Structural Analyses of Flow of Funds

(An Abridged Version)

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Chapter 1

PROLOGUE

The mode of economic analysis is not independent of the way in which data are presented. Certain key aggregate statistics, such as gross domestic product (GDP) or aggregate consumption expenditure are widely used by analysts, politicians, the press, the business community and the public at large, as indicators of economic activity at the level of the total economy. Such indicators are used for analyzing and evaluating the performance of an economy, just as body temperature is casually used to monitor human health conditions. These statistics however, as Wassily Wassilyovich Leontief asserts, do not of themselves suggest any ready explanation of the fluctuations in the overall performance of the national economy[1]. He pioneered structural data analysis by compiling input output table for the U.S. economy. He argued that dependence and independence, hierarchy and circularity are the four basic concepts of structural analysis. The definition and practical significance of each of these ideas can be demonstrated visually by schematic model

[1] Leontief (1963).

tables in which numbers signify the presence or absence of inter-industry transactions. If the corresponding boxes formed by the reverse combination of column and row of an input-output matrix are empty, then these two sectors can be described as being independent of each other; otherwise they are dependent. Such relations become clearer in the model in which all the squares fall below the diagonal running from the upper left corner to the lower right corner of the matrix.

Actually any input-output table forms a more or less triangle shape by rearrangement of the rows and columns. In the rearranged table, the sector in the far left column absorbs inputs from all the other sectors but delivers its entire output directly to final demand. Meanwhile the sector in the far right column requires for its operation, in addition to a portion of its own output, only labor, capital, and other prime factors; on the other hand, this sector delivers inputs to all other sectors as well as to final demand. In the hierarchical order of an economy with a strictly triangular matrix, the sectors below the horizontal row of any given sector are its suppliers: any increase in final demand for its product generates indirect demands that cascade down the diagonal slope of the matrix and leave the sectors above unaffected. The sectors above, however, are its customers; an increase in final demand for the output of any one of them generates indirect demand for the output of the sector in question. Leontief notes that the larger and the more advanced an

economy is, the more complete and articulated is its structure[2]. Table 1-1 and 1-2 show the triangulated matrices for Japan for 1960 and 1995 obtained by rearrangement of the rows and columns of input-output tables. To compare the two tables, 1995 input-output table with 93 sectors is aggregated into 58 sectors. It is obvious that the number of empty cells has decreased in the course from the poverty of 1960 to the prosperity of 1995. The number of non-zero cells increased not only in the left lower triangle but also in the right upper triangle as an indication of some circular trade involving service and transportation industries that showed strong development as the country matures.

Just as magnetic resonance imaging (MRI) technology that provides cross-sectional image of human body gives crucial information to detect specific medical problems, structural economic data such as input-output table or trade matrix is an indispensable tool to analyze economic phenomena and the problems contained in it. One of such data is flow of funds accounts. The Flow of Funds Accounts consists of balance sheets of various economic sectors or group of economic entities categorized by their function. The balance sheet of each sector records the stocks of financial assets and liabilities at the end of a period by type of instrument. By rearranging the flow of funds accounts, we can construct a sector × sector matrix, which is commonly referred to as asset-liability matrix. Tables 1-3 and 1-4 are the

[2] *Ibid.*

triangulated asset-liability matrices for Japan for 1954 and 1999. Most of the cells are empty for 1954 that is less than 10 years after the defeat in the World War II. The two matrices are not identical by any means. The left lower triangle of the 1999 table is filled with non-zero elements suggesting that the financial interdependence among all the sectors is stronger than ever. An instant survey of the financial system gives a picture in which the funds proceed from the households, the primary saving sector, go through the intermediaries, like commercial banks and other financial institutions, and end up in the non-financial corporate enterprises, the primary investing sector[3]. It is notable however that the central government and the rest of the world moved from the bottom to the top in the triangulation hierarchy. The backbone of the postwar economic policy was the priority production system, in which basic material and energy industries had priority in the fund allocation[4]. The Japanese government took a central role in the fund supply and the foreign capital also played an indispensable part in this scenario so that they were at the upstream in the flow of funds of the country. In contrast to this, the 1990s saw severe recession after the burst of the real estate bubble of the 1980s. The central government had no choice but to absorb surplus funds from the household savings by issuing sovereign bonds because not too many Japanese companies were brave

[3] Tsujimura and Mizoshita (2002).
[4] For further details, see Ozaki (1976).

enough to expand their investment in the production capacity. The excess savings in the households also went to abroad, thus both the government and the rest of the world were at the downstream rather than at the upstream. Certainly no macro indicator alone tells the story in this detail.

The system of structural data now known as the flow of funds accounts was the invention of Morris Albert Copeland based on the fundamental idea given by Wesley Clair Mitchell who guided the National Bureau of Economic Research in its first decades[5]. The flow of funds accounts – or as the originator referred to them, the money flows accounts – focus on the operation of the financial system on the flows of borrowing and lending and on the activities of banks and other financial institutions. Since its launching, the flow of funds field has undergone major changes both in the design of the accounts and in the types of analysis for which they have been used. Following Copeland's first complete presentation of the account in 1952, they went through a decade of what can be called data consolidation at the hands of the data producers at the Federal Reserve Board[6]. The nonfinancial parts of the accounts were truncated and whole system was moved toward integration with the national income and product accounts (NIPA) using the saving-investment account as the connecting link. Paralleling these data

[5] See Copeland (1952), p.3. For further details, see Burns (1949).
[6] Dawson (1996), p.4.

improvements were the beginnings of uses of the system. On one hand, it provided the material for regular current analysis of the financial system. But more sophisticated uses in financial projections also began, both within private institutions and within the Federal Reserve[7]. These projections were significant in a number of ways. They used the flow of funds accounts as a system, making use of the embedded social accounting constraints. Secondly, they firmed up an analytical approach toward the financial system referred to as the saving-investment process. Finally, the projection method forced analytical attention onto the current financial facts and toward identifying casual relationships among financial flow variables.

A flow of funds presentation of a nation's financial transactions has the advantage of identifying the significance and connotation of the various sub-balances between the individual accounts of the institutional units/sectors. In the light of this assertion, a flow of funds format is also a superior framework for balance of payments or international investment position data. Globally, the development of a flow of funds matrix for the world (as a closed system) identifies the constraints and interdependencies which must characterize the international financial system and transforms balance of payments or international investment position analysis from a partial to a general framework. The first author who

[7] *Ibid.*

pioneered in this field was Poul Høst-Madsen. As early as in 1963, he provided a general survey of international movements of capital during the postwar period in the context of the broader trends in world payments, with emphasis on the developments in movements of private capital[8]. The paper is based on the balance of payments statistics collected and published by the International Monetary Fund, but it also draws on other sources of information. Gray and Gray (1988) developed the global matrix from national sources and uses statements and identified the constraints on national freedom to pursue payments goals independently. The Asian crisis 1997-1998, for example, revealed major gaps in statistical coverage of the domestic financial sector and the external sector that permitted serious vulnerabilities to remain undetected. Immediately after the crisis, the International Monetary Fund (IMF) and the Bank for International Settlement (BIS) launched two alternative programs to collect international flow of funds data. The Coordinated Portfolio Investment Survey (CPIS) is conducted on an annual basis under the auspices of the IMF's Statistics Department; it provides information on individual economy year-end holdings of portfolio investment securities — equity securities and debt securities — valued at market prices, cross-classified by the country of issuer of the securities. The Consolidated Banking Statistics (CBS) report banks' on-balance sheet financial claims on the rest of the world and thereby

[8] Høst-Madsen (1963).

provide a measure of the risk exposures of lenders' national banking systems. The quarterly data cover contractual lending by the head office and all its branches and subsidiaries on a worldwide consolidated basis.

The latest published data of CPIS (December 2013) includes 80 investor and 243 investee countries while CBS (March 2015) does 25 investor and 214 investee countries. The publication called National Accounts of OECD Countries contains flow of funds data for 29 member countries. Many other countries including China and India produce such data either regularly or occasionally. U.S. flow of funds data is available since 1945 while Japanese data is periodically published after 1954. Most of the countries provide data quarterly while others supply it on an annual basis. The U.S. data covers 31 institutional sectors and 57 financial instruments[9] whereas the Japanese data does 36 sectors and 44 instruments. The total volume of the data is enormous. The flow of funds account is designed to provide a framework which gives a systematic, comprehensive and consistent description and analysis of the facts. It brings the various financial activities of an economy into explicit statistical relationship with one another and with data on the non-financial activities that generate income and production.

In Copeland (1952), the author did not only present for the United States a set of money flows accounts, but also showed how these accounts might be employed

[9] The summary tables contain 28 sectors and 31 instruments.

to interpret events in the U.S. economy. Variety of analysis has appeared since then. The first category of studies is footed on the basic principles of the quadruple entry system, which is the backbone of flow of funds data. Powelson (1960), Mathews (1962) and Alford (1986) among others applied this idea to simulate the effects of economic policies. The second category of studies including Taylor (1958), Mason (1976), Ruggles and Ruggles (1992), Dawson and Everhart (2000) and Ishida (2014) traces the changes in each cell of the flow-of-funds table along the time line. More recently, Christiano, Eichenbaum and Evans (1996), Bonci and Columba (2008) and Gameiro and Sousa (2010) produced vector autoregression models (VAR) based on such time series data. The third category of studies tried to build multi-sector macroeconomic model by taking flow-of-funds table as a system of simultaneous equations. Cohen (1963), Brainard and Tobin (1968), Hamada (1969), Alho (1991) and Zhang (1996) constructed a multi-sector macro models that included flow-of-funds accounts as a part. It was Tobin (1969) who merged the flow-of-funds model with the theory of portfolio choice. He proposed a prototype of the general equilibrium model. More practical multisector, multisecurity, general equilibrium model of the financial markets is proposed by Hendershott, (1971) Hendershott and Orlando (1976). The fourth category is the application of input-output analysis to the flow of funds data. Stone (1966), Ihara (1969), Stone and Roe (1971), Klein (1983, 2003) and Nishiyama (1992) proposed to convert flow-of-

funds table of balance sheet format into sector × sector square matrix. Leontief and Bródy (1993) and Bródy (2000) also belong to this category. The obvious advantage of this kind of scheme is that affluent assets of input-output analysis are readily available. There are also unique examples of applying Input-output analysis to analyze corporates' ownership; Futatsugi (1976, 1982), Ito and Hoshi (1992) and Kim (2004) belong to this category.

This thesis is an attempt to extend the scope of flow of funds analysis into the field of policy evaluation and strengthen the theoretical foundation even further. It consists of an introduction and seven independent chapters of which chapters 2, 3 and 4 use national flow of funds data while chapters 5 and 6 are examples of international flow of funds analyses. Chapter 7 takes a look on the original money flows accounts of Copeland in the full scope of the national accounts laying out a blueprint for the future course of expansion. Summary and concluding remarks are in Chapter 8. Chapters 2 through 7 are categorized into 3 groups according to the methodologies adopted: Chapters 2, 3 and 7 apply the traditional methodologies of input-output analysis to investigate the financial structure of the economy; Chapters 4 and 5 attempt to develop econometric methods to examine flow of funds structures based on the tools of panel data study; Chapters 6 is an experiment to explain the changes in the international flow of funds structure in the traditional framework of oligopoly model.

Chapter 2 discusses the fundamental meaning of the flow of funds analysis. According to Lawrence Robert Klein, the flow of funds analysis is based on the lender-borrower relationship between economic entities that is recorded in their balance sheets[10]. He demonstrated how to make sector × sector asset-liability matrix from the balance sheets of economic entities. This chapter finds out the real economic meaning of the matrix manipulations involved in the scheme through the recent episode of U.S. subprime mortgage crisis. Although Klein's idea resembles to that of Sir John Richard Nicholas Stone[11], the relation between the two alternative derivations of asset-liability matrix is not discussed elsewhere. Chapter 3 elucidates that the Stone formula is based on the liability portfolio of the balance sheets while the Klein Formula is on the asset portfolio. One of the leading peculiarities of the asset-liability matrix is that two distinct sector × sector Leontief-inverse matrices are derived from a set of balance sheets. This chapter explains why some monetary operation is more effective than others to improve economic conditions by an application of the two alternative Leontief-inverse matrices.

Chapters 4 and 5 discuss the changes and similarity/dissimilarity in the flow of funds structure. Since structural data such as flow of funds accounts has two or more dimensions, there is no standard routine to statistically test the

[10] See Klein (1977).
[11] See Stone (1966).

similarity/dissimilarity between two sets of data. As far as dimensions are concerned, they resemble to the panel data so that the well known statistical methods of the panel data analysis is hopefully available. The difference between the structural and panel data is that the former contain number of equal identities that are not common in the latter. Chapter 4 presents the way to measure changes and similarity/dissimilarity of flow of funds structure in terms of squared Euclidean distance in the net financial asset portfolio. Since Euclidean distance is a scalar, we can apply any widely known statistical methods to test the differences, changes, etc. Furthermore, by employment of Euclidean distance, we can directly estimate the system-specific parameters rather than component-specific parameters that relate to each element of the structure as an application of panel data analysis methods. The purpose of the chapter is to determine the dominant factor that influences the similarity/dissimilarity in national financial structure in relation to the conversion criteria of the Maastricht Treaty. Chapter 5 focuses in turn on the changes in the flow of funds structure over time rather than similarity/dissimilarity between that of different countries. Since international flow of funds structure is more volatile than that of domestic flows, it is rather difficult to determine if a specific event, such as an introduction of a new single currency, caused a significant structural change. Thus the chapter examines the effects of the launch of the euro on the international funds flow structure by a combination of the well known gravity

model and the mixed effects model, which is a hybrid version of the fixed and random effects models of panel data analysis. The chapter also shows the algorithm of the likelihood ratio tests of the mixed effects model that requires decomposition of the model into fixed and random effects elements.

Chapters 6 proposes a Cournot-Nash non-cooperative equilibrium model to replicate the capital allocation reflected in the international flow of funds table. The model explains the capital allocation between countries as well as the interest rate differences by taking the total amount of capital available for each country as exogenous variables and taking the exchange rate volatility and the shape of marginal revenue curve for capital as parameters. Chapter 6 with two country model proves that the interest rate disparity will diminish as the number of market participants increase; the model reduces to that of perfect competition when the number of players is infinite. It also proves that the exchange rate volatility plays an important role to create the home bias in the international capital allocation. The latter half of Chapter 6 expands the two country model presented in the first half into n countries and also presents the design of experiment to apply the Cournot-Nash equilibrium model to the real world. It proves that the Cournot-Nash equilibrium model replicate the international capital allocation among 5 countries without much difficulty by using parameters obtained independently of the flow of funds structure.

