Comparison of several types of knowledge industries between Japan and Europe

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(First tentative draft, not completed yet and not to be quoted.)

1. Introduction

EU and Japan have proclaimed the research and innovation policy to accelerate the construction of their proper knowledge society. Since 1960's, a lot of policy studies have been reported on R&D policy, technology transfer process etc., but few observation has been reported on the international comparison about the characteristics of knowledge industry between Japan and European countries.

As OECD discussed on the trade distortion provided by "Industrial Policy" in 1960s-70s, a central governmental expenditure for promoting R&D activities was examined carefully by the experts of policy studies. OECD concluded that some part of industrial R&D activities was targeted to reinforce the competitiveness of new products and thus linked to the trade distortion. To avoid this type of governmental interference on the free trade system, a political concept was introduced to separate the R&D into 2 phases. The first one is "common and basic R&D" and second is "specific and applied R&D". The later has been carefully watched by member state of GATT.

Under the rapid globalization of economic activities, some private industrial sectors re-confirmed to ask their government to increase budget expenditure for R&D or to create more favourable tax system to help their companies' R&D investment. The edge of high technology was considered as a source of economic growth. The investors

shifted their money to ICT, bio-tech or nano-tech ventures, and the government, which is restrained not to increase any budgetary expenditure, shifted national higher education system and career developing system toward the wider in-house training system for younger doctors and researchers to let them convert to private companies from national laboratories, while private sector prefers to reduce the number of in-house researchers and to enjoy the new coordination system between university and company.

This newer R&D policy has been started in the middle of 1990 or later in Japan and in European countries almost simultaneously to tend to re-trap the technology gap widened against the American high tech industries.

- Japan introduced a new fundamental law to promote R&D in 1995. National expenditure for R&D reached 3% of GDP in 1999. After 2000, Japanese government started to look for better productivity of R&D activities.

- EU declared Lisbon Strategy in 2000 to create European knowledge society by 2010. EU made member countries to the obligation to let increase their R&D expenditure at the level of 3% of GDP by 2010.

Pressures of free trade competition in global market push advanced economies toward the competition of R&D investment and protection of intellectual property right. The battle field is knowledge industry where many students with higher educational background, not only natural sciences background but also social and liberal arts, started their career in emerging knowledge sectors.

The aim of this paper is to prepare the bases of international comparative policy studies by induction method through the observation of R&D policy data, labour matrix evolution data and namely Input-Output table (I/O table) data.

2. Definition of several types of knowledge industries

Policy studies cover the problematic of the actual society. The basic method is not deductive but inductive because policy studies start with observation of actual society and abstract a couple of problems, and tackle them with collaborative approach of academicians, industrialists, managers and experts of field workers.

General observation, classification of object sectors, collection of operational data sets, quantitative analysis, and visualisation of characteristics of object sectors are the typical flow of industrial policy studies before entering the educational-industrial-government cooperation study to conclude a proposal of new industrial policy.

Just starting from the observation of governmental statistics[1] such as censuses and surveys data, operational data are collected, and then, characteristics of the several types of knowledge industries are compared and analysed between Japan and European countries. This means that heuristic approach is applied in this paper rather than theoretical one[2].

Through the observation of the R&D expenditure data, labour matrix data and I/O tables, the essential data set is selected and compiled to compare the industrial structure which reflects the characteristics of knowledge industries between Japan and European countries.

To enable the international comparison, common criteria are introduced and the common 6sectors format of I/O table is proposed. These 6 sectors are composed of Clark's traditional 3 industries and newly defined 3 knowledge based industries. The later 3 industries are the technology improving knowledge industry, the outsourcing

[1] There are two fundamental laws in Japan concerning censuses and surveys: the Statistics Law and the Statistical Reports Coordination Law. They obliges people to make correct answer.

[2] Any theoretical model, pure physical, mechanical, economical, sociological, psychological nor political model is not treated in this paper.

depending knowledge industry and the contents creating knowledge industry, of which abbreviation is KIa, KIb and KIc respectively.

2.1. Criteria

To define the several types of knowledge industry, the following criteria were selected.

(1) The first criterion is the input coefficient of R&D activity of each industry,

(2) The second criterion is the number of in-house knowledge based employees, such as professors, researchers and engineers in each industry.

Before this selection of criteria, books and articles on "knowledge" industry or "information and communication" society were consulted.

2.1.1. Surveillance

For example, there are a lot of important books for starting consideration on the definition of knowledge industry, such as Marshall (1920) translated in Japanese by Nagasawa (1997), Machlup (1962) translated in Japanese by Takahashi and Kida (1969), Sakamoto (1968), Yasuda (1972), Hiromatsu and Ohira (1990), *etc.*

Machlup's definition of knowledge was too vague to apply to the international comparison and many successors proposed stricter definition to have an operational concept of knowledge. Ohira[3] reported that there were 4 different estimations existed in Japan for 1963 to 1967 just after the apparition of Machlup's work. The obtained results varied from 16% to 22% per GDP. Porat's definition[4] (1977) enlarged the concerning area of knowledge in the industrial activities with the wider definition of information

[3] Ohira, G. (2003) Joho-keizaigaku-ron no keifu – Joho-keizai kara digital economy he – (Genealogy of Information Economics – From Information Economy to Digital Economy) in: Joho-Tsushin-gaku (Theory of Information and Communication) (Tokyo, Zaidan-hojin Joho-tsushin-gakkai)

[4] Porat, M.U. (1977) The Information Economy (USA, Department of Commerce).

industry which was adopted and disseminated by OECD (1981)[5]. The results varied 37.9% for Japanese economy in 1990[6] estimated by Yoshikawa, Tamaru and Yamaguchi (1999) or 43.5% for Japanese economy in 1980 estimated by Ohira (1985).

Hiromatsu and Ohira (1990) re-defined the information industry in stricter manner. According to them, the industry which supplies only "Joho-zai", namely, information commodities or services shall be provided by a knowledge industry. Thus, they separated the information industry from two other similar industries; the information equipment industry and the information service industry. According to their stricter definition of the information industry, the estimation value added amount of Japanese knowledge industry covers only 3.1% of GDP in 1990.

In this manner, the definition of knowledge industry is not yet stable and not sufficient to be applied in international comparison for industrial policy studies.

2.1.2. Introduction of new criteria

Two new criteria to separate the industrial groups of sectors are introduced here.

The first criterion is the value of the input coefficient of research activity for each industrial sector. When the research input coefficient in a certain sector is higher than the average of all groups of sectors, this sector can be considered as an outsourcing depending knowledge industry. This sector pays a lot of money to buy the outsourcing research activities. For example, the research input coefficient of the medicine sector reaches 5.4%. It shows that they purchase 5.4 yen of outsourcing research intermediate service to product final product of 100 yen. The purchased research service is integrated

[5] *e.g.* Information, Computer and Communications Policy Information Activities, Electronics, and Telecommunications Technologies, Volume 1: Impact on Employment, Growth, and Trade No. 6 OECD.
[6] Yoshikawa, Tamaru and Yamaguchi (1999) Chishiki/ Joho-shuyaku-gata keizai heno iko to nihon-keizai (Evolution of knowledge or information intensive economy and Japanese economy) (Tokyo, Keizai-kikakutyo)

in the output, *i.e.* medicine, which is considered as knowledge based commodity. A knowledge based commodity is provided by a knowledge industry[7].
(see Figure 1: Dispersion of input coefficient of research activity, Japan, 1990, 95 and 2000)

The second criterion depends on the percentage of employees of knowledge based occupations; professors, researchers and engineers, in a certain sector.

If the weight of knowledge based employees is bigger than the average of whole sector, this sector can be considered a contents creating knowledge industry, because it produces more endogenous knowledge integrated commodities or services with the in-house work force, such as researchers, professors and engineers. (see Figure 2: Dispersion of knowledge based employees by industrial sector, Japan, 1990, 95 and 2000)

Marshall (1920) distinguished 6 categories of workers; primitive, skilled, general workers *etc.* and Machlup (1962) pointed that the education system created and diffused general knowledge (liberal arts). The role of general labour and workers in education are primordial in knowledge industry. It is obvious that the weight of total number of professors, researchers and engineers in a certain industry corresponds to the importance of general knowledge in this industry. This is the reason why the second criterion is proposed in this paper.

Two criteria proposed in this paper are not deductive results. The practical value of these analytical axes should be proved in an inductive process by the concrete data through the real world observation.

[7] This is the definition of knowledge industry by Hiromatsu and Ohira (1990).

2.2. Definition of the types of knowledge industry

2.2.1. Separation of cases

Applying above mentioned two criteria, four types of knowledge industry can be separated.

Type-a: both criteria are satisfied.

Type-b: the first criterion is satisfied.

Type-c: the second criterion is satisfied.

Type-d: no criterion is satisfied

Type-a industry purchases more outsourcing research activity than average and hires more knowledge based employees than average simultaneously. The characteristics of this type of industry can be labelled as “the technology improving knowledge industry”. The knowledge based employees are considered workers for improving the research result provided by research sector, *i.e.* adding some value added on the purchased outsourcing knowledge.

Type-b industry can be simply labelled as “the outsourcing depending knowledge industry”, because this sector hires less number of knowledge based employees than average so that the purchased outsourcing knowledge can be used without much improvement comparatively.

Type-c industry can be labelled as “the contents creating knowledge industry”, because this sector is considered that it depends on less outsourcing knowledge than average but with more in-house professors, researchers or engineers than average it can be more creative to produce the original contents of knowledge.

These knowledge based industries are also labelled with the abbreviation; KIa, KIb and KIc respectively.

Type-d industry is categorized in an ordinary industry and separated in 3 Clark's industries; the primary, secondary and tertiary industry. No specific label is given on this industrial category.

As the research activity input coefficient and the weight of knowledge based employees in all industrial groups of I/O table can take 0 to 1 figure continuously, the borders of these groups of industries are not obvious. It is clear that each industrial group shown in Figure 3-a does not form any autonomous cluster. If the separate point of each type of knowledge industry moves slightly upper or lower, the result of grouping or clustering operation would be changed sensitively.

This point will be discussed in the later part of this paper to ameliorate a cluster forming operation.

