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The Internationalization and Performance of Korean and Japanese Firms: An Empirical Analysis Based on Micro-data

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(Abstract)

Both Korea and Japan are leading exporting countries of advanced manufactured products, and the competitive and efficient manufacturing activities are important pillars of the affluence of the two economies. Yet, comparing the manufacturing sectors of the two countries in the 1990s brings to light a startling contrast in their performance. Applying the same empirical method to the analysis of micro-data for Japanese manufacturing firms for 1994-2001 and Korean manufacturing plants for 1990-98, this paper examines differentials in Japanese and Korean productivity growth. This paper focuses on the role of competition in firm dynamics and on the importance of internationalization as a major determinant of firm performance.

Keywords: Total Factor Productivity (TFP), Exporting, Foreign Direct Investment (FDI), Micro-Data

JEL Classification: D24, F10, F20, O40.

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1. Introduction

Both Korea and Japan are leading exporting countries of advanced manufactured products, and the competitive and efficient manufacturing activities are important pillars of the affluence of the two economies. Yet, comparing the manufacturing sectors of the two countries in the 1990s brings to light a startling contrast in their performance.

As Figure 1.1 shows, the real gross value added of Korea's manufacturing sector has grown more than twofold from 1990 to 2000. Although capital accumulation and the growth of real value added slowed down after the currency crisis of 1997, the labor productivity of Korea's manufacturing sector increased two–and-a-half-fold in the period. In contrast, the real gross value added of Japan's manufacturing sector has grown only 12% in the period. But a more serious problem for Japan is that productivity growth in the manufacturing sector has been very disappointing: labor productivity increased by only 34% in the eleven years.

Many studies, such as Yoshikawa and Matsumoto (2001), Nishimura and Minetaki (2003), Miyagawa (2003), and Fukao, Inui, Kawai, and Miyagawa (2004), found that Japan's manufacturing sector experienced a substantial slowdown in total factor productivity (TFP) growth even after taking account of changes in capacity utilization.[1] Judging from the results of these studies, Japan's lost decade seems to have been partly caused by the stagnation of productivity growth in the manufacturing sector.

The present paper examines why Korea enjoyed very rapid productivity growth, using micro-data of Korean manufacturing plants for 1990-98. We also compare our results with Fukao and Kwon's (2004b) similar analysis on Japan.

We concentrate on two issues in particular. First, we decompose TFP growth in Korea's manufacturing sector into a within-plant effect, a reallocation effect, and an entry-exit effect, using plant-level data of the *Annual Report on Mining and Manufacturing Survey* by the Korea National

[1] Yoshikawa and Matsumoto (2001) found that the TFP growth in Japan's manufacturing sector has declined 2.8% from the 1980s to the 1990s. Nishimura and Minetaki (2003), Miyagawa (2003), and Fukao, Inui, Kawai, and Miyagawa (2004) similarly found 2.4%, 1.4%, and 0.9% decline of TFP growth respectively. Fukao and Kwon (2004b) provides a brief survey of studies on Japan's TFP growth at macro-level and at industry-level.

Statistical Office. The decomposition into these three components aims to measure the "metabolism" of the economy: if firms compete with each other and entry barriers are low, high-productivity firms will enter the market and expand their production. This "metabolism" will enhance the TFP growth of the industry.

In the case of Japan's manufacturing sector, there already exist similar decomposition analyses. Nishimura, Nakajima, and Kiyota (2003) and Fukao and Kown (2003, 2004a,b) studied the productivity of firms and conducted productivity decompositions, using the firm-level data of the Ministry of Economy, International Trade and Industry's *Kigyo Katsudo Kihon Chosa* (Basic Survey on Business Activities by Enterprises). These studies found that the average TFP level of exiting firms was higher than that of staying firms in some industries. This "negative metabolism" may have slowed down TFP growth in the manufacturing sector. We apply a similar approach to Korea and compare our results with Fukao and Kwon's (2004b) results on Japan. Through this comparison, we examine how the metabolism in Korea is different from that in Japan.

Second, we compare the determinants of plants' (in the case of Japan: firms') TFP growth in the two countries. In particular, we focus on the effects of R&D activities and exporting on productivity. As we shall show in section 3, existing studies on the internationalization and performance of firms suggest that exporting has been an important factor in driving productivity growth in Japan and Korea. Casual observations also reveal that many Japanese firms have already entered the higher stage of internationalization with active horizontal and vertical FDI activity. Early signs of horizontal and/or vertical expansion of Korean firms can be observed as well, but exporting still seems to be the major mode of internationalization for Korean producers. We explore the links between internationalization and performance in Japan and Korea, focusing on export and productivity growth. Using a large-scale micro-data set for Japanese manufacturing firms and Korean manufacturing plants, we look into the determinants of TFP growth.

The paper is organized as follows: in the next section, we conduct a decomposition of TFP growth in Korea's manufacturing sector and compare our results with Fukao and Kwon's (2004a,b) results on Japan. In section 3, we briefly survey existing studies on the effect of exports on firms' productivity. In section 4, we examine the determinants of TFP growth. Section 5 summarizes our findings.

2. Comparison of the Decomposition of TFP Growth in Korea and Japan

In this section we decompose TFP growth in Korea's manufacturing sector and compare our results with Fukao and Kwon's (2004a,b) results on Japan's manufacturing sector.

Fukao and Kwon's (2004a,b) decomposition is based on firm-level data of the *Kigyo Katsudo Kihon Chosa* (Basic Survey of Japanese Business Structure and Activities), which is conducted annually by the Ministry of Economy, Trade and Industry (METI). The survey covers all firms with at least 50 employees and 30 million yen of paid-in capital in the Japanese manufacturing, mining and commerce sectors and includes information such as production, financial accounts, ownership structure, overseas firm activities, and technology acquisition and transfer. The data cover the period 1994–2001.

For the decomposition analysis of TFP in Korea's manufacturing sector we use manufacturing plant data of the *Annual Report on Mining and Manufacturing Survey*, which is conducted annually by the Korea National Statistical Office. The survey covers all plants with five or more employees in mining and manufacturing industries and contains information on output, inputs, and additional information, e.g. on R&D investment and exports. The data cover the period 1990-1998.

There are two important differences between Fukao and Kwon's data on Japan and the data on Korea. Firstly, in the case of the data on Japan, the unit of observation is the firm, whereas in the case of the data on Korea, the unit of observation is the manufacturing plant. Secondly, the cut-off criteria for minor plants (firms) are different. The data on Korea seem to cover more small firms than the data on Japan.

Following Good, Nadiri, and Sickles (1997), Aw, Chen, and Roberts (2001), Fukao and Kwon (2004a,b), Hahn (2004), and Ahn (2004), we define the TFP level of plant f in year t in a certain industry in comparison with the TFP level of a hypothetical representative plant in year 0 in that industry by[2]

$$\ln TFP_{f,t} = (\ln Y_{f,t} - \overline{\ln Y_t}) - \sum_{i=1}^{n} \frac{1}{2}(S_{i,f,t} + \overline{S_{i,t}})(\ln X_{i,f,t} - \overline{\ln X_{i,t}})$$
$$+ \sum_{s=1}^{t} (\overline{\ln Y_s} - \overline{\ln Y_{s-1}}) - \sum_{s=1}^{t} \sum_{i=1}^{n} \frac{1}{2}(\overline{S_{i,s}} + \overline{S_{i,s-1}})(\overline{\ln X_{i,s}} - \overline{\ln X_{i,s-1}})] \qquad (2.1)$$

where $Y_{f,t}$, $S_{i,f,t}$, and $X_{i,f,t}$ denote the gross output of plant *f* in year *t*, the cost share of factor *i* for plant *f* in year *t*, and plant *f*'s input of factor *i* in year *t*, respectively.[3] The variables with an upper bar denote the industry average of that variable. As factor inputs, we take account of capital, labor and real intermediate inputs. We also assume that working hours and the capacity utilization rate at each plant is identical with the industry average.

We define the representative plant for each industry as a hypothetical plant whose gross output as well as input and cost share of all production factors are identical with the industry average. The first two terms on the right hand side of equation (2.1) denote the gap between plant *f*'s TFP level in year *t* and the representative plant's TFP level in that year. The third and the fourth term denote the gap between the representative plant's TFP level in year *t* and the representative plant's TFP level in year 0. Therefore, $lnTFP_{f,t}$ in equation (2.1) denotes the gap between plant *f* 's TFP level in year *t* and the representative plant's TFP level in year 0.

Adopting the methodology used by Baily, Hulten and Campbell (1992), Forster, Haltiwanger and Krizan (2001) and Fukao and Kwon (2004a,b), we define the industry-level TFP of a certain industry in year *t* by

$$\ln TFP_t = \sum_{f}^{n} \theta_{f,t} \ln TFP_{f,t} \qquad (2.2)$$

where $\theta_{f,t}$ denotes plant *f* 's output share in year *t* in that industry.

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[2] We divided the manufacturing plant data into 30 sets of different industries and evaluated each firm's relative TFP level in relation to the industry average.

[3] We gratefully acknowledge that quantitative analysis in this paper on Korean plants is based on plant-level TFP estimation by Chin Hee Hahn at the Korea Development Institute (cf. Hahn 2000, 2004). For detailed explanation on variables used, see Appendix A.

Then, as Forster, Haltiwanger and Krizan (1998) showed, we can decompose the manufacturing sector's TFP growth from year t-τ to year t, $lnTFP_{t} - lnTFP_{t-\tau}$, into the following five factors:

Within effect: the weighted sum of within-plant productivity growth. As the weight, each plant's output share in the initial year is used.

$$\sum_{f \in S} \theta_{f,t-\tau} \Delta \ln TFP_{f,t} .$$

Between effect: changing output shares weighted by the deviation of initial plant productivity from the initial average productivity in the industry.

$$\sum_{f \in S} \Delta\theta_{f,t} (\ln TFP_{f,t-\tau} - \overline{\ln TFP_{t-\tau}}) .$$

Covariance effect: the sum of productivity growth times output share. This term reflects gains in productivity resulting from high productivity growth plants' expanding output shares or from low productivity growth plants' shrinking output shares.

$$\sum_{f \in S} \Delta\theta_{f,t} \Delta \ln TFP_{f,t} .$$

Entry effect: the weighted sum of the difference between each plant's productivity and initial average productivity in the industry. As the weight, each plant's output share in the end year is used.

$$\sum_{f \in N} \theta_{f,t} (\ln TFP_{f,t} - \overline{\ln TFP_{t-\tau}}) .$$

Exit effect: the weighted sum of the difference between each firm's productivity and initial average productivity in the industry. As the weight, each plant's output share in the initial year is used.

$$\sum_{f \in X} \theta_{f,t-\tau} (\overline{\ln TFP_{t-\tau}} - \ln TFP_{f,t-\tau}) .$$

In the above definitions, *S* is the set of firms that stayed in that industry from year t-τ to year *t*, *N* is the set of newly entered firms and *X* is the set of exited firms.[4] *TFP* with an upper bar denotes the industry-average TFP level.