As it is demonstrated in the following chapters described above, flow of funds accounts is an indispensable tool to examine the current situation of the financial market and to evaluate the monetary policies. However, an urgent global need for the data system and accompanying analytical framework that depicts the interrelations between real and financial economy has been underscored by modern episodes of instability in real as well as in financial markets, ranging from the Asian debt crisis of the 1990s to the more recent subprime mortgage crisis in the U.S. To answer this demand, Chapter 7 discusses the future expansion of the study to the full scope of national accounts. In order not to repeat the bitter experience of the Great Depression that was preceded by the collapse of the financial bubble of the 1920s, Morris Copeland urged a better understanding of the circulation of funds in the macro economy. He asserted that the funds-flow based national accounting rests not only on the economics of funds, but also on legal foundations of properties, and quadruple entry system accounting. The problem was that the published national accounts of the present day are based of product-flow so that they are inadequate for monetary analysis. Thus there was no option but to design funds-flow based system of national accounting from the scratch. The objective of the chapter is twofold: (i) to design a funds-flow based national accounting system, an equivalent of cash-flow statement in business accounting; and (ii) to make from-whom-to-whom funds-flow matrix for the U.S. to find out if there were structural changes in

the first decade of the century. The matrix is tentatively derived from the Integrated Macroeconomic Accounts by removing the imputations that do not involve payment of funds. We found that there was a conspicuous structural change between 2008 and 2010 when the subprime mortgage crisis hit the economy; and the dominant factor was the shift in monetary policy. Our conclusion is that the economy is highly susceptible to both Federal Reserve's supply of funds and its portfolio. The Dietzenbacher-Los type decomposition procedure described in this chapter will help the policy makers to know, in advance, the consequences of particular actions such as open market operations.

Table 1-1: Triangulated Input-Output table for Japan (1960)

(100 million yen)

	44	39	15	40	34	55	56	1	16	21	6	18	27	41	29	13	23	43	20	35	4	12	42	19	17	25	38	46	50	26	30	54	33	14	11	3	8	9	36	10	24	47	28	22	37	7	5	32	2	51	53	45	52	31	48	49
44 Civil engineering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39 Electrical machinery	1070	2957	0	471	26	0	66	0	0	0	0	0	0	0	0	0	0	549	0	39	0	0	0	0	0	0	644	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	284	0	0	0	0
15 Other foods	0	0	2641	0	0	58	480	0	140	0	41	0	0	0	0	143	0	0	60	0	834	98	0	0	0	0	0	0	0	0	67	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
40 Transportation equipment	210	0	0	2754	0	24	0	0	0	0	134	0	0	0	0	0	0	98	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	1202	0	329	0
34 Pig iron and crude steel	0	0	0	0	5407	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7694	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0
55 Public services	59	44	0	0	0	44	41	0	0	0	0	0	0	0	47	0	0	75	0	40	0	0	0	0	0	49	0	0	0	0	35	0	0	0	0	0	0	0	0	0	26	0	26	0	29	0	0	0	0	0	0	0	0	0	0	36
56 Other services	63	279	138	76	0	53	1055	0	111	0	26	0	0	92	0	0	0	87	64	42	0	24	44	0	0	0	112	0	0	0	292	0	28	0	0	0	0	0	0	0	24	0	37	0	0	0	0	0	0	0	0	56	124	0	578	198
1 Food crops	0	0	1400	0	0	39	332	640	333	0	0	0	0	0	0	0	0	0	72	0	628	0	0	0	0	0	0	0	0	0	319	0	0	10088	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0
16 Drinks	0	0	30	0	0	0	1105	0	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 Clothing accessories	0	0	0	0	0	0	28	89	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	37	0
6 Fisheries	0	0	53	0	0	0	214	0	0	0	79	0	0	0	0	1143	0	0	0	0	0	0	89	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 Natural fiber spinning	0	26	0	0	0	0	0	0	0	74	0	90	0	0	0	0	0	0	4273	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 Rubber products	0	128	0	923	0	37	0	0	0	59	0	0	97	0	0	0	0	0	0	0	0	0	0	0	0	0	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 Precision instruments	50	86	0	43	0	131	165	0	0	0	0	0	0	273	0	0	0	24	0	0	0	0	0	0	0	0	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Chemical fiber raw material	0	0	0	0	0	0	0	0	0	0	0	98	0	0	361	0	0	0	954	0	0	0	0	927	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Processed marine products	0	0	0	0	0	0	166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 Furniture	0	79	0	0	0	39	40	0	0	0	0	0	0	0	0	0	0	361	0	0	0	0	0	0	0	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43 Construction	0	37	31	43	0	163	151	81	0	0	0	0	0	0	0	0	0	0	0	29	68	0	0	0	0	0	37	39	785	0	0	0	44	0	22	0	0	0	0	0	0	0	44	0	35	0	0	0	0	101	0	203	118	0	274	89
20 Textile products	0	0	0	34	0	0	0	165	0	2021	159	32	371	27	0	0	50	292	1466	0	0	0	0	0	0	0	22	0	0	42	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	34	0	0	0
35 Primary steel products	1029	1168	0	1554	0	0	0	0	0	30	0	0	0	114	0	0	143	1288	0	4476	0	0	86	0	0	0	2839	0	0	0	0	0	107	0	0	0	0	0	0	0	0	0	0	0	1602	36	0	0	0	0	0	0	0	0	0
4 Other livestock and sericulture	0	0	93	0	0	0	71	398	0	0	0	477	0	0	0	0	0	0	25	0	75	1434	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Meat products	0	0	104	0	0	31	264	0	0	0	0	0	0	0	0	0	0	0	0	0	0	371	0	0	0	0	0	0	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42 Other industrial products	37	230	40	96	0	100	129	37	0	29	25	0	30	25	0	27	32	242	0	0	0	0	123	0	0	0	88	0	0	0	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Chemical fiber spinning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1277	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 Publishing and printing	0	0	0	0	0	199	810	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	294	0	0	0	0	0	0	0	0	41	0	0	0	118	133
38 General machinery	316	322	95	1295	52	0	33	50	0	0	27	0	35	76	0	0	0	704	71	135	0	0	0	0	0	30	3090	0	0	0	0	0	63	25	0	0	0	0	38	0	25	0	83	26	0	35	42	0	0	0	0	22	0	0	0
46 City gas	0	30	0	27	0	49	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 Real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 Leather and leather products	0	0	0	0	0	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 Other chemical products	0	79	757	153	0	603	220	284	0	0	0	28	0	0	0	0	51	141	82	0	66	46	48	0	0	121	47	0	0	0	477	0	0	0	0	0	0	0	0	0	0	0	115	53	0	0	0	0	25	0	0	0	0	49	0	0
54 Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33 Ceramic, stone and clay products	1055	240	65	91	144	0	42	26	278	0	0	0	0	27	0	0	0	1827	0	73	0	29	26	0	0	0	64	0	0	0	66	0	407	0	0	0	0	0	31	0	0	0	24	0	26	0	0	0	0	0	0	0	0	0	0	0
14 Grain milling	0	0	1403	0	0	24	200	113	0	0	0	0	0	0	0	0	0	0	0	0	262	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 Mining n.e.c	265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	233	0	0	0	0	0	0	0	0	0	0	0	0	0	0	460	0	0	0	0	0	0	0	29	0	353	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Fiber producing livestock	0	0	0	0	0	0	0	0	0	0	0	864	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Iron ore	0	0	0	0	845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Nonferrous metal mining	0	0	0	0	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 Primary non-ferrous metal products	0	1509	0	307	46	0	0	0	0	0	0	0	0	103	0	0	0	55	0	124	0	0	81	0	0	0	384	0	0	0	0	0	28	0	0	0	0	0	1664	0	0	0	108	0	657	0	0	0	0	0	0	0	0	0	0	0
10 Crude petroleum and natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	0	0	1736	0	0	0
24 Pulp and paper	0	114	85	0	0	51	30	22	30	0	0	0	0	39	312	37	0	104	0	0	0	38	122	0	43	1185	0	0	0	0	261	0	137	40	0	0	0	0	0	0	2538	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0
47 Water supply and waste disposal services	0	0	0	0	0	41	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0
28 Basic chemicals	60	202	171	40	71	0	0	1014	0	0	0	0	254	78	521	0	67	29	326	162	36	0	841	0	0	31	74	0	0	0	728	0	94	0	0	0	0	0	0	0	175	0	2426	33	54	40	0	0	75	0	0	0	0	26	0	0
22 Timber and wooden products	401	0	50	145	0	0	54	0	51	0	44	0	0	0	0	27	278	3002	0	0	0	0	132	0	0	0	43	0	0	0	0	0	44	0	0	0	0	0	0	0	137	0	0	617	0	0	0	0	0	0	0	0	0	0	0	0
37 Metal products	1074	108	137	259	0	0	65	0	30	63	24	0	24	0	0	72	105	1573	0	37	0	0	23	0	0	0	297	0	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	65	171	0	0	0	0	0	0	28	0	93	0
7 Coal and lignite	0	0	34	0	0	36	26	0	0	0	0	0	0	0	52	0	0	0	40	0	0	0	0	0	0	0	0	287	0	0	45	0	215	0	0	0	0	0	0	0	109	0	126	0	0	32	0	809	0	0	0	573	144	0	0	0
5 Forestry	126	0	31	0	0	0	59	49	0	0	0	0	0	0	0	0	0	111	0	0	0	0	33	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	386	0	0	3392	0	104	2776	40	0	0	0	0	0	0	0	0
32 Coal products	137	0	0	0	753	0	24	0	0	0	0	0	0	0	0	0	0	0	0	103	0	0	0	0	0	0	35	0	0	0	0	0	33	0	0	0	0	0	35	0	0	0	206	0	22	0	99	0	0	0	0	32	86	0	0	0
2 Industrial crops	0	0	256	0	0	0	0	0	0	22	0	1403	495	51	0	0	0	0	353	0	0	0	0	0	37	403	0	0	0	0	406	0	0	47	0	0	0	0	0	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51 Real estate rental service	42	40	0	0	0	64	340	0	0	0	0	0	0	0	0	0	27	37	28	0	0	0	23	0	0	0	55	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0	0	28	155	0	583	289
53 Communication	107	69	27	48	30	199	190	0	0	0	0	0	0	0	0	0	0	152	40	55	0	0	55	0	0	44	106	0	0	0	0	0	28	0	0	0	0	0	31	0	37	0	0	0	37	0	0	0	0	0	0	136	0	339	224
45 Electricity	27	102	100	103	326	89	225	29	0	0	0	99	30	0	60	0	0	0	100	152	26	0	31	0	0	0	106	23	0	0	39	0	207	0	0	0	0	23	130	0	324	0	435	41	36	158	0	0	0	0	0	209	22	224	38
52 Transport (ind. Storage facility service)	510	213	234	215	254	245	180	125	58	39	44	36	32	38	66	0	42	683	146	188	58	26	68	0	0	112	280	49	0	0	100	0	263	254	0	0	0	0	90	0	190	0	249	138	113	32	0	149	0	0	62	152	803	0	685	111
31 Petroleum refinery products	351	87	130	47	85	59	111	68	27	0	263	0	46	0	49	0	0	106	78	143	0	0	43	0	0	0	53	25	0	0	62	0	198	0	102	0	0	0	39	0	70	22	223	28	22	0	62	0	0	0	0	387	1204	104	496	0
48 Commerce	412	437	367	479	260	334	276	220	182	326	38	173	98	81	75	119	135	1167	336	291	93	174	168	24	0	123	480	0	0	27	221	0	156	333	24	0	0	0	119	0	157	0	173	193	234	23	0	32	0	0	0	22	162	0	486	0
49 Finance and insurance	115	177	82	123	24	157	153	164	33	32	53	42	28	26	65	0	23	170	103	58	31	0	45	0	0	72	107	0	65	0	46	0	103	0	0	0	0	0	33	0	88	0	90	53	48	22	46	0	0	32	0	41	223	54	1103	274

Table 1-2: Triangulated Input-Output table for Japan (1995)

(100 million yen)

