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An Empirical Analysis Based on Micro-data on Japanese Manufacturing Firms

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Abstract

This paper compares the performance of foreign-owned and domestically-owned firms, using micro data on Japanese firms in the manufacturing sector for the period 1994–2000. The overall comparison between foreign-owned and Japanese companies shows that foreign-owned companies enjoyed 5% higher TFP as well as higher earnings and returns on capital. They also displayed a higher capital-labor ratio and higher R&D intensity. Reflecting their higher TFP and labor-saving production patterns, foreign-owned companies showed higher labor productivity and wage rates as well. By estimating Probit models, we found that foreign firms acquire Japanese firms with higher TFP levels and higher profit rates. In contrast, in-in M&As seem to have the characteristics of rescue missions. Small firms with a higher total liability/total asset ratio tend to be chosen as targets of in-in M&As. We also estimated the dynamic effects of M&As on target firms. The results indicate that out-in M&As improve target firms' TFP level and current profit/sales ratio. Compared with in-in M&As, out-in M&As bring a larger and quicker improvement in TFP and the profit rate but no increase in target firms' employment two years after the acquisition.

Journal of Economic Literature Classification Number: F23

Key Words: FDI, TFP, in-in M&A, out-in M&A

1. Introduction

Though the Japanese economy finally seems to be recovering after having stagnated since the early 1990s, many of the underlying problems remain. In order to accelerate structural adjustments and achieve a full-scale economic recovery, the Japanese government has therefore launched various policy packages, including the promotion of inward foreign direct investment (FDI). According to economic theory, FDI is a form of long-term international capital movement which is accompanied by investors' intangible assets (such as the accumulated technological knowledge through R&D or marketing know-how based on past advertising activity) and it is expected that the recipient country will benefit from such inflows.¹ Although FDI traditionally has not been considered economically important for Japan because it is the world's largest trade surplus country, the potential benefits of FDI and the contribution it can make to Japan's economy in the areas of employment, demand, capital investment, and productivity have recently gained attention. In his general policy speech to the Diet on January 31, 2003, Prime Minister Junichiro Koizumi promised to increase efforts to attract inward FDI with the aim of doubling the cumulative amount of investment within the next five years. Although foreign investment in Japan has increased rapidly in the past few years, the FDI stock is still very small when compared with that in other developed economies.

Despite the importance of the topic, reliable statistics on and analyses of inward FDI in Japan are very limited. Moreover, in the absence of any meaningful empirical studies on the subject, some observers have argued that Japan does not need more FDI (Werner 2003; *Nihon Keizai Shinbun* 2003). Like FDI in other developed economies, the largest part of recent inflows to Japan took the form of mergers and acquisitions (M&As). The critics fear that inward M&As are dominated by "vulture" funds seeking to reap quick profits by taking advantage of troubled firms (*Nihon Keizai*

¹ See, for example, Caves (1982) and Dunning (1992) on the standard theory of foreign direct investment.

Shinbun 2003). Another argument is that some inward M&As are in fact aimed at acquiring advanced technologies (Werner 2003) rather than transferring and employing intangible assets in Japan. However, according to quantitative studies on corporate performance in Japan, such as Fukao and Murakami (2003), Kimura and Kiyota (2003), and Murakami and Fukao (2003), foreign-owned firms tend to show higher productivity than domestically-owned firms in Japan. If foreign-owned firms are performing better than domestic ones, one would expect that the Japanese economy overall will benefit from more inward FDI. Foreign firms' financial resources and know-how could help struggling Japanese firms out of financial and management difficulties; and domestically-owned firms' economic performance may be improved by technological spillovers from foreign-owned firms and/or intensified competition in the market.

This paper aims to examine whether concerns such as those about a "technological drain" have any foundation or whether Japan does indeed benefit from the transfer of foreign firms' intangible assets. To this end, we compare the performance of foreign-owned and domestically-owned firms, using micro data on Japanese firms in the manufacturing sector for the period 1994–2000. Our method of investigation is based on the following reasoning: if foreign-owned firms in Japan possess technologies that are superior to those of their domestically-owned counterparts, then this should manifest itself in higher total factor productivity (TFP). In this case, Japan benefits from inward FDI. There is, of course, the possibility that foreign-owned firms may enjoy greater productivity because foreign firms pick firms with higher TFP as M&A targets. In order to take account of this possibility, we also test whether foreigners have tended to acquire firms that already enjoy higher TFP, or whether the acquired firms' productivity improved after the take-over.

The paper is organized as follows: the next section presents an overview of recent inward FDI trends in Japan using newly constructed statistics by detailed industry; section 3 compares the

performance of foreign-owned and domestically-owned firms; section 4 tests whether foreign firms choose domestically-owned firms with higher TFP as their M&A targets and whether the performance of Japanese firms improved after they were acquired by a foreign firm; section 5, finally, summarizes our results and considers the policy implications of this study.

2. An Overview of Inward FDI in Japan

2.1 Recent Trends in Japan's Inward FDI

Inward FDI in Japan is extremely low when compared with other countries. Based on Japan's balance of payment statistics, the ratio of the inward FDI stock to GDP in 2000 was only 1.1 percent.² This figure is only one-eleventh of that for the U.S. and one-twenty-eighth of that for the U.K., and it is also much smaller than that for neighboring countries such as South Korea and China. What is more, inward FDI is far outstripped by Japanese outward investment. And while foreign firms make significant contributions to fixed capital formation and employment in other countries, this is not the case in Japan: for example, in the manufacturing sector in the U.K. and France, more than 30 percent of total fixed asset formation is conducted by foreign-affiliated companies and nearly 30 percent of workers are employed by foreign-affiliated companies. Compared with these figures, the share of foreign-affiliated firms in capital formation and employment is extremely low in Japan.

In the five years from 1997 to 2002, however, Japan experienced an FDI boom in the newly

² Currently, capital reserves by foreign-owned firms are not included in the direct investment liabilities in Japan's international investment position statistics. The Ministry of Finance and the Bank of Japan are planning to include these in the statistics from the end of 2005. According to estimates by the Bank of Japan, this statistical change would raise Japan's inward FDI stock by 2.9 trillion yen from 9.4 to 12.3 trillion yen as of the end of 2002. It is to be hoped that the government will not claim that Japan has achieved the aim of doubling the cumulative amount of inward FDI through the help of this statistical manipulation.

deregulated finance/insurance, telecommunications, service, and retail/wholesale industries. In the manufacturing sector, the machinery industry (mainly in the automotive field) and the chemical industry (mainly in the pharmaceutical sector) also saw strong FDI inflows. However, 72% of the investment during this period went into non-manufacturing industries, which is in striking contrast to the period from 1950 to 1995, when 54% of all investment went into the manufacturing sector.³ According to Japan's international investment position statistics, the stock of inward FDI in Japan rose 2.7-fold to 9.4 trillion yen during the five years from 1997 to 2002.^{4, 5, 6}

2.2 Japan's International Transactions by Industry

In this subsection, we look at Japan's international transactions—both FDI and cross-border trade—at the 2-digit industry level, relying mainly on newly compiled data based on the

³ These industry-level data are based on FDI statistics of Japan's Ministry of Finance, which is gross-based (repayments and withdrawals of funds are not subtracted) and different from the balance of payments statistics.

⁴ The balance of payments and the international investment position statistics can be downloaded from the Bank of Japan web site (www.boj.or.jp) and the Ministry of Finance web site (www.mof.go.jp), respectively. We should note that in 1996, the Japanese government introduced a new survey on Japan's international investment position and in accordance with methodological changes in the 5th edition of the IMF's *Balance of Payments Manual* included reinvested earnings of foreign-owned firms in the FDI flow and stock statistics. Because of these changes, the statistics after 1996 are not directly comparable with those before 1996.

⁵ In recent years, globalization has brought a wave of large-scale M&As to Japan, involving companies such as AT&T, Cable & Wireless, GE Capital and Ripplewood. M&As in Japan were also driven by the growing excess capacity resulting from the prolonged domestic recession, which prompted both domestic and foreign investors to choose acquisition over investment in new facilities. However, the bust of the IT bubble in the U.S., the Enron scandal, and the Iraq war have taken the steam out of the global M&A boom.

⁶ From the end of 2002 to the end of 2003, the inward FDI stock in Japan increased by only 2% (from 9.4 to 9.6 billion yen). Further large-scale deregulation will be necessary to attract more FDI, though such an effort does not appear to be on the government agenda today.

Establishment and Enterprise Census for 2001 conducted by the Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications.⁷ These statistics are comparable with the inward FDI data for 1996 compiled by Ito and Fukao (2003a; 2003b).⁸

According to Ito and Fukao (2003a; 2003b), Japanese-affiliates of foreign firms (JAFF) with 33.4% or more foreign ownership employed 485,000 workers in all industries in 1996. Given that the total number of domestic workers was 63 million, only 0.77 percent of total domestic workers were employed by JAFF at that time. According to our new statistics for 2001, JAFF with 33.4% or more foreign ownership employed 756,000 workers in all industries. That is, the number of workers employed by JAFF increased by approximately 271,000 workers from 1996 to 2001. The largest share of the increase—228,000 out the 271,000 additional workers employed by JAFF—is attributable to the service sector. At the same time, the total number of domestic workers decreased by more than 2.6 million to 60 million in 2001. Consequently, the share of the number of workers employed by JAFF in the total number of domestic workers increased to 1.26 percent in 2001. Although this is still very low, it nevertheless represents a substantial increase in the number of workers employed by JAFF.