Table 2.1 compares our results for Korea's manufacturing sector as a whole with preceding studies for Japan (Fukao and Kwon 2004b), the US, and a number of European countries. We should note that the results for Japan and the European countries are based on firm-level data whereas our results for Korea and the results for the US are based on plant-level data.[5]

Insert Table 2.1

Table 2.1 highlights distinctive differences between our results for Korea and the results for Japan and the other countries.

1. In the case of Fukao and Kwon's results for Japan, both the exit effect (excluding the switch-out effect) and the switch-out effect for the manufacturing sector as a whole from 1994 to 2001 were negative and substantially contributed to the decline in TFP growth in the manufacturing sector. This means that the average TFP level of exiting firms was higher than that of staying firms. It is interesting to note that this negative exit effect is not special to Japan. Italy and the Netherlands also experienced a negative exit-effect (including the switch-out effect) in 1987-1992. In contrast with these cases, we found that the exit effect (including the switch-out effect) was positive in Korea's manufacturing sector. In Korea, the natural selection mechanism, i.e., less productive plants are closed down, works well.

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[4] As already mentioned, our data cover manufacturing plants, which are of a size greater than the cut-off level. Thus, our data on plants that "exited" includes plants, which shrunk or changed their main business from the manufacturing sector to other sectors. A similar caveat applies to Fukao and Kwon's (2004a,b) data. We should also note that in the case of Fukao and Kwon's data, firms which were merged and became part of another firm are treated as "exited."

[5] As already mentioned, these results are not strictly comparable, because of differences in terms of the unit of observation, cut-off criteria, and the periods covered.

2. Both the entry effect (excluding the switch-in effect) and the switch-in effect were positive in Japan's manufacturing sector. But probably as a result of the low entry rate, the size of the entry effect was not large when compared with that found in Korea. The annualized contribution of the entry effect (including the switch-in effect) to TFP growth in Japan's manufacturing sector was only 0.16 percentage points (1994-2001), while in Korea it was 1.95 percentage points (1990-98). In both countries, new entrants made a positive contribution to overall productivity growth. But the new entrant effect in Korea was much larger than in Japan, Finland, France, Italy, the Netherlands, and the UK.
3. The contribution of the net entry effect to overall productivity growth was positive in the US, Japan and Korea. Among all the countries listed in Table 2.1, Korea showed the largest net entry effect. In contrast, the net entry effect in Japan was very small.
4. There are no distinct cross-country differences with regard to the reallocation effect (the between effect plus the covariance effect). Both in Korea and in Japan, the reallocation effect was positive but relatively small in comparison with all the other countries except the Netherlands. The between effect was negative in Korea and Japan, suggesting that market shares were not reallocated from initially less productive plants (firms) to more productive ones among continuing plants (firms). The covariance effect was also positive in both the countries, implying that plants (firms) enjoying high productivity growth were able to expand their market shares.
5. The within effect, i.e. the effect of TFP growth within continuing plants (firms), was the largest factor among all the effects in Japan's manufacturing sector. Japan's overall productivity growth during its "lost decade" was largely driven by the within effect. In contrast, the within effect in Korea was smaller than the net entry effect. In other words, in Korea the process of entry and exit of plants plays a more important role in promoting overall productivity than productivity growth within continuing plants..

Tables 2.2 and 2.3 compare our decomposition results for Korea with Fukao and Kwon's (2004b) results for Japan at the industry level. It has been pointed out in preceding studies that decomposition results are affected by business cycles.[6] In order to take this into account, we also conducted our decomposition on an annual basis. The results are reported in Table 2.4. The switch-in and switch-out effects in Tables 2.2, 2.3 and 2.4 denote the TFP growth contribution of plants (firms) that changed from one industry to another. A comparison of these tables leads to the following observations:

Insert Tables 2.2, 2.3 and 2.4

1. In the case of Japan, we observe a negative exit effect in many industries. The exit effect takes particularly large negative values in the following industries: textiles and apparel, wood and furniture, miscellaneous electrical machinery and supplies, and petroleum and coal products. electronics parts and devices, motor vehicles, non-ferrous metals and products. In Korea, the exit effect is negative only in a small number of industries; examples are other transport equipment and other domestic appliances. Even when we decompose TFP growth on an annual basis, we find that the exit effect (including the switch-out effect) was negative for all seven years in the case of Japan (Table 2.4.a). In Korea, it took a negative value only for two periods, 1992-93 and 1993-94.
2. There are some similarities between the entry effects found in the two countries, although the size of the effect is much larger in Korea than in Japan. We observe a relatively large positive entry effect in high-tech industries, such as computers and office machinery, radio, television and communication equipment and apparatuses in Korea, and the electronic parts and devices and the precision instruments industries in Japan. New entrants seem to play an important role in the productivity growth of industries where ample opportunity for technological innovation exists.

[6] In the case of Japan, there were three official business cycle peaks in the period 1990-2002, namely in February 1991, in May 1997, and in November 2000, and three troughs, in October 1993, January 1999, and January 2002. Official peak and trough dates for Japan are available in *Business Cycle Reference Dates*, Economic and Social Research Institute, Cabinet Office, Government of Japan (<http://www.esri.cao.go.jp/>). In the case of Korea, there were two official business cycle peaks in the period 1990-1998, in January 1992 and in March 1996, and two troughs, in January 1993 and in August 1998.

When we decompose TFP growth on an annual basis, the entry effect (including the switch-in effect) was positive in both the upturn and the downturn periods in both countries except in one period, 1995-96 in Korea (Table 2.4). We also find that the net entry effect in Korea (Table 2.4.b) was smaller than the corresponding values derived from the 1990-98 comparison (Table 2.3). In the case of Japan, there is no such difference between the annual-difference decomposition and the decomposition of the 1990-98 difference.[7]

3. Many manufacturing industries in Korea experienced a much larger within effect than those in Japan. But there are also some similarities. This effect changed pro-cyclically in both countries (Table 2.4). Moreover, in both countries, the within effect tended to be large in high-tech industries, such as semiconductor components and other electronic components, motor vehicles, radio, television and communication equipment and apparatuses, and computers and office machinery in Korea, and drugs and medicine, communication equipment and related products, and electronic parts and devices in Japan. Figure 2.1 shows the relationship between within effects for Japan (vertical axis) and within effects for Korea (horizontal axis) for each corresponding industry.[8]

Insert Figure 2.1

4. Figure 2.1 also shows that in the case of Korea, many material industries, such as chemical fibers, non-ferrous metals and products, and iron and steel experienced large within effects. But in Japan, almost all the material industries had very small within effects.[9] Although machinery industries are coming to be leading exporting industries in Korea, similar to the way they did in Japan during the 1980s, Korea still has a comparative advantage in the material industries and continues to expand its

[7] Probably this gap between the two countries is the result of differences in the data. In the case of the Korean data, the unit of observation is the manufacturing plant and the data cover small plants. If we assume that it takes several years for newly established small plants to become productive, then the "entry effect" derived from the annual-difference decomposition for Korea would be reduced by the inclusion of such small plants.

[8] Since there are substantial differences in the industry classification between Japan and Korea, the matching of the two countries' corresponding industries in Figure 2.1 is imperfect.

[9] Petroleum and coal products are important exceptions. In this industry, the within effect in Japan was larger than that in Korea.

exports in this area. Probably this export-led growth in Korea's material industries contributed to their large within effects.

Our results can be summarized as follows. Korea's very rapid TFP growth in the manufacturing sector was accomplished mainly by the start-up of new plants with high productivity and large within effects in high-tech industries and material industries. In Japan's case, relatively large within effects occurred only in the high-tech industries. Entry effects were very small in almost all industries. Moreover, the exit effect for the manufacturing sector as a whole was negative and substantially contributed to the stagnation of TFP growth in the manufacturing sector.

The above findings suggest that in order to accelerate TFP growth in Japan's manufacturing sector it is important to promote new entries and to make both the exit process and the process of resource allocation more efficient. It seems that the following two factors contributed to Japan's low metabolism.

Firstly, the metabolism issue is closely related with the allocation of funds through the financial system. Therefore, the problems in Japan's banking system are likely to have contributed to the slowdown of Japan's TFP growth. In order to conceal their bad loans, Japanese banks have been keeping alive money-losing large borrowers by "evergreening" loans and discounting lending rates, although the chance that these borrowers will ever recover is slim (Caballero, Hoshi and Kashyap 2004). Because of the existence of zombie firms, the entry and growth of more productive firms are impeded and TFP growth slows down in industries infested by zombies (Ahearne and Shinada 2004).

Secondly, many Japanese large firms in the machinery industry relocated their production abroad. Figures 2.2 and 2.3 show that the production of Japanese affiliates abroad exceeds Japan's exports in both electrical machinery and automobiles. It is also important to note that Japan's imports of electric machinery have increased very rapidly. The imports mainly come from Japanese affiliates in East Asia. Probably because of this relocation abroad, the number of plant startups in Japan's manufacturing sector declined drastically in the 1990s (Fukao and Kwon 2004b).

Insert Figures 2.2 and 2.3

3. Preceding Studies on the Dynamic Effects of Internationalization on Firms' Productivity

Preceding studies suggest that the internationalization of firms relies mainly on two avenues: exporting and FDI. This paper is a first empirical attempt to measure and compare the effects of exporting on productivity growth by concentrating on two countries in East Asia that pursued the same export-oriented growth strategy but are at different stages in terms of their internationalisation and economic development. Before presenting our own findings, we briefly review the results of earlier studies.[10]

3.1 Internationalized Competition and Firm Dynamics

Comparative case studies of selected industries in the United States, Japan and Europe carried out by Baily (1993) and Baily and Gersbach (1995) suggest that competition (especially competition with best-practice producers in the global market) enhances productivity. Using micro-level panel data for the United Kingdom, Nickell (1996) and Disney, Haskel and Heden (2003) experimented with several indicators of competition in productivity regressions and concluded that competition has positive effects on productivity growth. Using a sample of 676 UK firms over the period 1975-86, Nickell (1996) found that competition (measured by the number of competitors or by the smallness of rents) was associated with higher productivity growth rates. Based on a more recent and much larger data set of around 143,000 UK establishments over the period 1980-1992, Disney, Haskel and Heden (2003) found that market competition significantly raised productivity levels as well as productivity growth rates. Controlling for R&D and other industrial characteristics and using unbalanced panel data for more than 10,000 Japanese manufacturing firms for the period 1994-2000, Okada (2004) also found that competition enhanced productivity growth.