	45	41	54	40	11	10	39	42	26	34	43	5	33	13	17	15	32	25	3	36	18	35	21	2	14	24	12	1	23	4	29	7	31	37	38	16	6	9	8	55	47	22	30	48	27	44	53	19	20	56	28	51	52	49	46	50
45 Civil engineering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 Transportation equipment	0	2E+05	6776	0	0	0	0	0	0	0	0	738	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17660	0	0	5934	0	0	0
54 Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40 Electrical machinery	3368	18334	2627	1E+05	0	0	13144	2916	0	0	1946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	726	0	0	0	0	548	0	0	0	0	0	6824	346	0	0	10889	0	0	139	282	0	0
11 Drinks	0	0	0	0	1403	429	0	0	0	0	0	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	696	0	0	0	0	0	0	0	0	0	22105	0	0	0	136	0	0
10 Foods	0	0	0	0	4090	41934	0	0	533	0	0	941	0	0	0	223	522	0	0	0	203	0	0	0	0	0	3059	0	205	243	0	0	0	0	0	0	0	0	0	4654	0	0	0	0	258	0	0	0	0	36439	0	0	0	0	0	0
39 General machinery	2520	5306	0	4410	0	0	53749	440	0	0	0	0	219	0	390	0	0	0	0	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	326	0	0	0	0	0	0	522	247	0	3181	0	0	0	0	14723	0	0	0	0	0	0
42 Precision instruments	0	255	203	432	0	0	1283	4725	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1900	0	0	0	0	0	0	0	0	0	537	0	0	0	1397	0	0
26 Medicaments	0	0	0	0	0	0	0	0	3039	0	0	114	0	0	0	0	0	0	261	0	0	0	0	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54535	0	0	0	258	0	0	0	0	0	0	0	0	0	0	0	0
34 Pig iron and crude steel	0	0	0	0	0	0	0	0	0	17285	0	0	0	0	0	0	0	0	0	2045	0	35713	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43 Other industrial products	2238	224	4362	143	160	112	208	230	0	0	3330	107	187	0	359	1945	159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2469	0	0	0	0	0	2689	211	0	0	5399	0	0	0	1011	0	0
5 Fisheries	0	0	0	0	0	14214	0	0	0	0	757	1304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	431	0	0	0	0	0	0	0	0	0	2754	0	0	0	0	0	0
33 Ceramic, stone and clay products	33301	2760	0	5255	1866	457	1517	702	702	1143	279	0	9778	0	923	0	0	0	0	351	104	0	0	0	0	0	0	148	0	0	0	0	0	325	672	0	0	0	0	981	0	328	598	174	385	24441	0	0	0	1833	0	0	0	411	0	0
13 Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Furniture and fixtures	0	385	706	964	0	0	114	0	0	0	306	0	167	0	967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	0	0	0	2651	0	0	125	200	0	11143	272	0	0	3158	0	341	363	1492	176	1108
15 Wearing apparel and other textile products	548	226	1218	1063	0	484	387	0	0	0	284	192	229	0	129	917	0	0	0	0	0	0	0	0	0	0	0	0	287	0	0	0	0	0	244	0	0	0	0	2247	0	0	0	295	0	1050	159	0	0	3156	0	0	919	3780	0	804
32 Leather, fur skins and miscellaneous leather products	0	0	0	0	0	0	0	169	0	0	0	0	0	0	0	119	1522	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	0	0	177	0	0	0	0	0	0
25 Synthetic fibers	0	0	0	0	0	0	0	0	0	0	292	0	0	219	0	1424	0	0	0	0	0	0	0	0	3654	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Agricultural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1722	0	0	0	3753	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104	0	0	0	0	0	0
36 Steel castings and forgings and other steel products	1754	9282	0	3177	0	0	12800	173	0	0	183	0	164	0	943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11002	0	0	0	0	0	0	0	0	0	0	287	0	0	0	0	0	0	0	0	0	0
18 Pulp, paper, paperboard and processed paper	0	0	0	1024	0	0	0	0	0	0	368	0	488	0	549	0	0	156	0	0	16178	0	0	0	0	0	0	0	0	0	0	0	0	0	0	285	0	0	0	709	0	0	276	0	474	2891	0	12032	14150	1365	0	0	1000	0	0	129
35 Steel products	6417	6626	0	4428	0	0	10549	267	0	0	264	0	887	0	783	0	0	0	0	11964	0	27323	0	0	0	0	0	0	0	0	0	0	0	0	20165	0	0	0	0	0	0	0	173	0	0	7598	0	0	0	0	0	0	193	0	0	0
21 Chemical fertilizer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	768	0	0	143	0	2937	417	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Livestock and sericulture	0	0	0	0	0	21152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2574	299	0	157	646	0	0	0	0	0	0	0	0	0	0	0	346	0	0	0	0	0	0	0	0	0	1147	0	0	0	0	0	0
14 Textile products	0	721	0	509	0	0	0	0	0	0	250	223	0	0	293	20527	321	0	0	0	168	0	0	0	9496	0	0	0	0	0	0	0	764	0	0	0	0	0	0	648	0	0	0	0	0	910	0	292	0	481	0	0	206	247	0	0
24 Synthetic resins	0	631	0	1628	0	0	0	150	0	0	296	0	153	0	129	0	0	536	0	0	213	0	0	0	0	131	0	0	0	0	0	0	0	384	0	0	0	0	0	0	0	0	19506	0	2151	0	0	149	0	0	0	0	0	0	0
12 Feeds and organic fertilizer, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	172	0	0	0	0	0	0	175	0	0	0	0	7980	0	0	416	1235	0	0	0	0	0	0	0	0	0	0	0	171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 Crop cultivation	1247	0	0	0	5624	39454	0	0	205	0	972	0	0	1969	0	0	0	0	0	0	0	0	0	3782	706	0	2443	1772	0	0	0	0	1045	0	0	0	0	0	0	1162	0	0	0	0	0	217	0	0	0	6103	0	0	0	0	0	0
23 Petrochemical basic products and intermediate chemical products	0	0	0	800	408	916	0	0	2456	0	0	0	424	0	0	0	0	1652	0	0	467	0	0	0	867	14119	0	0	21986	0	0	0	4762	210	0	0	0	0	0	478	0	757	2528	0	6690	0	0	0	0	0	276	0	0	0	0
4 Forestry	106	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3442	0	0	0	0	9578	0	0	0	0	0	0	0	0	0	0	283	0	0	0	0	375	0	0	0	0	0
29 Coal products	4151	0	0	0	0	0	0	0	2579	0	123	0	0	0	0	0	0	0	0	689	0	818	0	0	0	0	0	0	273	0	1004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	0	0	0	2682	0
7 Non-metallic ores	7471	0	0	0	0	0	0	0	0	241	401	0	7104	0	0	0	0	0	0	0	142	0	0	0	0	0	0	0	0	0	245	0	0	0	0	0	0	0	0	0	0	128	0	0	0	714	0	0	0	0	0	0	0	0	0	0
31 Rubber products	1551	7419	383	2190	0	0	3314	210	0	0	433	0	122	0	0	292	274	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	1441	0	323	0	0	0	0	513	0	0	0	273	0	0	0	0	0	5173	0	0	657	0	0	0
37 Non-ferrous metals	5791	7185	0	14871	116	288	5536	846	0	289	1747	0	362	0	197	0	0	0	0	0	0	1057	0	0	0	0	0	0	0	0	0	0	0	22317	8623	0	0	0	0	357	0	431	168	0	383	1384	0	0	124	267	0	0	0	0	0	0
38 Metal products	22154	4568	1595	8820	6667	1937	10907	565	749	0	1288	0	920	0	1793	232	0	0	0	179	0	0	0	0	0	0	0	0	272	0	0	221	823	124	10217	488	0	0	0	207	0	223	207	0	1247	60288	0	0	0	1911	164	162	855	2761	0	0
16 Timber and wooden products	1811	228	0	148	0	168	159	0	0	0	1206	0	432	0	5921	0	0	0	0	0	2994	0	0	0	0	0	0	0	0	0	0	0	0	238	266	8085	0	0	0	0	0	0	0	0	0	29482	0	0	0	570	0	0	1280	917	0	0
6 Metallic ores	0	0	0	0	0	0	0	0	0	3318	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4149	0	0	0	0	0	0	0	202	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Crude petroleum and natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	494	0	0	0	0	0	0	0	0	0	0	0	2427	0	0	0	0	0	0	0	0	0	31584	0	0	0	8401	0
8 Coal	0	0	0	0	0	0	0	0	0	169	0	0	533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	0	3838	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2311	0
55 Public services	1131	13762	0	33524	784	1655	8069	2406	10715	552	1227	0	2140	0	300	684	0	285	0	333	494	1166	196	0	333	1090	0	0	2741	0	0	0	1147	1556	1573	0	0	0	0	10487	355	800	1693	492	4035	2362	2958	181	228	4764	516	160	1458	2103	3689	1005
47 Gas and heat supply	111	214	187	240	175	429	119	0	0	0	0	0	220	0	0	0	0	0	0	0	0	207	0	0	0	0	0	0	0	0	0	0	0	0	214	0	0	0	0	1415	181	0	0	0	117	452	0	0	141	3308	0	165	220	728	0	192
22 Inorganic basic chemical products	189	0	0	985	209	939	204	0	1264	610	141	0	819	0	0	0	0	119	0	0	833	315	384	0	862	344	0	0	1839	0	0	0	1030	176	317	0	0	0	0	293	0	2437	476	546	3343	0	0	0	206	0	0	0	0	0	0
30 Plastic products	5818	9060	182	13754	2241	3650	2705	1236	1677	0	4113	247	299	0	1073	575	366	0	0	0	190	0	0	0	0	0	0	674	0	0	0	0	1150	724	517	124	0	0	0	1031	0	128	20308	1528	1967	5657	0	948	2739	2522	0	261	864	2778	0	700
48 Water supply and waste disposal services	789	414	4533	552	427	845	588	0	272	148	115	0	465	0	0	0	0	0	0	0	333	280	0	0	0	295	283	0	469	0	0	0	0	110	215	0	0	0	0	6697	0	181	111	3821	348	570	554	0	115	10492	0	343	2229	2345	887	641
27 Final chemical products, n.e.c.	505	2915	130	1578	138	490	1380	0	634	0	1042	0	592	0	946	195	0	0	0	0	581	129	0	112	744	125	0	3151	553	156	175	132	249	133	1122	1243	0	0	0	2352	0	0	668	123	5800	3595	179	658	2415	5364	132	0	128	0	0	0
44 Construction and repair	1517	819	4626	1761	265	653	878	170	142	408	106	0	1357	0	203	301	0	133	0	315	493	993	0	122	106	293	0	271	490	0	157	0	0	398	1305	124	0	0	0	6102	1812	194	588	1965	437	725	1590	257	219	5690	128	22788	4711	5923	7886	1340
53 Communication and broadcasting	3095	537	3826	1200	205	545	964	154	779	0	280	0	205	0	129	388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	171	673	0	0	0	0	6247	146	0	256	457	150	1816	9166	0	1040	30906	147	435	3465	19013	513	6739
19 Paper products	0	112	0	1400	2538	4036	229	204	1089	0	756	0	1020	184	457	488	0	0	291	0	0	0	0	0	221	119	0	1263	0	0	0	0	118	0	446	0	0	0	0	644	0	0	398	0	1861	361	0	340	200	1268	0	0	1443	6535	0	435
20 Publishing and printing	836	759	5872	3260	340	3177	1347	156	375	0	730	0	484	0	351	1046	0	0	0	0	0	0	0	0	189	0	0	0	0	0	0	0	0	0	961	0	0	0	0	13956	232	0	134	331	880	710	1838	1055	16520	28870	0	133	1348	10526	671	8232
56 Other services	33854	10647	18505	22820	3698	8056	11498	1674	4488	1385	2518	239	3815	483	1037	2844	185	242	142	1218	1334	1686	134	212	1003	687	180	852	2079	164	385	510	1330	1598	6139	949	0	0	0	35622	988	1163	3215	4457	5378	32597	16944	1408	6679	92046	872	10106	64118	51121	14480	36820
28 Petroleum refinery products	2134	429	984	444	185	644	282	0	0	0	0	1130	916	0	0	0	0	0	0	135	771	279	185	0	246	263	0	411	6097	144	1024	106	163	191	302	116	0	0	0	2516	635	261	139	617	184	608	124	0	0	2209	2095	261	37723	979	4523	0
51 Real estate	1130	597	498	1601	243	554	1240	214	466	139	250	0	657	0	235	549	0	0	0	177	178	365	0	0	189	114	0	0	213	0	0	119	136	167	842	129	0	0	0	9686	521	0	477	271	177	1600	2444	176	920	17952	112	4790	8308	38415	1741	6771
52 Transport	21829	6834	8369	9120	2310	10682	6016	759	1470	3056	2861	863	8092	327	1489	1672	258	228	377	1964	2147	2462	154	2231	1175	917	1399	2772	1579	1029	1108	3926	647	2353	5062	2494	0	0	0	13050	738	694	2096	2530	2023	25164	4150	1442	4591	25714	2661	1622	52904	53416	3512	7046
49 Commerce	26890	16642	4683	27958	5033	24700	15134	2659	2039	2570	4679	1197	4462	182	3169	5438	811	464	348	2757	3867	2373	138	744	1968	1163	970	3846	1917	421	725	265	1956	4558	6799	3970	0	0	0	28394	324	707	5762	1239	3530	34957	761	2283	4752	50059	1221	1065	18053	11241	1582	2225
46 Electricity	2143	3460	3806	5130	708	3199	2473	376	588	2429	456	148	3117	0	340	600	108	317	207	1234	2432	2685	208	0	994	712	119	114	2994	0	208	285	710	1745	2580	630	0	0	0	11697	313	2331	2443	3534	920	2135	1195	519	1129	12457	760	1755	6314	8580	16096	1106
50 Finance and insurance	5375	3822	823	4356	833	1868	4015	873	807	879	849	606	2662	146	805	1894	181	0	228	494	916	1333	0	1307	1422	516	141	2931	1169	228	178	642	874	1206	2809	653	0	0	0	7798	255	369	922	865	1417	4158	2252	676	2478	46027	1631	32705	30878	58661	6117	35348

Table 1-3: Triangulated asset-liability-matrix for Japan (1954)

(100 billion yen)

	21	14	2	18	4	7	5	20	3	1	10	9	15	12	16	6	17	13	8	11	23	19	22
21 Non-financial corporations	18992	0	0	0	0	462	0	89	0	570	0	0	0	0	868	0	0	0	0	0	0	0	1304
14 Securities companies etc.	696	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Long-term credit banks	1622	19	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 Public financial corporations	1217	0	0	710	0	0	0	1828	0	0	0	0	0	0	0	0	0	0	0	0	0	0	586
4 City banks	8624	234	363	130	327	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Foreign banks in Japan	0	0	0	0	174	23	0	0	0	104	0	0	0	0	0	0	0	0	0	0	915	0	0
5 Regional banks	3833	123	261	119	167	0	72	0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0
20 Non-financial public corporations	0	0	0	0	319	76	109	0	0	0	0	0	0	0	0	0	0	0	26	77	0	0	0
3 Trust banks	349	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 Bank of Japan	0	0	109	88	4047	0	66	0	173	41	0	0	0	0	0	0	60	0	0	0	0	663	0
10 Labor credit associations	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Credit cooperatives	75	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Other financial institutions	0	0	0	0	93	0	0	0	0	0	0	0	85	0	0	0	0	0	0	0	0	0	0
12 Trust accounts	1483	0	0	0	43	0	17	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0
16 Deposit insurance corporations	0	0	0	34	41	0	0	46	0	40	0	0	0	0	0	0	4767	0	0	0	0	0	0
6 Mutual loans and savings banks	1603	43	24	0	132	19	42	0	0	61	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Fiscal loan fund	1514	114	722	760	22	0	0	1969	0	0	0	0	0	0	0	0	0	0	0	89	0	0	637
13 Insurance	774	0	0	0	159	20	59	0	0	0	0	0	0	22	0	0	0	0	0	47	0	0	0
8 Credit associations	738	24	23	0	249	33	92	0	0	53	0	0	0	101	0	0	0	0	22	0	0	0	0
11 Financial institutions for agriculture, forestry and fisheries	1411	28	23	17	48	34	86	0	0	40	0	0	20	0	240	65	0	0	0	374	0	0	0
23 Rest of the world	739	0	0	0	109	0	147	108	17	159	0	0	0	0	0	21	0	0	23	62	2456	0	0
19 Central government	103	120	161	3745	309	31	290	379	0	0	0	20	0	0	0	0	1804	337	105	242	656	0	0
22 Households	0	63	116	0	7111	631	4071	27	275	4029	27	88	0	1155	3796	1724	0	976	1001	2290	0	932	0

Table 1-4: Triangulated asset-liability-matrix for Japan (1999)

(100 billion yen)

