Technology Choice in the IT Industry and Changes of the Trade Structure

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Abstract

In the IT industry, there has been a remarkable increase in the demand for system LSI. A system LSI must be produced, tailor-designed for each electrical appliance. It is said that this production method has made the IC cycle ambiguous in recent years. It can be sought that the choice of whether the economy pursues a development path centering on technology which is tradable or technology which is embodied in labor, depends on the historical background. The relationship between these two types of technologies is changing rapidly every one or two years. In this background, the analysis is focused on the new trend of technology. In the section 2, the newest trend of technology in the field of system LSI is explained. Then, which kind of technology will be developed and how it will have an affect in the near future, is considered.

Keywords: Technology Choice, IT industry, Trade Structure, System LSI
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Introduction

IT (Information Technology) industry is growing rapidly and its scale in production and demand is also very large. Japanese IT industry has been in full flourish in 1980's. However, then, its share in the world market shrunk affected by the technology progress of CPU (Central Processing Unit) in the United States and the investment behavior of Korean IT firms like an intense deluge taking advantage of the economies of scale that characterize the industry. The rapid progress of IT technology started to demand more salient function of IT products such as mobile phone digital camera and car navigation system. This phenomenon increased the demand for the system LSI (Large Scale Integrated Circuit) sharply. It is said that the business cycle caused by the IC (Integrated Circuit) become ambiguous because the system LSI is produced according to order. From 2003, Japanese IT firms started to recover rapidly by the increase in production of system LSI focusing on the digital household appliance. There are no scale merits in the production of system LSI and the technology embodied in labor is needed for it. It is produced by firms of Japan, Europe, and the United States. It is possible to categorize developments into two types. The first is the type which is promoted by the tradable technology and the second is the type which is promoted by the technology embodied in labor. It can be thought that the technology choice depends on the historical background. IT firms in the United States produce focusing on versatile products which can be manufactured by the method of mass production. IT firms of Japan and Europe produce focusing on the system LSI. Now, these two types of technologies are in the relationship of competition and the dominancy is alternated periodically. It is important to understand and predict the trend of IT technology to capture and analyze the economic development. In the next section, the trends of IT technology and industry, and the technology choice are explained.

The relationship between these two types of technologies is changing rapidly every one or two years. In this background, the analysis is focused on the new trend of technology. In the section 2, the newest trend of technology in the field of system LSI is explained. Then, which kind of technology will be developed and how it will have an affect in the near future, is considered.

1 IT Technology and an Economy

In the trade theory, until the 1980's, Heckscher-Ohlin-Vanek model was very popular. This model can be summarized as follows. In two economies, we have two factors of production, capital and labor, and they have different ratios of factor endowment. At the same time, factor endowments are fixed. It is assumed that we have two products such as agricultural and manufactured products. The production is conducted under the perfect competition with the production function which have the property of the constant return to scale. Then, it is assumed that the same technology is used in production in these two economies. The capital (labor) intensive good never change to the labor (capital) intensive good even if the price ratio of production factors change. In these two economies, the common and homothetic social welfare function which mean the share of consumption expenditure is determined when the relative price is determined, unrelated to the income level. The income elasticity of two goods is one. Factors of production can move inside economies with no costs, however, can not cross the border. Two goods are traded with no costs under free trade. Trade balance is always in equilibrium and there are no borrowing and lending between two economies. It is possible to summarize the conclusion which is brought by assumptions described above, as follows.

1. Stolper-Samuelson Theorem

When the relative price of labor intensive good increase, wage increases more and the price of capital service decreases under the assumption of production factors being constant.

2. Rybczynski Theorem

When prices of goods are constant and the endowment of labor increase, the production of labor intensive good increases more and the production of capital intensive good decreases.

3. Factor Price Equalization Theorem

When two economies produce two goods, prices of production factors are equalized in them.

4. Heckscher-Ohlin Theorem

The economy which is abundant in labor, exports labor intensive good and the economy which is abundant in capital, exports capital intensive good.

