Introduction

A Historic Survey of Macroeconometric Models in Japan

Shinichi Ichimura

1. Available Statistics in Japan

1.1. *Rich historic statistics*

Japan has very rich statistical data historically as well as now. Before emerging as a modern state in 1868, she had many reliable statistical data such that various economic activities could be traced back at least to the 16th century. Suffice it to show three examples. (1) In 1582–1591 the acreage and productivity of cultivated land were estimated almost nationwide by *Taiko Kenchi* (land-surveying by Toyotomi, Hideyoshi) by standardized measures and methods, and ever since then.[1] (2) Her foreign trade statistics with the Netherlands, China and Korea since the 16th century have been recorded, including the Edo period (1603–1867) when the country was closed to migration and trade, except for trade with those three countries.[2] (3) Wages and prices are known almost throughout the Edo period.[3]

1.2. *Long term economic statistics*

This archive-minded tradition was carried over to the new government in the Meiji era (1868–1912). It produced and kept many statistical data, covering prices, wages, various industries' amounts of production, consumption, foreign trade figures *etc*. These sources made it possible for the

[1] See Naotaro Sekiyama (1952), Hiroshi Kito (2000). They go back to the 8th century or even earlier. Data became more reliable in the mid-Edo period. On *Taiko Kenichi*, see Mitsuru Miyagawa (1957–1963).

[2] As for Japan-Netherlands trade, see Yoko Nagazumi (1987) and Yasuko Suzuki (2004).

[3] Nobuo Koyanagitsu (2006).

MACROECONOMETRIC MODELING OF JAPAN

http://www.worldscibooks.com/economics/7010.html

Hitotsubashi University group to produce the long-term economic statistics from about 1875 to 1940 in an impressive 14-volume *Japanese Long-Term Economic Statistics*, edited by Kazushi Ohkawa, Miyohei Shinohara and Mataji Umemura, Toyokeizai Shimpo-sha, 1965–1985.[4]

The Bureau of Statistics, Ministry of General Affairs, produces the post-World War II data for the long-term. These data are linked to the Hitotsubashi series and compiled as the continuous series. They are available in the home page of the Bureau of Statistics. They cover the main items in the areas: 1. Land, 2. Population, 3. Economy, 4. Society, 5. Culture. Economic statistics for the period from 1868 to 2002 include:

1. GDP statistics (personal consumption, wages, housing statistics, fixed investment, mining and manufacturing productions, their indices, tertiary industrial activities),
2. Enterprise statistics (enterprises' profits, employment, population, working hours),
3. Prices,
4. Exports and Imports,
5. Balance of payments,
6. Money and banking.

They are annually updated and made available.

On these bases the two leading economists at Hitotsubashi University: Kazushi Ohkawa, and Miyohei Shinohara published and edited with many others[5] a number of books and articles. The representative ones are listed below.[6]

1.3. *Japanese national income statistics*

The national income statistics were the core of those long-term economic statistics (often abbreviated as LTES). Long before then, however, even earlier than the works of Richard Stone and Simon Kuznets established the conception of national income and its social accounting, some economists in pre-war Japan tried to estimate the Japanese incomes and national product.

[4]They are presented in Japanese but the statistical tables have English terms.

[5]Their contributions were very significant too: Tsuyoshi Noda, Koichi Emi, Hiromitsu Ishi.

[6]Ohkawa-Rosowsky (1973); Ohkawa-Shinohara-Meissner (1979); Ohkawa-Ranis-Meissner (1985). Among many important contributions of M. Shinohara only two are quoted: one mainly for the pre-war development, and another for post-war development. Shinohara (1982, 1994).

In 1933, Shigemi Hijikata (U. of Tokyo) estimated the Japanese national incomes from 1900 to 1930. In the next year, the government Bureau of Statistics officially estimated and published the Japanese National Income for 1925.[7] This work was extended backward to 1887 and forward to 1928. Even during World War II, the Ministry of Finance estimated the National Income for 1939 and extended it backward to 1919.

International interest in the Japanese national income statistics increased, and some economists like Colin Clark began estimating it himself. However, the national income widely used abroad then was the one presented by Kazuki Mori at the International Statistical Conference held in Tokyo in 1930. It was the preliminary figure of the Cabinet Bureau of Statistics mentioned above.

Immediately before World War II, it was mainly Richard Stone who established the solid accounting system of national income. Post-war Japanese scholars and government statistical offices quickly adopted that system of national income accounts.[8] In 1952, they began supplying annually the solid national economic calculation report as an official work by the Institute of Economic Research (IEP) at the Economic Planning Agency (EPA). After 2001, the National Income Division, the Economic and Social Research Institute (ESRI) at the Cabinet Office took over this work.

Government statistical offices have maintained other ordinary statistics listed in connection with LTES above with occasional revisions and offered very rich sources of data even for compiling the input-output table for the year of 1951. *The Japan Statistical Yearbook* publishes annually almost all important statistics, but there are many other statistical data published by the statistical bureaus of many ministries and prefecture governments. Particularly for manufacturing industries, *the Census of Manufacturers* is conducted every year. No other advanced economies conduct it annually. Japan had the *Industrial Census* even before the war. *The Census of Commerce* has been conducted every three years since 1950, every five years after 1997.

1.4. *Interindustrial relations tables*

The first Japanese Interindustrial Relations Table (IO Table) was produced for the year of 1951 with the cooperation of various government statistical agencies around the Department of Research and Statistics, Ministry of

[7] Shigemi Hijikata (1933); Cabinet Bureau of Statistics (1934).

[8] A pioneering but somewhat deficient estimate of national income was provided by Yuzo Yamada (1951).

Trade and Industry (MITI) with some advice of S. Ichimura. The estimation methods followed closely to the ones used for the production of the US Table for 1947, but with many original devices.[9] The outcome was more detailed and reliable. The voluminous MITI report (1957) gave the methods and findings of the Japanese experiences in detail.[10] As soon as the table was completed, Ichimura (1957): *The Structure of the Japanese Economy* applied it to the analysis of the issues facing Japan then — dilemma between unemployment and unfavorable balance of trade.[11]

Soon it became fashionable to produce the IO table in each prefecture. It spread fast all over the country, and soon all 47 prefectures had their own prefecture IO tables.[12] Some go as far as to produce an interregional table within each prefecture and use it for regional designing for the prefecture. In 1958, the first 1951 interregional IO table for the *Kinki* Region and the rest of Japan was produced by Kansai Economic Federation's secretariat under the guidance of S. Ichimura, using the data of each prefecture in the *Kinki region*.[13] Soon it spread to other regions as well as to the central government. They integrated these regional IO tables to produce the Interregional IO Table, dividing Japan into several regions. Soon the MITI began producing the Interregional and Interindustrial Relations Table for nine regions every five years. Akita (1994) uses them for Interregional Analysis of the Japanese economy.

Thus, Japan became a paradise for IO specialists. The news spread worldwide and attracted the attention of statisticians in other Asian countries. The Philippines was the first to have taken up the project of producing its own IO table and then Indonesia.[14] Just when other countries

[9]During the WWII the Japanese government made use of partial input-output relations table for economic control. The experiences were used to fill in some input-output relations. Practical difficulties had to be overcome by young statisticians like Yoshizo Tonoki, Etsuo Oizumi, Kiyoshi Kamoshita and others.

[10]MITI (ed.) (1957) contains the methods and sources to construct the IO Table for 1951 and simple applications. In this project the key person was Nagase Shinetsu, director of Research and Statistics Department.

[11]Ichimura (1960) applied the table for predictive purposes by endogenizing household consumption.

[12]Ministry of General Affairs (2000).

[13]Secretariat of Kansai Economic Federation (1960). The interregionl tables were available in English, too.

