ECONOMETRIC MODELS OF THE JAPANESE ECONOMY

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To the memory of three pioneers in Japan's macroeconomic forecasting: Tsunehiko Watanabe (1926-76), Tadao Uchida (1924-86), and Masao Baba (1924-86). Uchida and Watanabe are the authors of a series of first-generation macroeconometric forecasting models; Baba introduced the diffusion index and business-cycle indicators.

ABSTRACT

This paper traces the history of Japan's macroeconometric model-building. The history has gone through three stages—learning, practice, and maturity. World War II left Japan intellectually much behind the West. The economics profession was no exception. It had to learn Keynesian macroeconomic theory and econometrics almost from scratch. Efforts at model-building started in the mid-1950s. The learning stage ran into the early 1960s. Then, in 1964, the Japanese government inducted young econometricians for help to its national plan-making. Short-term, medium-term, and long-term models provided the base for econometric predictions in the national plan. Having gained enough on-the-job experiences in the stage of practice, Japanese econometricians embarked upon building a model after another in the 1970s. The paper takes an inventory of some 40 macroeconometric models which have been and are still currently active in Japan.
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I. Introduction

Since the pioneering work of Jan Tinbergen (1939), macroeconometric model building has gone through a history of a half century. Like the career of a professional, its evolution exhibited three successive stages of growth, namely, learning, practice, and maturity.

This pattern of evolution is very clear in the case of the United States, the forerunner in this field. Stage 1 was from the late 1940s through the 1950s, the era of small annual models, the most celebrated of which was Klein and Goldberger (1955). With the accumulation of more time-series data and the rapid improvement of computer capability, stage 2 began and continued through the 1960s, the era of large-scale quarterly models, the most prominent of which was the Brookings model (Duesenberry et al (1965)). In stage 3, the 1970s and onward, these models were put to practical use. A few commercial forecasting services were set up. Also national models were linked together in order to analyze and predict the international transmission mechanism of economic activity.

Serious pursuits of macroeconometric model building were introduced into Japan in the late 1950s, some ten years later than in the U.S. This initial time lag, however, was very quickly eliminated as Japan's econometric profession has moved forward through the next quarter century. This, in Japan, stage 1 ran from the late 1950s to the early 1960s, stage 2 concentrated on the late 1960s, and stage 3 thereafter. By now, it may be that, outside of the U.S., model building is most flourishing in Japan.
This paper documents Japan's history of model building in a chronological order. The three stages are reviewed successively in sections II, III, and IV. The current state of model building and economic forecasting is examined in Section V. A tabular survey of leading contemporary macroeconomic models is given in the appendix.

II. The first stage: learning

In model building efforts, Japan was initially about ten years behind the United States. Reasons for this lag were that, owing to disruptions in academic life through World War II, Keynesian macroeconomics did not reach the mainstream of the economic profession until late, econometrics was an unknown discipline of economics, and not enough statistical data were available.

On the part of macroeconomic theory, it took time for Keynesian theory to take roots in Japan. Though the policy of aggregate demand management was put into practice by Finance Minister Korekiyo Takahashi in 1932 prior to the appearance of Keynes' General Theory (1936), the general public was not sufficiently exposed to Keynes' new ideas. Though Keynes' preface to the Japanese edition of his book dated December 4, 1936, a year after his original preface, the Japanese edition appeared on December 15, 1941, a week after Pearl Harbor! The second printing was released in August 1942, but then the book remained out of print until the third printing appeared in May 1949. Keynesian macroeconomics has to wait until the 1950s before getting popularized.¹

On the part of econometric theory, the quantitative approach was unfamiliar before World War II. The discipline of economic statistics was under a heavy influence of the German school which emphasized...
complete enumeration of the population. While sampling theory was known in mathematical statistics, it was an anathema to economic statistics. As for econometrics, there were some early attempts at demand-function estimation, but they belonged to a very small minority.

With regard to statistical data, it goes without saying that national income statistics is indispensable to macroeconomic model building. Though there were earlier attempts at national income estimation before World War II, it was in the early 1950s that the National Income and Product Accounts came to be officially prepared on a continuing basis by the Economic Planning Agency (EPA). The first official report for the year 1951 was published in 1953. The official annual data cover the period of 1930-44 and 1946 onward. Quarterly data became available beginning with the second quarter of 1951. The data base was initially meager, and econometricians had to wait about ten years before they could embark on any full-scale model building exercises on the postwar period.

With the country cut off in international cultural exchange through World War II, Japanese economists of the old generation found themselves quite behind the times. There was a great deal to catch up. The quickest way to fill the gap was to study abroad. So, many economics students went to the United States for graduate study from the early 1950s on which such opportunities opened up. The 1950s were thus a period of importation and digestion of economic theory and econometrics.

The acquired knowledge must be applied to practice. It is no coincidence that model building began to be practiced in good earnest in Japan in the late 1950s. As a matter of fact, the inception of model building can be dated a few years earlier. The very first model-building attempt was due to Isamu Yamada (1948) of the Institute of Economic
Research of Hitotsubashi University and a little later to Shozaburo Fujino and Yoshimasa Kurabayashi (1952) of the same institute. However, these were very small, primitive models, little better than learners' products. With this early foray, Hitotsubashi economists were to shun away from macroeconometric model building. The major stimuli in model building came from universities in Tokyo and Osaka.

(i) TCER Models

The very first attempt at building an economy-wide model was made by Tadao Uchida and Tsunehiko Watanabe, both in their early thirties, at the Tokyo Center for Economic Research (TCER), a private group of young economists in Tokyo which held regular seminars to stimulate members' academic interest (the group is still active). The first Uchida-Watanabe model, called TCER Model I, was made public in 1957. It was very primitive by present standards; it consisted of five behavioral and two definitional equations based on annual national income data for the period of 1951-56.

Better known is TCER Model II, which was published in Uchida and Watanabe (1959). In preparing this model, the authors imitated Colin Clark's model of the American economy (1949) in order to see whether an American model can also apply to Japan. The data were now quarterly covering 19 quarters (1952II - 1957I). The model consisted of five behavioral and two definitional equations. The dependent variables of the former were consumption (private plus public), imports, private fixed investment, private residential construction, and private inventory investment. The first four variables were functions of real GNP, while the fifth variable was a function of total sales, i.e., GNP minus inventory investment. Hence, two identities were added to define GNP sales.
Note that the model was strictly demand-determined and neither prices nor financial variables appeared.

After this small beginning, the TCER econometricians continued their efforts and the TCER models went through successive versions. Thus, TCER Model III adapted the Klein-Goldberger model of the U.S. economy, consisting of 16 equations (11 behavioral and 5 definitional) for the period of 28 quarters (1951II - 1957IV) (Uchida and Mori (1960)). TCER Model IV took a different tack by constructing two annual models, one of the prewar years (1926-40) and the other for the postwar period (1951-59). TCER Model V was an elaboration and extension of Model III developed by introduction of more details on government fiscal policy. Several versions were prepared and used for comparing simulation results. The model size expanded considerably. For instance, Model V-8-2 had two versions--I without and II with details on public finance. Version I consisted of 30 equations (18 behavioral and 12 definitional). These versions were constructed by Tadao Uchida and Kei Mori and several papers were published (e.g., Mori (1963a, 1963b).

Thus, by 1963, considerable expertise was accumulated by the TCER econometricians. Tadao Uchida and Tsunehiko Watanabe emerged as two prominent leading macroeconometricians.

(ii) Osaka University Models

Osaka University was a relatively young national university with specialization in science, technology, and medicine. After World War II, it added the faculties of humanities and social sciences. In creating its economics department, it was decided that it should be non-Marxian unlike other established economics departments which were (and still are) dominated by Marxians. In this orientation, the contribution of Yasuma
Takata (1883-1972), one of the most prolific economics writers in Japan, was great. Takata thought of establishing a research institute attached to the department and gave his junior colleague Michio Morishima who was in his very early thirties an academic leadership in running the institute. The institute came into being in the mid-1950s with the faculty including Hukukane Nikaido, Shin'ichi Ichimura, and Masahiro Tatemoto among others. This marks the beginning of the Osaka University Institute of Social and Economic Research. As one project which should distinguish the new institute, the institute thought of starting a team of young econometricians on building a large-scale model of the Japanese economy. Thus, the ISER organized late in 1959 an econometric team (including the present author as a member). Lawrence Klein was called in as an advisor to the project. In addition to the authors of the 1964 paper (Ochimura et al (1964))—Shin'ichi Ichimura, Lawrence Klein, Susumu Koizumi, Kazuo Sato, and Yoichi Shinkai, the team included at one time or another Masahiro Tatemoto, Mitsuo Saito, and Hiroshi Atsumi.

The project was ambitious. The model was to describe all parts of the economy—production, consumption, foreign trade, wages and prices, financial sector, and so on. It was expected to take account of salient features of the economy, such as the dual structure in industry, migration of labor from agriculture to industry, indirect financing, and so on. Thus, industry was divided into heavy industry, textiles, and other manufacturing with large and small firms separately identified. A special financial sub-sector model was constructed with considerable details (Ichimura (1962)). The final version of the model contained 211 equations (102 behavioral and 109 definitional)—roughly comparable in
size with the Brookings model of the U.S. economy which started its preparation in 1961.

The initial intention of the team was to publish details of the model including its mathematical properties and simulation results. Unfortunately, the team was broken up before the work was fully completed as some key members left the university. Ichimura et al. (1964) gave the skeleton structure of the model and the data base, but no adequate explanation was published until the whole model structure was fully documented in Ichimura et al (1977). Two factors made this project a hard going. One was the massive data requirement of this highly disaggregated model; a major part of research efforts had to be spent on preparing time-series data from primary statistical sources. Another was the poor level of computer facilities. The model was too large to be manageable by the computer facilities which were at the team's disposal in the early 1960s.  

However, this team exercise served its historical mission since it demonstrated the feasibility of a large-scale model from the data base available in the 1950s that could reflect special features of the Japanese economy. It also promoted academic interchange between Kanto and Kansai econometricians.

In addition to this gigantic ISER model, the Osaka University project was instrumental in producing three famous models, one by Klein and Shinkai, another by Klein, and one by Ueno.

Klein-Shinkai Model. To supplement the main model, a small annual model was build by Klein and Shinkai (1963) to describe economic changes of Japan covering the prewar (1930-36) and postwar (1951-58) years and consisting of 22 equations (15 behavioral and 7 definitional).
Characteristic of the model are the inclusion of both prewar and postwar periods distinguished by a dummy shift variable, the inclusion of demographic variables, and the emphasis on the price-wage formation. (For a retesting of the model, see Blumenthal (1965)).

