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Inter-industry analysis in the Korean flow-of-funds accounts

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Abstract

This study mainly aims to provide an inter-industry analysis through the subdivision of various industries in flow-of-funds (FOF) accounts. Combined with the *Financial Statement Analysis* data from 2004 and 2005, the Korean FOF accounts are reconstructed to form "from-whom-to-whom" basis FOF tables, which are composed of 115 institutional sectors and correspond to tables and techniques of input–output (I–O) analysis. First, power of dispersion indices are obtained by applying the I–O analysis method. Most service and IT industries, construction, and light industries in manufacturing are included in the first-quadrant group, whereas heavy and chemical industries are placed in the fourth quadrant since their power indices in the asset-oriented system are comparatively smaller than those of other institutional sectors. Second, investments and savings, which are induced by the central bank, are calculated for monetary policy evaluations. Industries are bifurcated into two groups to compare their features. The first group refers to industries whose power of dispersion in the asset-oriented system is greater than 1, mainly light industries, IT, and service. On the other hand, the second group indicates that their index is less than 1, mostly heavy and chemical industries. We found that the net induced investments (NII)–total liabilities ratios of the first group show levels half those of the second group since the former's induced savings are obviously greater than the latter.

Keywords: Inter-industry analysis, Flow-of-funds, Monetary policy evaluation

JEL Classification: C67, E01, E58, G30

1 Background

Flow-of-funds (FOF) accounts indicate the interrelations between the various institutional sectors of each nation, including overseas sectors, in a systematic and coherent manner. The FOF system adopts a quadruple-entry system proposed by Copeland (1952), wherein each transaction is recorded with a double entry. On the other hand, the input–output (I–O) table, which indicates production in the real economy, is composed of various industries. Transactions of production always involve funds transactions. Klein (2003) indicated a need for the "from-whom-to-whom" basis FOF table's construction, which corresponds to tables and techniques of I–O analysis. However, it is difficult to link the I–O table and FOF accounts. The economic agents in the I–O table are separated into hundreds of industries. Though the FOF accounts comprise all

economic agents in one country, data on only two types of institutional sectors, namely nonfinancial public corporations and nonfinancial private corporations, are announced in the FOF accounts. In other words, most economic agents in the I–O table are aggregated in the FOF accounts.

Numerous studies have explored inter-industry or firm financing, for example, studies by Corbett and Jenkinson (1996), Braun and Larrain (2005), and Marozzi and Cozzucoli (2016). Some previous researches have disaggregated the nonfinancial corporation sector of the FOF accounts into several institutional sectors. Nishiyama (1991) used the balance sheets and income statements of each industry to subdivide nonfinancial corporations in FOF accounts into 37 industries. In this paper, the power indices of 44 institutional sectors are reported. According to this study, using balance sheets and income statement data for each industry, it is possible to generate expanded FOF accounts that indicate the financial transactions of each industry. Kim (2014) examined the division of the nonfinancial private corporation sector into the *chaebol* sector, which indicates groups of large-scale and family-run management enterprises, and the private corporation (small- and middle-scale) sector.

Not only inter-industry analysis of FOF accounts has been intensified but also international money flow analysis has deepened, which corresponds with the international I–O table. Zhang (2005, 2009) built global FOF and estimated multiple-equation models. Tsujimura and Tsujimura (2008) constructed a financial transaction table between multiple countries. Kim and Song (2012) built a flow-of-FX-funds table for Korea based on the balance of payments (BOP), external debt, assets, and international investment position (IIP) tables.

There are some preliminary studies that link analysis methods between I–O tables and financial information. Ogawa et al. (2012) attempted to link the unique I–O table of Japan, which is augmented by firm size dimension, with balance sheet conditions. This paper uses *Financial Statistics of Corporations* data, which are published by the Ministry of Finance. Manabe (2014) estimated a production function with net induced investments (NII), which are computed from the US FOF accounts. This paper adopted an evaluation method using an asset–liability–matrix (ALM), which is derived by Tsujimura and Mizoshita (2003), though many literatures have evaluated monetary and financial policies (De Haan and Sterken 2006). Tsujimura and Mizoshita (2002a, b) devised the FOF analysis methods by applying I–O analysis methods. Originally, Stone (1966) and Klein (1983) proposed the concept of the Leontief inverse, which is applied to the ALM. Furthermore, Tsujimura and Mizoshita (2003), Tsujimura and Tsujimura (2006) estimated the induced amount of the supply and demand of funds to analyze the effect of central bank monetary policies, through financial transactions between institutional sectors represented in the Leontief inverse. Adopting this analysis method, Manabe (2009) also tried policy evaluations of public financial institutions using the FOF accounts of Japan.

However, the subdivision of industries was not examined by Manabe (2009). Therefore, only one production function is estimated in this paper, though the I–O table has around 400 industries (for example, in the cases of Korea and Japan). Kim et al. (2017) used a system of multi-sector, multifactor production functions to derive technological structure transitions associated with cost changes induced by an innovation. Applying

this model, production functions of each industry can be estimated using the linked I–O tables. Therefore, it is possible to link the FOF accounts and I–O table by obtaining the expanded FOF accounts, which are subdivided into various industries. Furthermore, productivity changes in every industry caused by monetary or financial policies can be estimated. First, each industry's NII, which is implemented by the policy authority, are calculated in the expanded FOF accounts. Second, each industry's productivity changes caused by the monetary or financial policies can be estimated using their NII. In other words, it is possible to combine the expanded FOF accounts and I–O table.

This study mainly aims to conduct an inter-industry analysis through the subdivision of the various industries in the FOF accounts. Using the expanded FOF tables, we examine the central bank's monetary policy evaluations. Previous studies have indicated that by obtaining the NII of each industry, which are caused by any kind of monetary or financial policy, it is possible to link the I–O table and NII from the FOF accounts. In this study, we will adopt the I–O analysis method, which is applied to the FOF accounts devised by Tsujimura and Mizoshita (2002a, b). Applying the I–O analysis method to the ALM derived from the FOF accounts, Y and Y^* matrices (ALM of institutional sector-by-institutional sector) are obtained. Using the Leontief inverse matrix, four kinds of indices (power of dispersion index in the liability-oriented system, power of dispersion index in the asset-oriented system, sensitivity of dispersion index in the liability-oriented system, and sensitivity of dispersion index in the asset-oriented system) are estimated. Furthermore, by employing ALM, it is possible to evaluate the effectiveness of a monetary policy by applying the Leontief inverse. In summary, if the expanded FOF accounts, which are separated into various inter-industries, are obtained, (1) a financial transaction table of each inter-industry by inter-industry, which are deeply related to the I–O table, is created; (2) the power index and sensitivity index of each industry are computed; and (3) an analysis method connected to the I–O table and the FOF accounts can be applicable. To subdivide the nonfinancial corporation sector of the FOF accounts into different types of industries, we adopt the *Financial Statement Analysis* (FSA) data compiled by the Bank of Korea (BOK). Since the FSA data announce annual balance sheets and income statements for each industry, it is possible to create expanded FOF accounts whose institutional sectors are divided into about 100 types of industry. This study aims to (1) analyze various inter-industries from the viewpoint of the FOF accounts, (2) examine policy evaluation methods and suggest monetary market operations, and (3) derive a new analysis tool to link the I–O table and FOF accounts for future works.

This paper contains five sections: The second section describes the data adopted for this analysis and explains the methodologies. The subdivision of industries and analysis results are reported in the third section. In this part, data for 2004 and 2005 are adopted. For future works, we will try to link the 2005 I–O table and the expanded FOF accounts. The reason for the data selection is that the 2005 I–O table is linked to the 2000 I–O table, and the linked I–O tables for 2000–2005 and 2005–2010 will be announced by the BOK in the near future. We need to choose the linked I–O tables to estimate production functions as a next step. Evaluations of BOK's monetary policies are presented in the fourth section. The conclusions of this paper are presented in the last section.

2 Data and methodology

2.1 Data

To achieve the first purpose of this analysis, the FOF accounts are used. The BOK (2001, 2005, 2006) publishes Korean FOF accounts both quarterly and yearly; these accounts contain (1) financial transactions (flows) and (2) financial assets and liabilities (stocks). Table 1 shows the number of institutional sectors and financial instruments in the Korean FOF accounts in the 1968, 1993, and 2008 Systems of National Accounts (SNA). The FOF account data in the 1993 SNA, which contain 22 institutional sectors and 35 financial instruments, are retroacted to 2002. Furthermore, the 2008 SNA data, which contains 23 institutional sectors and 46 financial instruments, have existed since 2008. We used the FOF accounts of the 1993 SNA to subdivide nonfinancial corporations into each industry since the 1968 SNA data have only nine institutional sectors.

