts over the next four to eight quarters, an activity that occurs quarterly unless updates are required. Additional forecasts are prepared to assess the longer run growth prospects of the economy.

Although long-range forecasts are checked for reasonableness, most of the effort, and careful examination of results, is devoted to the first four to eight quarters of the projections. The offices feel that they must have access to the forecasts generated by the three main commercial services and BEA. In this context, access to the forecasts is considered to be as important as the ability to access and manipulate the models themselves.

Another general categorization of large-scale national economic models is that they are used to explore the economic implications of present and proposed administration policies. The models are felt to be useful in establishing bounds for the policy debates that take place both within the Department at the Secretary's level and at meetings of the Economic Forecasting Group. 1/ It was also noted that the broad scope of economic decisions on policy are set each year by the budget and negotiated during the year. However, other policy decisions are made throughout the year.

In the judgment of the departmental staff, the commercial services do a reasonably good job in developing policy variations around a basecase. The results of these simulations are therefore available to service subscribers without having to run the model. This serves to decrease actual model use. Use of the models is also reduced by other factors. For example, the Chief Economist's Office has agreed with the Economic Forecasting Group on a standard set of policy multipliers that are based on the models themselves. The offices must weigh all factors when deciding what model to use, such as the effort required to use it, the time available for the response, and other possible means of obtaining the information. Clearly, a question such as, "What would be the effect if the tax cut were shifted in time by a quarter?" is appropriately answered by the use of national models. However, few questions are that easily implemented on the models.

1/ The Economic Forecasting Group is composed of technical representatives from Treasury, Commerce, Labor, the Office of Management and Budget, and the Council of Economic Advisers.

For example, one group felt that although all of its work was in national economics, it would be impossible to say to what extent the large-scale economic models were used. Another group said that 75 percent of its work was in national economics and about 80 percent of this work could use the large-scale economic models. It felt that it actually used models for about 1/4 of the 80 percent. Thus, it used models, in some fashion, for approximately 15 percent of the work. Since much of the group's work is for overnight response, it will accept existing simulations if possible.

Assuming the staff decides the use of a model is appropriate, the decision of which model to use is left to their discretion, as are the appropriate values of external variables. In those cases where the basic data are known to be wrong, the senior staff will reach a consensus of the appropriate assumption to make.

Modeling results are reviewed for reasonableness, but the choice of model and external variables does not have to be justified up the line. Generally, material that goes to the Secretary provides an overview of the estimates that are available and contrasts these with in-house estimates. The Department managers are aware that there are biases inherent in each model and that one may be better suited to a particular application than another. However, they leave the decision up to the staff.

It also appears that the senior staff and, by extension, the Department management are comfortable with the present models and their capabilities. At the same time, however, the staff are aware of the uncertainties inherent in economic forecasting and are cautious about using forecast data.

COUNCIL OF ECONOMIC ADVISERS

National economic forecasting and policy analysis at the Council of Economic Advisers is performed using derived results of one, or some combination of, three large-scale national economic models. These models are DRI, MPS, 1/ and a much smaller internal policy model. The model simulation work is the primary responsibility of one senior staff member

1/ This model was developed by the Massachusetts Institute of Technology, the University of Pennsylvania, and the Social Science Research Council. It is now known as the MPS model.

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(out of a senior staff of nine) and is estimated to require one-and-a-half full-time professional staff-years annually. A Council member has direct review responsibility; this same member also serves as the Council representative to the Troika, 1/ which is responsible for setting and coordinating domestic economic policy. Thus, both the policy and staff level economic analysis of the Council feed directly into the interagency group, as well as through the Council's network to the President's councils.

The Council maintains a baseline 5-year forecast which is revised monthly and serves as the core case for all ongoing macroeconomic analytical work. The forecast is developed by first analyzing the model results for the recent past using actual data. This information is used to make initial estimates of the adjustments. These are then modified to reflect future events, judgments of the Council members, and external estimates derived from alternatives produced from sectoral models. The results of this process are then presented to other senior staff specialists and reviewed by the responsible Council member. Additional adjustments are made to reflect the judgments of all interested parties, and the model is solved again until a consensus or finite number of alternatives is reached. These final results are presented to the head of the Council, further adjustments are introduced if necessary, and the results become the base forecast reflecting the best judgment of the Council.