10. Following literature review builds upon an earlier survey by Ahn (2002).

Micro-data also provide rich information on the effects of competition-promoting regulatory reform, which is very likely to involve changes in firm dynamics. Olley and Pakes (1996) analyzed productivity dynamics in the telecommunications equipment industry in the United States using unbalanced panel data for 1974-87 from the Longitudinal Research Database (LRD). They found that aggregate productivity increased sharply after each of the two periods in which the industry underwent changes that decreased regulation. Furthermore, the productivity growth that followed regulatory change appeared to result from a reallocation of capital from less productive plants to more productive ones rather than from an increase in average overall productivity. Their findings suggest that competitive selection processes via entry and exit facilitated the reallocation of production factors.

Whilst various studies have found import competition to induce productivity growth,[11] evidence on the role of exports and export competition is more ambivalent. For example, Roberts and Tybout (1997) developed a model of exporting with sunk costs of entry. In the presence of such entry costs, only relatively productive firms will choose to pay the costs and enter the foreign market. The implied relationship between exporting and productivity is positive in a cross-section of firms or industries, but the causality runs from productivity to exporting. In other words, exporting firms show higher productivity mainly because only firms with higher productivity can enter the export market and survive there. The empirical findings of Clerides, Lach and Tybout (1998) based on plant-level data from Colombia, Mexico, and Morocco also support the self-selection hypothesis, according to which it is more efficient firms that enter the export market.

Using plant-level data from the Longitudinal Research Database (LRD) in the United States, Bernard and Jensen (1999a) examined whether exporting had played any role in increasing productivity growth in US manufacturing. They found little evidence that exporting per se was associated with faster productivity growth rates at individual plants. The positive correlation between exporting and productivity levels appears to come from the fact that high productivity plants are more likely to enter foreign markets, as Roberts and Tybout (1997) suggested. While exporting does not

11. See, amongst others, MacDonald (1994) on the US, Levinsohn (1993) on Turkey, Bottasso and Sembenelli (2001) on Italy, and Pavcnik (2002) on Chile.

appear to improve productivity growth rates at the plant level, it is strongly correlated with increases in plant size. In other words, trade contributes to productivity growth by fostering the growth of high productivity plants, though not by increasing productivity growth at those plants.[12]

For deeper understanding of the links between exporting and productivity growth in the context of technological learning and economic development, however, aforementioned selected cases from a few developing and developed countries seem to be far from comprehensive: Colombia, Mexico, and Morocco do not represent good examples of export-led economic development and for technologically advanced economies like the US and Germany, the room for technological learning from exporting would appear to be rather limited.[13] Probably more interesting and more relevant would be the experiences of a number of East Asian economies (as examples of successful export-oriented development strategies). A comparative empirical study for a country-pair consisting of a developed and a developing country in East Asia (e.g., Japan and Korea), therefore, would seem to be much more informative.

3.2 Exporting and Firm Performance: Evidence from the East Asian NIEs

Not many studies have used micro-data to examine productivity and firm dynamics in the East Asian NIEs (Newly Industrializing Economies). Aw, Chen and Roberts (2001) measured differences in total factor productivity among entering, exiting, and continuing firms in Taiwan, using longitudinal firm-level data from the *Census of Manufactures* for 1981, 1986, and 1991. They found that the contribution of productivity differentials between entering and exiting firms to aggregate productivity growth was more pronounced there than in other countries in previous studies. In a similar study, Aw, Chung and Roberts (2000) examined and compared links between productivity and

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12. According to the results of a parallel study for Germany by Bernard and Wagner (1997), sunk costs for export entry appear to be higher in Germany than in the United States, but lower than in developing countries.

13 . Nevertheless, Marin (1992) found some evidence that exporting enhances productivity performance of developed countries as well as that of developing countries. The findings were based on co-integration and Granger-causality techniques applied to macro time series data on exports, productivity, terms of trade, and output of four developed countries (the US, Japan, Germany, and the UK).

turnover in the export market using the aforementioned data from Taiwan and comparable data from the Korean *Census of Manufactures* for 1983, 1988, and 1993. Interestingly, they found little evidence of links between plant productivity and export decisions in Korea, while they found some evidence of selection and learning effects in case of Taiwan.

Since pioneering exploratory studies on firm dynamics in Korean manufacturing by Hahn (2000) and Joh (2000), Korean longitudinal micro-data still remain rather unexploited. In fact, longitudinal micro-data in Korea are as rich as the data used in any of the existing studies. While Aw, Chung and Roberts (2000) focused on the 'five-yearly' census data, the Korea National Statistical Office compiles the plant-level data 'annually' covering all plants with no less than five employees. Taking advantage of this higher frequency data, and using the method of Bernard and Jensen (1999a and 1999b), Hahn (2004) detects evidence of self-selection and (short-lived) "learning-by-exporting" effects in the relationship between exporting and plant-level productivity in Korea.

Hahn's (2004) findings based on the Korean data are in fact qualitatively similar to those of Bernard and Jensen (1999a and 1999b) using US data in several respects:

(1) Significant and positive contemporaneous correlations are observed between levels of exports and productivity.

(2) While exporting plants have substantially higher productivity levels and are of bigger size than non-exporting plants, evidence that exporting increases plant productivity growth rates is weak.

(3) New exporters grow faster around the time when they enter the export market.

According to Bernard and Jensen (1999b), these findings contain both good and bad news. Exporting will contribute to aggregate productivity growth by facilitating the growth of high productivity plants, although such a reallocation effect would produce static rather than dynamic gains. In other words, Bernard and Jensen (1999a and 1999b) and Hahn (2004) appear to suggest that exporting cannot be an engine of sustained economic growth, either for an innovating technology leader like the US or for an imitating follower like Korea.

In fact, however, the degree and the channels of the contribution of exports to technology spillovers and to productivity growth vary from industry to industry, and also from country to country, depending on the economic and technological environment. For example, exporting grain from the US to China may well have little learning-by-exporting effects, while exporting cars from Korea to the US seems far more likely to generate some technology learning. Bernard and Jensen (1999a and 1999b) and Hahn (2004) found that, after controlling for year effects and industry effects, the productivity gap between exporting firms and non-exporting firms did not increase over time. They interpreted this finding as evidence showing that learning-by-exporting effects are only short-lived. Such a pattern, however, could arise not only when learning-by-exporting effects are short-lived, but also when persistent learning-by-exporting effects are rapidly diffused to non-exporters in the same industry.[14] Findings by Ahn (2004) based on plant-level data for Korea's manufacturing sector suggest that productivity gains associated with exporting tend to have strong intra-industry spillover effects. Hallward-Driemeier, Iarossi and Sokoloff (2002) analyzed survey data on about 2700 manufacturing plants in five East Asian countries (Indonesia, Korea, Malaysia, the Philippines, and Thailand) and argued that firms that explicitly target export markets make different decisions on investment, training, technology and the selection of inputs, which make firms with foreign ownership and firms that export significantly more productive.

3.3 Foreign Direct Investment: Horizontal Expansion and Vertical Expansion

This paper primarily concentrates on exports as a measure of the internationalization of producers, though it should be also emphasized that foreign direct investment (FDI, hereafter) are of growing importance in the internationalization of Japanese and Korean firms. Many Japanese firms, especially those in leading export industries such as electronics and transportation equipment, are rapidly relocating some segments of their production lines and establishing new export bases in China and other East Asian countries (Fukao 2003). As a result, the total sales by foreign affiliates of

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14. Marin (1992, p.678), among others, emphasized such spillover effects as follows:

> The idea that trade might influence productivity is not new. The hypothesis of "export-led growth" sees the growth of exports as having a stimulating influence across the economy as a whole in the form of technological spillovers and other externalities. […] Larger exports will contribute to the stock of knowledge and human capital in the economy thereby benefiting all firms.

Japanese firms started to exceed total exports of Japan in 1993 and the gap has been increasing since then (Fukao and Yuan 2001a). While most Korean firms are still far from the technology frontier and hence appear to have substantial room for learning-by-exporting, some Korean firms approaching the frontier have started to show signs of entering the higher stages of internationalization, namely, horizontal FDI and vertical FDI. This section briefly reviews findings from recent theoretical and empirical studies on horizontal FDI and vertical FDI.

We can get an insight into the relationship between exports and horizontal FDI from a multi-country, multi-sector general equilibrium model of Helpman, Melitz and Yeaple (2003). They built the model in order to explain the decision of heterogeneous firms whether to serve overseas markets through exports or through (horizontal) FDI. A basic idea of the model is that FDI involves higher sunk costs but lower per-unit costs than exporting does in serving the overseas market. The model predicts that only the more productive firms will choose to serve foreign markets and that the most productive firms among them will further choose FDI to serve the overseas market. In addition, the model predicts that the greater the heterogeneity of firms' productivity, the greater will be FDI sales relative to export sales. These predictions are strongly supported by data on US exports and sales of overseas US affiliate in 38 different countries and 52 sectors. In a simpler setting, Head and Ries (2003) also tested a model which predicts that firms choosing FDI are more productive than firms choosing exporting. Their findings based on data for 1,070 large Japanese firms show that firms using both FDI and exports to serve foreign markets are more productive than firms that only export.

While a firm can reduce trade costs by setting up foreign affiliates replicating the parent firm (horizontal FDI), it can also take advantage of international differences in factor prices by locating labor-intensive processing abroad and keeping capital-intensive input production and knowledge-intensive designing and R&D at home (vertical FDI). Using firm-level data on US multinationals' trade in intermediate inputs, Hanson, Mataloni and Slaughter (2003) show that vertical production networks are shaping trade patterns between US parents and their foreign affiliates. From the patterns of trade in intermediate inputs by industry, they find that certain industries (machinery, transportation equipment, and electronics, including computers) appear to be good candidates for vertical production networks. They point out that these industries share the following common features: First, production tends to involve distinct stages that are physically separable; and second, these production stages exhibit different factor intensities. As design activities and component production are more skill-intensive, while assembly activities are more labor-intensive, firms may have an incentive to locate labor-intensive activities in labor-abundant countries.

Incidentally, those industries identified by Hanson, Mataloni and Slaughter (2003) as good candidates for vertical specialization are also the leading export industries of Japan and Korea. In this context, we need to pay more attention to "the possibility that substitution among types of activities may take place not only between home and foreign operations of a firm, but also between parent firms and non-multinational firms in the same industry at home" (Lipsey 2002: p.18). An increasing number of empirical studies based on micro-data show that firm dynamics (i.e., entry and exit, growth and decline of individual firms) is an important component of innovation and aggregate productivity growth. Therefore, one cannot emphasize too much the importance of well-functioning factor markets which reallocate labor and capital of shrinking/exiting firms to entering/growing firms.