Table 2.1 shows various measures representing Japan's international transactions at the 2-digit industry level. In the manufacturing sector, the share of the number of workers employed by JAFF in the total number of domestic workers increased from 1.36 to 1.97 percent during the period 1996–2001. The drugs & medicines and motor vehicles & parts sectors show a remarkable increase in this share, while the share has not changed much in most of the other industries. On the other hand, in the service sector, the share increased from only 0.65 to 1.14 percent. The rise is distributed across

⁷ Although we originally compiled the data at the 3-digit industry level, due to space constraints we only present the more aggregated (2-digit level) statistics in this paper.

⁸ Our data compilation follows that in Ito and Fukao (2003a, 2003b), where the methodology of data compilation and details on the *Census* and other FDI statistics for Japan can be found.

a large number of industries, such as financial intermediary services and insurance, telecommunications & broadcasting, computer programming & information services, other business services, and eating and drinking places. This suggests that the presence of JAFF is expanding in many different service industries in Japan.

INSERT Table 2.1

Another indication of the historically low level of inward FDI and the recent change is provided by a comparison of Japan's inward FDI with its outward FDI (Table 2.1). In the case of the manufacturing sector, the imbalance between the activities of JAFF and those of FAJF (foreign affiliates of Japanese firms) is substantial. In terms of employment size, the JAFF/FAJF ratio was 0.095 (=1.36/14.29) in 1996. Assuming that the activities of FAJF in terms of employment remained unchanged, the JAFF/FAJF ratio would have been 0.138 (=1.97/14.29) in 2001. In the service sector, the imbalance between the activities of JAFF and FAJF is much smaller. In 1996, the JAFF/FAJF ratio was 0.344 (=0.65/1.89), and again assuming that the activities of FAJF in terms of employment remained unchanged in 2001, this would have increased to 0.603 (=1.14/1.89).

In the case of the United States, the ratio of the number of workers employed by the U.S. affiliates of foreign firms (USAFF) to the total number of domestic workers is about 11% in the manufacturing sector and approximately 4% in the service sector. Thus, in both sectors, this ratio is much higher than in Japan.⁹ Interestingly, however, the ratio did not change much in the U.S. during the period from 1992 to 1997, while in Japan the ratio increased 1.4-fold in the manufacturing sector and 1.8-fold in the service sector between 1996 and 2001. Nevertheless, at 1.97%, the ratio of workers employed by foreign-owned affiliates in Japan's manufacturing sector in 2001 was still less

⁹ We should note that the definition of the cut-off capital participation rate differs for Japan and the United States. In the case of the U.S. statistics on USAFF, the data include only those affiliates where a single foreigner owns 10% or more. On the other hand, in the case of Japan, our data on JAFF include all those affiliates where one or several foreigners own 33.4% or more in total.

than one-fifth of the corresponding ratio for the U.S. of 10.78%.

While this represents a large gap, there are good economic reasons why FDI penetration in Japan's manufacturing sector and hence the share of workers employed by foreign affiliates is low. In cases where cross-border transactions in goods and services are not difficult, multinational corporations will choose the location with the lowest production costs. Because of high wage rates and land prices, Japan probably has a locational disadvantage for manufacturing industries except those in which proximity to consumers plays an important role.

In contrast, the low level of inward FDI in Japan's service sector is a more serious issue. Since many services are untradable, Japanese customers cannot enjoy the advanced services foreign firms may offer if foreign firms do not establish affiliates in Japan. When compared with the U.S., inward FDI in Japan—despite the recent increase—has been limited to a small number of industries in the service sector. Some industries, such as medical services, education, and electricity, gas, and water supply have been “sanctuaries” where almost no inward FDI has occurred. As we showed in Fukao and Ito (2003) and Ito and Fukao (2003a, 2003b), the Japanese economy is still closed in some industries such as electricity, gas, transportation, postal services, medical services, health and hygiene, etc.¹⁰

Summarizing the observations above, the number of workers employed by JAFF has increased fairly rapidly in recent years, particularly in the service sector, though the share of workers employed by JAFF in total domestic workers is still low when compared with the United States.

3. TFP Comparison of Foreign-Owned and Domestically-Owned Firms

In this section, we compare the TFP level and other performance indicators of foreign-owned

¹⁰ Barriers against FDI often go beyond questions of “national treatment” to more fundamental issues of market access. For example, market entry in areas such as medical services and education is restricted even for Japanese companies.

and domestically-owned firms, using micro data of Japanese firms in the manufacturing sector for the period of 1994–2000. Quite a number of studies, on various countries, have dealt with this topic. These typically show that labor tends to be more productive in foreign-affiliated companies than in domestic companies.¹¹ However, this is generally due to a greater concentration of capital investment; total factor productivity (TFP) analysis indicates that foreign firms' productivity is not necessarily higher if differences in capital intensity are taken into account.¹²

A study that has examined the relationship between ownership and firms' performance indicators (such as the capital-labor ratio, real value-added and TFP) is that by Kimura and Kiyota (2003), which used the same data source as the present paper. Covering the period 1994–1998 (fiscal years), their study showed that foreign-ownership has a positive impact on the growth rate of real value-added, the rate of return to capital, and TFP. Compared with their analysis, our study is more sharply focused on the TFP level as a measure of performance and measures TFP using a more sophisticated approach. Moreover, this paper examines a longer period (1994–2000) and investigates how out-in and in-in M&As affect the performance of invested firms.¹³

¹¹ See, for example, Blomstrom and Sjöholm (1998) on Indonesia and Griffith and Simpson (2001) on Britain. Doms and Jensen (1998) in their study on the U.S. found that U.S. multinational plants had the highest labor productivity, followed by foreign-owned establishments, while U.S.-owned non-multinational plants had the lowest labor productivity.”

¹² Studies coming to this conclusion include Ito (2004b) on Indonesia, Ramstetter (2001, 2002) and Ito (2002, 2004a) on Thailand, and Globerman, Ries, and Vertinsky (1994) on Canada.

¹³ The approach used here also tries to deal with the following shortcomings of Kimura and Kiyota's (2003) paper. First, Kimura and Kiyota used the book-value of capital as capital inputs. As is well known, there may be a huge gap between the book-value of capital and the real capital stock, though the latter is more appropriate as input data for TFP analysis. Second, they used value-added instead of gross output as their output measure. As Baily (1986) has shown, value-added-based TFP may differ from gross-output-based TFP, which is commonly used in theoretical and empirical studies. Third, Kimura and Kiyota derived real value-added using the value-added deflator of the SNA statistics. However, this deflator is based on a relatively aggregated industry classification, so

3.1 Data Source and Definition of Nationality

We use the firm-level panel data underlying the *Basic Survey of Japanese Business Structure and Activities* conducted annually by the Ministry of Economy, Trade and Industry (METI).¹⁴ The survey covers all firms with at least 50 employees or 30 million yen of paid-in capital in the Japanese manufacturing, mining and commerce sectors. We use the data for manufacturing firms. Our data cover the period 1994–2000 (1994–2001 in the case of the analysis in section 4). After some screening of the data our unbalanced panel data consists of 93,880 observations.¹⁵

In the survey, firms were asked what percentage of their paid-in capital was owned by foreigners and whether they had a foreign parent owning more than fifty percent of the firm. Based on this information, we determine whether a firm is foreign-owned. We use the following two definitions of foreign-owned firms: a broad definition, where one or several foreigners own 33.4% or more of the firm’s paid-in capital in total, and a narrow definition, where firms are majority-owned by a single foreign firm. It should be noted, though, that there are several Japanese firms, where more than one third of issued stocks are owned by foreign institutional investors as portfolio

that their approach risks underestimating the TFP growth of firms in high-tech industries, where output prices decline more rapidly. Compared with their approach, we use the more disaggregated deflator of *Wholesale Price Statistics* and *Corporate Goods Price Statistics*. Fifth, as the benchmark for the TFP comparison they used a single hypothetical firm which was derived by taking the average of manufacturing firms from all industries. Since the cost shares of each input take quite different values among industries, there is a risk of large approximation errors in their approach. We use a different hypothetical firm for each industry.

¹⁴ The compilation of the micro-data of the METI survey was conducted as part of the project “Foreign Direct Investment in Japan” at the Cabinet Office, Government of Japan.