To subdivide the various industries, the FSA data, which are compiled annually by the BOK, are available. Balance sheets and income statements of enterprises are represented by industries in these data. However, the construction of the expanded funds transaction table subdivided into a hundred industries for each year of the FOF data is not a simple task. We adopted data from 2004 and 2005 to expand institutional sectors in the FOF accounts into various industries since it is useful to conduct the analysis with linked I–O tables for future challenges. As a framework for expanding the FOF accounts, seven financial instruments were chosen. Table 2 presents the financial instruments for the correspondence between the FOF accounts and the FSA data. In the FSA data, securities assets have adopted market values since the end of 1997, whereas capital stock in stockholders' equity takes face value. Since the FOF accounts in the 1993 SNA adopted market values for both assets and liabilities accounts, capital stocks from the FSA data need to be adjusted to reflect market value. Using listed capital stock and total market capitalization by industry group, which are announced by the Korea Exchange (2005), the capital stock of each industry is adjusted. Institutional sectors for the FOF accounts and industries in the FSA data are represented in Tables 3 and 4. There are 22 institutional sectors in the FOF accounts and 94 industries in the FSA data. We use the term "residual industry" to refer to the results obtained by subtracting all industries in the FSA data from the nonfinancial corporations in the FOF accounts. Since the total amount of financial assets or liabilities in the FSA data is not exactly equal to the total nonfinancial corporations in the FOF accounts, the variable residual industry is inserted in the expanded FOF accounts as a new sector. Therefore, residual industry includes items not included in the FSA data but included in the FOF accounts.

Table 1 Flow-of-funds accounts in Korea

	1968 SNA	1993 SNA	2008 SNA
Institutional sectors	9 sectors[a]	18 sectors[b]	23 sectors
Financial instruments	34 items	35 items	46 items
Period	1975Q1–2005Q4 (quarterly/annual)	2002Q4–2013Q4 (quarterly/annual)	2008Q4–present (quarterly/annual)

[a] Five sectors on the BOK Web site, Economic Statistics System

[b] Available to extend to 22 sectors

Table 2 Correspondence between FOF accounts and FSA data

Financial instruments selected for this study	The FOF accounts in 1993 SNA	The FSA data
Currency and deposits	Currency and deposits	Assets Cash and deposits
Insurance and pension reserves	Insurance and pension reserves	n/a
Securities	Securities other than shares, shares and other equities, financial derivatives	Assets Short-term securities, long-term securities and investments Liabilities Current maturities of bonds payable, bonds payable, capital stock (adjusted by market capitalization)
Loans	Loans, government loans	Liabilities Short-term borrowings from banking institutions, current maturities of long-term borrowings, other short-term borrowings, long-term borrowings from banking institutions, other long-term borrowings
Trade credits	Trade credits	Assets Trade receivables Liabilities Trade payables
Foreign exchange holdings	Foreign exchange holdings	n/a
Call loans and money	Call loans and money	n/a
Other claims and debts	Foreign direct investment, other foreign claims and debts, miscellaneous	Assets Nontrade accounts and notes receivable, other quick assets Liabilities Nontrade accounts and notes payable, liability provisions, other liabilities

2.2 Basic methodologies for the asset–liability–matrix model

2.2.1 Construction of the Y and Y tables (financial transaction matrices)*

In this analysis, we adopt the I–O analysis method devised by Tsujimura and Mizoshita (2002a, b)[1] for the FOF accounts. First of all, the two tables should be constructed for this procedure. The E table is a matrix that represents the fund-employment portfolio of each institutional sector, whereas the R table shows fund-raising in each institutional sector. By applying a method widely used in I–O analysis, it is possible to make two types of square matrices, Y and Y^*, using the E and R tables. The Y table is based on a fund-employment portfolio, whereas the Y^* table is founded on a fund-raising portfolio. The coefficient matrices, B and B^*, are constructed from R and E tables by dividing the column sums T vector, which consists of the sum of either assets or liabilities, whichever is greater.

$$b_{ij} = r_{ij}/t_j$$

$$b^*_{ij} = e_{ij}/t_j$$

[1] For details, refer to Tsujimura and Mizoshita (2002a) in English and Tsujimura and Mizoshita (2002b), pp. 32–43 and pp. 116–129 in Japanese.

Table 3 Institutional sectors in the FOF accounts

1	Central bank
2	Domestically licensed banks
3	Specialized banks
4	Other banks
5	Collectively managed trusts
6	Small loan financial companies for households and small businesses
7	Investment institutions
8	Other nonbanks
9	Life insurance companies
10	Nonlife insurance companies
11	Cooperative society
12	Pension funds
13	Securities institutions
14	Credit-specialized financial institutions
15	Public financial institutions
16	Other financial intermediaries
17	Financial auxiliaries
18	General government
19	Nonfinancial public corporations
20	Nonfinancial private corporations
21	Households and nonprofit organizations
22	Rest of the world

Likewise, the coefficient matrices D and D^*, which are obtained from $E\prime$ and $R\prime$ by dividing T^E and T^R, indicate the sums of the financial instruments. t_j^E represents the sum of assets, whereas t_j^R indicates the sum of liabilities for financial instrument j.

$$d_{ij} = e'_{ij}/t_j^E$$

$$d_{ij}^* = r'_{ij}/t_j^R$$

The $m \times m$ (m = number of institutional sectors) coefficient matrices C and C^* are estimated under the institutional sector portfolio assumption.

$$C = DB$$

$$C^* = D^*B^*$$

Then, each element of transaction quantity matrices Y and Y^* is obtained as follows:

$$y_{ij} = c_{ij}t_j$$

$$y_{ij}^* = c_{ij}^*t_j$$

where t_j represents the sum of either assets or liabilities; y_{ij} is the amount of funds provided from the ith institutional sector to the jth institutional sector; and y_{ij}^* identifies the amount of funds from the jth to the ith institutional sector. Y is founded on the

Table 4 Industries in the FSA data

1	B Fishing
2	C Mining and quarrying
3	D151 Production, processing, and preserving of meat, fish, fruits, vegetables, oils, and fats
4	D152 Dairy products and ice cream
5	D153 Grain mill products, starch products, and prepared animal feeds
6	D1541 Bakery and dry bakery
7	D1545 Condiments and food additive products
8	D1542,3,4,9 Sugar, cocoa, and chocolate, noodles, other food products
9	D1551-3 Distilling and blending of spirits, fermented alcoholic beverages, and malt liquors
10	D1554 Ice and nonalcoholic beverages, production of mineral waters
11	D171 Preparation and spinning of textile fibers
12	D172 Weaving of textile fibers
13	D173,4,9 Other textiles
14	D18 Sewn wearing apparel and fur articles
15	D191,2 Leather, luggage, handbags, saddlery, and harnesses
16	D193 Footwear
17	D20 Wood and products of wood and cork, except furniture
18	D21 Pulp, paper, and paper products
19	D221 Publishing
20	D222,3 Printing and reproduction of recorded media
21	D23 Coke, refined petroleum products, and nuclear fuel
22	D2411-3 Basic chemicals, except fertilizers
23	D2414 Fertilizers and nitrogen compounds
24	D2415 Synthetic rubber and plastics in primary forms
25	D242 Pharmaceuticals, medicinal chemicals, and botanical products
26	D2431 Pesticides and other agrochemical products
27	D2432 Paints, varnishes, and similar coatings, printing ink and mastics
28	D2433 Soap, cleaning compounds, and toilet preparations
29	D2434,9 Other chemical products
30	D244 Man-made fibers
31	D2511 Rubber tires and tubes
32	D2519 Other rubber products
33	D252 Plastic products
34	D261 Glass and glass products
35	D262 Ceramic ware
36	D2631 Cement, lime, and plaster
37	D2632 Articles of concrete, cement, and plaster
38	D269 Other nonmetallic mineral products
39	D271 Basic iron and steel
40	D272 Basic precious and nonferrous metals
41	D273 Cast of metals
42	D281 Structural metal products, tanks, reservoirs, and steam generators
43	D289 Other fabricated metal products and metal treating services
44	D2916 Work trucks, lifting, and handling equipment
45	D2911-5,7 Other general-purpose machinery
46	D292 Machine tools
47	D2931 Agricultural and forestry machinery
48	D2933 Machinery for mining, quarrying, and construction
49	D2932,4-6,9 Other special-purpose machinery
50	D295 Other domestic appliances
51	D30 Computers and office machinery

Table 4 continued

52	D311 Electric motors, generators, and transformers
53	D312 Electricity distribution and control apparatuses
54	D313 Insulated wires and cables
55	D314,5,9 Other electrical equipment
56	D321 Semiconductors and other electronic components
57	D322 Television and radio transmitters and apparatuses for line telegraphy
58	D323 TV and radio receivers, sound or video recording or reproducing apparatuses
59	D33 Medical, precision, and optical instruments, watches and clocks
60	D341 Motor vehicles and engines
61	D342,3 Bodies for motor vehicles, trailers, and semitrailers, and parts and accessories
62	D351 Building of ships and boats
63	D352,3,9 Railway locomotives, aircraft, and transport equipment
64	D361 Furniture
65	D369 Other manufacturing
66	D37 Recycling
67	E401 Electricity
68	E402,3 Gas, steam, and hot water supply
69	F Construction
70	G50 Sale of motor vehicles, retail sale of automotive fuel
71	G51 Wholesale trade and commission trade
72	G5211-9 Retail sale in nonspecialized stores except department stores
73	G52111 Department stores
74	G5280 General retail trade except retail sales via mail-order houses
75	G5281 Retail sales via mail-order houses
76	H551 Accommodation
77	I602 Transit and ground passenger transportation
78	I603 Road freight transport
79	I61 Water transport
80	I62 Air transport
81	I63 Supporting, auxiliary transport activities, and travel agencies
82	J642 Telecommunications
83	L70 Real estate, renting, and leasing
84	M722 Software consultancy and supply
85	M724 Database activities and online information provision services
86	M721,3,9 Other computer activities
87	M743 Architectural, engineering services
88	M745 Advertising
89	M741,2,4,9 Other professional, scientific, and technical services
90	M75 Business support services
91	Q872 Broadcasting
92	Q871,3 Motion picture and performing arts
93	Q88 Other recreational, cultural, and sporting activities
94	R90 Sewage and refuse disposal, sanitation, and similar activities

assumption that each institutional sector's fund-raising portfolio is settled. In contrast, Y^* is based on the assumption that the fund-employment portfolio of each institutional sector is fixed.