**Klein's Long-Term Model.** Klein (1961) wanted to describe in bold relief Japan's long-term economic growth in the spirit of Valavanis-Vail (1955) and Klein and Kosobud (1961), which referred to American economic growth. In this exercise, Klein connected 12 quinquennial observations from 1978-82 to 1933-37. Productivities and the labor-force participation ratio were explained as trends. The birth and death rates were quadratic functions of per capita output. Nonprimary production was made to respond to the expansion of the country's capacity to import. While the model was crude, it excited another econometrician into continuing with larger, more detailed long-term growth models of Japan.

**Ueno's Long-Term Model.** Hiroya Ueno is another econometrician who has been active in model building. He served as a consultant to the Osaka University project while he was on the faculty of Nagoya University. His interest in long-term model building was stimulated by the Klein-Shinkai efforts. Thus, he produced a long-term model of the Japanese economy going further back than the Klein-Shinkai model. His period covered 1920-36 and 1952-58 (Ueno (1961, 1963)) with a dummy shift variable distinguishing the two subperiods. As the national income data did not go beyond 1930 at the time, Ueno relied on industrial production series. His model therefore highlights long-term changes in the industrial structure over Japan's modern industrial development. The model consisted of 38 equations (22 behavioral and 16 definitional).
After this exercise, he was placed in charge of a long-term model for the government's Medium-Term Economic Plan (to be discussed in section III). The result of his related work was published in Ueno and Kinoshita (1965, 1968). Later on, he continued his research at the Economic Research Institute of the Economic Planning Agency, extending the time period to 1906-37 and 1954-68 and switching to national income series prepared by Kazushi Ohkawa and associates for their Long-Term Economic Statistics project (Ueno et al (1971)).

(iii) Other Models

There were a few other model-building exercises apart from the two major groups noted above. Prominent among these were (1) the Ministry of International Trade and Industry (MITI) model in three versions with a special emphasis on industrial production, (2) the short-term model prediction model in successive versions by the Economic Research Institute of the Economic Planning Agency (see Section III), (3) Ueno's short-term model, and (4) the initial efforts of Takao Fukuchi of the International Christian University (Tokyo) in model building, particularly regional models.

The late fifties to the early sixties were the period of learning by doing. Econometricians had to master the art of model building by themselves. Moreover, the data period was still short and electronic computer facilities were just becoming available to them. Nonetheless, econometricians had a good time, like kids with new toys. They were still playing with econometric models, not fully sure of their practical capability, which remained unknown and untested.
III. The second stage: practice

The Japanese government was engaged in preparing and publishing medium-term national economic plans since 1948. In the period of our first stage, there were six such national plans—I (the first provisional plan for economic recovery, May 1948, for 1949-52), II (the plan of economic recovery, May 1949, for 1949-53), III (the plan of economic autonomy, January 1951, for 1951-53), IV (the five-year plan of economic autonomy, December 1955, for 1955-59), V (the new long-term economic plan, December 1958, for 1957-61), and VI (the income-doubling plan, November 1960, for 1960-69). These plans set up various plan targets—globally for real GNP growth and sectorally by industry. Except probably for the last plan, they were not grounded on any macroeconomic model. Hence, there was little consistency between the global target and sectoral targets. In addition, the national government started the practice of announcing its macroeconomic predictions late in December for the next fiscal year (April to March) as essential background materials for national budget-making. The fiscal year of 1955 was the first instance of this practice. These short-term predictions also suffered from the same shortcomings as the medium-term plans on account of the lack of internal consistency.

This unsatisfactory state of affairs was inevitable as the economics profession itself was still struggling with macroeconomics and macroeconometrics in the 1950s. With the progress of learning in these fields, it was a matter of time for the bureaucracy to come for advice to econometricians in order to improve its plan-making and predictions. Thus, our stage 2 begins in 1964 when the government decided to pull econometricians out of their playground and to put them to hard work for
building its seventh postwar plan called the Medium-Term Economic Plan (January 1965 for 1964-68). Before proceeding to this important phase of our stage 2, let us take note of two important developments in the research front.

Two new research institutions began to operate in the early sixties. The first is the Economic Research Institute of the Economic Planning Agency, which was set up in 1958. Apart from the National Income Division, which was installed as a part of the Institute, it was established as a link between the national government and the academic economic profession so that applied economic research could be promoted. Its director-general (at the official rank of a ministerial bureau director-general) is given a tenure of three years, to be chosen (in principle) alternately from inside the Economic Planning Agency and from universities (Kanto and Kansai alternating). The first director-general was Kazushi Ohkawa of the Institute of Economic Research of Hitotsubashi University. The research division consists of several major senior research officers, the majority of whom are appointed from the university faculties. Each senior officer heads a research team of junior officers (partly from the Institute staff and partly from universities) who would work on a certain research topic to be completed within the tenure of the team leader. When the assignment is completed, the preliminary research results are to be published in Keizai Bunseki, a journal (irregularly published) of the Institute, and the final full-length results in a monograph of the Institute. So far, 41 such monographs have been published. One continuing assignment was the short-term econometric forecasting model.
Another new institution that came into being a little later is the Japan Economic Research Center (JERC), which was created in association with the Nihon Keizai Shimbun (Japan Economic Journal), a major business daily. The center was set up in December 1963 under the directorship of Saburo Okita, who had resigned from the Economic Planning Agency (he served as a foreign minister in the late 1970s). The center is a private institution supported by contributions from member firms. Its primary objective is to disseminate economic information through public lectures, round-table panel discussions, workshops, seminars, and so on and to train junior officers of member firms in economic and business research through its training program. One important project in which trainees participate is the quarterly forecasting exercise. The center maintains a small research staff of its own with library facilities, physically located on the premises of the newspaper.

These two new institutions considerably increased academic economists' involvement with the government and the private sector.

(i) Medium-Term Economic Plan Models

Econometric models were introduced into plan making for the first time in the seventh plan, namely, the Medium-Term Economic Plan which was announced in January 1965 for the plan period of 1964-68. The sixth plan, i.e. the celebrated Income Doubling Plan, had to be revised soon after it was announced because the economy performed much better in the first half of the 1960s than that ambitious plan had anticipated. This was the onset of the rapid-growth era which was to last into the early 1970s. Thus, a revision was requested for the remainder of the plan period. The request was formally accepted by the government in January 1964. The final draft was to be produced by October of the same year.
In this rush job, econometric models came onto the center stage. A group of econometricians was appointed to the Econometric Subcommittee to give the quantitative framework to the seventh plan. The overall model consisted of four submodels. The first was a long-term model based on Ueno's earlier work and intended to show long-term directions that Japan's economic development and growth would take. In this version, the submodel covered the period of 1906-39 and 1951-60, consisting of 21 equations (11 behavioral and 10 definitional). The second was a "medium-term" model covering 1954-63 with semiannual observations. It consisted of 60 equations, equally divided between stochastic and definitional equations. The model was a direct descendant of TCER models since its builders were Tadao Uchida, Tsunehiko Watanabe, and Masahiro Tatamoto. The model was designed to predict short-term changes. Since the plan was to provide more disaggregated targets at the industry level, the medium-term model was to be linked to an input-output model, which was supervised by Ken'ichi Miyazawa. The linkage was provided by specifying highly disaggregated consumer demand function (including consumer price formation equations). This final part was the responsibility of Kotaro Tsujimura.

The 1985 plan clearly established the reputation of the econometric approach. Thus, the Committee for Econometric Model Analysis (Keiryo Linkai) was permanently installed in the Economic Deliberation Council, an advisory body to the Economic Planning Agency. A dozen or so members are appointed from among academic econometricians, and its secretariat is the Division for Econometric Model Analysis, Planning Bureau, Economic Planning Agency. The committee has been in charge of providing the quantitative framework for all subsequent plans. Since its installation,
the committee has dealt with eight plans. Over time, the model structure did not basically change for nearly ten years. A new change was adopted in the 1977 plan exercise by introducing multi-sector models in the medium term (5 years), the long term, and the super long term.17, 18

Interactions were reciprocal between plan makers and econometrists. While the latter's models provided the basic framework for economic planners to follow, the former's requirements gave new orientations to further model developments.

(ii) The Short-Term Prediction Pilot Model of the Economic Planning Agency

The Economic Planning Agency's Economic Research Institute had been experimenting with short-term prediction models (SP) since 1960. After the Medium-Term Economic Plan was prepared, the Institute mobilized its seven units to produce a new "pilot" model. The work began in 1965. There are about 20 versions to this model. An expanded version of the pilot model was prepared in 1967 under the name of the Short-Term Economic Prediction Master Model, consisting of 125 equations (60 behavioral and 65 definitional (Shishido et al (1970)). At this time, the pilot model was of 53 equations (23 behavioral and 30 definitional).

(iii) The JERC Short-Term Forecasting Model

After the completion of the government's medium-term plan model, Uchida and Watanabe were asked by the JERC to carry on their model for the purpose of short-term economic predictions. The project was also funded by the Central Research Institute of Electric Power Industry (Denken). The first full-length report of this model is found in Uchida et al (1966). The model in this report consisted of 35 equations (23
behavioral and 12 definitional). The behavioral equations were 8 on expenditure components, 3 on income distribution, 3 on taxes, 5 on price changes, 1 on wage change, 1 on employment, 1 on labor's share, and 1 on industrial production. Subsequent version of the model are larger in size. 21

Econometricians' participation in the plan making of the Medium-Term Economic Plan demonstrated the practical utility of the macroeconometric model analysis. Continued efforts to elaborate short-term prediction models and to try economic forecasting based on these models gave enough confidence to practicing model builders. Also, the time was kind to them since rapid economic growth, which was at full steam into the early 1970s, virtually guaranteed success to any econometric forecasting then.

IV. The third stage: maturity

Macroeconometric models had proved their worth. Those macroeconometricians who mastered techniques went on their own ways and began to construct their individual models. Thus, a tremendous proliferation of models followed. As early as 1972, knowledgeable model builders commented that Japan was probably No. 1 in the world as regards the number of macro models developed so far (Tatemoto and Uchida (1972), p.1). Subsequent developments should place Japan, if not at the top, at least abreast of the United States in this field. Needless to say, such an exuberance of model building activity makes any survey of the field a very difficult task. Therefore, our survey of Stage 3 models has by necessity to be selective. First of all, locating whereabouts of existing models is by itself a major enterprise. 22 Only a few of them publish specifications in a readily accessible form. A number of model builders
failed to respond to the present writer's request for information. These have made the coverage of this survey far from being truly comprehensive. Even so, as is to be seen below, there are already too many models to allow us to give each model a full review in limited space.