¹⁵ We exclude all observations with zero values for material costs, compensation of employees, and tangible fixed assets from our data set. We also exclude observations with an extremely high or low capital-labor ratio. Through this screening process, the number of observations declined by about 8% in comparison with our original set of observations.

investments,¹⁶ and there is therefore a risk that our broad definition includes such firms.¹⁷

3.2 “Entry” and “Exit” of Foreign-Owned Firms

Table 3.1, which is based on our data, shows how the presence of foreign-owned firms in Japan’s manufacturing sector increased in 1994–2000. Let us see how the presence of foreign-owned firms has expanded, using our broad definition of foreign-owned firms. Their number grew from 195 in 1994 to 236 in 2000. During the same period, the sales of foreign-owned firms nearly doubled from 12.2 trillion yen to 23.7 trillion yen. 62 foreign-owned firms exited and 73 foreign-owned firms newly entered in this period.¹⁸ 61 domestically-owned firms in 1994 had become foreign-owned by 2000. We regard these firms as having been acquired by foreign firms.

INSERT Table 3.1

The increase in foreign-owned firms’ market share was mainly caused by these 61 M&As. The total sales of these 61 firms amounted to 14.1 trillion yen in 2000, which is greater than the total increase in foreign-owned firms’ sales of 11.5 trillion yen in the 1994–2000 period. We will examine these out-in M&A cases more closely in the following section.

To sum up the above results, the expansion of the market presence of foreign-owned firms was caused primarily through M&As and the growth of incumbents. In comparison, the contribution of greenfield investments was negligible.

¹⁶ According to the *Nihon Keizai Shinbun* (2004), the number of Japanese listed firms in which foreign institutional investors held more than 40% of issued stocks as portfolio investment increased from four at the end of March 2003 to nine at the end of March 2004.

¹⁷ Theoretically, it would be possible to exclude such firms. However, unfortunately we did not have access to the firm name list of the *METI Survey* which would have enabled us to do so.

¹⁸ As already mentioned, the METI survey covers only those firms in the manufacturing and the commerce sector that are of a size that is greater than the cut-off level. Thus, our data on firms that “entered” includes firms which expanded or changed their main business.

Table 3.2 shows the distribution of foreign-owned firms by industry. Foreign-owned firms are predominantly found in “high-tech” industries, such as drugs and medicines, other chemical products, miscellaneous machinery and machine parts, and electric communication equipment and related products.

INSERT Table 3.2

3.3 Measurement of TFP

In this paper, we measure each firm’s TFP level using the method developed by Good, Nadiri, and Sickles (1997). This method is based on Caves, Christensen, and Diewert’s (1982) “hypothetical firm” approach, which measures TFP as the gap between (1) the deviation of a firm’s output level from the industry average output level and (2) the summation of the deviations of the firm’s input level of production factor i from the industry average input level of that factor multiplied by the simple mean of the firm’s cost share of that factor and the industry average cost share of that factor for all the production factors. This index is particularly useful for a comparison of the productivity level of more than two firms in one particular period. However, this method is not suitable for inter-temporal comparisons.

Good, Nadiri, and Sickles (1997) overcome this problem by combining the “chain index” approach with the “hypothetical firm” approach of Caves, Christensen, and Diewert (1982). They achieve this by assuming a hypothetical firm for each cross-sectional comparison and then chaining the hypothetical firms together over time. The productivity index thus obtained is particularly useful because it provides a consistent way of summarizing the cross-sectional distribution of firms’ TFP and the intertemporal change of distribution over time. Aw, Chen, and Roberts (1997), Fukao and Ito (2002), and Hahn (2000) applied this approach to data of the manufacturing sector either at the firm level or at the plant level for Taiwan, Japan and Korea, respectively.

Using the industry classification of the METI survey, we divided our data into 30 manufacturing industries. For each industry we measured the TFP level of firm f at time t by

$$\begin{aligned} \ln TFP_{ft} = & (\ln Y_{ft} - \overline{\ln Y_t}) + \sum_{s=1}^t (\overline{\ln Y_s} - \overline{\ln Y_{s-1}}) \\ & - \left[\sum_{i=1}^n \frac{1}{2} (S_{ift} + \overline{S_{it}}) (\ln X_{ift} - \overline{\ln X_{it}}) + \sum_{s=1}^t \sum_{i=1}^n \frac{1}{2} (\overline{S_{is}} + \overline{S_{is-1}}) (\overline{\ln X_{is}} - \overline{\ln X_{is-1}}) \right] \end{aligned} \quad (1)$$

where Y_{ft} denotes the output level of firm f in year t and X_{ift} represents the input level of factor i at firm f in year t . S_{ift} stands for the cost share of input i at firm f in year t . Upper bars indicate the average value of that variable over all firms in that industry.

Figure 3.1 compares the histograms of foreign-owned and domestically-owned firms' TFP. This figure shows that foreign-owned firms tend to have substantially higher TFP levels than domestically-owned firms. The distributions are based on pooled data and determinants of the TFP level other than foreign ownership are not taken into account. Therefore, our interpretation carries the risk of being biased. For example, suppose that the average TFP level grows over time and the market presence of foreign-owned firms is on the increase. Then foreign-owned firms in pooled data tend to have higher TFP than domestically-owned firms even when there is no cross-sectional gap in TFP between foreign-owned and domestically-owned firms. In order to avoid this kind of bias, we conduct a regression analysis.

INSERT Figure 3.1

3.4 Comparison of Performance by Regression Analysis

We regress firm's performance on the foreign-ownership dummy and firms' other characteristics. As a first step, we use only the industry and year dummies.¹⁹

Our main results (using the narrow definition of foreign-owned firms) are as follows (Table 3.3a).

INSERT Tables 3.3a and 3.3b

- 1) Foreign-owned firms' TFP is about 8% higher and their current profit-sales ratio 1.5 percentage points higher.
- 2) Foreign-owned firms enjoy slightly higher TFP growth.
- 3) Foreign-owned firms spend proportionately more on R&D per worker. They also have a significantly higher capital-labor ratio. Probably because of this, the labor productivity of foreign-owned firms is higher than that of domestically-owned firms.
- 4) There is no significant difference between domestically-owned and foreign-owned firms in the growth rates of real sales and employment. But foreign-owned firms show a significantly lower growth rate of tangible assets.
- 5) Average wages at foreign firms are 1.28 million yen higher per year.

Using the broad definition of foreign-owned firms (Table 3.3b), we obtain similar results.

¹⁹ In the case of the regression with the TFP level as the dependent variable, we also included a cross-term of the year dummy and the industry dummy in order to control for differences in average TFP growth rates.

3.5 Empirical Model of the Determinants of TFP

As we have seen, foreign-owned firms tend to conduct more R&D and pay higher wage rates. Although their TFP level is significantly higher than that of Japanese firms, this difference might be caused not by the inflow of knowledge from their parent firms but by their own R&D activities and the (potentially) higher quality of their labor. In order to test which of the above two hypotheses is correct, we examine the determinants of each firm's TFP level and TFP growth rate empirically. Descriptive statistics of the main variables used in the regression are presented in Table 3.4, while the results of this regression are reported in Table 3.5. The regression is conducted using OLS and pooled data for 1994–2000.

INSERT Tables 3.4 and 3.5

Again, foreign-owned firms display a TFP level about 5% higher than that of Japanese firms even after controlling for other factors such as R&D intensity, the percentage of non-production workers, years passed since the firm was established, and firm size (sales) in addition to industry differences (industry dummies) and observation year (Table 3.5a).

However, when we add firm dummies to the regression model, the gap between the TFP level of foreign-owned firms and Japanese firms becomes insignificant. This result suggests that the strong correlation between foreign ownership and the TFP level is at least partly the result of the higher TFP level of the firms later acquired by foreign firms. We will study this issue in more detail in the next section.

Table 3.5c shows that the foreign-owned firms has a 1.4–1.8 percentage points higher TFP than that of Japanese firms even after controlling for other factors. Yet, this positive correlation between foreign ownership and the TFP growth rate again becomes insignificant in the fixed effect models.

Using regional dummies for parent firms' location, we also tested whether firms owned by

U.S. or European firms show a better performance than firms owned by firms from other regions. In addition, we tested whether firms majority-owned by foreign firms exhibited a better performance than other foreign-owned firms (Table 3.5b and Table 3.5d). We found that firms with a U.S. or a European parent show a better performance than firms with parents from other regions. We also found that firms majority-owned by foreign firms show a better performance than other foreign-owned firms. However, these relationships disappear in the fixed effect models.

Overall, the comparison between foreign-owned and domestically-owned firms in this section shows that foreign-owned companies had a 5% higher TFP, and higher returns on capital. Moreover, they displayed a higher capital-labor ratio and R&D investment per worker. They also enjoyed a higher TFP growth rate. Probably reflecting the higher levels of capital intensity and technology, foreign-owned companies showed higher labor productivity and wage rates as well. But in the fixed effect models we could not find a significant positive correlation between foreign ownership and the TFP level (TFP growth rate).