4. Determinants of TFP Growth: the Japanese Firms and the Korean Plants

Our brief survey of existing studies on the internationalization and performance of firms seems to suggest that exporting is an important factor for productivity growth in Japan and Korea. Casual observations also reveal that many Japanese firms have already entered the higher stage of internationalization with active horizontal and vertical FDI activities. Early signs of a horizontal and/or vertical expansion of Korean firms can be observed as well, though exporting still seems to be the major mode of internationalization for Korean producers. This section will explore the links between internationalization and performance in Japan and Korea focusing on export and productivity growth. Using a large-scale micro-data set for Japanese manufacturing firms and Korean manufacturing plants, we will look into the determinants of TFP growth.

4.1 Correlation between Industry-Level Export Intensity and Industry Productivity Growth

Table 4.1 shows correlations between the industry-level export intensity (in the initial year) and the industry-level aggregate productivity growth (over the sample period) as well as correlations between export intensity and the components of aggregate productivity growth. Industry-level export-intensity and industry-level productivity growth ("total effect") show a positive and significant correlation for both Japan (0.4578) and Korea (0.5074). In other words, industries with a higher export-intensity in the initial year tend to show faster productivity growth over the sample period.

Insert Table 4.1

Among the components of industry-level aggregate productivity growth, the "within effect" and the "net entry effect" show a positive and significant correlation with initial export-intensity. In Japan's case, the correlation between export-intensity and the within effect is 0.4413 and the correlation between export-intensity and the net entry effect 0.4460. In Korea's case, the correlation between export-intensity and the within effect is 0.3022 and the correlation between export-intensity and the net entry effect 0.3824. On the other hand, the "reallocation effect" shows only a small and insignificant correlation with initial export-intensity both in Japan and Korea.

The bivariate correlations in Table 4.1 suggest that exporting makes a positive contribution to productivity growth in the subsequent period. The correlations also suggest that the main channel for this contribution is that it makes continuing firms more productive and facilitates entry and exit effects which raise aggregate productivity growth. But, we need to be cautious in interpreting these bivariate correlations. For example, firms with a high export-intensity are typically big firms with large R&D expenditures and highly-skilled employees. Therefore, multivariate regression analysis is needed in order to obtain a clearer picture of the net contribution of exporting after controlling for such factors.

4.2 Specification for the Regression Analysis

This section examines the relationship between internalization, in particular export, and productivity growth, by using regression methods. The TFP growth rate of a firm (in Japan's case) or a plant (in Korea's case) in each year is regressed on the previous year's values of the its own export intensity and of the export intensity at the industry level, controlling for other factors such as R&D intensity, human capital, firm size, industrial characteristics, and year effects. Table 4.2 summarizes the variables used in our regressions as well as their descriptive statistics.

Insert Table 4.2

We estimate the following equation:

$$\ln TFP_{it} - \ln TFP_{it-1} = \alpha + \beta \ln TFP_{it-1} + \gamma \cdot Z_{it-1} + \lambda \cdot X_{t-1} + \varepsilon_{it} \quad (4.1)$$

where ln *TFP* is the logarithm of TFP, *Z* is a vector of firm-level variables on exports, R&D, and human capital, and *X* represents industry-level variables, industry dummies, and year dummies. The last term ε_{it} is an independent and identically distributed disturbance term. Subscripts *i* and *t* refer to firms and time respectively.

In specification (4.1), we include the one-year lagged TFP level in order to control for the convergence effect. If there is a convergence effect, firms with a low productivity level will show higher productivity growth than firms with a high productivity level. In order to check the robustness of our regression based on the annual TFP growth, we also regressed the average TFP growth over the initial year to the end year on the variables of the initial year.

In various empirical studies on the determinants of productivity growth since Griliches's seminal work on the topic, R&D has been regarded as a major determinant. A typical estimation strategy employed in the literature is to either use R&D capital stock (calculated from the R&D expenditure series using the permanent inventory method) as a determinant of the productivity level, or its first-difference as a determinant of productivity growth. In particular, the TFP growth rate can be expressed as a function of R&D intensity.[15] Another major source of productivity growth included in many empirical studies is the contribution of human capital.[16] We used the share of non-production workers in total workers as a proxy for the quality of human capital.

It is well known that the benefits from R&D activities of a firm tend to spillover to other firms. To capture potential intra-industry spillover effects or externalities of exporting, R&D, and human capital, we included both firm-level and industry-level values of export intensity, R&D intensity, and the non-production worker share. To control for potential size effects, the logarithm of the number of workers was included. To reduce the potential problem of a simultaneity bias, one-year lagged values were used for all of these variables.

Finally, industry dummies and year dummies were included in the estimation equation in order to control for intrinsic differences across industries and also for year-specific shocks due to macroeconomic business cycle effects. The manufacturing sector was classified into 30 industries as shown in Table 2.2 and Table 2.3.

4.3 Estimation Results

Table 4.3 and Table 4.4 report the estimation results for Japanese manufacturing firms (1995-2001) and Korean manufacturing plants (1991-1998). In each table, Column (1) – Column (3) report the results of annual TFP growth regressions with different specifications. Column (1) includes R&D and human capital related variables. Column (2) includes exporting and R&D related variables. Column (3) includes all the variables on exporting, R&D, and human capital. Column (4) reports the results of regressing the average TFP growth rate over the sample period on the variables for the initial year.

Insert Tables 4.3 and 4.4

15. See Griliches (1998) and references there for details.
16. See Lucas (1988), among others.

First of all, all the explanatory variables show the expected sign with significant coefficients in most cases. In addition, the estimated coefficients appear quite stable across columns in most cases.[17] The convergence term has negative coefficients across all cases, suggesting that there was a convergence effect. The convergence effect appears to have been stronger in Korea than in Japan.

Now let's look further into the results related to exporting which is at the center of our interests. First, the coefficient for Korean plants' export intensity is significantly positive at around 3% (0.0351 in Column (2) and 0.0298 in Column (3)). In terms of the size of the point estimates, the contribution from exporting is even bigger than that from R&D. Second, if we can interpret the coefficients for the industry-level ratios as measures of the industry-wide spillover effects,[18] Korean plants appear to be enjoying substantial positive externalities from exporting activities in the industry they belong to. Third, the coefficient for Japanese firms' export intensity is also positive, but its size is less than 1% and only marginally significant. Fourth, unlike Korean plants, Japanese firms do not seem to be enjoying intra-industry spillovers of learning-by-exporting.

Insert Table 4.5

The regression results reported in Table 4.3 and Table 4.4 provide some evidence of learning-by-doing effects in Korea and, to a lesser degree, in Japan. Both countries show positive and significant coefficients for plant-level or firm-level export intensity, even after all other factors such as R&D, human capital, and size are controlled for. In addition, the Korean case suggests that such learning-by-exporting effects have substantial externalities. On the other hand, such learning effects seem to be much smaller in Japan.

17. The industry-level export intensity showed a negative sign in Japan, and the industry-level non-production workers' share showed negative but insignificant coefficients in both countries. But, those negative signs disappeared in the last columns for long-term average TFP growth for both countries.
18. For example, industry-level R&D intensity shows significantly positive and economically large coefficients in each and every specification for both Japan and Korea. This result seems consistent with the common view that R&D usually has strong spillover effects.

One plausible explanation might be the difference in the distance to the technology frontier. Table 4.5 shows the technology gap between Korea and Japan. Korea still has much lower productivity levels, especially in major exporting industries. In other words, Korean exporters still have much room for learning-by-exporting in the sense that their productivity levels are low relative to the technology frontier, while Japanese exporters now have little room for learning-by-exporting. This conjecture is supported by the regression results in Table 4.3 and Table 4.4 which show that own R&D is much more important in Japan than in Korea.

Another important reason might be the difference in the role of exporting as a vehicle for internationalization. For Japanese firms, horizontal and vertical FDI now seems to be more important than exporting (Fukao and Yuan 2001a). Existing studies on FDI reviewed in the previous section suggest that such horizontal and vertical FDI has a more complex impact on other parts of the economy or on other firms in the same industry.[19]

5. Concluding Remarks

This study started from the observation that Korea showed a much better overall growth performance during the 1990s than Japan. Applying the same empirical method to the analysis of micro-data for Japanese manufacturing firms for 1994-2001 and Korean manufacturing plants for 1990-98, this paper examined differentials in Japanese and Korean productivity growth. As a common analytical framework for the comparative empirical analysis in this paper, we focused on the role of competition in firm dynamics and on the importance of internationalization as a major determinant of firm performance.

The main findings of this paper can be summarized as follows:

(1) The decomposition of aggregate TFP growth revealed that, in many industries in Japan, firms with above-average productivity rather than those with below-average productivity were exiting.

19. In our continuing research, we also ran regressions for Japanese firms that included extra explanatory variables representing horizontal FDI and vertical FDI. Adding those variables makes both individual export-intensity and industry export-intensity insignificant. Our preliminary results also suggest that both horizontal FDI and vertical FDI have positive and significant own effects while horizontal FDI appears to have negative externalities.

The fact that most of the industries showing negative exit effects are technology-intensive industries with fierce global competition suggests that such “negative metabolism” might be somehow closely related with internationalization and restructuring in those industries.

(2) Indeed, both in Japan and Korea, industry-level export intensity in the initial year showed a significant and positive correlation with industry-level productivity growth over the subsequent period. Especially, it is observed that, both in Japan and Korea, the positive contribution of exporting to aggregate productivity growth in the following period appeared to be channeled mainly through the within effect and the net entry effect.

(3) The results of the regression analysis showed that both own exporting and industry-level exporting make a significant and positive contribution to plant-level productivity growth in Korea’s case. In Japan’s case, however, the contribution of firms’ own exporting to productivity growth was positive but its size was rather small. Evidence of industry-wide spillovers (or positive externalities) of learning-by-exporting was found only in Korea. The regression analysis also revealed that both own R&D and industry R&D made a strong contribution to firms’ productivity growth. In Korea’s case, the own R&D effect was rather small while industry-wide spillovers of R&D appear to have been quite large.

All in all, the fact that Korea showed much better growth performance than Japan in the 1990s seems to be mainly due to the following two factors. First, Korean exporters still have much room for learning-by-exporting in the sense that their productivity levels are low relative to the technology frontier, while Japanese exporters now have little room for learning-by-exporting. Second, horizontal FDI and vertical FDI are now more important than exporting in explaining the internationalization and performance of Japanese firms, and such horizontal and vertical expansion has more complex impacts on other parts of the economy or on other firms in the same industry than exporting does.

