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ABSTRACT

This study analyzes the cause of the slowdown in Japan's TFP growth during the 1990s. Many preceding studies, examining the issue at the macro- or industry-level, have found that the slowdown was primarily due to the stagnation in TFP growth in the manufacturing sector. Using establishment level panel data covering the entire sector, we investigate the causes of the TFP slowdown and find that the reallocation of resources from less efficient to more efficient firms was very slow and limited. This "low metabolism" seems to be an important reason for the slowdown in Japan's TFP growth.

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1. Introduction

In the 1990s, Japan experienced a significant slowdown in the growth of total factor productivity (TFP) – a trend that stands in stark contrast with many other advanced countries. A number of empirical studies have examined the causes of this slowdown in TFP growth by focusing on the micro level.[1] Although these studies have thrown light on some aspects of Japan's economic malaise, few studies showed how much of the TFP slowdown at the macro level can be explained by the diseases they diagnosed.

In the case of the United States, Canada, and the EU countries, there has been a dramatic increase in the number of productivity studies using longitudinal micro-level data sets. In the EU KLEMS project, for example, Eric J. Bartelsman and other scholars are trying to link their results on productivity at the micro-level with sector- and macro-level results on productivity. Japan, however, probably because of the lack of appropriate data sets, has been relatively left behind in such studies, which link micro-level productivity analyses with sector- or macro-level productivity analyses.

In order to fill this gap, the research project "Study on Industry-Level and Firm-Level Productivity in Japan" at the RIETI (Research Institute of Economy, Trade and Industry) has been compiling a sector- and micro-level database with, in the case of sector-level data, covers the whole economy or at least, in the case of micro-level data, a substantial part of the Japanese economy. The sector-level data set is called the Japan Industrial Productivity (JIP) Database.[2]

Using the JIP 2006 Database and establishment-level data of the *Census of Manufactures*

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[1] See Fukao and Kwon (2006) for overview of empirical studies on Japan's TFP growth rate of the 1990s at the macro- and the sector-level.

[2] The original version of the JIP Database (ESRI/Hi-Stat JIP Database 2003) was compiled in a collaboration between ESRI (Economic and Social Research Institute, Cabinet Office, Government of Japan) as part of its research project on "Japan's Potential Growth" and Hitotsubashi University as part of its Hi-Stat project (A 21st-Century COE Program, Research Unit for Statistical Analysis in the Social Sciences).

compiled by this project, this paper investigates the causes of the stagnation of productivity in Japan.

In this paper we first show that productivity slowdown mainly occurred in Japan's manufacturing sector. Next, we decompose the aggregate productivity growth of Japan's manufacturing sector into a within effect, a reallocation effect, and a net entry effect. Although Nishimura, Nakajima and Kiyota (2005), Fukao Kwon (2004, 2006) and Ahn, Fukao and Kwon (2004) already 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 do not allow an examination of the causes of Japan's productivity slowdown because the *Basic Survey* only covers the period after 1992.

In this paper, we assess changes in productivity dynamics at the sector- and the micro-level from the 1980s to 2003 using the JIP 2006 Database and the establishment-level data of the *Census of Manufactures*. To the best of our knowledge, this paper is the first study that compares Japanese micro-level productivity dynamics in the 1990s with those of the 1980s.

Our analysis suggests that the decline in aggregate productivity growth was not due to a decline in the reallocation effect but due to (a) a slowdown in TFP growth within establishments; and (b) a worsening negative exit effect, meaning that closures of productive establishments were more frequent than closures of unproductive establishments.

Finally, we examine why the negative exit effects have worsened and productivity growth within each establishment has drastically declined since the collapse of the bubble economy. We found some evidence supporting the hollowing-out hypothesis, namely, that productive establishments seem to be closed down and production relocated abroad. We also found that the slowdown in productivity growth within existing establishments is partly caused by the low start-up rate and the high closure rate during the lost decade.

The remainder of this paper is organized as follows: In the next section, using the JIP 2006 database, we present an overview of Japan's TFP growth from 1970 to 2002. In Section 3, we conduct a decomposition of TFP growth in the manufacturing sector and compare our results with preceding studies on other developed economies. In Section 4, we examine TFP dynamics and entry and exit at establishment level. Finally, in Section 5, we summarize our results and discuss the policy implications of our findings.

2. An Evidence of Japan's Macro and Sectoral TFP Growth from 1970 to 2002

Since the early 1990s, Japan has suffered a large decline in aggregate productivity growth when compared to the relatively rapid growth in the 1980s (Hayashi and Prescott 2001, Fukao et al. 2004).[3] Sector-level analysis shows that the decrease in productivity growth can be seen across the board sector (Fukao et al. 2004, Fukao and Kwon 2006). In addition, previous studies have shown that the slowdown in TFP growth was more severe in the manufacturing sector than in the non-manufacturing sector. From an international perspective, Japan's productivity growth over the past decade or so has been extraordinarily low, and in contrast with Japan, many countries enjoyed significant improvements in productivity as a result of the ICT revolution in the 1990s.

In this section, we provide a detailed examination of the reasons for the slowdown in Japan's productivity growth during the 1990s using growth accounting. We will use aggregate and sectoral data from the JIP 2006 database developed by Fukao et al. (2006).[4]

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[3] It should be noted, however, that there are also several studies that came to the conclusion that the slowdown in the TFP growth in the 1990s was not that large. See, e.g., Jorgenson and Motohashi (2004) and Kawamoto (2004).

[4] The JIP 2006 Database was compiled as part of a RIETI research project. The detailed results of this project are reported in Fukao et al. (2006). The database contains annual information on 108 sectors, including 56 non-manufacturing sectors, from 1970 to 2002. These sectors cover the whole Japanese economy. The database includes detailed information on factor inputs, annual nominal and real input-output tables, as well as some additional statistics, such as capacity utilization rates,

Table 2.1 summarizes the result of the macro-level growth accounting. In our growth accounting exercise, we divided the period 1970-2002 into five-year intervals and into three long subperiods. We included the three long subperiods because growth accounting for shorter periods tends to be more strongly affected by cyclical variations in productivity growth. According to our calculations based on data from the JIP database, real GDP growth, which we calculated using a Laspeyres chain index, declined from 4.41 percent in 1980-1990 to 1.10 percent in 1990-2002.[5] This decline of 3.31 percentage-points can be decomposed into the following factors:

– a decline in man-hour growth of 0.86 percentage points;

– a decline in labor quality growth of 0.08 percentage points;

– a decline in capital stock growth of 0.82 percentage points;

– a decline in capital quality growth of 0.40 percentage points;

– a decline in TFP growth of 1.17 percentage points.

As this list shows, all factors contributed to the decline in economic growth during Japan's lost decade. The decline in TFP growth rate is smaller than the results of Hayashi and Prescott (2002) and Yoshikawa and Matsumoto (2001), suggesting that the TFP growth rate at the macro-level declined by more than 2 percentage points from the 1980s to the 1990s. Our results also show that the most important factor underlying the stagnation during the 1990s is the decline in TFP growth. But what is also remarkable is the large drop in the growth contribution of capital. In fact, the slowdown in capital deepening – i.e., the contribution of the change in capital stock and capital quality taken

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Japan's international trade by trade partner, inward and outward FDI, etc., at the detailed sectoral level. An Excel file version of the JIP2006 Database is available on RIETI's web site.

[5] As Fukao and Kwon (2006) indicate, the fixed-weighted Laspeyres price index for ICT products suffers from bias because the outputs share of ICT products, which registered faster price declines, increased.

together – was even more severe than the decline in TFP growth. These results indicate that the stagnation of Japan’s economy has been caused by both supply-side and demand-side factors.

Insert Table 2.1

Table 2.2 compares the growth accounting results for the manufacturing and the non-manufacturing sector. The results indicate that real output growth and man-hour growth slowed much more significantly in the manufacturing than in the non-manufacturing sector. On the other hand, the growth contribution of capital in the non-manufacturing sector, which had been substantial in the 1970s and 1980s, fell markedly during the 1990s. Finally, like many previous studies, we found that the slowdown in TFP growth was more severe in the manufacturing than in the non-manufacturing sector.

Looking at the estimates for the five-year intervals, we find that all growth indicators – real GDP, man-hours, capital stock, and TFP – saw a remarkable drop immediately after the collapse of the bubble economy. TFP growth, capital deepening, and labor supply all saw a much more pronounced deceleration than in previous business cycles. Following the collapse of bubble economy, Japan’s economy failed to rebound quickly and TFP growth and capital deepening stopped.

Considerable differences in productivity growth across industries can be observed and it is quite possible that a few industries account for most of the productivity growth at the macro level. We therefore examined the contribution of individual sectors to macro-level productivity growth and the results are illustrated in Figures 2.1, 2.2, and 2.3. Figure 2.3 shows that during the “lost decade” of the 1990s, the wholesale sector accounts for all the productivity growth in the economy as a whole. In contrast, during the preceding decade, productivity growth in the economy as a whole was supported by eleven sectors. The aggregate productivity acceleration in 1980s was supported by eleven sectors, led by the wholesale, finance, retail, and civil engineering sectors due their relative size (Figure 2.2). In the 1970s, six sectors accounted for 95 percent of total productivity growth.

These sectors included the motor vehicle parts and accessories, electronic parts, household electric appliances, and motor vehicles sectors, which registered the highest rates of productivity growth during this period.

The rank of leading industry has remained fairly stable over the decades. The top five industries in the 1970s were: wholesale, retail, motor vehicle parts and accessories, electronic parts, and household electric appliances. In the 1980s, the order was as follows: wholesale, finance, retail, civil engineering, and electronic data processing machines. Finally, in the 1990s, the list was again topped by wholesale, followed by public administration, electronic parts, finance, and electronic data processing machines.

Comparing the top ten contributing sectors in Japan and the United States, we find that these are fairly similar.[6] Two sectors, wholesale and electronic parts, are among the top ten in the two countries in all periods. Overall, the two major industries making the greatest contribution to aggregate productivity growth both in Japan and the United States and throughout the entire period were the commerce and the electrical machinery/electronics sector.

During lost decade, all industries experienced decline of productivity growth, and sector with strong productivity growth could not maintain their acceleration of productivity. There was good news such as five of the top ten contributing industries to productivity growth hailed from the service sector, such as “telegraph and telephone,” “finance” and “information services and internet-based services.” The above results indicate that for Japan’s economy to once again achieve sustained rates of growth, the emergence of new growth sectors and an acceleration of productivity growth in the service sector are indispensable.

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[6] See Farrell, Baily and Remes (2005) for case of United States.

3. Decomposition of Total Factor and Labor Productivity Growth in the Manufacturing Sector by Industry

As Baily, Hulten and Campbell (1992) and Foster, Haltiwanger and Krizan (1998) have shown in their productivity decomposition analyses, the start-up of productive establishments and the closure of unproductive establishments substantially contributed to TFP growth in the United States. Figure 3.1 shows that, in the 1980s, the start-up rate (the number of newly set up establishments divided by the number of all establishments) and the closure rate in Japan were only about half of the corresponding values for the U.S. Moreover, the gap widened in the 1990s as the start-up rate in Japan's manufacturing sector declined to only about 2%. This factor is likely to have contributed to the slowdown in TFP growth in Japan's manufacturing sector. We examine this crucial issue in this section.

Insert Figure 3.1

We use a longitudinal database on Japanese manufacturing establishments for the period 1981-2003. The establishment-level data are taken from the *Kogyo Tokei Chosa* (*Census of Manufactures*), which is conducted annually by the Ministry of Economy, Trade and Industry (METI).[7] We created this longitudinal database making use of work of the "Quantitative Analysis Database Group" at RIETI on the linkage of establishment identification numbers over time.[8]

The census covers all Japanese manufacturing establishments except those belonging to the government as well as head offices not directly engaged in the manufacturing, processing or repair of industrial products. The census covers all establishments in years ending with 0, 3, 5 and 8 of the Western calendar year. In the other years, the Census covers establishments with four or more

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[7] The compilation of the microdata of the *Census of Manufactures* was conducted as part of the RIETI project "Study on Industry- and Firm-Level Productivity in Japan."

[8] This group at RIETI includes Kazunari Shinbo, Mutsuharu Takahashi, Hyeog Ug Kwon, Toshiyuki Matsuura and others. For details on this linkage process, see Shinbo, Takahashi and Omori (2005).

employees. In the case of censuses covering all establishments, data on establishments with less than four employees until a few years ago used to be managed and stored by prefectural governments. Most of these data appear to already have been discarded and therefore were not available to us.[9] For this reason, we had to confine our analysis to establishments with four or more employees. It is important to note that in this study, our data on establishments that "closed" include establishments which shrunk to a size of less than four employees or changed their main business from the manufacturing sector to another sector.

There are 9,049,011 establishment observations for the period of 1981-2003. Out of these 9 million observations, we can calculate the labor productivity (real value added per man-hour) for about 8,852,575 observations and TFP for about 3,485,030 observations. Many small establishments did not provide information regarding key variables, such as capital stock, which are indispensable for our calculation of TFP. We treated establishments that failed to provide such information in one year as ongoing establishments, not as closed establishments, but we did not include these establishments in our calculation of industry-level TFP growth. This, however, means that our decomposition analysis of TFP growth at the industry level might be biased as a large number of small firms are not included. In order to examine whether our TFP growth estimates are biased and to correct for this problem, we also decompose labor productivity by industry.

We divide the manufacturing establishments into 48 industries and calculate the relative TFP and labor productivity of each establishment in relation to the industry average. Following Good, Nadiri, and Sickles (1997) and Aw, Chen, and Roberts (1997), we define the TFP level of establishment f in year t in a certain industry in comparison with the TFP level of a hypothetical representative establishment in year 0 in that industry by

[9] For more on this issue, see Shimizu and Miyagawa (2003).

$$\ln TFP_{f,t} = (\ln Q_{f,t} - \overline{\ln Q_t}) - \sum_{i=1}^{n} \frac{1}{2}(S_{i,f,t} + \overline{S_{i,t}})(\ln X_{i,f,t} - \overline{\ln X_{i,t}})$$
$$+ \sum_{s=1}^{t} (\overline{\ln Q_s} - \overline{\ln Q_{s-1}}) - \sum_{s=1}^{t} \sum_{i=1}^{n} \frac{1}{2}(\overline{S_{i,s}} + \overline{S_{i,s-1}})(\overline{\ln X_{i,s}} - \overline{\ln X_{i,s-1}})] \quad (3.1)$$

where $Q_{f,\,t}$, $S_{i,\,f,\,t}$, and $X_{i,\,f,\,t}$ denote the gross output of establishment *f* in year *t*, the cost share of factor *i* for establishment *f* in year *t*, and establishment *f*'s input of factor *i* in year *t*, respectively. Variables with an upper bar denote the industry average of that variable. We use 1981 as the base year 0. We assume constant returns to scale. As factor inputs, we take account of capital, labor and real intermediate inputs.

We define the representative establishment for each industry as a hypothetical establishment 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 (3.1) denote the gap between establishment *f*'s TFP level in year *t* and the representative establishment's TFP level in that year. The third and fourth term denote the gap between the representative establishment's TFP level in year *t* and the representative establishment's TFP level in year 0. Therefore, $lnTFP_{f,\,t}$ in equation (3.1) denotes the gap between establishment *f*'s TFP level in year *t* and the representative establishment's TFP level in year 0.

In a similar way, we define the labor productivity level of establishment *f* in year *t* in a certain industry in comparison with the labor productivity level of a hypothetical representative establishment in year 0 in that industry by

$$\ln LP_{f,t} = (\ln Y_{f,t} - \overline{\ln Y_t}) - (\ln L_{f,t} - \overline{\ln L_t})$$
$$+ \sum_{s=1}^{t} (\overline{\ln Y_s} - \overline{\ln Y_{s-1}}) - \sum_{s=1}^{t} (\overline{\ln L_s} - \overline{\ln L_{s-1}}) \quad (3.2)$$

where $Y_{f,\,t}$, and $L_{i,\,f,\,t}$ denote the real value added (real gross output minus real intermediate input) of establishment *f* in year *t* and establishment *f*'s labor input in year *t*, respectively.