	20	19	21	7	23	14	18	2	1	4	3	15	17	6	16	5	8	9	12	10	11	13	22
20 Non-financial public corporations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Central government	11782	48417	253419	0	0	0	0	0	0	0	0	0	682747	0	0	0	0	0	0	0	0	0	0
21 Non-financial corporations	7212	0	3E+06	0	2534	0	0	0	0	0	0	0	0	0	98218	0	0	0	181536	0	0	0	21353
7 Foreign banks in Japan	4483	15777	3623	12765	60164	0	0	0	673	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 Rest of the world	7789	197804	0	0	731452	9995	0	0	0	0	0	0	0	0	0	0	0	216	0	133	0	0	0
14 Securities companies etc.	10301	68636	64215	534	0	2957	1770	1318	0	0	0	2510	0	0	0	0	0	0	0	0	0	0	0
18 Public financial corporations	317349	73743	274945	5531	124730	0	343506	0	0	8083	0	0	0	0	0	0	0	0	0	0	0	0	219223
2 Long-term credit banks	11086	35059	238650	193	47388	0	3957	4960	0	0	1178	0	0	0	0	0	0	0	0	0	0	0	0
1 Bank of Japan	2843	464354	14106	0	29779	2715	5681	409	8738	0	0	0	476	0	0	0	0	0	0	0	0	0	0
4 City banks	9068	90492	957065	8370	494530	9757	0	5304	41007	165114	26402	0	0	0	0	0	0	0	0	0	0	0	0
3 Trust banks	8976	30993	198193	1068	10547	1367	3605	0	2597	0	9363	8970	144	0	0	0	0	0	0	0	0	0	0
15 Other financial institutions	36427	10713	32324	7350	0	0	39435	4814	14629	14911	0	112996	0	0	17912	0	0	0	0	0	0	0	25152
17 Fiscal loan fund	829636	0	621573	0	0	2112	837064	5942	0	0	0	0	0	0	0	0	565	0	0	0	1295	0	532933
6 Mutual loans and savings banks	7210	34653	191761	3946	13293	4291	1988	13957	7913	16574	10665	17764	0	1062	0	0	0	0	0	0	0	0	0
16 Deposit insurance corporations	337346	413172	0	3554	70547	3877	25091	3670	10109	26635	1129	0	2E+06	3118	54869	4744	0	0	0	0	0	0	0
5 Regional banks	65951	108569	483477	10679	28075	9226	10020	30781	25694	45009	25992	48219	0	156	0	14110	0	0	0	0	0	0	0
8 Credit associations	28792	49414	309119	5175	8043	7832	10504	28138	14107	50049	19397	25505	0	6591	34852	16769	22489	0	0	0	0	0	0
9 Credit cooperatives	1356	4157	67592	1466	0	636	814	2591	2175	14920	4499	5141	0	2098	2386	7430	386	933	0	0	0	0	0
12 Trust accounts	85763	302658	0	39299	330880	20018	26947	58145	23301	133995	9757	77093	0	4836	50836	13149	1586	991	323	0	2961	0	0
10 Labor credit associations	662	4167	29519	133	0	610	625	2337	380	5687	2159	1625	0	1408	7457	3214	1004	279	5058	427	0	0	0
11 Financial institutions for agriculture, forestry and fisheries	10186	94059	153315	8218	45928	3651	6974	21480	7665	113860	24050	28880	0	24825	179989	62997	30637	7237	0	3234	133456	0	0
13 Insurance	160695	328533	662058	24383	250982	30681	24477	69076	8607	118233	21757	39673	135	8007	15001	26275	17704	2273	64459	1215	45049	7606	0
22 Households	34855	67332	0	6426	0	3575	0	13100	403166	883581	109565	0	0	252771	3E+06	673794	501385	102344	860652	69333	798833	1988482	0

Chapter 2

BALANCE SHEET ANALYSIS OF THE SUBPRIME MORTGAGE CRISIS

This chapter is based on “Balance Sheet Economics of the Subprime Mortgage Crisis,” which is published in the *Economic Systems Research*, vol.23, no.1, pp.1-25. Page 19 through page 54 of the original thesis are omitted because of copyright issue. Following is the summary of the chapter.

Summary of Chapter 2

The current U.S. housing crisis is the culmination of a large boom and bust in house prices and residential construction that began earlier in the first decade of the century. Home sales and single-family housing starts held steady through the 2001 recession and then rose dramatically over the subsequent four years. National indexes of home prices accelerated significantly over that period, with prices in some metropolitan areas more than doubling over the first half of the decade. One unfortunate consequence of the rapid increases in house prices was that providers of mortgage credit came to view their loans as well-secured by the rising values of their collateral and thus paid less attention to borrowers’ ability to repay. Subprime

mortgages, which are loans made to borrowers who are perceived to have high credit risk, often because they cannot afford to make a large enough down payment or have other characteristics that are associated with high probabilities of default, increased dramatically as a consequence. The situation was complicated by a number of additional factors; continued increases in the prices of energy and other commodities, together with high levels of resource utilization, put the Fed on inflation alert. The Federal Open Market Committee implemented a sequence of rate increases, beginning in mid-2004 and ending in June 2006, which ranged from a historical low of one percent to as high as 5.25 percent. The delinquency rate of the subprime variable-rate mortgage literally skyrocketed after 2006.

As Copeland (1947, 1949 and 1952) demonstrated with his money-flow accounts more than half a century ago, the balance sheets of economic entities are closely interrelated through the lender-borrower relationship. The subprime mortgage crisis reminded us of this simple fact. The direct loss from delinquency occurs in the sectors that extend home mortgages. Home mortgages are often pooled and sold to a special purpose vehicle, or SPV; the SPV issues tradable securities to fund the purchase; it is referred to as mortgage backed securities (MBS). Since the payment flows are solely backed by the principal and interest payments of a set of mortgage loans, the market value of MBS decreases as the delinquency rate rises. When mark-to-market accounting is used, the depreciation of MBS pushes down

the share prices of the institutional investors, such as financial institutions or insurance companies that have MBS in their portfolio. Now it is the general public to suffer because the equity shares of institutional investors are held by just anybody. Some foreign investors also have such equities in their portfolio so that they are not immune either. Among the companies that experienced this dynamic most forcefully at earlier stage were the government-sponsored enterprises (GSE), Fannie Mae and Freddie Mac; the investment bank Lehman Brothers Holdings; and the insurance company American International Group (AIG).

The crisis we face in the financial markets has many novel aspects, largely arising from the complexity and sophistication of today's financial institutions and instruments and the remarkable degree of global financial integration that allows financial shocks to be transmitted around the world at the speed of light. Because the U.S. mortgages were packaged into securities and sold around the world, banks in Europe and elsewhere suffered losses when home mortgage delinquency rate increased. The global economy was slowing, stocks were plummeting, and short-term credit markets were locked up. This paper is an attempt to describe the subprime mortgage crisis in the framework of the 'balance sheet economics', which is attributable to Klein (1977). We will depict the propagation process of loss from home mortgage delinquencies in the light of the lender-borrower relationship. Since it is almost impossible to collect all the balance sheets of economic entities, we use

flow-of-funds accounts instead to simulate the negative consequences. The potential loss incurred by each economic sector and the asset depreciation in each financial instrument will be estimated based on two assumptions: (1) the market value of an asset reflects the current value of the investment; (2) mark-to-market accounting is used. In the next section, we will discuss the theoretical framework of balance sheet economics to depict the interrelations between various sectors of the economy. In Section 2.3, we will simulate the domestic consequences in that framework while the international consequences are investigated in Section 2.4. Concluding remarks are in Section 2.5.

Chapter 3

ASSET-LIABILITY MATRIX ANALYSIS OF THE JAPANESE QUANTITATIVE MONETARY POLICY

This chapter is based on the following papers: “Asset-Liability-Matrix Analysis Derived from Flow-of-Funds Accounts: the Bank of Japan’s Quantitative Monetary Policy Examined,” published in *Economic Systems Research*, 15(1), 51-67; “Does Monetary Policy Work under Zero-Interest-Rate?” published in *Journal of Applied Input-Output Analysis*, 11, 49-72; “A Flow-of-Funds Analysis of Quantitative Monetary Policy," published in Shinichi Ichimura and Lawrence R. Klein (eds.) *Macroeconometric Modeling of Japan*, Singapore: World Scientific, Chapter 7, 173-193. Page 55 through page 91 of the original thesis are omitted because of copyright issue. Following is the summary of the chapter.

Summary of Chapter 3

Flow-of-funds (FOF) analysis stems from Copeland (1947, 1949). Since then, it has developed as an accounting system describing the intersectoral financial transactions between the institutional sectors. FOF accounts were included in the System of National Accounts in 1968, along with National Income Accounts,

National Balance Sheets, Balance of International Payments Accounts and IO Tables. FOF Accounts consist of balance sheets of the institutional sectors, in their traditional tabulation practice. This FOF format is widely employed because of the ease of compilation based on the corporate accounting system.

To bring FOF accounts in practical economic analysis, several attempts have been made since the early days of FOF development. It is possible to classify the analytical framework of FOF into three large groups. Firstly, Powelson (1960) and Mathews (1962) extended the idea by making full use of the quadruple-entry system originally proposed by Copeland (1952). Alford (1986) brought this accounting-oriented technique to completion. The disadvantage of this technique for policy examination, however, is the existence of multiple (i.e. non-unique) solutions. Secondly, Dawson (1958), Cohen (1963), Hamada (1969), Tobin (1969) and Alho (1991) developed general equilibrium models based on FOF accounts. Later, these studies expanded into SAM-CGE models, using traditional FOF as part of them. The problem is that this kind of model tries to include all economic activities at once, which makes it rather difficult to examine the effects of detailed changes in a particular policy. Thirdly, Stone (1966) and Klein (1983) proposed converting balance sheets of FOF accounts into a square matrix known as asset-liability matrix (ALM), by means of the supply-and-use method that is widely employed in the compilation of the System of National Accounts (see United Nations (1999)). The

merit of the square matrix is that we can apply the affluent assets of IO analysis to the FOF data. That is, ALM makes it possible to examine the effects of a certain policy on each separate institutional sector from the perspective of inter-sectoral financial transactions.

The reason why the flow of funds analysis is getting more attention today is that the key policy interest rate is less than one percent in most of the advanced economies after 2009. As early as in the spring of 1999, the Japanese call money rate, an equivalent of U.S. federal funds rate, reached to the zero-interest-rate level, and has remained under quarter percent up to now. In June 2003, even the key long-term interest rate, the yield of the Japanese Government Bond (JGB), hit 0.43 percent for a brief time. The U.S. Federal Open Market Committee lowered its intended federal funds rate to one percent on June 25, 2003. Actually the federal funds rate was hovering somewhere around one percent for more than one year till the Fed raised the interest rate by 25 basis points to 1.25 percent on June 30, 2004. In the aftershock of the U.S. subprime mortgage crisis, the key policy interest rates are less than one percent in not only in Japan and the U.S. but also in the 16-country euro area, the U.K., Switzerland, Sweden, Canada, etc. Keynes (1936) suggests that the interest rate oriented monetary policy become ineffective at near zero interest rate level because of the existence of the liquidity trap. How about some other type of monetary policy, then? “Does monetary policy work under zero-interest-rate at

all?” is the question to be answered in this study.

Chapter 4

THE CONVERGENCE OF FINANCIAL STRUCTURES IN EUROPE: A EUCLIDEAN DISTANCE PANEL DATA APPROACH[1]

4.1 Introduction

It is not an easy task to implement common monetary policy on countries with considerable divergence, not only in business practices but also in economic backgrounds. That is why it was considered so important for every one of the candidate states to fulfill the four convergence criteria laid out in the Maastricht Treaty[2] before joining the single currency. Although it is no secret that some of the countries have had difficulties satisfying the criteria from time to time, the European Central Bank (ECB) has not faced undue difficulty in day-to-day monetary operations up to now. Is the fear greater than the danger as the proverb

[1] An earlier version of this paper was presented at the 24th International Symposium on Money, Banking and Finance, Rennes, 14-15th June 2007. We are grateful to Prof. Michel Boutillier (Université Paris X) for his helpful comments and constructive suggestions. We would also like to acknowledge our indebtedness to Prof. Kazuhiko Matsuno (Chuo University, Tokyo, Japan) for his detailed advices in the statistical methods.

[2] Provisions Amending the Treaty Establishing the European Economic Community with a View to Establishing the European Community (Maastricht, 7 February 1992), Article 109j(1).

suggests? Some people say it is a chicken and egg problem after all. The idea is that, once the single currency is introduced, convergence necessarily follows through the neoclassical market mechanism. It is no wonder that many academic papers investigate the introduction of the euro in this perspective. The problem is an increasingly important one since many of the countries that gained membership to the European Union (EU) during its 2004 enlargement are trying to join the single currency at the earliest opportunity. If the neoclassical market mechanism solves the convergence problem without undue difficulty, it is needless to wait for the new comers to meet the strict convergence criteria of the Maastricht Treaty.

In the theoretical field, Barro and Sala-i-Martin (1992, 1995), Sala-i-Martin (1996), Quah (1993, 1996) and Bernard and Durlauf (1995, 1996) among others provided empirical schemes for studying convergence in the framework of the neoclassical growth model. Sala-i-Martin (1996), applying the concept of β convergence and σ convergence on numerous personal income data, including those of 90 European regions, concluded in favor of regional convergence. In contrast to this, Quah (1993, 1996), fortifying stratification argument with cross-country income data, urged against convergence. On the other hand, Bernard and Durlauf (1995) constructed a stochastic definition of convergence based on the theory of integrated time series and revealed little evidence of convergence. Instead of income, Tsionas (2000) examined convergence of TFP (total factor productivity)

in 15 European countries, and found that it is difficult to conclude whether or not economies converge or diverge relying on a single test. Another example of a study in the convergence of productivity is Hobijn and Franses (2000); the uniqueness of their approach lies in the introduction of cluster analytical procedure that distinguishes several convergence clubs.

Since the official launch of the single currency, more specific issues have come to light. By dividing euro countries into high and low income groups, Carvalho and Harvey (2005) concluded that per capita real income convergence was achieved only within groups, based on a multivariate structural time series model. Busetti, Forni, Harvey and Venditti (2006) studying convergence property of inflation rates among EMU (the European Monetary Union) countries found two separate convergence clubs: lower inflation group and higher inflation group. For new EU member countries, by employing panel unit root test, Kutan and Yigit (2004, 2005) found real stochastic convergence but no nominal convergence. These studies cover not only the growth rate of production and prices, but also nominal interest rate spreads i.e. convergence in the financial indicators, one of the recurrent topics in the latest literatures. Cabral, Dierick and Vesala (2002), employing various statistics, concluded that the euro area had led to convergence in the levels of retail loan and deposit interest rates, but market segmentation had remained strong in the wholesale levels. Sander and Kleimeier (2004) examined the interest rate pass-

through process of 10 euro-zone countries, and found little evidence of retail banking integration. Applying the dynamic fixed-effects model on corporate fund raising, Murinde, Agung and Mullineux (2004) reported that there is a tendency of convergence in the domain of equity finance and internal funds but not in that of bank debt and bonds issuance.