[14]Bantegi, head of Statistical Bureau in Manila, asked Ichimura to train his staff to compile IO tables and produced the first IO table in 1967. In Indonesia, Takao Kaneko produced in 1972 the first preliminary IO table for 1969 for LEKNAS-Kyoto U. Project by using the Philippine input coefficients.

were about to follow, the Institute of Developing Economies (IDE) in Japan stepped into this area. A little earlier, R. J. Wonnacott had constructed an international IO table for Canada and the US in 1964. IDE was attracted by a proposal of T. Watanabe to use international IO models for the North-South issues and during 1965 to 1971 tried to compile some international IO tables covering six regions (North America, Europe, Oceania, Latin America, Asia and Japan) or ten Asian countries. These experimental attempts gave the staff good opportunities to evaluate the reliability of statistical materials in those developing countries. In 1973, IDE launched a proper project to compile a comprehensive international IO table among East and Southeast Asian countries *plus* the US. They began the work by sending some experts to the countries like Indonesia, Thailand and Singapore, which had no reliable IO tables, to construct them and also to study the bilateral trade relations in IO tables with the countries which already had the national IO tables. The IDE experts, in collaboration with national statistical offices and research institutes, completed three national IO tables (Indonesia for 1971, Singapore for 1973, and Thailand for 1975) and three bilateral IO tables for 1970 (Korea-Japan, the US-Japan, and the Philippines-Japan). This laid the foundation of their subsequent works.

In 1978, IDE re-started the project to construct the 1975 multilateral IO table among ASEAN countries, Japan, Korea and the US. First, existing tables had to be updated to the year 1975 for Malaysia, the Philippines, Singapore, and the US. Second, the 1975 bilateral IO tables were constructed for Indonesia-Japan, Thailand-Japan, and for Korea-Japan. Third, they were linked together as a single multilateral IO table. It was completed in 1983 and became the prototype of the subsequent projects. After 1988 the major task was to include China and some Asia-Pacific countries. Thus, the 1985 multilateral table covered both China and Taiwan. Since then, IDE has successfully completed the multilateral tables for every five years.[15] The latest development is the release of "Transnational Interregional IO Table between China and Japan 2000", which linked the interregional table of China and that of Japan to present cross-border transactions on a region-to-region basis.[16] The tables available now are listed in Table 1, together with Table 2 which gives a list of World Trade Matrices including important trade partners of Japan.

[15]S. Inomata and H. Kuwamori (2008).

[16]The 2005 Asian International IO Table, and the 2005 BRICs International IO Table will be published soon. This is the first international IO table incorporating the BRICs (Brazil, Russia, India, China) with the major three: the US, Japan and the EU.

Table 1. IDE Input-Output Tables.

A: National Input-Output Tables		B. International IO Tables	
Country	**Years**	**Countries**	**Years**
Indonesia	1971, 75, 85, 90	Japan-Korea	1970, 75, 85, 90
Singapore	1972, 75, 85, 90	Japan-Philippines	1970, 85, 90
Thailand, basic	1975	Japan-USA	1970
Thailand, analytical	1975	Japan-Indonesia	1975, 85, 90
Malaysia, peninsula	1975, 85, 90	Japan-Thailand	1975, 85, 90
The Philippines	1975, 90	ASEAN	1975
China	1985, 90, (2000)	Japan-China	1985, 90
Taiwan	1985, (90), 90	Japan-Singapore	1985, 90
		Japan-Malaysia	1985, 90
USA	(1975), (05)	Japan-Taiwan	1985, 90
Multi-regional for China	2000	Asian	1985, 90, 95
		Asian (I: notes, II data)	2000, 05
		Transna'l & Interre'l China-Japan*	2000
		BRICs (I: notes, II data)	2005

*Those in ( ) are updated ones.
**IO between regions in China and regions in Japan are recorded.
Note: Most tables are available from: (English) http://www.ide.go.jp/English/Publish/Books/Sds/material.html, (Japanese) http://www.ide.go.jp/Japanese/Publish/Books/Tokei/material.html.

Table 2. IDE Trade Matrix List.

1. World Trade Matrix, 1964 — Total Value of All Commodities
2. World Trade Matrix, 1966 — Total Value of All Commodities
3. World Trade Matrix, 1968 — Total Value of All Commodities
4. World Trade Matrix, 1964–1976
5. International Trade Matrix for Asia and Pacific Region, by Industry: 1965–1983
6. International Trade Matrix for USSR and Eastern Europe: 1980–1984
7. International Trade Matrix for Asia-Pacific Region by Industrial Group, 1975–1992: I: Export; II: Import; III: Analytical Tables
8. World Trade Matrix: By Asian International Input-Output Table 24 Sectors
9. Trade Matrix for Asia-Pacific Region, 2000

1.5. *Survey data*

Similarly to other major industrialized countries, Japan has been using various business indexes and survey data for the purpose of capturing and forecasting economic trends. The *Diffusion Index* (DI), the *Consumer*

Confidence Survey, the Bank of Japan (BOJ) *Short-Term Economic Survey on Enterprises* (abbreviated as *Tankan*) as well as the Nikkei Index at the stock market are widely reported in the newspapers and used for forecasting business trends. There have been few comparative studies, however, on the relationship between these survey findings and the other short-term forecasts using econometric models. Shimanaka-Shikano (2010): "Business Indexes and Survey Data for Forecast" is a new contribution to Ichimura-Klein (2010) and gives an exposition of availability and the use of those indices for forecast.

1.6. *Flow of funds table*

The last important source of data for macroeconometric modeling is the statistics of financial activities. Availability of the *Flow of Funds Tables* and the *Assets and Liabilities Tables a la* IMF format shows the quality and the standard of various financial statistics in Japan. They are prepared by the BOJ and are very reliable. Tsujimura (2003) gives an exposition and use of those tables for modeling. It is adopted as "A Flow-of-Funds Analysis of Quantitative Monetary Policy" in Ichimura-Klein (2010).

2. Social Accounting Approaches and Use of Survey Data

2.1. *Great ratios in national income accounts*

The first economic survey of the Japanese economy was issued in 1947. Since then, the government has published the survey annually, up to the present time. It is popularly called the *Economic White Paper* and has been a best seller, since it has been regarded as the government economists' best analysis of the current conditions of the Japanese economy. Its concise quantitative analysis has almost been a textbook for university students and businessmen. Its standard style has settled: first to rely on the national income accounts for macroeconomic analysis of the national economy and then dig into the problems of the sectors where some urgent issues have arose. The White Paper improved in quality year after year and offered the major topics for policy discussions among government, business and academic circles.

The most straightforward way to use the national income accounts was suggested by Klein-Kosobud (1961); as *great ratios*: saving ratio, capital-output ratio (or incremental capital output ratio), and money to real GDP ratio in combination with some information of labor force and population. The Japanese Economic Survey has not strictly followed any

specific conceptual framework but adopted more or less the similar social accounting formats and combined them with sectoral or industrial analyses. As examples of such social accounting approaches, Ichimura-Klein (2010) adopted two articles: (1) Ichimura (1968): "Rapid Growth of the Japanese Economy — A Social Accounting Approach for the Early Reconstruction Stage of the Japanese Economy", and (2) Hyun Suk (2010): "Social Accounting Analysis of Japan's Lost 90s" for its mature stage. Ichimura tries to identify the specific factors of rapid recovery and development by subdividing the Japanese economy into several industrial sectors and large and small scale enterprises with careful attention to technological changes. Suk tries to see if the over-all general or formal approach can depict some characteristics of the lost 1990s without any specific hypotheses. Interpretation of the Japanese economy in the 1990s, however, requires a deeper understanding of the financial sectors so that Tsujimura (2003) mentioned above must be considered.[17]

2.2. *Identification of post-war Japanese business cycles*

The Japanese government has regarded the business cycles as an important factor for policy decisions and identified mainly with reference to the Diffusion Index published by the EPA (or ESRI after 2002). As the knowledge of post-war business circles is needed for understanding the discussions on the Japanese economy, the government's identification of business cycles is reproduced as Table 3.[18] Shimanaka-Shikano (2010) explains how the phases of cycles are identified and interpreted according to Burns-Mitchell or Schumpeter.

3. Input-Output Analysis and CGE Models

3.1. *Structural analysis with IO tables*

Since the first application of Ichimura (1957) already quoted, there have been mushrooming studies of interindustrial analyses. The earliest noteworthy one was the application of the first IO table and some supplementary

[17] As for the arguments on the lost 1990s, the most comprehensive is Fumio Hayashi (2008).
[18] Among academic economists, Shozaburo Fujino (Hitotsubashi U.) was known as a pioneer of business cycle studies (Fujino, 1965). Fujino (2008) examines the cycles before the Meiji reform on scanty data.

Table 3. Reference Business Cycles in the Japanese Economy, 1951–2008.