(see Figure 3-a: 2-dimensional distribution of 99 industrial sectors (Japan) and Figure 3-b: Schema of 2-dimensional distribution of 99 industries)

2.2.2 Characteristics of separated knowledge based industry

The explication of each type of knowledge based industry is as follows;

(1) Technology improving knowledge industry (KIa)

This industrial sector purchases intermediate research service from the research industry more than average of all groups of industry and improves the proper goods or services by the in-house professors, researchers or engineers. Output of this sector enjoys not only the integration of the outsourcing research activities but also improving

the proper products to higher knowledge intensive goods or services. This means a typical transforming or improving industry.

Typical industries in this category are; communication equipment, electric measuring instruments and electronic apparatus, electronic parts, computers and related apparatus, household use electron and electric apparatus, heavy electric machine, precision machines *etc.*

(2) Outsourcing depending knowledge industry (KIb)

This industrial sector purchases intermediate research service from the research industry more than average of all groups of industry but there is less value added process because there are less researchers or engineers in the proper sector than the average of whole industry. This sector prefers buying research activities to investing the proper human resource in R&D.

Typical industries in this category are; medicines, glass and glassware, chemical fertilizer, chemical fibres *etc.*

(3) Contents creating knowledge industry (KIc)

This industrial sector does not purchase average research service from the independent research industry but propels the knowledge creative activities by hiring researchers or engineers in the proper industry. There are more numerous in-house researchers, professors or engineers in this sector than other ordinary industry.

Typical industries in this category are; research, advertisements, investigations and information services, water service, electric power supplies, other engineering and construction *etc.*

2.3. Selected countries and period

For the reason of data availability, Japan, France, Germany, Norway and Switzerland are selected in CY2000 or CY2001 in this paper. We intend to extend this study further in other countries and period.

The I/O tables of France and Germany have been merged into one I/O table of which title is France+Germany or Fr+DE. This I/O table may be considered as one of the most advanced economies of European Union. Thus, the I/O tables of Norway and Switzerland will be merged into one for letting us observe the performance of EFTA advanced economies.

Thus, Japan, EU and EFTA can be compared in this paper.

3. Aggregation of I/O tables

The reason why I/O tables are aggregated in a fewer sectors is to let us observe the targeted industries at a glance, to let us by-pass the complexity of big I/O tables and to make comparison with much simpler and easier way.

As the aggregation process contains the inductive analysis, finding adequate definition of aggregated sectors is depend on heuristic trial and error method.

Before the aggregation of I/O tables, the first step is to collect the adequate I/O tables. Eurostat publishes 59 sectors I/O tables at basic prices for 2000 or 2001 and Japanese government publishes 99 sectors I/O table at producers' prices linked for 1990-1995-2000. We use these I/O tables downloaded via Internet.

Japanese government does not publish I/O tables at basic prises for CY2000. Ms ARAI Sonoe and Mr ARAKAWA Shinya, member of PAPAIOS, have reported a tentative compilation data of Japanese basic price I/O table for 2000[8].

The second step is to harmonize the definition of industrial classification. From 59 sectors Eurostat I/O table and 99 Japanese I/O tables, a sector to sector reference table was compiled. Mapping tables were prepared for Japan and European countries respectively to aggregate I/O tables into 6 sectors.

The final step is the aggregation of the each I/O table in 6 sectors; three sectors according to Clark's definition; the primary, the secondary, the tertiary, and three sectors of knowledge industries defined by above mentioned criteria and definition; KIa, KIb and KIc. Three traditional sectors extracted by the definition of Clark do not contain the part of knowledge based sectors which have been carried away into the newly defined knowledge based industries.

After the aggregation process, the monetary unit has been changed to Euro from Japanese yen or Norwegian kroner. The exchange rates used in this paper are 99.3 yen/Euro and 8.11 Norwegian kroner/Euro, respectively. These exchange rates reflect the average exchange rate for CY2000.

3.1. Aggregation of I/O table into 6 sectors

The 6 sectors I/O tables were aggregated from Japanese 1990-1995-2000 Linked I/O table at "producers' prices" composed of 99 industrial sectors and Eurostat I/O tables at "basic prices" composed of 59 industrial sectors for 2000 or 2001.

[8] Arai, S. (2006) 2000 Input-Output Tables for basic price and 2000 Inter-regional Input-Output Tables (Pan Pacific Association of Input-Output Studies, The 17th Conference, Okinawa International University October 28-29, 2006)

3.1.1. Primary industry, knowledge based sectors excepted

The primary industry, knowledge based sectors excepted contains; (1) Products of agriculture, hunting and related services, (2) Products of forestry, logging and related services, (3) Fish and other fishing products; services incidental of fishing and (4) Other mining and quarrying products.

3.1.2. Secondary industry, knowledge based sectors excepted

The secondary industry, knowledge based sectors excepted contains; (5) Food products and beverages, (6) Tobacco products, (7) Textiles, (8) Wearing apparel; furs, (9) Leather and leather products, (10) Wood and products of wood and cork (except furniture); articles of straw and plaiting materials, (11) Pulp, paper and paper products, (12) Printed matter and recorded media, (13) Coke, refined petroleum products and nuclear fuels, (14) Basic metals, (15) Fabricated metal products, except machinery and equipment, (16) Furniture; other manufactured goods n.e.c.

3.1.3. Tertiary industry, knowledge based sectors excepted

The tertiary industry, knowledge based sectors excepted contains; (17) Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of automotive fuel, (18) Wholesale trade and commission trade services, except of motor vehicles and motorcycles, (19) Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods, (20) Hotel and restaurant services, (21) Land transport; transport via pipeline services, (22) Water transport services, (23) Air transport services, (24) Supporting and auxiliary transport services; travel agency services, (25) Financial intermediation services, except insurance and pension funding services, (26) Insurance and pension funding services, except

compulsory social security services, (27) Services auxiliary to financial intermediation, (28) Real estate services, (29) Renting services of machinery and equipment without operator and of personal and household goods, (30) Public administration and defence services; compulsory social security services, (31) Health and social work services, (32) Sewage and refuse disposal services, sanitation and similar services, (33) Membership organisation services n.e.c., (34) Recreational, cultural and sporting services, (35) Other services, (36) Private households with employed persons.

3.1.4. Technology improving knowledge industry

The technology improving knowledge industry (KIa) contains; (37) Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying, (38) Uranium and thorium ores, (39) Metal ores, (40) Chemicals, chemical products and man-made fibres, (41) Machinery and equipment n.e.c., (42) Office machinery and computers, (43) Electrical machinery and apparatus n.e.c., (44) Radio, television and communication equipment and apparatus, (45) Medical, precision and optical instruments, watches and clocks, (46) Motor vehicles, trailers and semi-trailers, (47) Other transport equipment, (48) Secondary raw materials.

3.1.5. Outsourcing depending knowledge industry

The outsourcing depending knowledge industry (KIb) contains; (49) Coal and lignite; peat, (50) Rubber and plastic products, (51) Other non-metallic mineral products, (52) Post and telecommunication services. The medicine sector is not included in this KIb, but allocated in the technology improving knowledge industry (KIa), because it is not separated independently in the classification of Eurostat and it is classified in the (40) Chemicals, chemical products and man-made fibres, which belong to KIa.

3.1.6. Contents creating knowledge industry

The contents creating knowledge industry contains; (53) Electrical energy, gas, steam and hot water, (54) Collected and purified water, distribution services of water, (55) Construction work, (56) Computer and related services, (57) Research and development services, (58) Other business services, (59) Education services.

3.2. Result of I/O table aggregation and compilation

The provisional 6 sector I/O tables are shown in table 1 for Japan, table 2 for France + Germany, and table 3 for Norway respectively[9]. The 6 sector I/O table for Japan at basic prices, 6 sector I/O table for Norway + Switzerland at basic prices are under compilation.

Fig 4 shows the rapid comparison of the amount of sectoral demand or total uses of each economy.

Fig 5 shows the comparative industrial structure shown by the weight of final demand by sector.

3.2.1. 6 sector I/O table of Japan (at producers' prices)

Table 1 shows compiled 6sector input output table for Japan in 2000 to observe the characteristics and performance of different types of knowledge industries. Japanese 6 sector I/O tables are compiled from the linked I/O table for 1990-1995-2000 so that the evolution of the knowledge industry structure can be observed.

As basic price 6 sector I/O table for 2000 is under compilation, producers' price 6 sector I/O table for 2000 is shown in table 1 and analysed in this paper.

[9] The data of these tables may be corrected at the occasion of 16th conference in Istanbul.

The total amount of final demand of Japan in 2000 is about 5,225,504 million Euro[10] (producers' price), which is 4,444,676 Euro in France + Germany (2000, purchasers' price) and 242,052 in Norway (2001, purchasers' price).

Total of final demand for each type of knowledge industry in Japan is 731,783 million Euro for KIa, 91,008 million Euro for KIb and 1,119,957 million Euro for KIc, respectively. The weight of knowledge industries in Japan is about 14.0% for KIa, 1.74% for KIb and 21.4% for KIc. Total weight of KI in Japanese economy is about 37%. (see Table 1, Fig4 and 5)

3.2.2. 6 sector I/O table of France + Germany (at purchasers' prices)

Table 2 shows compiled 6sector input output table for France + Germany in 2000 to observe and compare the characteristics and performance of the different advanced economies; Japan, EU and EFTA.

The total amount of final uses of aggregated two EU countries; France and Germany in 2000, is about 4,444,676 million Euro (purchasers' price) and total of final uses for each type of knowledge industry in France + Germany is 996,989 million Euro for KIa, 97,934 million Euro for KIb and 657,773 million Euro for KIc, respectively. The weight of knowledge industries in France + Germany is about 22.4% for KIa, 2.20% for KIb and 14.8% for KIc. Total weight of KI in France + Germany economy is about 39.4%. (see Table 2, Fig4 and 5)

3.2.3. 6 sector I/O table of Norway (at purchasers' prices)

[10] The exchange rates used here is 99.3 yen/Euro.

Table 3 shows compiled 6sector input output table for Norway in 2001 to observe and compare the characteristics and performance of different types of knowledge industries and different advanced economies.