Most of the above mentioned studies focus on the economic indicators like income, outputs, prices, interest rates and so forth. However, as a policy maker rather than a third-party observer, the attention of the central banks lies not only in those economic indicators but also in the economic structure that should implement the monetary policy at the retail level. Since central banks operate through the banking system and the financial market, it is difficult for them to carry out common monetary policy if there is no convergence in the financial structures. For most central banks, the main policy instrument is the short-term interest rate. This instrument is set in order to achieve the monetary policy objectives. The monetary policy transmission mechanism consists of all the channels through which the interest rate changes, decided by the central bank, affect the economy. Financial structures or financial systems can play an important role for a number of these channels. This is why ECB (2002) is vigorously investigating the financial structures of the member states of the monetary union.

Concerning financial structure, Demirgüç-Kunt and Levine (2001) gathered

sector-by-sector assets and liabilities data of IMF countries, and not a few authors are contributing to investigate the data empirically based on the ideas laid by Goldsmith (1969). Byrne and Davis (2003) studied the balance sheet structure of the main economic sectors in the major OECD countries in terms of the long-run equilibrium portfolio compositions. Similarly, Hartmann, Maddaloni and Managanelli (2003) examined the financial accounts of the euro area, the U.S. and Japan to compare the asset-liability composition of the institutional sectors. Furthermore, Tsujimura and Mizoshita (2003) studied the financial structure in this context from the viewpoint of the transmission mechanism of the monetary policy.

The primary objective of this paper will be to investigate whether there has been a convergence in the financial structures of the European countries since the introduction of the euro. Although financial structure could be interpreted in a variety of ways, we will confine it to the balance sheet structure of the main economic sectors, commonly referred to as financial accounts. In the first part, we will canvass the squared Euclidean distances of the financial structure between 21 OECD countries to determine if there has been a noticeable reduction in it among the European countries. In the second half, we will attempt to establish the dominant factors that determine the financial structure of an economy. We will test several demographic factors along with widely used economic indicators, as suggested by Poterba (2001, 2004).

4.2 Observation of the Squared Euclidean Distances

The panel data of financial structures used in this study was prepared from Volume III-b of the *National Accounts of OECD Countries*. This publication contains information on the financial stocks held by institutional sectors, at the end of the year, in the form of financial balance sheets. The historical tables of 21 OECD countries provide an overview of changes in the holding of financial instruments' stocks by the different institutional sectors between 1995 and 2004. The countries include nine euro member states (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal, and Spain), seven non-euro European countries (Czech Republic, Denmark, Hungary, Norway, Poland, Sweden, and the U.K.) and five non-European countries (Australia, Canada, Japan, Korea, and the U.S.). The institutional units, which correspond to economic entities capable of engaging in transactions with other units, are grouped together into four categories called institutional sectors: non-financial corporations, financial corporations, general government and households (inclusive of non-profit institutions serving households (NPISH)). A fifth sector, the rest of the world, reflects transactions between resident institutional units and non-resident units. Financial assets and liabilities are classified under seven major categories of instruments: monetary gold and special drawing rights, currency and deposits, securities other than shares, loans, shares and other equity, insurance technical reserves, and other accounts receivable/payable.

The financial balance sheet account also presents a balancing item which corresponds to the financial net worth (financial assets less liabilities).

To compare the financial structure of the countries, we prepared following matrix of net financial assets from the original data.

$$\mathbf{Y}_{kt} = \begin{bmatrix} y_{11kt} & \cdots & y_{1jkt} & \cdots & y_{1\upsilon kt} \\ \vdots & \ddots & \vdots & \iddots & \vdots \\ y_{i1kt} & \cdots & y_{ijkt} & \cdots & y_{i\upsilon kt} \\ \vdots & \iddots & \vdots & \ddots & \vdots \\ y_{\iota 1kt} & \cdots & y_{\iota jkt} & \cdots & y_{\iota\upsilon kt} \end{bmatrix} \quad ; \tag{4-1}$$

where

$$y_{ijkt} = \frac{e_{ijkt}}{\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon} e_{ijkt}} - \frac{r_{ijkt}}{\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon} r_{ijkt}} \quad . \tag{4-2}$$

e_{ijkt} and r_{ijkt} denote asset and liability elements of the balance sheets[3], in the form of instrument i, held by institutional sector j; k and t refer to country and time concerned; $\iota, \upsilon, \kappa, \tau$ are the numbers of instruments, sectors, countries and periods respectively. Since

$$\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon} e_{ijkt} = \sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon} r_{ijkt} \quad , \tag{4-3}$$

so that

$$\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon} y_{ijkt} = 0 \quad for \quad k = 1, \cdots, \kappa \quad t = 1, \cdots, \tau \, . \tag{4-4}$$

[3] The financial net worth is also included; it is listed either on the liability side (if positive) or on the asset side (if negative).

Although several alternatives could be considered, one of the most convenient measures of similarity or dissimilarity is the Euclidean distance. In our case, squared Euclidean distance at period t, between two countries k and l, is defined by the rearrangement of the matrix (4-1) as follows:

$$d_{klt} = \left\| \mathbf{y}_{kt} - \mathbf{y}_{lt} \right\|^2$$

where $\mathbf{y}_{kt} = \left[\mathbf{y}_{1kt}' \cdots \mathbf{y}_{jkt}' \cdots \mathbf{y}_{\upsilon kt}' \right]'$ and $\mathbf{y}_{jkt} = \left[y_{1jkt} \cdots y_{ijkt} \cdots y_{\iota jkt} \right]'$. (4-5)

Condensed statistics given in Table 4-1 provides an overview of whether there has been a convergence in the financial structure of the European countries since the introduction of the euro. The mean and standard deviation of the squared Euclidean distances of the combination of the countries before and after the introduction of the new currency are presented there. For the sake of comparison, the 21 countries are divided into three groups: euro countries (EE), non-euro European countries (NE) and non-European countries (NN); the combinations are summarized in Table 4-2. The figures in parentheses are the number of combinations of the countries included in particular categories. Although the official launch of the euro took place in January 1999[4], we divided the observation periods into two halves (1995-1999 and 2000-2004) allowing one year time lag for the restructuring.

[4] The euro became the single currency of the euro area; conversion rates were fixed irrevocably for the former national currencies of the participating member states; a single monetary policy was conducted for the euro area.

Table 4-1: Squared Euclidean distances between the countries

	1995-1999		2000-2004		$\frac{\mu_2 - \mu_1}{\sqrt{\frac{\sigma_2^2}{n_2} + \frac{\sigma_1^2}{n_1}}}$
Combination categories	Mean μ_1	Std. dev. σ_1	Mean μ_2	Std. dev. σ_2	
EE-EE	0.0398	0.0324	0.0330	0.0283	-2.118**
EE-NE	0.0504	0.0264	0.0434	0.0241	-3.368**
EE-NN	0.0467	0.0273	0.0419	0.0222	-2.026**
NE-NE	0.0458	0.0198	0.0479	0.0273	0.574
NE-NN	0.0539	0.0221	0.0537	0.0199	-0.105
NN-NN	0.0512	0.0223	0.0449	0.0168	-1.553*

Note: ** and * denote that the null hypothesis $\mu_1 = \mu_2$ is statistically rejected at 1% and 5% significance level, respectively.

Table 4-2: Categories of combination of the countries

	Euro Area	Non Euro Europe	Non Europe
Euro Area	EE-EE (36)	EE-NE (63)	EE-NN (45)
Non Euro Europe		NE-NE(21)	NE-NN (35)
Non Europe			NN-NN (10)

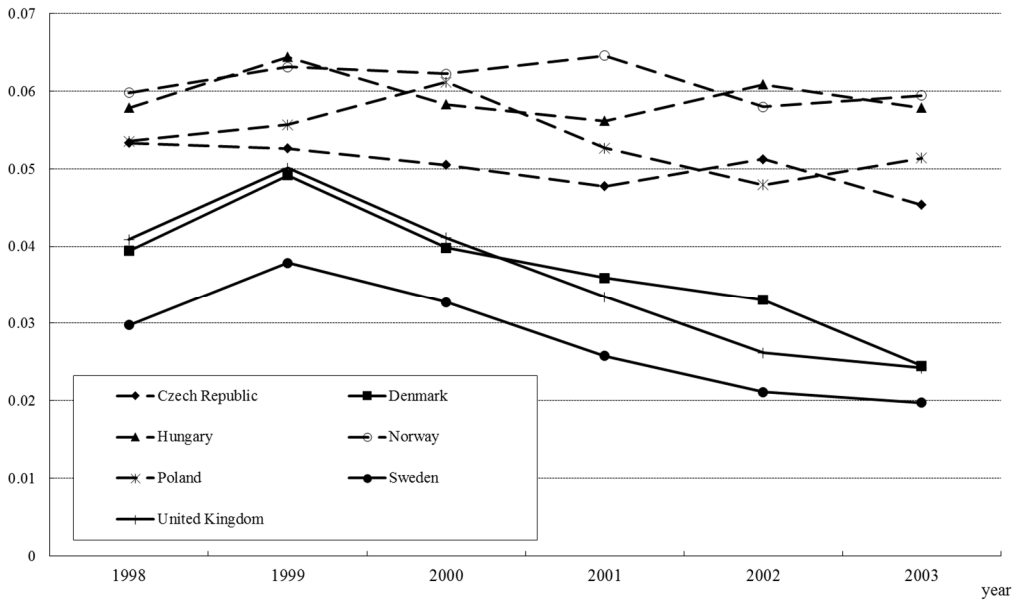
Note: The numbers in the parentheses are sample size of the particular category.

As shown in Table 4-1, even before the introduction of the new currency, the combinations of euro countries, compared to other combinations of the countries, had the smallest squared Euclidean distance in average, demonstrating the similarity of financial structures represented in the balance sheets. After the introduction of the euro, the distance diminished even further. The test statistics in the last column show that the difference between the means of the two eras is statistically significant at 1% level. The squared Euclidean distance between the euro countries and the non-euro European countries is far greater than that among euro-area countries. In fact, it is even greater than the distance to the non-European countries, though the differences in the distance concerning to the two categories of combinations closed after the launch of the new currency. These results could be summarized as follows: a) the participating countries of the euro at the first stage had more or less similar financial structures even before the introduction of the currency; it might be partially because the Maastricht criteria was laid out well in advance; b) at the time of introduction of the euro, the non-participating European countries were somewhat different, in terms of financial structures, from the participating countries; c) after the launch of the new currency, the similarity in the financial structures increased in all combinations of the countries involving euro-member states.

The primary concern regarding future expansion of the single currency lies

in the dissimilarity among the non-euro European nations, which remained even in the latter half of the observation period. The fluctuations in the average squared Euclidean distances between each of the non-members and the euro member countries are depicted in Figure 4-1. It is rather obvious that the non-euro countries are divided into two groups. One group consists of Sweden, Denmark and the U.K.; in these countries, the squared Euclidean distances to the euro countries are apparently reduced in recent years. The other group comprises three Central European countries, Czech Republic, Hungary and Poland, along with Norway; in sharp contrast to the former group, the countries belonging to this group failed to narrow the gap.

Figure 4-1: Changes in the squared Euclidean distances to the euro area



4.3 Determinants of Financial Structures

4.3.1 Fundamental Model

There should be some dominant factors that determine the financial structure of a country. If we could find the determinants, we can examine the convergence of the financial structure by identifying systematically explainable portion of the changes in the squared Euclidean distances from country specific as well as other miscellaneous segments. Since our data is in the form of cross-sectional time-series, we can apply the well-known techniques of the panel data analysis, specifically the random effects and fixed-effects approaches. In assuming the random effects model, the fundamental structure of our system of equations is expressed as follows; we will use the suffixes as indicated below:

financial instrument: $i, m = 1, \cdots, \iota$;

institutional sector: $j, n = 1, \cdots, \upsilon$;

country: $k, l = 1, \cdots, \kappa$;

period: $t, s = 1, \cdots, \tau$;

explanatory variable identifier: $h, g = 0, \cdots, \eta$.

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\mu} + \boldsymbol{\nu} \quad \text{where} \quad \mathbf{y} = \left[\mathbf{y}_{11}{}' \cdots \mathbf{y}_{ij}{}' \cdots \mathbf{y}_{\iota\upsilon}{}' \right]' \quad \text{and} \quad \mathbf{y}_{ij} = \left[y_{ij11} \cdots y_{ijkt} \cdots y_{ij\kappa\tau} \right]' . \tag{4-6}$$

$\mathbf{X}$ is a matrix containing explanatory variables; $\mathbf{I}_{\iota\upsilon}$ is a unit matrix of dimension

$\iota\upsilon$, $\mathbf{i}_{\kappa\tau}$ is a vector of ones of dimension $\kappa\tau$;

$$\mathbf{X} = \mathbf{I}_{\iota\upsilon} \otimes \mathbf{Z} \quad ; \tag{4-7}$$

$$\mathbf{Z} = \left[\mathbf{z}^0 \cdots \mathbf{z}^h \cdots \mathbf{z}^\eta \right] \text{ where } \mathbf{z}^0 = \mathbf{i}_{\kappa\tau} \text{ and } \mathbf{z}^h = \left[z_{11}^h \cdots z_{kt}^h \cdots z_{\kappa\tau}^h \right]' \text{ for } h = 1, \cdots, \eta ; \tag{4-8}$$

$\boldsymbol{\beta}, \boldsymbol{\mu}, \boldsymbol{\nu}$ are the vectors of unknown parameters, country specific random effects elements, and remaining stochastic components, respectively;

$$\boldsymbol{\beta} = \left[\boldsymbol{\beta}_{11}' \cdots \boldsymbol{\beta}_{ij}' \cdots \boldsymbol{\beta}_{\iota\upsilon}' \right]'$$

$$\text{while } \boldsymbol{\beta}_{ij} = \left[\beta_{ij}^0 \cdots \beta_{ij}^h \cdots \beta_{ij}^\eta \right]' \text{ and } \sum_{i=1}^{\iota} \sum_{j=1}^{\upsilon} \beta_{ij}^h = 0 \text{ for } h = 0, \cdots, \eta ; \tag{4-9}$$

$$\boldsymbol{\mu} = \left[\boldsymbol{\mu}_{11}' \cdots \boldsymbol{\mu}_{ij}' \cdots \boldsymbol{\mu}_{\iota\upsilon}' \right]' \text{ while } \boldsymbol{\mu}_{ij} = \left[\mu_{ij1} \cdots \mu_{ijk} \cdots \mu_{ij\kappa} \right]' \otimes \mathbf{i}_\tau \quad ; \tag{4-10}$$

$$\boldsymbol{\nu} = \left[\boldsymbol{\nu}_{11}' \cdots \boldsymbol{\nu}_{ij}' \cdots \boldsymbol{\nu}_{\iota\upsilon}' \right]' \text{ while } \boldsymbol{\nu}_{ij} = \left[\nu_{ij11} \cdots \nu_{ijkt} \cdots \nu_{ij\kappa\tau} \right]' \quad . \tag{4-11}$$