It is useful here to outline relevant events that took place in the decade and a half a stage 3 from the early 1970s to the mid-1980s. During this period, there were ups and downs in model building activity. Japan's rapid growth which lasted for a decade through the 1960s faced a transition period in the early 1970s. Its demise came with the first oil shock of 1973-74. The inflation rate went above 20% in 1974 and the economy was confronted by a severe recession. Needless to say, macroeconometric forecasting failed miserably. The honeymoon came to an end to model builders. They had to reassess their own work in the light of these failures. At the same time, Japan's national accounts shifted from the old to the new versions of the UN System of National Accounts. It took sometime before the new edition became available in early 1979. The revision was substantial (available from 1965 onwards for broad aggregates and from 1970 on for disaggregated accounts), and the scope of statistical coverage was expanded considerably. This necessitated extensive re-specification and re-estimation of all active models. In the meantime, Japan's decelerated economic growth became a permanent feature. Investment fell sharply but saving did not in the private sector. The resulting excess private saving was absorbed into government deficits. Also, Japan became more open to international trade and capital transactions, thereby making its economy more susceptible to external shocks. These new developments have increased the demand for macroeconomic forecasting greatly, and revised models have had to take
them into account adequately. Thus, the early 1980s had witnesses renewed interest in model building exercises.

In the meantime, the Japanese computer industry came into matur-ation. Computer facilities made rapid strides in the private and public sectors. Large-scale computer systems of domestic make were installed in universities (especially, national)\(^23\) and became liberally accessible to their faculties.

A related noteworthy development is the growth of electronic data bank services. The \textit{Nihon Keizai Shimbun} (Japan Economic Journal) set up a data bank bureau which maintains the Nikkei Economic Electronic Data Service (NEEDS) allowing subscribers access to its data bank through time-sharing computer terminals. Similar services are provided by other institutions, e.g., the Nomura Research Institute, which markets its data bank of a few thousand economic time series throughout the world via its international computer network. Other ancillary data such as input-output tables and corporate income statements and balance sheets are computerized and commercially available.

To academic researchers, however, these data services are limited in coverage and very expensive. According, in 1983, an ambitious inter-university consortium was organized for the objective of creating a comprehensive data bank on all aspects of social sciences albeit with dominant emphasis on economics. The project was funded by the Ministry of Education for three years, 1983-85, and directed by Shuntaro Shishido of the University of Tsukuba with the participation of more than a hundred social scientists from various universities.\(^24\)

Reflecting these new changes, model building has also been transformed. Models tended to be larger and more differentiated. Combining a
macro model with an input-output table has been a popular line of model building, especially suited for simulating the effect of an external shock which hits a particular segment of the economy. As external transactions have become a significant influence on Japan's domestic economy while Japan's presence has grown in the world economy, international linkage models have been developed. Also, other economic sectors which used to be treated largely exogenous have come to be endogenized. Such are the monetary-financial sector and the government sector.

In the late 1970s and the early 1980s, public interest in short-term forecasting recovered, a large number of private and public institutions have joined forecasting crowd. They make extensive use of macro models.

On another front, following academic turbulences abroad, a counter-attack was staged by monetarists against Keynesian macro models. Monetarists have been vocal, especially from their stronghold at Japan's central bank, Bank of Japan (BOJ), though the mainstream of macroeconomics still remains Keynesian in Japan. Few monetarist macro models have been tried on Japan.

In view of those recent developments, we classify major macro models of Stage 3 into five groups according to their functions and objectives. The classification is somewhat arbitrary as these criteria are not necessarily mutually exclusive. These five groups are: (1) general-equilibrium and projection models; (2) special-purpose models; (3) international linkage models; (4) short-term forecasting models (5) monetarist models. Each group is further divided into subgroups. A brief description is given to each individual model. In what follows, a model is identified by a 3-digit code, e.g., 1A1. References are limited to either the most representative, the latest, or relatively accessible
(preferably in English). The reader is reminded that there are many other models (hopefully, less important) which are not touched upon.

1. General-equilibrium and projection models

   A. General-equilibrium models. Academic econometricians are more interested in studying the working of a macro economy than in forecasting. For this purpose, general equilibrium theory provides a challenging test ground. There have been at least two such models. As their principal objective is theory testing, they are not maintained on a continuing basis.

   1A1: Keio Multi-Sector Model (Tsujimura and Kuroda (1974), Tsujimura, Kuroda, and Shimada (1981)). Keio University's Economic Observatory elaborated the annual multi-sector model which Kotaro Tsujimura, its leader, developed for the government's 1965 Medium-Term Economic Plan. This medium-sized model was intended to analyze the general equilibrium structure of the Japanese economy by connecting behavior equations to successive versions of the input-output table. The demand-supply equilibrium of money, goods, and services is emphasized.

   1A2: Interindustry general-equilibrium model (Saito (1974)). Mitsuo Saito of Kobe University expanded the input-output model by endogenizing consumption functions, making production coefficients variable according to the Cobb-Douglas technology, and determining outputs and prices by equating demand and supply in each industry. While this model is not kept up, the idea of interindustry price formation is carried into Saito's later modeling, e.g., 2C1.

   B. Projection models. There are macro models specifically designed for medium- to long-term projections. Some of them are described below.

1B2: EPA Medium-Term Multi-Sector Model (Committee for Econometric Model Analysis (1977, 1980, 1984) and Ueno (1980)). The model was prepared in 1977 by the Committee for Econometric Model Analysis to provide highly disaggregated projections for the government's medium-term planning. Semi-annual behavioral equations cover all aspects of economic activity (both supply and demand) with imperfect quantity and price adjustments embedded in them. These equations are connected with an input-output table (14 industries/15 commodities).

Attached to this model is a long-term turnpike multi-sectors model (with 10 sectors in the 1980 version and the maximum of 33 sectors in the 1984 version) in the 1980 version and the maximum of 33 sectors in the 1984 version) in order to trace the optimum turnpike trajectory for economic growth (through maximizing cumulative consumption) subject to various external constraints. The model was utilized to provide long-term projections for a 1982 Economic Deliberation Council study, Japan in Year 2000 (1982).

1B3: EPA-Kinoshita Multi-Sector Model (Kinoshita et al (1982), Kinoshita (1983, 1984)). This is the Japan Model of a World Trade and Industry Model (3A3) constructed at the Economic Research Institute of the Economic Planning Agency under the direction of Soshichi Kinoshita of Nagoya University. It is an annual model (1963-78) with 22 sectors separately identified. Its heavy emphasis is on the production side (estimating equations by industry for domestic demand, imports, production, capacity, capacity utilization, employment, wages, prices, value added, and capital retirement). The financial side, however, is represented by one equation (bank rate). Linked with other national/regional models and trade linkage models (by commodity), the model is used to assess the impacts of changes in comparative advantages and protectionism on Japan's industrial structure.

1B4: JERC Medium-Term Projection Model (JERC (1986)). The Japan Economic Research Center, with Hiromichi Muto in charge, has been issuing medium-term projections (five years ahead) every year (the twelfth in 1986). Projections are based on the successive approximation technique (see 4D1). A macroeconometric model of a medium size is employed as one of the inputs into the projections. Simulations are reported based on the model.

2. Special-purpose models

Embedded on an economy-wide model, a special-purpose model highlights a certain specific sector or aspect of an economy in order to provide structural analysis and/or projections and simulations. These models are divided by topic.
A. Public finance.

2A1: Medium-Term Public Finance Model (Kansai Keizai Kenkyu Center [Kansai Economic Research Center] (1980)). The KERC organized in 1978 a study group directed by Chikashi Moriguchi of Kyoto University to study the country's public finance position. A large-sized annual model detailing the public finance sector was constructed. It was linked to the Kyoto University Model (4B1) to produce medium-term (1979-85) policy simulations.

B. Financial sector.

2B1: Bank of Japan Econometric Model (Bank of Japan 1972)). The Bank of Japan's Statistics Department built a medium-sized quarterly macro model in 1972 and revised in 1978. It details the financial sector, paying particular attention to special features of Japan's financial structure, in particular to the fact that the interest rate was not a market-clearing variable. (See 4A4 for the BOJ's official forecasting model.)

2B2: KERK Financial Model (Kansai Keizai Kenkyu Center (1984)). As a sequel to its public finance model (2A1), the KERC reconvened its study group headed by Chikashi Moriguchi with an assignment of endogenizing the financial sector within an overall macro model. The work was undertaken in 1982 and 1983, and the final report was published in 1984. This medium-sized quarterly model was employed for investigating multiplier properties in response to a change in the discount rate, a change in nominal public fixed investment, and an introduction of the sales tax.

C. Natural resources/energy.

2C1: KIC Econometric Model (Kansai Joho Center [Kansai Information Center] (1978)). The KIC organized a study group in 1976-78 directed by Mitsuo Saito of Kobe University to construct a macroeconometric model with the specific objective of predicting the macroeconometric effects of resource constraints (imported food and petroleum). This small macro model was linked to an interindustry price model (1A2) so as to estimate the price effect of scarce resources. A computer program system was developed for future deployment of the model.

2C2: Kobe University Energy Model (Saito and Oono (1985)). Mitsuo Saito continued his work on the energy problem of Japan in association with Takuyuki Oono of Kagawa University. This medium-sized annual model (1961-79) is a Keynesian-type model covering all aspects of the economy but with special focus on the external sector (19 equations) and the price sector (35 equations). Final demands are disaggregated so as to give a prominent place for energy demands. Price equations incorporate input-output information. Production functions are specified as two-level CES functions. The model is used to evaluate the impact of an oil price change on the whole economy.

2C3: Computable General Equilibrium Model (Ezaki (1985)). Mitsuo Ezaki of Kyoto University constructed a CGE model (as developed by
the World Bank) with special emphasis on the energy industry. The economy is divided into 12 industries with four institutional sectors (business, households, government, and external). Each industry is given a Cobb-Douglas production function. There are 12 product market, 1 labor market, and 1 foreign exchange market in which product prices, wage rate, and the exchange rate are to be determined via demand-supply equilibrium. The exchange rate is taken for the numeraire as the financial side is yet to be covered. As a bona fide CGE model, some 500 parameters in the model are either predetermined from the 1980 Input-Output Table or borrowed from other studies. The model is used to evaluate the macroeconomic effects of changes (doubling and halving) in import oil prices.