No.	Trough	Peak	Trough	Boom	Recession
1		1951/6	1951/10	Special Procurement boom	
2	1951/10	1954/1	1954/11	Investment boom	
3	1954/11	1957/6	1958/6	"Jinmu" boom	Flat pan recession
4	1958/6	1961/12	1962/10	"Iwato" boom	
5	1962/10	1964/10	1965/10	Olympic boom	Security slump
6	1965/10	1970/7	1971/12	"Izanagi" boom	Nixon slump
7	1971/12	1973/11	1975/3	Archipelago reform boom	First oil crisis
8	1975/3	1977/1	1977/10		Mini recession (Yen revalued)
9	1977/10	1980/2	1983/2		Global recession (second oil crisis)
10	1983/2	1985/6	1986/11	High-Tech boom	Yen revaluation recession
11	1986/11	1991/2	1993/10	Bubble boom	First Heisei recession
12	1993/10	1997/5	1999/1	Camphor boom	Second Heisei recession
13	1999/1	2000/11	2002/2	IT bubble	Third Heisei deflationary recession
14	2002/2	2007/10	2008/10	"Izanami" boom	
15	2008/10			Global financial crisis	

Notes: Jinmu is the name of the first emperor in Japanese history. "Jinmu" boom means the unprecedented boom since Jinmu's reign. Similarly for Iwato (an event in Japanese myth times), Izanagi (a mythical male figure) and Izanami (a mythical female figure). Heisei is the yearly calendar for the present emperor.

data of sectoral capital coefficients to the so-called Leontief Paradox: Tatemoto-Ichimura (1959): "Factor Proportions and Foreign Trade — the case of Japan", *The Review of Economics and Statistics,* which is in Ichimura-Klein (2010). The second important contribution was Chenery-Watanabe-Shishido (1962): "The Patterns of Japanese Growth, 1914–1954". By constructing even the pre-war IO tables, they proposed the way of identifying the factors for economic growth with changes of final demand, technology and industrial composition.[19] T. Watanabe pursued the applications to economic policy-making and compiled his publications

[19]This work had a significant impact on the studies at the World Bank in analyzing the factors of growth for developing countries when H. Chenery was its Vice President.

in Watanabe (1970).[20] S. Shishido made a significant contribution in the historical and prospective analyses of industrial composition and technical progress in the Japanese economy. Only three works among many are quoted below.[21] There are many other applications of various kinds by many authors. In 1999 those economists as well as business and government circles organized the Pan-Asian and Pacific Association for Input-Output Studies (PAPAIOS[22]) and published the organ quarterly, three times in Japanese and once in English (*Journal of Applied Input-Output Studies*). A list of articles published in them includes the main works in the field, though contributions elsewhere are also important.

3.2. *Applications to regional analyses and CGE models*

Most applications of IO analysis in Japan have been to regional analyses, especially within a prefecture or some sub-national region. As Section 1.4 mentioned, the MITI has produced the nation-wide interregional IO tables every five years since 1960. Their practical applications are, however, very rare, such that Akita (1994) is precious. Section 1.4 also referred to the IO tables of other Asian economies. The IDE helped them and completed International IO tables. On those bases IDE attempted to analyze the international, interindustrial or interregional linkages. A list of important works are given in Inomata-Kuwamori (2008).

Another application of IO tables is constructing computable general equilibrium (CGE) models. IO analysis itself is the simplest CGE model.[23] When the statistical data are scanty or just for one or a few years, it is an unavoidable choice. Sometimes it is useful for analysis of taxation or environmental issues. In Japan Ezaki (1986): "A Computable General Equilibrium Model of the Japanese Economy", *Kobe Economic and Business Review* was perhaps a forerunner in this field. Then followed some works by others. Ezaki-Ito (1995): "A CGE Model of Flying Geese Pattern of

[20]It contains some important contributions of his IO analyses. For example, Chapters II. The Pattern of Japanese Industrialization; IV. Technical Progress and Economic Growth; VIII. Stabilization Policies and Business Cycles. His concern was also an international comparison of IO analyses.

[21]Shishido (1990); Shishido (1991); Shishido, with Kiyo Harada and Yuh Matsumura (1991). Shishido's contribution to macroeconometric models incorporating IO tables are quoted in Section 4.

[22]Its home page: http://www.sanken.keio.ac.jp/papaios/index-jp.html.

[23]A useful up-to-date collection of papers in the field of applications of CGE models to regional analyses is Masaru Doi (ed.) (2006). It gives a useful list of past works as well.

Development in East Asia", is a precious piece combining Japanese and Asian IO tables to analyze the development pattern among Japan, Asian NIEs and Southeast Asian countries in succession. That is why it is accepted in Ichimura-Klein (2010).

3.3. *Flow of funds tables and its applications*

IO tables are concerned primarily with the transactions of goods and services. Some CGE models cover financial or monetary transactions but not very extensively. The Flow of Funds (FOF) accounts, however, systematically compile the financial transactions and the financial assets and liabilities. Tsujimura (2003)[24] presented the procedure to produce the Asset-Liability-Matrix (ALM) from the FOF accounts, so as to be able to use the tools and experiences of IO analysis. It applied ALM to examine the quantitative monetary policy introduced by the BOJ in March 2001 and concluded that there was a tactical error in the BOJ's policies in money market operations. Thus, it proved to be a powerful device for such an examination. Tsujimura (2004) collected more articles applying the information of FOF tables, including an important contribution by Ogawa-Saito-Tokutsu (2004). Their paper integrated the FOF analysis with standard econometric models and methods.

4. Macroeconometric Models

4.1. *Kazuo Sato's survey and other readings of Japanese models*

The most comprehensive and relatively up-to-date excellent survey of Japanese macroeconometric models is K. Sato's "Econometric Models of the Japanese Economy", in Bodkin-Klein-Marwah (1991) and covers macroeconometric models up to 1988. Yet it missed some important works during the period. The reason was that although Sato read an outstanding survey of macroeconometric models: Saito-Moriguchi (1985), he missed three particularly important readings of econometric models[25]: Tatemoto-Ichimura (1970), Morishima-Murata-Nosse-Saito (1972), and

[24]Kazusuke Tsujimura and Masako Tsujimura compiled their contributions in their new book (2008).

[25]It is the best survey in Japanese of the models up to 1985, based on a questionnaire survey to the authors of major models. It comparatively examines the parameter values of main behavior equations and estimation methods for many models. Some parts are reproduced in Sato (1991).

Kosobud-Minami (1977) and also overlooked the valuable proceedings of an international conference at the BOJ: Ando-Eguchi-Farmer-Suzuki (1985). As a result many outstanding works were not on his list. They are listed in the references below. Tatemoto-Ichimura (1970) collected the 20 best models up to 1970. Morishima *et al.* (1972) collected some works around the important Saito model. Kosobud-Minami (1977) translated some models in Tatemaoto-Ichimura (1970) into English and assembled some more by selecting later excellent models. Ando *et al.* (1986): *Monetary Policies in Our Times* is a valuable record of the international conference at the BOJ mainly on the monetary policies against stagflation. It contains a model by Amano (1985) and discussions on monetarist *vs* Keynesian policies, including the empirical examination by Ando (1985).

Basically, I support Sato's observations,[26] identifying the three stages of development of model-building in Japan: first, learning in the late 1950s to the early 1960s; second, practice in the late 1960s, and third, maturation in the 1970s to the present. Pioneering groups were concentrated in Tokyo, Osaka-Kyoto, and Nagoya. Since the early 1960s, hundreds of econometric models have been constructed. Among them, we take up in this historic survey only the models of the Japanese economy as a whole. For instance, Kosobud-Minami (1977) selected 15 models in 5 parts: 1. consumption and investment, 2. production and factors of production, 3. market clearing and price formation, 4. international trade, 5. growth models. According to this classification, our historic survey covers only Parts 3 and 5.[27] Many outstanding sectoral models are not covered.

In Tokyo, T. Uchida, T. Watanabe, K. Mori and others tried to construct relatively small models first at the Tokyo Center for Economic Research

[26] Apart from model-building, I would add one critical note on his remarks about the state of modern economics in pre-war and war-time Japan. Sato underestimates the influence of J. M. Keynes' *General Theory* (1936) and J. R. Hicks, *Value and Capital* (1936) in Japan. During the war both books were re-printed in Japan and used as text-books for reading seminars in many universities. Although Marxian economics and German historical school were more influential in most universities, there were some outstanding economists who not only read them but also published outstanding original articles on the themes of the books before and even during the WW II. Examples are: Nisaburo Kito (Hitotsubashi University), Takuma Yasui (Tohoku University), Yasuma Takata, Masazo Sono, Hideo Aoyama (Kyoto University) and others.