4. Selection Model and Dynamic Effects of Mergers and Acquisitions

As pointed out in the previous section, there are two possible theoretical explanations for the positive correlation between foreign ownership and productivity. One potential explanation is that foreign-owned firms enjoy greater productivity because foreign firms choose firms with higher TFP as their M&A targets. We call this mechanism the selection effect. The alternative explanation is that Japanese firms that were acquired by foreign firms receive new technologies and management skills from their foreign owners and this transfer of intangible assets boosts their TFP. For short, we call this mechanism the technology-transfer effect.

In order to determine which one of the two effects is responsible for the positive correlation between foreign ownership and productivity, we conduct two empirical tests. First, we estimate a

Probit model explaining whether a firm is chosen as an M&A target based on its TFP level and other characteristics. Second, we test whether the TFP of Japanese firms that were acquired by foreign firms improves after the investment.²⁰

4.1 Data Used

We use data of manufacturing firms for the years 1994–2001 from the same source as in section 3. Following our broad and narrow definition of foreign ownership above, we distinguish between firms in which several foreigners acquire 33.4% or more of the equity, and firms in which a single foreign firm takes a majority stake. In order to compare out-in M&As with in-in M&As (M&As involving only domestic firms), we define in-in M&As as cases where a firm that did not have a parent firm with majority ownership in time $t-1$ comes to have a domestic parent firm with majority ownership in time t . This definition of in-in M&As resembles our narrow definition of out-in M&As.²¹

Table 4.1 shows the number of out-in and in-in M&A cases in our data. We have 143 cases of broadly defined out-in M&As, 67 cases of narrowly defined out-in M&As, and 1,362 cases of in-in M&As.

INSERT Table 4.1

²⁰ In many countries, exporting firms tend to have higher productivity than non-exporting firms. Several studies, such as Bernard and Jensen (1999) and Hahn (2004), have tried to discover whether exporting improves productivity (learning) and/or whether more productive firms export (self-selection). These studies provide important insights that have helped us formulate our approach in this section.

²¹ Because of data limitations, there are several inconsistencies in our definition of M&As. For example, cases where a firm changes its parent firm from one Japanese firm to another Japanese firm are not included in our in-in M&As.

4.2 Are Good Firms Chosen as M&A Targets?

Using our panel data of manufacturing firms for 1994–2001, we estimated a Probit model explaining whether a firm is chosen as an M&A target based on its TFP level and other characteristics. The dependent variables are the broadly defined out-in M&A dummy, the narrowly defined out-in M&A dummy, and the in-in M&A dummy. Each M&A dummy variable takes value one when this type of M&A occurs. As explanatory variables, we use the logarithm of the TFP level, the growth rate of TFP, firm size (the number of workers), the current profit/sales ratio, the total liability/total asset ratio, year dummies, and industry dummies. All the explanatory variables are values at the period (time $t-1$) preceding the M&A transaction (time t).

Table 4.2 shows the estimation results. The determinants of M&As are surprisingly different for out-in M&As and in-in M&As. In the case of out-in M&As, firms with higher TFP, a higher profit rate, and of a larger size are chosen as targets. In the case of in-in M&As, firms with a lower profit rate, larger liabilities, and of a smaller size are chosen as targets. In both cases, the growth rate of firms' TFP (from $t-2$ to $t-1$) does not have any significant effect on the selection.

INSERT Table 4.2

These results imply that foreign firms acquire Japanese firms that already at the time of acquisition show a better performance. It thus seems that at least some part of the higher TFP of foreign-owned firms is caused by the selection effect. In contrast, in-in M&As tend to display characteristics of rescue measures. One possible explanation is that in-in M&As in Japan are mainly conducted within vertical and horizontal *keiretsu* networks and financially distressed small firms are salvaged by other member firms through M&As.

4.3 Does M&A Improve the Performance of Target Firms?

In this subsection, we examine the technology-transfer effect by estimating how the

performance of out-in and in-in M&A target firms changes after the acquisition. We estimate the following model:

$$Y_{f,t+\tau} - Y_{f,t-1} = \alpha + \beta_1 \text{outinM \& ADummy}_{f,t} + \beta_2 \text{ininM \& ADummy}_{f,t} + \sum_i \gamma_i X_{i,f,t-1} + \sum_j \delta_j \text{IndustryDummy}_{j,f,t} + \sum_T \theta_T \text{YearDummy}_{T,f,t} + \varepsilon_{f,t} \quad (2)$$

where $Y_{f,t}$ denotes the performance of firm f in year t . As $Y_{f,t}$, we use the logarithm of the TFP level, the logarithm of the number of workers, and the current profit/sales ratio. It is quite likely that it takes several years for technology-transfer effects to manifest themselves and in order to take account of this time lag, we study the effects two years ($\tau=1$) and three years ($\tau=2$) after the acquisition. As explanatory variables, we use out-in and in-in M&A dummies in year t , the values of the three performance variables (the logarithm of the TFP level, the logarithm of the number of workers, and the current profit/sales ratio) in year $t-1$, the R&D/sales ratio, the total liability/total sales ratio, industry dummies, and year dummies. In the case of the estimation where changes in employment are the dependent variable, we used sales per worker as an additional explanatory variable in order to take account of labor hoarding. As out-in M&A dummies, we used both the broad and narrow definition of out-in M&A. The narrowly defined M&A dummy takes value one if firm f becomes majority-owned by a foreign firm.

The regression results on the effects two years ($\tau=1$) after the acquisition are reported in Table 4.3, while the results on the effects three years after ($\tau=2$) are reported in Table 4.4.

INSERT Tables 4.3 and 4.4

The results indicate that out-in M&As improve target firms' TFP level and current profit/sales ratio. It seems that out-in M&As where a single foreign firm obtains majority-ownership (the narrow definition) tend to have larger and more statistically significant positive effects on these performance indicators than out-in M&As where one or more foreign firms do not become majority-owners (the broad definition). Compared with out-in M&As, in-in M&As bring a smaller and slower

improvement in target firms' TFP level and there is no improvement in the current profit/sales ratio. The impact of out-in M&As on target firms' employment is also sharply different from that of in-in M&As. In the case of in-in M&As, there is a significant and positive effect on employment two years after the acquisition, while in the case of out-in M&As, the effect on employment is negative but insignificant.

Overall, we found some evidence showing that target firms' TFP improved as a result of out-in M&As. Compared with in-in M&As, out-in M&As bring a larger and quicker improvement in TFP and the profit rate but, at least in the short-run (i.e. two years after the acquisition) do not increase employment at the target firms.

5. Conclusions

Our analysis of inward FDI has shown that FDI penetration in Japan (as measured by the number of workers employed by JAFF in total domestic workers) has increased substantially in recent years although the inward FDI penetration still remains low when compared with the United States. The increase in FDI penetration in Japan during the period 1996–2001 was more pronounced in the service sector than in the manufacturing sector. What is more, the growing presence of foreign companies was distributed across a wide spectrum of service industries (though important exceptions, “sanctuaries,” remain). In the manufacturing sector, the drugs & medicines and motor vehicles & parts sectors show a remarkable increase in the share of workers employed by JAFF in total domestic workers, while in most other industries this share remained largely unchanged.

Taking these observations as our point of departure, we investigated the economic performance both of foreign-owned and of domestically-owned firms and tried to evaluate whether Japan benefits from the transfer of intangible assets of foreign firms.

The overall comparison between foreign-owned and Japanese companies shows that

foreign-owned companies enjoyed 5% higher TFP as well as higher earnings and returns on capital. They also displayed a higher capital-labor ratio and higher R&D intensity. Reflecting their higher TFP and labor-saving production patterns, foreign-owned companies showed higher labor productivity and wage rates as well.

By estimating Probit models, we found that foreign firms acquire Japanese firms with higher TFP levels and higher profit rates. In contrast, in-in M&As seem to have the characteristics of rescue missions. Small firms with a higher total liability/total asset ratio tend to be chosen as targets of in-in M&As.

We also estimated the dynamic effects of M&As on target firms. The results indicate that out-in M&As improve target firms' TFP level and current profit/sales ratio. Compared with in-in M&As, out-in M&As bring a larger and quicker improvement in TFP and the profit rate but no increase in target firms' employment two years after the acquisition.

To sum up the above results, we found that both the selection effect and the technology-transfer effect play a role in explaining the positive correlation between foreign ownership and productivity. The transfer of intangible assets from foreign firms to M&A takeover targets represents one important avenue by which Japan can benefit from FDI, and the evidence presented here show that such a technology-transfer effect is indeed operating.

Other potential benefits from FDI include, for example, the various spillover effects associated with increased competition and exposure to best global practice that the presence of foreign multinationals entails. Such spillovers are likely to be most pronounced in previously sheltered sectors of the economy, most of which are to be found in the service sector. The analysis presented here, focusing on technology-spillover effects in the manufacturing sector, thus represents only a first step in evaluating the impact of out-in M&As, and FDI more generally, on TFP in Japan.

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

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 calculate 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 take the data on the book value of tangible fixed assets of year 1976 from the *Census of Manufactures 1976* published by METI. We then convert 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 is calculated using the perpetual inventory method. We use the capital formation deflator in the *Annual Report on National Accounts* and Matuda's (2000) estimate of the depreciation rate of 0.0792 for the calculation.