In this analysis, we created the FOF accounts that are combined with the FSA data. Figure 1 displays the prototype of the expanded Y table whose nonfinancial corporation sector is subdivided into many types of industry for this paper. Therefore, it contains

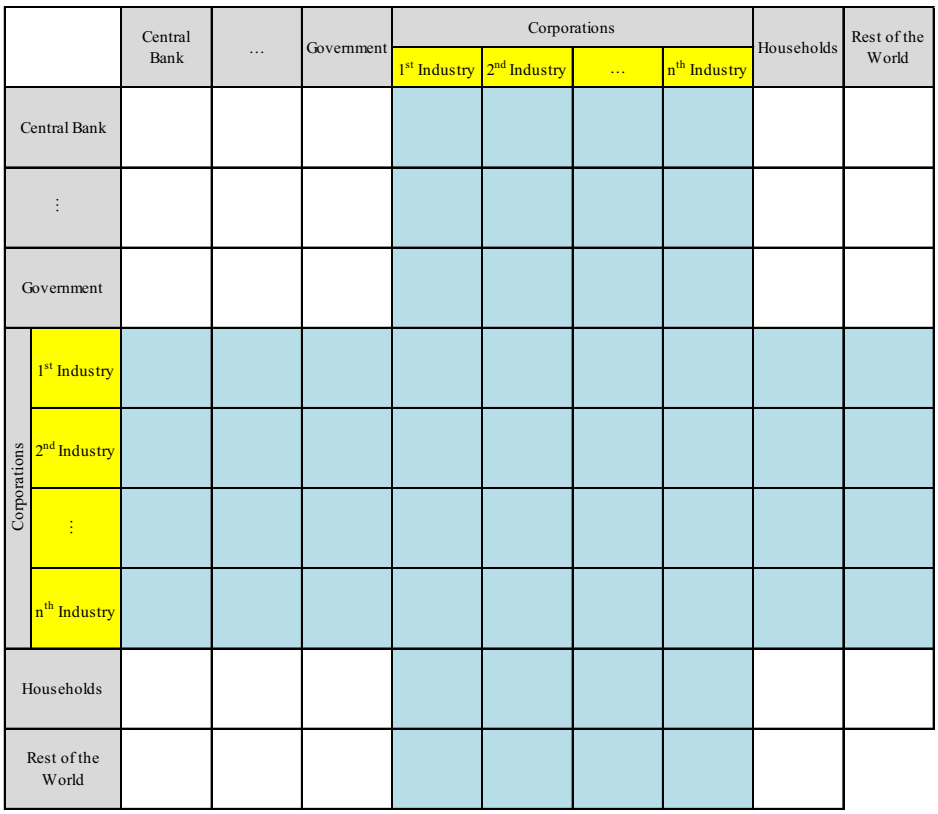

Fig. 1 Expanded financial transaction table (*Y* table)

additional blue-colored blocks of information compared with the original *Y* table, which is not separated into industries.

2.2.2 Power of dispersion index and sensitivity of dispersion index

Next, we will apply the Leontief inverse to obtain the indices of the power and sensitivity of dispersion to the ALM. The *Y* table can be expressed as follows in matrix terms, where ε^Y represents excess liabilities:

$$CT^Y + \varepsilon^Y = T^Y$$

Solving each equation for T^Y yields

$$T^Y = (I - C)^{-1}\varepsilon^Y$$

$$T^Y = I\varepsilon^Y + C\varepsilon^Y + C^2\varepsilon^Y + C^3\varepsilon^Y + \cdots$$

where I denotes the $m \times m$ unit matrix and $(I - C)^{-1}$ is Leontief inverse matrix. Matrix Γ is described as follows:

$$\Gamma = (I - C)^{-1} = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1m} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_{m1} & \gamma_{m2} & \cdots & \gamma_{mm} \end{bmatrix}$$

It is possible to calculate indices for both power of dispersion and sensitivity of dispersion in the liability-oriented system. The power of dispersion index, ω_j^Y, and the sensitivity of dispersion index, z_i^Y, are expressed as follows.

$$\omega_j^Y = \frac{\sum_{i=1}^{m} \gamma_{ij}}{\frac{1}{m}\sum_{j=1}^{m}\sum_{i=1}^{m} \gamma_{ij}}$$

$$z_i^Y = \frac{\sum_{i=1}^{m} \gamma_{ij}}{\frac{1}{m}\sum_{i=1}^{m}\sum_{i=1}^{m} \gamma_{ij}}$$

Based on the same method of Y^*, the power of dispersion index, $\omega_j^{Y^*}$, and the sensitivity of dispersion index, $z_i^{Y^*}$, in the asset-oriented system are also obtained.

3 Subdivision of the FOF accounts into types of industry

3.1 Inter-industry liability and asset portfolio

The nonfinancial corporation sector in the FOF accounts will now be subdivided into types of industry. Tables 5 and 6 show the liability portfolio and financial asset portfolio of 25 industries[2] in 2005. In Table 5, industries' liabilities consist of loans, securities, trade credits, and other foreign debts, which mean instruments for fund-raising. The average[3] portfolio liabilities consist of is 14.4% loans, 61.8% securities, 9.1% trade credits, and 14.7% other foreign debts. Overall, industries raised more than half of their funds through securities, which is one form of direct financing, except three industries as follows: (1) fishing (41.8% of loans, 32.9% of securities), (2) textiles, apparel, and leather (29.5% of loans, 42.2% of securities), and (3) rubber and plastic products (22.5% of loans, 48.0% of securities) all show fewer securities and more loans than other industries. On the other hand, the telecommunications (81.4%); coke, refined petroleum products and nuclear fuel (74.5%); and business activities (73.1%) industries are mainly dependent on securities. Trade credits for gas, steam, and hot water (14.1%) and wholesale and retail trade (13.6%) are greater than in other industries. On the contrary, accommodation (0.7%) and real estate, renting, and leasing (1.0%) have a low level of trade credits. Lastly, real estate, renting, and leasing (29.5%) and motor vehicles, railway, and transport equipment (21.7%) show more fund-raising from overseas sector than other industries.

Table 6 demonstrates the inter-industry fund employment. It is composed of currency and deposits, securities, trade credits, and other foreign claims. The average[4] financial asset portfolio contains 18.3% currency and deposits, 38.2% securities, 31.5% trade credits, and 11.9% other foreign claims. Fishing (33.6%), sewage, refuse disposal, sanitation, and similar activities (40.3%) have more currency and deposits than average. In contrast, electricity (5.4% currency and deposits, 81.2% securities) and accommodation (16.1% currency and deposits, 73.2% securities) held more securities than other financial assets. Gas, steam, and hot water (63.6%) and recycling (50.0%) held larger portions of trade credits than other industries. On the other hand, accommodation (4.4%) and real estate,

[2] Some industries are aggregated since there are 94 industries in the expanded FOF accounts in Tables 5 and 6.

[3] Residual industry is excluded.

[4] Residual industry is excluded.