For details on the definition of and data source for each variable, please see Appendix A.

Because of data limitations, we cannot take account of the change in labor quality in our productivity analysis. It is probably for this reason that we arrive at a higher TFP growth estimate than the industry-level result based on the JIP 2006 in the previous section. We also assume that the working hours at each establishment are equal to the industry average.

Adopting the methodology used by Baily, Hulten and Campbell (1992) and Foster, Haltiwanger and Krizan (1998), we define the industry-level TFP of a certain industry in year *t* by

$$\ln TFP_t = \sum_{f \in F} \theta_{f,t} \ln TFP_{f,t} \tag{3.2}$$

where $\theta_{f,\,t}$ denotes establishment *f*'s sales share in year *t* in that industry. *F* is the set of all the establishments existed at least either in year t-τ or in year *t* in this industry. Then, as Foster, 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: $\sum_{f \in S} \theta_{f,t-\tau} \Delta \ln TFP_{f,t}$

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

Covariance effect: $\sum_{f \in S} \Delta \theta_{f,t} \Delta \ln TFP_{f,t}$

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

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

where *S* is the set of establishments that stayed in that industry from year t-τ to year *t*, *N* is the set of establishments that newly entered and *X* is the set of establishments that exited. TFP with an upper bar denotes the industry-average TFP level.

In a similar way, we define the industry-level labor productivity of a certain industry in year *t* as

$$\ln LP_t = \sum_{f \in F} \lambda_{f,t} \ln LP_{f,t} \tag{3.2}$$

where $\lambda_{f,\,t}$ denotes establishment *f*'s labor input share in that industry in year *t*. Then we can decompose labor productivity growth in the manufacturing sector from year t-τ to year t, $lnLP_t$ – $lnLP_{t-\tau}$, into the following five factors.

Within effect: $\sum_{f\in S}\lambda_{f,t-\tau}\Delta\ln LP_{f,t}$

Between effect: $\sum_{f\in S}\Delta\lambda_{f,t}(\ln LP_{f,t-\tau}-\overline{\ln LP_{t-\tau}})$

Covariance effect: $\sum_{f\in S}\Delta\lambda_{f,t}\Delta\ln LP_{f,t}$

Entry effect: $\sum_{f\in N}\lambda_{f,t}(\ln LP_{f,t}-\overline{\ln LP_{t-\tau}})$

Exit effect: $\sum_{f\in X}\lambda_{f,t-\tau}(\overline{\ln LP_{t-\tau}}-\ln LP_{f,t-\tau})$

where S is the set of establishments that stayed in that industry from year t-τ to year t, N is the set of establishments that newly entered and X is the set of establishments that exited. LP with an upper bar denotes the industry-average labor productivity level.

The results of our decomposition for the period from 1981 to 2003 are reported in Table 3.3 and Figures 3.2 and 3.3. We divided the whole period into five sub-periods: 1981-85, 85-90, 90-95, 95-2000, and 2000-2003. The switch-in and switch-out effects in Table 3.1 and Figures 3.2 and 3.3 show the contribution of those establishments that moved from one industry to another to the industry average of the total factor and labor productivity level. It has been pointed out in preceding studies that decomposition results are affected by business cycles.[10] Figure 3.4 shows capacity utilization rate and diffusion index of business conditions. In order to minimize the impact of business cycles on our estimation, we also decompose growth rates for the longer time spans of 1981-1990 and

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[10] In 1981-2002, there were four official business cycle peaks, June 1985, February 1991, May 1997, and November 2000, and five troughs, February 1983, November 1986, October 1993, January 1999, and January 2002. Official peak and trough dates are available in *Business Cycle Reference Dates*, Economic and Social Research Institute, Cabinet Office, Government of Japan (<http://www.esri.cao.go.jp/>).

1990-2003. The results are also reported in Table 3.2.

Insert Tables 3.1 and 3.2 and Figures 3.2, 3.3 and 3.4

Our most important findings can be summarized as follows

1. The final column of Table 3.1 reports the exit effect (including the switch-out effect). The contribution of exit effect in whole periods was negative, irrespective of productivity indexes. What is more, the negative exit effect has been steadily growing. The negative exit effect means that the productivity level of exiting establishments has been higher than the industry average. We also found that exit effect was negative for all industries. Fukao and Kwon (2006) also found similar negative exit effects using firm-level data in the 1990s.
2. The entry effect (including switch-in effect) was both positive and has tended to increase (Table 3.1). The entry effect was positive in almost all the industries. Contrary to exit of establishments, the entry of new establishments contributes to raise industry productivity growth.[11]
3. Moreover, the net entry effect has been positive in all periods. The entry and exit process tends to raise productivity growth as the entry of high productivity establishments has exceeds exit of high productivity. The net contribution to overall productivity growth of the entry and exit of establishments is small and has declined over time. In the long-term, contribution of net entry effect to productivity growth is stable but gradually decreasing. It is noteworthy that the Japanese economy has experienced the decline of the contribution of plant turnover to productivity growth in the 1990s.

[11] Because of five and ten year interval, we observe as entry establishements not start-up establishments but 2 years over establishments. Therefore, in case of annual data, our entry effect is calculated as the productivity growth of surviving establishments.

4. The within effect, i.e. the effect of TFP growth within staying establishments, made the largest contribution to overall productivity growth in all periods (Table 3.1). However, this effect saw a sharp drop in the 1990s. The decline in the within effect is primarily attributable to the slowdown in productivity growth in the manufacturing sector.

5. The reallocation effect, which is the sum of the between effect and the covariance effect, contributed about half of the total productivity growth in the 1990s (in the case of TFP growth). This indicates that market forces have played an important role in efficiently allocating resources away from establishments that perform poorly and to establishments that perform well. In particular, the covariance effect, which gives the contribution of surviving establishments with increasing shares and growing productivity, seems to have been more important in the 1990s. This indicates that, instead of low net entry effect, the reallocation effect across existing establishments plays a stronger role to promote productivity growth in the 1990s (Table 3.1). The reallocation effect is interpreted as reflecting the creative destruction processes (Bartelsman et al, 2004). The creative destruction within existing establishments in Japan’s 1990s was very important factor to support aggregate productivity. In this context, it is encouraging that the Japanese government is trying to further strengthen the role of market forces through structural reforms.

In order to put Japan’s productivity performance into international perspective, we compare our results of those with studies for the U.S., Canada, the U.K., and South Korea. However, it should be borne in mind that such a comparison presents various problems as the studies use different data sets, weights, and time spans. Below, we compare our results with those of studies for the countries mentioned that use the same methodology, although the time periods differ:

1. In recessionary periods, the reallocation effect rather than the within effect dominates. In contrast,

during boom periods, it is the within effect that dominates. In Japan, however, share of within effect do not change even in great depression, although the growth of within effect drastically dropped.

2. In all periods and all countries, the net entry effect is positive, suggesting that productivity grows as less productive establishments exit and more productive ones enter In addition, we find that in almost all countries except Japan, the net entry effect is the major source of overall productivity growth during recessionary periods. Yet, although Japan's recession lasted longer than those in other countries, we find that the contribution of the net entry effect is smallest, indicating that the mechanism of "creative destruction" in Japan's manufacturing sector is very weak.
3. The redistribution of market shares among incumbents, whereby high productivity establishments increase market shares and relatively low productivity decrease them, contributes positively to aggregate productivity growth in all periods and countries. Overall, the productivity dynamics-sum of reallocation effect and net entry effect is larger than the within effect in all countries except Japan. This means that productivity growth due to market selection is essential to boost aggregate productivity growth. In Japan, productivity dynamics positively contributed to aggregate productivity growth, but the effect was smaller than that of other countries. This "low metabolism" seems to have slowed down the TFP growth of the manufacturing sector.

To sum up the above results, we find that the decline in Japan's TFP growth in 1990s is largely due to the drop in the within effect. Conversely, the share of the reallocation effect has grown due to a strengthening of the role of the market. Yet, while the above analysis allowed us to determine the relative contribution of the within and the reallocation effect, it tell us little about why the within effect declined and why the negative exit effect enlarged.

4. Analysis of Causes of Negative Exit Effects and Sharp Decline in Within Effects

As shown in the previous section, the decline in Japan's TFP and labor productivity growth in the 1990s and the early 2000s was not caused by a slowdown of the "metabolism," i.e., the reallocation effect. Rather, it was primarily caused by a decline in the within effect. That is, in the period since 1990, it was the TFP and labor productivity growth within establishments that slowed down. We also showed that the absolute size of the negative exit effect became larger in the 1990s and the early 2000s. On a brighter note, we found that the positive entry effect increased during the period from 2000 to 2003. In order to understand how these changes in the 1990s and early 2000s came about, in this section we investigate the productivity dynamics and the entry and exit of establishments in greater detail.

Panel A of Figure 4.1 shows the share of establishments that were newly opened or closed in the total number of establishments.[12] Panel B shows the share accounted for by such establishments in total manufacturing output. These two figures show that the closure rate has been growing almost continuously since the beginning of the 1990s. On the other hand, the start-up rate declined in the 1990s, but then recovered during 2000-2003. The share of start-up establishments in total output did not decline in the 1990s because larger establishments were opened in this period than in the 1980s.

Insert Figure 4.1

Many establishments could not survive in the period 1990-2003. We can confirm this by

[12] As we already explained in the previous section, the Census covers all establishments in years ending with 0, 3, 5 and 8 of the Western calendar year. For other years, the Census covers establishments with four or more employees. In years when the Census covers only establishments with four or more employees, some establishments with more than four employees report that they employ less than four in order to evade the obligation to fill in the questionnaire. Because of such behavior, the number of establishments and our figures on "start-ups" tend to become higher in years when the Census covers all establishments. For more on this issue, see Shimizu and Miyagawa (2003).

looking at transition matrices of establishments' rank in labor productivity (Table 4.2). Only 44% of all the establishments which existed in 1990 survived until 2003 (the average annual survival rate was 93.8%). In contrast, from 1981 to 1990, 65% establishments continued to operate (the annual survival rate was 95.4%). In the 1990-2003 period, 239,482 establishments were closed and only 101,152 establishments were opened. As a result, the number of establishments declined by 33% from 424,535 to 286,205. In the 1980-1990 period, the number of closures and the number of start-ups were more or less in balance and the number of establishments actually increased slightly.

Insert Table 4.2

Table 4.2 also shows that the degree of persistence of labor productivity is very high. 56% of establishments which originally ranked in the bottom three deciles in 1990 remained in the same three deciles in 2003. Similarly, 55% of establishments which originally ranked in the top three deciles in 1990 remained in the same three deciles in 2003 (if they survived). We also found a similar persistence of productivity in the case of TFP.[13]

It is important to note that the survival rate is not high even in the case of establishments in the top labor-productivity group. From 1990 to 2003, only 47% of establishments in this group survived. The survival rates of establishments in the higher labor productivity groups are slightly greater than those of establishments in the lower labor productivity groups. But the average size of establishments in the higher labor productivity groups is larger than in the lower labor productivity groups. These factors cause the negative exit effect that can be seen in Figure 3.2 and Figure 3.3.[14] As these figures show, the negative exit effect worsened after 1995.

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[13] Several studies examining plant level TFP found the degree of persistence to be also very high in the U.S. manufacturing sector (Baily *et al.*, 1992; Bartelsman and Doms, 2000). Fukao and Kwon (2006) found a similar high persistence in firm-level TFP in Japan’s manufacturing sector.

[14] Using firm-level TFP data for Japan’s manufacturing sector for the period after 1994, Nishimura, Nakajima and Kiyota (2005) and Fukao and Kwon (2006) found similar negative exit effects.

Why did the negative exit effect worsen after 1995? One possible explanation is a hollowing-out effect as a result of direct investment abroad. In the 1990s, Japanese firms relocated production to Asian countries (primarily the ASEAN countries and China) in order to lower production costs. As Figure 4.2 shows, in the case of the electrical machinery industry, there was indeed a very rapid increase in production abroad and a decline in domestic production and net exports in the period 1990-2003. Since it is mainly productive large firms that invest abroad, this relocation of production may have led to the closure of productive establishments in Japan.

Insert Figure 4.2

If we can link our establishment data with firm-level data of direct investment abroad, we could test the above hypothesis. Unfortunately, we do not have such linked micro data at this moment. But at the industry level, we can test our hypothesis. Figure 4.3 compares changes in Japanese firms' production in East Asia (China, Korea, Taiwan, Hong Kong, Indonesia, Thailand, the Philippines, and Malaysia) from 1990 to 2002 with the exit effect in 1990-2003. We have 48 cross industry observations. Consistent with our hypothesis, we can observe a negative correlation between production in Asia and the exit effect. The correlation coefficient is 0.42, which is statistically significant at the 5% level. When we exclude observations for the communication equipment industry, which seems to strongly contribute to the negative correlation, the correlation coefficient declines to 0.24 but is still significant at the 5% level.

Insert Figure 4.3

Based on a different approach but using similar longitudinal labor productivity data on manufacturing establishments (for the period 1985-95) , Shimizu and Miyagawa (2003) found that in many industries, such as the mechanical rubber products and household electric appliances industries, the labor productivity of establishments that closed was significantly higher than that of establishments that stayed. Although they focused on an earlier period than ours, they arrived at similar inferences as we did, that is, the closure of productive establishments may be caused by the relocation of production from Japan to foreign countries.

Although we need linked micro data in order to draw conclusions about the cause of the worsening negative exit effect, the hollowing-out hypothesis seems to be a leading hypothesis.

Next, let us analyze about the slowdown of within effects in Japan's manufacturing from the 1990s. In order to completely understand the trend of within effect, we need firm level data such as, R&D, IT investment at head office, M&A, international trade and out-sourcing etc. At this moment we do not have such data. But using the data we have, we can analyze how sharp decline of number of establishments contributed the slow-down of within effects.

According to proceeding studies, new establishments gradually expand their size and improve their productivity overtime (Baldwin 1998, Bartelsman and Doms 2000). And exiting firms have lower performance several years before their exit (Kiyota and Takizawa 2006). In our decomposition analysis some part of such learning effects and shadow-of-death effects might be included in our within effect. For example, suppose one establishment is opened in 1983 and gradually improved their productivity from 1983 to 1990. If the productivity level of this establishment has already become high by 1985, this fact is counted as positive entry effect for the period of 1980-1985. But their productivity improvement after 1985 is counted as within effect for the period of 1985-1990. In a similar way some part of shadow-of-death effect might be included in within effect.

As a result of low open-up rate and high closure rate in the 1990s, the output share of establishments set up in the previous six years has declined from 1988 to 1995 (Panel A of Figure 4.4) and the share of establishments closing in the next ten years has drastically increased from 1985 to 1993 (Panel B of Figure 4.4). These changes of age structure of manufacturing establishments might have reduced within effect.