In order to obtain capital input, we multiply the net capital stock by the capital utilization ratio of each industry, provided in the JIP database.²²

²² 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,

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

Finally, we derived the cost shares of the factors of production. For labor cost, we use 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 is calculated by multiplying the real net capital stock with the user cost of capital. The latter is estimated as follows:

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

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 unit 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*, and the *Bank of Japan*. The depreciation rate for each industry is estimated using the book value of tangible fixed assets at the beginning of year t and depreciation expense during year t in the *Census of Manufactures* published by METI.

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 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.

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Table 2.1. Japan's Inward and Outward FDI

Industry		Inward		Outward	U.S. Inward	
		Ratio of no. of workers employed by JAFF to total no. of domestic workers, 1996 (%)	Ratio of no. of workers employed by JAFF to total no. of domestic workers, 2001 (%)	Ratio of no. of workers employed by FAJF to total no. of domestic workers, 1996 (%)	Ratio of no. of workers employed by USAFF to total no. of domestic workers, 1992 (%)	Ratio of no. of workers employed by USAFF to total no. of domestic workers, 1997 (%)
Manufacturing Total		1.36	1.97	14.29	11.01	10.78
03	Food products	0.29	0.38	5.17	10.39	8.38
04	Textiles & apparel	0.15	0.18	11.50	4.78	5.83
05	Wood and paper products	0.06	0.17	2.65	4.91	4.95
06	Publishing & printing	0.13	0.25	1.07	6.56	7.83
07	Chemical products	3.61	3.69	30.96	26.91	21.80
08	Drugs & medicines	7.21	15.49	10.04	33.30	31.90
09	Petroleum and coal products	7.24	2.91	2.96	23.69	22.20
10	Plastic products	0.41	0.45	3.91	10.41	10.03
11	Rubber products	1.08	1.18	44.25	23.70	40.18
12	Ceramic, stone and clay	0.28	0.38	11.19	19.76	21.45
13	Iron & steel	0.01	0.14	23.04	19.16	19.35
14	Non-ferrous metals	1.61	0.45	13.20	14.82	15.73
15	Metal products	0.31	0.21	1.90	7.23	7.52
16	General machinery	1.68	1.78	7.98	11.03	12.75
17	Electrical machinery	2.46	2.50	29.96	13.74	13.78
18	Motor vehicles & parts	4.72	10.82	42.05	11.74	15.60
19	Miscellaneous transport equipment	0.70	0.63	6.02	3.43	4.23
20	Precision instruments	0.41	0.91	14.81	14.03	11.16
21	Miscellaneous manufacturing	0.47	0.72	5.65	8.47	6.62
Services Total		0.65	1.14	1.89	4.03	4.31
22	Construction and civil engineering	0.05	0.06	0.70	1.97	1.72
23	Electricity, gas, steam and water supply, e	0.00	0.00	0.04	1.19	1.96
24	Wholesale trade	2.31	2.78	5.85	8.37	7.89
25	Retail trade	0.29	0.51	0.66	3.79	4.50
26	Financial intermediary services	1.47	3.86	13.37	6.62	6.10
27	Insurance	1.67	8.46	5.23	14.34	6.40
28	Real estate	0.02	0.10	1.38	1.97	1.64
29	Transportation & postal service	0.50	0.51	1.52	5.80	4.82
30	Telecommunications & broadcasting	0.22	2.53	0.27	0.62	7.66
31	Education & research institutes	0.34	0.98	0.00	6.44	6.39
32	Medical services, health and hygiene	0.02	0.04	0.01	2.72	1.99
33	Computer programming & information se	1.83	2.92	16.69	4.08	3.88
34	Goods & equipment rental & leasing	0.88	1.21	3.44	5.45	3.66
35	Other business services	0.52	1.64	1.19	4.09	4.77
36	Eating & drinking places	1.58	2.36	0.55	2.71	2.48
37	Other personal services	0.12	0.44	1.14	5.08	4.23
38	Other services	0.01	0.00	0.01	n.a.	n.a.

Note: FAJF: Foreign Affiliates of Japanese Firms (10% or more Japanese-owned), JAFF: Japanese Affiliates of Foreign Firms (33.4% or more foreign-owned), USAFF: U.S. Affiliates of Foreign Firms (10% or more foreign-owned)

Sources: Compiled from micro-data of the *Establishment and Enterprise Census* for 1996, MITI (1998), Toyo Keiza Shimpou-sha (1996), and U.S. Department of Commerce (1995a). Also see Appendix.

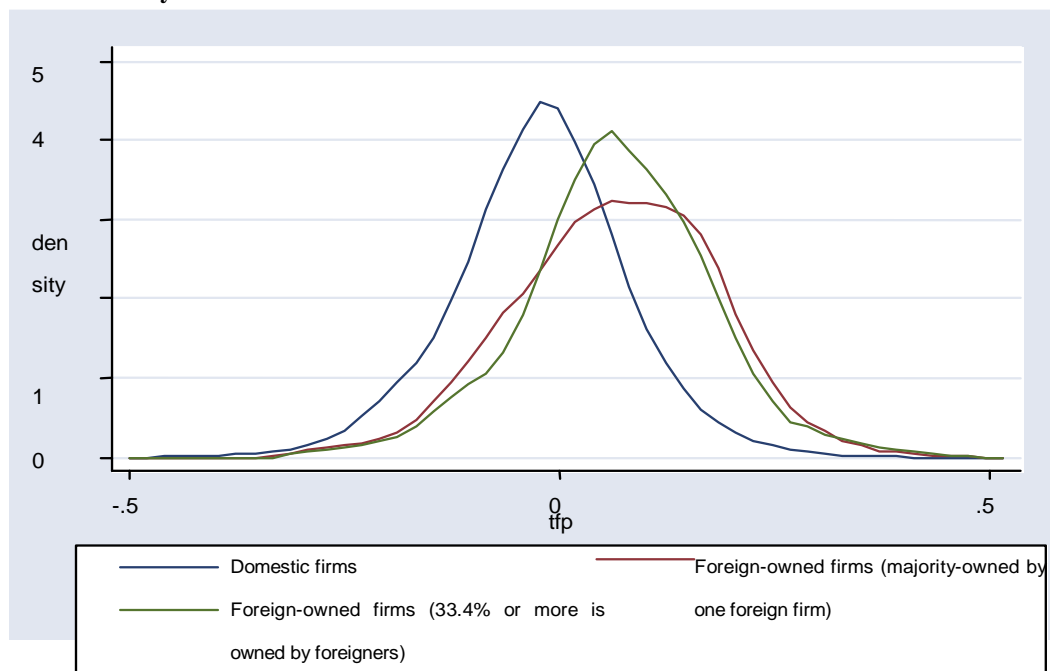
**Table 3.1 "Entry" and "exit" of domestically-owned and foreign-owned firms in the manufacturing sector
(number of firms; figures in parentheses are total sales in billion yen)**

Manufacturing	1994			2000		
	Total firms	Other firms	33.4% or more is owned by foreigners	Total firms	Other firms	33.4% or more is owned by foreigners
Total	13731 (250000)	13536 (238000)	195 (12200)	13486 (265000)	13250 (241000)	236 (23700)
Firms that "exited" in 1994-2000	4207 (34044)					
Breakdown of "exited" firms		4145 (31900)	62 (2124)			
Firms that "entered" in 1994-2000				3962 (32300)		
Breakdown of "entered" firms					3889 (31000)	73 (1221)
Firms that "stayed" in 1994-2000	9524 (216000)			9524 (233000)		
Breakdown of firms that "stayed"						
"Stayed" as domestically-owned		9330 (192200)			9330 (205700)	
"Stayed" as foreign-owned			102 (6785)			102 (8285)
Changed from domestically-owned to foreign-owned		61 (13800)				61 (14100)
Changed from foreign-owned to domestically-owned			31 (3215)		31 (4300)	

Table3.2. Distribution of foreign-owned firms by industry: Pooled data for 1994-2000