2C4: Saitama University Energy Model (Murota (1985), Ito and Murota (1984)). Yasuhiro Murota of Saitama University has build an energy model for projection of energy demand and supply. The model includes a Japanese macro model and a U.S. model in addition to the detailed modelling of energy demand and supply at the global level. The model is used for projecting energy demand and supply in 1995. The Japanese model is a very small one consisting of real expenditures, production (cost shares of capital, labor, and energy in translog forms), deflators, and income distribution.

D. The external sector.

2D1: Kobe University FLEX Model (Amano (1982)). Out of his long-standing interest in Japan's external transactions, Akihiro Amano of Kobe University went heavily into econometric studies of Japan's external sector. His earlier work is Amano (1973) which built a balance-of-payments model. Since 1978 he turned his attention to the endogenous determination of the yen exchange rate. For this purpose he built a medium-sized model with heavy emphasis on the external sector (FLEX 4 (1982) contains 94 equations on the domestic sector and 87 equations on the external sector). The model went through a few revisions until FLEX 4B (1982). Further work has been temporarily suspended as he has been busy with advising on the EPA World Economy Model (4A2).

E. Socioeconomic indicators.

2E1: JERC Social Indicator Model (Uno (1978)). Kimio Uno of the University of Tsukuba, with the assistance of the JERC's Econometric Unit, prepared a social indicator model which explains changes in demographic and environmental indicators within a macroeconometric model.

3. International linkage models

With the globalization of economic activities and resource constraints at the world-wide level, a number of supra-national macro models have come into being since 1968 when Project LINK started its activity.
These models are discussed elsewhere in this volume. However, as six of them are made or organized in Japan, we briefly touch on them below (see Amano (1985) for a detailed comparison of performance of these six models).

A. World economy models

3A1: EPA World Economy Model (Economic Planning Agency (1982, 1984)). As Japan is no longer a small country, it is necessary to take a full account of international repercussions of Japan's actions in macroeconomic forecasting. With this objective in mind, the Economic Research Institute of the Economic Planning Agency began in April 1979 to construct a giant quarterly world macro model connecting nine major countries (U.S., U.K., France, Germany, Italy, Canada, Japan, Australia, and Korea). Each country has its own model, ranging from large (247 equations for the U.S.) to small (92 equations for Korea). In addition, the rest of the world is divided into six regions. A trade linkage model connects those countries and regions. Exchange rates are treated as endogenous variables. The first version of the model was completed in February 1982 and revised in February 1984. It is very actively employed for international policy simulations. Its Japan submodel (4A3) is used for domestic short-term predictions.

3A2: Tsukuba-FAIS World Model (Shishido et al (1980)). Shuntaro Shishido of the Institute of Socio-economic Planning, University of Tsukuba, in association with the International Economic Forecast Project of the Foundation for Advancement of International Science (FAIS) (which is located at the University of Tsukuba), developed a world-wide annual economic predictions have been announced every spring. The model covers 19 countries and 4 regions including developed, developing, and centrally planned economies. Its Japan model (4B2) is employed for domestic annual economic predictions.

3A3: EPA-Kinoshita World Trade and Industry Model (see 1B3). At the Economic Research Institute of the Economic Planning Agency, a team headed by Soshichi Kinoshita of Nagoya University started in 1979 constructing a multi-country multi-sector annual model of international trade and industry. With the initial focus on Japan, the U.S., Asian NICs, ASEAN, other developed, and the rest of the world, the model links national multi-sector models through trade linkage models (with 21 industries separately identified). The principal objective is to evaluate the impacts of shifting comparable advantages and rising protectionism upon industrial structures of Japan and elsewhere.

3A4: FUGI Model (Onishi (1983)). Akira Onishi of the Center for Global Modeling, Soka University, and associates started in 1976 working on an ambitious annual world economy model called the Future of Global Interdependence (FUGI) Model with the objective of preparing medium to long-term projections for the world economy,
especially with respect to the North-South economic relations. The model consists of a Global Macroeconomic Model (GMEM), Global Metal Resources Model (GMRM). The GMEM covers 54 countries and 8 regions, with the total number of equations at about 12,000. Models for developed countries are effective demand type covering not only the real but also the financial side, with additional emphasis on government finances, balance of payments, official development aids and private direct investment to developing countries.

B. Asian Link models. The economic interdependence is great between Japan and East and Southeast Asian countries. Yet the latter countries are often lumped together into one region in international linkage models. Therefore, two attempts have recently been made to connect Japan and the U.S. to these countries individually.

3B1: ELSA (Institute of Developing Economies (1985)). The Institute of Developing Economies (Tokyo) organized in 1981 a 4-year project, with international cooperation, of constructing an econometric link system for ASEAN (ELSA). Country models are built for 5 ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand), Hong Kong, South Korea, Taiwan, the U.S., and Japan. Country models are linked together via an international trade matrix. Its Japan model (as well as the U.S. and Hong Kong) is a simple monetarist model with 7 equations (see 5A2).

3B2: Asian Link System (Ezaki (1979), Ezaki et al (1984), Ichimura and Ezaki (1985)). The Center for Southeast Asian Studies, Kyoto University, organized in 1978, with international cooperation, an Asian Link System project which covers the same ten countries as the ELSA (3B1) does. The ten country models plus the rest-of-the-world model (divided into 3 regions) are linked by an international trade model. Country models, which are not standardized, vary in size from 73 equations (Indonesia) to 20 equations (Philippines). The objective of the system is to analyze the structure of economic interdependence via in-period dynamic simulations and policy simulations. The Japan model in this system was developed by Ezaki and Moriguchi of Kyoto University. It is a small annual model of effective-demand type with no financial sector, no financial sector, no industry breakdown, and no traded commodity breakdown.

4. Short-term forecasting models

In model-building exercise, short-term forecasting attracts the greatest attention as it is the most readily understandable output of those exercises. Short-term forecasting has a considerable history behind it. The Japanese government has been issuing its annual economic
outlook every December for the next fiscal year (beginning April 1) since 1954. The number of forecasts rose over time. For the year 1967, Muto (1980) cites 18 forecasts. By 1985, the number exceeded 40 (Sato (1986)). These forecasts are conveniently put together in a January or February issue of the Japan Economic Research Center's bimonthly bulletin and in Toyo Keizai's Economic Statistics Yearbook. Most of them, it is understood, are based on respective macro models.27

Models in this category are basically demand-determined Keynesian type. The expenditure and distribution sides of the economy are usually well described though they differ in the degree of disaggregation (e.g., how far consumption is divided among different types of goods and services). The production and employment sides are more aggregative. The price and wage sector is based on the Phillips curve and the markup relations; the tightness of the market is an additional explanatory variable. Depending on the primary objective, models also differ in details of the foreign sector. Some models are highly detailed on this score, while others may merely take total merchandise trade. Probably the greatest difference appears in the financial sector. Some models are virtually nonfinancial while others emphasize real-financial interactions. Needless to say, those models look very much alike in their basic characteristics since they are all of the same genus. Many of them trace their ancestry to the 1965 Medium-Term Plan.

Who are those forecasters and which of them carry more weight than others? In these respects, Japan and the U.S. differ in an important manner. For one thing, the government's annual forecasts carry a very heavy weight in Japan as is natural in a country in which the national government is looked upon for more direct intervention in the private
sector. For another, there is only one commercially-run forecasting service in Japan, whose commercial success is reportedly far from being satisfactory. There seems to be a public perception in Japan that economic forecasts are public goos. In fact, when there are so many public and private forecasters around who supply their forecasts free of charge, customers are unwilling to pay for forecasts unless they are specifically tailored to meet their special needs. On this point, Japan's big firms pride themselves in possessing an excellent research staff of their own which can develop in-house models and forecasts.

In any event, there is a large variety of economic forecasters in Japan. They are classified below by status.

A. Government agencies.

4A1: EPA's Annual Economic Outlook. In order to facilitate national budget making for the next fiscal year (beginning on April 1), the national government, with the Economic Planning Agency in charge, announces its Annual Economic Outlook in late December. The Outlook contains annual forecasts on real GNP growth, inflation rates, gross national expenditure components in current and constant prices, industrial production, balance-of-payments items, and so on. Coming from the government, these forecasts are taken seriously by the private sector. While macro-model forecasts must provide basic data, there are many arbitrary adjustments in these forecasts in order to reconcile various ministries' demands.

4A2: EPA's Short-Term Prediction (SP) Econometric Model (EPA (1978)). The model had an early start as noted in section III. It was kept up with successive revisions by the EPA's Economic Research Institute through the 1970s. The model, eventually a compact forecasting model of a standard type, was used actively for short-term predictions for policy making and policy simulations as requested by the government. The final version is SP-19 vintage. It was replaced by 4A3 in 1982.

4A3: EPA World Economy Model (see 3A1, Yoshitomi et al (1981)). This gigantic model, constructed in 1970-81, contains a Japan Model which replaced SP-19 as the official model. With more than 200 equations in its latest (1984) version, the model is an all-round one.

4A4: BOJ Short-Term Forecasting Econometric Model As distinct from its Macro Econometric Model (2B1), the Bank of Japan's Research and Statistics Department has maintained for quite some time another
medium-sized model (about 170 endogenous and 50 exogenous variables in it). The model is a Keynesian type with a comprehensive coverage of the economy (expenditure components, production, employment, prices, balance of payments, and financial variables). The bank employs this model for quarterly predictions and policy simulations for monetary policy decision making. Strictly for internal use, the model is confidential to the outsiders.

4A5: MOF Model (Yoshida (c1984)). As a relative new comer to model building, the Ministry of Finance (MOF) economists built a compact quarterly macro model in its research office (since 1985, the Institute of Fiscal and Monetary Policy). The first version, built in collaboration with Takamitsu Sawa of Kyoto University, is a cross between the Keynesian and monetarist types in that aggregate demand is built up from expenditure items and aggregate supply is influenced by money supply (via prices and wages). Its primary objective is to test the efficacy of fiscal and monetary policy in Japan.

4A6: Other ministries. The Ministry of International Trade and Industry (MITI), which prepares inter alia medium-term projections of energy demand and supply, reportedly maintains its own macro model. If so, the model is not in the public domain. Other ministries likewise engage in short- and medium-term predictions of variables of their respective interests. They may also have macro models.

B. University econometricians.

4B1: Kyoto University Macro Model (KYQ). This quarterly macro model is a relative newcomer to the field of short-term forecasting. It was constructed for the first time in 1975 (Amano, Ban, and Moriguchi (1975)) to serve as a national model for Project LINK (to replace 4D8). Since then, the model has been revised annually and short-term forecasts have been conducted regularly in association with the Kansai Economic Research Center. Chikashi Moriguchi of Kyoto University has remained its principal supervisor. The model seems to have achieved a high status. In its earlier versions, the model was heavy on the real side, especially on the external sector but very light on the financial sector. Since then, the financial and government sector models are attached (see 2A1, 2B2).

