RIETI Discussion Paper Series 11-E-063

Entry of Foreign Multinational Firms and Productivity Growth of Domestic Firms: The case of Japanese firms

ITO Keiko
RIETI

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 11-E-063
August 2011

Entry of Foreign Multinational Firms and Productivity Growth of Domestic Firms: The case of Japanese firms

ITO Keiko
Senshu University and RIETI

Abstract

This paper examines whether and how the entry of foreign multinational firms affects productivity growth of domestically owned firms, using Japanese firm-level data for the period 2000-2007. Although there are a considerable number of studies conducting productivity analyses on foreign multinationals and domestic firms for the manufacturing sector, there are few such studies for the service sector. Against this background, the present paper focuses on the role of foreign entry in the service sector, where cross-border trade is often difficult and firms are therefore less likely to be exposed to international competition.

The results of the analysis suggest that foreign multinationals perform better than domestically owned firms in many sectors. However, although the productivity levels of the former tend to be higher than those of the latter, no significant difference in productivity growth rates is found. Moreover, once firm-fixed effects are controlled for, foreign presence in a particular industry tends to negatively affect the productivity growth rate of domestically owned firms in the industry. However, firms that are catching up with the productivity frontier enjoy positive FDI spillovers, implying that foreign entry accelerates productivity catch-up.

Keywords: foreign direct investment, service sector, productivity, and spillovers.
JEL classification: F21; L1; L23

This research was conducted as part of the project titled "Research on Productivity Growth in Service Sector" for the Research Institute of Economy, Trade and Industry (RIETI). The author would like to thank Noor Aini Khalifah and participants at the 12th International Convention of the East Asian Economic Association for helpful comments. The author is also grateful for the helpful comments and suggestions made by seminar participants at the Research Institute of Economy, Trade and Industry (RIETI). In addition, financial support from the Japan Society for the Promotion of Science (KAKENHI #19683003, 23683003) is gratefully acknowledged.

1. Introduction

It has been argued that attracting foreign direct investment (FDI) can play an important role in a country's economic development and in productivity growth. In addition to the entry effects associated with FDI – that is, the fact that the entry of high productivity foreign firms itself raises the overall productivity level in the economy – another reasons why many countries have adopted policies to promote FDI is the possible existence of positive spillover effects. FDI spillovers can occur through various channels. For example, if a new technology is successfully introduced by a foreign-owned firm, this will encourage domestic firms to adopt it. This channel, the so-called demonstration or imitation effect, involves the spillover of technologies and/or know-how. Another important channel is the increased competition induced by the entry of foreign firms. Competition from foreign-owned firms provides an incentive for domestic firms to be more productive by using existing resources more efficiently and adopting new technologies. However, FDI spillovers are not always positive and depend on various factors such as the entry mode of FDI as well as the characteristics of foreign firms and of the domestic economy, sector, and firms.[1] Although FDI spillovers have already been widely investigated, empirical analyses based on firm-level data produce mixed results. For example, Aitken and Harrison (1999), examining Venezuelan manufacturing plants, found that foreign investment negatively affected the productivity of domestically-owned firms, while other studies, such as Haskel et al. (2007), who used plant-level data for U.K. manufacturing establishments, found positive spillover effects. Given these mixed results, a number of studies have examined the conditions under which FDI has positive spillover effects. Girma (2005), for example, highlights the importance of the absorptive capacity of domestic firms. On the other hand, Javorcik (2004) suggests that positive FDI spillovers may take place through backward linkages, based on evidence that an increase in foreign presence in downstream sectors is associated with a rise in productivity of domestically-owned firms in supplying industries.[2] Another strand of literature focuses on the relationship between innovation incentives and FDI spillovers. Aghion et al. (2009) find that the productivity growth of incumbent firms is positively correlated with lagged greenfield foreign firm entry in technologically advanced industries, but not in laggard

[1] See Crespo and Fontoura (2007) for a survey of the literature on FDI spillovers.

[2] Along similar lines, Kugler (2006) highlights the importance of outsourcing relationships of foreign multinational firms with local upstream suppliers as a channel for technology diffusion and argues that positive FDI spillover effects can be seen between industries but not within industries.

industries, suggesting that entry of technologically advanced foreign firms encourages incumbent innovation and productivity growth in sectors that are close to the technological frontier, whereas it discourages incumbent innovation and productivity growth in sectors further behind the frontier. Thus, the empirical evidence available to date is insufficient to allow us to draw definitive conclusions regarding the factors resulting in positive FDI spillovers.

Moreover, most previous empirical studies are confined to analyses of the manufacturing sector. Therefore, particularly for the non-manufacturing sector, our knowledge on the issue raised here is still limited and there remains ample room for research on what factors are relevant in order for recipient economies to enjoy positive FDI spillovers.