	Industry	Number of domestic firms	Number of Foreign firms			Number of firms
			(A) or (B)	(A) Majority-owned by one foreign firm	(B) 33.4% or more is owned by foreigners	
1	Foods	10968 (99.38)	68 (0.62)	39	65	11036 (100.00)
2	Textiles	6049 (99.74)	16 (0.26)	10	14	6065 (100.00)
3	Woods and furniture	2459 (99.72)	7 (0.28)	0	7	2466 (100.00)
4	Pulp and paper	3052 (99.74)	8 (0.26)	4	5	3060 (100.00)
5	Printing and publishing	5403 (99.59)	22 (0.41)	13	15	5425 (100.00)
6	Industrial chemicals and chemical fibers	2084 (93.66)	141 (6.34)	53	131	2225 (100.00)
7	Oils and paints	951 (98.14)	18 (1.86)	7	17	969 (100.00)
8	Drugs and medicines	1322 (91.17)	128 (8.83)	93	118	1450 (100.00)
9	Other chemical products	1657 (91.24)	159 (8.76)	86	141	1816 (100.00)
10	Petroleum and coal products	340 (87.86)	47 (12.14)	14	47	387 (100.00)
11	Plastic products	4512 (98.84)	53 (1.16)	19	44	4565 (100.00)
12	Rubber products	978 (98.39)	16 (1.61)	6	16	994 (100.00)
13	Ceramics	4070 (99.29)	29 (0.71)	11	24	4099 (100.00)
14	Iron and steel	2760 (99.89)	3 (0.11)	2	1	2763 (100.00)
15	Non-ferrous metals and products	2212 (98.53)	33 (1.47)	17	32	2245 (100.00)
16	Fabricated metal products	6862 (99.77)	16 (0.23)	11	10	6878 (100.00)
17	Metal working machinery	1815 (99.34)	12 (0.66)	3	10	1827 (100.00)
18	Special industry machinery	2767 (98.68)	37 (1.32)	22	27	2804 (100.00)
19	Office, service industry and household machines	1085 (98.55)	16 (1.45)	8	14	1101 (100.00)
20	Miscellaneous machinery and machine parts	5155 (97.63)	125 (2.37)	65	101	5280 (100.00)
21	Industrial electric apparatus	2798 (99.26)	21 (0.74)	3	19	2819 (100.00)
22	Household electric appliances	1180 (98.91)	13 (1.09)	6	10	1193 (100.00)
23	Communication equipment and related products	2086 (98.86)	24 (1.14)	4	23	2110 (100.00)
24	Electronic data processing machine and electronic equipment	1386 (98.58)	20 (1.42)	14	17	1406 (100.00)
25	Electronic communication equipment and related products	4745 (98.34)	80 (1.66)	49	72	4825 (100.00)
26	Miscellaneous electrical machinery and supplies	1411 (97.38)	38 (2.62)	25	35	1449 (100.00)
27	Motor vehicles	6247 (98.66)	85 (1.34)	28	76	6332 (100.00)
28	Miscellaneous transportation equipment	1529 (98.14)	29 (1.86)	2	29	1558 (100.00)
29	Precision instruments	2340 (97.70)	55 (2.30)	35	46	2395 (100.00)
30	Other manufacturing	2301 (98.42)	37 (1.58)	31	20	2338 (100.00)
	Manufacturing	92524 (98.56)	1356 (1.44)	680	1186	93880 (100.00)

Figure 3.1 Kernel density estimates for TFP level: Comparison between foreign-owned and domestically-owned firms



The number of pooled observations is 93880. The horizontal axis denotes the log value of firms' TFP level.

Table 3.3.a OLS estimation results: Comparison between foreign-owned (majority-owned by one foreign firm) and domestically-owned firms

	TFP level	Growth rate of TFP	Capital-labor ratio	R&D-sales ratio (%)	Current profit per worker (million yen per worker)	
Foreign-ownership dummy (majority-owned by one foreign firm)	0.0773 *** (18.35)	0.0037 (1.09)	2.7577 *** (4.00)	0.0065 *** (5.80)	1.4956 *** (9.79)	
_cons	-0.0524 *** (-21.29)	0.0025 *** (3.03)	8.5831 *** (51.93)	0.0038 *** (20.53)	0.6475 *** (18.76)	
Industry dummy	yes	yes	yes	yes	yes	
Year dummy	yes	yes	yes	yes	yes	
Industry dummy*Year dummy	yes	no	no	no	no	
No. of observations	93880	70332	93880	93880	93880	
	Current profit-sales ratio (%)	Growth rate of real assets	Wage level (million yen per worker)	Growth rate of workers	Labor productivity (million yen per worker)	Growth rate of real sales
Foreign-ownership dummy (majority-owned by one foreign firm)	0.0192 *** (6.36)	-0.0230 ** (-2.00)	1.2754 *** (18.52)	0.0003 (0.03)	16.2696 *** (7.91)	0.0121 (1.17)
_cons	0.0169 *** (20.13)	0.0477511 *** (12.79)	3.4736 *** (178.78)	-0.0042 ** (-2.13)	31.9526 *** (73.06)	0.0379 *** (17.51)
Industry dummy	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes
No. of observations	93880	70332	93880	70332	93880	70332

Notes) 1.Pooled data for 1994-2000 are used.

2. The values in parentheses are t-statistics.

3.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 3.3.b OLS estimation results: Comparison between foreign-owned (33.4% or more is owned by foreigners) and domestically-owned firms

	TFP level	Growth rate of TFP	Capital-labor ratio	R&D-sales ratio (%)	Current profit per worker (million yen per worker)	
Foreign-ownership dummy (33.4% or more is owned by foreigners)	0.0809 ***	0.0064 ***	5.7805 ***	0.0073 ***	2.1479 ***	
_cons	(27.92)	(2.82)	(8.53)	(8.44)	(15.40)	
	-0.0525 ***	0.0024 ***	8.5550 ***	0.0037 ***	0.6392 ***	
	(-21.33)	(2.99)	(51.76)	(20.41)	(18.52)	
Industry dummy	yes	yes	yes	yes	yes	
Year dummy	yes	yes	yes	yes	yes	
Industry dummy*Year dummy	yes	no	no	no	no	
No. of observations	93880	70332	93880	93880	93880	
	Current profit-sales ratio (%)	Growth rate of real assets	Wage level (million yen per worker)	Growth rate of workers	Labor productivity (million yen per worker)	Growth rate of real sales
Foreign-ownership dummy (33.4% or more is owned by foreigners)	0.0244 ***	-0.0090	1.3031 ***	-0.0061	25.17698 ***	0.0089
_cons	(11.78)	(-1.01)	(25.39)	(-1.21)	(11.41)	(1.32)
	0.0168 ***	0.0478 ***	3.4702 ***	-0.0042 **	31.8494 ***	0.0379 ***
	(20.04)	(12.79)	(178.77)	(-2.11)	(72.08)	(17.49)
Industry dummy	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes
No. of observations	93880	70332	93880	70332	93880	70332

Notes) 1. Pooled data for 1994-2000 are used.

2. The values in parentheses are t-statistics.

3.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

4. The industry dummy corresponding to the electronic data processing machine and electronic equipment industry is omitted.

5. The year dummy corresponding to year 1994 is omitted.

Table 3.4 Descriptive statistics of the main variables used in the regression analysis

Variable	Number of observations	Average	Standard deviation	Minimum value	Maximum value
TFP level	93880	-0.0216	0.1022	-0.4905	0.5076
Growth rate of TFP	70332	0.0058	0.0634	-0.5430	0.6132
R&D investment-sales ratio	93880	0.0086	0.0202	0.0000	1.6391
No. of years passed since established	93880	36.6372	15.0046	0.0000	110.0000
(No. of years passed since established)^2	93880	1567.42	1159.86	0.0000	12100.00
Outsourcing ratio	93880	0.1071	0.1496	0.0000	9.8890
ln(Sales)	93880	8.4190	1.2958	4.8255	16.0220
(ln(Sales))^2	93880	72.5595	23.7767	23.2855	256.7040
Share of non-production workers in total workers	93880	0.3315	0.2492	0.0000	1.0000

Table 3.5 Estimation results: determinants of TFP level and TFP growth rate

Table 3.5a Dependent variable: TFP level

Foreign-ownership dummy (majority-owned by one foreign Foreign-ownership dummy (33.4% or more is owned by	0.0521 *** (18.43)	0.0488 *** (17.26)			0.0031 (0.96)	0.0031 (0.96)			
			0.0480 *** (11.73)	0.0426 *** (10.47)				-0.0038 (-0.76)	-0.0038 (-0.76)
Ratio of non-production workers		0.0377 *** (29.79)		0.0379 *** (29.88)		0.0003 (0.24)			0.0003 (0.24)
R&D investment-sales ratio	0.2067 *** (7.02)	0.1518 *** (5.96)	0.2107 *** (7.07)	0.1556 *** (6.04)	-0.1208 *** (-7.69)	-0.1208 *** (-7.70)	-0.1207 *** (-7.69)	-0.1207 *** (-7.69)	-0.1207 *** (-7.69)
No. of years passed since established	-0.0007 *** (-9.43)	-0.0008 *** (-10.45)	-0.0007 *** (-9.30)	-0.0007 *** (-10.34)	0.0004 *** (3.44)	0.0004 *** (3.44)	0.0004 *** (3.45)	0.0004 *** (3.45)	0.0004 *** (3.45)
(No. of years passed since established)^2	0.0000 *** (5.82)	0.0000 *** (6.37)	0.0000 *** (5.46)	0.0000 *** (6.04)	0.0000 ** (-2.11)	0.0000 ** (-2.11)	0.0000 ** (-2.12)	0.0000 ** (-2.12)	0.0000 ** (-2.12)
Outsourcing ratio	0.0087 *** (4.14)	0.0064 *** (3.14)	0.0083 *** (3.96)	0.0060 *** (2.96)	-0.0030 (-1.58)	-0.0030 (1.58)	-0.0030 (-1.58)	-0.0030 (-1.58)	-0.0030 (-1.58)
ln(Sales)	0.1339 *** (66.71)	0.1282 *** (63.96)	0.1330 *** (66.45)	0.1273 *** (63.71)	0.2418 *** (35.21)	0.2418 *** (35.20)	0.2417 *** (35.20)	0.2417 *** (35.19)	0.2417 *** (35.19)
(ln(Sales))^2	-0.0056 *** (-51.26)	-0.0053 *** (-49.00)	-0.0055 *** (-50.86)	-0.0053 *** (-48.62)	-0.0073 *** (-18.20)	-0.0073 *** (-18.20)	-0.0073 *** (-18.19)	-0.0073 *** (-18.19)	-0.0073 *** (-18.19)
Constant	-0.7592 *** (-80.81)	-0.7419 *** (-79.25)	-0.7561 *** (-80.65)	-0.7390 *** (-79.10)	-1.5198 *** (-50.53)	-1.5199 *** (-50.53)	-1.5195 *** (-50.52)	-1.5196 *** (-50.52)	-1.5196 *** (-50.52)
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry dummy*Year dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm dummy	no	no	no	no	yes	yes	yes	yes	yes
Number of observations	93880	93880	93880	93880	93880	93880	93880	93880	93880
Number of groups	-	-	-	-	19652	19652	19652	19652	19652