4B2: Tsukuba-FAIS Annual Model (see 3A2). This compact annual model is the Japan Model in the Tsukuba-FAIS World Model. Its principal supervisor has been Shuntaro Shishido of the University of Tsukuba who had been in charge of the Economic Planning Agency's short-term prediction pilot and master models in the 1960s when he was a senior officer of the EPA. The model is small and of a standard type. Annual forecasts are made every spring for the forthcoming fiscal year since 1978.

4B3: Keio University Macroeconometric Model (KOMN2) (Hamada (1978, 1984)). Fumimasa Hamada of Keio University (Economics) has long been interested in analyzing the short-term macroeconomic behavior of the Japanese economy, especially in the interdependence between
financial and real variables and in the effects of fiscal and monetary policies. He has continued his model building efforts. Having developed an efficient computer program, he maintains his compact model in his personal computer.

4B4: Kei Mori's Quarterly Macroeconomic Model (KS53). Having engaged in model building since the very early 1960s, Kei Mori of Keio University (Science & Technology Faculty) has maintained a medium-sized macro model. The model endogenizes the financial sector, the exchange rate, and new issues of national bonds. The model is revised every year. Reportedly the model is employed for the purpose of graduate training.

C. Commercial forecasting.

4C1: NEEDS Model (NEEDS (1984)). The NEEDS (Nikkei Economic Electronic Data Service) Model is the only commercially operated macro forecasting model in Japan. The Nihon Keizai Shimbun's Data Bank Bureau has been running this model since 1973. (Its initial advisor was Tadao Uchida.) The quarterly model has frequently been revised and its size varies from one version to the next. The model is fairly standard and covers all macro aspects more or less evenly. It is a correspondent with the DRI in the U.S.

D. Think tanks.

4D1: JERC Quarterly Forecasts by Successive Approximations (Katsumura (1977)). Since 1967 the JERC's Short-Term Forecasting Unit has been issuing quarterly forecasts. Its hallmark is the technique of successive approximations. The econometric approach provides basic inputs for forecasts; then, these forecasts go through several steps of "successive approximations", adding many other pieces of extraneous information including subjective judgments of experts and the forecasters themselves. There is a faith that this approach ensures better internal consistency and injects more flexibility than the purely econometric techniques. Hence, this is not based purely on a macro model. However, the JERC forecasts have attained professional respectability in Japan.

4D2: JERC Short-Term Forecasting Model (JERC (1976)). Starting with the short-term forecasting model prepared by Uchida, Watanabe et al at the JERC's Econometric Unit in the late 1960s, this relatively compact quarterly model was kept up there with periodical quarterly forecasts (as distinct from 4D1). The model was more detailed on production and prices but was very light on the financial side (only two equations). Because of the mounting cost of maintaining the model and the duplication with 4D1, the model was discontinued in 1979.

4D3: JERC Simultaneous Interindustry Model (Ueno and Muto (1975), Ueno (1980)). The model consists of six institutional sectors (households, nonfinancial corporations, banks, general government, central bank, and external) and 12 industries. Activities in these industries are connected with those at the macroeconomic level,
namely, expenditure, income, distribution, and price formation. The model annexes another large model on industrial financing along with two submodels on pollution and household portfolio choices. Behavior equation are estimated on semi-annual observations. The model was discontinued because of the heavy cost of maintenance.

4D4: RINE Model. The Research Institute of National Economy is a non-profit research outfit, originally created in 1945, which is engaged in disseminating economic information to the business sector which support the institute through its membership subscriptions. One of its running projects is its quarterly and annual economic predictions. The model is reportedly very small.

4D5: NRI Model (Nomura Research Institute (1982)). Originally a research unit of the Nomura Securities Co., the NRI became a separate entity in April 1965. One of its continuing projects is short-term forecasting undertaken by its Economic Research Unit. Its medium-sized quarterly model covers the entire economy comprehensively.

4D6: MRI Model. As a research arm of the Mitsubishi zaibatsu, the Mitsubishi Institute of Economic Research was long active in economic research before World War II. More recently, it was renamed the Mitsubishi Research Institute, and its new work included macroeconomic forecasting on an annual basis. Its macro model is reportedly of a medium size (specifications not available to the present reviewer).

E. Private enterprises. Those who have swelled the roster of short-term forecasters in recent years are banks, life insurance companies, and general trading firms, they have their own macro models. In addition, it is reported that there are many other firms, especially in manufacturing such as automobiles, steel, and electronics, which employ their in-house models for their specific economic predictions. These models are restricted for internal use.

5. Monetarist models

Models reviewed so far are by and large Keynesian. Namely, aggregate demand is the sum of expenditure items and aggregate supply is moderately upward sloped in the short run. Autonomous injections thus have positive multiplier effects. Monetarism and later New Classical
Macroeconomics (NCM) view them in a different light. Aggregate demand is very strongly (if not entirely) governed by the quantity of money. Aggregate supply is positively related to the excess of the actual over expected price levels. When expectations are rational, this excess reduces to zero except for a random error. Thus, the position of the aggregate supply curve is determined by the natural rate of unemployment subject to random shocks. The money supply is a crucial determinant of macroeconomic activities. Autonomous injections have little power. To monetarists, then, Keynesian macro models are incorrect. A simple model which relates nominal national income to money supply can perform as well as a large structural model as far as very aggregative variables are concerned. The very first such model for the U.S. economy was the St. Louis Model developed by Anderson and Carlson (1970) at the Federal Reserve Bank of St. Louis.

Just as Keynesianism came late to Japan, monetarism also took some time before settling roots in Japan. Yoshio Suzuki (1982), a prominent Bank of Japan economist, reports Milton Friedman's visit to Japan in the summer of 1963 when Friedman speculated that the money supply must be leading price changes by two quarters in Japan just as in the U.S. The BOJ Research Department carried out a small study in 1963 which verified Friedman's conjecture. The finding was incorporated into Suzuki's book (1964). However, Suzuki remained basically a Keynesian, and his well-received book (1974) (English edition (1980)) on Japan's monetary system was based on the Tobin approach. In the meantime, Friedman in 1968 introduced the concept of the natural rate of unemployment, which was to emphasize the role of inflationary expectations. The Japanese economy had already been inflationary before the Great Inflation took
place in the wake of the 1973-74 oil shock. Inflationary expectations
which were engendered by rapid monetary expansion seemed to be the root
cause. In this regard, Suzuki was inspired by Keran (1970), a study by
another St. Louis Fed economist on Japan's allegedly money-caused busi­
ness cycles. This is the very first self-contained monetarist model of
the Japanese economy.31 However, monetarists needed more rigorous
theorizing to convince even themselves of the persuasiveness of their own
approach, and such a theory was provided by New Classical Macroeconomics
which rediscovered the rational expectations hypothesis that enabled
inflationary expectations to be endogenous and its empirical testing in
the U.S. came to appear in quick succession since the mid-1970s. As
Suzuki (1982) acknowledges, it was 1979 that Suzuki and his fellow BOJ
economists were fully aware of the importance of this new approach
through the interest of junior economists in the Special Studies Division
of the Bank (which was elevated in October 1982 to the Institute for
Monetary and Economic Studies).

Work has flourished along monetarist and New Classical Macroeconomic
lines in the BOJ Institute (whose current director-general is Suzuki).32
This, however, is not the place to review the monetarist literature in
Japan.33 It suffices to note here that monetarists have been more
interested in hypothesis testing than in model building. Hypothesis
testing is concerned with the proposition that "money causes income" and
the neutrality of money (Okina (1985, 1986)).

When it comes to model building, monetarist models are very aggrega-
tive and small-scale as they are not really interested in producing
detailed forecasts. In fact, there are only a very few full-fledged
monetarist macro models to the best of my knowledge.
5A1: EPA-Shimpo Monetarist Model (Shimpo et al (1978), Shimpo (1980, 1985)). The model is typical monetarist model. Of 12 equations, 5 are behavioral. The change is nominal GNP is dependent on (current and lagged) changes in money supply, government spending, and export earnings. Price-level changes are influenced by the demand pressure, anticipated inflation (based on business intention surveys), and import price changes. Anticipated inflation rates are explained by changes in the WPI and the trend deviation of the velocity of money. Unemployment rate is a function of the GNP gap. Changes in the WPI are due to the demand pressure, (lagged) inflation anticipations, and import price changes.

5A2: ELSA Japan Model (see 3B1; chap. 8 of IDE (1985)). Mitsuru Toida and Hiroshi Osada of the Institute of Developing Economies (Tokyo) gives a 7-equation monetarist model of Japan. 5 equations are behavioral: (1) changes in nominal GNP due to changes in money supply, government spending, and exports; (2) price-level changes based on its lagged values, changes in nominal GNP/potential output, and import price changes; (3) potential-output production function; (4) investment as a function of real output, capital stock, and relative price of oil; (5) real imports as a function of real output and relative import price. 2 identities are real output (nominal output/price level) and capital growth.

V. Issues in Macro Model Building

Model structures. Japan's macro models, with strong emphasis on the demand side, are almost exclusively Keynesian, and as such, they are similar as far as the core part is concerned, i.e., expenditure functions, production functions (usually Cobb-Douglas), employment functions, wage-price functions (Phillips curve), and so on. In degree of coverage, they notably differ in the government, financial, and external sectors. Attempts have been made by a few model builders to endogenize some variables which are usually treated as exogenous, e.g., government expenditure, money supply, labor supply, and the exchange rate.

One way to compare model properties is via simulation analysis, e.g., comparing time-profiles of dynamic multipliers. As Saito and Moriguchi (1985) reports, models they compare yield fairly similar
results among themselves, which are not dissimilar from those observed for American models. For instance, the dynamic multiplier values showing the effects of a permanent increase of government investment expenditure (nominal) upon GNP (nominal) are, when averaged for models under comparison, 1.37, 2.00, 2.38, 2.76, and 3.04 over the successive five quarters. While variances tend to widen over time, there is little dispersion in the impact multiplier (between 1.24 and 1.44).^37

An important issue is the stability of coefficients. When an economy goes through structural changes, behavioral equations are likely to be subject to considerable change. The Japanese economy experienced structural changes several times. A significant one occurred between the prewar and postwar periods. Within the postwar period, excluding the late 1940s of the postwar dislocation, there have been three distinct sub-periods, namely, the period of normalization in the 1950s, the rapid-growth era of the 1960s to the early 1970s, and the "stable" growth period since the mid-1970s. Did the economic structure remain unchanged so that equations can be estimated for the entire period? For the first two sub-periods, Moriguchi (1979, 1983) conducted the Chow test to see if coefficient estimates could be judged unchanged between them (1965I-1965IV vs 1966I-1976I). His findings is that the null hypothesis is rejected with respect to, e.g., the consumption function and the fixed investment function. Among others, Moriguchi takes note that personal consumption responds more to expected inflation, fixed investment has a longer gestation period and responds more to firms' internal fund position, the Phillips curve has shown a wage drift, and the demand for labor has a higher adjustment speed. I have seen no similar test for later years, namely, between the rapid-growth and slow-growth periods. There
is no doubt the structural change that took place between the two sub-periods is great. Practicing econometricians have faced a dilemma here. If they limit their sample period to the last sub-period, the sample size is too small and some coefficient estimates have large standard deviations because economic relationships seem to have become less stable after the first oil shock. So far, a compromise is accepted by extending the sample period before 1975.