It seems like that the model described above have a shortage in explanation of change of trade structure caused by the rapid growth of IT industry from 1990's. In 1989, the production of Japanese IT industry shared 53% in the world. After that, with the breakdown of so-called "Babble Economy" its share started to decrease rapidly and this trend held more than ten years. IT firms of the United States, such as Intel[1] and AMD, monopolized the production of MPU(Micro Processing Unit) and they occupied the large shares in the production of semi-conductor. IT firms of the United States started to have the strategy as follows. they concentrated resources of management on invention, innovation, and designs of products to avoid risks accompanied by plant and equipment

investment. They disassembled production process into two parts. The first is so-called “Fables” which is related to invention, innovation, and designs of products. The second is related to the real production. They started to take the latter on consignment. In Taiwan, IT firms such as TSMC[2] and UMC[3] which produce semi-conductor appeared. It is possible to find the effect of government policy on the background. A semi-government firm took the role of Research and Development for the production of semi-conductor and private firms could concentrate management resources on production process. It can be thought that IT firms of Taiwan could make rapid growth supported by introduction of technology from Japan and the United States, and government policy. Then, IT firms of Taiwan started to specialize into the consignment from the United States, that is to say, the foundry, They were started to be set in the business model of the United States. On the other hand, Japanese IT firms had the top share in the field of DRAM (Dynamic Random Access Memory) in the world, around 90 %, in the second half of 1980’s. However, Korean IT firms such as Samusung repeated investments like intense deluges an intense deluge, taking advantage of the economies of scale that characterize the industry and increased shares. In 2004, Japanese share decreased to less than 10%. In this situation, Japanese IT firms changed the strategy and shifted from DRAM to the system LSI for the digital household appliance. The feature of Korean IT firms is to repeat large investments taking advantage of scale merits in the fields of LCD (Liquid Crystal Display) and DRAM. In this way, they succeeded to capture large share, however, they are below in the technology, compared with Taiwan[4].

According to Ikeda[20], it is said that horizontal division of labor will be more beneficial when needs for feed-backs of information in design and production become small, in a matured stage of technology. In this situation, outsourcing of parts should be beneficial. However, in it is not possible to find any superiority of horizontal division of labor in the growing stage of technology in which feed-backs of information in designs and productions are active. Formerly, it was said that the strength of Japanese IT firm is based on the sharing of intelligence and information in a firm. By the intensive exchange of information between the stages of design and production, problems in the stage of production were reported to the stage of design and the quality of products was improved. It is possible to find this type of technology structure in the industry which has complicated production process with large number of parts, like in the automobile industry. However, since 1990’s, in industries such as the semi-conductor, design was started to be conducted using the computer language with modules. Then, it became possible to divide the production process into the fables and the foundry. Problems in the stage of production became controllable in the stage of design. They succeeded in shortening of period in production and reduction of costs. In the field of three-dimensional CAD (Computer-Aided Design), we can find same phenomena.

In 2003, Japanese IT firms started to show the rapid recovery. In 2004, they shared 28% of production in the world, which is next to 40% of the United States. Before, mobile-phone had only

one function of talking. Now, it has other functions such as TV reception, photograph and television telephone. Then, the production of digital household appliances such as digital camera and DVD recorder increases rapidly. The production method of module mentioned above could not satisfy the needs in this kind of progress of function. To produce such kind of manufactured goods, the technology of system LSI is needed. It is to design LSI for each product item and assemble them. For the production of system LSI, frequent exchanges of information and adjustments between the stage of design and production, are necessary. The technology embodied in labor is observed in this field. Firms in Japan, Europe and the United States are producing system LSI (For example, Panasonic and Hitachi in Japan, ST Micro Electronics in France and Italy, Texas Instruments in the United States) Formerly, in the sector of semi-conductor, at first, firms estimated the demand of it , then invested and started to produce. It was rather hard to meet the demand and supply. Four-year cycle existed in the production of semi-conductor. However, the production of system LSI is conducted by tailor-design. It is said that the cyclical movement become ambiguous.