Insert Figure 4.4

Using our data, we evaluate magnitude of learning effects and shadow-of-death effects in Japan's manufacturing. First, we estimate how quickly young establishments improve their productivity in comparison with older establishments. We estimated the following equation.

$$\ln TFP_{t,f}* = \alpha^{L} + \sum_{T=0}^{16} \beta^{Ls}{}_{T} D^{Ls}_{f,T} + \sum_{T=0}^{16} \beta^{Lm}{}_{T} D^{Lm}_{f,T} + \sum_{i=1}^{49} \chi^{L}{}_{i} D^{L}{}_{f,i} + \sum_{y=1}^{Y} \delta^{L}{}_{y} D^{L}{}_{t,year} + \varepsilon^{L}{}_{t,f} \tag{4.1}$$

where an age dummy variable $D^{Lm}{}_{f,T}$ takes value one if the establishment f belongs to a firm operating multiple establishments (we call such an establishment as multi-plant establishment) and is started up in T years ago. Otherwise $D^{Lm}{}_{f,T}$ takes value zero. $D^{Ls}{}_{f,T}$ takes value one if the establishment f belongs to a firm not operating multiple establishments (we call such an establishment as single-plant establishment) and is started up in T years ago. Otherwise $D^{Ls}{}_{f,T}$ takes value zero. The set of $D^{L}{}_{f,t}$ demote year dummies and the set of $D^{L}{}_{t,year}$ denote industry dummies. $TFP_{t,f}*$ denotes a gap between establishment f's TFP level and simple average TFP level of that industry in year t;

$$\ln TFP_{f,t}* = (\ln Q_{f,t} - \overline{\ln Q_{t}}) - \sum_{i=1}^{n} \frac{1}{2}(S_{i,f,t} + \overline{S_{i,t}})(\ln X_{i,f,t} - \overline{\ln X_{i,t}})$$

Since we found large differences of both TFP level and learning effects between single-plant establishment and multi-plant establishment, we assumed different age coefficient between the two groups.

If we include establishments closed later within our sample, our age coefficients pick up not only learning effects but also selection effects; the effects caused by closure of establishments. As Table 4-3 shows, there is a severe selection process. Less than 50% of newly opened establishments can survive in the next 10 years. In order to exclude selection effects, we exclude establishments closed before 2003 from our observations for estimation. In the case of establishments set up before

1981, we do not know their age and all the age dummies take value zero. Such establishments plus establishments older than 16 years are the base group for the estimation. The data is pooled and we used OLS regression.

Insert Table 4.3

Figure 4.5 shows estimated learning effect. Vertical line segments denote 5% confidence intervals. Multi-plant establishments and single-plant establishments have similar level of TFP in the open-up year. But multi-plant establishments more quickly improve their productivity after the open-up.

Insert Figure 4.5

In a similar way, we estimate the following equation in order to evaluate shadow-of-death effects.

$$\ln TFP_{t,f}* = \alpha^{C} + \sum_{T=0}^{20} \beta^{Cs}{}_{T} D^{Cs}_{f,T} + \sum_{T=0}^{20} \beta^{Cm}{}_{T} D^{Cm}_{f,T} + \sum_{i=1}^{49} \chi^{C}{}_{i} D^{C}{}_{f,i} + \sum_{y=1}^{Y} \delta^{C}{}_{y} D^{C}{}_{t,year} + \varepsilon^{C}{}_{t,f} \tag{4.2}$$

where an closure year dummy variable $D^{Cm}{}_{f,T}$ takes value one if the establishment f is a multi-plant establishment and is closed in T years later. Otherwise $D^{Cm}{}_{f,T}$ takes value zero. $D^{Cs}{}_{f,T}$ takes value one if the establishment f is a single-plant and is closed T years later. We exclude establishments, which entered after 1982 and survived until 2003, from our observations for estimation since we do not know whether they can survive for more than 21 years. Establishments which survived for more than 21 years are the base group for the estimation.

Figure 4.6 shows estimated shadow-of-death effect. Vertical line segments denote 5% confidence intervals. Although the average TFP level of multi-plant establishments is much higher than that of single-plant establishments, they deteriorate before the closure in a similar way. We also calculated inter-temporal changes of ratio of the average plant size of establishments set up in the same year to the industry average plant size (Table 4.4) and inter-temporal changes of ratio of the average plant size of establishments closed in the same year to the industry average plant size (Table 4.5). These tables show that behind learning effects and shadow-of-death effects on TFP, size of establishments also sharply changes overtime.

Insert Figure 4.6, Table 4.4 and 4.5

We found substantial learning effects, which works for longer than five years after the open-up, and shadow-of-death effects, which works more than five years before the closure. We also found that as a result of low open-up rate and high closure rate in the 1990s, the output share of young establishments has declined and the share of establishments closing in the next ten years has drastically increased from the 1980s to the 1990s. Therefore it seems that we can explain the decline of within effects in the period of 1990-2003, at least partly, by the low open-up rate and high closure rate in the 1990s.

5. Conclusion

Using the JIP 2006 Database and establishment-level data of the *Census of Manufactures*, we examined why Japan's TFP growth slowed down in the 1990s. The major results obtained through our analysis are follows:

1. Using JIP 2006 data, we examined Japan's TFP growth decline at the macro and the sectoral level. Like previous studies, we found that the growth rate of TFP declined at the macro level and the slowdown in TFP growth was more severe in the manufacturing than in the non-manufacturing sector.
2. Our productivity decomposition analysis based on establishment-level data showed that the decline in aggregate productivity growth was not due to a decline in the reallocation effect but due to (a) a slowdown in TFP growth within establishments; and (b) a worsening negative exit effect, meaning that closures of productive establishments were more frequent than closures of

unproductive establishment.

3. In all periods and all countries, the net entry effect is positive, suggesting that productivity grows as less productive establishments exit and more productive ones enter In addition, we find that in almost all countries, the net entry effect is the major source of overall productivity growth during recessionary periods. Yet, although Japan's recession lasted longer than those in other countries, we find that the contribution of the net entry effect is smallest, indicating that the mechanism of "creative destruction" in Japan's manufacturing sector is very weak. However, on the bright side, the contribution of the entry effect has increased in recent years.
4. Transition matrices reveal a considerable persistence in the level of productivity. 56% of establishments which originally ranked in the bottom three deciles in 1990 remained in the same three deciles in 2003. Similarly, 55% of establishments which originally ranked in the top three deciles in 1990 remained in the same three deciles in 2003. However, the survival rate is not high even in the case of establishments in the top labor-productivity groups.
5. The average productivity of establishments that exited was higher than the average productivity in that industry. Probably, this is a consequence of the relocation of production from Japan to foreign countries.
6. Without doubt, most of the decline in productivity growth comes from the decrease in the within effect. It seems also certain that the decline in the within effect was caused by the low start-up rate and high closure rate during the 1990s. This implies that an active turnover in plants is essential to boost Japan's aggregate productivity.

Appendix A. Definition of Variables Used in the Econometric Analysis and Data Sources

The data source of this study is the *Census of Manufactures*, which is conducted annually by the Ministry of Economy, Trade and Industry (METI). The survey covers all manufacturing plants with four or more employees, and it excludes plants that ceased operating or whose employment fell below the survey's threshold of four employees. It contains detailed information on plant characteristics, such as output, employees, intermediate inputs, tangible capital, location, etc. The available data cover the period 1981-2003.

A1. Construction of variables to measure productivity

Output: Gross output is measured as the sum of shipments, revenues from repairing and fixing services, and revenues from performing subcontracted work. Gross output is deflated by output deflators derived from the JIP 2006. Real value added is defined as real gross output minus real intermediate inputs.

Intermediate inputs: Intermediate inputs are defined as the sum of raw materials, fuel, electricity and subcontracting expenses for consigned production used by the plant. Intermediate inputs are deflated by intermediate input deflators provided in the JIP 2006.

Labor input: As labor input, we used each firm's total number of workers multiplied by the sectoral working hours from the JIP 2006.

Capital Stock: Using the nominal book values of tangible fixed assets including buildings, machinery, tools and transport equipment, we calculated the net capital stock of plant *i* in industry *j* in constant 1995 prices as follows:

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

where BV_{it} represents the book value of firm *i*'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 in 1976 from the *Census of Manufactures 1976* published by METI. We then converted the book value of year 1976 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 investment deflator in the JIP 2006. The sectoral depreciation rate used is also taken from the JIP 2006.

Cost Shares: Labor costs are defined as total salaries and intermediate costs are defined as the sum of raw materials, fuel, electricity and subcontracting expenses for consigned production provided in the *Census of Manufactures*, respectively. Capital costs were calculated by multiplying the real net capital stock with the user cost of capital. The latter was estimated as follows:

$$c_k = \frac{1-z}{1-u} p_k \{(1-u)i + \delta_j - (\frac{\dot{p}_k}{p_k})\}$$

where p_k, i, δ, u and z are the price of investment goods, the interest rate, the depreciation rate, the corporate tax rate, and the present value 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 JIP 2006, the *Bank of Japan* and the *Ministry of Finance Statistics Monthly*. The depreciation rate for each sector is taken from the JIP 2006. We measure the cost share of each factor by dividing the costs of each factor by total costs, which is the sum of labor costs, intermediate input costs, and capital costs.

A2. Treatment of Outliers

Data for the Analysis of Labor Productivity

To begin with, we excluded plants that reported either zero employees or a negative number of employees, and negative value added. Next, we defined as outliers those plants whose annual average labor productivity fell outside four times standard deviations of labor productivity and eliminated these plants from our sample.

Data for the Analysis of TFP

We dropped plants that did not provide information on the book value of tangible fixed asset and plants that report zero total salaries and intermediate inputs. We also excluded outliers from our sample using the same rule as that applied for labor productivity.

References

Ahn, S., K. Fukao and H. U. Kwon (2004) "The Internationalization and Performance of Korean and Japanese Firms: An Empirical Analysis Based on Micro Data" *Seoul Journal of Economics*, Vol. 17, No. 4, pp. 439-82.

Aw, B. Y., X. Chen and M. J. Roberts (2001) "Firm-level Evidence on Productivity Differentials and Turnover in Taiwanese Manufacturing," *Journal of Development Economics*, Vol. 66, No.1, pp. 51-86.

Baily, M. N., C. Hulten and D. Campbell (1992) "Productivity Dynamics in Manufacturing Plants," *Brookings Papers on Economics Activity: Microeconomics*, Vol. 2, pp. 187-249.

Baldwin, J. R. and W. Gu (2006) "Plant Turnover and Productivity Growth in Canadian Manufacturing," *Industrial and Corporate Change*, Vol.15, pp. 417-465.

Bartelsman, E. J. and M. Doms (2000) "Understanding Productivity: Lessons from Longitudinal Microdata," *Journal of Economic Literature*, Vol. 38, No.3, pp. 569-594.

Bartelsman, E. J., J. Haltiwanger and S. Scarpetta (2004) "Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries," *Policy Research Working Paper Series* 3464, The World Bank.

Disney, R., J. Haskel, and Y. Heden (2003) "Restructuring and Productivity Growth in UK Manufacturing," *Economic Journal*, Vol.113, pp.666-694.

Doms, M., J,B, Jensen, F. Kramarz, K. Motohashi, and V. Nocke (1995) "A Micro Economic Comparison of the Manufacturing Sectors in France, Japan and the United States," paper presented at the NBER Summer Institute, Productivity Workshop, July 1995, Cambridge. MA.

Farrell, D., M. Baily and J. Remes (2005) "US Productivity After the Dot Com Bust," MGI Report "U.S. Productivity Growth, 1995-2000" at <http://www.mckinsey.com/mgi/publication/us/index.asp>

Foster, L., J. Haltiwanger and C. J. Krizan (2001) “Aggregate Productivity Growth: Lessons from Microeconomic Evidence,” in C. R. Hulten, E.R. Dean, and M. J. Harper (eds.), *New Contributions to Productivity Analysis*, Chicago: The University of Chicago Press, pp. 303-372.

Fukao, K., T. Inui, H. Kawai and T. Miyagawa (2004) "Sectoral Productivity and Economic Growth in Japan, 1970-98; An Empirical Analysis Based on the JIP Database," in T. Ito and A. K. Rose (eds.), *Growth and Productivity in East Asia*, National Bureau of Economic Research-East Asia Seminar on Economics, Vol. 13, Chicago: University of Chicago Press, pp.177-227.

Fukao, K. and H.U. Kwon (2006) “Why Did Japan’s TFP Growth Slow Down in the Lost Decade? An Empirical Analysis Based on Firm-Level Data of Manufacturing Firms,” *The Japanese Economic Review*, Vol. 57, No. 2, pp. 195-227.

Fukao, K., S. Hamagata, T. Inui, K. Ito, H.U. Kwon, T. Makino, T. Miyagawa, Y. Nakanishi, and J. Tokui (2006) “Estimation Procedures and TFP Analysis of the JIP Database 2006 Provisional Version,” paper presented at the EU KLEMS 3rd Consortium Meeting, May 7-9, 2006, Valencia (Spain).

Good, D. H., M. I. Nadiri and R. C. Sickles (1997) “Index Number and Factor Demand Approaches to the Estimation of Productivity,” in M.H. Pesaran and P. Schmidt (eds.), *Handbook of Applied Econometrics: Vol. 2. Microeconometrics*, Oxford, England: Basil Blackwell, pp. 14-80.

Griliches, Z. and H. Regev (1995) “Productivity and Firm Turnover in Israeli Industry: 1979-1988,” *Journal of Econometrics*, Vol. 65, No.1, pp.175-203.

Hayashi, F. and E. C. Prescott (2002) “The 1990s in Japan: A Lost Decade,” *Review of Economic Dynamics*, Vol. 5, No. 1, pp. 206-35.

Jorgenson, D. W. and K. Motohashi (2003) “The Role of Information Technology in the Economy:

Comparison between Japan and the United States," prepared for *RIETI/KEIO Conference on Japanese Economy: Leading East Asia in the 21st Century?* Keio University.

Kawamoto, T. (2004) "What Do the Purified Solow Residuals Tell Us about Japan's Lost Decade?" Bank of Japan IMES Discussion Paper Series, No. 2004-E-5, Bank of Japan, Tokyo.

Kiyota, K. and M. Takizawa (2006) "The Shadow of Death: Pre-exit Performance of Firms in Japan," mimeo.

Motohashi, K. (2001) "Development of Longitudinal Micro-Datasets and Policy Analysis for Japanese Industrial Sectors," *RIETI Discussion Paper Series* 01-E-007, RIETI, Tokyo.

New Business Creation Subcommittee, New Growth Policy Committee, the Industrial Structure Council (2002) *New Business Creation Subcommittee Report: For the Promotion of New Business and the Facilitation of Growth*, Ministry of Economy, Trade and Industry, Government of Japan.

Nishimura, K. G., T. Nakajima and K. Kiyota (2005) "Does the Natural Selection Mechanism Still Work in Severe Recessions? Examination of the Japanese Economy in the 1990s." *Journal of Economic Behavior and Organization*, forthcoming.

Shimizu, M. and K. Miyagawa (2003) *Sannyu-Taishutsu to Takakukano Keizai Bunseki* (Economic Analysis on Entry-Exit and Diversification of Business), Tokyo: Keio University Press.

Shinbo, K., M. Takahashi, and M. Omori (2005) "Kogyo Tokei Panel Data no Sakusei: Sangyo Kozo Database no Ikkan Toshite (Creation of the Census of Manufactures Panel Data: As Part of an Industrial Structure Database)," *RIETI Policy Discussion Paper Series*. 05-P-001, RIETI, Tokyo.

Small and Medium Enterprise Agency, Ministry of Industry, Trade and Industry, Japanese Government (2001) *2001 White Paper on Small and Medium Enterprises in Japan*, Ministry of Industry, Trade and Industry, Japanese Government, Tokyo (available at http://www.chusho.meti.go.jp /sme_english/index.html).

Small Business Administration, U.S. Government (1998) *The State of Small Business: A Report of the President*, Small Business Administration, U.S. Government, Washington D.C..

Study Group on "Industry Hollowing-out" and Tariff Policy, Ministry of Finance, Japanese Government (2002) *Chairperson's Report*, Ministry of Finance, Japanese Government, Tokyo.