**Estimation methods.** Econometric theory has taught us that a simultaneous-equation system ought to be estimated by sophisticated econometric techniques which minimize simultaneity bias. In Stage 2, econometricians took this advice seriously. For example, Tatemoto, Uchida, and Watanabe (1967) opted for the two-stage least squares (TSLS) and the limited information maximum likelihood (LIML) methods. In Stage 3, however, Japanese econometricians reverted back to the ordinary least squares (OLS) method. Thus, with rare exceptions, Japanese models are nowadays estimated by OLS. This is because econometricians have learned that the OLS is the simplest, cheapest, and most robust—free from the rather arbitrary choice of instrumental variables involved in the TSLS and LIML. Serial correlations are taken care of by the application of the Cochrane-Orcutt iterative procedure.

One study which compared performances of these three alternative estimation techniques is Ban (1979), which examined within-sample and post-sample prediction errors for the Kyoto University Model (4B1, 1977 version). He concludes that the OLS estimator gives, "on the average, the best performances...in the one-period prediction over the post-sample
periods." In other words, there is "sufficient evidence to contend that the LIML class is superior" (Ban (1979, p. 21).

**Cost of model maintenance.** To develop a new model is extremely expensive. Even maintaining an already established model in a routine manner is expensive because it requires the full-time presence of professional econometricians and some support staff. (Updating time-series data is no longer a problem as the data bank offers such data on a regular basis on a fixed fee. In the case of Japan, the NEEDS has become a popular data source.) The Daiwa Securities Institute maintains 5 professionals to run its macro model (4D7) and sends a junior member for a year's apprenticeship at the Wharton Econometric Forecasting Associates. The Institute (or rather its parent company) bears this heavy cost because, on the one hand, it believes that trained staff will prove useful for other research functions and, on the other, it has a sense of public mission (such as helping the government to produce economic projections). The NEEDS, the only commercial forecasting establishment in Japan, maintains 3 professionals on a rotating basis (assigned from the parent newspaper's research department). As its financial fortune rises and falls, it often leads to a headache to the parent company.

**Performance checks.** To check how well a macro model performs, one has to evaluate the success of its predictions. There are a number of ways to do this. One of them is post-mortem analysis. It shows where the errors of prediction comes from, i.e., missspecifications of the model adopted, structural changes not reflected in the model, errors in the assigned values of exogenous variables, and so on. What makes this analysis difficult to undertake is the fact that macroeconometric forecasters often engage in small modifications to their models (fine tuning,
constant-term adjustments, or "licking the pencil" as the Japanese expression goes). So, full details of predictions, particularly the basic assumptions about the assigned values of exogenous variables, are not usually published (with a few exceptions).39

If a simulation analysis is undertaken to compare predictive powers of competing models by standardizing them with common data and sample periods, it should provide us with valuable insights. The only study which came close to this exercise is Hatanaka and Saito (1974). They took five major (but anonymous) models in order to compare short-term predictive powers by examining errors of prediction four quarters ahead with respect to some 30 endogenous variables. The forecast year was 1971, which covered a recession. The authors found that econometric predictions were very unsatisfactory even in comparison with the naive model (extrapolations of past trends). If these models all performed poorly in the high growth period, one could not expect them to perform well after 1973.

Macroeconomic forecasting. Predictions and projections have long been familiar in Japan. National economic plans, which started in the late 1940s', set up medium-term targets for macro variables though they are apt to be more of lip service as Japan is not a planned economy. Since the end of 1954, the national government has been engaged in announcing its annual "economic outlook" for the next fiscal year.

As the model-building exercise became popularized in the late 1960s, there appeared a number of private-sector forecasting institutions which provided macroeconomic forecasts--more often annual or semi-annual than
quarterly. Annual forecasts are for the next fiscal year (starting on April 1) announced usually toward the end of the calendar year.

Some Japanese newspapers carry these annual forecasts as a special feature in their New Year edition. The most convenient source of those alternative forecasts is the Japan Economic Research Center's semi-monthly bulletin. One of its early-year issue (used to be the February 1 issue) assembles a large number of annual forecasts with forecasters' explanatory notes. The number of forecasters reported in this source was 18 in 1967 and rose to 23 in 1969-71. Then, the number fell sharply to 6 in 1974. This decline must have been largely due to the loss of confidence on the part of forecasters as well as the general public in face of the rising uncertainties on the macroeconomic scene. As the economy moved into the phase of decelerated growth and macroeconomic stability was regained, the number of reporting forecasters also increased. In 1980, it was 20. In the early 1980s, this number rose sharply. For the year of 1986, there are 35 forecasters.

Another source, equally convenient and with larger coverage (with semi-annual forecasts when available), is Toyo Keizai's Keizai Tokei Nenkan [Economic Statistics Yearbook]. Its 1986 edition reports 47 forecasters. They are broken down by type thus: 17 research institutions (think tanks and the like, 22 commercial banks, 3 life insurance companies, 4 trading companies, and 1 newspaper (NEEDS). Many of the 17 research institutions are reviewed in section IV.

A number of these forecasters are engaged in quarterly forecasting on the continuing basis. For quarterly forecasts, one must go to forecasters' respective periodicals, though newspaper carry feature articles when forecasts have been greatly revised owing to the occurrence of some
unforeseen major event, e.g., the large appreciation of the yen in early 1986. A convenient source has become available as far as aggregative variables are concerned. Since January 1984, an international monthly journal, Economic Forecasts (Amsterdam: North Holland), has been publishing short-term macroeconomic forecasts of major countries of the world. The Japanese correspondent is Professor Shuntaro Shishido of the University of Tsukuba. As of now, nine forecasters are covered. They are, for quarterly forecasts, Kyoto University (4B1), JERC (4D1) RINE (4D4), Nomura (4D5), Daiwa (4D7), and NEEDS (4C1), and, for annual forecasts, EPA (4A1), Tsukuba-FAIS (4B2), and Mitsubishi (4D6).^41^

Annual forecasts can be graded for predictive power after the year is passed. Kanamori (1977) mentions that he did such grading for 1967-69 when he was a staff member of the JERC but had to suspend the exercise since the JERC's own forecasts (4D1) did not perform particularly well, and responsible researchers at some banks became despondent over the poor ratings they had received. Nonetheless, Kanamori provides an interesting comparative study of some of these forecasts of 1974-76.

A more systematic, quantitative approach was taken by Muto (1980), who compared a few major private annual forecasts for the period of 1967 to 1978 (JERC (4D1), JERC (4D2), RINE (4D4), NRI (4D5), and Daiwa (4D7)) against the naive forecast (applying the growth rates of the year just passed) with respect to rates of change of GNP (real, nominal), private consumption (nominal), housing investment (nominal), business fixed investment (nominal), and private inventory investment (nominal). Among other interest findings, Muto found that the private forecasts did not do much better than the naive forecasts if judged by the size of the root-mean-squared-errors.
The period covered by Muto (1980) was not favorable to macro-econometric forecasts. Sato (1986) did a follow-up study by shifting the period to 1976-84, in which the Japanese economy moved on to a "stable" path of low growth. A comparison of government forecasts and consensus private forecasts (average of all private forecasts covered in the Toyo Keizai source) with the naive forecasts with respect to rates of change of real GNP, industrial production, implicit GNP deflator, consumer price index, and wholesale price index. But for the GNP deflator, the naive forecasts did the poorest this time. Going one step farther, the study set up a forecasting generating function in which the current forecasts is a linear combination of the expected value of the current growth rate and the growth rate observed for the year which has just passed. As the expected value is equal to the actual value plus a random error, the forecasted growth rate is regressed on the two successive growth rates. Regression results should show how well forecasters forecast and whether they are backward looking or forward looking (including a test of the rational expectations hypothesis). It is seen that the national government has been much more backward looking that the concensual private forecast. Both, however, significantly overforecast the inflation rate (GNP deflator). The exercises are replicated on a dozen private forecasts for which the time series data are (nearly) continuously available with respect to the real growth rate and the inflation rate. As for the former, $R^2$ ranges from .09 to .80, indicating wide diversity in forecasting ability among those forecasters. As for the latter, $R^2$ is in a much narrower range, from .60 to .84, and all forecasts overestimate by 1 to 2 percentage points.
While not all forecasts perform equally well, informed opinion has it that good ones among them have demonstrated satisfactory performance on international standards. More in-depth analysis of forecasting performances seem to be difficult because of constant-term adjustments which are extensively practiced by Japanese forecasters. According to one knowledgeable forecaster, "clean" forecasts in the sense that they are relatively free of fine tuning are few.

Critical views. Large-scale macro model building exercises have been criticized on various accounts. Mainstream economists of Keynesian persuasion ought to be sympathetic with this sort of work, but some of them have expressed concern and scepticism. For instance, Shozaburo Fujino of the Hitotsubashi University Institute of Economic Research, who is a leading quantitative economist himself, commented as follows: "As Japanese macroeconometric models have become larger and larger, theoretical reflections and reconsiderations which should accompany them constantly have become less and less visible and the state of 'measurement without theory' has set in" (Fujino (1980), p. 204).

Others, especially in the monetarist camp, believe that "small is beautiful." So long as our interest is in highly aggregated variables such as the growth rate and the inflation rate, why should we bother with a gigantic model? A small model may perform as well as a large model. Thus, monetarist models have the virtue of being small and straightforward. The monetarist approach has led to the time-series or multivariate autoregressive approach. In Japan, the time-series approach has not been popular except among the monetarists.
Summary. Without trying really to be comprehensive, we have already counted more than 40 full-fledged macro models in Stage 3, many of which have been in active operations. If we have tried to be really exhaustive by looking into every nook and corner and adding a number of special-purpose models, we could easily expand our list beyond one hundred. It is the best indicator of macroeconomic model building currently going on in Japan. The Japanese macroeconometric profession ought to be commended for this thriving business. If there is anything which should be criticized, it is the seeming lack of communications within the model-building profession and the absence of the market test which weeds out the weak and incompetent. However, time will solve these problems.
NOTES

1 It is not that the General Theory was unknown. In fact, a few leading economic theorists of Japan picked the book up soon after its publication and even introduced it in the classroom. But they were a minority. The book was really seriously studied in the late 1940s after the end of World War II when a number of expository books appeared in Japan.