As mentioned above, in 2003 a large change in the IT industry occurred. In 2003 and 2004, Japanese IT firms increased productions and profits smoothly. Then, in 2005, profits decreased considerably by intensified competition. At the same time, development of the substitutable technology with the system LSI became active. It is so-called ASSP（Application Specific Standard Product）The tradable technology and the technology embodied in labor are in the relationship of competition and it seems like that the dominancy is alternated periodically. In the background of the development of ASSP, it is possible to find the effect of “Moore’s Law” which means the capacity of memory becomes twice by every one year and half. It seems that this periodical alternation of dominancy will be held for seven year from now on[5 6].

Mainly, firms of the United States develop technologies based on invention and innovation. Firms of Japan and Europe are good in the system LSI. The fact that firms of the United States are good in tradable technology and firms of Japan and Europe are good in the technology embodied in labor, was pointed out before the start of IT industry already. It seems like that each economy has proper technology which depends on the historical background.. It is rather unrealistic that technology is chosen by the relative price of capital and labor, and envelopes of group of production functions.

According to the Heckscher-Ohlin theorem, each economy has the same technology and the economy which is abundant in capital exports capital intensive good and the economy which is abundant in labor exports labor intensive good. This theorem can not explain the trade and economic situation in this age with the rapid progress of technology. Leontief pointed out that the United States which should be the capital abundant economy exports labor intensive goods and imports capital intensive goods for 1960’s. Leamer[1980] argued against this contention with changing the calculation method. But, it is not an decisive argument. Trefler[1995] inspected this theorem with

comparing the real trade and the trade which is estimated by factor endowments. The, he explained some points which is not consistent with that theorem, using the idea of home bias in consumption and the technology difference in each economy. He compared the real exports and exports capacity about 9 kinds of production factors and 33 countries. He pointed out that it is often that the real export is rather small even if the export capacity is large. He called it "the missing trade"[7]. The correlation coefficient of production factor which is contained in export and factor endowment from which domestic consumption deducted, is only 0.28. Then, he calculated the surplus capacity of export which is gained by deducting real export from export capacity by each country and each production factor. He found that if the country is poorer, it has more production factors of which surplus capacity of export is large[8]. If the country is poorer, it is more passive in export. He called it "the factor endowment paradox".

He explained "the missing trade" by the biased preference of consumer toward domestic product. For example, if a high tax rate is set for foreign product, domestic product is consumed a lot. Then, real export becomes very small. He explained "the factor endowment paradox" as follows. In the case of richer country, the share of investment in expenditure is larger. Therefore, if we recalculate with excluding investment, the difference disappears. Then, he presented the alternative explanation for that theorem, using technology difference. It is assumed that the technology of rich country is neutral and the technology of poor country is not neutral. For example it is assumed that France and Germany have the same capital-labor ratio, but, Bangladesh has the different capital-labor ratio in the agricultural sector. Maskus[1985], Brecher etc.[1988], and Bowen[1987] argued about the Heckscher-Ohlin theorem. However, only Arminton[1969] and Trefler[1995] presented the alternative explanation.

It is plausible that each economy has a proper combination of capital and labor which depends on the historical background. It seems like that Ricardian model is more preferable to Heckscher-Ohlin model, with assuming that capital labor ratio is constant and proper for each economy, and direction of technology progress is proper for each economy. In this background, labor is omitted in the estimation of potential production function in the macro econometric model for Hungary described below. In cases of Japan and Germany, they use more labor than capital. In the case of the United States, they use more capital than labor. In the case of Korea which pursues scale merit with introducing technology from Japan and the United States, they use capital most. In the case of Taiwan, they use a lot of capital, but, it is less than Korea. Generally speaking, in Western Europe, it seems like that technology is embodied in labor. However, in Eastern Europe it seems like that situation is different by each country. In the case of Czech, they experienced the development of machine and precise machine industries already before the World War II. It seems that the combination of capital and labor is similar to Germany. In the case of Hungary, the situation is different. Hungary has a small population, around 10 million, however, it is possible to find many