The staff's view of this process is that the large-scale national economic model is used initially to point up sectors requiring analytical attention and finally to assure general consistency in the forecast. Approximately 20 alternative simulations, varying from the base forecast only with respect to assumptions within a single sector, are then put in a readily accessible form for use by members of the staff with specific sectoral concerns. This assures baseline consistency in the staff's work.

1/ The "Troika" refers to the 3-member group consisting of the Secretary of the Treasury, the Director of the Office of Management and Budget, and a member of the Council of Economic Advisers. This was later expanded to include the Secretaries of Commerce and Labor.

Most of the Council's national economic policy analysis is initiated by Council members. Much of it is performed using a set of policy multipliers derived from the testing runs, fully modified to reflect the Council's judgment. The use of the multipliers saves money by reducing the use of computer and staff time. These same policy multipliers are also used by the Economic Forecasting Group in deriving its analysis and policy recommendations.

Because an interactive process involving top-level presidential advisers is used in determining the economic model forecasts, feedback from policymakers to modelers approaches 100 percent. The use of national economic models for problem identification, assurance of consistent results, and alternative policy analysis is fully integrated into the Council's daily operations.

INTERSTATE COMMERCE COMMISSION

The Bureau of Economics of the Interstate Commerce Commission began using national economic models to provide the Commission with tools for injecting greater economic and financial considerations into the decisionmaking process. The Bureau prepares a quarterly report for the Commission and staff on the general state of the economy and projections for 2 years in the future on a quarterly basis. For the general economic outlook, key DRI projections are presented and supplemented with staff analysis.

For this quarterly report, the Bureau's Economic Projections and Forecasting staff uses DRI forecasts as a driver for an in-house model of various components of the freight transportation industry. Generally the staff accepts the DRI base case; on occasion, though, they will modify certain DRI projections of industry detail (the specification between the two models) based on the staff's own judgment and on the results of their own analysis of trends and developments in the relevant industries.

The results provided by the in-house model also help the Bureau influence Commission policy. Those results, along with the review and forecast of the general economy, comprise a major portion of the quarterly Transportation Outlook and Projections report distributed to Commission members and staff. In addition, the in-house model provides information for adjudication of specific cases and special studies.

The Financing and Pricing Analysis Section uses DRI long-term forecasts (up to 10 years) as a basis for its projection of revenues and capital needs of the railroad and motor freight industries. This use of DRI results has recently been formalized. It now constitutes the basis for Commission fulfillment of the legislative requirement for projecting adequate revenues to meet long-term capital needs.

The Bureau uses only one national economic model--DRI--chiefly because resources are limited. The Bureau decides which model to use, based on a professional judgment selection process by the Economic Projections and Forecasting staff. The decision is approved by the Managing Director and is subject to agency budget office review, although until this year that review had been perfunctory.

DEPARTMENT OF TREASURY

Within the Treasury Department, the Office of Financial Analysis is primarily responsible for using national econometric models to analyze the domestic economy. The Office of Financial Analysis uses the DRI model and occasionally other models as an aid in forecasting and for simulating the impact of alternative fiscal or other policy actions. The models are used both with the Treasury Department's participation in the interagency group charged with preparing administration economic forecasts (the "Forecasting Group," or sometimes referred to as the "Troika") and for internal Treasury analysis. Another office, the Office of Special Studies, which reports to the Deputy Assistant Secretary for Domestic Economic Policy, also occasionally uses macro models for policy simulation.

The Office of Financial Analysis is responsible for informing Treasury officials of current and prospective developments in the domestic economy and, along with the Office of Special Studies, in providing policy analysis. The staff of the Office of Financial Analysis supports the Assistant Secretary for Economic Policy in his role as a member of the interagency Forecasting Group. As part of its participation in the forecasting process, the Office of Financial Analysis prepares forecast simulations using one of the major models and incorporating administration economic policy or policy alternatives. Other agencies prepare simulations with other available models. These simulations provide one of the bases for assessing the economic outlook and the impact of alternative policy measures.

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The Office of Financial Analysis also uses the models to conduct simulations for other offices within the Treasury Department for use in assessing macroeconomic impact of policy alternatives. The primary source of such requests has been the Office of Tax Analysis, which bears primary responsibility within Treasury for revenue estimation and formulation of tax policy alternatives.

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