Table 5 Inter-industry liability portfolio in 2005

Industry	Total liabilities (Bil. KRW)	Loans (%)	Securities (%)	Trade credits (%)	Other foreign debt (%)
Fishing	909.7	41.8	32.9	6.1	19.1
Mining and quarrying	2633.2	15.3	71.3	3.7	9.6
Food and beverages	67,318.7	13.8	71.0	4.9	10.3
Textile, apparel, and leather	30,838.1	29.5	42.2	12.9	15.4
Wood, pulp, and paper products	34,742.8	21.6	58.3	6.5	13.5
Coke, refined petroleum products, and nuclear fuel	32,794.2	10.7	74.5	8.1	6.8
Chemicals and chemical products	77,407.7	11.8	72.1	7.4	8.7
Rubber and plastic products	20,079.6	22.5	48.0	12.0	17.5
Nonmetallic mineral products	24,063.5	23.0	53.8	11.3	11.9
Metals and metal product except machinery and equipment	96,925.1	16.6	66.0	8.8	8.5
Machinery and equipment, computers	190,587	15.2	57.6	10.9	16.3
Motor vehicles, railway, and transport equipment	174,943.9	10.2	56.6	11.6	21.7
Other manufacturing, furniture, medical, precision, optical instruments, watches, and clocks	17,844	17.4	61.1	10.5	11.0
Recycling	1903	31.6	56.5	3.9	8.0
Electricity	82,564.6	7.7	71.9	3.9	16.6
Gas, steam, and hot water supply	22,648.1	23.4	56.5	14.1	6.1
Construction	179,571.4	15.0	57.1	10.9	17.0
Wholesale and retail trade	260,203.7	15.2	59.4	13.6	11.8
Accommodation	23,046.4	17.3	62.5	0.7	19.4
Transport	78,220.5	26.1	54.8	5.7	13.4
Telecommunications	73,651.6	1.9	81.4	2.5	14.2
Real estate, renting, and leasing	29,472.8	18.4	51.1	1.0	29.5
Business activities	36,046.3	7.1	73.1	6.9	13.0
Recreational, cultural, broadcasting, and performing arts	50,004.6	8.9	68.5	1.4	21.2
Sewage and refuse disposal, sanitation, and similar activities	2875.3	16.0	71.6	1.2	11.1
Total	1,611,295.6	14.4	61.8	9.1	14.7

renting, and leasing (9.7%) show small portions of trade credits in common with a liability portfolio. Sewage, refuse disposal, sanitation, and similar activities (24.1%), recycling (21.9%), and construction (21.7%) invested more in foreign countries than other industries. In contrast, electricity (2.0%), gas, steam, and hot water (4.2%) held less foreign claims than the others.

The real assets term is obtained by subtracting total financial assets from total liabilities. Real assets are composed of inventories, tangible assets, and intangible assets in the FSA data. Finished or semi-finished goods, raw materials, and other inventories are included in these inventories. Land, buildings and structures, machinery and equipment, ship vehicles and transportation equipment, construction in progress, and other tangible assets are considered tangible assets. Lastly, intangible assets contain development costs and the like. Table 7 represents the component ratio of real assets. On average,[5] the real assets term is composed of 18.9% inventories, 76.4% tangible assets, and 4.7% intangible assets. Each of

[5] Residual industry is excluded.

Table 6 Inter-industry financial asset portfolio in 2005

Industry	Total financial assets (Bil. KRW)	Currency and deposits (%)	Securities (%)	Trade credits (%)	Other foreign claims (%)
Fishing	909.7	33.6	34.7	9.9	21.8
Mining and quarrying	2633.2	16.9	17.1	35.0	31.0
Food and beverages	67,318.7	24.2	45.3	23.3	7.2
Textile, apparel, and leather	30,838.1	20.2	27.8	40.9	11.1
Wood, pulp, and paper products	34,742.8	24.4	28.9	37.6	9.1
Coke, refined petroleum products, and nuclear fuel	32,794.2	22.5	35.5	36.8	5.2
Chemicals and chemical products	77,407.7	15.3	39.5	39.0	6.2
Rubber and plastic products	20,079.6	16.8	26.8	37.1	19.3
Nonmetallic mineral products	24,063.5	17.5	33.6	38.9	10.0
Metals and metal product except machinery and equipment	96,925.1	14.4	42.3	37.9	5.4
Machinery and equipment, computers	190,587	21.9	38.8	29.3	10.0
Motor vehicles, railway, and transport equipment	174,943.9	24.2	32.2	32.1	11.5
Other manufacturing, furniture, medical, precision, optical instruments, watches, and clocks	17,844	22.3	27.3	40.0	10.4
Recycling	1903	11.7	16.5	50.0	21.9
Electricity	82,564.6	5.4	81.2	11.4	2.0
Gas, steam, and hot water supply	22,648.1	10.3	21.8	63.6	4.2
Construction	179,571.4	16.6	26.1	35.7	21.7
Wholesale and retail trade	260,203.7	14.4	39.3	34.1	12.2
Accommodation	23,046.4	16.1	73.2	4.4	6.2
Transport	78,220.5	23.2	32.5	27.1	17.1
Telecommunications	73,651.6	15.0	45.5	26.9	12.7
Real estate, renting, and leasing	29,472.8	20.7	54.0	9.7	15.5
Business activities	36,046.3	28.9	24.6	31.6	15.0
Recreational, cultural, broadcasting, and performing arts	50,004.6	26.8	48.6	12.6	11.9

Table 6 continued

Industry	Total financial assets (Bil. KRW)	Currency and deposits (%)	Securities (%)	Trade credits (%)	Other foreign claims (%)
Sewage and refuse disposal, sanitation, and similar activities	2875.3	40.3	18.0	17.7	24.1
Total	669,764.1	18.3	38.2	31.5	11.9

the top four distinguished industries that show greater than 43% inventories, 95% tangible assets, or 25% intangible assets are listed in this table. First, two manufacturing industries ([1] sewn wearing apparel and fur articles, and [2] leather, luggage, handbags, saddlery, and harnesses), which are related to apparel, are ranked first and fourth in their share of inventories. The largest inventory of these industries is finished or semi-finished goods, since these industries need finished goods, for example, textile products, threads, and yarn to produce clothing. Likewise, most inventories in wholesale trade and commission trade are finished or semi-finished goods, since this industry conducts trade rather than manufacture products. On the other hand, the greatest component of construction inventories is the raw materials item, comprising 33.4%. Second, (1) sewage and refuse disposal, sanitation, and similar activities; (2) other recreational, cultural, and sporting activities; (3) air transport; and (4) electricity sectors all demonstrate tangible asset ratios greater than 95%. Of these four industries, air transport in particular shows a tangible asset ratio of 83.0% machinery, transportation equipment, and other. Finally, the four industries of (1) real estate, renting, and leasing; (2) software consultancy and supply; (3) support and auxiliary transport activities, and travel agencies; and (4) database activities and online information provision services all have intangible asset ratios above 25%. This table reflects well the characteristics of each industry. The composition rate of real assets depends on an industry's features. For example, development costs, one component of intangible assets, are almost a necessity for software and database activity-related industries. To understand the general peculiarities of different industries, composition rates of real assets by type and level are listed in Table 8. Domestic enterprises, light industries, and living and other industries have greater inventories and smaller tangible assets than export enterprises and heavy and chemical industries. Similarly, high- and medium–high-technology industries possess larger portions of tangible assets and lower inventories than low- and medium–low-technology industries. Finally, information and communication technology industries (services) have greater intangible assets than any other industry.

3.2 Analysis of financial transactions and the power of dispersion indices

It is possible to construct a Y table that represents financial transactions and the coefficient C matrix by 115 institutional sectors combined with FSA data. In this subsection, we describe the structure of financial markets using the financial transaction matrix (Y table) and power of dispersion indices calculated from the Leontief inverse matrix. The Y table displays financial transactions on a "from-whom-to-whom" basis, which corresponds to the I–O table. Table 9 shows a fund-raising portfolio of total industries. In other words, nonfinancial corporations raised approximately 2051 trillion Korean won from other institutional sectors in 2005. Among this, funds from nonfinancial

Table 7 Component ratio of real assets of distinguished industries in 2005

Industry	A (%)	B (%)	C (%)	A + B + C (%)	D (%)	E (%)	F (%)	D + E +F (%)	G (%)	Total (%)
D18 Sewn wearing apparel and fur articles	37.6	9.4	12.3	59.2	18.6	16.6	5.4	40.5	0.2	100.0
F Construction	9.2	33.4	14.5	57.0	16.2	16.4	9.0	41.6	1.4	100.0
G51 Wholesale trade and commission trade	38.9	2.7	2.0	43.6	23.4	18.7	12.0	54.1	2.3	100.0
D191,2 Leather, luggage, handbags, saddlery, and harnesses	25.9	10.8	6.3	43.0	31.5	17.0	8.2	56.7	0.3	100.0
R90 Sewage and refuse disposal, sanitation, and similar activities	0.2	0.1	0.3	0.6	41.7	25.0	31.5	98.2	1.1	100.0
Q88 Other recreational, cultural, and sporting activities	0.4	0.5	0.8	1.6	24.8	36.0	37.2	98.0	0.4	100.0
I62 Air transport	0.1	0.2	1.6	1.9	5.1	8.5	83.0	96.6	1.5	100.0
E401 Electricity	0.0	1.6	1.1	2.7	8.7	53.0	34.1	95.8	1.5	100.0
L70 Real estate, renting, and leasing	2.1	1.3	3.3	6.7	19.5	20.3	4.4	44.2	49.0	100.0
M722 Software consultancy and supply	10.9	5.1	0.7	16.7	12.6	15.5	25.7	53.8	29.5	100.0
I63 Supporting, auxiliary transport activities, and travel agencies	2.2	0.4	0.3	3.0	18.7	14.0	35.4	68.1	28.9	100.0
M724 Database activities and online information provision services	3.0	2.3	0.0	5.3	17.5	7.2	44.2	68.9	25.8	100.0
Average	9.2	6.3	3.4	18.9	18.3	28.3	29.8	76.4	4.7	100.0

A, finished or semi-finished goods; B, raw materials; C, other inventories; A + B + C, inventories; D, land; E, buildings, structures, construction in progress; F, machinery, transportation equipment, and others; D + E + F, tangible assets; G, intangible assets