famous scientists especially in the field of physics and chemistry. Foreign firms, such as IBM (International Business Machines Corporation), Nokia (Nokia Corporation), Siemens (Siemens AG), and Intel set up institutes for Research & Developments. Hungary became the base for research activity of IT in Eastern Europe. Especially, in the case of IBM, they have about one thousand researchers in that institute. Its scale is same with the Mitsubishi Research Institute in Japan. Recently, exports of IT industry are growing rapidly in Hungary. It may be plausible that such research activities are started to be linked with IT industry, in Hungary. On the other hand, in the case of Poland, it is impossible to find similar phenomena. In Poland, each sector of manufacturing is showing similar movement and the economy is showing the steady performance as a whole. It is important to capture the trend of technology when we analyze the economy which is driven by IT industry. According to the Moore's law, capacity of memory doubles by one year and half. Demands for functions are sophisticated more and the technology embodied in labor such as the system LSI obtains dominancy. In this condition, the economy which is good in this kind of technology increases production and export. However, then, scientists and engineers try to replace the technology embodied in labor to versatile technology brought by invention and innovation. To predict the trend of IT technology and capture the effect to economies, the structure of IT technology, focusing on the system LSI, is explained in the next section.

2 Development of the System LSI

In 1990's, the share of Japanese IT in the world reduced consecutively. On the other hand, Japanese IT firms started to focus on the production of System LSI on which memory, logic, and peripheral devices are integrated. The information of semi-conductor and System LSI is from [16], [17], and [27].

For the production of System LSI, many devices are needed, which are as follows, Individual Semiconductor such as transistor and diode, Optical Devices such as bipolar analog and luminescent diode, Memory Oriented Semiconductor such as DRAM, SRAM[9], and flash memory, and ASIC[10] such as calculate logic oriented semiconductor, gate array, and standard cell. Japanese firms have basis of production for these items. In the case of Game Device, the technology of System LSI is used for the Cell Engine in Play station 3 of Sony and Game Cube of Nintendoh. For the production of digital household appliances such as Plasma TV, digital camera, and DVD recorder, System LSI is necessary. The technology of System LSI has some features. At first, the period to develop and produce System LSI is long. Then, the production volume for one product (appliance) is small. Thirdly, profit margin is small because variety of products (appliances) is very large. In the case of digital camera, reorganizations of firms were

conducted. Some makers of optical camera and makers of digital household appliances were integrated. However, still, in the field of digital household appliances, many firms are producing various appliances with high qualities and low prices. Sony, Canon, Olympus, Fujifilm, Nikon, Casio, Konica-Minolta, and Pentax are Japanese firms in this field. Some firms such as Fujitsu, Rohm, Toshiba, and Renesas Technology are supplying System LSI for digital camera. Fujitsu has a feature to produce System LSI which is applicable to various appliances. Rohm developed the design system named "Real Socket" which make possible to design more complicated System LSI compared with the standard level, easily. Toshiba is producing System LSI using NAND type Flash Memory which has been originated by it. Renesas Technology produces DSP[11] which is the core part of mobile phone. It is producing the System LSI using SH Micom which is the name of that DSP. The size of the market of digital camera is more than 10 billion US Dollars and Japanese firms occupy 90 % of it. However, there are too many firms and production volume of each product is too small. It is impossible to capture a large profit.

Japanese government adopted the individual standard, PDC[12] for the second generation of the mobile phone. As the result, Japanese market became to be separated from the world market. Japanese firms are producing mobile phones with various functions such as TV phone etc. However, the volume of export and the production volume of each product are small. BlackBerry and iPod which are kinds of the smart phone and have been developed from PDA[13], has showed the boom in markets of Western Europe and North America. In Japan, it has not showed a boom. But, at the same time, the export of Japanese mobile phone has not increased rapidly. Now, two standards of mobile phone, CDMA2000 and W-CDMA are competing in Japan.