[27] Similarly Sato (1991) took up only the national economy models, classifing them into 5 groups: 1. general equilibrium and projection model, 2. special purpose models, 3. internationally linked models, 4. short-term forecast models, 5. monetarist models. We do not classify them but similarly characterize each model.

(TCER). Soon some government economists like Shuntaro Shishido at the IER of the EPA joined. At Osaka University a group of economists like S. Ichimura, S. Koizumi, K. Sato, Y. Shinkai, and others at the Institute of Social and Economic Research (ISER) began to construct a large model in 1959 endeavoring under the guidance of L. R. Klein, depicting the characteristics of the developing Japanese economy. Soon, M. Saito and A. Amano joined.[28] Both groups began producing some practical models in the early 1960s.

4.2. *Long-term modeling and quantitative economic history*

While most economists in Osaka were working on data preparation and parts of a large econometric model, L. R. Klein spent part of his time with his colleagues to produce small long-term Japanese models by making use of the Hitotsubashi LTES. They were Klein (1961), Klein-Shinkai (1963), and Ueno (1961; 1963; 1968; 1977). The earliest by Klein covered the pre-war period only: 1878–1938, whereas Klein-Shinkai covered 1930–1950 — both in Ichimura-Klein (2010), and Ueno (1977) 1906–1968. All these models used the same LTES for pre-war period, so that their findings are comparable with the Hitotsubashi group's analyses. These are also comparable with the contributions by quantitative economic historians like Takafusa Nakamura.[29]

4.3. *Standard macroeconometric models in early stages*

As far as the macroeconometric models *a la* Klein-Goldberger (1955) are concerned, in the 1960s, the Tokyo group began producing a few practical models of medium size such as Uchida-Mori (1960), Uchida-Kuribayashi-Yajima-Watanabe (1966), and its peak was Tatemoto-Uchida-Watanabe (1967). In the late 1960s and the 1970s to the 1980s, the EPA Institute of Economic Research played an important role in producing excellent macroeconometric models themselves as well as mobilizing the best econometricians in Tokyo, Osaka-Kyoto and Nagoya. Examples are Shishido-Kohno-Nagaya-Tanaka (1968) and Shishido-Ichikawa-Noda-Furuya-Oshizaka-Nishi kawa (1970).

[28] Ueno participated in the group's seminar from Nagoya U. as a pioneering econometrician in Nagoya.

[29] Representative works are: Nakamura (1968); (1971), (1979, 3rd ed. 1993); (1985); (1995); and (2004).

In Osaka ISER, on the other hand, we independently worked on the construction of a large Japanese model comparable with the US Brookings Model,[30] primarily to depict the characteristics of Japanese economic growth at that stage. What we had in mind then were: (1) its high dependence on foreign trade, particularly imports of food and energy, (2) the dual structure of industries (large and small size enterprises), and (3) deliberate monetary policy to keep the interest rate low. We encountered two difficulties in conducting the work: first, the data problem, and second, computation limits.

First, we began constructing a model for the manufacturing sectors, subdividing them into five industries: Primary, Heavy, Light, Energy, and Tertiary Industries. Heavy and Light Industries were further divided into large and small sizes. This subdivision into large and small enterprises of production, labor, capital, and wages was most time-consuming and hard work. *The Census of Manufacturers* data made it possible to subdivide the enterprises, but *the Census of Commerce* was only available every five years so that the Tertiary Industry could not be subdivided. The demand side for the industrial output was based on the principles of effective demand for sectoral basis similar to input-output analysis. The production functions were used to determine the factor incomes and demand for labor. Export and import functions were divided more in details than the industrial sectors, and the demand for and the supply of money were analyzed, distinguishing cash and deposit money to trace the Bank of Japan's policies in determining its money supply and official discount rate of interest. This ISER model is adopted as a chapter in Ichimura-Klein (2010).

The second difficulty was the limitations in computer facilities. Not only in Japan, but also in the US in 1960 to 1961, the best IBM computers could provide the estimated results of behavior equations every three days or so due to the need of punching in the specification. This condition did not improve much at UC Berkeley and U of Pennsylvania even around 1965 to 1967 when I was working to complete and simulate the model. For example, the available computers could not solve a simultaneous system of about 500 non-linear (in variables) equations without linearization.[31] As

[30]In 1960–1961 when we were working on the ISER model in Osaka with L.R. Klein, we had no knowledge of the Brookings model being constructed in the US which was later published as Duesenberry *et al.* (1965).

[31]To overcome the difficulty, I had to linearize the variables at the point of last year of observations and obtain the coefficients of all the variables in the form of matrix about 500×500 to calculate its inverse matrix. Then the impact and other multipliers presented in ISER model book were obtained.

for the appropriate computer programs for large, multi-country models, see the Appendix.

Anyhow, the whole ISER model and its simulation were completed in 1967, and the findings were made available as discussion papers of Osaka University ISER and reported at the International Symposium in Novosibirisk in 1969. The entire results were not widely known, however, until a mimeographed monograph: *An Econometric Analysis of the Japanese Economy* (Ichimura-Klein-Koizumi-Sato, 1977) was distributed at the 1977 LINK meeting in Kyoto. This extensive model was simulated for fiscal expenditure, taxation and monetary policies, and its findings were compared with the results of a medium size Evans-Klein model in the US (Evans-Klein, 1968), because the Brookings model was not simulated for any policies. It was significant, therefore, that such a large ISER model proved to be workable with sufficient care.[32] This model would be still useful to see the characteristics of Japanese growth process in the early stage and to learn the way of building and simulating econometric models for developing countries.

4.4. *Models integrated with IO analysis and internationally linked*

Soon, however, the honeymoon period for model-builders in the late 1960s came to a sudden end in the early 1970s. Two major events in the world hit Japan as well: the first oil shock and the Nixon devaluation of US dollars accompanied by flexible exchange rates. These changes forced model-builders to reconsider the structure of their models in many aspects. Moreover, the National Income statistics of Japan were completely revised in the 1970s according to the UN Standard of National Accounts, and the revised time-series did not become available until early 1979. The 1970s were, therefore, a rather futile decade to build new models. Simultaneously, however, two favorable developments occurred for model-builders in the 1970s. One is that construction of IO tables and their applications and macroeconometric model-building spread to other Asian countries. The former was already explained. The latter was undertaken at central banks' research departments (Korea, the Philippines, and Thailand) or planning agencies (Taiwan, Indonesia) or universities (Hong Kong, Singapore, Malaysia).

[32]Osaka ISER model had about 500 equations including identities. Asian LINK model: (Ichimura-Ezaki, 1985) was also about the same size. However, in the 1980s, an improvement of computer capacity and the application of the Gauss-Seidel method resolved the problem to solve a system of many non-linear equations.

Those models were assembled with their later improvements in Ichimura-Matsumoto (1993). Another was that the growing Japanese economy became more integrated with the East Asian neighbors. These two facts necessitated and made it possible to construct the Japanese models internationally linked with Asian economies.

Under these circumstances, Japanese model-builders made some important steps forward even in the 1970s, more in the 1980s and later, offering several new models.[33] One of the common characteristics was to integrate IO tables, as the Osaka ISER model was designed from the very beginning. The Japanese models had to deal with the changing industrial composition of the manufacturing sector and international trade. Important works were: Saito (1971), Tsujimura-Kuroda (1974), and Moriguchi (1979). In particular, Saito (1971): "An Interindustry Study of Price Formation", *Review of Economics and Statistics* was the econometric model that integrated IO analysis more extensively than the Osaka ISER model. Despite the title, it was an ordinary econometric model and analyzed the changes in output, employment and prices of industrial sectors.[34] It marked a start of his outstanding works and resulted in some more works by his colleagues in Morishima *et al.* (1972). Tsujimura-Kuroda (1974): *General Equilibrium Analysis of the Japanese Economy* (J) was also a multisectoral standard model combined with IO analysis and established a base of the Keio group.[35] There quickly followed a similar work by Tsujimura-Kuroda-Shimada (1981). At Kyoto U., Moriguchi (later Osaka U.) initiated model-building and produced his KQ75 model after several earlier models (Moriguchi, 1979). Leading a group of academic and business economists at the Kansai Economic Research Center (now Kansai Institute of Social and Economic Research: KISER), he produced a medium annual model emphasizing the public finance sector: KERC (1978).[36]

[33]It was most regrettable that Sato's survey almost completely missed Saito's outstanding contributions. Sato missed also one important individual work: Seiji Hirai (1982). He performed a stochastic simulation of his Japan model. It is the first and genuine experiment of that type in Japan.