Notes) 1.The values in parentheses are t-statistics.

2.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 3.5 Estimation results: determinants of TFP level and TFP growth rate

Table 3.5b Dependent variable: TFP level

US firm dummy	0.0538 *** (8.82)	-0.0106 (-1.49)	Foreign-ownership dummy (0.1=<FO<0.334)	0.0258 *** (8.25)	0.0036 (1.36)
European firm dummy	0.0470 *** (7.84)	0.0002 (0.03)	Foreign-ownership dummy (0.334=<FO<0.5)	0.0496 *** (8.03)	0.0034 (0.52)
Other country dummy	0.0144 (1.33)	0.0027 (0.24)	Foreign-ownership dummy (0.5=<FO)	0.0537 *** (17.05)	0.0035 (0.98)
R&D investment-sales ratio	0.2103 *** (7.06)	-0.1205 *** (-7.68)	R&D investment-sales ratio	0.1995 *** (6.88)	-0.1211 *** (-7.71)
No. of years passed since established	-0.0007 *** (-9.28)	0.0004 *** (3.44)	No. of years passed since established	-0.0007 *** (-9.29)	0.0004 *** (3.49)
(No. of years passed since established)^2	0.0000 *** (5.44)	0.0000 ** (-2.11)	(No. of years passed since established)^2	0.0000 *** (5.64)	0.0000 ** (-2.19)
Outsourcing ratio	0.0083 *** (3.98)	-0.0030 *** (-1.59)	Outsourcing ratio	0.0087 ** (4.14)	-0.0030 (-1.57)
ln(Sales)	0.1330 *** (66.46)	0.2418 *** (35.21)	ln(Sales)	0.1366 *** (67.66)	0.2420 *** (35.21)
(ln(Sales))^2	-0.0055 *** (-50.86)	-0.0073 *** (-18.21)	(ln(Sales))^2	-0.0057 *** (-52.42)	-0.0074 *** (-18.23)
Constant	-0.7560 *** (-80.66)	-1.5199 *** (-50.53)	Constant	-0.7701 *** (-81.61)	-1.5208 *** (-50.52)
Industry dummy	yes	yes	Industry dummy	yes	yes
Year dummy	yes	yes	Year dummy	yes	yes
Firm dummy	no	yes	Firm dummy	no	yes
Industry dummy*Year dummy	yes	yes	Industry dummy*Year dummy	yes	yes
Number of observations	93880	93880	Number of observations	93880	63584
Number of groups	-	19652	Number of groups	-	93880

Notes) 1.The values in parentheses are t-statistics.

2.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 3.5 Estimation results: determinants of TFP level and TFP growth rate

Table 3.5c Dependent variable: growth rate of TFP

lagged TFP level	-0.2817 *** (-86.60)	-0.2792 *** (-86.52)	-0.2825 *** (-86.69)	-0.2800 *** (-86.62)	-0.8325 *** (-223.08)	-0.8324 *** (-222.94)	-0.8325 *** (-223.08)	-0.8324 *** (-222.94)
Foreign-ownership dummy (majority-owned by one foreign	0.0145 *** (4.56)	0.0155 *** (4.92)			-0.0072 (-1.15)	-0.0076 (-1.21)		
Foreign-ownership dummy (33.4% or more is owned by			0.0173 *** (8.10)	0.0180 *** (8.40)			0.0027 (0.71)	0.0026 (0.70)
Ratio of non-production workers	0.0074 *** (7.58)		0.0073 *** (7.52)		0.0021 (1.36)		0.0021 (1.37)	
R&D investment-sales ratio	0.0234 * (1.81)		0.0224 * (1.74)		-0.1276 *** (-7.37)		-0.1278 *** (-7.38)	
No. of years passed since established	-0.0004 *** (-7.24)	-0.0004 *** (-6.88)	-0.0004 *** (-7.24)	-0.0004 *** (-6.88)	0.0006 *** (4.72)	0.0006 *** (4.72)	0.0006 *** (4.71)	0.0006 *** (4.72)
(No. of years passed since established)^2	0.0000 *** (4.57)	0.0000 *** (4.37)	0.0000 *** (4.69)	0.0000 *** (4.49)	0.0000 *** (-3.09)	0.0000 *** (-3.07)	0.0000 *** (-3.08)	0.0000 *** (-3.06)
Outsourcing ratio	-0.0006 (-0.41)	-0.0002 (-0.17)	-0.0005 (-0.31)	-0.0001 (-0.06)	-0.0076 *** (-3.36)	-0.0079 *** (-3.46)	-0.0076 *** (-3.36)	-0.0079 *** (-3.46)
ln(Sales)	0.0421 *** (27.92)	0.0426 *** (28.34)	0.0425 *** (28.14)	0.0431 *** (28.57)	0.2369 *** (29.16)	0.2361 *** (29.06)	0.2369 *** (29.16)	0.2361 *** (29.05)
(ln(Sales))^2	-0.0017 *** (-21.82)	-0.0017 *** (-22.16)	-0.0017 *** (-22.10)	-0.0018 *** (-22.46)	-0.0063 *** (-13.40)	-0.0063 *** (-13.26)	-0.0063 *** (-13.40)	-0.0063 *** (-13.26)
Constant	-0.2250 *** (-31.16)	-0.2263 *** (-31.34)	-0.2268 *** (-31.36)	-0.2282 *** (-31.56)	-1.5209 *** (-42.13)	-1.5192 *** (-42.06)	-1.5209 *** (-42.13)	-1.5192 *** (-42.06)
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes	yes	yes
Firm dummy	no	no	no	no	yes	yes	yes	yes
Number of observations	70332	70332	70332	70332	70332	70332	70332	70332
Number of groups	-	-	-	-	16471	16471	16471	16471

Notes) 1.The values in parentheses are t-statistics.

2.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 3.5 Estimation results: determinants of TFP level and TFP growth rate

Table 3.5.d Dependent variable: growth rate of TFP

lagged TFP level	-0.2796 *** (-86.53)	-0.8325 *** (-223.07)	lagged TFP level	-0.2806 *** (-86.68)	-0.8325 *** (-223.08)
US dummy	0.0183 ** (3.93)	-0.0043 (-0.49)	Foreign-ownership dummy (0.1=<FO<0.334)	0.0089 *** (4.05)	0.0046 * (1.66)
European firm dummy	0.0147 *** (3.21)	-0.0097 (-1.12)	Foreign-ownership dummy (0.334=<FO<0.5)	0.0173 *** (4.03)	0.0073 (1.05)
Other country dummy	-0.0003 (-0.03)	-0.0081 (-0.52)	Foreign-ownership dummy (0.5=<FO)	0.0184 *** (7.60)	0.0019 (0.45)
R&D investment-sales ratio	0.0335 ** (2.54)	-0.1275 *** (-7.36)	R&D investment-sales ratio	0.0297 ** (2.27)	-0.1281 *** (-7.40)
No. of years passed since established	-0.0004 *** (-6.92)	0.0006 *** (4.73)	No. of years passed since established	-0.0004 *** (-6.87)	0.0006 *** (4.78)
(No. of years passed since established)^2	0.0000 *** (4.37)	0.0000 *** (-3.09)	(No. of years passed since established)^2	0.0000 (4.42)	0.0000 *** (3.19)
Outsourcing ratio	-0.0003 (-0.17)	-0.0077 *** (-3.38)	Outsourcing ratio	-0.0001 (-0.07)	-0.0076 *** (-3.35)
ln(Sales)	0.0429 *** (28.41)	0.2370 *** (29.17)	ln(Sales)	0.0444 *** (28.78)	0.2374 *** (29.20)
(ln(Sales))^2	-0.0017 *** (-22.27)	-0.0063 *** (-13.41)	(ln(Sales))^2	-0.0018 *** (-22.83)	-0.0064 *** (-13.47)
Constant	-0.2271 *** (-31.40)	-1.521 *** (-42.11)	Constant	-0.2332 *** (-31.72)	-1.5223 *** (-42.14)
Industry dummy	yes	yes	Industry dummy	yes	yes
Year dummy	yes	yes	Year dummy	yes	yes
Firm dummy	no	yes	Firm dummy	no	yes
Number of observations	70332	70332	Number of observations	70332	70332
Number of groups	-	16471	Number of groups	-	16471

Notes) 1.The values in parentheses are t-statistics.