2 The Economic Stabilization Board was created in August 1946 as a government ministry in charge of enforcement of economic policy measures for the reconstruction of the Japanese economy. The first annual white paper on the economy was put out in February 1947. It was later reorganized into the Economic Planning Agency with less direct involvement in policy enforcement.

3 Before World War II, Japanese economics had been under the strong influence of German institutionalism. Marxism then came in and was growing until it was suppressed in the late 1930s. Anglo-Saxon economics was relatively less popular.

4 Staff members of Hitotsubashi University, especially its Institute of Economic Research, expended their intellectual energy on constructing their massive and monumental Long-Term Economic Statistics of Japan Since 1868, a project which started in the early 1950s. Its first volume was published in 1965; two volumes are still to be published out of the 14-volume set. For an English summary, see Ohkawa and Shinohara (1979).

5 Most prominent in academic economic research are Hitotsubashi University, University of Tokyo, Kyoto University, and Osaka University among national universities and Keio University among private universities.
The original intention of covering sociological research (Takata was initially a sociologist) was never realized but the term Social remains in the institute's official title.

In following historical developments of model building in Japan, one cannot miss considering how poor computer facilities were in our Stage 1. Before the mid-1950s, practicing econometricians had to depend on pencils, abacuses (at which the Japanese were very adept), and at best manual hand calculators. In the late 1950s, electric digital calculators (made in America and Western Europe) became available, but they broke down so easily. Computing was a highly labor-intensive exercise, made feasible only because of the prevailing cheap labor of research assistance. In the very early 1960s, high-speed electronic computers were introduced, but a few years had to pass before universities could install them for academic research.

Two major academic centers of Japan are the Kanto or Tokyo metropolitan area and the Kansai or Kyoto-Osaka-Kobe metropolitan area.

The early survey of Nerlove (1966) covers the Osaka ISER, Klein-Shinkai, and Ueno models only. For other models, see MITI (1964) and Koizumi (1963).

For such a model, see Osamu Shimomura (1961) who was an economic advisor in private capacity to Prime Minister Hayato Ikeda who was responsible for the Income Doubling Plan. See also Bronfenbrenner (1965).

This evaluation is due to Watanabe (1969, 1970).

For the characteristics of this model, see Tatemoto, Uchida, and Watanabe (1967). Watanabe and Tatemoto resigned from the committee before the completion of the assignment is disagreement with the
government in final plan target figures (Watanabe (1969), p. 116, and (1970)).

13 The input-output table was officially prepared for the first time for the year 1951. From the year 1955 on, the table has been prepared every five years.

14 For the details of the overall model, see Economic Planning Agency (1965, 1966). Other members of the Econometric Subcommittee were Kazushi Ohkawa (chairman), Masao Baba, Akira Yajima, and Yasuhiko Yuize. Shuntaro Shishido was the principal liaison officer of the Economic Planning Agency.

15 The committee remains active. Over the last ten years, it produced three reports—fifth (1977), sixth (1980), and seventh (1984). In 1984, the committee consisted of 21 members.

16 For details, see its seven successive reports from 1966 to 1984.

17 For the long-term optimization model, see Tsukui and Murakami (1973, 1979).

18 The model size has been expanding rapidly. The number of endogeneous variables in the medium-term multi-sector model was 691 in the 1977 version and 1156 in the 1984 version.

19 For SP-1 (1960) and SP-2 (1963), See MITI (1964).

20 For an early sample, see Shishido et al (1968).


22 In my first literature search for stage 3 (Sato (19681)), I much benefited from the advice of Chikashi Moriguchi, who made available to me the list of participants in the Kyoto Econometric Models Project which he organized. This project holds semi-annual conferences of leading model
builders. The first meeting was held in November 1977 and is still running.

My second literature search for the early 1980s was facilitated by two survey papers of Japan's econometric models which were presented to the Fall 1985 Convention of the Japan Economic Association, namely, Saito and Moriguchi (1985) on domestic models and Amano (1985) on international linkage models.

The Japanese government maintained the "Buy Japanese" policy for national-university computers, with the market shared by three major computer firms (Hitachi, Fuji, and Nippon Electric). For the development of Japan's computer industry, see Shinjo (1987). For the current state of university computer systems, see Statistical Data Bank, 1 (Nov. 1983).

On progress reports of this project, see its newsletter, Statistical Data Bank. The project is fully explained in its first issue (October 1983).

Other than those covered in the text and of recent vintage are as follows:

<table>
<thead>
<tr>
<th>Projector</th>
<th>Date</th>
<th>Projection Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Institute of National Economy</td>
<td>July 1985</td>
<td>1995</td>
</tr>
<tr>
<td>Nomura Research Institute</td>
<td>April 1984</td>
<td>1993</td>
</tr>
<tr>
<td>Japan Industrial Bank</td>
<td>January 1984</td>
<td>1990</td>
</tr>
<tr>
<td>Japan Economic Research Center</td>
<td>March 1985</td>
<td>2000</td>
</tr>
</tbody>
</table>

c  Japan Economic Research Center (1985).
Among those topics not reviewed here, honorable mention may be made of regional models which were popular at one time (the 1960s) and models of social security and medical care which are getting popular.

Forecasters announce their own short-term forecasts in their special bulletins and/or regular periodicals. Newspapers report some of them.

Therefore, "neither the specific structure of the model nor predictions therefrom are released to the public" (a private communication from Mr. Soichi Oagwa, Associate Advisor, Research and Statistics Department, Bank of Japan).

MOF prepares medium-term projections on public finance (e.g., its January 1985 report on the fiscal balance up to 1988). These projections seem to have been obtained from a relatively crude noneconometric model.

The name of the model is expected to be changed as Professor Moriguchi moved to the Institute of Social and Economic Research of Osaka University in April 1986.

Keran's recursive system is as follows (variables in growth rate):

\[
\text{imports} \rightarrow \text{foreign reserve} \rightarrow \text{money supply} \rightarrow \text{nominal GNP}
\]

\[
\begin{array}{ccc}
2Q \text{ lag} & 1Q \text{ lag} & 2Q \text{ lag} \\
\hline
\text{no lag}
\end{array}
\]

Note, however, that the two BOJ models (2B1, 4A4) are of the Keynesian type. They are maintained by the Bank's Research Department, not by the Institute.

Most of this literature can be found in the Bank of Japan Institute's periodicals (Kin'yu Kenkyu Shiryo (14 issues from January 1979 to September 1982), Kin'yu Kenkyu (quarterly from October 1982), and
Monetary and Economic Studies (quarterly from June 1983) as well as its discussion papers (available in English).

A more detailed tabular survey as of the end of the 1970s) is available in Sato (1981) for the following models: 1A1, 1B1, 2A1, 2C1, 2D1, 2E1, 4A2, 4A3, 4B1, 4B2, 4C1, 4D2, 4D7, 4D8. Saito and Moriguchi (1985) review the following models: 1B2, 1B3, 2C2, 2C3, 2D1, 4A3, 4A5, 4B1, 4B2, 4B3, 4B4, 4C1, 4D3, 4D8. Amano (1985) reviews 3A1, 3A2, 3A3, 3A4, 3B1, 3B2.

Saito and Moriguchi (1985) give an equation-by-equation comparison of structural parameter estimates for consumption, business fixed investment, housing investment, inventory investment, merchandise exports and imports, production functions, and demand-for-financial assets.

Reported are the effects of fiscal policy (an increase in government spending and a cut in corporation income tax), oil shock, wage raise, and exchange rate change. These are computed by model builders themselves.

See Saito and Moriguchi (1985), table 3-1.

I owe these points to Dr. T. Taya of the Daiwa Securities Institute.

Analysis of prediction errors was often reported for the EPA-SP model (4A2) in Keizai Bunseki. The EPA Medium-Term Models (1B1, 1B2 do likewise. For the Kyoto University Model (4B1) and the FLEX Model (2D1), see Moriguchi (1983) and Amano (1983) respectively.

The GNP growth rate is the weighted average of growth rates of GNP components. Thus, one should be able to pinpoint principal sources of prediction errors of the GNP growth rate. Takeuchi et al (1985) did this exercise by applying the principal component analysis to the 1983 and 1984 forecasts.

Private communication of Professor Lawrence Klein based on performance comparisons of LINK models.

The exceptions which he cites include the Kyoto University Model (4B1), the Daiwa Model (4D7) and the NEEDS Model (4C1).

The same point was made by Takamitsu Sawa (1980), who is one of Japan's leading econometric theorists. Sawa not only criticizes macroeconometric models but also is even more critical of the time-series approach.

For an interesting dialogue between pro and con on macroeconometric models, see Uzawa and Uchida (1980). The con position is taken by Hiroyumi Uzawa who long forsook the neoclassical camp, and the pro position by Tadao Uchida, the initiator of macro model building in Japan. (His coworker, Tsunehiko Watanabe died prematurely in 1976).

See the foreword of S. Kobayashi, Executive Director of the Institute of Developing Economies, to ELSA (1984).

The Special Studies Department of the Bank of Japan (1981) sponsored a panel discussion of leading econometricians of Japan to review the possibility of reconciling the two approaches but there were few constructive suggestions.

This is based, first, on my personal impression derived from my talks with Japanese model builders and, second, the list of participants
in Professor Chikashi Moriguchi's semi-annual meetings of the Kyoto Econometric Models Project—participants are mostly academic model builders and, at most, highly academic-minded (very few) business forecasters.

Forecasts are provided free of charge except for the commercially operated NEEDS. (Some business forecasters are now thinking of marketing their quarterly forecasts on diskettes in order to become more self-supportive.) They are thus public goods and, as such, free from public criticisms. Though those forecasts were conveniently put together in the JERC Bulletin and Toyo Keizai's Yearbook, they are seldom subject-ed to systematic reviews. In the absence of the market test and the competitive milieu, the survival of the fittest does not work. See Sato (1986) on these points.
APPENDIX: A Tabular Survey of Principal Macro Models in the 1970s and the early 1980s

Legend

No. Identification code

Model name

Builder

Size:
- small (less than 100 equations)
- medium (100 to 200 equations)
- large (more than 200 equations)

B = behavioral equations (including regression estimated statistical equations)

D = definitional equations

Time unit: Quarterly, annual, etc.
(active/ (active = the model is kept up
inactiv) inactive = the model is not kept up but not given up
discontinued = the model is abandoned.