The total amount of final uses of Norway in 2000, is about 242,052 million Euro[11] (purchasers' price) and total of final uses for each type of knowledge based industry in Norway is 64,876million Euro for KIa, 3,347 million Euro for KIb and 29,984 million Euro for KIc, respectively. The weight of knowledge based industries in Norway is about 26.8% for KIa, 1.38% for KIb and 12.4% for KIc. Total weight of KI in Norway economy is about 40.1%. (see Table 3, Fig4 and 5)

4. Observation

4.1. Comparison of the industrial structure of Japan, EU and EFTA economy.

(1) Comparison of size

Comparison of the outline of industrial structure of Japan, EU and EFTA economies are presented in Figure 4a where the amount of total production or total uses is compressed in logarithmic number because of the better visibility. The original numbers are presented in Table 1, 2 and 3.

The amount of final demand for the tertiary industry is the biggest and the technology improving knowledge industry (KIa), the contents creating knowledge industry (KIc), the secondary industry, the outsourcing depending knowledge industry (KIb) and the primary industry become smaller gradually. The amount of the KIb is smaller than other types of knowledge industry because it is composed of fewer sectors.

[11] The exchange rate used here is 8.11Norwegian kroner/Euro.

The amount of final demand by each sector or the total amount of final demand (GDP) of Japan is bigger than any other economy. (see Figure 4a)

Though the pattern of distribution of final demand of 6 sectors in Figure 4a looks like coherent, the distribution of final demand by sector presents different impression in Figure 4b where the distribution of final demand by sector is expressed in component rate (weight of sector).

(2) Comparison of component rate (weight of sector)

The total weight summarized of KIa, KIb and KIc in total final demand of each economy is not so different. Norwegian's total knowledge based industry (KI) weight reaches 40% as a top of 3 economies, and France+Germany's KI weight follows it with 39% and Japan's weight is 37%.

These figures are comparable with the some results calculated under Porat's knowledge based industry definition; 43.5% for Japan in 1980[12] or 37.9% for Japan in 1990[13].

Figure 4b shows that the weight of Japanese tertiary industry (after having carried away the part of knowledge based sectors) is 55.7%, and France +Germany is 43.1% and Norway is 43.7%. This can be explained by the assumption that Japanese tertiary industry does not contain the important weight of the knowledge based industries in any types. By contrast, Japanese secondary industry contains bigger knowledge based industries which has been carried away to certain knowledge based industries, and it represents smaller weight than other economies apparently.

[12] Hiromatsu, T. and Ohira, G. (1990)
[13] Yoshikawa, Tamaru and Yamaguchi (1999)

Japan shows bigger part of the contents creating knowledge industry (KIc) of which figure is 21.4% than other types of knowledge industry, France+Germany 15.7% and Norway 13.4%.

France+Germany and Norway economies show bigger part of the technology improving knowledge industry (KIa) of which figure is 28.9% and 23.8% respectively. Japan's weight of KIa is 14.0%. This difference between Japan and European economies is focussed in later part.

The outsourcing depending knowledge industry; KIb does not cover bigger part of industrial activities in any economy. The figures of Japan, France+Germany and Norway are 1.7%, 2.3% and 1.5% respectively.

Before entering the further discussion, it had better confirm the sensibility of grouping method again. The separation between KIa, KIb or KIc is not self-evident. For example, the chemical end-products (except medicine) sector belongs to KIa and the sector of medicine belongs to KIc under the actual criterion. The former figure of input coefficient of research activity is 0.22 and the later figure is -0.07 when the average number is assumed zero (method of standardized data), so that two industries are considered as different type of knowledge based industry.

Anyway, the borders of industrial groups should be determined objectively, transparently and mechanically by the simplest way for affording the international comparison for applied policy studies.

4.2. Comparison of Final Demand Vector and Value Added Vector in three types of KI

4.2.1. Final demand vector

Final demand vector is composed of final consumption expenditure, gross capital formation and exports. Japan produces the intermediate goods and services in 2000 of which value is 4,319,935 million Euro, and the total final demand: 5,770,934 million Euro which is composed of the final consumption expenditure: 3,886,035 million Euro, the gross capital formation: 1,305,979 million Euro and the exports: 578,920 million Euro (at current price). The corresponding figures of France+Germany are 2,993,374, 4,196,023, 2,469,852, 692,291 and 1,033,880 million Euro at current price for the intermediate expenditure, the total final demand, the final consumption expenditure, gross capital formation and exports respectively in 2000. Norway's final demand vector is composed of 143,528, 224,355, 105,235, 33,570 and 85,550 million Euro (at current price) for the intermediate expenditure, the total final demand, the final consumption expenditure, gross capital formation and exports respectively in 2001.

Thus, the final demand vectors according to the type of knowledge based industry; KIa, KIb and KIc are calculated and presented in Figure 6a, 6b and 6c.

The composition of final demand vector of KIa is presented in Fig 5a. European economies show clearly bigger weight of exports than Japan, in spite of the fact that the specific crude petroleum export pushes up the weight of KIa of Norway.

While Japanese technology improving knowledge industry; KIa, is composed mainly of "information and machinery industry"; such as automobiles, communication equipment, electric measuring instruments and electronic apparatus, electronic parts, computers and related apparatus, household use electron and electric apparatus, heavy electric machine, precision machines *etc.*, the performance of the European KIa reflects the potential of international competitiveness of "transformation technology of raw materials and chemical industries"; such as crude petroleum and natural gas; services

incidental to oil and gas extraction excluding surveying, chemicals, chemical products and man-made fibres.

Figure 6b shows the outsourcing depending knowledge industry's final demand composition. The distribution pattern of final demand of this KIb is quite similar, except of the France+Germany exports pattern. The weight of exports of this EU economy is observed much higher than Japan. The KIb is composed of coal and lignite; peat, rubber and plastic products, other non-metallic mineral products, and post and telecommunication industry. The weight of coal related industry is less important in Japan and EU economy can be much competitive in these industries.

Figure 6c shows the contents creating knowledge industry (KIc)'s final demand composition. KIc is composed of Electrical energy, gas, steam and hot water, collected and purified water, distribution services of water, construction work, computer and related services, research and development services, other business services and education services.

Electrical energy, gas, steam and hot water, collected and purified water and distribution services of water provide mainly the intermediate services and construction work provides capital formation.

Japanese KIc is highly oriented to the gross capital formation in the final demand vector. This means probably that the some of the sectors of KIc, such as construction work provides big plants or public construction work. Other groups of knowledge providing service sectors in the KIc, such as research, advertisements, investigations and information services *etc.* prefer providing incorporeal property to power plants. The weight of construction industry may be bigger in Japan than in European economies.

This is the reason why Japanese KIc provides more capital formation than intermediate demand.

4.2.2. Europe's superiority in knowledge industry exports

Some major points are observed in a comparison of final demand structure in the specifically compiled 6 sectors input-output table.

The first one is the superiority of exports observed in European economies.

(1) High competitiveness of European technology improving knowledge industry (KIa)

Norway enjoys the export of crude petroleum and France+Germany enjoys the export of chemical products. These industrial sectors belong to the technology improving knowledge industry (KIa) of which definition is "higher input coefficient of research activities and numerous knowledge based employees; professors, researcher or engineers". Their products or services are oriented to the exports mainly (see Fig 6a). This shows the high competitiveness of European KIa in the world. The motor vehicle, chemicals, chemical products and man-made fibres, and machinery and equipment industries export 150,409, 121,856 and 110,219 million Euro respectively. The export ratio of chemicals is the highest; 40.3%, and 40.0% for machinery and 39.2% for motor vehicle.

Development of crude oil production needs the accumulation of academic researchers, highly trained people, data processing ability of geological information and enormous research reports. But the base of the competitiveness of this type of industry may be the scale. Large scale production site is primordial for surviving in the world market and it is too difficult to maintain and develop a new production site without

European industries' expertise. The similar situation is able to be imagined in chemicals industry development process.

(2) Few rivalry in KIa between Japan and Europe

On the other hand, Japanese KIa's exports are composed of motor vehicles, machinery and information technology goods and services. The final demand of KIa in Japan is mainly allocated to the intermediate demand and capital formation. These industries need numerous knowledge based employees and skilled workers, and scientific or technical information network to develop the new state-of-the-art industrial products and its production-line. Production-line is less agglomerated than chemicals industry but dispersed in many local sites because it has to adopt the technology innovation or the evolution of market needs as soon as possible. This type of industry can be classified in a crenelation industry ("l'industrie de crenaux" in French word) of which domestic market condition is so competitive that there is few reserve for exports. Japanese market trains its domestic KIa.

Japan and Europe are enjoying this type of industrial segregation at the technology improving knowledge industry (KIa).

(3) Little dependence of KIb and KIc on exports

France+Germany's outsourcing depending industry (KIb) exports 44,330 million Euro in 2000, of which 28,664 million Euro is exported by rubber and plastic products (export ratio: 27.2%). This industry's input coefficient of research activity is positive while the weight of knowledge based employees is negative so that it is classified in KIb. But it is near the position of inorganic basic chemical products industry which is grouped in KIa, where European chemicals industry is the most competitive industry. Next to the rubber and plastics industry, the other non-metallic mineral products

industry exports 12,342 million Euro similar to the rubber and plastics final demand vector (export ratio: 17.0%).

However, the post and telecommunication industry and the coal and lignite industry are the domestic demand oriented industries of which export ratio are 2.5% (3,115 million Euro in 2000) and 3.4% (209 million Euro) respectively.

Contents creating knowledge industry (KIc) is exporting little amount of its final demand in any economies but European KIc shows the cross border business in even the research services and electricity sector. EU's single market policy in services endeavours for the market integration. For example, the sector of "Research and development services" in France+Germany economy exports 6,668 million Euro in 2000. The export ratio reaches 12.2%. Other business services exports 27,123 million Euro. This is 5.6% of export ratio. Computer and related services exports 6,352 million Euro, export ratio 6.1%. Electrical energy, gas, steam and hot water exports 3,605 million Euro, export ratio 3.6%.

The post and telecommunication industry is classified in KIb and Electrical energy, gas, steam and hot water industry is classified in KIc in this paper but the both are classified in KIc according to another year I/O data. The former exports 2.5% of total production and the later exports 3.6% under the similar single market policy of EU committee.

4.2.3. Personnel cost and capital cost

Figure 7a, 7b and 7c show the value added structure in Japan, France+Germany and Norway. Compensation of employees and reserve of capital depletion are both highly distributed to the tertiary industry and KIc in any economies. According to the

definition of knowledge based industry, the weight of highly educated workers, such as professors, researchers and engineers, is bigger in KIa and KIc.