It seems like that Panasonic have a strategy to reduce the variety of products and monopolize some products. They succeeded to increase the production volume for each product. This strategy is effective especially in DVD recorder and Plasma TV. It gained top shares and large profitability in markets. Its management is still robust in this worldwide economic depression. Panasonic is producing OFDM LSI for digital TV receiver, MPEG-4 Multi Codec LSI and System LSI for digital Hi-vision TV etc. other than them. As described above, it is important to increase the production volume of each product. It could be said that firms which implemented this task, increased their profitability.

In the field of digital household appliances, the demand for System LSI was expected much more initially, around in 2003. However, the real demand was smaller. Then, recently, the demand of System LSI is increasing rapidly in the automobile

industry. The amount of production in automobile industry is about 700 billion US dollars every year in the world. It is about 200 billion US dollars in the case of personal computer, about 140 billion US dollars in mobile phone, and about 350 billion US dollars in digital household appliances. Now the amount of parts related to IC is about 5% of car production. But, in 2015, the amount of production in automobile industry is predicted as about 1 trillion US dollars. Then, it is forecasted that 20% of it is for parts related to IC.

In Japan, Kyushu area is showing the rapid increase of car production[14]. In 1994, they produced about 380 thousand cars in Northern Kyushu area. They produced more than 500 thousand cars in 1996, and about 700 thousand cars in 2003. Miyata Factory of Kyushu Toyota increased their production capacity in 2005. In 2006, Karita Factory of Kyushu Toyota started its operation. Related firms to Toyota, such as Aishin Kyushu in Kumamoto (in Kyushu), Koito Kyushu in Saga (in Kyushu), Denso Kita-Kyushu, have plans to increase investments rapidly. Daihatsu-Shatai started the operation of Nakatsu Factory in Oita (in Kyushu) in 2004. Daihatsu has a plan to build a new factory in the neighbor of Nakatsu Factory for complete cars. They will produce 200 thousand cars in 2009. Nissan-Kyushu started operation in 1976. Now, 4700 employees are working. Nissan-Shatai has a plan to transfer the equipment of Shonan Factory to Kyushu to increase the production capacity. In Yamaguchi prefecture which is next to Kyushu, Mazda has its main factory, Hohu Factory. In Kumamoto, Honda has its main factory of motor-cycle. Honda is now producing large and middle size motor cycles in Hamamatsu Factory. t seems like that they transfer the production to Otsu Factory in Kumamoto. They are going to increase the production from 500 thousand to 1 million, annually. They will concentrate the production to Kumamoto. It can be thought that the production of cars in Kyushu will exceed 1 million in 2009. The non-profit corporation, Kitakyushu Foundation for the Advancement of Industry Science and Technology FAIS), which is an organization of industry-university cooperation, is supporting to promote car-electronics in Kita-Kyushu area, having functions of semi-conductor technology center and supporting center for small size ventures. Kyushu area has an accumulation of factories of semi-conductor makers and occupies 30% of domestic production. Many bases of design and development for semi-conductor were created in Momochi in Fukuoka City supported by the Plan of Silicon Sea Belt promoted by Fukuoka Prefecture. In Momochi, Sony, Hitachi, NEC, and Fujitsu are operating. In Kita-Kyushu City, Toshiba Kita-Kyushu Factory is producing analog semi-conductors, Yasukawa Electronics is producing robots, and Zenrin is producing soft wares for car navigators. Also, many material makers for semi-conductors such as

Mitsubishi Chemical and Shokubai-Kasei are operating in this area. Fukuoka prefectural government set up Fukuoka System LSI Development Center which is the core of the silicon sea belt in 2004. They intend to bring up ventures of semi-conductor which work for designs of IT. They set up educational organizations such as System LSI colleges also.