[34]In this sense it differed from many CGE models that handled the same issues.

[35]In Tokyo, Hitotsubashi U., U. of Tokyo and Keio U. led econometric studies; a little later was Tsukuba U.

[36]Moriguchi offered his forecast at KERC for many years, and his forecast was reported in the Nikkei newspapers and provided the business circles with economic forecasts independent of the government. After 1988 he was a leading econometrician of the PEO (Pacific Economic Outlook) conference sponsored by the PECC (Pacific Economic Cooperation Conference) annually held in Osaka with the participants from the APEC member countries.

Macroeconometric model-building developed not only in Asia but earlier in Europe. L. R. Klein initiated to organize an international project called Project LINK and construct the world-wide model linking multiple national models together. In this project[37] the Japan model has always been an important part. Moriguchi contributed his quarterly model from the beginning to the mid-1990s, when Kanemi Ban (Osaka U.) took over. The latest version of Ban model is taken as the Japan model for LINK in Ichimura-Klein (2010). Besides Project LINK, however, a number of internationally linked econometric models and interindustrial trade relations models were developed in Japan in the 1980s and continued into the 1990s. Sato's survey referred appropriately to the models of (1) Kyoto U. Center for Southeast Asian Studies, (2) the IDE group, (3) Shishido groups at Tsukuba U. and the International U. of Japan, (4) Kinoshita group at Nagoya U., and, (5) the EPA world model and other groups.

Representative reports of each group were: (1) Ichimura-Ezaki (1985): (2) IDE (1984: 1984a); (3) Shishido (1988); (4) Kinoshita *et al.* (1983); (5) EPA world model (1983; 1989). Among these, the global models that closed the system for the world as a whole with the rest of the world were only Ichimura-Ezaki (1985), Shishido (1988) and the EPA world model. Along with the world model at EPA, Soshichi Kinoshita (Nagoya U.) also cooperated with the EPA and produced with others an international trade model: Kinoshita *et al.* (1983). It was accidental that they all started about the same time and completed at nearly the same time, except for the EPA world model which lasted longer. Unfortunately those model-builders had no good opportunities for comparative examination of their models.

The most ambitious of all was the EPA World Model: a global quarterly model consisting of Japan, France, UK, Germany, Italy, Canada, US, Australia, Korea and the rest of the world. The project was led by Akihiro Amano on the academic side and Masaru Yoshitomi on the EPA side in cooperation with many capable government economists. The first version was published in October, 1982, and the fifth version was presented at the Sixth International conference at the EPA, Tokyo in February, 1989 and at many other international conferences. Its structure, simulation analyses,

An annual report of the forecasts of APEC member economies based on participants' econometric models has been published by KISER every year. In 2004 the role of chief economist from Japan was succeeded by Yoshihisa Inada (Konan U.).

[37]Project LINK held its annual meeting twice at the UN and another country for many years, but their proceedings are not published, except for one for 1991 and 1992 in Moscow and Ankara: Hickman-Klein (1998). It includes two contributions by S. Shishido and Mitsuru Toida from Japan.

multipliers are made available in the project's Discussion Papers (1989).[38] The Japan model in the World Model was originally the Master model in Shishido *et al.* (1970) and has been carried over, after termination of the world model project, as the present ESRI short-term quarterly model and has been updated ever since.

This World Model squarely dealt with the issues of flexible Yen/dollar exchange rate after 1973–1974. It was a significant contribution of A. Amano as an international economics expert. Amano (1983; 1985; 1988) was the first to construct an econometric model with flexible exchange rates. He applied his approach to Project LINK models with their experts Amano-Holtham-Hooper-Pauly (1986) and Amano (1986).

4.5. *Macroeconometric models after 1988*

None of the Japanese or Asian models covered by Sato's survey integrated any model of China nor trade with China. Although Ichimura-Ezaki (1985) had a model of China by Haruki Niwa, it could not include China in Asian LINK mainly due to the data problem. But after 1979, China adopted Den Xiaoping's *reform and open* policies and achieved enormous development, so that in the late 1980s it became non-negligible for any model-builders. Besides, the statistical data similar to Western countries became available.[39] Then, many Japanese econometricians specialized in Asia began working on Asian models including China.

Besides those included in Ichimura-Klein (2000): *Econometric Modeling of China*, S. Kinoshita (1993) at Nagoya U. and later Sugiyama U. constructed his own East Asian model including China. His group pursued to construct the global model and produced Ozaki (1999) and Yamada-Kinoshita (2006).[40] S. Shishido continued his world model (1988) and shifted his interest to Northeast Asia including China (1999, 2007). Yoshihisa Inada (Konan U.) as an adjoined professor at ICSEAD (International Center for the Study of the East Asian Development) led a project of East Asian model including China. His China model is available in Ichimura-Klein (2000) and his entire Asian model as discussion papers of

[38]They can be seen in the home page of ESRI.

[39]On these matters and China model as such, see Ichimiura-Klein (2000).

[40]Their Japan models contained forward-looking variables for expectation so that they adopted the "Fair method" for solving the system and simulation. See Appendix, Fair (1984, pp. 371–375, and http://fairmodel.econ.yale.edu/fp/fp.htm.

ICSEAD. The Japan models in the internationally linked models were of standard Klein-Goldberger size. The elaborate EPA world model was not revised to take account of the Chinese economy.[41]

M. Saito has been a persistent macroeconometric model-builder of the Japanese economy at Osaka U. and later Kobe U., working almost independently of the groups mentioned above. Even after Saito (1971), a characteristic of his models has been to incorporate the IO tables both in real IO relations and the formation of industrial prices. The same is true with the latest version of his Japan model: Saito (2000). A core system of equations of his model is included in Ichimura-Klein (2010) with some new notes responding to L. R. Klein's queries. This is probably the best model for beginners to learn about macroeconometric modeling of the Japanese economy now.

As for the financial side of the Japanese economy, Saito and his colleagues produced Ogawa-Saito-Tokutsu (2003) by making use of the flow of funds information but simultaneously relying on all the other statistics about the financial transactions of Panel data. It is an outstanding piece of work following the general equilibrium model of Tobin-Brainard type and strictly follows the standard econometric methods to avoid the multi-collinearity prevalent among the financial variables. The conclusions derived from this model combined with his real side model gave a plausible ex-post forecast for the bubble economy in the 1990s.[42]

Saito's and Keio group's multi-sectoral models were applied to the energy and environmental issues in Japan, as Saito (1982) and Kuroda (1998; 2000). There are many models applied to energy and environmental problems, but they are not taken up here unless they have unique characteristics as macroeconometric models.

The Japanese government has had several models for the public use besides the world model. One is the ESRI quarterly short-term model already referred to previously. It is updated every year by the ESRI economists, and its simulation results like multipliers are used for government policy-making and made available in the ESRI homepage. Despite its importance, it was not adopted in Ichimura-Klein (2010) because of

[41]The ESRI maintained its efforts to analyze the feedback between the world economy and Japan. A significant contribution was made by K. Ban *et al.* (2002).

[42]His simulation showed that the 5 trillion Yen increased demand for land for two years, supported by the sufficient increase of money supply, causes land price to rise by 2.15%–3.15%, cpi to increase by 0.33%–0.77% and a decline of real GNP rate of growth by 0.14%–0.21% during the period.

the difficulties for ordinary econometricians to understand the specifications.[43] Another model currently in use and available in ESRI home page is an annual model for the medium-term programming. It consists of a core part of about 280 equations and identities *plus* a few thousand equations in the sub-models. It is too difficult for outsiders to dig into without detailed exposition. The ESRI not only uses these two models for official purposes but also organizes a consensus forecast group, asking the selected research groups to offer their quarterly forecasts. It is explained in Inada (2010).

The Bank of Japan used to have an internationally known econometric model like Eguchi (1972). See, for instance, Eguchi (1976) in Federal Reserve Bank of SF (1976). K. Sato (1991) reports that the BOJ used some monetarist models for forecast and analysis in the mid-1970s, but no specific articles seem to have been available to outsiders. Some economists inside the BOJ say that it still uses some econometric models, but no published articles contain empirical equations.