The stochastic assumptions applied to the random disturbances accompanying the above model are expressed in the following manner:

$$\mathrm{E}\left[\mu_{ijk} \right] = 0, \quad \mathrm{E}\left[\mu_{ijk}^2 \right] = \sigma_{\mu_{ij}}^2, \qquad \text{for all } i, j, k ; \tag{4-12}$$

$$\mathrm{E}\left[\nu_{ijkt} \right] = 0, \quad \mathrm{E}\left[\nu_{ijkt}^2 \right] = \sigma_{\nu_{ij}}^2, \qquad \text{for all } i, j, k, t ; \tag{4-13}$$

$$\mathrm{E}\left[\mu_{ijk} \nu_{mnlt} \right] = 0, \quad \text{for all } i, j, m, n, k, l, t ; \tag{4-14}$$

$$\mathrm{E}\left[\mu_{ijk} \mu_{mnl} \right] = \sigma_{\mu_{ij}\mu_{mn}}, \quad k = l$$

$$= 0 \qquad \text{elsewhere;} \tag{4-15}$$

$$\mathrm{E}\left[\nu_{ijkt} \nu_{mnls} \right] = \sigma_{\nu_{ij}\nu_{mn}}, \quad k = l \quad \textit{and} \quad t = s$$

$$= 0 \qquad \text{elsewhere ;} \tag{4-16}$$

In addition, z_{kt}^{h} are independent of the μ_{ijk} and ν_{ijkt} for all i, j, k and t. The probability density functions are specified in the form of multivariate normal distributions:

$$\boldsymbol{\mu}_k \sim \mathbf{N}\left(\mathbf{o}_{\iota\upsilon}, \boldsymbol{\Sigma}_{\mu}\right) \text{ while } \boldsymbol{\mu}_k = \left[\mu_{11k} \cdots \mu_{ijk} \cdots \mu_{\iota\upsilon k}\right]' \text{ ;} \tag{4-17}$$

$$\mathbf{v}_{kt} \sim \mathbf{N}\left(\mathbf{o}_{\iota\upsilon}, \boldsymbol{\Sigma}_{\nu}\right) \text{ while } \mathbf{v}_{kt} = \left[\nu_{11kt} \cdots \nu_{ijkt} \cdots \nu_{\iota\upsilon kt}\right]' \text{ ;} \tag{4-18}$$

where $\mathbf{o}_{\iota\upsilon}$ is a vector of zeros of dimension $\iota\upsilon$; $\boldsymbol{\Sigma}_{\mu}$ and $\boldsymbol{\Sigma}_{\nu}$ are the variance-covariance matrices of μ_{ijk} and υ_{ijkt}. The total structure of the variance-covariance matrix could be expressed in the following formation:

$$\boldsymbol{\Omega} = \boldsymbol{\Sigma}_{\mu} \otimes \left(\mathbf{I}_{\kappa} \otimes \mathbf{J}_{\tau}\right) + \boldsymbol{\Sigma}_{\nu} \otimes \left(\mathbf{I}_{\kappa} \otimes \mathbf{I}_{\tau}\right) \text{ ;} \tag{4-19}$$

where $\mathbf{J}_{\tau}$ is a matrix of ones of dimension τ.

4.3.2 Estimation Procedures for the Random Effects Model

It is obvious that the above model could be solved by employment of a technique widely known as SUPR or seemingly unrelated panel regression. The estimation method was initially proposed by Avery (1977) and further developed by Baltagi (1980), Magnus (1982), Howrey and Varian (1984), Biørn (2004), etc. However, there are several shortcomings accompanying the direct estimation of equation (4-6) using SUPR: a) the estimation method involves cumbersome

iteration procedure; b) the size of the panel data describing an economic structure could be too large to conveniently handle — the combination of a) and b) makes SUPR practically beyond management; and c) the structural parameters are component-specific (i.e. sector and instrument) rather than system-specific (i.e. financial structure as a whole). Since we are interested in the factors that will bring convergence to the financial structure rather than in the determinants of the structure themselves, an alternative to the conventional SUPR is the application of the squared Euclidean distance mentioned in the previous section. The merit of this procedure in terms of data size reduction is obvious when the number of the variables depicting an economic structure is large relatively to the number of the countries involved. In any case, as will be proved below, the reduced form parameters are system-specific rather than component-specific, so that they can be employed to determine the dominant factors that will cause convergence in the financial structures.

The squared Euclidean distance d_{klt} between countries k and l could be expressed in the following manner by employment of the fundamental model explained in the previous subsection. We obtain equation (4-20) below by rearranging the fundamental equation (4-6), focusing on the kt elements;

$$\mathbf{y}_{kt} = \mathbf{X}_{kt}\boldsymbol{\beta} + \boldsymbol{\mu}_k + \mathbf{v}_{kt} \qquad (k = 1, \cdots, \kappa) \quad (t = 1, \cdots, \tau). \tag{4-20}$$

Plugging the above equation into equation (4-5) produces the relation below:

$$d_{klt} = \left\| \mathbf{y}_{kt} - \mathbf{y}_{lt} \right\|^2 = \left\| \left(\mathbf{X}_{kt}\boldsymbol{\beta} + \boldsymbol{\mu}_k + \mathbf{v}_{kt} \right) - \left(\mathbf{X}_{lt}\boldsymbol{\beta} + \boldsymbol{\mu}_l + \mathbf{v}_{lt} \right) \right\|^2$$

$$\left(k, l = 1, \cdots, \kappa,\ k \neq l \right) \quad \left(t = 1, \cdots, \tau \right). \tag{4-21}$$

where $\mathbf{X}_{kt} = \mathbf{I}_{\iota\upsilon} \otimes \mathbf{z}_{kt}'$, $\mathbf{y}_{kt} = \left[y_{11kt} \cdots y_{ijkt} \cdots y_{\iota\upsilon kt} \right]'$, $\mathbf{z}_{kt} = \left[z_{kt}^0 \cdots z_{kt}^h \cdots z_{kt}^\eta \right]'$, $\boldsymbol{\mu}_k = \left[\mu_{11k} \cdots \mu_{ijk} \cdots \mu_{\iota\upsilon k} \right]'$, and $\mathbf{v}_{kt} = \left[\nu_{11kt} \cdots \nu_{ijkt} \cdots \nu_{\iota\upsilon kt} \right]'$ respectively. By expanding both sides of the equation (4-21), we obtain the following equations (see appendix for details):

$$\left(\mathbf{y}_{kt} - \mathbf{y}_{lt} \right)' \left(\mathbf{y}_{kt} - \mathbf{y}_{lt} \right)$$

$$= \boldsymbol{\beta}' \left(\mathbf{X}_{kt} - \mathbf{X}_{lt} \right)' \left(\mathbf{X}_{kt} - \mathbf{X}_{lt} \right) \boldsymbol{\beta} + \left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right)' \left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right) + \left(\mathbf{v}_{kt} - \mathbf{v}_{lt} \right)' \left(\mathbf{v}_{kt} - \mathbf{v}_{lt} \right). \tag{4-22}$$

As the consequences of the specifications concerning to the probability density functions, we have some additional particulars as proved in Matsuno, Tsujimura and Tsujimura (2006):

Since $\boldsymbol{\mu}_k \sim \mathbf{N}\left(\mathbf{o}_{\iota\upsilon}, \boldsymbol{\Sigma}_\mu \right)$, $\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \sim \mathbf{N}\left(\mathbf{o}_{\iota\upsilon}, 2\boldsymbol{\Sigma}_\mu \right)$; (4-23)

so that $\left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right)' \left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right) \sim \mathrm{Q}\left(\sum_{i=1}^{\iota} \sum_{j=1}^{\upsilon} \lambda_{\mu ij}, 2\sum_{i=1}^{\iota} \sum_{j=1}^{\upsilon} \lambda_{\mu ij}^2 \right)$; (4-24)

and as $\iota \cdot \upsilon \to \infty$, $\left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right)' \left(\boldsymbol{\mu}_k - \boldsymbol{\mu}_l \right) \xrightarrow{d} \mathrm{N}\left(\sum_{i=1}^{\iota} \sum_{j=1}^{\upsilon} \lambda_{\mu ij}, 2\sum_{i=1}^{\iota} \sum_{j=1}^{\upsilon} \lambda_{\mu ij}^2 \right)$; (4-25)

where $\mathrm{Q}\left(m_\mu, \sigma_\mu^2 \right)$ denotes a probability density function of a linear combination of chi-square distributions, with mean m_μ and variance σ_μ^2; $\lambda_{\mu ij}$ are the eigenvalues of $2\boldsymbol{\Sigma}_\mu$. Likewise,

$$\text{as } \iota\cdot\upsilon\to\infty,\ \left(\mathbf{v}_{kt}-\mathbf{v}_{lt}\right)'\left(\mathbf{v}_{kt}-\mathbf{v}_{lt}\right)\xrightarrow{d}\mathrm{N}\left(\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon}\lambda_{vij},\,2\sum_{i=1}^{\iota}\sum_{j=1}^{\upsilon}\lambda_{vij}^{2}\right)\ . \qquad (4\text{-}26)$$

These additional features allow us to estimate the last line of equation (4-22) by conventional estimation methods of panel data analysis including GLS and maximum likelihood methods as long as the regularity conditions are satisfied.

4.3.3 Estimation Results

Based on the last line of equation (4-22), a reduced form equation in the following form will be estimated for the random effects model. As mentioned earlier, the reduced form parameters b^{hh} and b^{hg} are directly related to the system (i.e. the financial structure as a whole) rather than to its components (i.e. sectors and instruments):

$$d_{klt}=a+\sum_{h}b^{hh}\left(z_{kt}^{h}-z_{lt}^{h}\right)^{2}+\sum_{h}\sum_{g\neq h}b^{hg}\left(z_{kt}^{h}-z_{lt}^{h}\right)\left(z_{kt}^{g}-z_{lt}^{g}\right)+\rho\cdot\hat{e}_{klt-1}+u_{kl}+e_{klt}\,, \qquad (4\text{-}27)$$

where

$$a=m_{\mu}+m_{\nu}>0\ ; \qquad (4\text{-}28)$$

$$b^{hh}=\sum_{i}\sum_{j}\left(\beta_{ij}^{h}\right)^{2}\geq 0\ ; \qquad (4\text{-}29)$$

$$b^{hg}=2\sum_{i}\sum_{j}\beta_{ij}^{h}\beta_{ij}^{g}\quad ,\quad for\quad h\neq g\ ; \qquad (4\text{-}30)$$

$$u_{kl}=\sum_{i}\sum_{j}\left(\mu_{ijk}-\mu_{ijl}\right)^{2}-m_{\mu}\,,\ u_{kl}\sim\mathrm{Q}\left(0,\sigma_{\mu}^{2}\right);\ \text{as}\ \iota\upsilon\to\infty,\ u_{kl}\xrightarrow{d}\mathrm{N}\left(0,\sigma_{\mu}^{2}\right).$$

(4-31)

$$e_{klt} = \sum_i \sum_j \left(v_{ijkt} - v_{ijlt}\right)^2 - m_v, \;\; e_{klt} \sim \mathrm{Q}\left(0, \sigma_v^2\right); \text{ as } \; \imath\upsilon \to \infty, \;\; e_{klt} \xrightarrow{d} \mathrm{N}\left(0, \sigma_v^2\right).$$

(4-32)

At this stage, the AR(1) term $\hat{e}_{klt-1}$ with coefficient ρ is added to take the autocorrelation into consideration[5]. It should be noted that m_μ and m_v are indigenous to $\boldsymbol{\Sigma}_\mu$ and $\boldsymbol{\Sigma}_v$ respectively, so that the constant term a is free from suffixes. As mentioned earlier, the squared Euclidean distance approach may reduce the data size in many cases, but it depends on the construction of the panel data; the comparisons between the structural and reduced form estimations in this aspect are listed in Table 4-3.

Table 4-3: Comparison between structural and reduced form estimations

Number of ;	Structural form	Reduced form
Observations	$\imath \cdot \upsilon \cdot \kappa \cdot \tau$	$\frac{\kappa(\kappa-1)}{2} \cdot \tau$
Parameters to be estimated	$\imath \cdot \upsilon \cdot (\eta+1)$	$\frac{\eta(\eta+1)}{2}+1$
Random effects elements	$\imath \cdot \upsilon \cdot \tau$	$\frac{\kappa(\kappa-1)}{2}$
Remaining stochastic elements	$\imath \cdot \upsilon \cdot \kappa \cdot \tau$	$\frac{\kappa(\kappa-1)}{2} \cdot \tau$

[5] Consequently, the sample size is reduced to 1773.

In relation to the economic criteria, which are clearly stipulated in the Maastricht Treaty, we picked three indicators as explanatory variables: [1] the proportion of budget deficit to the nominal GDP; [2] the yield of 10 year government bonds or equivalent; and [3] rate of inflation in the consumer prices. Since the exchange rate between the euro countries were fixed in January 1999, we excluded this criterion from the explanatory variable. Instead two more Eurostat structural economic indicators were introduced as explanatory variables: [4] the growth rate of GDP at constant prices; and [5] per capita GDP at constant prices adjusted by PPP. In addition, two demographic factors were included according to the suggestions made by Poterba (2001, 2004), etc.[6]: [6] the total population of the country; and [7] the ratio of population aged 65 and over to the total population.

The maximum likelihood estimation[7] results for both random and fixed effects models are listed in Table 4-4 as well as in Table 4-5. The log-likelihood ratio test rejects the hypothesis that $\sigma_u = 0$. The test statistics indicate that the specification is reasonably acceptable; the coefficient ρ of the AR(1) element is statistically significant. Although some of the estimated parameters are contrary to the expected signs, those figures are not statistically significant in any cases. Table 4-5 indicates that all the explanatory variables are statistically significant in some

[6] For further survey on this subject, see Bosworth, Bryant and Burtless (2004).
[7] We opted for maximum likelihood method because some missing values made the data unbalanced panel.

combination or another.

Among the square of the seven explanatory variables, only two economic variables were statistically significant at 5% level: [2] the yield of 10 year government bonds, and [5] per capita GDP. In addition, a demographic factor, [6] the total population of the country, was also significant at that level. As for the cross terms of the quadratic formation, 8 out of 21 were statistically significant at 5% level. Although the squares of [1] the proportion of budget deficit to the GDP, [3] rate of inflation, [4] the growth rate of GDP, and [7] the ratio of population aged 65 or over to the total population were not statistically significant even at 10% level; several cross terms involving these four variables are significant at 5% level: [1] and [4], [1] and [5], [1] and [7], [3] and [6], [4] and [5], [4] and [6], [6] and [7]. While the square of the variable is not statistically significant, it is confirmed that [1] the proportion of budget deficit to the GDP and [4] per capita GDP are the dominant factors in the determination of the financial structures as long as cross terms are concerned. Also worthy of note is the finding that the product of the two demographic factors [6] and [7], the population aged 65 and over, is an indispensable factor. The sign is negative only in the combinations of [1] and [7], and [3] and [6]. All other parameters are positive, indicating that as the difference in the explanatory variable decreases, the Euclidean distance between the countries diminishes.