Table 2.1: Macro-level Growth Accounting Results: 1970-2002 (annual rate of growth in %)

	Real GDP Growth	Contribution of Labor	Man-hour Growth	Labor Quality Growth	Contribution of Capital	Capital Stock Growth	Capital Quality Growth	Contribution of TFP Growth
	(a)	(b)=(c)+(d)	(c)	(d)	(e)=(f)+(g)	(f)	(g)	(h)=(a)-(b)-(e)
1970-75	5.47%	0.24%	-0.42%	0.66%	3.59%	2.94%	0.65%	1.64%
1975-80	5.69%	1.35%	0.87%	0.48%	1.98%	2.06%	-0.08%	2.37%
1980-85	3.92%	0.81%	0.31%	0.51%	2.12%	1.72%	0.40%	0.98%
1985-90	4.91%	0.68%	0.38%	0.30%	2.46%	1.87%	0.59%	1.77%
1990-95	1.45%	-0.01%	-0.41%	0.40%	1.41%	1.35%	0.05%	0.04%
1995-2000	1.27%	-0.06%	-0.42%	0.36%	0.92%	0.79%	0.13%	0.41%
2000-2002	-0.22%	-0.98%	-1.03%	0.04%	0.37%	0.31%	0.06%	0.39%
1970-80	5.58%	0.78%	0.24%	0.54%	3.17%	2.82%	0.36%	1.63%
1980-90	4.41%	0.75%	0.35%	0.41%	2.24%	1.76%	0.49%	1.42%
1990-2002	1.10%	-0.19%	-0.51%	0.33%	1.03%	0.94%	0.09%	0.25%

Source: JIP 2006 database.

Note: The growth accounting at the sector-level was conducted using the divisia index.

Table 2.2: Sector-level Growth Accounting Results: 1970-2002 (annual rate of growth in %)

	Real Output Growth	Intermediate Input Growth	Contribution of Labor	Man-hour Growth	Labor Quality Growth	Contribution of Capital	Capital Stock Growth	Capital Quality Growth	Contribution of TFP Growth
	(a)	(b)	(c)=(d)+(e)	(d)	(e)	(f)=(g)+(h)	(g)	(h)	(i)=(a)-(b)-(c)-(f)
Panel A. Manufacturing Sector									
1970-75	3.29%	1.75%	-0.28%	-0.44%	0.16%	0.57%	0.59%	-0.02%	1.25%
1975-80	5.11%	3.47%	0.32%	0.19%	0.13%	0.18%	0.16%	0.02%	1.13%
1980-85	4.08%	2.02%	0.36%	0.27%	0.09%	0.45%	0.33%	0.12%	1.25%
1985-90	4.59%	2.90%	0.05%	-0.05%	0.11%	0.62%	0.51%	0.11%	1.01%
1990-95	-0.09%	-0.30%	-0.46%	-0.60%	0.14%	0.39%	0.38%	0.01%	0.27%
1995-2000	0.57%	0.00%	-0.31%	-0.46%	0.16%	0.20%	0.14%	0.05%	0.68%
2000-2002	-2.73%	-1.94%	-0.73%	-0.83%	0.10%	-0.03%	-0.02%	0.00%	-0.03%
1970-80	4.20%	2.67%	0.02%	-0.11%	0.14%	0.36%	0.36%	0.00%	1.15%
1980-90	4.33%	2.48%	0.21%	0.11%	0.10%	0.51%	0.40%	0.11%	1.13%
1990-2002	-0.26%	-0.45%	-0.43%	-0.56%	0.13%	0.23%	0.21%	0.03%	0.39%
Panel B. Non-manufacturing Sector									
1970-75	4.72%	1.79%	0.42%	0.02%	0.40%	2.42%	1.85%	0.57%	0.09%
1975-80	4.94%	1.92%	0.83%	0.55%	0.28%	1.44%	1.47%	-0.03%	0.74%
1980-85	2.98%	1.34%	0.40%	0.06%	0.34%	1.36%	1.12%	0.23%	-0.11%
1985-90	4.69%	1.88%	0.49%	0.33%	0.16%	1.52%	1.15%	0.37%	0.80%
1990-95	2.24%	1.31%	0.25%	0.02%	0.22%	0.85%	0.82%	0.03%	-0.17%
1995-2000	1.13%	0.45%	0.11%	-0.09%	0.20%	0.58%	0.50%	0.08%	-0.02%
2000-2002	0.61%	0.38%	-0.35%	-0.35%	0.00%	0.27%	0.21%	0.06%	0.30%
1970-80	4.83%	1.89%	0.60%	0.28%	0.32%	2.25%	1.90%	0.35%	0.10%
1980-90	3.84%	1.63%	0.45%	0.20%	0.25%	1.39%	1.10%	0.29%	0.37%
1990-2002	1.50%	0.83%	0.09%	-0.09%	0.17%	0.63%	0.57%	0.06%	-0.04%

Source: JIP 2006 database.

Note: The growth accounting at the sector-level was conducted using the divisia index.

Figure 2.1: Cumulative Contribution of Industries to TFP Growth (1970-1980, Macro)

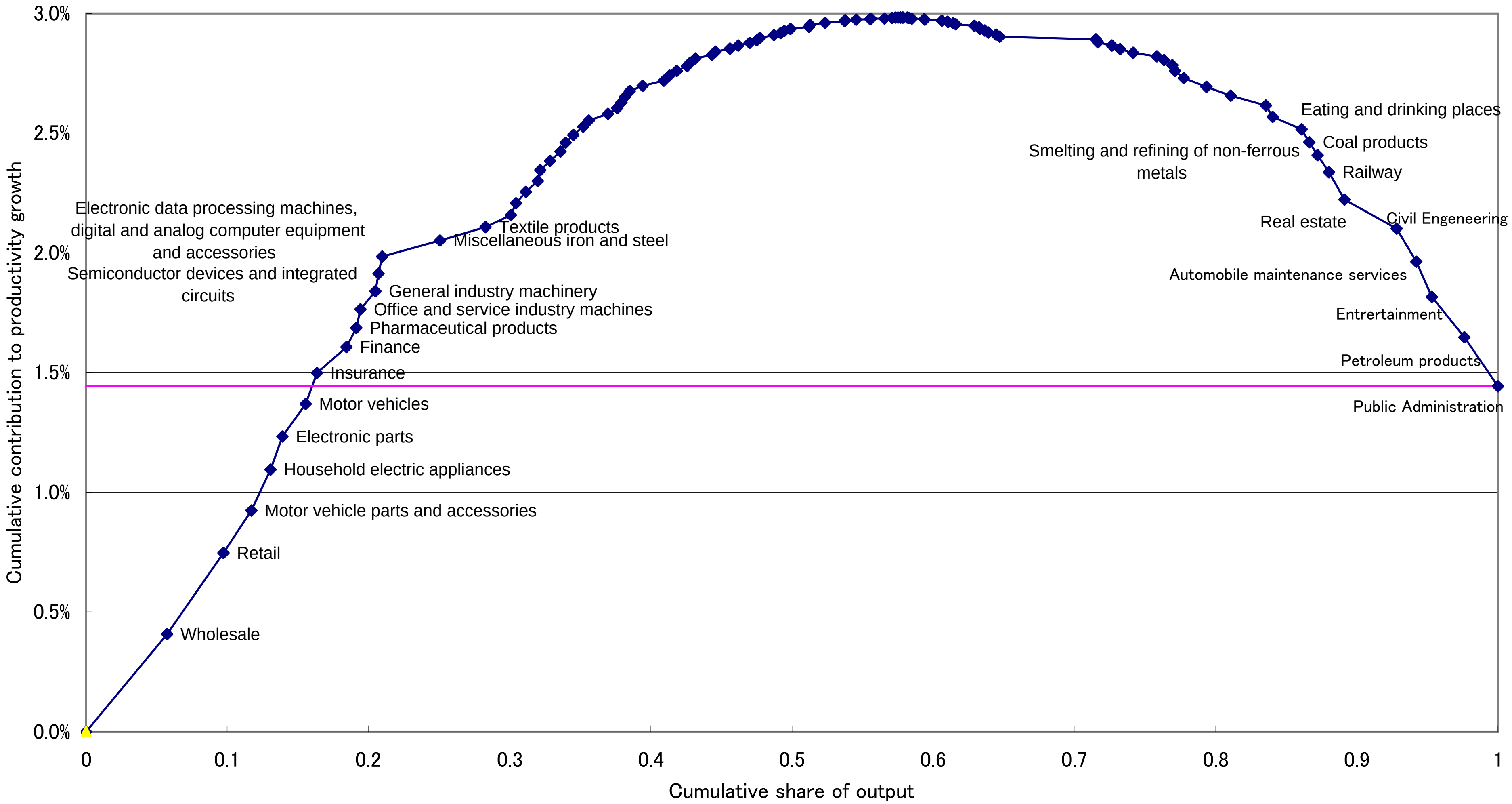


Figure 2.2: Cumulative Contribution of Industries to TFP Growth (1980-1990, Macro)

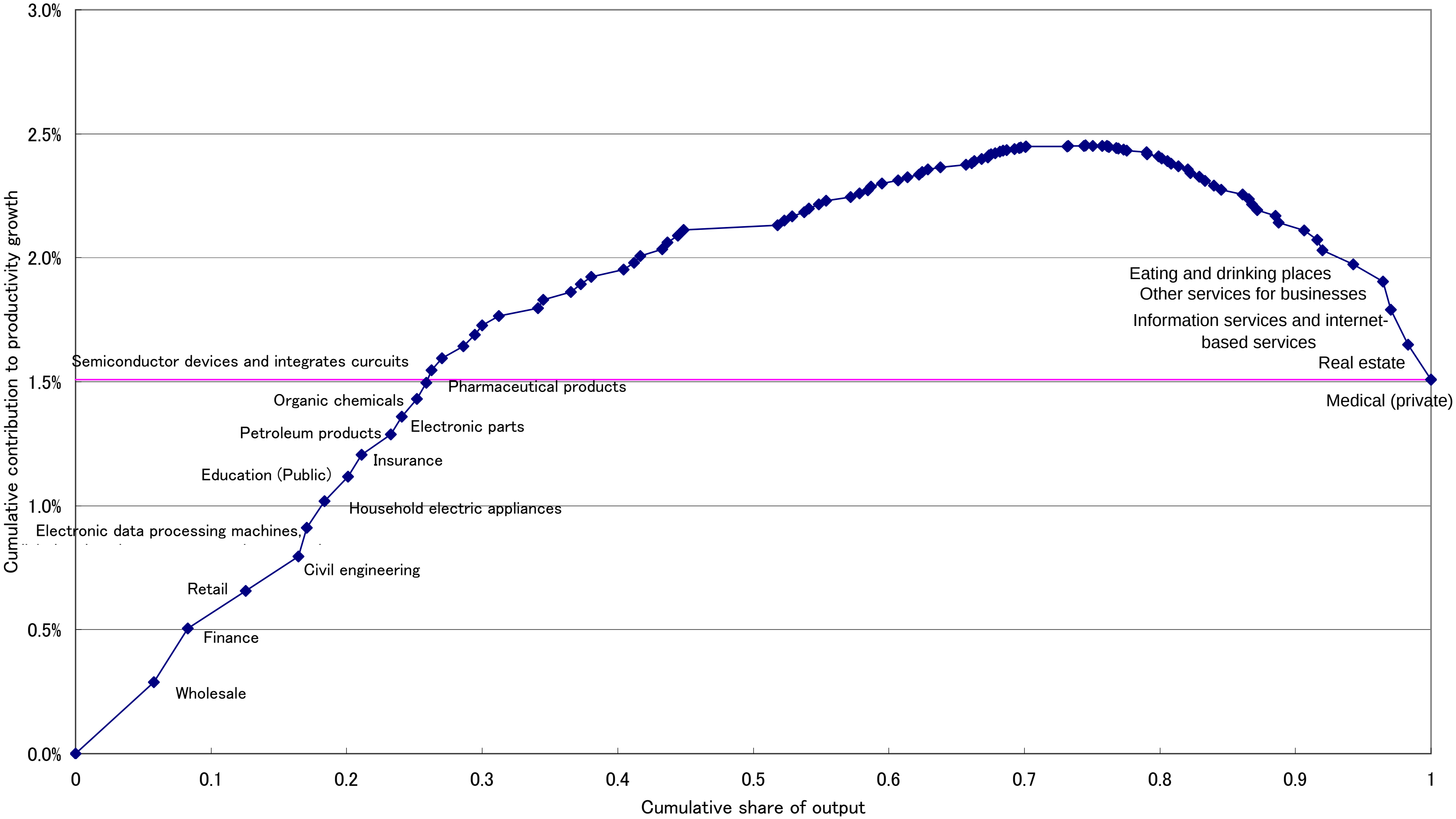


Figure 2.3: Cumulative Contribution of Industries to TFP Growth (1990-2002, Macro)

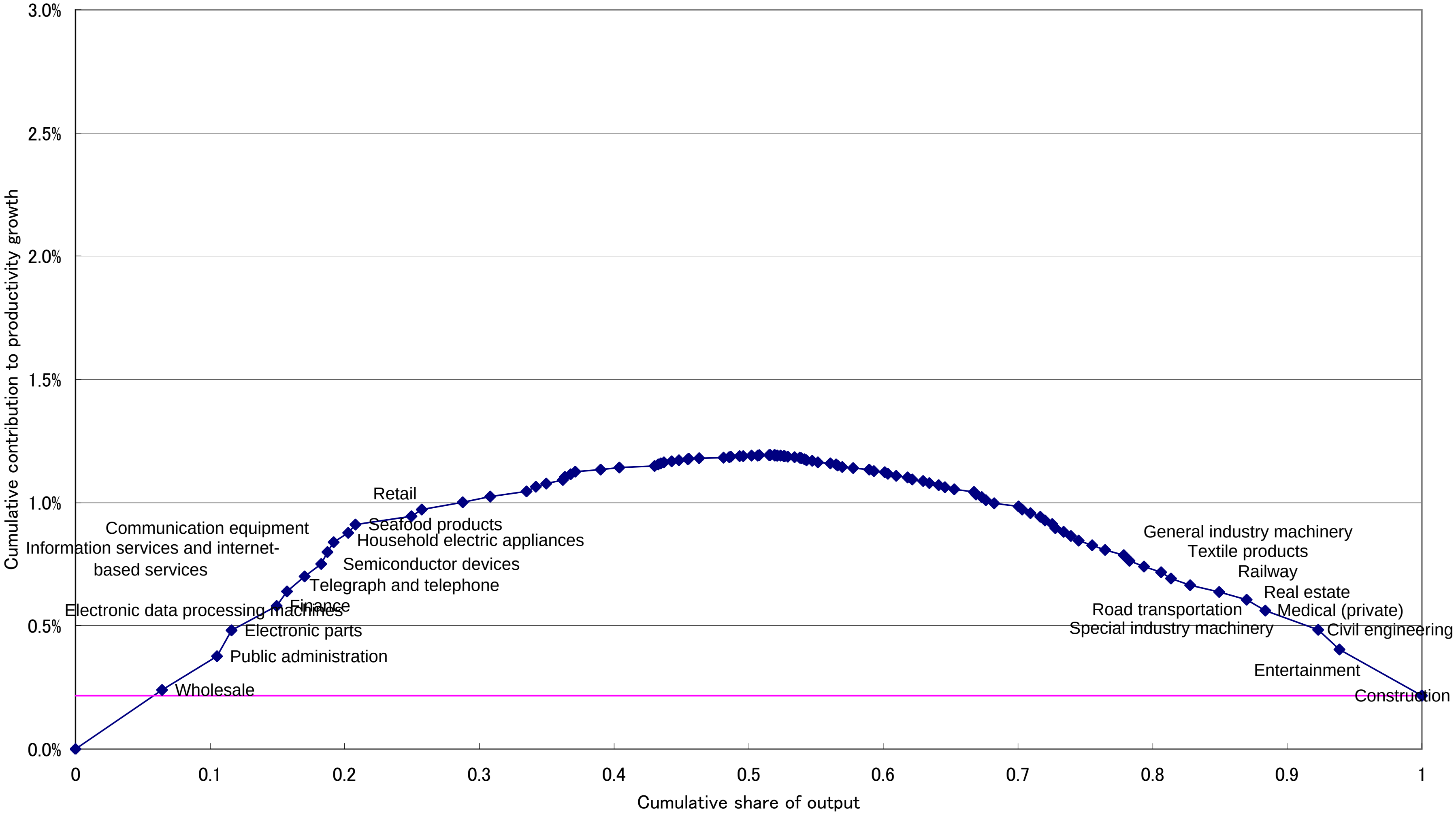
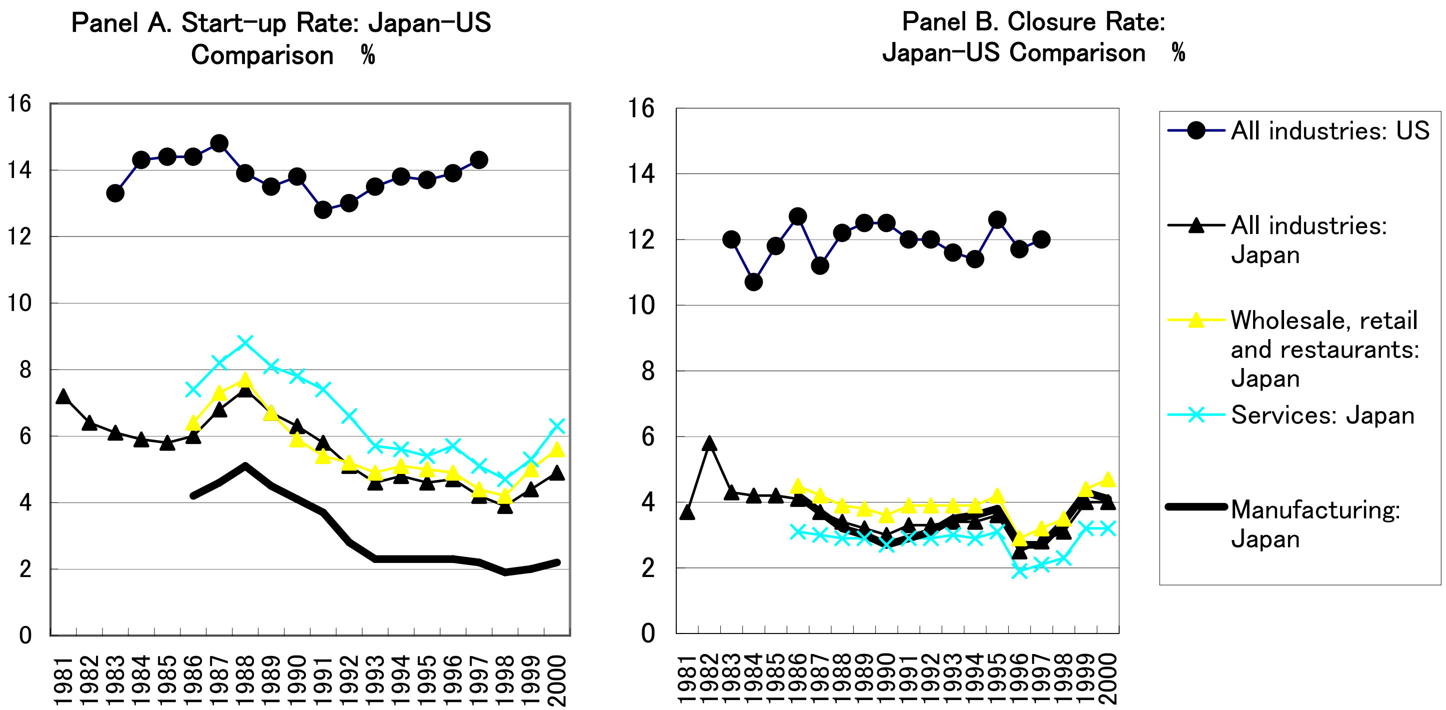