2.*P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 4.1 Number of out-in and in-in M&A cases

	Out-in M&A		In-in M&A
	Foreign-ownership dummy (33.4% or more is owned by foreigners)	Foreign-ownership dummy (majority-owned by one foreign firm)	
1994–1995	7	12	228
1995–1996	5	6	218
1996–1997	13	14	291
1997–1998	63	9	169
1998–1999	29	5	177
1999–2000	9	11	119
2000–2001	17	10	160
Total	143	67	1362

Table 4.2 What firms are chosen as M&A targets? Probit analysis

Dependent variable	Out-in M&A (based on 33.4% cut-off point)			Out-in M&A (based on majority ownership by one foreign firm)			In-in M&A		
ln(TFP) _{t-1}	1.466 (3.93) ***	0.956 (2.47) **	1.053 (2.22) **	1.930 (4.05) ***	1.525 (3.28) ***	1.542 (2.47) ***	-0.027 (-0.23)	0.129 (1.05)	0.195 (1.24)
TFP growth rate: ln(TFP) _{t-1} -ln(TFP) _{t-2}			-0.863 (-1.29)			-0.172 (-0.18)			-0.233 (-0.98)
ln(Number of workers) _{t-1}	0.082 (3.16) ***	0.085 (3.23) ***	0.094 (3.20) ***	0.006 (0.20)	0.007 (0.23)	0.042 (1.25)	-0.064 (-5.19) ***	-0.055 (-4.42) ***	-0.047 (-3.28) ***
(Current profit/sales) _{t-1}		1.631 (2.29) **	1.576 (1.97) **		1.250 (1.43)	1.836 (1.74) *		-0.065 (-1.26)	-0.058 (-1.17)
(Total liability/total asset ratio) _{t-1}		-0.038 (-0.31)	-0.065 (-0.44)		-0.013 (-0.08)	0.005 (0.03)		0.271 (9.27) ***	0.291 (8.37) ***
Constant term	-3.901 (-16.19) ***	-3.932 (-14.97) ***	-4.457 (-13.22) ***	-3.298 (-12.21) ***	-3.336 (-10.33) ***	-4.201 (-9.52) ***	-1.680 (-21.82) ***	-1.929 (-23.28) ***	-2.046 (-21.22) ***
Industry dummy (30 industries)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sample size	78167	78165	58333	67242	67240	49204	81549	81547	62802
Log pseudo-likelihood	-922.34	-918.15	-728.55	-485.76	-484.40	-339.65	-6834.39	-6802.75	-4905.44

1. The values in parentheses are z-statistics.

2. *P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 4.3 Dynamic effects of M&A: effects two years later

Dependent variable	TFP growth rate: $\ln(\text{TFP})_{t+1} - \ln(\text{TFP})_{t-1}$				Growth rate of number of workers: from $t-1$ to $t+1$				Change of (Current profits/Sales): from $t-1$ to $t+1$				
Out-in M&A dummy (based on 33.4% cut-off point)	0.011 (1.56)				-0.004 (-0.17)				0.007 (1.34)				
Out-in M&A dummy (based on majority ownership by one foreign)		0.022 (2.30)	**			-0.013 (-0.44)				0.017 (2.37)	**		
In-in M&A dummy	0.004 (1.78)	*	0.004 (1.75)	*	0.004 (0.56)		0.004 (0.56)		0.001 (0.54)		0.001 (0.51)		
$\ln(\text{TFP})_{t-1}$	-0.316 (-60.79)	***	-0.316 (-60.78)	***	0.148 (8.27)	***	0.148 (8.27)	***	0.071 (4.31)	***	0.071 (4.31)	***	
$\ln(\text{number of workers})_{t-1}$	0.007 (23.65)	***	0.007 (23.67)	***	-0.022 (-27.98)	***	-0.022 (-28.00)	***	-0.001 (-3.35)	***	-0.001 (-3.34)	***	
(Current Profit/Sales) $_{t-1}$	-0.042 (-2.30)	**	-0.042 (-2.30)	**	0.111 (1.54)		0.111 (1.54)		-0.871 (-10.67)	***	-0.871 (-10.67)	***	
(R&D/sales) $_{t-1}$	0.216 (9.66)	***	0.216 (9.67)	***	0.089 (1.99)	**	0.089 (1.99)	**	0.140 (7.92)	***	0.140 (7.92)	***	
Dummy for firms which do not report R&D expenditure in $t-1$	-0.003 (-3.72)	***	-0.003 (-3.73)	***	0.004 (2.36)	**	0.004 (2.37)	**	0.000 (-0.18)		0.000 (-0.19)		
(Total liability/total asset) $_{t-1}$	-0.002 (-1.36)		-0.002 (-1.36)		-0.015 (-3.16)	***	-0.015 (-3.16)	***	-0.038 (-7.01)	***	-0.038 (-7.01)	***	
(Sales/number of workers) $_{t-1}$					0.000 (6.44)	***	0.000 (6.44)	***					
Constant term	-0.026 (-9.36)	***	-0.026 (-9.37)	***	0.127 (15.20)	***	0.127 (15.21)	***	0.061 (8.09)	***	0.061 (8.09)	***	
Industry dummy (30 industries)		yes				yes				yes			
Year dummy		yes				yes				yes			
Sample size		62804				62804				62804			

1. The values in parentheses are t-statistics based on White's method.

2. *P=.10, **P=.05, ***P=0.1 (two-tailed test).

Table 4.4 Dynamic effects of M&A: effects three years later

Dependent variable	TFP growth rate: $\ln(\text{TFP})_{t+2} - \ln(\text{TFP})_{t-1}$				Growth rate of number of workers: from $t-1$ to $t+2$				Change of (Current Profit/Sales): from $t-1$ to $t+2$			
Out-in M&A dummy (based on 33.4% cut-off point)	0.017 (2.05)	**			-0.001 (-0.05)				0.008 (1.16)			
Out-in M&A dummy (based on majority ownership by one foreign firm)			0.018 (1.66)	*			-0.032 (-0.64)				0.016 (1.90)	*
In-in M&A dummy	0.010 (3.59)	***	0.010 (3.59)	***	0.014 (1.81)	*	0.015 (1.84)	*	0.000 (0.08)		0.000 (0.05)	
$\ln(\text{TFP})_{t-1}$	-0.369 (-72.08)	***	-0.369 (-72.08)	***	0.189 (8.72)	***	0.189 (8.73)	***	0.063 (4.76)	***	0.063 (4.76)	***
$\ln(\text{number of workers})_{t-1}$	0.009 (24.71)	***	0.009 (24.73)	***	-0.030 (-29.28)	***	-0.030 (-29.29)	***	-0.001 (-3.08)	***	-0.001 (-3.07)	***
(Current Profit/Sales) $_{t-1}$	-0.031 (-2.64)	***	-0.031 (-2.64)	***	0.119 (1.41)		0.119 (1.41)		-0.903 (-13.64)	***	-0.903 (-13.64)	***
(R&D/sales) $_{t-1}$	0.238 (7.81)	***	0.238 (7.81)	***	0.220 (3.32)	***	0.220 (3.33)	***	0.128 (6.30)	***	0.128 (6.29)	***
Dummy for firms which do not report R&D expenditure in $t-1$	-0.003 (-3.48)	***	-0.003 (-3.49)	***	0.009 (4.08)	***	0.009 (4.08)	***	-0.001 (-0.92)		-0.001 (-0.92)	
(Total liability/total asset) $_{t-1}$	0.000 (-0.23)		0.000 (-0.25)		-0.020 (-3.17)	***	-0.019 (-3.17)	***	-0.038 (-7.05)	***	-0.038 (-7.05)	***
(Sales/number of workers) $_{t-1}$					0.000 (6.18)	***	0.000 (6.44)	***				
Constant term	-0.051 (-17.30)	***	-0.051 (-17.32)	***	0.178 (17.11)	***	0.178 (17.11)	***	0.060 (9.14)	***	0.060 (9.14)	***
Industry dummy (30 industries)			yes				yes				yes	
Year dummy			yes				yes				yes	
Sample size			49556				49556				49556	

1. The values in parentheses are t-statistics based on White's method.

2. *P=.10, **P=.05, ***P=0.1 (two-tailed test).