Internationalization of firm activities through exporting and FDI makes it possible for successful firms to enhance their performance and to grow further. At the same time, however, internationalization also implies that unsuccessful firms are likely to suffer as a result of fierce global competition. Therefore, aggregate productivity effects of firms’ internationalization crucially depend on how efficiently resources are reallocated from declining firms to growing firms, within an industry or across industries. Our findings in this paper comparing Korean and Japanese micro-data suggest that both challenges and opportunities from internationalization increase as internationalization advances from the earlier stage of exporting to the higher stage of horizontal and vertical FDI. Given that systemic and institutional adjustments to internationalization require substantial time and effort, it would be fruitful to extend the data sample period and the scope of the study. For example, in the case of Korea, FDI has increased rapidly along with various regulatory reforms after the Asian financial crisis, but our data do not cover the after-crisis period. Our study could be improved by extending the sample period, by improving the comparability of the data, and by extending the scope of analysis beyond Japan and Korea. These issues are left for future research.

Appendix A: Variables Used in the TFP Calculation and Data Sources

Variables on Japanese Firms

We used each firm's total sales and cost of intermediate inputs as nominal gross output and nominal intermediate input data. We derived the deflator for each industry's gross output and intermediate input from the Bank of Japan's *Wholesale Price Statistics* and *Corporate Goods Price Statistics*.

For capital stock, the only data available are the nominal book values of tangible fixed assets in the *Basic Survey of Japanese Business Structure and Activities*. Using these data, we calculated the net capital stock of firm *f* in industry *j* in constant 1995 prices as follows:

$$K_{ft} = BV_{ft} * (INK_{jt} / IBV_{jt})$$

where BV_{ft} represents the book value of firm *f*'s tangible fixed capital in year *t*, INK_{jt} stands for the net capital stock of industry *j* in constant 1995 prices, and IBV_{jt} denotes the book value of industry *j*'s capital. INK_{jt} is calculated as follows. First, as a benchmark, we took the data on the book value of tangible fixed assets for the year 1976 from the *Census of Manufactures 1976* published by METI. We then converted the 1976 book value into the real value in constant 1995 prices using the net fixed assets deflator provided in the *Annual Report on National Accounts* published by the Cabinet Office, Government of Japan. Second, the net capital stock of industry *j*, INK_{jt}, for succeeding years was calculated using the perpetual inventory method. We used the capital formation deflator in the *Annual Report on National Accounts* and Masuda's (2000) estimate of the depreciation rate of 0.0792 for the calculation.

In order to obtain capital input, we multiplied the net capital stock by the capital utilization ratio of each industry provided in the JIP database.[20]

[20] The JIP Database was compiled as part of an ESRI (Economic and Social Research Institute, Cabinet Office, Government of Japan) research project. The detailed result of this project is reported in Fukao, Miyagawa, Kawai, Inui (2004). The database contains annual information on 84 sectors, including 49 non-manufacturing sectors, from 1970 to 1998. These sectors cover the whole Japanese economy. The database includes detailed information on factor inputs, annual nominal and real input-output tables, and some additional statistics, such as R&D stock, capacity utilization rate, Japan's

As labor input, we used each firm's total number of workers multiplied by the sectoral working-hours from the Ministry of Health, Labor and Welfare's *Monthly Labor Survey*. We were not able to take account of differences in labor quality among firms, though it seems fair to assume that high-TFP firms probably tend to employ more educated workers. Our estimates of the TFP level may be biased upwards for high-TFP firms as a result of this neglect of the quality of labor.

Finally, we derived the cost shares of the factors of production. For labor costs, we used the wage data provided in the *Basic Survey of Japanese Business Structure and Activities*. Intermediate input cost is defined as total production cost plus cost of sales and general management minus wages minus depreciation. Capital cost was calculated by multiplying the real net capital stock with the user cost of capital. The latter was estimated as follows:

$$P_k = q * (\frac{1-\tau z}{1-\tau})[r + \delta_k - \frac{dq}{q}]$$

where q, r, δ, τ and z are the prices of investment goods, interest rates, depreciation rates, corporate tax rates, and the present values of depreciation deduction on a unit of nominal investment, respectively. Data on investment goods prices, interest rates, and corporate tax rates were taken from the *Annual Report on National Accounts* and the *Ministry of Finance Statistics Monthly*. The depreciation rate for each industry is estimated using the book value of tangible fixed assets at the beginning of year *t* and the depreciation expense during year *t* in the *Census of Manufactures* published by METI.

Variables on Korean Plants[21]

As a measure of output, we used the data on gross output (production) of each plant in the *Annual Report on Mining and Manufacturing Survey* (*Survey* henceforth) deflated by the producer price index at a disaggregated level. As a measure of capital stock, we used the average of the book

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international trade statistics by trade partner, inward and outward FDI, etc., at the detailed sectoral level. An Excel file version (in Japanese) of the JIP Database is available on ESRI's web site.

[21] TFP calculation for Korean plants followed Hahn (2004). The description below is from Hahn's (2004) appendix.

value capital stock at the beginning and the end of the year provided in the *Survey* deflated by the capital goods deflator. As a measure of labor input, we used the number of workers, which includes paid employees (production and non-production workers), working proprietors and unpaid family workers. In this study we took account of the quality differential between production workers and all the other types of workers. The labor quality index for the latter was calculated as the ratio of the average wage of non-production workers to that of production workers at each plant, averaged again over all plants in a year. As a measure of intermediate input, we used the items "major production costs" plus "other production costs" in the *Survey*. Major production costs cover costs arising from materials and parts, fuel, electricity, water, manufactured goods outsourced and maintenance. Other production costs cover outsourced services, such as advertising, transportation, communication and insurance. The estimated intermediate input was deflated by the intermediate input price index. We assumed constant returns to scale so that the sum of factor elasticities equals to one. The labor and intermediate input elasticities for each plant are measured as average cost shares within the same plant-size class in the five-digit industry in a given year. Thus, the factor elasticity of plants is allowed to vary across industries and size classes and over time. Here, plants are grouped into three size classes according to the number of employees: 5-50, 51-300, and over 300.

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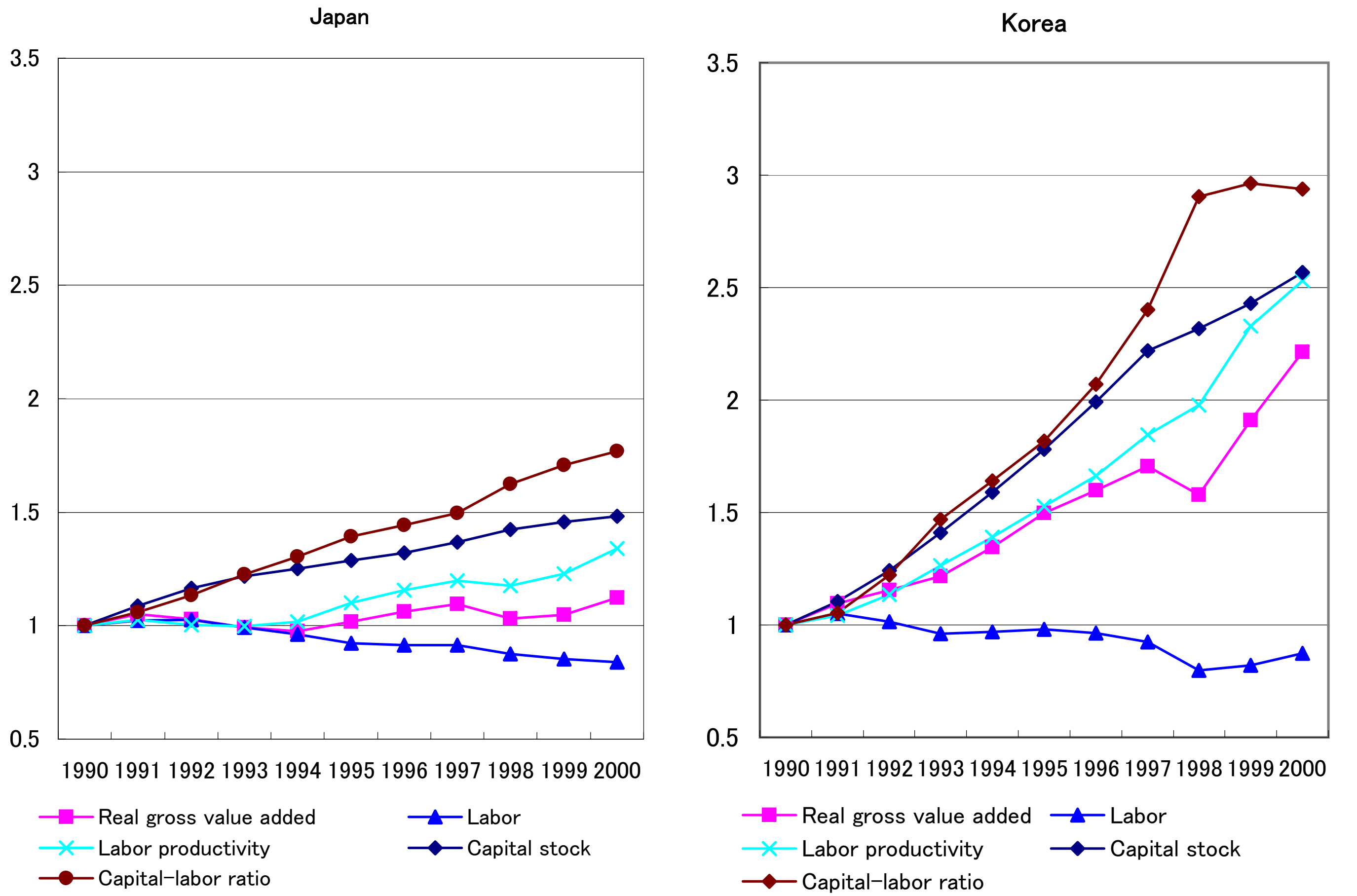
Figure 1.1 Gross Value Added and Labor Productivity of the Manufacturing Sector in Japan and Korea: 1990-2000 (1990=1)



Sources: Economic and Social Research Institute (2004a, b), Pyo (2004). GDP statistics for Korea were downloaded from the Economic Statistics System, Bank of Korea, http://ecos.bok.or.kr.