Figure 3.1: Start-up and Closure Rate of Establishments: Japan-U.S. Comparison



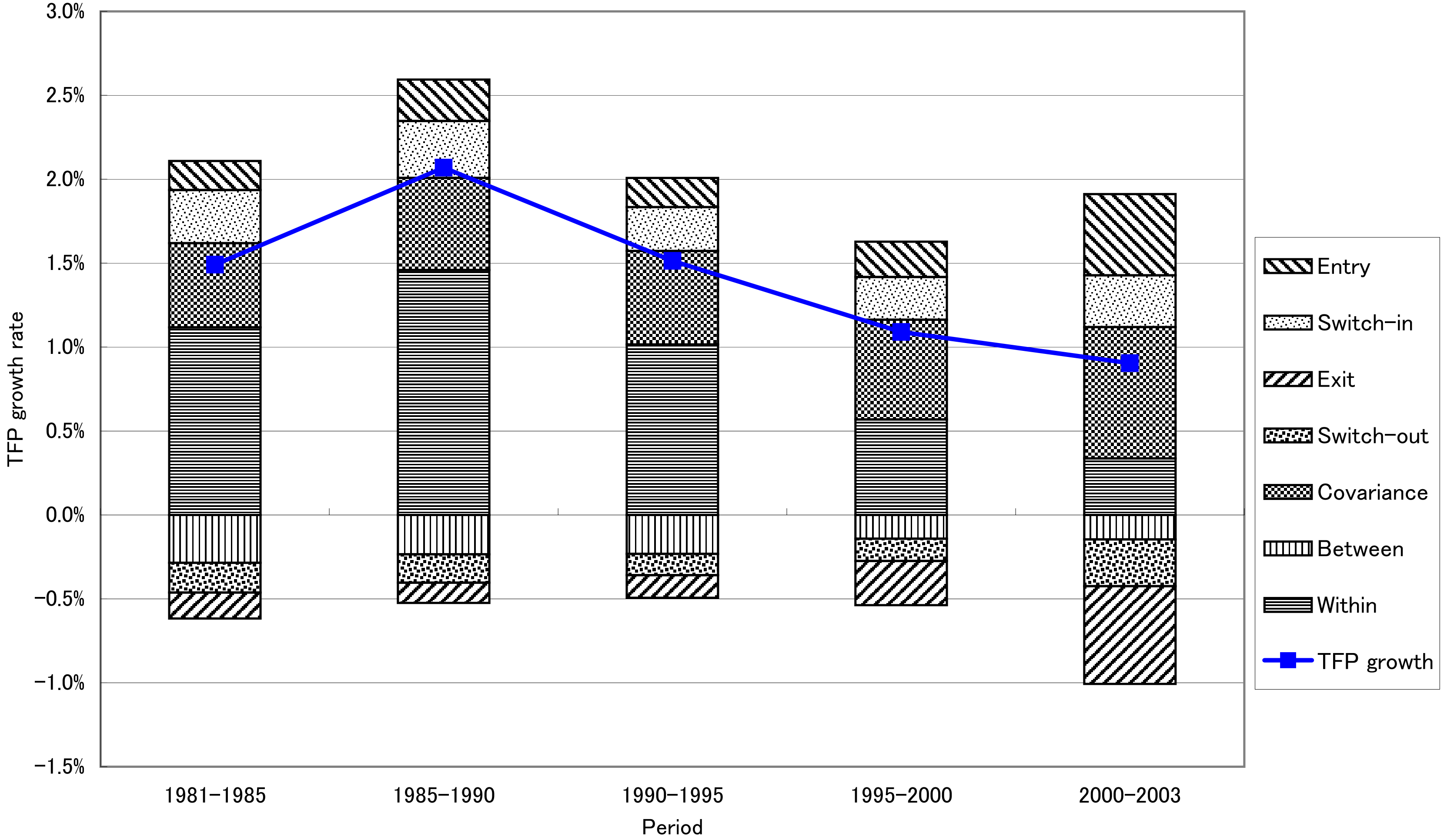
Both the data for the U.S. and for Japan are based on national employment insurance program statistics.
Sources: New Business Creation Subcommittee, New Growth Policy Committee, Industrial Structure Council (2002). The original data are taken from Small Business Administration, U.S. Government (1998), Small and Medium Enterprise Agency, Ministry of Industry, Trade and Industry, Japanese Government (2001), and Study Group on "Industry Hollowing-out" and Tariff Policy, Ministry of Finance, Japanese Government.

Table 3.1: Productivity Decomposition for the Manufacturing Sector as a Whole

Period	Annual productivity growth total (%)	Within share (%)	Reallocation share subtotal (%)	Between share (%)	Covariance share (%)	Net entry share (%)	Entry share (%)	Exit share (%)
	a=b+c	b	c=d+e+f	d	e	f=g+h	g	h
			A. TFP Growth					
1981-90	1.81	65.50	34.50	-7.97	15.32	27.15	40.24	-13.09
1990-2003	1.12	48.77	51.23	-3.37	30.72	23.88	53.14	-29.26
1981-85	1.49	74.96	25.04	-19.14	33.62	10.55	32.89	-22.33
1985-90	2.07	70.54	29.46	-11.37	26.52	14.31	28.34	-14.03
1990-95	1.51	67.11	32.89	-15.38	36.82	11.45	28.77	-17.31
1995-2000	1.09	52.19	47.81	-13.05	54.50	6.35	42.72	-36.37
2000-2003	0.90	37.16	62.84	-16.17	86.64	-7.63	87.62	-95.25
			B. Labor Productivity Growth					
1981-90	4.44	75.24	24.76	-0.22	-10.21	35.20	44.44	-9.24
1990-2003	2.41	47.69	52.31	12.39	-0.93	40.85	64.13	-23.27
1981-85	3.65	98.78	1.22	0.31	-17.49	18.39	33.66	-15.27
1985-90	5.39	83.50	16.50	3.56	-11.08	24.01	31.34	-7.33
1990-95	3.75	74.38	25.62	13.63	-10.96	22.95	32.86	-9.91
1995-2000	1.69	74.20	25.80	22.58	-20.06	23.28	55.73	-32.45
2000-2003	1.61	80.95	19.05	69.67	-58.60	7.98	96.42	-88.45

Weight: Gross output
JIP 2006 industry classification
Annual rate

Figure 3.2: Decomposition of TFP Growth



Weight :Employment
JIP 2006 industry classification
Annual rate

Figure 3.3: Decomposition of Labor Productivity Growth

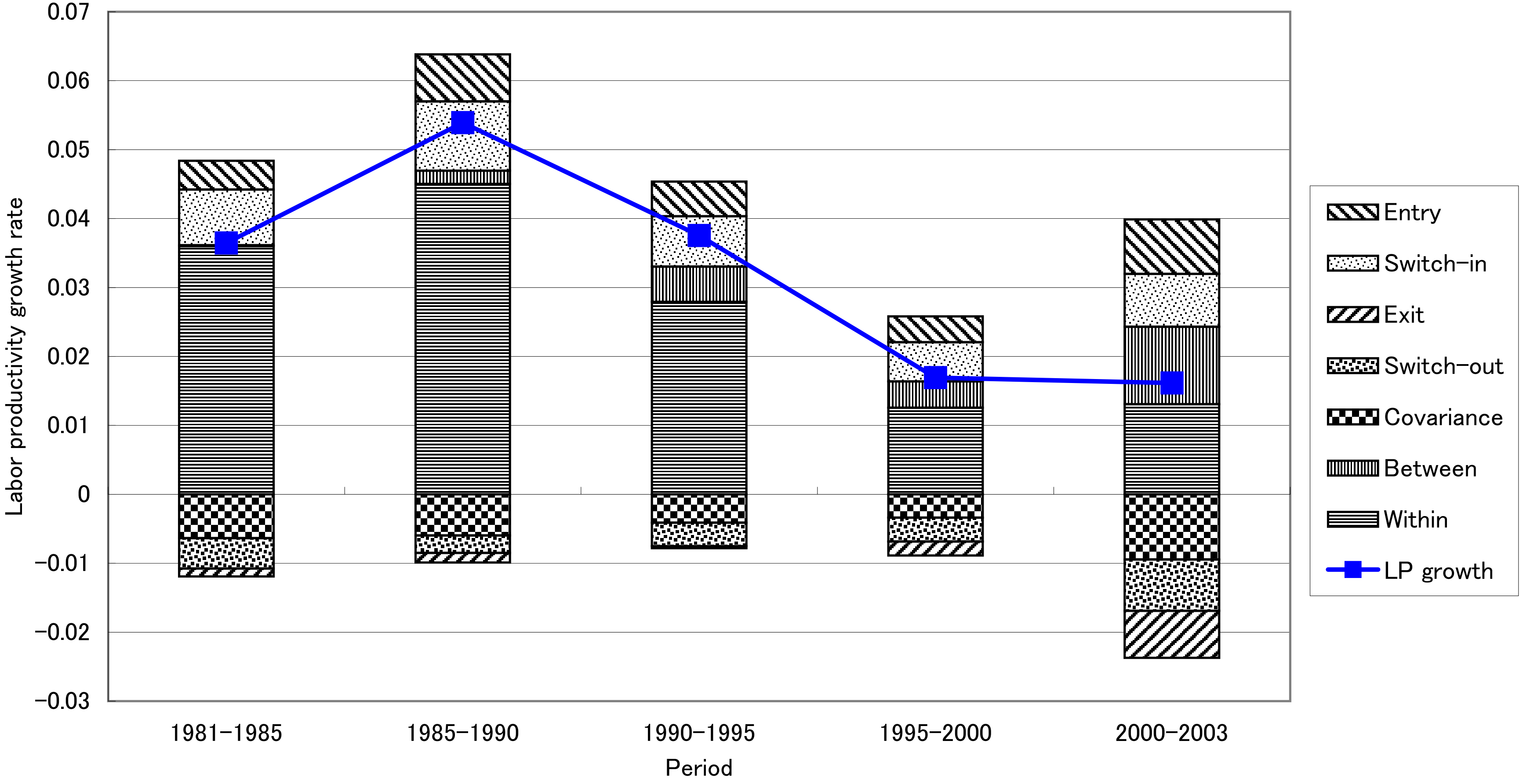
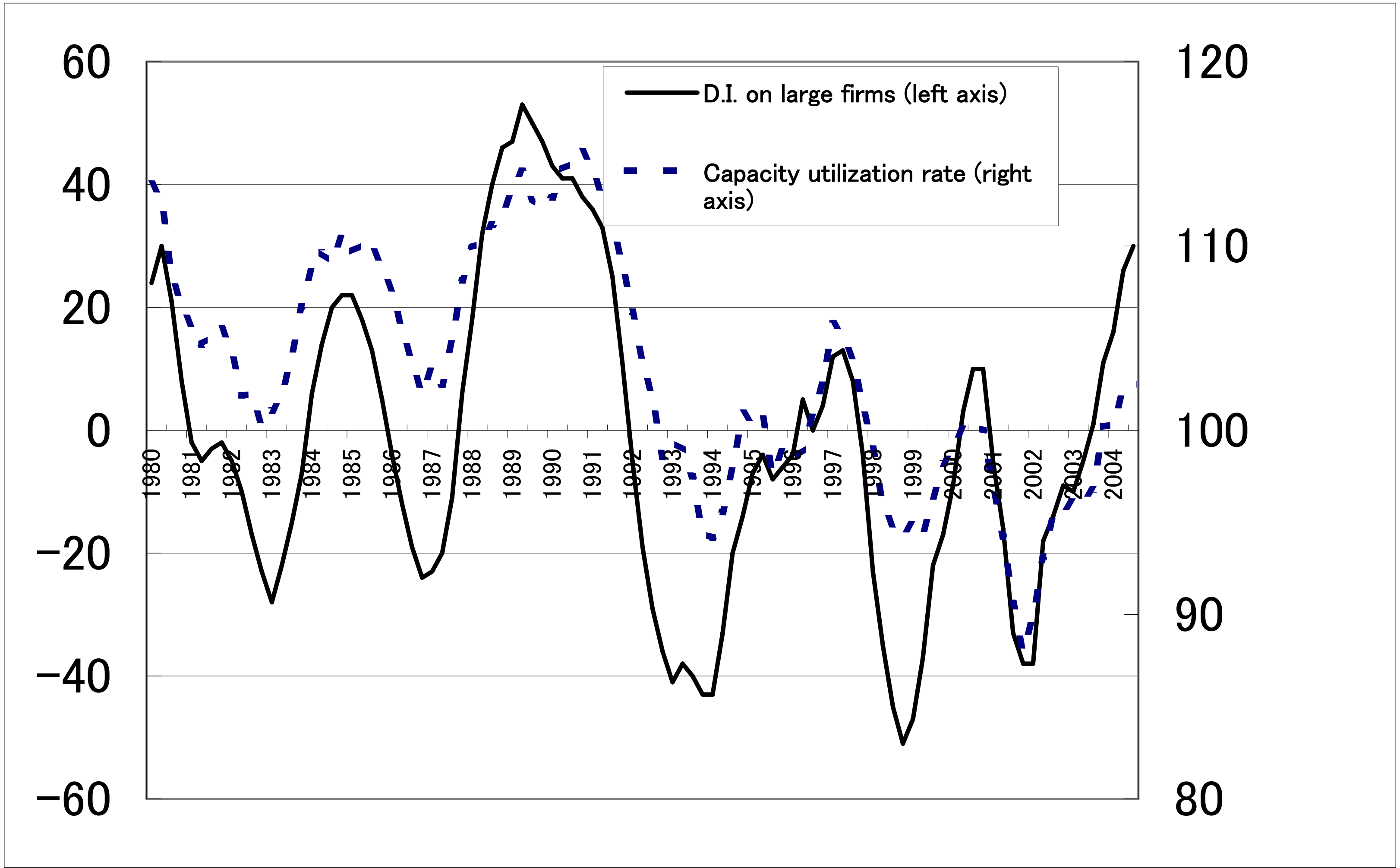