The Nihon Keizai Newspaper's subsidiary, Nikkei Digital Media, Inc. offers NEEDS data bank and their own econometric model services. Their models are made available only to their customers.[44] Its other subsidiary Japan Center for Economic Research kindly organizes an annual meeting of academic and business econometricians for exchange of information and runs a course to train econometricians.[45]

4.6. *High frequency short-term forecasting model and medium-term model*

Fortunately, however, there are two most up-to-date macroeconometric models that are intensively used and offer their findings in the public domain. They are comparable with the government official forecasts and analyses. One is Yoshihisa Inada's High Frequency Model, and another is Shishido's multi-sectoral model called DEMIOS. Both are adopted in Ichimura-Klein (2010). Inada Model is the Japanese version of similar models in the US, utilizing daily, weekly or monthly data to improve the short-term forecast more often than quarterly. He is following closely the

[43]One difficulty is complex notations, and another is many complicated identities. Unless further explained in detail, outsiders could not understand the system.

[44]Saito-Moriguchi (1985) offers some information of NEEDS models in the past.

[45]Many other private business corporations or their think-tanks run their own econometric models, but most of them are not published, as the Central Institute of Electric Power Industry used to do.

methods explored by L. R. Klein's group at the U. of Pennsylvania. Every month he announces his forecast at the KISER a few quarterlies ahead and for next year, and every week at his own Konan U. to his clients as well as through the home page of Project LINK. His model is constantly tested against the real outcomes every month. Inada (2010) compares his findings with the Consensus Forecast announced by the Economic Planning Association, affiliated with the EPA.

The Shishido model is one of the medium term models in use for many years, constantly updated and improved. It has been giving the forecasts 4 to 5 years ahead with some prescribed policy alternatives. His prognosis has been rather different from the government's, often more optimistic, and his policy recommendations have been bolder than the government's. The government has been rather concerned with the cumulating public debt, whereas he seems to be more optimistic in assuming the high elasticity for income multipliers and tax revenues. The interested reader may compare his findings with another optimism of Klein-Adams-Kumasaka-Shinozaki (2007): *Accelerating Japan's Economic Growth: Resolving Japan's Growth Controversy*.

Appendix: On Computer Programs for Large Multi-County Econometric Models

The computer limitations were briefly sketched in the text, as I have experienced them. After solving the Osaka ISER model, the computer facilities at Japanese universities quickly improved year after year. Yet the standard programs available around 1970 like SPSS etc. or later TSP. SPSS, SAS, Eviews and RAT7 were not adequate enough to solve the large econometric models with nonlinear variables and equations. It was highly desirable to have some devices for checking the human errors in inputting the data or specifications. Many expert econometricians and computer scientists or informatics cooperated to produce convenient programs for multi-country dynamic system. The central figure of the group was Ippei Sugiura (1925–2009). Similar issues have been handled in the US by Ray Fair, Yale U. The representative contributions are as follows.

1. Ezaki, Mitsuo, M. Shibayama, and S. Ichimura (1984). An Econometric Link System for the East and Southeast Asian Countries, Japan and the United States. *Southeast Asian Studies*, 22(3) 260–283.
2. Fair, Ray (1984). *Specification, Estimation, and Analysis of Macroeconometric Models*. Harvard University Press.

3. Fair, Ray (1994). *Testing Macroeconometric Models*. Harvard University Press.
4. Fair, Ray (2004). *Estimating How the Macroeconomy Works*. Harvard University Press.
5. Ichimura, S., Ippei Sugiura and Hans Tjian (1966). A Simulation System Program for Large Econometric Models, Working Paper No. 198, Center for Research in Management Science, U. of California, Berkeley.
6. Sadamichi, H. and Y. Nunokami (1993). International Use of the Econometric Models and Data Base Via Bulletin Board Systems. In *the Proceedings of the International Conference of OA & International Management*, Beijing, October. In *Office Automation*, 14(3, 4) 128–130.
7. Sadamichi, H. and Y. Nunokami (1982). A Database System of Economic Time Series. *Kobe Economic & Business Review*, 28, 43–47.
8. Shibayama, M. *et al.* (1989). Research Report to Scientific Grant (B): An Integrated Computer Network for Econometric System of Japan, US and Asian Countries (Japanese).
9. Sugiura, Ippei (1973). *ASTRO-FOIL — Program System for Planning and Prediction*. Nihon Hyoronsha, Tokyo (Japanese).
10. Sugiura, Ippei H. Sadamichi and Y. Nunokami (1981). *STEPS — Econometric Analysis by Computers*. Toyokeizai Shimposha, Tokyo (Japanese).
11. Yasuda, Satoshi (1985). Sekai Model Bunseki System (An Analytical system for the World Model). Annual Report of Economic and Management Research, Kobe University Institute of Economic and Management Research (Japanese).
12. Yasuda, Satoshi (1986). A system of Solving LINK World Models — for the case of CSEAS. *News Letters of Special Research Project for Development of Programs for Multi-Purpose Statistical Data Bank*, 13(4) (Japanese).
13. Yasuda, Satoshi (1986). Virtual Computers and System of Computer Languages — Analytical Systems for World Econometric Model. Monograph Series of Kobe University Institute of Economics and Management (Japanese).
14. Yasuda, Satoshi (1999). *Structures of Econometric Models and Solution Methods — Ordering and Sparsing*. The Japanese Institute of Management Science (Japanese).

References

Akita, Takahiro (1994). Interregional Interdependence and Regional Economic Growth in Japan. *International Regional Science Review*, 16(3).

Amano, Akihiro, K. Ban and C. Moriguchi (1976). A Quarterly Forecasting Econometric Model of Japan: KYQ 75 Discuss. Paper 095, KIER, Kyoto U (Japanese).

Amano, Akihiro (1977). Japan's Balance of Payments and its Adjustment: Quarterly Econometric Model, 1961–1967. In Kosobud-Minami (1977).

Amano, Akihiro (1983). Exchange Rate Modeling in the EPA World Econometric Model. In de Grauwe-Peters (1983).

Amano, Akihiro (1985). Alternative Approaches to Exchange-Rate Determination and Some Implications of Structural Balance of Payments Approach for International Macroeconomic Interdependence. In Ando *et al.* (1985).

Amano, Akihiro, Gerald Holtham, Peter Hooper and Peter Pauly (1986). Comparative Exchange Rate Simulations. *The European Economic Review*, 30(1).

Amano, Akihiro (1986). Exchange Rate Simulation — A Comparative Study. *EER, ibid.*

Amano, Akihiro (1988). Comment on Simulation Properties of Three Internationally Linked Models. In EPA (1988).

Amano, Akihiro (1988). Japan's External Imbalance and Exchange Rates. In Uno-Shishido (1988).

Ando, Albert, H. Eguchi, Roger Farmer and Yoshio Suzuki (eds.) (1985). *Monetary Policy in Our Times*. Cambridge, MIT Press.

Ando, Albert (1985). Coordination of Monetary and Fiscal Policies. In Ando *et al.*

Ban, Kanemi and Kiyomi Watanabe *et al.* (2002). An East Asian macroeconometric LINK model — Structure and simulation properties. *The Economic Analysis*, 164. Esri.

Bodkin, R. G., L. R. Klein and K. Marwah (1991). *A History of Macroeconometric Model-Building*. Brookfield, Vermont: Edward Elgar.

Cabinet Bureau of Statistics (1934). Study report of National Income in 1925.

Chenery, Hollis, T. Watanabe and S. Shishido (1962). The Patterns of Japanese Growth, 1914–1954. *Econometrica*, January.

De Grauwe, Paul and Thoo Peters (eds.) (1983). *Exchange Rates in Multi-Country Econometric Models*. London: Macmillan.

Dietzenbacher, Erik and Michael L. Lahr (eds.) (2004). *Wassily Leontief and Input-Output Economics*. Cambridge University Press.

Doi, Masaru (ed.). (2006). *Computable General Equilibrium Approaches in Urban and Regional Policy Studies*. WSPC.

Dusenberry, M. J., G. From, L. R. Klein and E. Kuh (eds.) (1965). *The Brookings Quarterly Econometric Model of the U. S. Economy*. Chicago: Rand McNally.

Eguchi, Hidekazu (1972). The Bank of Japan Econometric Model of Japan. *Chosa Geppoh*, Bank of Japan (Japanese).

Eguchi, Hidekazu (1976). Econometric Modeling at the Bank of Japan. In *Fed. Reserve Bank, San Francisco Proceedings*, 1976.