Objectives
<table>
<thead>
<tr>
<th>No.</th>
<th>Model name</th>
<th>Builder</th>
<th>Size</th>
<th>Time unit</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A1</td>
<td>Keio Multi-Sector Model</td>
<td>Economic Observatory, Keio Univ.</td>
<td>medium</td>
<td>Annual</td>
<td>Analysis of general-equilibrium interdependence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>166 (52B/114D)</td>
<td>(inactive)</td>
<td></td>
</tr>
<tr>
<td>1B1</td>
<td>EPA Medium-Term Macro Model</td>
<td>Committee for Econometric Model Analysis</td>
<td>small</td>
<td>Semi-annual</td>
<td>policy simulation (replaced by 1B2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>72 (43B/29D)</td>
<td>(discont.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1976 vers.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1B2</td>
<td>EPA Medium-Term Multi-Sector Model</td>
<td>Committee for Econometric Model Analysis</td>
<td>large</td>
<td>Semi-annual</td>
<td>Medium-term plan projections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>834 (212B/622D)</td>
<td>(active)</td>
<td></td>
</tr>
<tr>
<td>1B3/3A3</td>
<td>EPA-Kinoshita Multi-Sector Model</td>
<td>Soshichi Kinoshita (Nagoya Univ.) in assoc. with the EPA Institute</td>
<td>large</td>
<td>Annual</td>
<td>Analysis of impacts of shifting comparative advantage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>390 (314B/76D)</td>
<td>(active)</td>
<td></td>
</tr>
<tr>
<td>1B4</td>
<td>JERC Medium-Term Projections Model</td>
<td>Japan Economic Research Center</td>
<td>small</td>
<td>Annual</td>
<td>Medium-term projections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>62 (43B/19D)</td>
<td>(active)</td>
<td></td>
</tr>
<tr>
<td>2A1</td>
<td>Medium-Term Public Finance Model</td>
<td>Kansai Economic Research Center</td>
<td>large</td>
<td>Quarterly</td>
<td>Fiscal policy simulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>440 (218B/222D)</td>
<td>(inactive)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(only for public finance)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B1</td>
<td>BOJ Macro Model</td>
<td>Research &amp; Statistics Department, Bank of Japan</td>
<td>medium</td>
<td>Quarterly</td>
<td>Analysis of financial behaviors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>151 (64B/87D)</td>
<td>(?)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1979 vers.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B2</td>
<td>KERC Financial Model</td>
<td>Kansai Economic Research Center</td>
<td>medium</td>
<td>Quarterly</td>
<td>Endogenizing the financial sector; monetary and fiscal simulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 (88B/112D)</td>
<td>(inactive)</td>
<td></td>
</tr>
<tr>
<td>2C1</td>
<td>KIC Econometric Model</td>
<td>Kansai Information Center</td>
<td>small</td>
<td>Annual</td>
<td>Evaluating the macro-effects of natural resource constraints</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>82 (59B/23D)</td>
<td>(inactive)</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Model name</td>
<td>Builder</td>
<td>Size</td>
<td>Time unit</td>
<td>Objective</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------</td>
<td>----------------------------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2C2</td>
<td>Kobe University Energy Model</td>
<td>Mitsuo Saito (Kobe Univ.) &amp; Takoyuki Oono (Kagawa Univ.)</td>
<td>medium</td>
<td>Annual (active)</td>
<td>Energy problems and its medium-term forecasting</td>
</tr>
<tr>
<td>2C3</td>
<td>Computable general equilibrium model</td>
<td>Mitsuo Ezaki (Kyoto Univ.)</td>
<td>large 334 eqns*</td>
<td>Annual (active)</td>
<td>Simulation of macro-economic effects of oil price changes</td>
</tr>
<tr>
<td>2C4</td>
<td>Saitama University Energy Model</td>
<td>Yasuhiro Murota (Saitama Univ.)</td>
<td>small 25 (18B/7D)</td>
<td>Annual (active)</td>
<td>Long-term projections of energy</td>
</tr>
<tr>
<td>2D1</td>
<td>Kobe University FLEX Model</td>
<td>Akihiro Amano (Kobe Univ.)</td>
<td>medium 181 (87B/94D) (FLEX 4, 1982)</td>
<td>Quarterly (inactive)</td>
<td>Endogenous determinants of the exchange rate</td>
</tr>
<tr>
<td>2E1</td>
<td>JERC Social Indicator Model</td>
<td>Kimio Uno (Univ. of Tsukuba in assoc. with the JERC)</td>
<td>medium 132 (101B/31D)</td>
<td>Annual (inactive)</td>
<td>Projections of social indicators (demographic &amp; environmental)</td>
</tr>
<tr>
<td>3B2</td>
<td>Asian Link Model</td>
<td>Center for Southeast Asian Studies (Kyoto Univ.)--Mitsuo Ezaki &amp; Chikashi Moriguchi</td>
<td>small 57</td>
<td>Annual (active)</td>
<td>Analysis of economic interdependence and policy simulation in East &amp; Southeast Asia</td>
</tr>
<tr>
<td>4A2</td>
<td>EPA-SP Model</td>
<td>Economic Research Institute, Economic Planning Agency</td>
<td>medium 112 (45B/67D) (SP-19, 1979)</td>
<td>Quarterly (discont.)</td>
<td>Short-term predictions and policy simulations (replaced by 4A3)</td>
</tr>
<tr>
<td>4A4</td>
<td>BOJ Short-Term Forecasting Econometric Model</td>
<td>Research &amp; Stat. Dep't, Bank of Japan</td>
<td>medium 171 (60B/111D)</td>
<td>Quarterly (active)</td>
<td>Quarterly predictions &amp; policy simulations</td>
</tr>
</tbody>
</table>

* Coefficient estimates are either determined by the 1980 input-output or taken from other studies in the case of behavioral equations.
<table>
<thead>
<tr>
<th>No.</th>
<th>Model name</th>
<th>Builder</th>
<th>Size</th>
<th>Time unit</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A5</td>
<td>MOF Macro Model</td>
<td>Institute of Fiscal &amp; Monetary Policy, Ministry of Finance</td>
<td>small, 100 (50B/50D) (approximate)</td>
<td>Quarterly (active)</td>
<td>Testing the efficacy of fiscal-monetary policy</td>
</tr>
<tr>
<td>4B1</td>
<td>Kyoto University Macro Model (KYQ)</td>
<td>Kyoto University Institute of Economic Research--Chikashi Moriguchi</td>
<td>medium, 179 (80B/99D)</td>
<td>Quarterly (active)</td>
<td>Quarterly forecasting</td>
</tr>
<tr>
<td>4B2/3A2</td>
<td>Tsukuba-FAIS Annual Model</td>
<td>Tsukuba University-FAIS--Shuntaro Shishido</td>
<td>small, 95 (39B/56D)</td>
<td>Annual (active)</td>
<td>Annual predictions with international linkage</td>
</tr>
<tr>
<td>4B3</td>
<td>Keio University Macroeconomic Model (KOMN 2)</td>
<td>Fumimasa HAmada (Keio Univ.)</td>
<td>medium, 117 (60B/57D)</td>
<td>Quarterly (active)</td>
<td>Quarterly forecasting</td>
</tr>
<tr>
<td>4B4</td>
<td>Kei Mori's Macro Model (KS53)</td>
<td>Hirofumi Hayashi (Management Engineering, Keio Univ.)</td>
<td>medium, 167 (83B/84D)</td>
<td>Quarterly (active)</td>
<td>Forecasting and policy simulation</td>
</tr>
<tr>
<td>4C1</td>
<td>NEEDS Model</td>
<td>Nihon Keizai Shimbun [Japan Economic Journal]</td>
<td>large, 251 (116B/135D) (1984 vers.)</td>
<td>Quarterly (active)</td>
<td>Quarterly predictions &amp; simulation analysis</td>
</tr>
<tr>
<td>4D2</td>
<td>JERC Short-Term Forecasting Model</td>
<td>JERC Econometric Unit</td>
<td>medium, 122 (46B/76D) (1976 vers.)</td>
<td>Quarterly (discont.)</td>
<td>Quarterly forecasting</td>
</tr>
<tr>
<td>4D3</td>
<td>JERC Simultaneous Interindustry Model</td>
<td>JERC Econometric Unit--Hiroya Ueno and Hiromichi Muto</td>
<td>large, 291</td>
<td>semi-annual (discont.)</td>
<td>Medium-term predictions at the macro &amp; industry levels</td>
</tr>
<tr>
<td>4D4</td>
<td>RINE Macro Model</td>
<td>Research Institute of National Economy</td>
<td>small, 28 (13B/15D)</td>
<td>Quarterly (active)</td>
<td>Quarterly and annual forecasting</td>
</tr>
<tr>
<td>4D5</td>
<td>NRI Short-Term Macro Forecasting Model</td>
<td>Nomura Research Institute</td>
<td>medium, 152 (66B/86D)</td>
<td>Quarterly (active)</td>
<td>Quarterly forecasting and simulations</td>
</tr>
<tr>
<td>No.</td>
<td>Model name</td>
<td>Builder</td>
<td>Size</td>
<td>Time unit</td>
<td>Objective</td>
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<td>-----------------------------------------------------------</td>
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<td>4D6</td>
<td>MRI Macro Model</td>
<td>Mitsubishi Research Institute</td>
<td>medium</td>
<td>Quarterly (active)</td>
<td>Annual forecasting</td>
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<td>180 (120B/60D)</td>
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<td>4D7</td>
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<td>Daiwa Securities Economic Research Institute</td>
<td>large</td>
<td>Quarterly (active)</td>
<td>Quarterly forecasting</td>
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<td>283 (91B/192D)</td>
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<td>4D8</td>
<td>Denken Macro Model</td>
<td>Central Research Institute for Electric Power Industry</td>
<td>small</td>
<td>Quarterly (active)</td>
<td>Quarterly forecasting with emphasis on energy &amp; electricity</td>
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<td>64 (35B/29D)</td>
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<td>12 (5B/7D)</td>
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<td>5A2/3B1</td>
<td>ELSA Japan Model</td>
<td>Institute of Developing Economies</td>
<td>small</td>
<td>Annual (active)</td>
<td>Analysis of economic interdependence in East &amp; Southeast Asia</td>
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<td>7 (5B/2D)</td>
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