Table 2.1 Comparison of Total Factor Productivity Decomposition Results

Source	Country	Unit of analysis	Period	Annual TFP growth total (%) a=b+c+f	Contribution of each effect						
					Within effect b	Reallocation effect subtotal c=d+e	Between effect d	Covariance effect e	Net entry effect subtotal f=g+h	Entry effect g	Exit effect h
This paper	Korea	Establishment	1990-98	3.51	1.42 (0.40)	0.08 (0.02)	-0.28 (-0.08)	0.36 (0.10)	2.01 (0.57)	1.95 (0.56)	0.06 (0.02)
Foster, Haltiwanger, and Krizan (1998)	USA	Establishment	1977-87	1.02	0.49 (0.48)	0.27 (0.26)	-0.08 (-0.08)	0.35 (0.34)	0.27 (0.26)		
Fukao and Kwon (2004)	Japan	Firm	1994-2001	0.31	0.17 (0.56)	0.05 (0.15)	-0.01 (-0.04)	0.06 (0.20)	0.09 (0.29)	0.16 (0.53)	-0.07 (-0.24)
Barnes, Haskell, and Maliranta (2001)	Finland	Firm	1987-92	1.08	-1.02 (-0.94)	1.27 (1.18)	0.57	0.70 (0.65)	0.82 (0.76)	0.58 (0.54)	0.24 (0.22)
	France	Firm	1987-92	-1.54	-2.03 (1.32)	0.29 (-0.19)	0.32 (-0.21)	-0.03 (0.02)	0.20 (-0.13)	0.18 (-0.12)	0.02 (-0.01)
	Italy	Firm	1987-92	3.10	1.64 (0.53)	0.43 (0.14)	0.71 (0.23)	-0.28 (-0.09)	1.02 (0.33)	1.09 (0.35)	-0.06 (-0.02)
	Netherlands	Firm	1987-92	0.54	0.83 (1.54)	-0.03 (-0.06)	0.49 (0.91)	-0.52 (-0.97)	-0.26 (-0.48)	0.03 (0.06)	-0.29 (-0.54)
	UK	Firm	1987-92	-0.90	-1.39 (1.54)	0.28 (-0.31)	-0.21 (0.23)	0.49 (-0.54)	0.21 (-0.23)	0.05 (-0.05)	0.15 (-0.17)
Motor vehicles, trailers and semi trailers											

Notes: The entry and exit effects in this paper and in Kwon and Fukao (2004) include the switch-in and switch-out effects, respectively. Values in parentheses denote the share of each effect in total TFP growth.
All studies are for the manufacturing sector and are based on the method employed by Foster, Haltiwanger, and Krizan (2001).

Table 2.2 Decomposition of Japan's Sectoral TFP Growth: 1994-2001 (Growth over the Seven-Year Period)

	Industry	**Within effect**	Between effect	Covariance effect	**Total effect among stayers**	Entry effect (excluding switch-in effect)	Exit effect (excluding switch-out effect)	Switch-in effect	Switch-out effect	**Net-entry effect**	**Industry total**	Share
		a	b	c	**d=a+b+c**	e	f	g	h	**i=e+f+g+h**	**j=d+i**	
1	Food	0.003	-0.001	0.001	0.003	0.006	-0.005	0.001	0.000	0.002	0.005	0.119
2	Textiles and apparel	-0.008	-0.002	0.007	-0.002	0.007	-0.027	0.001	0.000	-0.019	-0.020	0.024
3	Wood and furniture	0.000	-0.002	0.001	0.000	0.004	-0.017	0.001	-0.015	-0.027	-0.028	0.014
4	Pulp and paper	0.007	0.000	0.001	0.008	0.000	-0.002	0.000	0.000	-0.001	0.007	0.025
5	Printing and publishing	0.008	-0.001	0.003	0.011	0.010	0.000	0.000	0.000	0.010	0.020	0.039
6	Industrial chemicals and chemical fibers	0.007	0.001	0.002	0.010	0.001	-0.001	0.002	0.000	0.000	0.011	0.042
7	Oils and paints	0.004	-0.001	0.001	0.004	0.003	-0.004	0.001	0.000	0.000	0.005	0.010
8	Drugs and medicine	0.073	0.005	0.022	0.100	0.010	0.000	0.001	0.000	0.010	0.110	0.021
9	Other chemical products	0.016	0.001	0.000	0.017	0.007	0.001	0.002	0.001	0.012	0.028	0.017
10	Petroleum and coal products	0.027	0.015	0.014	0.056	0.000	-0.010	0.000	0.000	-0.010	0.046	0.030
11	Plastic products	-0.003	-0.002	0.003	-0.001	0.004	-0.002	0.005	-0.001	0.006	0.005	0.027
12	Rubber products	-0.024	0.002	0.000	-0.022	0.000	0.000	0.001	-0.001	0.000	-0.022	0.010
13	Ceramics	0.013	-0.003	0.003	0.013	0.002	-0.004	0.003	0.008	0.009	0.022	0.026
14	Iron and steel	0.003	-0.005	0.000	-0.002	0.000	0.001	0.001	-0.001	0.000	-0.002	0.038
15	Non-ferrous metals and products	0.008	-0.001	0.002	0.009	-0.006	-0.005	0.001	-0.001	-0.011	-0.002	0.024
16	Fabricated metal products	-0.009	-0.006	0.006	-0.009	0.003	-0.003	0.003	-0.003	0.000	-0.009	0.053
17	Metal working machinery	0.037	-0.002	0.015	0.050	0.009	0.000	0.012	-0.007	0.015	0.065	0.009
18	Special industrial machinery	0.022	-0.003	-0.002	0.017	0.003	-0.004	0.003	-0.001	0.000	0.018	0.024
19	Office, service industry and household machines	0.040	-0.001	0.009	0.048	0.013	0.000	0.045	-0.002	0.055	0.103	0.018
20	Miscellaneous machinery and machine parts	-0.005	-0.002	0.002	-0.005	0.003	-0.003	0.002	-0.002	-0.001	-0.006	0.043
21	Industrial electric apparatus	-0.015	-0.005	0.002	-0.018	0.005	-0.003	0.001	-0.003	0.000	-0.018	0.030
22	Household electric appliances	0.015	-0.002	-0.002	0.010	0.007	0.001	0.005	-0.002	0.010	0.020	0.008
23	Communication equipment and related products	0.071	-0.001	0.010	0.081	0.008	0.003	0.108	0.002	0.120	0.201	0.037
24	Electronic data processing machines and electronic equipment	0.026	0.003	0.005	0.033	0.008	-0.002	0.004	-0.012	-0.002	0.031	0.060
25	Electronic parts and devices	0.044	-0.001	0.010	0.053	0.017	-0.008	0.007	-0.002	0.014	0.067	0.055
26	Motor vehicles, trailers and semi trailers	0.014	0.000	0.004	0.017	0.033	-0.012	0.011	-0.007	0.025	0.042	0.013
27	Motor vehicles	0.018	0.000	0.005	0.023	0.001	-0.001	0.000	0.000	0.000	0.022	0.135
28	Miscellaneous transportation equipment	0.040	0.000	0.002	0.041	0.005	0.002	0.003	0.000	0.011	0.052	0.014
29	Precision instruments	0.017	-0.002	0.011	0.026	0.011	0.003	0.003	-0.001	0.016	0.041	0.016
30	Other manufacturing	-0.005	0.004	-0.001	-0.002	0.046	-0.005	0.009	-0.004	0.046	0.045	0.018
	Weighted average of all the industries	0.012	-0.001	0.004	0.015	0.006	-0.004	0.005	-0.001	0.006	0.021	
	Share of each effect in industry's TFP growth	0.56	-0.04	0.20	0.71	0.28	-0.17	0.25	-0.07	0.29	1.00	

Source: Fukao and Kwon (2004b)

Table2.3 Decomposition of Korea's Sectoral TFP Growth: 1990-1998 (Growth over the Eight-Year Period)

	Industry	**Within effect**	Between effect	Covariance effect	**Total effect among stayers**	Entry effect (excluding switch-in effect)	Exit effect (excluding switch-out effect)	Switch-in effect	Switch-out effect	**Net-entry effect**	**Industry total**	Share
		a	b	c	**d=a+b+c**	e	f	g	h	**i=e+f+g+h**	**j=d+i**	
1	Food	**0.043**	-0.056	0.052	**0.039**	-0.002	0.013	0.001	0.005	**0.017**	**0.056**	0.091
2	Textiles	**0.067**	-0.022	0.074	**0.119**	0.237	-0.010	0.018	0.004	**0.249**	**0.368**	0.058
3	Apparel	**0.041**	-0.039	0.117	**0.119**	0.341	-0.014	0.002	0.014	**0.343**	**0.462**	0.021
4	Leather, luggage, and footwear	**0.004**	0.012	0.087	**0.103**	0.159	0.006	0.006	0.003	**0.175**	**0.278**	0.020
5	Wood and wood products (except furniture)	**-0.030**	-0.016	0.023	**-0.023**	-0.039	-0.014	-0.001	0.001	**-0.053**	**-0.076**	0.007
6	Pulp and paper	**-0.020**	-0.022	0.041	**-0.001**	0.024	0.010	0.000	-0.003	**0.031**	**0.030**	0.025
7	Printing and publishing	**-0.094**	-0.032	0.048	**-0.078**	0.019	0.035	-0.002	0.017	**0.069**	**-0.009**	0.017
8	Industrial chemicals	**0.155**	-0.020	-0.022	**0.113**	0.068	0.002	0.010	-0.002	**0.079**	**0.191**	0.056
9	Chemical fibers	**0.251**	0.007	-0.106	**0.151**	0.179	-0.006	0.029	0.001	**0.203**	**0.354**	0.011
10	Other chemical products	**0.146**	-0.037	0.029	**0.138**	0.056	0.008	0.004	0.009	**0.078**	**0.216**	0.037
11	Coal, petroleum, and other fuel products	**-0.520**	-0.063	0.016	**-0.568**	-0.006	0.005	-0.003	0.002	**-0.002**	**-0.570**	0.063
12	Rubber products	**0.080**	-0.010	0.022	**0.092**	0.144	0.009	0.022	0.002	**0.177**	**0.269**	0.027
13	Plastic products	**0.068**	-0.052	0.089	**0.104**	0.036	0.060	0.007	0.002	**0.106**	**0.210**	0.011
14	Ceramics	**0.098**	-0.036	0.057	**0.119**	0.089	-0.008	0.005	0.001	**0.087**	**0.206**	0.037
15	Iron and steel	**0.175**	-0.049	0.044	**0.170**	0.042	0.005	0.003	0.002	**0.052**	**0.222**	0.070
16	Non-ferrous metals and products	**0.215**	0.024	0.068	**0.307**	0.056	0.003	0.040	0.002	**0.102**	**0.409**	0.019
17	Metal casts	**0.030**	-0.002	0.020	**0.049**	0.158	0.011	0.055	-0.022	**0.202**	**0.250**	0.003
18	Fabricated metal products	**0.122**	-0.014	0.051	**0.158**	0.179	0.001	0.028	-0.017	**0.191**	**0.349**	0.037
19	General purpose machinery	**0.212**	-0.039	-0.100	**0.073**	0.148	0.009	0.034	0.010	**0.201**	**0.274**	0.025
20	Other special purpose machinery	**0.042**	-0.014	0.042	**0.070**	0.190	0.007	0.021	-0.003	**0.216**	**0.286**	0.030
21	Other domestic appliances	**0.157**	-0.030	0.083	**0.210**	0.080	-0.032	0.013	0.011	**0.073**	**0.283**	0.013
22	Computers and office machinery	**0.155**	-0.053	-0.119	**-0.017**	0.106	0.053	0.688	0.002	**0.849**	**0.832**	0.024
23	Electrical machinery and apparatuses	**0.149**	-0.006	0.009	**0.152**	0.148	0.002	0.062	0.003	**0.215**	**0.367**	0.033
24	Semiconductor and other electronic components	**0.412**	0.017	-0.067	**0.362**	0.149	0.022	0.066	-0.013	**0.224**	**0.586**	0.065
25	Radio, television and communication equipment and apparatuses	**0.185**	0.048	0.155	**0.388**	0.471	0.003	0.017	0.015	**0.505**	**0.893**	0.054
26	Motor vehicles, trailers and semi trailers	**0.313**	-0.022	-0.024	**0.267**	0.134	0.000	0.014	-0.002	**0.147**	**0.414**	0.082
27	Other transport equipment	**0.395**	-0.021	0.079	**0.453**	0.053	-0.063	0.022	0.001	**0.014**	**0.467**	0.037
28	Medical, precision and optical instruments	**0.066**	0.010	0.016	**0.091**	0.235	-0.019	0.048	0.024	**0.288**	**0.380**	0.009
29	Furniture and other manufacturing	**0.049**	-0.022	0.101	**0.128**	0.184	-0.006	0.014	-0.001	**0.190**	**0.319**	0.017
30	Recycling	**0.006**	0.001	-0.002	**0.005**	0.486	-0.002	0.015	-0.002	**0.496**	**0.501**	0.001
	Weighted average of all the industries	**0.113**	-0.023	0.029	**0.120**	0.123	0.003	0.033	0.002	**0.161**	**0.281**	
	Share of each effect in industry's TFP growth	**0.404**	-0.081	0.103	**0.426**	0.437	0.012	0.118	0.006	**0.574**	**1.000**	