EPA world model team (1982). EPA Sekai Keizai Model no Kozo (The Structure of EPC World Model). *Keizai Bunseki*, 87 (Japanese).

EPA world model team (1982). The EPA World Econometric Model: Overview. (Japanese).

EPA (ed.) (1988). *Papers and Proceedings of the Fourth EPA International Symposium, 1988*. EPA.

EPA world model team (1989/2). Analyses of Model derived from IS-LM, Aggregate Demand-Aggregate Supply, and BP Curves, World Econ. Model Disc. Pap. no. 29 presented at the 6th Intern'l Conf. at EPA.

Evans, M. K. and L. R. Klein (1968). *The Wharton Econometric Forecasting Model. 2d ed. Philadelphia*. The Wharton School, University of Pennsylvania.

Ezaki, Mitsuo (1986). A Computable General Equilibrium Model of the Japanese Economy. *Kobe Economic and Business Review, 32 annual*.

Ezaki, M. and S. Ito (1995). The Flying-Geese Pattern of Development in East Asia: a computable general equilibrium approach. Discussion Paper No. 31, GSID Nagoya U., July.

Federal Reserve Bank of San Francisco (1976). *Proceedings of the First Pacific Basin Central Bank Conference on Econometric Modeling*, Held May 27–29, 1975.

Fujino, Seizaburo (1965). *Business Cycles in Japan*. Keiso Shobo (Japanese).

Fujino, Shozaburo (2008). *Japanese Growth and Cycles*. Keiso Shobo (Japanese).

Furukawa, S. and S. Inomata (1993). Significance of Construction and Analysis of International IO Tables of Asia-Pacific Region. In Sano-Tanamura (1993).

Hayashi, Fumio (ed.) (2008). *Keizai Seido no Jissho-Bunseki to Sekkei (Positive Anaysis and Design of Economic Institutions. I. Causes for Long Stagnation and Institutions; II. Functional Disorder of Finance; III. Designing Economic Institutions*. Keiso Shobo (Japanese).

Hickman, B. G. and L. R. Klein (ed.) (1998). *LINK 1991–1992 Proceedings*. WSPC.

Hijikata, Shigemi (1933). *Kokuminshotoku no Kosei (Composition of National Income)*. Nihon Hyoron Sha, Tokyo (Japanese).

Hirai, Seiji (1982). *Simulation Analysis of the Japanese Economy*. Sobunsha (Japanese).

Ichimura, Shinichi (1957). *The Structure of the Japanese Economy*. Sobunsha (Japanese).

Ichimura, Shinichi (ed.) (1960). *The Future of the Japanese Economy*. Yuhikaku (Japanese).

Ichimura, Shinichi (1968). Factors for Rapid Economic Growth — A Social Accounting Approach. In Ohkawa-Klein (1968).

Ichimura, Shinichi (1977). An Econometric Analysis of Japanese Exports and Imports. In Kosobud-Minami (1997).

Ichimura, S., L. R. Klein, S. Koizumi and K. Sato (1977). *An Econometric Analysis of the Japanese Economy*. The Japanese Association for Asian Studies.

Ichimura, S. and M. Ezaki (ed.) (1985). *Econometric Models of Asian LINK*. Springer-Verlag.

Ichimura, S. and Yasumi Matsumoto (ed.) (1993). *Econometric Models of Asia-Pacific Countries*. Springer-Verlag.

Ichimura, S. and L. R. Klein (ed.) (2000). *Econometric Modeling of China*. WSPC.

Ichimura, S. and L. R. Klein (ed.) (2010). *Macroeconometric Modeling of Japan*. WSPC.

IDE (1984). *Econometric LINK system for ASEAN: Overview*. IDE.

IDE (1984). *Econometric LINK system for ASEAN: Vol I and II*. IDE.

Inada, Yoshihisa (2010). High Frequency Model vs. Consensus Forecast. In Ichimura-Klein (2010).

Inomata, S. and H. Kuwamori (2008). *Compilation of the International Input-Output Table for the BRICs — A Feasibility Study*. Asian International IO Series, No. 71, IDE, March.

Kansai Economic Federation (1960). *Nihon Keizai to Chiiki Keizai (The Japanese Economy and the Regional Economy)*. Sobunsha, Tokyo (Japanese).

Kansai Economic Research Center (1978). *Econometric Analysis of the Japanese Economy and its Public Finance*. KERC.

Kinoshita, Soshichi (1993). A Linked International Model for the Pacific Basic Economy. In Ichimura-Matsumoto (1993).

Kinoshita, Soshichi, Y. Kajino, M. Saito, Y. Shiina and M. Yamada (1983). Development and application of a world industry and trade model for the analysis of international industry and trade structure focusing on Japan. ERI, EPA mono. series no. 38 (Japanese).

Kinoshita, Soshichi and Mitsuo Yamada (1989). The Impacts of Robotization on Macro and Sectoral Economies within a World Econometric Model. *Technological Forecasting and Social Change*, April, 211–230.

Kito, Hiroshi (2000). *Jinko kara Yomu Nihon no Rekishi (Japanese History seen from Population)*. Kodan-sha (Japanese).

Klein, L. R. and Arthur. S. Goldberger (1955). *An Econometric Model of the United States, 1929–1952*. Amsterdam: North-Holland.

Klein, L. R. and Richard F. Kosobud, (1961). Some Econometrics of Growth: Great Ratios in Economics. *QJ E*, 12(2), 139–150.

Klein, L. R., F. G. Adams, Y. Kumasaka and A. Shinozaki (2007). *Accelerating Japan's Economic Growth: Resolving Japan's Growth Controversy*. Routledge.

Kosubud, R. F. and Ryoshin Minami (eds.) (1977). *Econometric Studies of Japan*. Urbana, U. of Illinois Press.

Koyanagitsu, Nobuo (2006). *Kinsei Chingin Bukka Shi Shiryo: revised (Sources for History of Wages and Prices in the Edo period)*. Seiko-sha (Japanese).

Kuroda, Masahiro (1998). Multisectoral general equilibrium model and its simulation for environmental preservation policies, KEO Dis. Pap.-.15. (Japanese).

Kuroda, Masahiro (2000). Forecasting Baseline CO_2 Emissions in Japan. In Ching-Cheng Chang, Robert Mendelsohn, and Daigee Shaw (eds.), *Global Warming and Asian Pacific*.

MITI Department of Research and Statistics (ed.) (1957). *Nihon Keizai no Sanngyo Renkanhyo* (*Interindustrial Analysis of the Japanese Economy*). Toyokeizai Shipo-sha (Japanese).

MITI Statistical Association and Institute of Industries (ed.) (1979). *Tsusan Tokei-Shi (History of MITI Statistics)*, Volume IV: Statistical Analysis; Chap. 3: Interindustrial Analysis (Japanese).

Ministry of General Affairs (2000). *Report of Interindustrial Relations Tables in All Prefectures* (Japanese).

Miyagawa, Mitsuru (1957–1963). *Taiko Kenchi Ron (On the Taiko land Survey)*, Vol. 1–3. Ochanomizu-Shobo, Tokyo (Japanese).

Moriguchi, Chikashi (1979). The Structural Change of the Japanese Economy in the recent decade from a Macroeconometric viewpoint. *Keizai Kenkyu*, January, 20–29 (Japanese).

Moriguchi, C., M. Aoki and T. Sawa (1983). *Nihon Keizai no Kozo Bunseki (Structural Analysis of the Japanese Economy)*. Sobunsha (Japanese).

Morishima, M., Y. Murata, T. Nosse and M. Saito (1972). *The working of econometric models*. Cambridge Univ. Press.

Morishima, M., M. Shinohara and T. Uchida (1960). *Atarashii Keizai Bunseki (New Economic Analysis)*. Sobunsha, Tokyo (Japanese).

Nagazumi, Yoko (ed.) (1987). *Exports and Imports Items and Commodities by Chinese Ships: 1637–1833*. Sobunsha (Japanese).

Nakamura, Takafusa (1968). *Sengo Nihon Keizai — seicho to Junkan (Postwar Japanese Economy — Growth and Cycles)*. Iwanami-shoten.

Nakamura, Takafusa (1971). *Senzenki Nihon Keizai Seicho no Bunseki (Analysis of Prewar Japanese Economy)*. Iwanami-shoten (Japanese).