Figure 3.4: Capacity Utilization Rate and Diffusion Index of Business Conditions ("Favorable" minus "Unfavorable," for Large Firms) in the Manufacturing Sector



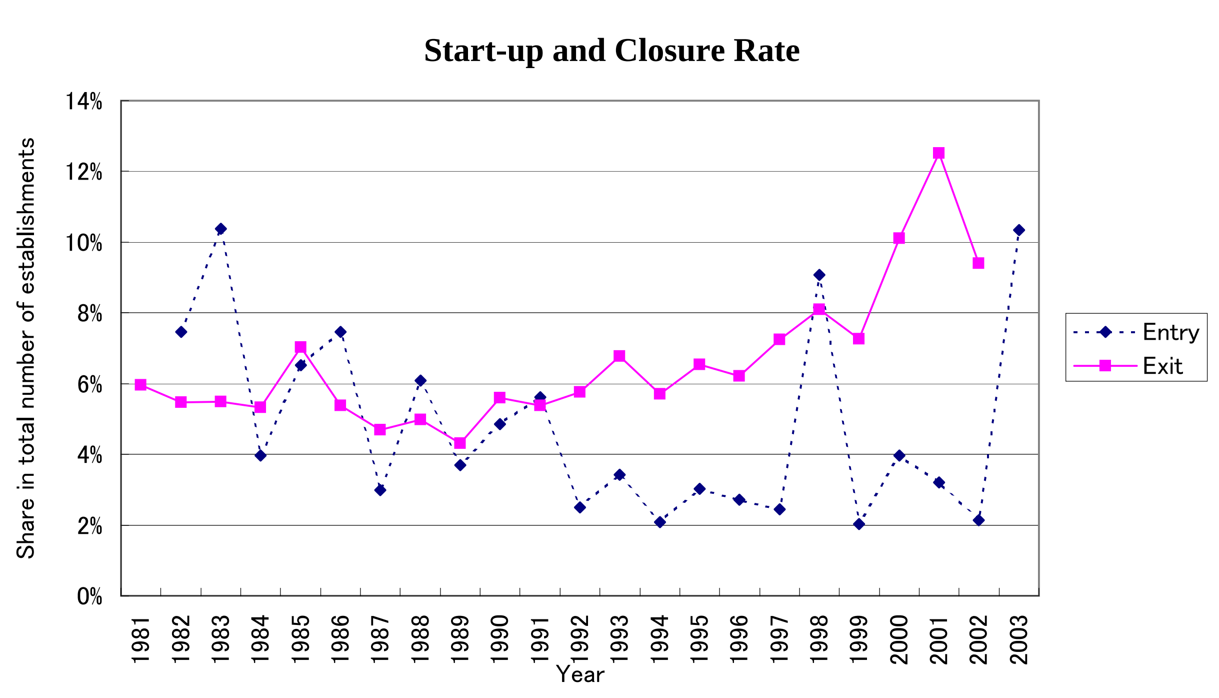
Sources: 'Tankan (Short-term Economic Survey of Enterprises in Japan),' Bank of Japan (diffusion index); METI (capacity utilization index).

Table 3.2: Comparison of the Decomposition of Total Factor Productivity for Various Countries

Source	Country	Period	Annual productivity 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
Panel A. TFP Growth										
Ahn, Kwon, Fukao (2005)	South Korea	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	U.S	1977-87	1.02	0.49 (0.48)	0.27 (0.26)	-0.08 (-0.08)	0.35 (0.34)	0.27 (0.26)		
		1977-82	0.54	-0.05 (-0.09)	0.45 (0.83)	-0.18 (-0.33)	0.63 (1.16)	0.14 (0.25)		
		1982-87	1.46	0.76 (0.52)	0.48 (0.33)	-0.26 (-0.18)	0.75 (0.51)	0.20 (0.14)		
		1987-92	0.66	-0.04 (-0.06)	0.47 (0.71)	-0.26 (-0.39)	0.73 (1.10)	0.23 (0.35)		
Disney , Haskel, and Heden (2003)	U.K.	1980-92	1.06	0.05 (0.05)	0.43 (0.41)	0.16 (0.15)	0.28 (0.26)	0.57 (0.54)		
		1982-87	3.08	1.26 (0.41)	1.48 (0.48)	-0.09 (-0.03)	1.57 (0.51)	0.37 (0.12)		
This paper	Japan	1981-90	1.81	1.18 (0.66)	0.13 (0.07)	-0.14 (-0.08)	0.28 (0.15)	0.49 (0.27)	0.73 (0.40)	-0.24 (-0.13)
		1990-2003	1.12	0.55 (0.49)	0.31 (0.28)	-0.04 (-0.03)	0.35 (0.31)	0.27 (0.24)	0.60 (0.53)	-0.33 (-0.29)
Panel B. Labor Productivity Growth										
Foster, Haltiwanger, and Krizan	U.S.	1977-87	2.13	1.64 (0.77)	-0.13 (0.06)	0.17 (0.08)	-0.30 (-0.14)	0.62 (0.29)		
		1977-82	0.51	0.62 (1.22)	-0.22 (-0.22)	0.43 (0.85)	-0.65 (-1.27)	0.10 (0.20)		
		1982-87	3.73	3.10 (0.83)	-0.07 (0.02)	0.49 (0.13)	-0.56 (-0.15)	0.71 (0.19)		
		1987-92	1.43	1.34 (0.94)	-0.23 (0.16)	0.47 (0.33)	-0.70 (-0.49)	0.30 (0.21)		
Baldwin and Gu (2003)	Canada	1973-79	2.15	1.66 (0.77)	-0.05 (0.03)	1.47 (0.68)	-1.52 (-0.71)	0.54 (0.25)	0.24 (0.11)	0.30 (0.14)
		1979-88	1.41	1.44 (1.02)	-0.30 (0.22)	0.23 (0.16)	-0.53 (-0.38)	0.28 (0.20)	0.15 (0.11)	0.13 (0.09)
		1988-97	2.91	2.85 (0.98)	-0.37 (0.13)	0.27 (0.09)	-0.64 (-0.22)	0.42 (0.15)	0.26 (0.09)	0.17 (0.06)
This paper	Japan	1981-90	4.44	3.34 (0.75)	-0.46 (-0.10)	-0.01 (-0.002)	-0.45 (-0.10)	1.56 (0.35)	1.97 (0.44)	-0.41 (-0.09)
		1990-2003	2.41	1.15 (0.48)	0.28 (0.11)	0.30 (0.12)	-0.02 (-0.01)	0.98 (0.41)	1.54 (0.64)	-0.56 (-0.23)

Notes: The entry and exit effects in this paper and in Ahn, Kwon, and Fukao (2004) include the switch-in and switch-out effects. Values in parentheses denote the share of each effect in total TFP growth. The decomposition of TFP for each country is based on the method of Foster, Haltiwanger and Krizan (2001)

Figure 4.1: Share of Newly Opened and Closed Establishments in Total Establishments



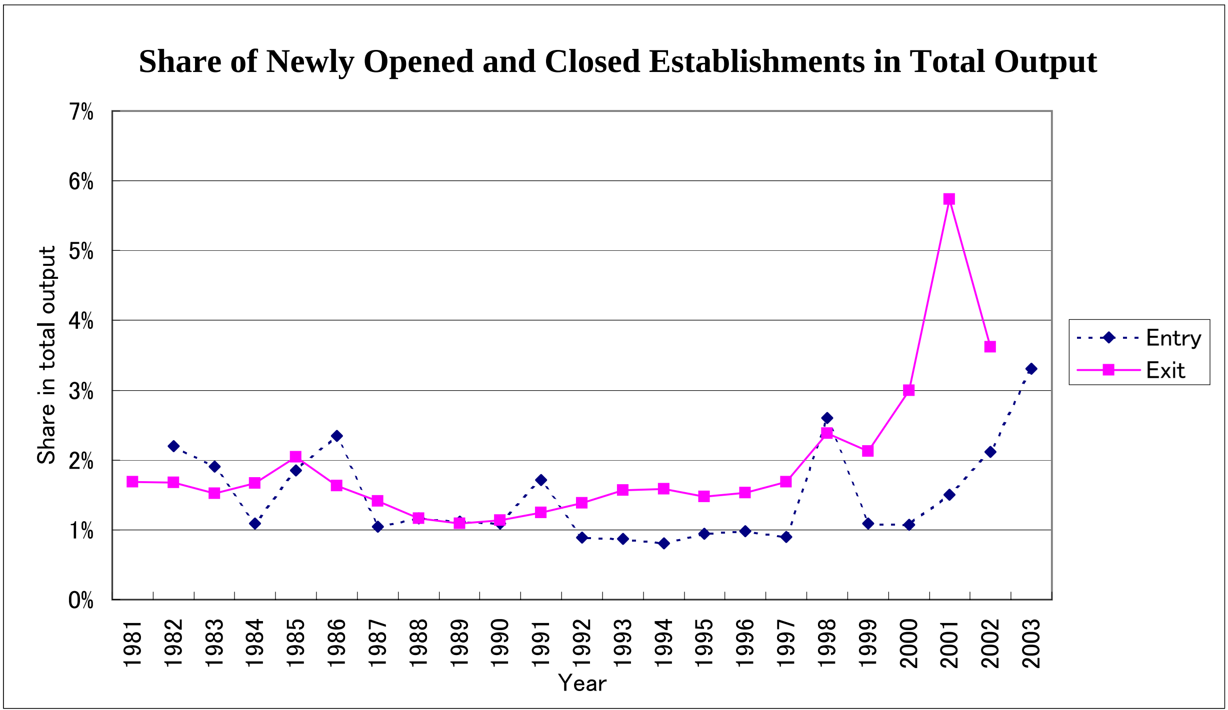


Table 4.2: Transition Matrices of Establishments' Rank in Labor Productivity: 1981-1990 and 1990-2003

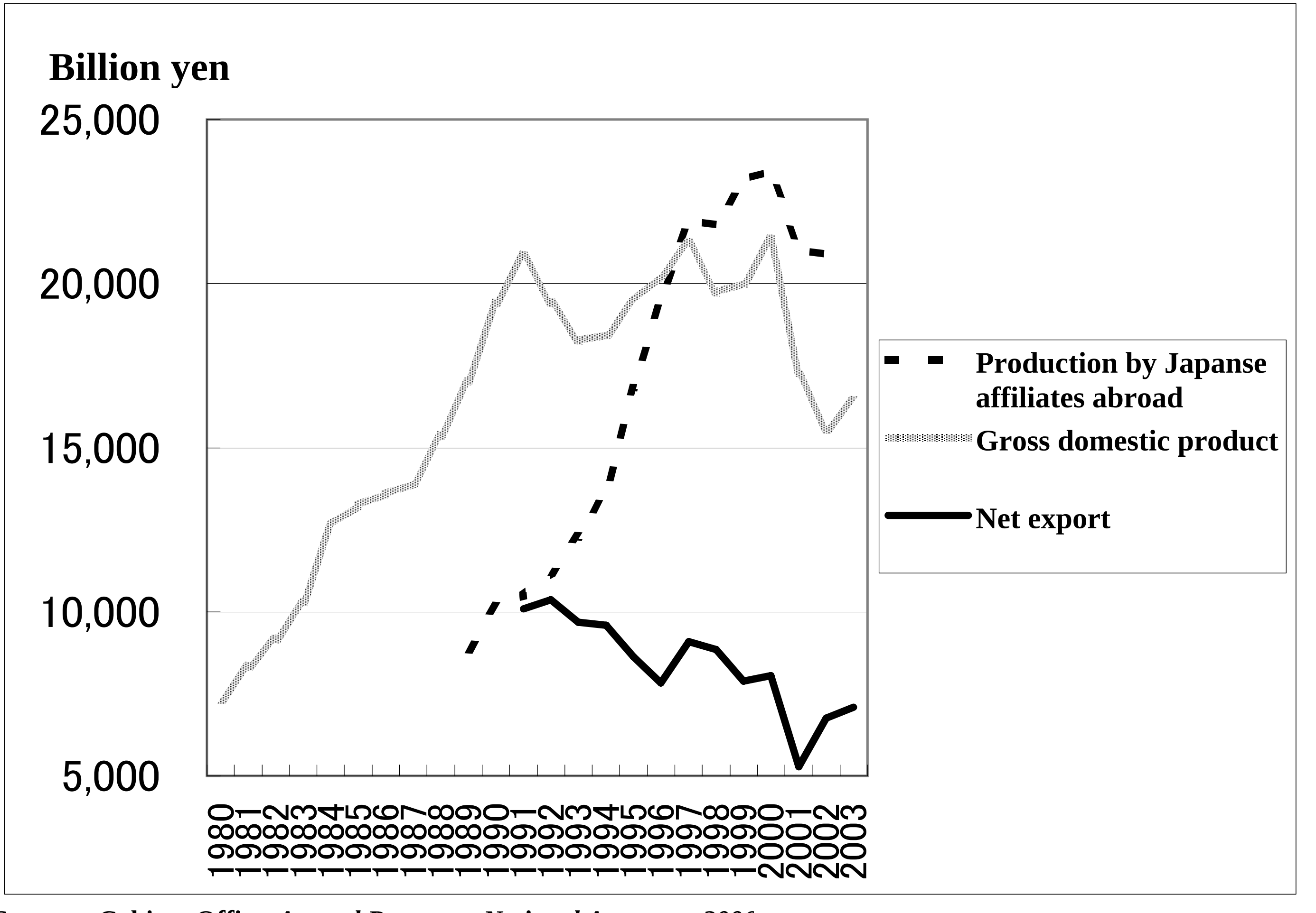
1981-1990

		1990										Closed establish-ments	Total	
		Top LP group	2nd LP level group	3rd LP level group	4th LP level group	5th LP level group	6th LP level group	7th LP level group	8th LP level group	9th LP level group	Lowest LP group			
1981	Top LP group	11,741	5,886	3,376	2,259	1,636	1,230	963	748	619	570	13,086	42,114	421,367
	2nd LP level group	5,572	6,686	5,119	3,630	2,653	1,823	1,472	1,075	782	615	12,712	42,139	
	3rd LP level group	3,266	5,039	5,320	4,501	3,479	2,626	1,909	1,458	983	755	12,795	42,131	
	4th LP level group	2,174	3,533	4,510	4,708	4,207	3,400	2,554	1,802	1,288	887	13,079	42,142	
	5th LP level group	1,527	2,555	3,458	4,139	4,392	3,975	3,212	2,481	1,708	1,094	13,599	42,140	
	6th LP level group	1,218	1,808	2,524	3,362	3,894	4,293	3,910	3,264	2,350	1,433	14,080	42,136	
	7th LP level group	925	1,332	1,888	2,536	3,202	3,888	4,251	4,000	3,256	1,955	14,898	42,131	
	8th LP level group	706	976	1,331	1,840	2,521	3,258	3,963	4,522	4,279	2,863	15,881	42,140	
	9th LP level group	541	737	970	1,304	1,688	2,379	3,158	4,391	5,547	4,536	16,882	42,133	
	Lowest LP group	544	615	793	883	1,167	1,456	2,057	2,990	4,549	7,639	19,468	42,161	
Newly set-up establishments		13,956	13,028	12,897	13,030	13,362	13,856	14,738	15,464	16,822	19,872		147,025	
Total		42,170	42,195	42,186	42,192	42,201	42,184	42,187	42,195	42,183	42,219	146,480		
		421,912												