The added value vector of each economy is presented in Figure 8a, 8b and 8c.

The added value vector of Norwegian KIa is strongly influenced by the presence of the crude petrol industry with the highest operating surplus and reserve of capital depletion.

<Further analysis will be added before the 16th Istanbul Conference of IIOA>

4.2.4. Analysis with labour matrix and social data

The number of professors has been increased in the 1990-1995-2000 period despite of clear decrease of the number of salaried researchers in private sectors. It is possible that this social movement accelerated the exchange of information between academia and industry in Japan while the compensation of employees of the knowledge based industry simply increased from 25 trillion yen to 30 trillion yen in ten years from 1990 to 2000.

<This part will be presented before the 16th Istanbul Conference of IIOA>

4.4. Characteristics of input coefficient vector of each country

Figure 8a, 8b and 8c show the input coefficient table for Japan, France+Germany and Norway.

<This part will be presented before the 16th Istanbul Conference of IIOA>

5. Assessment of inductive price augmentation of personal cost in knowledge industries

The propagation of indirect effects of higher labour cost in KIa, KIb and KIc has been analysed in Japan, France+Germany and Norway. The comparison of I/O propagation analysis via value added process shows us that higher knowledge cost pushed up the KIc output prices in European economies but not in Japan. KIc corresponds to design intensive industry such as construction and engineering industry.

<This part will be presented before the 16th Istanbul Conference of IIOA>

6. Conclusion

<This part will be presented before the 16th Istanbul Conference of IIOA>

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Table 1: Aggregated 6 sector I/O table for Japan, producers' price in 2000

Tble 1: 6sectors IO table compiled from_linked_IOtable_1990-95-2000_Japan
curent_price in 2000 million Euro (exchange rate 99.3yen= 1 Euro)
basic exchange table (99 sectors)

		1	2	3	A	B	C	105			118	124	125	128
	BRANCHES	primary	secondary	tertiary	knowredge A	knowledge B	kowledge C	total of intermediate production	Final consumption expenditure	Gross fixed capital formation	exports adjusted	total of import (deduction)	total amount of final demand	domestic production
1	primary industry	15732	82740	13298	2084	6974	8806	129634	39867	9817	869	−22993	27559	157193
2	secondary industry	18299	331391	189109	141110	13593	202282	895783	441714	14513	44216	−154505	345938	1241721
3	tertiary industry	23533	156917	634731	176023	61433	239928	1292565	2765022	116300	99814	−71876	2909259	4201824
A	knowledge creative industry A	7839	87592	148277	555364	32063	47808	878940	203360	379467	407554	−258599	731783	1610723
B	knowledge creative industry B	1698	27769	76301	69933	61634	112598	349933	93981	−597	16611	−18988	91008	440941
C	knowledge creative industry C	3036	69180	307657	165503	47541	180162	773079	342091	786479	9855	−18469	1119957	1893036
105	total of intermediate production	70136	755589	1369373	1110017	223237	791583	4319935	3886035	1305979	578920	−545430	5225504	9545439
107	final consumption expenditure by non-households	1637	20673	84862	31037	18428	36427	193063						
108	compensation of employees	15023	210976	1426060	276186	105553	741520	2775319						
109	operating surplus, gross	48460	89751	640851	68369	26674	97014	971118						
110	reserve for capital depletion	15975	55893	453260	96052	52997	138354	812532						
111	reserve for capital depletion (part of public works)	0	15	97963	0	0	24559	122537						
112	indirect tax (except tariff)	7778	114234	165149	29626	14264	72165	403215						
113	subsidies (deduction)	−1814	−5410	−35695	−564	−213	−8585	−52281						
125	total value added	87057	486132	2832452	500706	217703	1101454	5225504						
128	total of industrial product	157193	1241721	4201824	1610723	440941	1893036	9545439						
129	total pure product (element cost)	63482	300727	2066911	344555	132227	838534	3746437						
130	gross domestic product	85421	465459	2747589	469669	199276	1065027	5032440						

(articulated input-output table for 1990-1995-2000, edited and published by Japanese Governemnt, translated in English by NAKANO Yukinori, 01 March 2007)

Table 2: Aggregated 6 sector I/O table for France + Germany, basic price in 2000

Table 2: 6sector Input-output table at basic prices
EU_Fr_DE_siot2000 Mio. Euro current prices
Year: 2000
FINAL USES

	PRODUCTS (CPA)	1	2	3	A	B	C							
	BRANCHES	primary industry	secondary industry	tertiary industry	knowledge industry category A	knowledge industry category B	knowledge industry category C	Financial intermediation services indirectly measured (FISIM)	Total	Final consumption expenditure	Gross capital formation	Exports	Final uses	Total use
1	primary industry	11922	69579	5747	1026	4559	5522	0	98356	32972	3295	14813	51080	149436
2	secondary industry	14098	233070	101556	119598	8404	63852	0	540579	326154	36738	219186	582078	1122657
3	tertiary industry	15004	87818	458584	85705	21847	135646	99119	903722	1641245	50358	118565	1810169	2713891
A	knowledge industry category A	11474	82365	55316	343600	33291	52792	0	578837	163249	240612	593128	996989	1575826
B	knowledge industry category B	1815	22991	40880	45375	41751	58890	0	211703	54070	−466	44330	97934	309637
C	knowledge industry category C	6798	77247	243316	114904	25965	191949	0	660177	252161	361755	43857	657773	1317950
60	Total	61111	573070	905398	710208	135816	508651	99119	2993374	2469852	692291	1033880	4196023	7189397
61	Taxes less subsidies on products	2658	10068	57386	15370	3895	20229	0	109606	200266	49106	−719	248653	358259
62	Total intermediate consumption/Final use at purchasers' prices	63769	583138	962785	725578	139711	528880	99119	3102980	2670118	741397	1033161	4444676	7547656
63	Compensation of employees	18547	165508	861122	238465	74149	455944	0	1813736					
64	Other net taxes on production	−1728	7406	36882	7431	−1018	6676	0	55649					
65	Consumption of fixed capital	8264	21930	199729	26873	16566	58513	0	331876					
66	Operating surplus, net	32955	73103	586536	34026	34822	228294	−99119	890618					
67	Operating surplus, gross	41219	95033	786265	60899	51388	286807	−99119	1222494					
68	Value added at basic prices	58038	267947	1684269	306796	124520	749427	−99119	3091879					

(Eurostat I/O data compiled by Nakano in 6 sectors)

Table 3: Aggregated 6 sector I/O table for Norway, basic price in 2001

Table 3: 6sector Input-output table at basic prices for Norway (2001)
Norway
Year: 2001 Mio. Euro (exchange rate: 8.11 NAC =1 Euro) current prices

Code	PRODUCTS (CPA)	1	2	3	A	B	C							
	HOMOGENEOUS BRANCHES	primary industry	secondary industry	tertiary industry	knowledge industry category A	knowledge industry category B	knowledge industry category C	Financial intermediation services indirectly measured (FISIM)	Total	Final consumption expenditure	Gross capital formation	Exports	Final uses	Total use
1	primary industry	498	4533	260	171	153	207	0	5822	1063	302	1243	2608	8430
2	secondary industry	1461	9772	7234	3460	440	3780	0	26148	11081	2133	12259	25473	51621
3	tertiary industry	636	4729	26627	4961	1439	6943	4698	50033	73575	5145	19346	98067	148100
A	knowledge creative industry A	551	4913	4573	8467	628	2164	0	21295	5463	11950	47463	64876	86171
B	knowledge creative industry B	152	1115	2858	863	2960	2059	0	10007	2102	353	891	3347	13354
C	knowledge creative industry C	364	2232	12675	2532	1644	10775	0	30223	11951	13686	4347	29984	60207
60	Total	3662	27294	54228	20454	7263	25928	4698	143528	105235	33570	85550	224355	367883
61	Taxes less subsidies on products	96	−193	4405	21	75	947	0	5351	13894	3374	430	17697	23048
62	Total intermediate consumption/Final use at purchasers' prices	3758	27101	58634	20475	7337	26875	4698	148879	119129	36944	85980	242052	390931
63	Compensation of employees	1066	6644	44385	7523	2601	21716	0	83935					
64	Other net taxes on production	−971	−171	−906	746	−97	113	0	−1288					
65	Consumption of fixed capital	1155	1396	12862	7539	975	2690	0	26616					
66	Operating surplus, net	2155	2641	21355	29095	635	4696	−4698	55880					
67	Operating surplus, gross	3311	4037	34217	36634	1610	7386	−4698	82496					
68	Value added at basic prices	3405	10510	77696	44903	4113	29215	−4698	165143					

(Eurostat I/O data compiled by Nakano in 6 sectors)

Figure 1: Dispersion of input coefficient of research activity, Japan, 1990, 1995 and 2000

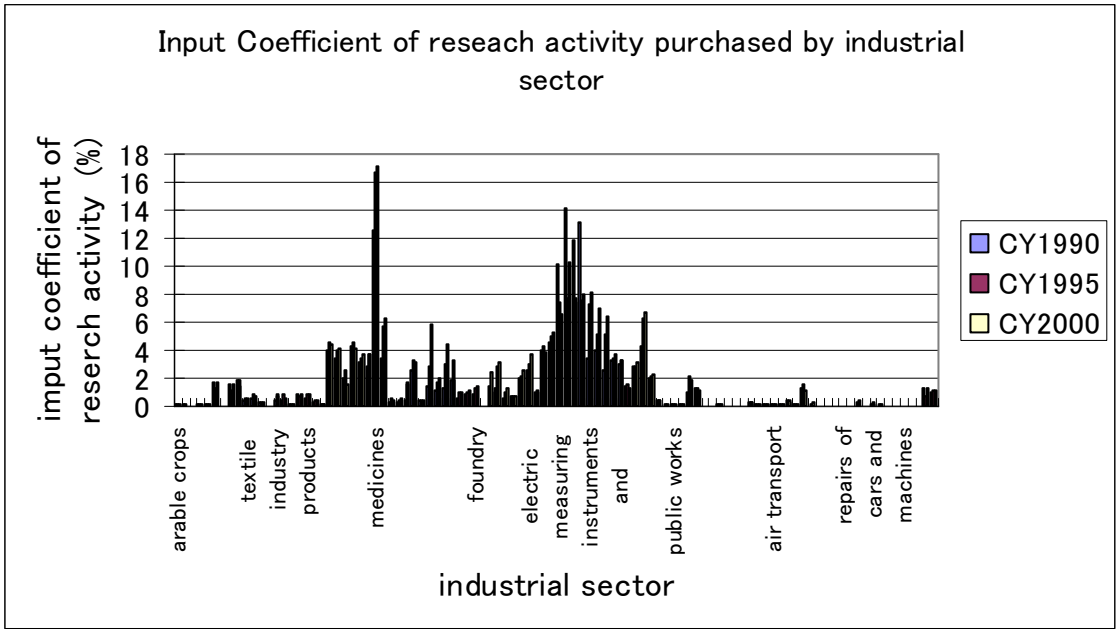


Fig 2: Dispersion of knowledge intensive employees by industrial sector, Japan, 1990, 1995 and 2000