Table 8 Composition rates of real assets by type and technology level in 2005

Industry	A (%)	B (%)	C (%)	A + B + C (%)	D (%)	E (%)	F (%)	D + E + F (%)	G (%)	Total (%)
Export enterprises (manufacturing)	7.9	5.9	4.0	17.7	15.7	27.9	35.3	78.9	3.4	100.0
Domestic enterprises (manufacturing)	11.9	8.2	3.6	23.6	22.1	26.5	25.1	73.7	2.6	100.0
Heavy and chemical industries (manufacturing)	9.2	6.8	3.8	19.7	17.5	27.5	32.1	77.0	3.2	100.0
Light industries (manufacturing)	13.9	8.5	3.6	26.0	26.4	25.8	19.8	71.9	2.0	100.0
High-technology industries (manufacturing)	5.9	5.7	4.6	16.2	10.7	28.5	39.7	78.8	4.9	100.0
Medium–high-technology industries (manufacturing)	9.7	6.0	3.7	19.4	20.3	26.0	30.6	76.9	3.7	100.0
Medium–low-technology industries (manufacturing)	11.3	8.5	3.3	23.1	19.9	28.5	26.9	75.3	1.6	100.0
Low-technology industries (manufacturing)	13.4	8.3	3.6	25.4	26.4	25.1	21.3	72.8	1.8	100.0
Primary material industries (manufacturing)	12.3	7.7	2.9	22.9	20.0	26.1	29.5	75.6	1.5	100.0
Processing assembly industries (manufacturing)	7.0	6.0	4.5	17.5	16.7	28.5	32.9	78.1	4.4	100.0
Living and other industries (manufacturing)	14.4	9.5	4.1	28.0	26.1	25.3	18.1	69.5	2.5	100.0
Information and communication technology industries (goods)	5.4	5.3	4.6	15.3	10.7	28.0	41.1	79.9	4.8	100.0
Information and communication technology industries (services)	2.7	0.8	0.3	3.7	7.2	18.3	52.5	78.0	18.2	100.0

A, finished or semi-finished goods; B, raw materials; C, other inventories; A + B + C, inventories; D, land; E, buildings, structures, construction in progress; F, machinery, transportation equipment, and others; D + E+F, tangible assets; G, intangible assets

Table 9 Fund-raising portfolio of total industries in 2005

Institutional sectors (from-whom-to industries)	Amount (Bil. KRW)	Ratio (%)
Central bank	12,476	0.6
Domestically licensed banks	292,575	14.3
Specialized banks	133,441	6.5
Other banks	47,597	2.3
Collectively managed trusts	41,523	2.0
Small loan financial companies for households and small businesses	100,937	4.9
Investment institutions	88,384	4.3
Other nonbanks	17,774	0.9
Life insurance companies	17,271	0.8
Nonlife insurance companies	115,310	5.6
Cooperative society	1785	0.1
Pension funds	13,778	0.7
Securities institutions	25,501	1.2
Credit-specialized financial institutions	20,956	1.0
Public financial institutions	38,892	1.9
Other financial intermediaries	25,859	1.3
Financial auxiliaries	6072	0.3
General government	207,298	10.1
Credit-specialized financial institutions	402,166	19.6
D321 Semiconductors and other electronic components	20,296	1.0
E401 Electricity	17,866	0.9
F Construction	48,183	2.3
G51 Wholesale trade and commission trade	48,330	2.4
Households and nonprofit organizations	210,624	10.3
Rest of the world	230,780	11.3
Total	2,050,999	100.0

corporations (19.6%) is the largest. There are four specific industries on average that have larger ratios than the other industries.[6] Funds from wholesale trade and commission trade (2.4%), construction (2.3%), semiconductors and other electronic components (1.0%), and electricity (0.9%) to nonfinancial corporations are comparatively larger than for other industries. Among these, only semiconductors and other electronic components are included in manufacturing. Semiconductors are one of the Korea's leading export industries.[7] Except fund-raising from nonfinancial corporations by themselves, funds from domestically licensed banks (14.3%), the rest of the world (11.3%), households and nonprofit organizations (10.3%), and the general government (10.1%) are remarkable. Since the rest of the world provided more than 10% of the funds, Korean industries have a high level of dependence on foreign funds. Industries highly dependent on foreign funds are listed in Table 10.[8] Retail sales via mail-order houses (18.0%) are the highest foreign fund-dependent industry. Electricity, telecommunications, services, and arts and cultural activities also have high ratios. In manufacturing, only three industries,

[6] The other industries show less than 0.6%.

[7] According to market research firm IC insights, Korea became the world's second-largest semiconductor manufacturer in 2013.

[8] The ratios of industries having more than 14% of funds raised from foreign countries to total liabilities are listed in Table 9.

Table 10 Industries highly dependent on foreign funds

Industry	Ratio (%)
D321 Semiconductors and other electronic components	14.2
D341 Motor vehicles and engines	14.0
D351 Building of ships and boats	17.8
E401 Electricity	14.5
G5281 Retail sale via mail-order houses	18.0
I602 Transit and ground passenger transportation	15.6
J642 Telecommunications	15.0
L70 Real estate, renting, and leasing	15.3
M724 Database activities and online information provision services	14.8
M743 Architectural, engineering services	14.9
M75 Business support services	14.6
Q871,3 Motion picture and performing arts	14.1
Q88 Other recreational, cultural, and sporting activities	17.3

namely the building of ships and boats (17.8%), semiconductors and other electronic components (14.2%), and motor vehicles and engines (14.0%), are shown in this table. The building of ships and boats, motor vehicles, and engines are categorized as traditional core industries of Korea in the Korea Development Bank (KDB) (2005a). According to the KDB (2005b), the ratio of the electronic components industry[9] in Korean manufacturing has increased steadily owing to the development of the semiconductor and other electronic components industry. After 2003, Korean semiconductor firms had driven aggressive investment into facilities and equipment to expand their market power. Domestic demand for semiconductors rose owing to an upswing in the export of mobile phones, MP3 players, and digital televisions. In contrast, investments by foreign competitors were conservative in that period by fall in semiconductor prices. As a result, Korean semiconductor companies could expand their market share in the global market.[10]

Figures 2 and 3 display the power of dispersion index for each institutional sector in 2004 and 2005. The index baseline is 1, which is used to identify the extent of dispersion. The major benefit of these indices is that they identify the relative position of each institutional sector in a financial market where these institutional sectors are inter-dependent, either directly or indirectly. The power of dispersion index in the liability-oriented system is displayed in the rows, whereas the columns show the power of dispersion index in the asset-oriented system. Each institutional sector is placed in the four-quadrant graph. For example, households with excess savings are generally located in the second quadrant since they exercise more power over assets and less power over liabilities. Meanwhile, corporations with excess investment are generally displayed in the fourth

[9] According to the KDB (2005b), there are two groups in the electronic components industries: one is a technology-intensive industry and the other is a labor-intensive industry. Semiconductors and LCDs, which are capital- and technology-intensive industries, are led by large firms with mass production systems. On the other hand, other electronic components are led by labor-intensive industries dominated by small and medium enterprises with small quantity batch production methods.

[10] Korea ranked fourth with the largest share at 10.0% (Korea's production was recorded as US$39,904 million out of the world total of US$398,826 million) in global electronic component production in 2005. Japan ranked first with US$95,604 million, whereas the USA and China ranked second (US$61,236 million) and third (US$41,368 million) (source: Reed Electronic Research 2005).