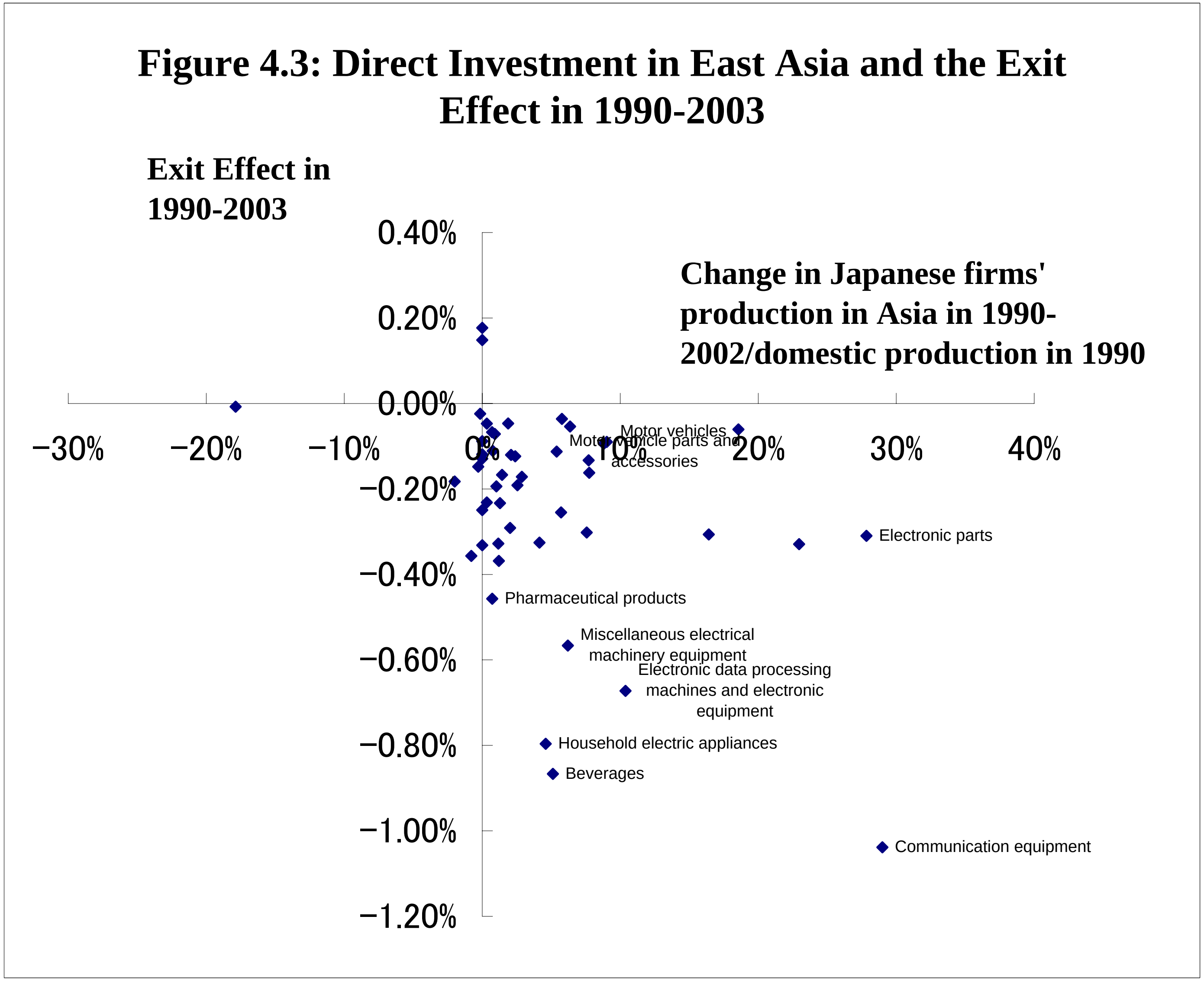
1990-2003

		2003										Closed establish-ments	Total	
		Top LP group	2nd LP level group	3rd LP level group	4th LP level group	5th LP level group	6th LP level group	7th LP level group	8th LP level group	9th LP level group	Lowest LP group			
1990	Top LP group	8,137	4,472	2,887	1,915	1,399	1,064	852	648	544	511	20,007	42,436	424,535
	2nd LP level group	3,583	4,508	3,877	3,044	2,317	1,671	1,337	984	691	582	19,854	42,448	
	3rd LP level group	2,028	3,325	3,571	3,259	2,804	2,256	1,678	1,226	924	708	20,678	42,457	
	4th LP level group	1,323	2,250	2,808	3,047	2,915	2,515	2,107	1,659	1,256	839	21,735	42,454	
	5th LP level group	952	1,603	2,097	2,598	2,801	2,683	2,505	1,949	1,491	1,024	22,757	42,460	
	6th LP level group	737	1,062	1,612	1,986	2,332	2,732	2,684	2,387	1,881	1,201	23,834	42,448	
	7th LP level group	534	786	1,097	1,534	1,954	2,348	2,629	2,636	2,279	1,590	25,063	42,450	
	8th LP level group	400	608	787	1,040	1,393	1,913	2,367	2,718	2,793	2,080	26,360	42,459	
	9th LP level group	333	399	576	729	949	1,242	1,701	2,484	3,034	2,824	28,177	42,448	
	Lowest LP group	319	348	409	518	588	799	1,028	1,469	2,354	3,626	31,017	42,475	
Newly set-up establishments		10,255	9,263	8,897	8,953	9,174	9,392	9,728	10,466	11,370	13,654		101,152	
Total		28,601	28,624	28,618	28,623	28,626	28,615	28,616	28,626	28,617	28,639	239,482		
		286,205												

Figure 4.2: Gross Domestic Product and Production Abroad by Japan's Electrical Machinery Industry

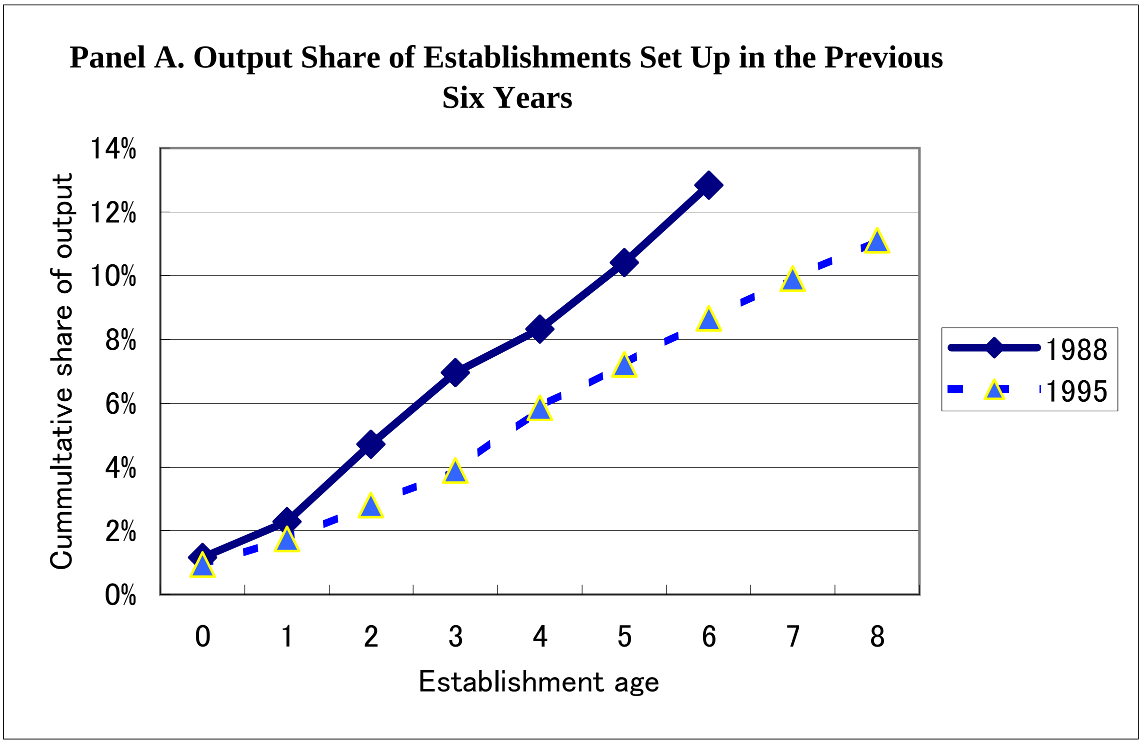


Sources: Cabinet Office, ***Annual Report on National Accounts, 2006***
RIETI's Database on Japan's Direct Investment Abroad, downloaded from http://www.rieti.go.jp/jp/database/d02.html#01 on July 15, 2006.



Source: Data on Japanese firms' production in East Asia is from the JIP 2006.

Figure 4.4: Output Share of New Establishments and Establishments Closing in the Near Future



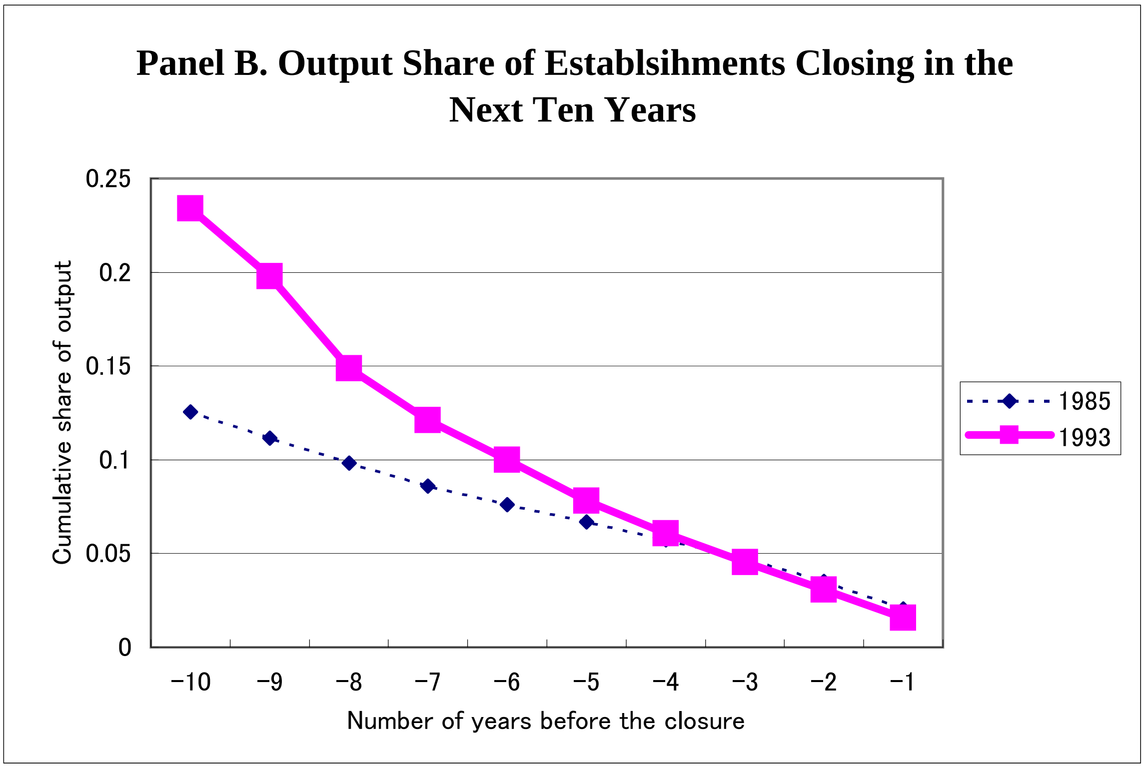
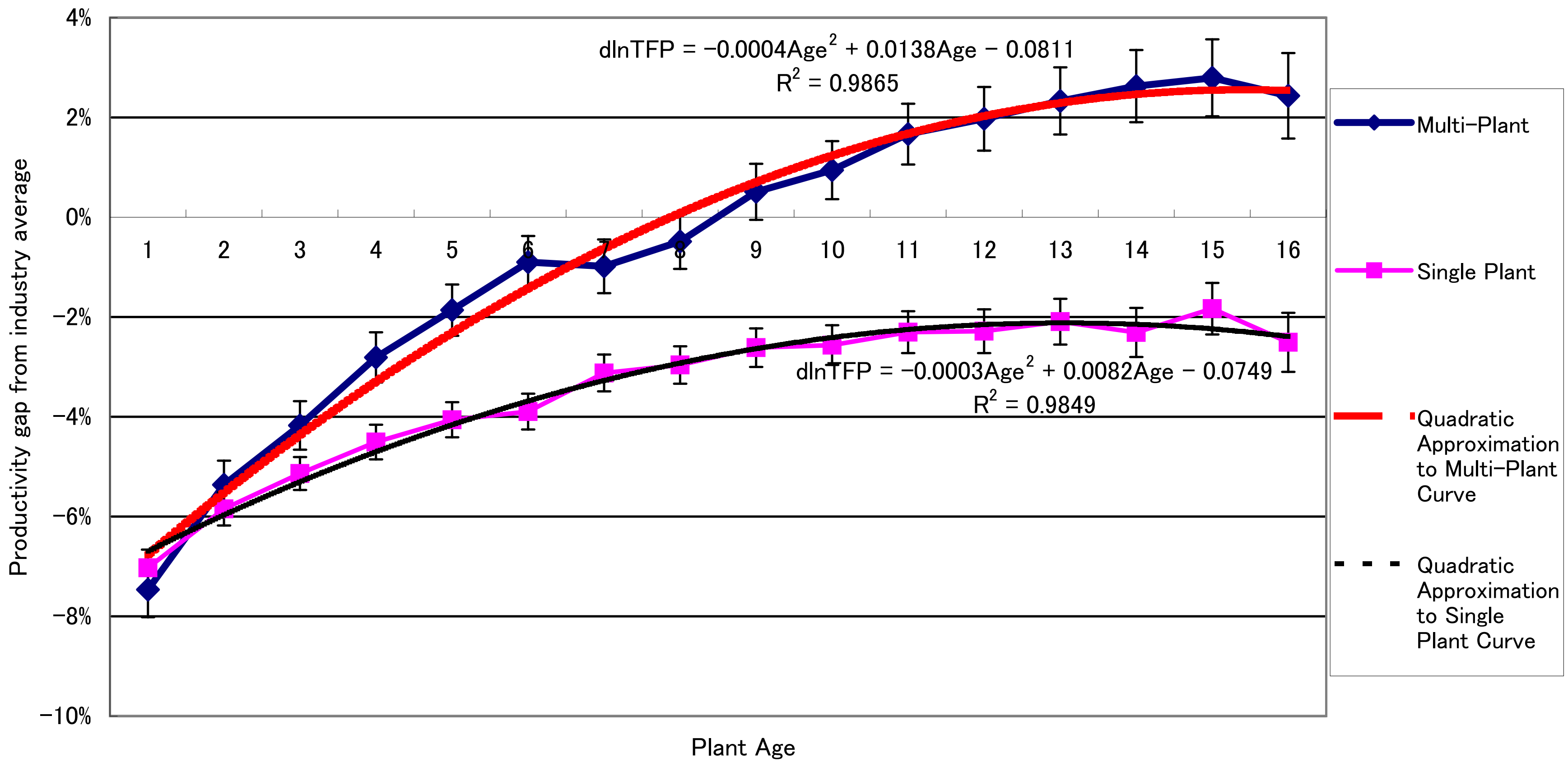


Figure 4.5: Age Effect on TFP by Multi and Single Plant Group



1. Base Group is the Plants which were established in 1981 or earlier and have been operating until 2003.
2. Observations of the plants which were closed before 2003 are not included in the estimations.