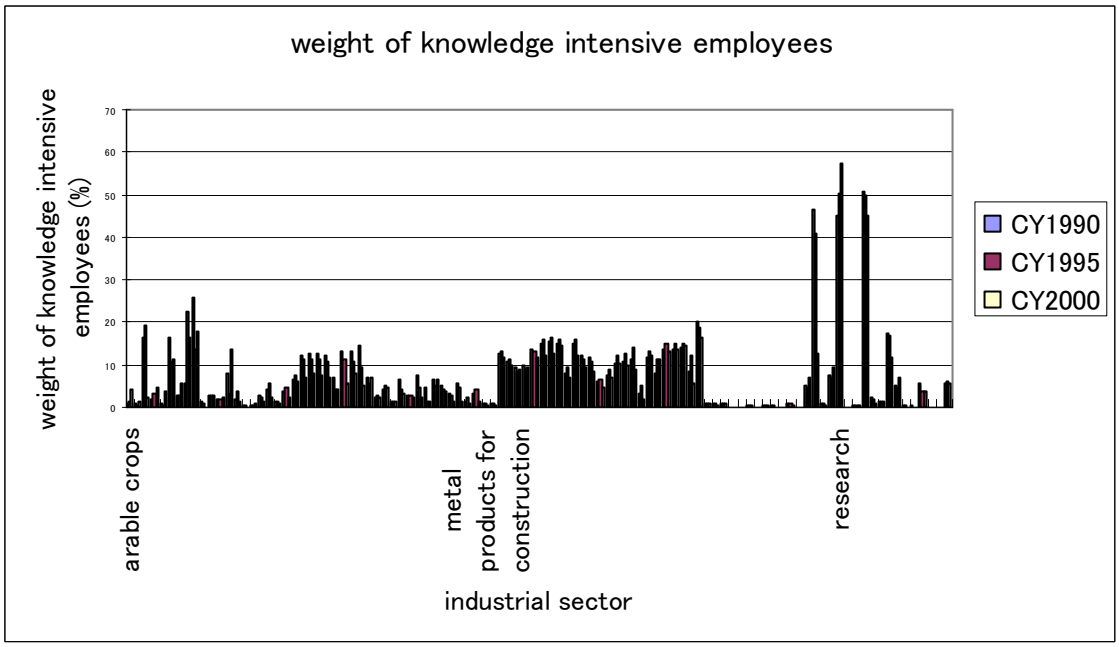


Figure 3-a: 2-dimensional distribution of 99 industrial sectors (Japan)
(classification by the criteria; research activity input coefficient
and input number of knowledge based employees)

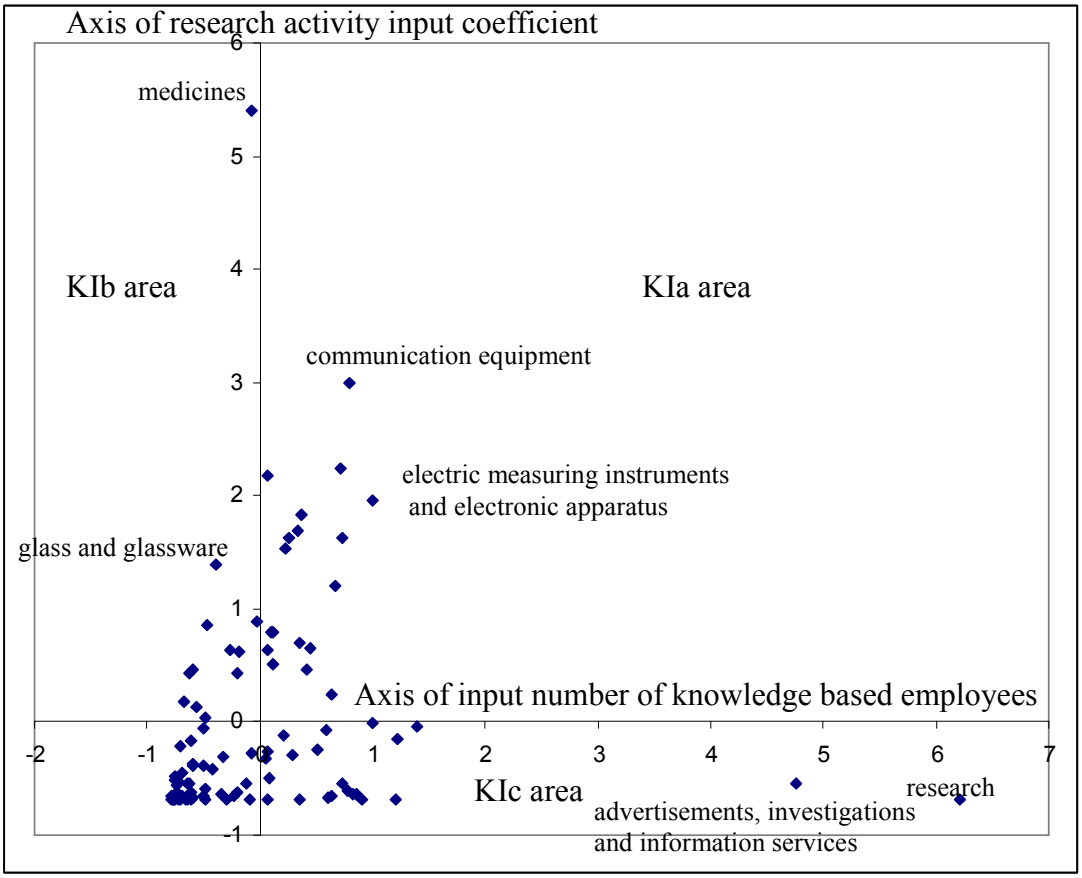
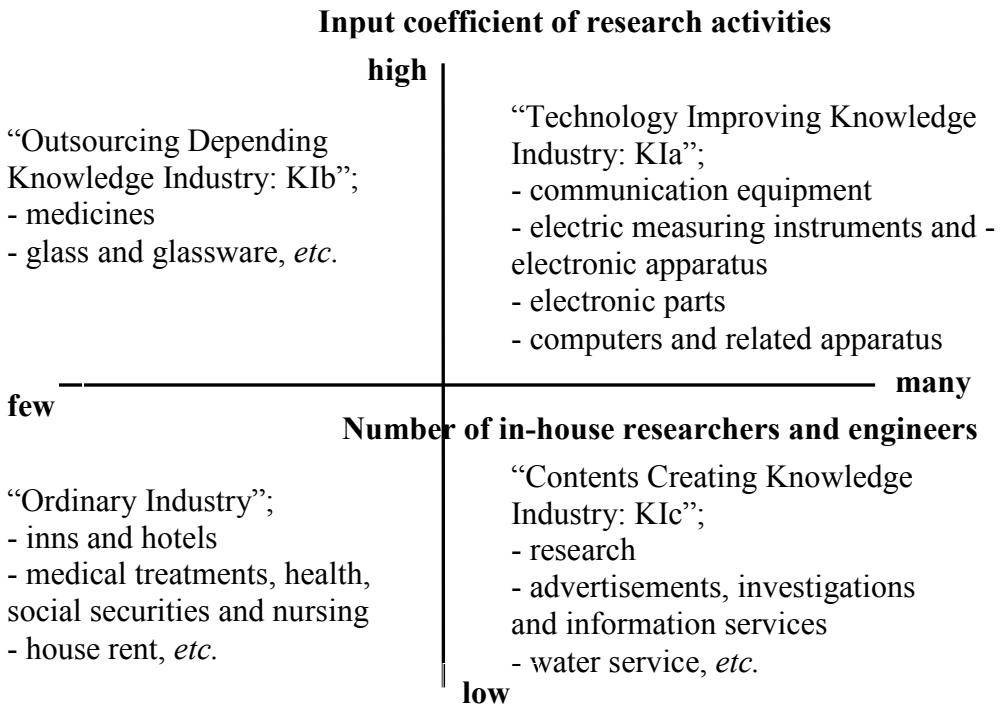


Figure 3-b: Schema of 2-dimensional distribution of 99 industries



note;
The first dimension area shows "Technology Improving Knowledge Industry: KIa",
The second dimension area shows "Outsourcing Depending Knowledge Industry: KIb",
The third dimension area shows "Ordinary Industry",
The forth dimension area shows "Contents Creating Knowledge Industry: KIc".