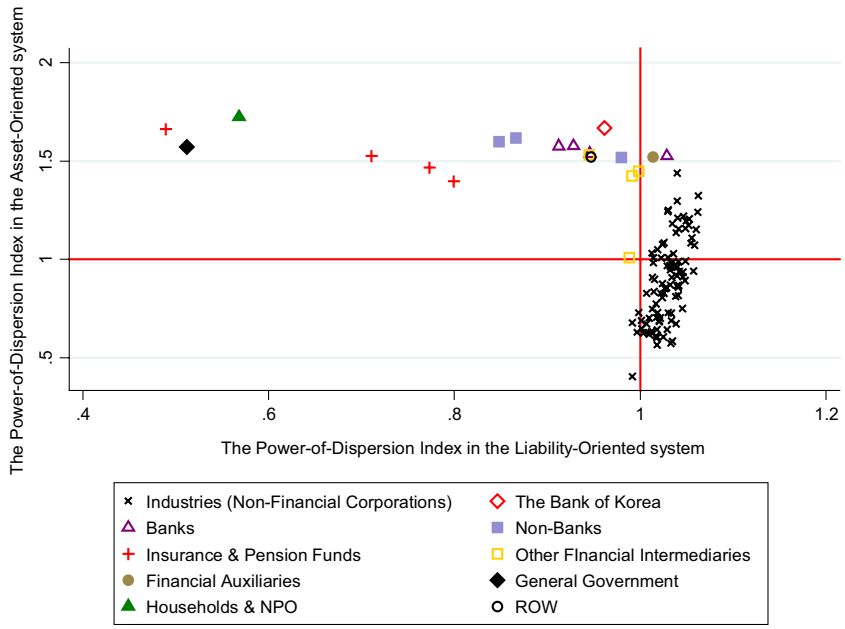

Fig. 2 Power of dispersion index in 2004

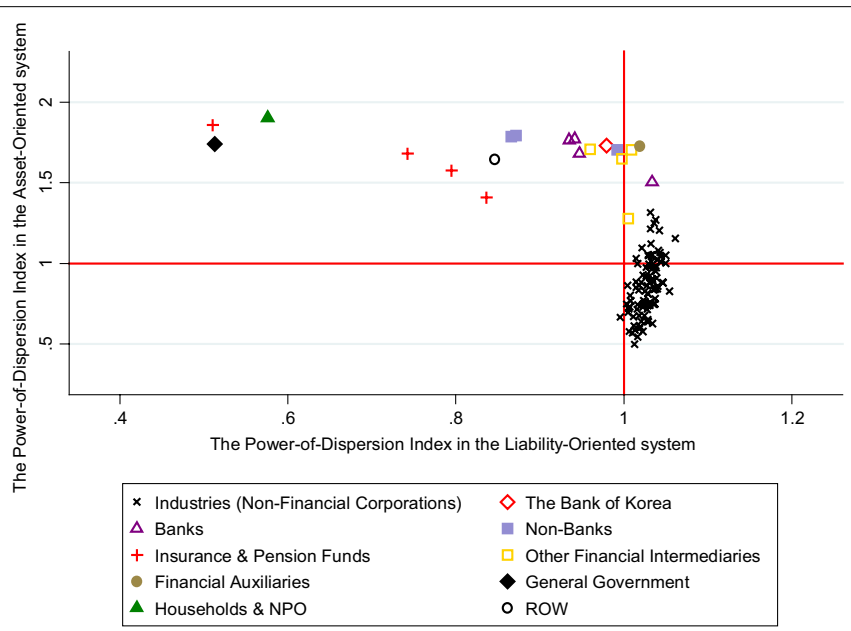

Fig. 3 Power of dispersion index in 2005

quadrant since they hold more power over liabilities and less power over assets. In Figs. 2 and 3, most institutional sectors other than nonfinancial corporations are located in the second quadrant. Financial auxiliaries and only a few financial institutions are included in the first quadrant. Most nonfinancial corporations are located in the fourth quadrant. However, 27 industries in 2004 and 22 industries in 2005 are sited in the first quadrant, indicating that both of their power indices are greater than 1.

Table 11 lists industries included in the first quadrant in 2004 or 2005. Most service and IT industries, as well as construction industries, are included in the first-quadrant group. In manufacturing and light industries, for example, food products, textile fibers and apparel, and glass and ceramics are located in the first quadrant, whereas fishing, mining, and quarrying as well as heavy and chemical industries including metal products and petroleum represent the fourth quadrant, since their power indices of fund employment are comparatively smaller than those of other institutional sectors. Furthermore, four industries, namely (1) support and auxiliary transport activities and travel agencies, (2) telecommunications, (3) other professional, scientific, and technical services, and (4) broadcasting, are included in the third-quadrant group in 2004 as listed in Table 12, which means that both of their power indices are very small. Three industries moved to the fourth-quadrant group in 2005, although broadcasting remained in the third quadrant.

Table 11 Industries whose dispersion power indices are in the first quadrant

2004	2005
	B Fishing
D152 Dairy products and ice cream	D152 Dairy products and ice cream
D1545 Condiments and food additive products	D1541 Bakery and dry bakery
D1542,3,4,9 Sugar, cocoa, and chocolate, noodles, other food products	D171 Preparation and spinning of textile fibers
D18 Sewn wearing apparel and fur articles	D18 Sewn wearing apparel and fur articles
D193 Footwear	D191,2 Leather, luggage, handbags, saddlery, and harnesses
D221 Publishing	
D2432 Paints, varnishes, and similar coatings, printing ink, and mastics	D2432 Paints, varnishes, and similar coatings, printing ink and mastics
D2519 Other rubber products	D2519 Other rubber products
D252 Plastic products	D252 Plastic products
D261 Glass and glass products	D261 Glass and glass products
D262 Ceramic ware	
D2632 Articles of concrete, cement, and plaster	D2632 Articles of concrete, cement, and plaster
D269 Other nonmetallic mineral products	D269 Other nonmetallic mineral products
D312 Electricity distribution and control apparatuses	
D313 Insulated wire and cable	D313 Insulated wire and cable
D321 Semiconductors and other electronic components	D321 Semiconductor and other electronic components
D341 Motor vehicles and engines	D322 Television and radio transmitters and
D351 Building of ships and boats	D323 TV and radio receivers, sound or video
F Construction	F Construction
G51 Wholesale trade and commission trade	G51 Wholesale trade and commission trade
G5281 Retail sale via mail-order houses	G5281 Retail sale via mail-order houses
M722 Software consultancy and supply	M722 Software consultancy and supply
M724 Database activities and online information provision services	
M721,3,9 Other computer activities	
M743 Architectural, engineering services	M743 Architectural, engineering services
M745 Advertising	
Q871,3 Motion pictures and performing arts	Q871,3 Motion pictures and performing arts

Table 12 Industries whose dispersion power indices are in the third quadrant

2004	2005
I63 Supporting and auxiliary transport activities and travel agencies	
J642 Telecommunications	
M741,2,4,9 Other professional, scientific and technical services	
Q872 Broadcasting	Q872 Broadcasting

Nishiyama (1991) subdivided Japanese FOF accounts into 37 industries and calculated one type of power of dispersion index. Nishiyama (1991) demonstrated that food products, textile fibers and apparel, pulp, paper, and paper products, publishing and printing, metal products, retail sale, real estate, construction, broadcasting, transport, motion pictures, and recreational activities have relatively smaller indices than other industries in some periods. The results of this paper are not comparable exactly with Nishiyama's (1991) results, since two types of indices based on liability and asset approaches are obtained for the Korean case. However, we could say that some industries located in the first or third quadrants, for example, most of the service and IT industries, light industries, construction, and broadcasting in Korea, overlap with the smaller Japanese power of dispersion indices' industries.

4 Inter-industry monetary policy evaluations in the FOF accounts

In the SNA, the difference between assets and liabilities in the FOF accounts reflects net investments, i.e., the difference between savings and investments, in the real economy. Earlier, the Y and Y^* tables showing the financial transactions between institutional sectors were calculated. Using the Y and Y^* tables, Tsujimura and Mizoshita (2003), Tsujimura and Tsujimura (2006) examined the effectiveness of the central bank's monetary policies, namely the so-called quantitative easing policy introduced by the Bank of Japan (BOJ). To evaluate this monetary policy, the central bank is treated as an exogenous institutional sector in the Y and Y^* tables. In this section, we adopt the evaluations method by Tsujimura and Mizoshita (2003).[11] The previous study estimated the induced amount of fund demand and supply to analyze the effect of the central bank's monetary policies through the financial transactions between institutional sectors, which are represented in Leontief inverse.

In this subsection, each industry's net investments induced by the BOK in 2004 and 2005 are calculated. Table 13 demonstrates only distinguished industries in NII or changes in NII. First, industries that had greater NII than other industries are listed in this table. Since the NII of some particular industries on a large scale might be larger than others, the fourth and fifth columns display NII divided by its total liabilities, whereas the second and third columns show NII denominated in billions of Korean won. Next, industries in red have negative changes in NII when subtracting NII in 2004 from 2005. In other words, industries in red saw their NII in 2005 shrink as compared with that in the previous year. Consequently, this table shows a distinguished group that

[11] For details, please see Appendix.

Table 13 Industries with remarkable NII or changes in NII

Inter-industry	NII (Bil. KRW)		NII/total liabilities (%)		ΔNII (Bil. KRW)
	2004	2005	2004	2005	
B Fishing	114	60	12.6	6.6	*−54*
C Mining and quarrying	622	409	23.6	15.5	*−214*
D151 Production, processing, and preserving of meat, fish, fruits, vegetables, oils, and fats	670	1513	6.7	15.2	843
D1554 Ice and nonalcoholic beverages, production of mineral waters	621	939	10.5	15.9	318
D172 Weaving of textile fibers	1261	1012	16.6	13.3	*−249*
D191,2 Leather, luggage, handbags, saddlery, and harnesses	298	266	11.0	9.8	*−32*
D23 Coke, refined petroleum products, and nuclear fuel	5163	4787	11.9	11.0	*−377*
D2411-3 Basic chemicals, except fertilizers	5396	4547	16.5	13.9	*−849*
D2415 Synthetic rubber and plastics in primary forms	40,99	3619	15.1	13.3	*−480*
D2432 Paints, varnishes, and similar coatings, printing ink and mastics	467	386	9.0	7.4	*−80*
D2433 Soap, cleaning compounds, and toilet preparations	811	652	15.3	12.3	*−160*
D244 Man-made fibers	1152	627	24.0	13.1	*−524*
D2631 Cement, lime, and plaster	1077	1005	14.1	13.1	*−72*
D2931 Agricultural and forestry machinery	205	315	10.3	15.9	110
D2933 Machinery for mining, quarrying, and construction	653	1187	8.9	16.2	534
D30 Computers and office machinery	938	864	11.8	10.9	*−74*
D351 Building of ships and boats	5361	8291	10.0	15.4	2930
D352,3,9 Railway locomotives, aircraft, and transport equipment	767	1454	8.5	16.1	687
D369 Other manufacturing	639	568	13.1	11.6	*−71*
E401 Electricity	9437	9426	11.4	11.4	*−11*
G5211-9 Retail sale in nonspecialized stores except department stores	2193	5286	6.9	16.7	3093
G52111 Department stores	3541	4223	12.8	15.2	682
H551 Accommodation	1979	3802	8.6	16.5	1824
I602 Transit and ground passenger transportation	824	842	16.8	17.1	18
I62 Air transport	3073	2985	15.2	14.8	−88
I63 Supporting and auxiliary transport activities and travel agencies	9318	1834	61.7	12.2	*−7484*
J642 Telecommunications	13,904	10,852	18.9	14.7	*−3052*
L70 Real estate, renting, and leasing	1702	4465	5.8	15.2	2764
Q88 Other recreational, cultural, and sporting activities	3771	4015	15.9	17.0	244
Residual industry	56,722	10,191	15.5	2.8	*−46,531*

Italic values: negative NII (NII < 0)

includes (1) industries having positive and greater NII than their 15% of total liabilities in either 2004 or 2005 and (2) industries whose NII fell during that 1 year.