Table 4-4: Estimation results of equation (4-27)

Dependent variable: d_{klt}

	Coef.	Std. Err.	t ratio	p-value
a	3.6321	0.1906	19.05	0.000
b_{11}	-0.0026	0.0021	-1.25	0.213
b_{22}	0.0263	0.0124	2.12	0.034
b_{33}	-0.0031	0.0036	-0.86	0.389
b_{44}	0.0015	0.0039	0.38	0.707
b_{55}	0.0048	0.0016	3.08	0.002
b_{66}	0.0000	0.0000	2.71	0.007
b_{77}	0.0014	0.0062	0.23	0.817
b_{12}	-0.0016	0.0080	-0.20	0.843
b_{13}	0.0093	0.0048	1.96	0.051
b_{14}	0.0135	0.0048	2.82	0.005
b_{15}	0.0077	0.0029	2.63	0.009
b_{16}	0.0001	0.0002	0.52	0.600
b_{17}	-0.0126	0.0049	-2.55	0.011
b_{23}	-0.0063	0.0126	-0.50	0.616
b_{24}	-0.0025	0.0112	-0.23	0.821
b_{25}	0.0019	0.0059	0.32	0.749
b_{26}	0.0014	0.0005	2.90	0.004
b_{27}	0.0106	0.0102	1.04	0.299
b_{34}	0.0127	0.0065	1.94	0.052
b_{35}	-0.0048	0.0033	-1.45	0.147
b_{36}	-0.0008	0.0003	-2.84	0.004
b_{37}	-0.0044	0.0066	-0.66	0.509
b_{45}	-0.0093	0.0033	-2.79	0.005
b_{46}	0.0008	0.0002	3.31	0.001
b_{47}	0.0035	0.0060	0.59	0.554
b_{56}	-0.0002	0.0002	-0.64	0.522
b_{57}	-0.0009	0.0046	-0.20	0.841
b_{67}	0.0014	0.0005	2.97	0.003
ρ	0.5807	0.0217	26.81	0.000
Wald	$\chi^2(29)$=766.20			0.000
Log likelihood	-3029.68			
No. of Obs.	1773			
No. of groups	210			
test				
H_0: σ_u=0	$\bar{\chi}^2(1)$= 1711.04			0.000

Table 4-5: Statistically significant combinations of explanatory variables

Explanatory Variables		1	2	3	4	5	6	7
Proportion of budget deficit to nominal GDP	1	-						
Yield of 10 year government bonds or equivalent	2	-	**					
Rate of inflation in consumer prices	3	*	-	-				
Growth rate of GDP at constant prices	4	***	-	*	-			
Per capita GDP adjusted by PPP	5	***	-	-	***	***		
Total population	6	-	***	***	***	-	***	
Ratio of population aged 65 or over	7	**	-	-	-	-	***	-

Note: Asterisks denote significance level: *** 1%, ** 5%, * 10% respectively.

4.4 Concluding Remarks

In this study, we investigated whether there was convergence in the financial structure of the European countries, as reflected in the composition of the balance sheets, after the introduction of the euro. We further extended our investigation into the determinants of the financial structure, which was vital since while some factors could be controlled by economic policies relatively easily, other factors are clearly beyond control. Since research in this field is still nascent, we applied several experimental ideas. The technical aspects of this paper could be summarized as follows:

(a) It is confirmed that squared Euclidean distance could be a useful indicator of similarity or dissimilarity of economic structures. By categorizing the raw data into several groups, we can apply any widely known statistical methods to test

the differences, changes, etc.

(b) In the estimation process of the panel data of economic structures, squared Euclidean distance plays an important role. By employment of Euclidean distance, we can directly estimate the system-specific parameters, which will cause convergence in the economic structure, rather than component-specific parameters that relate to each element of the structure. In some cases, the introduction of the Euclidean distance also helps to cut the data size in the estimation procedure.

More practical implications extracted from this empirical study could be concluded in the following manner:

(c) Even before the introduction of the euro, the similarity of financial structures among the member countries was rather obvious. Additionally, the differences among them diminished even further after the launch of the new currency.

(d) Although there was a reduction in the dissimilarity between the euro and non-euro members of the European countries after the introduction of the currency, the gap within the non-member group exhibited no significant reduction.

(e) The demographic factors, along with economic variables including per capita GDP and long-term interest rates, play an eminent role in the convergence of

the economies' financial structure. Specifically, not only the total population, but also the magnitude of aged population was found to be an important determinant of the convergence.

The empirical evidence suggests that convergence is not easily attainable as far as financial structure is concerned. It is true that there was a convergence in the financial structures of the member states after the introduction of the euro, but there was a similarity among them even before the introduction of the new currency. We cannot deny the possibility that the convergence was easily achieved among them due to their longstanding similarities in economic as well as demographic backgrounds. If this is the case, convergence at the first stage of the single currency does not necessarily guarantee the success at the next stage when some countries with completely different economic as well as demographic background join the union. One significant fact is that the divergence in financial structures among the non-member states cannot be overlooked. If it is determined that these differences arise not only from economic factors, but also from demographic features, it will be difficult to overcome. The eligibility of a particular country should be carefully examined case by case.

4.A Appendix

The details of the manipulation of equation (4-22) is as follows:

$$(\mathbf{y}_{kt}-\mathbf{y}_{lt})'(\mathbf{y}_{kt}-\mathbf{y}_{lt})$$

$$=\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})\}'\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})\}$$

$$=\left[\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}'+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'\right]\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})\}$$

$$=\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}'\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}+\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}'(\mathbf{v}_{kt}-\mathbf{v}_{lt})$$

$$+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\mathbf{v}_{kt}+\mathbf{v}_{lt})$$

$$+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'\{(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}\}+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\mathbf{v}_{kt}-\mathbf{v}_{lt})$$

$$=\boldsymbol{\beta}'(\mathbf{X}_{kt}-\mathbf{X}_{lt})'(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\mathbf{v}_{kt}-\mathbf{v}_{lt})$$

$$+\boldsymbol{\beta}'(\mathbf{X}_{kt}-\mathbf{X}_{lt})'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}$$

$$+\boldsymbol{\beta}'(\mathbf{X}_{kt}-\mathbf{X}_{lt})'(\mathbf{v}_{kt}-\mathbf{v}_{lt})+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}$$

$$+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\mathbf{v}_{kt}-\mathbf{v}_{lt})+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)$$

$$=\boldsymbol{\beta}'(\mathbf{X}_{kt}-\mathbf{X}_{lt})'(\mathbf{X}_{kt}-\mathbf{X}_{lt})\boldsymbol{\beta}+(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)+(\mathbf{v}_{kt}-\mathbf{v}_{lt})'(\mathbf{v}_{kt}-\mathbf{v}_{lt}).$$

It should be noted that the stochastic assumptions mentioned in section 4.3.1 brought us several conditions to the equations above:

since z_{kt}^h are independent of the μ_{ijk}, $2\boldsymbol{\beta}'(\mathbf{X}_{kt}-\mathbf{X}_{lt})'(\boldsymbol{\mu}_k-\boldsymbol{\mu}_l)=0$;

since z_{kt}^{h} are independent of the ν_{ijkt}, $2\boldsymbol{\beta}'\left(\mathbf{X}_{kt}-\mathbf{X}_{lt}\right)\left(\mathbf{v}_{kt}-\mathbf{v}_{lt}\right)=0$;

since $\mathrm{E}\left[\mu_{ijk}\nu_{ijkt}\right]=0$, $\left(\boldsymbol{\mu}_{k}-\boldsymbol{\mu}_{l}\right)'\left(\mathbf{v}_{kt}-\mathbf{v}_{lt}\right)+\left(\mathbf{v}_{kt}-\mathbf{v}_{lt}\right)'\left(\boldsymbol{\mu}_{k}-\boldsymbol{\mu}_{l}\right)=0$.

Chapter 5

THE CONSEQUENCES OF THE INTRODUCTION OF THE EURO: A NESTED MIXED-EFFECTS ANALYSIS OF THE INTERNATIONAL BANKING TRANSACTIONS

This chapter is based on "The Consequences of the Introduction of the Euro: A Nested Mixed-Effects Analysis of the International Banking Positions," which is published in the *Empirical Economics*, 37(3), 583-597. Page 118 through page 138 of the original thesis are omitted because of copyright issue. Following is the summary of the chapter.

Summary of Chapter 5

It was a long way from the creation of the European Monetary System in March 1979 to the cash changeover on 1 January 2002. The introduction of euro banknotes and coins was a symbolic event indeed. On the first day of its launch, from Bastille to Défence, Paris was filled with fellow Europeans, euro cash in their hands, replacing the Americans and the Japanese who once roamed Champs Élysées and Faubourg St. Honoré. The introduction of the new currency did not impoverish their non-euro neighbours either. In London, the shops on Oxford and

Regent Streets are crowded with more foreign visitors than before. “Then, what is happening behind the scene?” is the question to be answered in this study. The purpose of this paper is to examine the outcome of the introduction of euro from the perspective of the flow of funds between the leading countries of the world.

The data used in this study were prepared from the International Banking Statistics (IBS) published by the Bank for International Settlements (BIS). This statistics primarily cover the international banking transactions between industrial countries and developing countries. However, after the second quarter of 1999 (1999Q2), the data include the bilateral transactions among developed countries as well. In this paper, we excluded the lending vis-à-vis developing countries because they are beyond the scope of this study. This means that our quarterly data is in shape of square matrices. We picked only the countries that reported regularly to the BIS between 1999Q2 and 2004Q2; these numbered 14 in total. They are: 8 euro countries (Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, Spain); 3 non-euro EU countries (Denmark, Sweden, U.K.); and 3 non-EU countries (Canada, U.S.A., Japan). Since data for 1999Q3 are missing, there are 20 observation periods.

To draw out only the direct effects of the launch of euro, we opted to combine the gravity and the mixed effects models. Since we cannot underestimate the effects of low interest rates in the U.S. and Japan during the latter half of the observation

period, we added the term of forward exchange rate premium, as a proxy for the relative interest rates, to the usual gravity model. This variable could also be interpreted as a predictor of the future spot exchange rate. As for the panel analysis, we introduced the term of random effects to account for the country-specific factors in addition to the economic-zone-specific fixed effects terms.

Chapter 6

INTEREST RATE DISPARITY AND HOME BIAS IN THE INTERNATIONAL CAPITAL MARKET

An earlier and extended version of the paper was presented at the 18th Conference of the Pan Pacific Association of Input-Output Studies, Chukyo University, November 10-11, 2007. The paper is submitted to a journal and currently under review. Page 139 through page 187 of the original thesis are omitted because of copyright issue. Following is the summary of the chapter.

Summary of Chapter 6

When a brand new currency was born in 1999, not a few people predicted it would be the beginning of the fall of one dominant currency system. Although the euro successfully brought prosperity to Europe, it failed to reverse the capital flow over the Atlantic. As for the international banking, the U.S. asset invested in the euro area grew 66% between 1999 and 2005, while the euro-area asset invested in the U.S. increased as much as 137% during the same period. However, it is also noteworthy that the capital invested across the Atlantic was less than 5% of the available assets in both areas. In that sense, the so-called home bias is still intact.

Another observation is that the long-term interest rate declined in both areas. The yield of 10 year bond fell from 5.6% in 1999 to 4.3% in 2005 in the U.S. while the equivalent rate went down from 4.7% to 3.4% in the euro area[1]. Although there was a convergence in the interest rate among the euro member states, the interest rate spread between the two currencies is still obvious. The present paper is an attempt to construct a simple model to explain all of the above observations. We opted for the Cournot-Nash equilibrium model with consideration to the fact that only a handful of participants dominate the international capital market. Indeed, as of 2006, only three participants have global market share of 10% or more in the foreign exchange market: Deutsche Bank, UBS and Citigroup. Furthermore, the top 10 institutions have cumulative market share of more than 80%.

Any introductory textbook of finance illustrate in detail that the investors benefit from diversification of their assets in the context of mean-variance model developed by Markowitz (1952) and his followers. Grubel (1968) as well as Levy and Sarnat (1970) were some of the earliest literatures demonstrating that this rule also applies to the international diversification of capital. Solnik (1974), Lessard (1976), Grauer and Hakansson (1987), Kaplanis and Schaefer (1991) and many others followed suit. Nonetheless, the majority of countries of the world hold most of their wealth in domestic assets: it is called home bias. It was Adler and Dumas

[1] Data source: *Eurostat*.

(1983) who addressed this enigma for the first time by pointing out that the investors are trying to hedge purchasing power parity deviations. In an empirical study, however, Cooper and Kaplanis (1994) concluded that the structure of international portfolios cannot be explained by the Adler-Dumas model with conventional risk aversion, even if observable costs to cross-border investment are included. They alternatively suggested that any explanations for the home bias should include informational asymmetries. French and Poterba (1991) also showed that substantial differences in expected returns across countries for investors in a given nation are needed to rationalize observed home bias in the portfolio. By employment of simple portfolio model, they found that British investors must expect annual returns in the U.K. market more than 500 basis points above those in the U.S. market to explain their 82 percent investment in domestic shares. Broer and Jansen (1998), with their multi-asset dynamic portfolio balance model, concluded that capital controls can explain part of the international diversification of the German portfolio, but cannot account for the domestic bias still present in the portfolio. They argued that the extremely high variances govern portfolio selection provides strong evidence against the portfolio model. Meanwhile, Aizenman (1999) compared the diversification patterns of agents who maximizes a generalized expected utility with the diversification patterns of agents who follows the Capital Asset Pricing Model (CAPM). He found that even a small amount of undiversifiable exchange rate risk

led to low or zero international diversification among countries when agents maximized generalized expected utility, whereas CAPM implied considerable diversification.

The model of portfolio balance originated by Markowitz (1952) explains the optimal asset allocation taking the rate of return given exogenously, as are the most of his successors mentioned before. It was Stultz (1983) who pioneered an intertemporal general equilibrium model that included interest rate as an endogenous variable. In this model, the solution of the interest rate falls within certain maximum and minimum interval. This model might explain at least partially the interest rate disparity among countries. By application of this model, Sellin and Werner (1993) showed that there is a difference between the cases when there was some sort of capital controls and when capital was allowed to flow freely across national borders. Herrera and Valdés (2001), using a dynamic optimization model with uncertainty and transaction costs, tried to find an optimal rule that gave the limits for interest rate differentials that trigger capital inflows and outflows. These literatures considered the interest rate discrepancies between countries as results of variety of capital controls. On the other hand, Calvo and Mendoza (2000), working from the models of informational efficiency developed by Grossman and Stiglitz (1976, 1980), revealed that the internal solution for the expected return has some interval as globalization proceeds, because the gain of gathering information at a

fixed cost may diminish as markets grow.