Kumamoto prefecture occupies about 40% of production in semiconductors in Kyushu. NEC Kyushu, Sony Semi-Conductor Kyushu and Renesas Technology are operating. Then, Tokyo Electron Kyushu which is the device maker, Teradyne which is the tester maker, Mitsui Hi-Tech which is the maker of lead frame, and Tokyo Ouka Kogyo which is the maker of photo resist, have their factories. Kumamoto prefectural government is promoting the Plan of Kumamoto Semi-Conductor Forest. They intend to invite firms related to semi-conductors into the prefecture and increase the shipment up to 10 billion US dollars until 2010 and implement the projects for semi-conductors. They also intend to bring up 1000 engineers for semi-conductors and bring up 100 ventures for semi-conductors. Kagoshima (in Kyushu) prefectural government has the Plan of Electronic Device Frontier. Nagasaki (in Kyushu) prefectural government has the Plan of Electronic Device Nagasaki. It seems like that usage of IC parts for cars increase certainly according to the development of car industry. Especially in Kyushu area, it can be thought that it is possible to find synergism of these two industries. Elpida Memory was set up by the integration of DRAM sectors of Hitachi and NEC in 1999. But their management was not in good condition for a long time. In 2002, its share in the world market was only 5%. Mr. Yukio Sakamoto who is originally from Japan-Texas Instruments was installed as the president. Then its achievement started to show rapid improvement. Supported by the active investment, it showed about 200 million US dollars surplus which was the record in the settlement of account in September 2006. In 2005, it had shown deficit of about 60 million US dollars. In the world market it is possible to find Samsung Electronics, Qimonda, Hynix, and Micron. Now, Elpida has the share of 10% next to these firms in the market. Recently, they announced that Elpida had a plan to invest about 16 billion US dollars and build factory of DRAM in Taiwan. They have the cooperation with Taiwanese firm, Power Chip. If this investment is realized, it can be thought that they obtain salient export competitiveness 3 or 4 years later. Toshiba is active in the investment for production of NAND Type Flash Memory. They have the newest and most powerful technology in the production of 56 nm^{15} class memory.

In the case of LCD TV, investment of Japanese firms recorded about 3 billion US dollars annually from 2004 to 2006. This is not large enough. Only Sharp invested

actively and increased the profit. Sharp decided to build the factory which is for the 10th generation LCD. This is the newest and most powerful equipment having the cost of about 50 billion US dollars. It can be thought that it should have a large impact to the market. It is possible to think that Panasonic obtain the leading status in the market of Plasma TV. In the case of Plasma TV, the cost of IC parts such as System LSI occupies about 30% of the price of product. It had a strategy to reduce the variety of System LSI and increase the production volume of each System LSI. This strategy increased the efficiency. Now, Panasonic occupies about 50% in the market of Plasma TV. However, in the case of LCD TV, IC parts occupy only 10% of the price of product. The strategy of Panasonic can not be applicable. It can be thought that this is the reason why Japanese firms except for Sharp are not in good conditions in the market of LCD TV. The size of the market of the Flat Panel Display TV is about 50 billion US dollars, now. It is forecasted that it will increase up to about 250 billion US dollars in 2015. LCD occupies 90% and Plasma occupies 10% of the market. Then, Korean firms occupy large part of the market. Recently, the third device, the Organic EL[16] appeared in this market. Sony has started to sell the product of Organic EL with the size of 11 inches. Because the mechanism of the Organic EL is more complicated than other devices, it can be thought that the share of cost of IC parts which contribute to control the device, in the product price, should be much larger. It can be thought that this is advantageous for Japanese firms.

Japanese industries of semi-conductor producing machines and LCD producing machines started in 1970's. Since the beginning period, Japanese firms maintained the high growth of production and recently, obtained the largest share in the world. They are Tokyo Electron, Advantest, Nikon, Dai-Nippon Screen, Canon, Hitachi Hi-Technologies, and Tokyo Seimitsu. Their features are the large profit rates in managements. The size of this market is less than 100 billion US dollars. But their profit rates are high and stable. The managements of memory makers are unstable. In the cases of device makers, they have some advantages and surpluses in managements. This is the reason why they started to use large budgets for R&D. It seems like that the share of technology which is driven by device makers is becoming larger than the share of technology which is driven by memory makers[17].