Figure 4a: International comparison of outline of industrial structure
(Amount of final demand or total uses by industry in Japan (2000), France+Germany (2000) and Norway (2001))

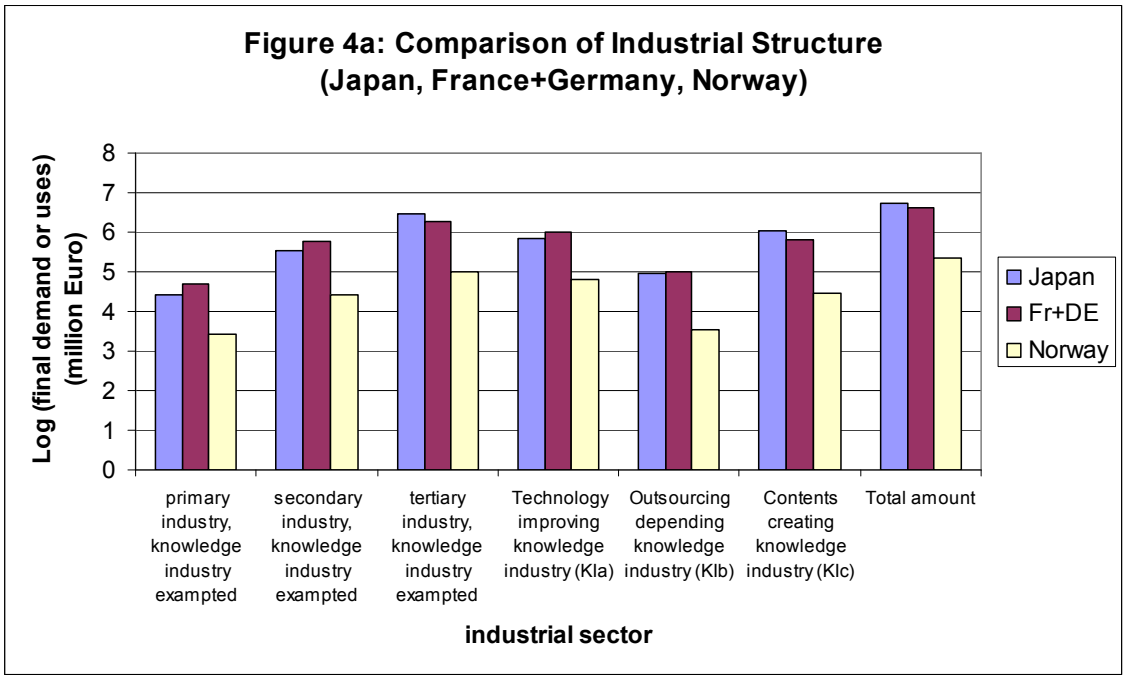
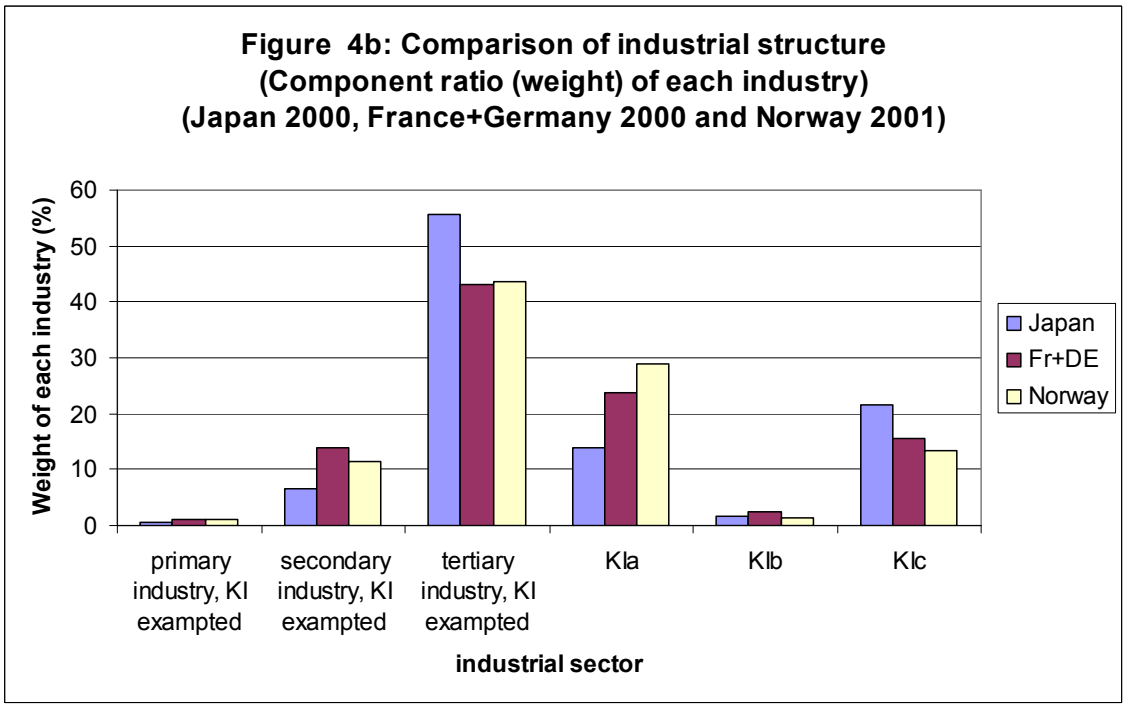


Figure 4b: Comparison of the outline of industrial structure
(Weight of each industry by final demand in Japan (2000), France+Germany (2000) and Norway (2001))



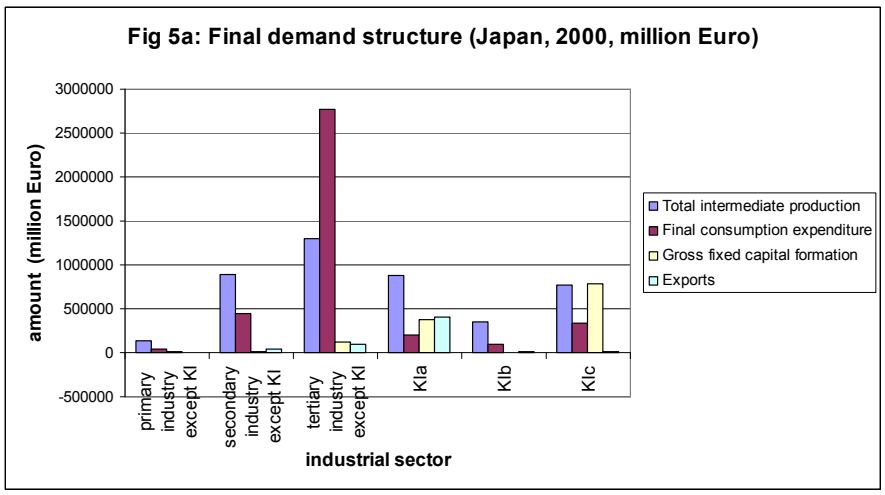


Fig 5a: Final demand structure (Japan, 2000, million Euro)
amount (million Euro)
3000000
2500000
2000000
1500000
1000000
500000
0
-500000
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
industrial sector
Total intermediate production
Final consumption expenditure
Gross fixed capital formation
Exports

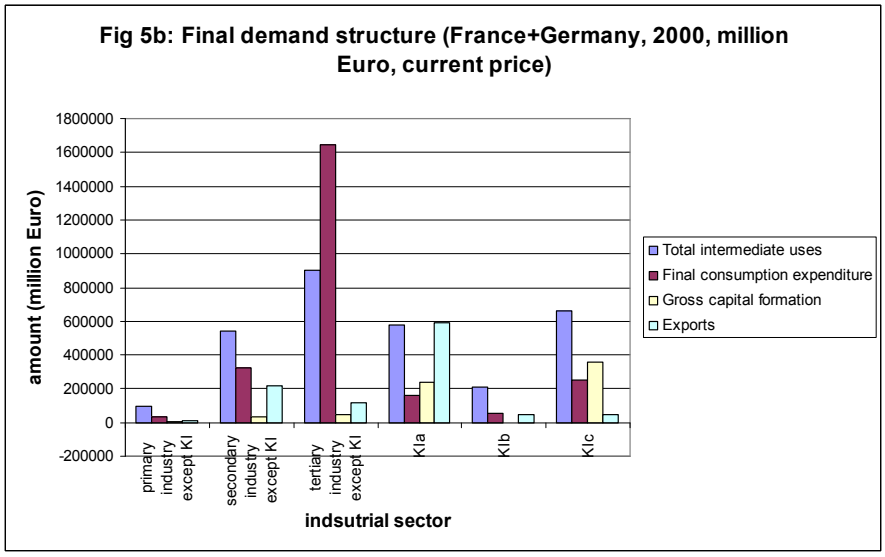


Fig 5b: Final demand structure (France+Germany, 2000, million Euro, current price)
amount (million Euro)
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
-200000
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
indsutrial sector
Total intermediate uses
Final consumption expenditure
Gross capital formation
Exports

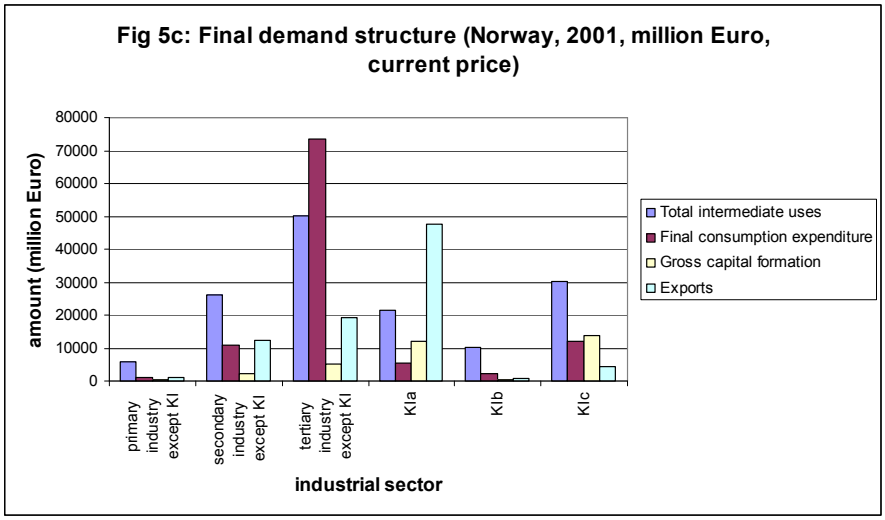


Fig 5c: Final demand structure (Norway, 2001, million Euro, current price)
amount (million Euro)
80000
70000
60000
50000
40000
30000
20000
10000
0
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
industrial sector
Total intermediate uses
Final consumption expenditure
Gross capital formation
Exports