Nakamura, Takafusa (1979; 1993). *Nihon Keizai — Seicho to Kozo (The Japanese Economy — Growth and Structure)*. University of Tokyo Press (Japanese).

Nakamura, Takafusa (1985). *Meiji Taisho Ki no Keizai (The Japanese Economy in the Meiji-Taisho Era)*. University of Tokyo Press (Japanese).

Nakamura, Takafusa (1995). *Showa Keizai-shi (Economic History of Showa)*. Iwanami- shoten (Japanese).

Nakamura, Takafusa (2004). *A History of Showa Japan*.

Ogawa, K., M. Saito and I. Tokutsu (2004). Land Prices and Share Prices in Japan: An Econometric Approach. In Tsujimura (2004), pp. 177–210.

Ohkawa K. and L. R. Klein (ed.) (1968). *Economic Growth: Japanese Experiences since the Meiji Era*. Ill. Irwin: Homewood.

Ohkawa, Kazushi and Henry Rosowsky (eds.) (1973). *Japanese Economic Growth; Trend Acceleration in the Twentieth Century*. Stanford University Press.

Ohkawa, Kazushi, M. Shinohara and M. Umemura (ed.) (1965–1985). *Nihon Choki Keizai Tokei (Japanese Long-Term Economic Statistics)*. Toyokeizai Shimposha (Japanese).

Ohkawa, Kazushi, G. Ranis and Larry Meissner (ed.) (1985). *Japan and the developing countries: a comparative analysis*. Basil Blackwell.

Ohkawa, Kazushi, M. Shinohara and Larry Meissner (ed.) (1979). *Patterns of Japanese Economic Development — A Quantitative Appraisal*. Yale University Press.

Ozaki, Taiyo (1999). *Sekai Keizai no Macro Keiryo Model Bunseki (Macroeconometric Analysis of the World Economy)*. Koyoshobo.

Peterson, William (ed.) (1991). *Advances in Input- Output Analysis*. Oxford Univ. Press.

Saito, Mitsuo (1971). An Interindustry Study of Price Formation. *Review of Econ. and Stat.*, Feb. 11–25, in Morishima *et al.* (1972).

Saito, M. and T. Oono (1982). An Energy Model of the Japanese Economy, 1961–1979. In *Research Report on Energy to M. of Education*, 1–51 (Japanese).

Saito, M. and C. Moriguchi (1985). A Survey of Econometric Models of Japan. Discussion Papers 8503 Kyoto Institute of Economic Research, October (Japanese).

Saito, Mitsuo (2000). *The Japanese Economy*. WSPC.

Sato, Kazuo (1991). Econometric Models of the Japanese Economy. In Bodkin *et al.* (1991).

Sano, T. and C. Tamamura (eds.) (1993). *International Industrial Linkages and Economic Interdependency in Asia-Pacific Region*. IDE.

Sekiyama, Naotaro (1952). *Nihon no Jinko* (*Japanese Population*). Shibundo (Japanese).

Shimanaka and Shikano (2010). Business indexes and survey data for forecast. In Ichimura-Klein (2010).

Shinohara, Miyohei, (1982). *Industrial Growth, Trade, and Dynamic Patterns in the Japanese Economy*. University of Tokyo Press.

Shinohara, Miyohei (1994). *Postwar Business Cycles for 50 Years*. Nihon Keizai Shimbun (Japanese).

Shishido, S., A. Kohno, S. Nagaya and S. Tanaka (1968). Use of national accounts for short-term econometric model, 1954–1966. *Review of Income and Wealth*, Sept., 267–309.

Shishido, S., Y. Ichikawa, T. Noda, K. Furuya, A. Oshizaka and S. Nishikawa (1970). A Master Model for Short-Term Economic Predictions. Monograph No. 21, IEP, EPA. Government printing office (Japanese).

Shishido, Shuntaro (1988). The Japanese growth alternatives and the world economy simulations with Tsukuba-FAIS world econometric model. In Uno-shishido (1988).

Shishido, Shuntaro (1990). Technical Innovations and IO Analysis. *PAPAIOS-Business Journal*, 1(1) (Japanese).

Shishido, Shuntaro (1991). Prediction Methods for Input Coefficients — V. RAS Algorithm. *PAPAIOS-Business Journal*, 1(2) (Japanese).

Shishido, S., K. Harada and Y. Matsumura (1991). Technical Progress in an IO Framework with special reference to Japan's High Technology Industries. In Peterson, W. (1991).

Shishido, S., S. Itoh, M. Hamada, K. Kawamura, O. Kwon and T. Nakajima (1999). Multi-regional Econometric Model for Northeast Asia. *Journal of Econometric Study of Northeast Asia (JESNA)*, March.

Shishido, Shuntaro (2004). Japan's economic growth and policy-making in the context of IO models. In Dietzenbacher, E. and M. Lahr (2004).

Shishido, S, A. Kawakami, M, Kuroka- wa, A, Movshuk and K, Tamashiro (2007). Policy Simulation with an Integrated Model for Japan and Northeast Asia. *JESNA*, November.

Shishido, S. Akira Kawakami and Kiyoshi Tamashiro (2010). Policy Alternatives for Japan Toward 2020. In Ichimura-Klein (2010).

Suk, Hyun (2010). Social Accounting Analysis of Japan's Lost 90s. In Ichimura-Klein (2010).

Suzuki, Yasuko (2004). *Kinsei Nichi-Ran Boeki no Kenkyu (A Study of the Japan-Netherlands Trade in the Edo Period)*. Shibunkaku (Japanese).

Tatemoto, Masahiro and Shinichi Ichimura (1959). Factor Proportions and Foreign Trade — The Case of Japan. *The Review of Economics and Statistics*, 41(4), 442–446.

Tatemoto, Masahiro and Shinichi Ichimura (eds.) (1970). *Nihon Keizai no Keiryo-Bunseki (Econometric Analyses of the Japanese Economy)*. Toyokeizai Shimposha (Japanese).

Tatemoto, M., T. Uchida and T. Watanabe (1967). A Stabilization Model of the postwar Japanese Economy. 1954–1962. *International Economic Review, February*. In Kosobud-Minami (1977).

Tsujimura, Kotaro and Masahiro Kuroda (1974). *Nihon Keizai no Ippan Kinko bunseki (General Equilibrium Analysis of the Japanse Economy)*, Kogakusha, Tokyo (Japanese).

Tsujimura, Kotaro, Masahiro Kuroda and Haruo Shimada (1981). *Economic Policy and General Interdependence*. Kogakusha (Japanese).

Tsujimura, Kazusuke and Masako Tsujimura (2003). Asset Liability Matrix Analysis derived from the Flow of Funds Accounts: the Bank of Japan's Quantitative Monetary Policy Examined. *Economic Systems Research*, 15(1).

Tsujimura, Kazusuke (ed.) (2004). *Shikin Junkan Bunseki no Kiseki to Tenbo (Traces and Prospects of Flow of Funds Analysis)*. Keio U. Press (Japanese).

Tsujimura, Kazusuke and Masako Tsujimura (2008). *Kokusai Shikin Junnkan Bunseki (International of Flow of Funds Analysis — Techniques and Applications)*. Keio Univ. Press (Japanese).

Uchida, Tadao and Kei Mori (1960). A Simulation Analysis of the Japanese Economy. In *Atarashii Keizai Bunseki (New Economic Analysis)*. Sobunsha (Japanese).

Uchida, T., S. Kuribayashi, A. Yajima and T. Watanabe (1966). *Economic Forecasting and Macroeconometric Models*. Nihonkeizai Shinbunsha (Japanese).

Ueno, Hiroya (1977). A Long-term Model of Japanese Economic Growth. In Kosobud-Minami (1977).

Uno, Kimio and S. Shishido (1988). *Statistical Data Bank Systems: Socio-Economic Database and Model-Building in Japan*. Northholland-Elsevier.

Watanabe, Tsunehiko (1970). *Quantitative Economic Analysis*. Sobunsha, Tokyo (Japanese).

Yamada, Mitsuo and Soshichi Kinoshita (eds.) (2006). Macroeconometric Analysis of East Asian Development). Chukyo U. Institute of Econ. Res. Monograph no. 12 (Japanese).

Yamada, Yuzo (ed.) (1951). *Nihon Kokumin Shotoku Suikei Shiryo (Materials for Estimating Japanese National Income)*. Toyokeizai Shimposha (Japanese).