Compared with Table 11, wherein both of their power of dispersion indices are greater than 1, Table 13 exhibits an interesting feature. Most industries that are listed in Table 11 are not included in Table 13.[12] In other words, the NII of the first-quadrant industries

[12] Only two industries, namely (1) paints, varnishes, and similar coatings, printing ink and mastics, and (2) the building of ships and boats, are duplicated, since the NII of the former industry shrank in this period, whereas the latter industry had a NII-to-total liabilities ratio greater than 15% in 2005.

group are computed comparatively smaller than that of other industries listed in Table 11. Industries whose power of dispersion index in the asset-oriented system is greater than 1 are included in the first quadrant.

Table 14 shows GIS, GII, and NII bifurcated by the sign of the power of dispersion index in the asset-oriented system. They are expressed as proportions of GIS, GII, and NII to total liabilities. It is clear that for the GIS–total liabilities ratios of the first group, the index is larger than 1 and mainly includes light industry, and the ratios are obviously smaller than in the second group. Since no significant gap exists between the GII of the two industry groups, the NII–total liabilities ratio of the first group is half that of the second group.

To clarify the distinction between these two groups, let us explain using industry asset portfolios. Table 15 demonstrates the asset–total liabilities ratios of two groups using a Y table, which represents transactions between institutional sectors; the central bank column and row are not removed. The same method of grouping industries is used in Table 14. It is obvious that (1) financial assets, in other words, funds from each group, have inter-industry flows, and (2) excess liabilities show large differences. It is clear that the assets of the first group, which are invested in other nonfinancial corporations and which comprised 30.4% in 2004 and 27.2% in 2005, are greater than those of the second group, which were 16.9 and 16.8%. On the other hand, the second group's excess liabilities, which run to nearly 60%, are significantly greater than those of the first group. Since excess liabilities are calculated by subtracting total financial assets from total liabilities, substantial excess liabilities imply that the industry has carried out large-scale real investments. There is not much difference between the two groups in other institutional sectors, with the exception of funds supplied to domestically licensed banks from the first group, which edged up to 10.0% in 2004.

Table 14 implies two primary features of Korean industries. Mainly light industries, IT, and service industries are included in the first group, while the second group consists of heavy and chemical industries in the main. NII–total liabilities ratios of the second group are higher than the first group, since GIS–total liabilities ratios of the first group are larger than the second group. First feature is that intuitionally heavy and chemical industries need huger plant and equipment investment than light industries. A high level of the real investment is able to cause small savings, in other words, lower GIS–total liabilities ratios. Second characteristic is possibility of compensatory balance, in other words, forced deposits in return for bank loans. According to Park (2003), the compensating balance is useful when banks make loans to informationally opaque firms. This paper argues that banks in Korea came to exercise power after onset of the financial

Table 14 GIS, GII, and NII bifurcated by sign of power of dispersion index in the asset-oriented system

Inter-industries	Year	GIS/total liabilities (%)	GII/total liabilities (%)	NII/total liabilities (%)
First group: index > 1	2004	9.1	15.4	6.2
	2005	11.5	18.5	7.1
Second group: index < 1	2004	6.1	18.4	12.3
	2005	5.3	19.6	14.2

Table 15 Asset–total liabilities ratios of industries bifurcated into two groups

Institutional sector	2004		2005	
	First group (%)	Second group (%)	First group (%)	Second group (%)
Central bank	2.8	1.9	1.9	1.8
Domestically licensed banks	10.0	6.4	6.8	6.8
Specialized banks	3.8	2.5	2.6	2.6
Other banks	1.3	0.9	1.0	0.9
Collectively managed trusts	1.6	1.1	1.1	1.0
Small loan financial companies for households and small businesses	3.5	2.2	2.3	2.4
Investment institutions	2.6	1.8	2.1	1.8
Other nonbanks	0.7	0.4	0.5	0.5
Life insurance companies	0.1	0.1	0.2	0.1
Nonlife Insurance Companies	0.2	0.1	0.1	0.1
Cooperative society	0.0	0.0	0.0	0.0
Pension funds	0.0	0.0	0.0	0.0
Securities Institutions	0.9	0.6	0.8	0.8
Credit-specialized financial institutions	0.7	0.5	0.5	0.4
Public financial institutions	1.5	1.0	0.9	0.8
Other financial intermediaries	1.0	0.7	0.7	0.6
Financial auxiliaries	0.2	0.2	0.2	0.1
General government	2.2	1.6	1.8	1.5
Households and nonprofit organizations	4.0	1.7	3.5	1.5
Rest of the world	2.6	1.6	2.3	1.6
Inter-industry (nonfinancial corporations)	30.4	16.9	27.2	16.8
Excess liabilities	29.8	57.9	43.5	58.0
Total liabilities	100.0	100.0	100.0	100.0

crisis in late 1990s based on anecdotal and empirical evidence. Historically, small and medium enterprises have been forced more than large firms to make a deposit when they get a bank loan in Korea. Thus, forced deposits can reduce adverse selection problems of banks. A high compensating balance brings about bigger savings and higher GIS–total liabilities ratios. Therefore, huger compensating balance can be one of the reasons of higher GIS–total liabilities ratios of the first group.

5 Concluding remarks

Expanded FOF accounts, which contain a range of industries, are developed in this paper. Combined with 2004 and 2005 FSA data, the FOF accounts are subdivided into 115 institutional sectors, including 95 types of inter-industries. First, inter-industry analysis of the FOF accounts was examined. Liability and financial asset portfolios and real assets ratios of industries were explained. Domestic enterprises, light industries, and medium–low-technology industries show larger inventories and fewer tangible assets than export enterprises, heavy and chemical industries, and high and medium–high-technology industries. Liability portfolios of Korean core industries (semiconductors and other electronic components and the building of ships and boats, motor vehicles,

and engines) are more dependent on foreign funds than other manufacturing industries. Power of dispersion indices were then presented, which showed that most service and IT industries, construction, and light industries in manufacturing are included in the first-quadrant group, whereas heavy and chemical industries are placed in the fourth quadrant since their power indices in the asset-oriented system are comparatively smaller than those of other institutional sectors. Second, inter-industry policy evaluations in the FOF accounts are derived in the fourth section. The evaluation results of monetary policies implemented by the central bank are reported. Industries are bifurcated into two groups to compare their features. The first group contains industries whose power of dispersion in the asset-oriented system is greater than 1, whereas the second group contains those whose index is less than 1. We found that the NII–total liabilities ratios of the first group were half those of the second group, since GIS–total liabilities ratios of the former are obviously greater than the latter.

The FOF table has a weakness in that it does not correspond to the I–O table, since it is not subdivided into various industries. Previous researches, for example, Tsujimura and Mizoshita (2003), Tsujimura and Tsujimura (2006), and Manabe (2009), examined policy evaluations using the FOF accounts that were not separated into industries. In this respect, the main contribution of this study is demonstrating the possibility of constructing "from-whom-to-whom" tables that correspond to the I–O tables and a technical I–O analysis, as Klein (2003) mentioned. Though Nishiyama (1991) tried to build "from-whom-to-whom" tables with 44 institutional sectors including 37 industries and obtained one type of power of dispersion index, this paper aimed to design more detailed tables and calculate two power of dispersion indices based on the liability approach and asset approach to evaluate the central bank's monetary policy.

There are many possibilities and potentialities to suggest desirable economic policies by applying and extending these analytical methods. For future work, we consider an analysis method to link the I–O table and FOF accounts separated into various types of industries, for example, an estimation of production functions using inter-industry data from the linked I–O table and the NII calculated from the FOF accounts.

It has been shown here that 18 industries showed negative NII changes in 2004 and 2005, for example, fishing, mining and quarrying, certain manufacturing industries, electricity, air transport, support and auxiliary transport activities and travel agencies, and telecommunications. Challenges for the future include estimations of production functions for every industry, including a variable for changes in NII. This work will enable us to analyze how negative or positive changes in each industry's NII, which are caused by the central bank's monetary policy, affect the real economy. In addition, policymakers will be able to refer to these estimation and simulation results as indicators to evaluate policies and make decisions for both the financial market and the real economy.