In the field of digital household appliances, the demand for System LSI was expected much more initially, around in 2003. However, the real demand was smaller. In the market, they had too many producers and too many types of products. They had to produce too many types of System LSI to obtain large profits. Then, recently, the demand of System LSI is increasing rapidly in the automobile industry. It is forecasted

that the size of market will become 4 times compared with now. It is desirable that they increase the production with improving efficiency by making production equipment of System LSI simple and common. In the field of Flat Panel Display (larger than 40 inches), 70% of market is occupied by Plasma. LCD has the large advantage if it is smaller than 40 inches. In the case of Organic EL, the share of the cost of System LSI in production cost is larger compared with the case of Plasma. It is desirable that they focus on the relatively small size and make production equipment of System LSI simple and common. It can be thought that this market will become hopeful by this measure.

Now, January 2009, the world economy is under serious depression. In the beginning of 2008, the price of crude oil was about 40 US dollars per one barrel, then, it increased to about 150 US dollars temporally in 2008. Now it is less than 40 US dollars. Many economists forecast that it will increase to 80 US dollars one year later. I seems like that the income distribution between resource producing country and industrialized country is changing according to the economic growth of BRICS. The increase of parts price in IT industry may be caused by this phenomenon. Then, in IT industry, the share of technology which is driven by device makers is becoming larger than the share of technology which is driven by memory makers. Until now, the scale merit has been worked strongly in IT industry. However, it seems like that the role of technology embodied in labor which can be found in parts, material, and device sectors in IT industry, is becoming more important.

3 Conclusion

IT industry is growing rapidly and its scale in production and demand is also very large. In this paper, the recent trend of IT technology has been analyzed. The tradable technology and the technology embodied in labor are in the relationship of competition and it seems like that the dominancy is alternated periodically. It has been understood that the way of Trefler is preferable to the way of Heckscher-Ohlin to explain the trend of IT technology and the technology choice. It has been also analyzed what kind of technology will appear in the near future and how it will affect economies and trades. In the field of digital household appliances, the demand for System LSI was expected much more initially, around in 2003. However, the real demand was smaller. Then, recently, the demand of System LSI is increasing rapidly in the automobile industry. In this sense, still, System LSI has a large demand. It has been explained that the production of Organic EL Display will grow rapidly by the similar measure with Plasma Display, also. Then, in IT industry, the share of technology which is driven by device makers is becoming larger than the share of technology which is

driven by memory makers. It has been explained that the role of technology embodied in labor which can be found in parts, material, and device sectors in IT industry, is becoming more important. As mentioned above, the newest trend of technologies has been explained.

[1] Intel: Integrated Cooperation
AMD: Advanced Micro Devices

[2] TSMC: Taiwan Semiconductor Manufacturing Company, Limited

[3] UMC: United Microelectronics Corporation

[4] Compared with Taiwanese IT firms, Korean IT firms procure raw materials domestically more. However, Taiwanese IT firms is more advanced in the field of high technologies. Taiwanese IT firms have capacities to have consignments of productions from the United States.

[5] Mr. Gordon Moore, the honorary president of Intel, suggested this law. It is that the memory of IC doubles every one year and half. It is said that this trend will decline within ten years by some specialists.

[6] If we consider the trend of technology, it is rather natural that Moore's law survives seven years from now.

[7] The export means the export of production factor which is embodied in the product.

[8] The correlation coefficient is 0.87.

[9] Static Random Access Memory, Because the operation of refresh is not needed, the consumption of electricity to keep memory, is small. This is different from DRAM.

[10] Application Specific Integrated Circuit, This is the LSI which collect together plural circuits for specified usages.

[11] Digital Signal Processor

[12] Personal Digital Cellular
[13] Personal Digital Assistant
[14] References[27]
[15] Nanometre, 1 Nanometreis 1/1000,000,000 metre.
[16] Organic Electro-Luminescence
[17] References[27]

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