Table 2.4.a Decomposition of Annual TFP Growth in the Japanese Manufacturing Sector

Period	TFP growth total	Contribution of each effect								
		Within effect	Reallocation effect subtotal	Between effect	Covariance effect	Net entry effect subtotal	Entry effect (excluding switch-in	Exit effect (excluding switch-out effect)	Switch-in effect	Switch-out effect
	a=b+c+f	b	c=d+e	d	e	f=g+h+i+j	g	h	i	j
1994-1995	**0.029**	**0.024**	**0.000**	-0.002	0.002	**0.005**	0.006	-0.003	0.006	-0.003
1995-1996	**0.011**	**0.008**	**0.001**	0.000	0.002	**0.002**	0.004	-0.002	0.005	-0.005
1996-1997	**-0.002**	**-0.002**	**0.003**	0.001	0.002	**-0.003**	0.001	-0.004	0.004	-0.004
1997-1998	**-0.007**	**-0.008**	**0.001**	0.000	0.002	**0.000**	0.003	-0.003	0.002	-0.001
1998-1999	**0.011**	**0.010**	**0.000**	-0.002	0.002	**0.001**	0.003	-0.003	0.002	-0.002
1999-2000	**0.017**	**0.013**	**0.003**	0.001	0.002	**0.001**	0.004	-0.004	0.002	-0.001
2000-2001	**-0.005**	**-0.008**	**0.003**	-0.001	0.004	**-0.001**	0.003	-0.004	0.003	-0.003

Table 2.4.b Decomposition of Annual TFP Growth in the Korean Manufacturing Sector

Period	TFP growth total	Contribution of each effect								
		Within effect	Reallocation effect subtotal	Between effect	Covariance effect	Net entry effect subtotal	Entry effect (excluding switch-in	Exit effect (excluding switch-out effect)	Switch-in effect	Switch-out effect
	a=b+c+f	b	c=d+e	d	e	f=g+h+i+j	g	h	i	j
1990-1991	**0.059**	**0.041**	**0.013**	-0.020	0.032	**0.005**	0.001	-0.001	0.003	0.001
1991-1992	**0.027**	**0.003**	**0.016**	-0.024	0.040	**0.008**	0.006	0.001	0.001	0.001
1992-1993	**0.022**	**-0.007**	**0.019**	-0.017	0.036	**0.009**	0.009	-0.002	0.001	0.001
1993-1994	**0.067**	**0.047**	**0.016**	-0.022	0.037	**0.004**	0.005	-0.003	0.003	-0.001
1994-1995	**0.074**	**0.047**	**0.018**	-0.015	0.032	**0.009**	0.005	-0.001	0.004	0.001
1995-1996	**0.004**	**-0.015**	**0.018**	-0.020	0.038	**0.002**	0.001	0.001	-0.002	0.002
1996-1997	**0.007**	**-0.024**	**0.026**	-0.023	0.049	**0.005**	0.005	0.000	-0.002	0.003
1997-1998	**0.018**	**-0.015**	**0.025**	-0.015	0.040	**0.008**	0.003	0.002	0.000	0.003

Figure 2.1 Correlation of the Within Effect by Industry in Japanese and Korean Manufacturing

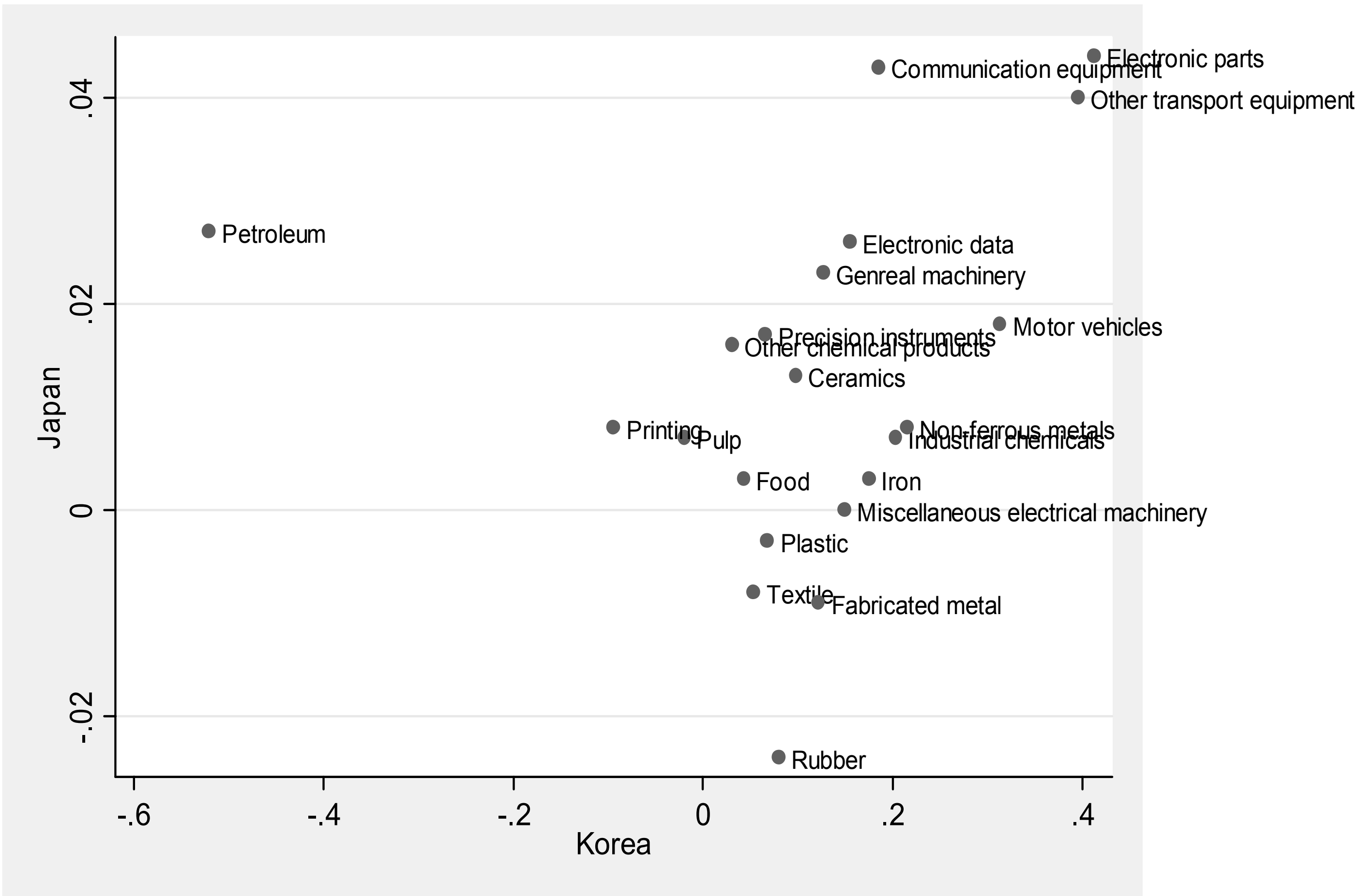


Figure 2.2 Japan's Trade and Production Abroad: Electrical Machinery (trillion yen)