It is our intention to construct a single model that accommodates both of the above problems: the home bias in the international capital allocation and the interest rate disparity between countries. In the field of international capital movements, Cournot-Nash equilibrium models are not uncommon. One of the pioneers in this domain is Manning (1974). However, Cournot-Nash equilibrium models developed more rapidly in the neighboring field of international trade. A good example is the strategic trade policy models initiated simultaneously by Dixit (1984) and by Brander and Spencer (1985). Among them, the model with expected utility function proposed by Anam and Chiang (2000, 2003) resembles the theory of portfolio choice, thus it can be easily converted into a model of international asset diversification. Since Cournot-Nash equilibrium does not presuppose equalization of prices, this type of model is a prospective candidate to explain the existence of interest rate disparity. On top of that, Anam and Chiang (2000, 2003) incorporated stochastic elements along with risk aversion factors into the model, as Aizenman (1999) did, so that it accommodates the home bias as well. The fundamental difference between this kind of model and the traditional portfolio model is that the former specifies market reaction in some functional form while the latter takes it as purely stochastic phenomenon. As mentioned earlier, the international capital market is highly oligopolistic, so that it must be plausible to consider that the

players choose their strategy, taking other players' behavior and the consequent market reactions into account as Manning (1974) suggested. Although it is beyond the scope of the present study, the employment of foreign-exchange reserves of major economic powers could give decisive effects on the performance of the market as well.

In the next section we will construct a multi-player Cournot-Nash non-cooperative game model of international capital allocation based on the above literatures. This kind of multi-player model is not just suitable to describe an oligopolistic market but it also applies to atomistic market with perfect competition as a special case when the number of participants is infinite; the case will be discussed at the end of Section 6.2 as well as in 6.3.1. We will delve into the problems of interest rate disparity and the home bias in Section 6.3. Some additional features of the model in relevance to the parameters will be discussed in Section 6.4. Furthermore because of its simplicity, it is not too difficult to construct a multi-country model as an extension of the above approach. By application of such model to the observed from-whom-to-whom matrix of the international capital allocation, we will be able to test the model in a more vigorous manner. Multi-country model and the assessment of it are shown in Section 6.5 through Section 6.8. We will conclude this paper with some policy implications in Section 6.9.

Chapter 7

FUNDS-FLOW BASED NATIONAL ACCOUNTING: A STRUCTURAL DECOMPOSITION OF THE U.S. CREDIT EASING POLICY

Two earlier versions of the paper were presented at the following conferences: International Association for Research in Income and Wealth, 32nd General Conference, Boston, MA, August 5-11, 2012; 21st International Input-Output Conference, July 9-12, 2013, Kitakyushu, Japan. The paper is submitted to a journal and currently under review. Page 188 through page 231 of the original thesis are omitted because of copyright issue. Following is the summary of the chapter.

Summary of Chapter 7

In April 2009, in the midst of the financial crisis and global recession triggered by the collapse of the U.S. housing bubble, the Group of Twenty (G-20) finance ministers and central bank governors called for exploration of information gaps and provision of appropriate proposals for strengthening data collection. As has been true of previous international financial crises, these gaps are highlighted when a lack of timely, accurate information hinders the ability of policy makers and

market participants to develop effective responses. The subprime mortgage crisis has reaffirmed an old lesson — good data and good analysis are the lifeblood of effective surveillance and policy responses at both the national and international levels. In response to the G-20 initiative, Financial Stability Board and International Monetary Fund (2009) recommended to develop a strategy to promote the compilation and dissemination of the balance sheet approach, flow of funds, and sectoral data more generally.

It is well known that it was Copeland (1947) who systematically drew the ground design of the money flows accounts, or flow of funds accounts as we now call it. In order not to repeat the bitter experience of the Great Depression that was preceded by the collapse of the financial bubble of the 1920s, which is commonly known as the Roaring Twenties, Copeland (1949) urged a better understanding of the circulation of funds in the macro economy. Copeland's significant but less recognized role is his contribution to the development of national accounting (Dawson (1991), p.93). Kuznets' (1937) national income accounts is based on the macroeconomic identity between production, distribution and consumption of goods and services. Copland's system of money flows accounts is based on the payer-payee relationship between institutional units, and rests on legal foundations — on the law of property, of contract and negotiable instruments (Copeland (1952), p.212). Kuznets' system was referred to as commodity-flow method, and

Copeland's system as money-flow method of national accounting; more recently, the national accounting based on the input-output accounts is known as product-flow method, and the system based on the national balance sheets is referred to as funds-flow method respectively. Unfortunately, Copeland and his contemporary authors such as Van Cleeff (1941), Stone (1945) and Derksen (1946) did not explicitly define the fundamental concepts of funds-flow method of national accounting because they just borrowed the idea from the business accounting of the time. Moreover, the present-day Flow of Funds Accounts (also known as Financial Accounts), as a result of the drastic remodeling by the Fed in the 1950s, covers only the lender-borrower (or creditor-debtor) relationship rather than the more general payer-payee relationship.

The objective of this paper is twofold: (i) to design a funds-flow based national accounting system, an equivalent of cash-flow statement in business accounting, and (ii) to make from-whom-to-whom funds-flow matrix for the U.S. to find out if there were structural changes in the first decade of the century, specifically before and after the subprime mortgage crisis. The next two sections discuss the fundamental concepts of funds and the national accounting system that is based on it. In the latter half of the paper, we will show the procedure to convert the T-shaped balance statements into funds-flow matrices and the framework of the structural decomposition. We will use the funds-flow matrix, which is tentatively

derived from the Integrated Macroeconomic Accounts for the United States supplemented by Annual Input-Output Accounts and Economic Census, to examine the structure of the economy between the years of 1998 and 2011. We found that there was a conspicuous structural change in the U.S. economy during the years between 2008 and 2010 when the subprime mortgage crisis hit the economy; and the dominant factor was the shift in monetary policy. Our conclusion is that the economy is highly susceptible to both Federal Reserve's supply of funds and its portfolio. The Dietzenbacher-Los type decomposition procedure described at the end of the paper will help the policy makers to know, in advance, the consequences of particular actions such as open market operations.

Chapter 8

EPILOGUE

As Copeland (1947, 1952) demonstrated with his money flows accounts more than 60 years ago, the balance sheets of economic entities are closely interrelated through the lender-borrower relationship. Since then the flow of funds accounts have been constructed on the basic principle that the total source and the total use of funds are equal. Although many researchers have developed financial models using flow of funds accounts, there have been few studies which take full advantage of the enormous information included in it and the indispensable proposition implied in the basic principle. By using these advantages, the current study sheds light on the contemporary policy problems faced by many developed countries. In this chapter, further remaining problems will be discussed alongside with the key policy implications drawn from the empirical analysis.

Chapter 2 simulates the negative consequences of the home mortgage delinquencies in the perspective of the interrelations between the balance sheets of various economic sectors based on an assumption that the market value of an asset

reflects the book value of the investment. With the present scheme, we can simulate the hypothetical negative consequences from home mortgage delinquencies by employment of flow of funds accounts even if the balance sheets of individual entities are unavailable. We can also estimate the international consequences by use of international flow-of-funds accounts such as Coordinated Portfolio Investment Survey compiled by IMF. It helps to comprehend the propagation process of the subprime mortgage crisis and to derive some useful policy implications. We show that the pass through sequence converges when the original delinquency is made up by loss of net worth in any of the economic entities. Although some of the sectors escape the loss by passing it onto others, the home mortgage delinquency is eventually compensated by the ‘household and nonprofit organizations’, and ‘the rest of the world’.

Stone (1966) and Klein (1983) proposed converting balance-sheets of the flow of funds accounts into a square matrix, called the asset-liability matrix (ALM), by means of the supply-and-use method that is widely employed in the compilation of the SNA. The merit of the square matrix is that we can apply the affluent assets of input-output analysis, notably the concept of Leontief inverse to the flow of funds data. The asset-liability matrix makes it possible to examine the effects of a certain policy on each separate institutional sector from the perspective of the inter-sectoral

financial transactions. Chapter 3 presents the compilation procedure of the asset-liability matrix from the flow of funds accounts in the balance sheet format that is widely available in the IMF member countries. We demonstrate an application of the asset-liability matrix to the examination of the quantitative monetary policy (QEP) introduced by the Bank of Japan (BOJ) in March 2001. There is an asymmetry in the propagation of the supply and the demand of the funds in the financial system. The demand for funds should be eventually financed by the gross induced savings (GIS), while the supply of funds brings gross induced investments (GII) in due course. The difference between the GII and the GIS gives net induced investments (NII). We have calculated the GIS, GII and NII for December 1997 through December 2004 quarterly and decomposed the cause of increasing or decreasing of these indices into two elements. They are 1) the portion attributed to BOJ's monetary policy, and 2) the segment attributable to the structural changes in the financial market. The analysis suggests that the effect of the former is obviously greater than that of the latter. This reconfirms the usefulness of the asset-liability matrices derived from the flow of funds accounts in the assessment of the effects of the money market operations.

Chapter 4 examines whether there has been a convergence in the financial structures of the European countries since the introduction of the euro. Although

financial structure could be interpreted in a variety of ways, we confine it to the balance sheet structure of the main economic sectors, commonly referred to as financial accounts. Firstly the squared Euclidean distances of the financial structure between 21 OECD countries are presented. Those indicators are used to determine if there has been a noticeable reduction in it among the European countries. Then we estimated a model based on squared Euclidean distance to determine the dominant factors that cause convergence in the economic structure represented in the matrices. Since our data is in the form of cross-sectional time-series, we can apply the well-known techniques of the panel data analysis, specifically the random effects and fixed-effects approaches. The empirical evidence suggests that convergence is not easily attainable as far as financial structure is concerned. It is true that there was a convergence in the financial structures of the member states after the introduction of the euro, but there was a similarity among them even before the introduction of the new currency. It cannot be denied the possibility that the convergence was easily achieved among them due to their longstanding similarities in economic as well as demographic backgrounds.

Chapter 5 examines the outcome of the introduction of euro from the perspective of the flow of funds between the leading countries of the world. An augmented gravity model is applied to the banking transactions between creditor

and debtor countries. The original Consolidated Banking Statistics (CBS) data consist of transactions between 14 x 14 countries for 20 quarters between 1999 and 2004. To focus on the effects of the launch of the new currency, we developed a nested panel mixed effects model, which apply the fixed effects approach to the upper-level group (i.e. economic-zones and eras) and the random effects approach to the lower-level group (i.e. countries and quarters). Then specification is examined by the likelihood ratio tests by decomposing the model into fixed and random effects elements. The empirical study suggests that the new currency seems to promote intra-economic-zone banking transactions to some extent. However, it is doubtful that the introduction of the euro will accelerate the globalization process. In fact, it might encourage the development of new regional currencies within other economic blocks.

The first half of Chapter 6 develops a two-country model that accommodates two notable puzzles in international macroeconomics: the home bias in the international capital allocation and the interest rate disparity between countries. A Cournot-Nash non-cooperative game model based on Dixit (1984), Brander and Spencer (1985) and Anam and Chiang (2000, 2003) is applied to the international capital allocation reflected in the international asset-liability matrix. Since Cournot-Nash equilibrium does not presuppose equalization of prices, this type of model is

suitable to explain the interest rate disparity peculiar to international capital market. Furthermore, this model incorporated with stochastic elements, which reflects the uncertainties associated with currency conversions, has no difficulty describing the home bias, another essential feature of international capital allocation, using parameters obtained independent of the object function. Some practical implications of this study are; (1) it seems certain that the saving glut in Europe as well as in other continents is the dominant factor behind the global downward trend in the interest rates; (2) volatile swing in the interest rate most probably leads to capital flight and to consequent currency crises. A tight control of interest rate might be a good idea to avoid massive capital outflow from a country. The latter half of chapter 6 constructs a multi-country model as an extension of the model proposed in the first half of the chapter. To assess the performance of the model, we prepared international portfolio data of monetary financial institutions (MFI) obtained from Coordinated Banking Statistics compiled by BIS. The international asset allocation among five major industrial economies, namely Canada, Euro Area, Japan, the United Kingdom and the United States, is examined. Estimation results suggest that an increment in MFIs' assets of any country will give positive effects on both own and foreign country in terms of capital absorption, and their asset effects are larger than the effects of increase in public debt on capital allocation.

Chapter 2 through 6 focused only on the financial aspect of the economy, but it is apparent that the balance sheet economics alone is not enough to depict the whole situation. Thus Chapter 7 revisits the original money-flows accounts proposed by Copeland to see if we can make an alternative national accounting system. There are not so many researches to use all three major accounting statements: national income and product accounts (NIPA), input–output accounts (IO), and flow-of-funds accounts (FF) because there are several conceptual differences among them; while the former two are based on product-flow method of national accounting, the latter is based on funds-flow method. The last chapter proposes a national accounting system and accompanying analytical framework that integrate the above three accounts under the concept of funds-flow. The empirical study suggests that there was a conspicuous structural change between 2008 and 2010 in the U.S. when the subprime mortgage crisis hit the economy; and the dominant factor was the shift in Federal Reserve portfolio. Our conclusion is that the economy is more susceptible to monetary policies than we have ever suspected. Indeed over the last quarter century, monetary policy was the dominant factor in both stabilizing and unstabilizing the economy. It is necessary for policy makers and market participants alike to observe and understand the circulation of funds in the macro economy in order to cope with upcoming financial problems. The author sincerely hope that the funds-flow based national accounting and from-

whom-to-whom funds flow matrix proposed in the final chapter could be any assistance in developing more effective policies.

As we have seen in the above chapters, flow of funds analysis answers many questions that are otherwise inexplicable. However, the author must admit that there are not a few areas that need more explorations.

(i) Although an international capital allocation model for the international flow of funds accounts is presented in Chapters 6 and 7, a model that determines the asset and liability portfolio of the domestic sectors is an urgent necessity to fully benefit from the flow of funds analysis, especially in the field that needs future forecast. Existing models fail to fully accommodate either the accounting identities or the multiple-sector data sets.

(ii) It is also an urgent necessity to develop the theory to explain how commodity and asset prices are determined under the frame work of the funds-flow based national accounting. This will make it possible to fully understand the destabilizing and stabilizing process of the economy. In this direction, we should reexamine the accounting practices in detail.

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