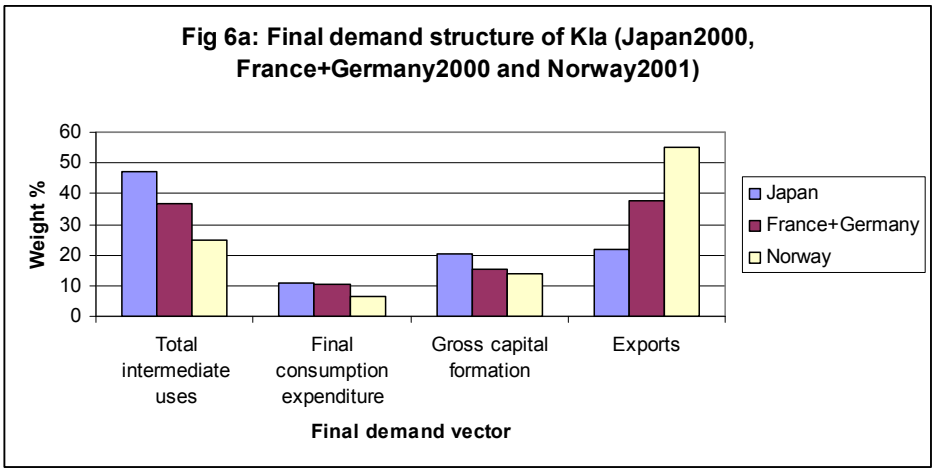


Fig 6a: Final demand structure of Kla (Japan2000, France+Germany2000 and Norway2001)
Weight %
60
50
40
30
20
10
0
Total intermediate uses
Final consumption expenditure
Gross capital formation
Exports
Final demand vector
Japan
France+Germany
Norway

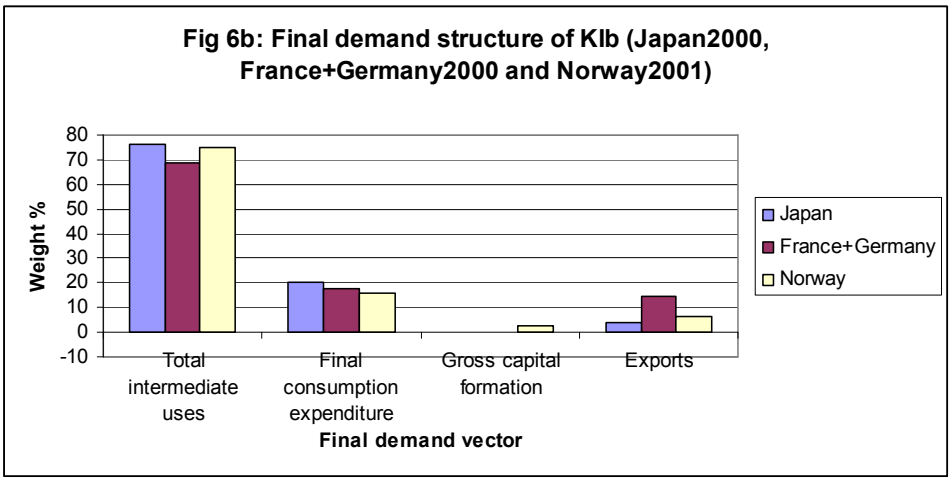


Fig 6b: Final demand structure of Klb (Japan2000, France+Germany2000 and Norway2001)
Weight %
80
70
60
50
40
30
20
10
0
-10
Total intermediate uses
Final consumption expenditure
Gross capital formation
Exports
Final demand vector
Japan
France+Germany
Norway

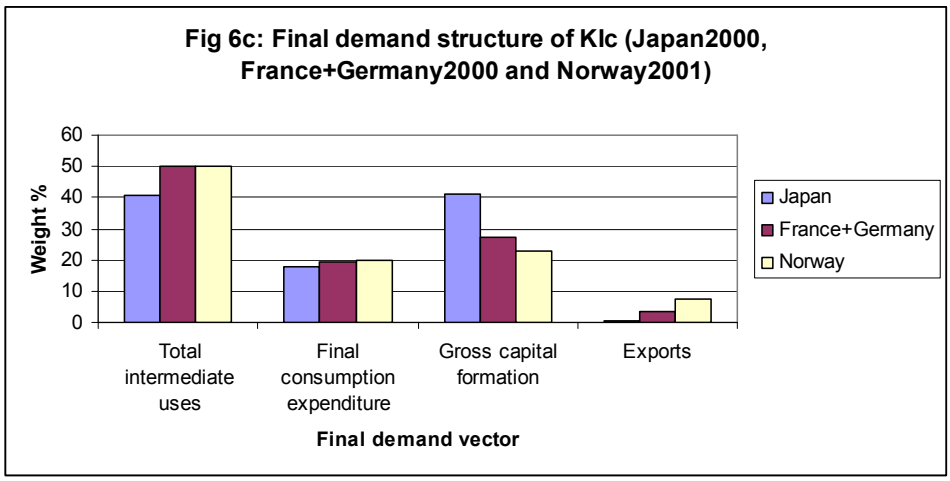


Fig 6c: Final demand structure of Klc (Japan2000, France+Germany2000 and Norway2001)
Weight %
60
50
40
30
20
10
0
Total intermediate uses
Final consumption expenditure
Gross capital formation
Exports
Final demand vector
Japan
France+Germany
Norway

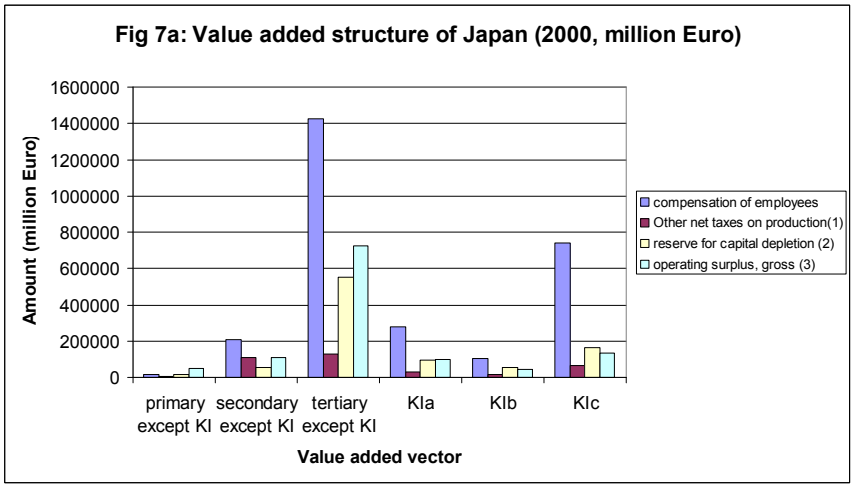


Fig 7a: Value added structure of Japan (2000, million Euro)
Amount (million Euro)
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
primary except KI
secondary except KI
tertiary except KI
KIa
KIb
KIc
Value added vector
compensation of employees
Other net taxes on production(1)
reserve for capital depletion (2)
operating surplus, gross (3)

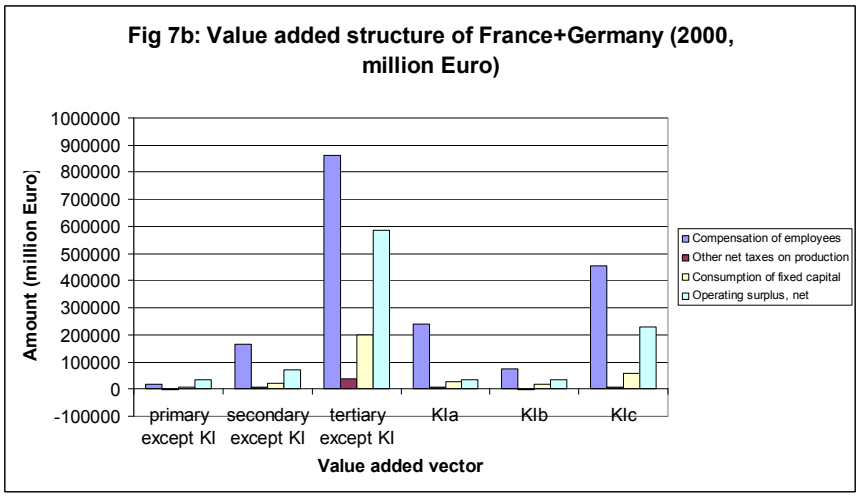


Fig 7b: Value added structure of France+Germany (2000, million Euro)
Amount (million Euro)
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-100000
primary except KI
secondary except KI
tertiary except KI
KIa
KIb
KIc
Value added vector
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net

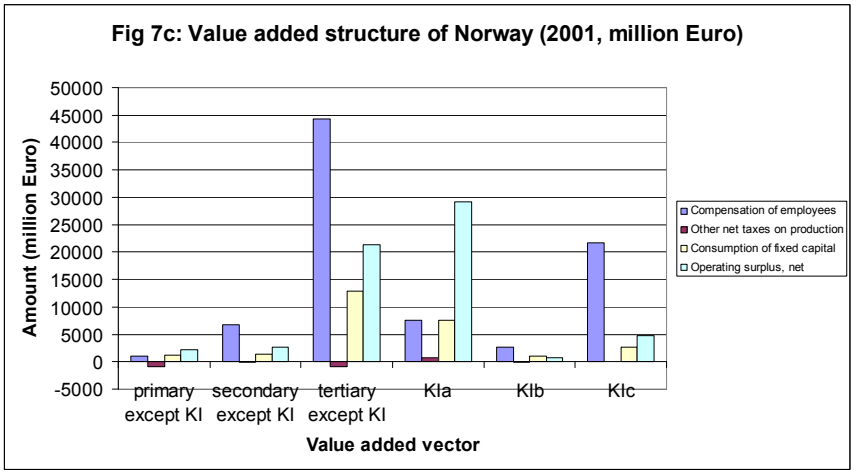


Fig 7c: Value added structure of Norway (2001, million Euro)
Amount (million Euro)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
primary except KI
secondary except KI
tertiary except KI
KIa
KIb
KIc
Value added vector
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net