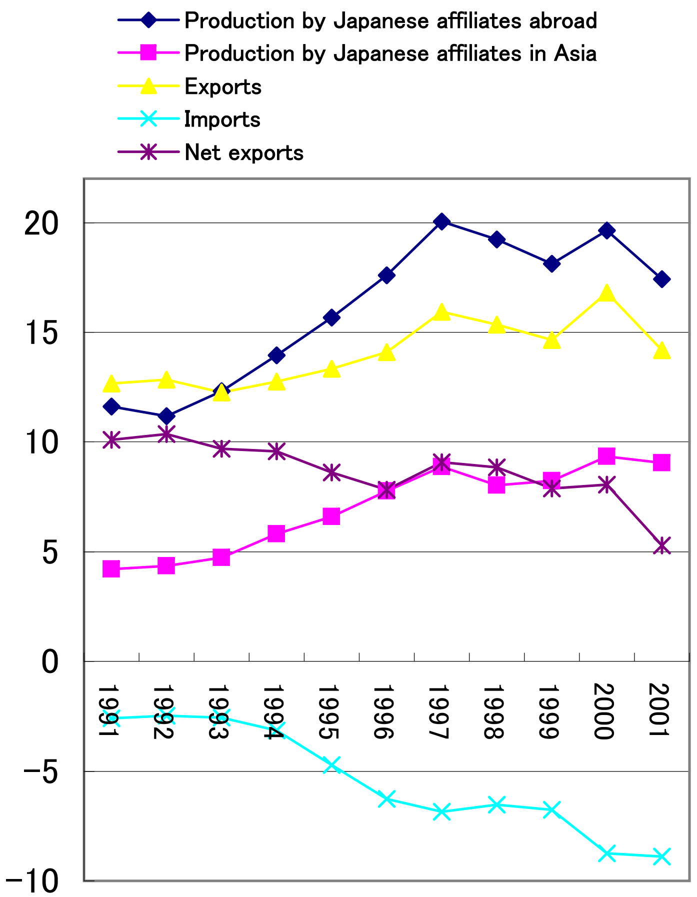
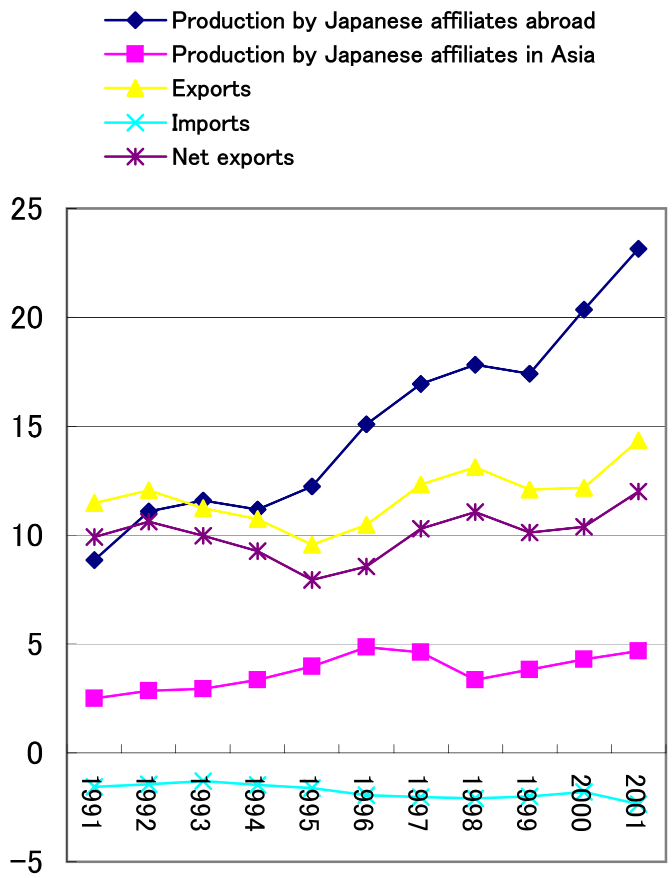


Figure 2.3 Japan's Trade and Production Abroad: Automobiles (trillion yen)



Sources: Fukao and Yuan (2001b); Ministry of Finance (various years) Trade Statistics, Tokyo: Ministry of Finance, downloaded from http://www.customs.go.jp/toukei/download/index_d011_e.htm on December 18, 2004.

Table 4.1 Correlation matrix

Japan	Export intensity ('94)	Total effect	Within effect	Redistribution effect	Net entry effect
Export intensity ('94)	1				
Total effect	0.4578*	1			
Within effect	0.4413*	0.8917*	1		
Redistribution effect	-0.0318	0.5490*	0.6047*	1	
Net entry effect	0.4460*	0.8517*	0.5480*	0.1594	1

Korea	Export intensity ('90)	Total effect	Within effect	Redistribution effect	Net entry effect
Export Intensity ('90)	1				
Total effect	0.5074*	1			
Within effect	0.3022*	0.6777*	1		
Redistribution effect	0.2432	0.0566	-0.2537	1	
Net entry effect	0.3824*	0.7832*	0.1505	-0.0859	1

Note: * significant at 5% level

Table4.2 Descriptive Statistics of the Variables Used for the Regression Analysis on the Determinants of TFP Growth

Japan	Sample size	Sample average	Standard deviation	Minimum value	Maximum value
TFP level	84,923	-0.026	0.129	-4.511	1.432
Growth rate of TFP level	84,923	0.004	0.091	-3.547	4.565
Exports/total sales	84,923	0.030	0.098	0.000	1.000
(Exports/total sales of the industry)	84,923	0.096	0.094	0.001	0.401
R&D investment/total sales	84,923	0.009	0.020	0.000	0.740
(Total R&D investment of the industry/total sales of the industry)	84,923	0.021	0.017	0.002	0.088
Number of non-production workers/number of all workers	84,923	0.326	0.245	0.000	1.000
(Number of all non-production workers in the industry/number of all workers in the industry)	84,923	0.361	0.095	0.215	0.719
ln (number of workers)	84,923	5.221	0.985	3.912	11.254
Korea					
TFP level	474,879	0.132	0.380	-3.858	5.837
Growth rate of TFP level	474,879	0.037	0.349	-5.738	4.763
Export/production	474,879	0.064	0.212	0.000	4.050
(Export/production of the industry)	474,879	0.193	0.146	0.004	0.739
R&D investment/production	474,879	0.006	0.089	0.000	28.800
(Total R&D investment of the industry/total sales of the industry)	474,879	0.010	0.010	0.000	0.076
Number of non-production workers/number of all workers	474,879	0.194	0.187	0.000	1.000
(Number of all non-production workers in the industry/number of all workers in the industry)	474,879	0.258	0.066	0.125	0.455
ln (number of workers)	474,879	2.753	0.987	0.693	10.421

Table4.3 Determinants of Japanese Firms' TFP Growth: 1995-2001, All Manufacturing Firms

Dependent variable: ln(TFP)t-ln(TFP)t-1	(1)		(2)		(3)		(4)	
ln(TFP)t-1	-0.2919	***	-0.2874	***	-0.2919	***	-0.0895	***
	(-15.40)		(-15.32)		(-15.38)		(-10.49)	
(Exports/total sales)t-1			0.0091	**	0.0080	*	0.0082	***
			(1.96)		(1.73)		(3.10)	
(Total exports of the industry/total sales of the industry)t-1			-0.0208	*	-0.0206	*	0.0250	***
			(-1.76)		(-1.75)		(8.90)	
(R&D investment/total sales)t-1	0.1799	***	0.2043	***	0.1732	***	0.0572	***
	(4.25)		(4.69)		(4.02)		(4.09)	
(Total R&D investment of the industry/total sales of the industry)t-1	0.3488	***	0.4161	***	0.4207	***	0.0598	***
	(6.11)		(5.90)		(5.95)		(3.50)	
(Number of non-production workers/number of all workers)t-1	0.0180	***			0.0179	***	0.0049	***
	(9.97)				(9.99)		(4.45)	
(Number of all non-production workers in the industry/number of all workers ir the industry)t-1	-0.0090				-0.0091		0.0043	**
	(-0.92)				(-0.93)			
ln (number of workers)t-1	0.0075	***	0.0074	***	0.0074	***	0.0026	***
	(14.53)		(14.64)		(14.68)		(11.26)	
Intercept	-0.0360	***	-0.0337	***	-0.0359	***	-0.0221	***
	(-6.41)		(-10.06)		(-6.44)		(-12.31)	
Industry dummies	yes		yes		yes		no	
Year dummies	yes		yes		yes		no	
Number of observations	84923		84923		84923		9108	
R-squared	0.1855		0.1836		0.1856		0.3422	

1. The values in parentheses are heteroskedasticity-robust t-statistics .
2. *P=.10, **P=.05, ***P=0.01.
Source: Fukao and Kwon (2004b).

Table4.4 Determinants of Korean Plants' TFP Growth: 1991-98, All Manufacturing Plants

Dependent variable: ln(TFP)t-ln(TFP)t-1	(1)		(2)		(3)		(4)	
ln(TFP)t-1	-0.5088	***	-0.5040	***	-0.5094	***	-0.1028	***
	(-269.36)		(-267.27)		(-269.64)		(-82.4)	
(Exports/production)t-1			0.0351	***	0.0298	***	0.0110	***
			(15.81)		(13.67)		(6.68)	
(Exports/production of the industry)t-1			0.0156	**	0.0216	***	0.0503	***
			(2.07)		(2.80)		(18.19)	
(R&D investment/production)t-1	0.0182	*	0.0267	**	0.0181	*	0.0108	*
	(1.78)		(2.55)		(1.77)		(1.87)	
(Total R&D investment of the industry/total production of the industry)t-1	0.8218	***	0.7409	***	0.7288	***	0.4729	***
	(10.97)		(9.69)		(9.23)		(10.41)	
(Number of non-production workers/number of all workers)t-1	0.1231	***			0.1212	***	0.0298	***
	(41.67)				(41.28)		(13.19)	
(Number of all non-production workers in the industry/number of all workers in the industry)t-1	-0.0325				-0.0109		0.0520	***
	(-1.54)				(-0.51)			
ln (number of workers)t-1	0.0041	***	0.0093	***	0.0027	***	0.0015	***
	(9.08)		(21.18)		(5.64)		(4.56)	
Intercept	-0.0933	***	-0.0968	***	-0.0975	***	-0.0124	***
	(-16.25)		(-37.54)		(-16.43)		(-5.47)	
Industry dummies	yes		yes		yes		no	
Year dummies	yes		yes		yes		no	
Number of observations	474879		474879		474879		21456	
R-squared	0.2853		0.2822		0.2856		0.3814	

1. The values in parentheses are heteroskedasticity-robust t-statistics .

2. *P=.10, **P=.05, ***P=0.01.

Table 4.5 Labor Productivity Level per Hour Worked in Manufacturing Sectors: Korea and Japan (Index: USA=1)

Industry	Korea	Japan	Japan/Korea
Mechanical engineering	0.147	0.794	5.406
Leather and footwear	0.141	0.672	4.772
Scientific instruments	0.166	0.734	4.427
Rubber & plastics	0.287	1.044	3.638
Other instruments	0.150	0.489	3.257
Motor vehicles	0.344	1.100	3.196
Chemicals	0.600	1.857	3.096
Pulp, paper & paper products	0.347	0.974	2.811
Other electrical machinery and apparatus	0.173	0.474	2.744
Telecommunication equipments	0.349	0.954	2.732
Railroad equipments and transport equipments	0.189	0.474	2.500
Electronic valves and tubes	0.351	0.784	2.231
Clothing	0.157	0.335	2.136
Printing & publishing	0.389	0.786	2.023
Basic metals	0.678	1.309	1.931
Radio and television receivers	0.267	0.514	1.926
Non-metallic mineral products	0.351	0.673	1.917
Office machinery	0.404	0.734	1.819
Furniture, miscellaneous manufacturing; recycling	0.244	0.423	1.732
Fabricated metal products	0.324	0.515	1.590
Insulated wire	0.327	0.510	1.561
Mineral oil refining, coke & nuclear fuel	3.341	4.933	1.476
Wood & products of wood and cork	0.291	0.376	1.293
Food, drink & tobacco	0.393	0.505	1.285
Building and repairing of ships and boats	0.306	0.335	1.093
Textiles	0.205	0.223	1.088
Aircraft and spacecraft	0.547	0.590	1.080
Total All Industries	0.304	0.708	2.326

Source: Groningen Growth and Development Centre, 60-Industry Database, October 2004, http://www.ggdc.net