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Appendix

Evaluation method of the central bank's monetary policy

According to the preceding section, the Y and Y^* tables are expressed as follows:

$$CT^Y + \varepsilon^Y = T^Y$$

$$C^* T^{Y^*} + \rho^{Y^*} = T^{Y^*}$$

First, it is necessary to separate the policy authority sector from the Y and Y^* tables. Let us denote matrices C_π and C_π^* so that the row and column elements of the central bank are removed from the matrices C and C^*

$$C_\pi T^Y + \varepsilon_\lambda^Y = T^Y$$

$$C_\pi^* T^{Y^*} + \rho_\lambda^Y = T^{Y^*}$$

where each element of ε_λ^Y is the sum of excess liabilities (ε^Y) and the liabilities of the central bank (ε_π^Y). Each element of ρ_λ^Y means the sum of excess assets (ρ^{Y^*}) and the assets of the central bank (ρ_π^Y)

$$\varepsilon_\lambda^Y = \varepsilon_\pi^Y + \varepsilon^Y$$

$$\rho_\lambda^Y = \rho_\pi^Y + \rho^{Y^*}$$

ε_λ^Y and ρ_λ^Y are expressed as an $(m-1) \times 1$ vector, since elements of the policy authority are eliminated from the matrices C and C^*. Solving each equation for T^Y and T^{Y^*} yields

$$T^Y = (I - C_\pi)^{-1} \varepsilon_\lambda^Y$$

$$T^{Y^*} = \left(I - C_\pi^*\right)^{-1} \rho_\lambda^Y$$

where I denotes the $[(m-1) \times (m-1)]$ unit matrix, and $(I - C_\pi)^{-1}$ and $\left(I - C_\pi^*\right)^{-1}$ are the Leontief inverse matrix. Denote $(I - C_\pi)^{-1}$ as matrix Γ_π and $\left(I - C_\pi^*\right)^{-1}$ as matrix Γ_π^*. Using the Leontief inverse matrices Γ_π and Γ_π^*, it is possible to calculate the amount of ultimately induced demand and supply of funds. From the nonfinancial economy's point of view, the induced demand for funds can be regarded as gross induced savings (GIS), which represents the amount of new savings required. On the other hand, the induced supply as gross induced investments (GII) shows the ability to increase new investments.

Since the central bank is an exogenous institutional sector in this model, we can calculate the effect of the monetary and financial policies carried out by the central bank. The policy authority can choose among various instruments of monetary and financial policy. For example, the BOK has three methods of monetary policy: open market operations, lending and deposit facilities, and a reserve requirements policy. If open market operations are selected, the BOK may buy and sell monetary stabilization bonds (MSBs) or securities to and from the public and banks. In the case of MSBs issued by the BOK, financial bonds in their liabilities accounts (R table) will rise. In the asset portfolio (E table), the BOK mostly increases foreign exchange holdings. Another example is Japan's quantitative easing policy. The current account balance increases appeared as liabilities for the BOJ due to its monetary policy. Corresponding to these heightened liabilities, the BOJ intended to increase the amount of Japanese government bonds in their asset portfolio. Let us denote the liabilities held by the policy authority as ε_π, which is an $n \times 1$ vector. In the same regard, an $(n \times 1)$ vector, ρ_π, represents the policy authority's financial instruments. It is necessary to transform ε_π and ρ_π vectors into $(m-1) \times 1$ vectors when using a Leontief inverse. For the transformation, we will adopt $(m-1) \times n$ matrices, D_π and D_π^*, which are represented in the row of the policy authority, which is omitted from $m \times n$ matrices D and D^*.

$$f_\varepsilon = D_\pi \varepsilon_\pi$$

$$f_\rho = D_\pi^* \rho_\pi$$

As ε_π and ρ_π are exogenously given, the induced savings and induced investments are obtained as follows:

$$\eta_S = (I - C_\pi)^{-1} f_\varepsilon$$

$$\eta_I = \left(I - C_\pi^*\right)^{-1} f_\rho$$

where η_S and η_I are $(m-1) \times 1$ vectors. Element η_{Si} indicates the induced savings generated in the ith institutional sector, whereas η_{Ii} means the induced investments by the ith institutional sector. Then, the GIS and the GII are gained as follows:

$$H_S = \sum_{i=1}^{m-1} \eta_{Si}$$

$$H_I = \sum_{i=1}^{m-1} \eta_{Ii}$$

Finally, we can gain the NII as a monetary and financial policy evaluation indicator by subtracting the GIS from the GII:

$$H_N = H_I - H_S$$

The changes in the NII in period t can be calculated as the first difference of H_{Nt}:

$$\Delta H_{Nt} = H_{Nt} - H_{Nt-1}$$

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References

Braun M, Larrain B (2005) Finance and the business cycle: international, inter-industry evidence. J Finance 3:1097–1128
Copeland MA (1952) A study of money flow in the United States. NBER, Cambridge
Corbett J, Jenkinson T (1996) The financing of industry, 1970–1989: an international comparison. J Jpn Int Econ 10:71–96
De Haan L, Sterken E (2006) The impact of monetary policy on the financing behaviour of firms in the euro area and the UK. Eur J Finance 2:401–420
Kim J (2014) Financial structure of South Korea's chaebol and flow-of-funds analysis. Pan Pacific association of input–output studies. The 25th conference reports, pp. 93–97
Kim KS, Song EY (2012) Building flow of FX funds table: the case of Korea. Int Econ J 18(3):37–62 **(in Korean)**
Kim J, Nakano S, Nishimura K (2017) Multifactor CES general equilibrium: models and applications. Econ Model 63:115–127. doi:10.1016/j.econmod.2017.01.024
Klein LR (1983) Models of the economy as a whole. Lectures in econometrics. North Holland, Amsterdam, pp 1–46
Klein LR (2003) Some potential linkages for input–output analysis with flow-of-funds. Econ Syst Res 15(3):269–277
Manabe M (2009) Policy evaluation of public insurance institutions from the view points of flow of funds. Osaka University discussion papers in economics and business, No. 09-25 (**in Japanese**)
Manabe M (2014) Beikokuno Shikinjunkantoukei -Baransu Keisiki to Seidobumonkanno Matorikusuno Suikei (The flow of funds accounts in the US-construction of balanced form and estimation of inter-institutional sectors matrix). University of Hyogo discussion papers in simulation studies, No. 4 (**in Japanese**)
Marozzi M, Cozzucoli PC (2016) Inter-industry financial ratio comparison of Japanese and Chinese firms using a permutation based nonparametric method. Electr J Appl Stat Anal 9(1):40–57
Nishiyama S (1991) An interindustry study of flow-of-funds accounts in Japan. Ehime Econ J 11(2):27–40 **(in Japanese)**
Ogawa K, Sterken E, Tokutsu I (2012) Financial distress and industry structure: an inter-industry approach to the lost decade in Japan. Econ Syst Res 24(3):229–249
Park K (2003) Relationship banking and compensating balance: a theoretical approach. Korean J Money Finance 8(2):1–14
Reed Electronics Research (2005) The yearbook of world electronics data 2005—Americas, Japan, Asia Pacific, vol 2
Stone R (1966) The social accounts from a consumer's point of view. Rev Income Wealth 12(1):1–33
The Bank of Korea (2001) Explanation of flow of funds accounts. The Bank of Korea, Seoul **(in Korean)**
The Bank of Korea (2005) Financial statement Analysis for 2004. The Bank of Korea, Seoul **(in Korean)**
The Bank of Korea (2006) Financial statement analysis for 2005. The Bank of Korea, Seoul **(in Korean)**
The Korea Development Bank (2005a) Industry of Korea for 2005 (1). The Korea Development Bank, Singapore **(in Korean)**
The Korea Development Bank (2005b) Industry of Korea for 2005 (2). The Korea Development Bank, Singapore **(in Korean)**
The Korea Exchange (2005) Capital stock and total market capitalization (**in Korean**). http://eng.krx.co.kr
Tsujimura K, Mizoshita M (2002a) European financial integration in the perspective of global flow of funds. KEO discussion paper, No. 72
Tsujimura K, Mizoshita M (2002b) Flow-of-funds analysis-basic technique and policy evaluation. Keio University Publication, Tokyo **(in Japanese)**
Tsujimura K, Mizoshita M (2003) Asset–liability–matrix analysis derived from the flow-of-funds accounts: the bank of Japan's quantitative monetary policy examined. Econ Syst Res 15(1):51–67
Tsujimura K, Tsujimura M (2006) Does monetary policy work under zero-interest-rate? J Appl Input Output Anal 11&12:49–72
Tsujimura K, Tsujimura M (2008) International flow-of-funds analysis: techniques and applications. Keio University Press, Tokyo
Zhang N (2005) The global-flow-of-funds analysis in theory and application. Minerva-shobo, Kyoto **(in Japanese)**
Zhang N (2009) Re-examination of the theoretical model for global-flow-of-funds analysis. J Econ Sci 12:21–35