Table 4.3: Survival Rate after Entry

Entry Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1981 and before	100.0%	90.7%	86.0%	81.2%	78.4%	74.2%	70.7%	69.5%	66.1%	65.2%	62.1%	59.5%	57.8%	53.7%	52.8%	49.9%	47.6%	45.6%	42.4%	40.6%	37.4%	34.4%	31.7%
1982		100.0%	79.4%	71.6%	68.5%	62.2%	58.4%	57.4%	53.9%	53.1%	50.2%	47.5%	45.9%	41.9%	41.2%	38.8%	36.6%	34.8%	32.0%	30.4%	27.7%	25.2%	23.0%
1983			100.0%	74.6%	69.9%	59.5%	53.8%	55.4%	49.4%	50.7%	45.7%	42.4%	42.0%	36.8%	37.3%	33.7%	31.5%	30.8%	27.3%	26.3%	23.3%	20.8%	18.8%
1984				100.0%	78.9%	68.7%	63.7%	61.8%	57.7%	57.2%	54.2%	50.5%	48.2%	44.2%	43.2%	40.3%	38.4%	36.4%	33.8%	32.1%	29.2%	26.8%	24.4%
1985					100.0%	71.2%	62.5%	62.7%	56.3%	57.4%	52.1%	48.4%	47.5%	41.9%	42.3%	38.3%	36.1%	35.3%	32.0%	30.6%	27.1%	24.7%	22.5%
1986						100.0%	84.1%	78.0%	72.5%	70.1%	65.7%	61.8%	58.8%	53.5%	52.1%	48.5%	45.9%	43.4%	40.0%	37.9%	34.4%	31.2%	28.4%
1987							100.0%	80.2%	73.7%	70.6%	66.0%	61.5%	57.9%	52.8%	51.5%	48.2%	45.4%	43.0%	39.1%	37.1%	33.7%	30.6%	28.0%
1988								100.0%	70.5%	71.7%	62.7%	56.8%	56.2%	48.3%	49.1%	44.0%	41.0%	39.9%	35.2%	33.9%	29.8%	26.8%	24.1%
1989									100.0%	84.4%	77.5%	71.8%	66.6%	59.2%	57.8%	53.6%	50.4%	47.2%	43.7%	41.2%	37.2%	34.0%	30.8%
1990										100.0%	73.8%	65.5%	63.2%	53.9%	54.4%	49.0%	46.1%	45.4%	40.1%	38.6%	34.0%	30.8%	27.8%
1991											100.0%	82.4%	74.8%	66.2%	64.2%	59.6%	55.7%	52.2%	47.6%	44.9%	40.5%	36.6%	33.3%
1992												100.0%	79.2%	69.8%	67.9%	62.4%	58.2%	54.0%	49.5%	46.8%	42.4%	38.4%	35.4%
1993													100.0%	69.3%	67.9%	59.2%	54.1%	52.6%	46.2%	44.4%	38.7%	34.5%	31.1%
1994														100.0%	79.7%	71.6%	66.2%	61.9%	56.4%	52.7%	47.4%	43.2%	39.1%
1995															100.0%	74.1%	67.2%	63.2%	55.0%	52.2%	45.7%	40.7%	36.5%
1996																100.0%	81.2%	72.9%	65.5%	61.6%	55.5%	49.4%	44.0%
1997																	100.0%	79.5%	70.8%	66.5%	59.0%	52.3%	47.1%
1998																		100.0%	77.0%	71.8%	62.6%	54.5%	48.1%
1999																			100.0%	77.8%	68.2%	58.7%	51.0%
2000																				100.0%	64.1%	54.3%	44.7%
2001																					100.0%	70.2%	58.8%
2002																						100.0%	79.3%
2003																							100.0%

Figure 4.6 Shadow-of-Death Effect on TFP by Multi and Single Plant Group

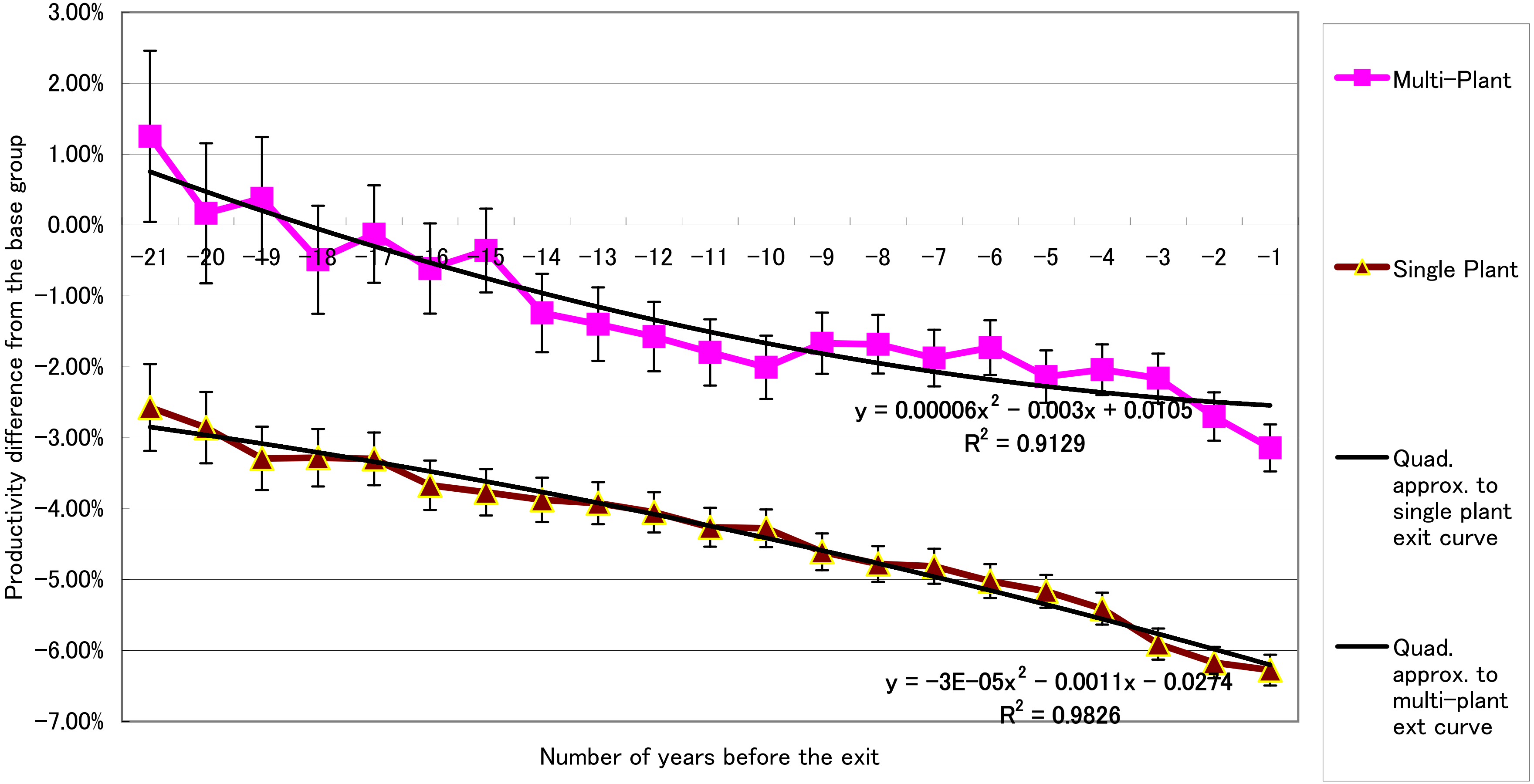


Table 4.4: Ratio of the Average Plant Size of Establishments Set Up in the Same Year to the Industry Average Plant Size: By Start-up Year and by Year of Observation

Entry Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1981 and before	100.0%	111.9%	120.5%	121.4%	128.6%	133.4%	133.6%	138.9%	139.3%	143.2%	146.7%	146.4%	147.6%	146.6%	149.0%	149.1%	150.4%	158.8%	156.2%	158.3%	156.4%	154.8%	159.6%
1982		41.9%	52.3%	56.6%	61.8%	65.2%	66.2%	70.1%	69.6%	71.7%	72.9%	73.8%	75.1%	73.6%	74.2%	74.5%	76.1%	81.8%	81.1%	81.0%	80.5%	83.8%	88.7%
1983			34.0%	42.8%	46.3%	52.9%	54.0%	53.7%	57.2%	57.6%	58.7%	61.3%	62.3%	63.3%	63.0%	66.1%	66.4%	70.1%	72.4%	70.7%	73.7%	75.4%	81.2%
1984				43.9%	60.0%	65.1%	66.1%	77.1%	79.2%	83.8%	84.0%	85.7%	85.1%	85.9%	88.5%	88.2%	88.5%	97.4%	101.2%	99.0%	101.1%	91.4%	98.9%
1985					40.4%	55.9%	61.8%	64.8%	69.3%	73.7%	79.4%	82.8%	85.5%	88.5%	86.5%	89.2%	89.8%	93.6%	97.1%	101.3%	101.3%	97.3%	98.6%
1986						40.5%	46.2%	51.4%	51.9%	56.2%	58.7%	58.5%	59.2%	57.8%	59.3%	60.2%	61.0%	65.4%	64.7%	64.6%	62.8%	62.9%	67.1%
1987							43.4%	57.8%	63.1%	68.9%	70.8%	69.8%	75.1%	75.4%	79.3%	79.9%	80.4%	87.4%	87.3%	89.4%	89.1%	88.5%	95.3%
1988								33.3%	43.6%	46.8%	52.1%	52.2%	54.2%	55.6%	56.2%	59.0%	61.9%	66.3%	68.3%	71.9%	75.4%	78.7%	82.4%
1989									39.9%	52.5%	58.9%	60.8%	68.2%	69.4%	73.4%	77.4%	79.9%	87.8%	84.0%	90.4%	87.1%	95.1%	86.6%
1990										36.0%	49.2%	53.1%	58.0%	61.9%	62.1%	67.4%	66.5%	68.6%	70.7%	72.4%	77.0%	81.3%	88.7%
1991											37.6%	46.4%	52.1%	55.1%	55.4%	59.4%	59.8%	64.6%	65.4%	66.2%	67.2%	68.0%	74.4%
1992												47.1%	52.2%	59.6%	65.4%	61.9%	68.7%	73.2%	80.5%	80.5%	79.2%	84.7%	96.3%
1993													33.8%	45.9%	51.3%	53.8%	55.4%	58.6%	63.0%	67.9%	73.4%	73.8%	78.9%
1994														47.5%	56.5%	60.7%	63.5%	71.8%	71.5%	75.7%	77.8%	85.2%	90.4%
1995															42.1%	56.7%	60.5%	68.9%	71.3%	74.8%	72.5%	70.4%	75.7%
1996																41.1%	49.4%	57.9%	62.6%	70.2%	69.3%	70.0%	79.4%
1997																	40.2%	55.6%	57.7%	61.5%	65.0%	67.2%	79.2%
1998																		35.0%	40.7%	41.6%	42.4%	42.8%	49.1%
1999																			50.1%	61.5%	63.6%	66.9%	74.4%
2000																				36.7%	49.7%	55.7%	63.5%
2001																					53.0%	69.1%	82.1%
2002																						63.1%	84.6%
2003																							41.3%

Note: Establishment size is measured by nominal output.

Table 4.5: Ratio of the Average Plant Size of Establishments Closed in the Same Year to the Industry Average Plant Size: By Closure Year and by Year of Observation

Year of closure	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1981	36.4%																						
1982	46.8%	40.5%																					
1983	67.7%	55.7%	43.2%																				
1984	53.3%	50.3%	47.1%	40.2%																			
1985	59.5%	56.3%	50.1%	48.4%	38.4%																		
1986	58.5%	56.2%	50.9%	49.6%	42.2%	36.8%																	
1987	60.1%	59.0%	55.7%	49.3%	50.0%	44.6%	39.0%																
1988	64.4%	61.6%	58.5%	57.8%	53.3%	45.5%	42.0%	37.0%															
1989	73.3%	69.0%	65.2%	62.5%	56.9%	52.2%	49.8%	46.2%	38.0%														
1990	55.9%	54.7%	53.8%	52.3%	49.3%	46.8%	44.8%	41.5%	39.7%	32.4%													
1991	49.1%	47.2%	46.8%	47.8%	45.6%	44.4%	43.3%	41.8%	40.3%	37.7%	33.0%												
1992	62.4%	60.9%	57.5%	54.9%	52.6%	51.5%	48.9%	47.8%	43.7%	41.1%	39.4%	34.2%											
1993	68.4%	66.3%	65.0%	62.2%	59.2%	58.5%	56.0%	52.2%	51.2%	49.2%	47.0%	45.3%	37.0%										
1994	75.2%	75.3%	69.8%	69.5%	65.6%	64.1%	59.9%	58.3%	56.7%	53.7%	49.4%	49.0%	42.7%	40.0%									
1995	76.8%	72.5%	67.8%	65.3%	62.7%	59.4%	56.6%	53.6%	53.4%	51.4%	50.4%	52.0%	44.5%	41.5%	34.2%								
1996	80.0%	78.2%	76.2%	71.2%	68.8%	65.5%	62.5%	58.7%	54.9%	57.8%	56.1%	53.0%	53.3%	45.3%	42.2%	36.4%							
1997	83.4%	80.6%	79.3%	73.8%	73.3%	68.9%	66.5%	63.7%	60.4%	58.4%	56.3%	56.8%	56.0%	51.2%	47.2%	43.8%	35.9%						
1998	89.7%	85.1%	83.4%	82.0%	80.8%	77.4%	74.2%	72.8%	70.6%	69.0%	67.2%	63.1%	59.6%	58.0%	54.0%	52.0%	49.9%	41.1%					
1999	124.5%	142.9%	123.1%	117.2%	113.5%	107.7%	101.0%	90.5%	84.4%	79.3%	82.3%	78.6%	67.0%	66.5%	63.4%	58.7%	55.3%	49.1%	42.4%				
2000	91.1%	89.3%	86.5%	82.5%	82.2%	78.3%	75.3%	73.6%	71.0%	69.7%	68.7%	65.8%	62.4%	59.8%	58.3%	58.9%	56.1%	52.3%	49.1%	41.2%			
2001	114.1%	107.3%	108.4%	107.1%	101.5%	96.4%	95.4%	95.2%	92.9%	93.4%	89.0%	84.6%	81.9%	76.9%	74.5%	70.4%	67.6%	63.8%	60.4%	55.9%	47.0%		
2002	143.7%	140.2%	135.1%	134.1%	137.2%	124.5%	118.0%	117.7%	113.8%	110.9%	106.4%	102.5%	101.2%	93.3%	89.9%	84.1%	80.3%	75.4%	68.8%	65.8%	60.3%	51.5%	
2003 and after	199.6%	193.2%	194.0%	188.0%	186.0%	178.9%	172.1%	173.1%	167.8%	167.9%	163.3%	157.7%	155.6%	148.3%	146.8%	140.7%	136.8%	135.3%	128.1%	124.7%	117.4%	108.1%	100.0%

Note: Establishment size is measured by nominal output.