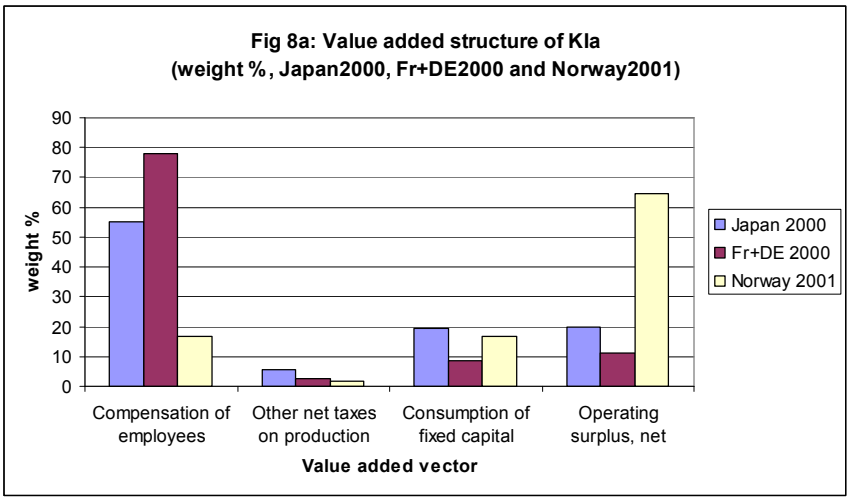


Fig 8a: Value added structure of KIa
(weight %, Japan2000, Fr+DE2000 and Norway2001)
weight %
90
80
70
60
50
40
30
20
10
0
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Value added vector
Japan 2000
Fr+DE 2000
Norway 2001

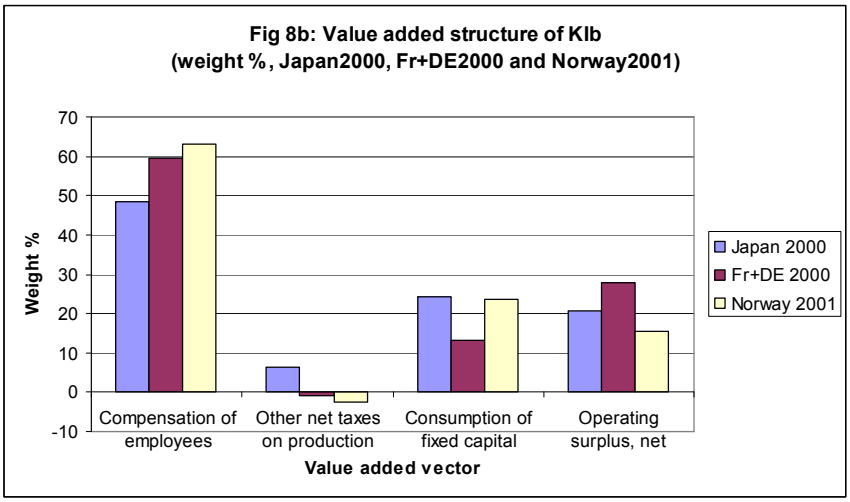


Fig 8b: Value added structure of KIb
(weight %, Japan2000, Fr+DE2000 and Norway2001)
Weight %
70
60
50
40
30
20
10
0
-10
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Value added vector
Japan 2000
Fr+DE 2000
Norway 2001

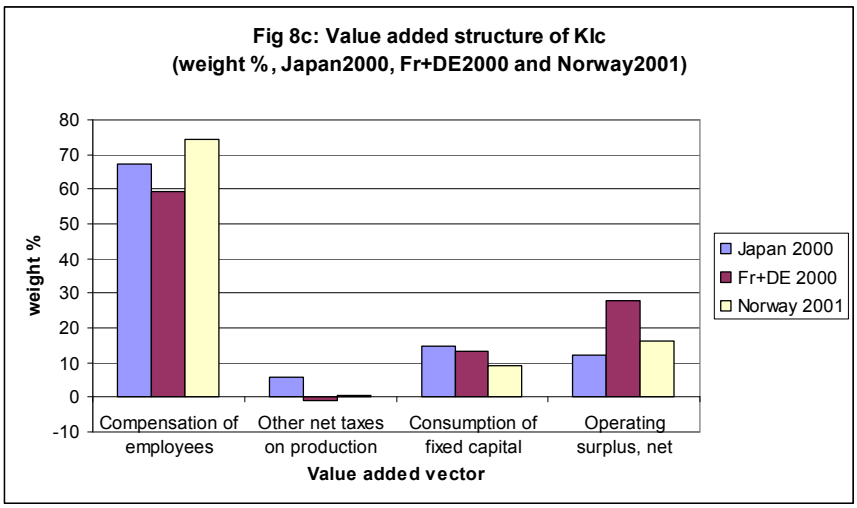


Fig 8c: Value added structure of KIc
(weight %, Japan2000, Fr+DE2000 and Norway2001)
weight %
80
70
60
50
40
30
20
10
0
-10
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Value added vector
Japan 2000
Fr+DE 2000
Norway 2001

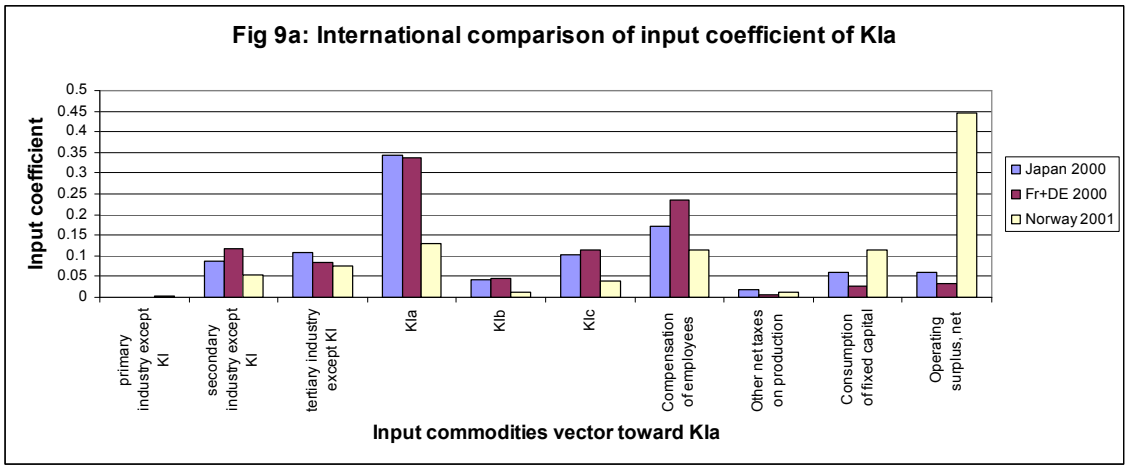


Fig 9a: International comparison of input coefficient of KIa
Input coefficient
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Japan 2000
Fr+DE 2000
Norway 2001
Input commodities vector toward KIa

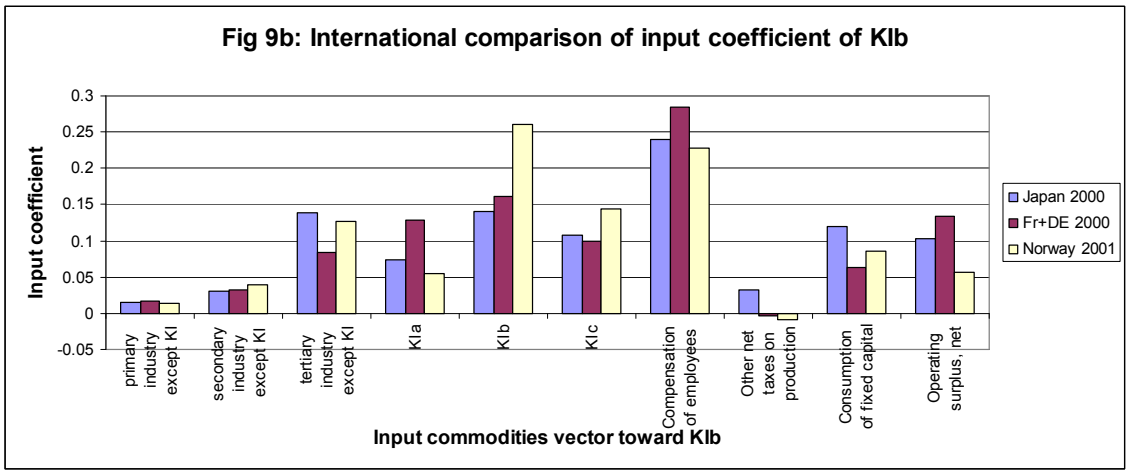


Fig 9b: International comparison of input coefficient of KIb
Input coefficient
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Japan 2000
Fr+DE 2000
Norway 2001
Input commodities vector toward KIb

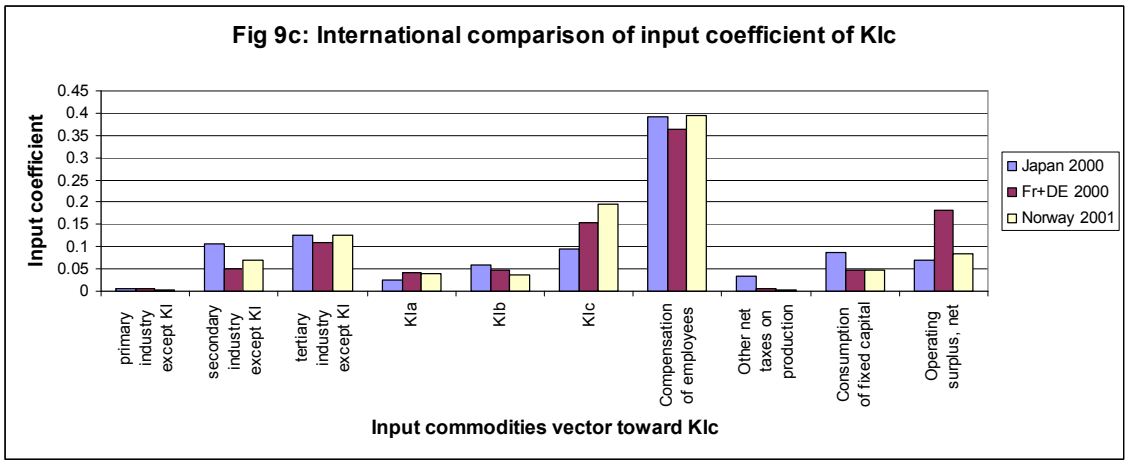


Fig 9c: International comparison of input coefficient of KIc
Input coefficient
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
primary industry except KI
secondary industry except KI
tertiary industry except KI
KIa
KIb
KIc
Compensation of employees
Other net taxes on production
Consumption of fixed capital
Operating surplus, net
Japan 2000
Fr+DE 2000
Norway 2001
Input commodities vector toward KIc