In the case of Japan, the government set a target in 2003 to double inward FDI within five years in order to provide a boost to the stagnant economy. Moreover, given the fact that the service sector (including construction and utilities) accounts for nearly 80 percent of total GDP, raising productivity growth in the non-manufacturing sector has been one of the top policy priorities to increase the long-term growth potential of the economy. For the non-manufacturing sector, foreign entry may be more important than for the manufacturing sector. Because international transactions are sometimes difficult for certain types of services, the service sector is less likely to be exposed to international competition than the manufacturing sector and hence to learn from foreign firms with advanced technology, management know-how, etc. In this sense, foreign entry should be particularly important for the service sector to improve productivity through competition effects and learning effects.[3] However, there are very few empirical studies on foreign entry effects in the service sector, mainly due to data constraints. One of the few exceptions is Arnold et al. (2007). Focusing on the case of the Czech Republic, the study finds that opening service sectors to foreign providers is a key channel through which services liberalization contributes to improved performance in downstream manufacturing sectors. However, the study did not examine FDI spillover effects on domestic firms in the service sector itself.

In order to address the various shortcomings highlighted so far, this paper examines whether the productivity of domestic firms is correlated with the presence of FDI in their industry utilizing a Japanese large-scale firm-level dataset including data for firms in the service sector.

[3] Ito (2007), using data on listed Japanese firms, found that firms in the non-manufacturing sector achieved faster productivity growth at home than firms in the manufacturing sector after conducting direct investment abroad. This result suggests that the learning effect of FDI is larger for services firms than for manufacturing firms.

The major contribution of this paper is to add to the literature by examining the spillover effects of foreign-owned firms on domestic firms in the service sector. Although at least some empirical studies on the manufacturing sector suggest that FDI improves productivity in the recipient economy through technology diffusion and other channels, it is possible that such channels of FDI spillover may not operate to the same extent in the service sector. Given the scarcity of empirical evidence on the service sector, the main purpose of this paper therefore is to examine the existence of FDI spillovers in the service sector. To the best of my knowledge, this study is the first rigorous empirical analysis of FDI spillover effects based on large-scale firm-level panel data for the service sector.

The major findings of this paper are as follows. Both for the manufacturing and the service sector, negative FDI spillover effects on the productivity of domestically-owned firms are found once firm fixed effects are controlled for. Only firms whose productivity growth is relatively high enjoy positive spillover effects from foreign-owned firms in the same industry. These results imply that foreign entry will not raise the overall productivity level of domestic firms unless low productivity firms are forced to exit or policies for raising the productivity levels of less productive firms go hand-in-hand with foreign entry. Moreover, the negative FDI spillover effect tends to be larger in the service than in the manufacturing sector, implying that there may be systematic differences in FDI spillover effects in the manufacturing and the non-manufacturing sector.

The remainder of this paper is organized as follows. Section 2 provides an overview of the role of foreign-owned firms in Japan in terms of employment and value added. Section 3 then discusses the theoretical background and presents the empirical model for the productivity spillover analysis, while Section 4 presents the empirical results. Section 5 concludes.

2. Data and Characteristics of Foreign-Owned Firms in Japan

2.1 Data

Before examining aggregate-level and firm-level productivity in Japan, this sub-section briefly describes the data used in this study. The data used is the firm-level panel data underlying the *Basic Survey on Business Structure and Activities* (BSBSA) collected annually by the Ministry of Economy, Trade and Industry (METI). 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 and several other service sectors. Although the survey started in 1992 (data for fiscal 1991), data for 2000-2007 are used for this study because observations for the non-manufacturing sector – the main focus of this paper – increased substantially from the 2001 survey (data for fiscal 2000).[4] Observations for firms for which data on sales, number of employees, total wages, tangible fixed assets, depreciation, or intermediate inputs are not positive or are missing for at least one year are dropped from the dataset for the analysis in this paper. After this screening, the unbalanced panel dataset contains approximately 24,000 firms, half of which are service sector firms.[5]

Utilizing the firm-level panel data, two kinds of productivity measures are constructed: labor productivity and total factor productivity (TFP). Because information about working hours at the firm level is not available, labor productivity is calculated as the real value added per employee. Real value added is calculated as real output minus real intermediate input using industry-level price deflators taken from the JIP Database 2009. TFP for each firm is calculated based on the production function estimated using the semi-parametric estimation technique suggested by Levinsohn and Petrin (2003).[6]

2.2 Productivity trends in the Japanese economy and the presence of foreign-owned firms in Japan

While productivity in the Japanese economy overall has "only" stagnated since the 1990s, productivity in the Japanese service sector has in fact fallen sharply and it has often been pointed out that both the level and the growth rate of productivity in the Japanese service sector are much lower than that in the manufacturing sector (e.g., Ministry of Health, Labour and

[4] The survey contains detailed information on firm-level business activities such as the 3-digit industry in which the firm operates, its number of employees, sales, purchases, exports and imports, R&D and patents, the number of domestic and overseas subsidiaries, and various other financial data such as costs, profits, investment, and assets. Although the survey also asks non-manufacturing firms for information on exports and imports, they are required to provide the amount of trade in goods only. The survey does not cover international transactions in services. The firm-level data of the BSBSA were obtained through the Trade and Investment Facilitation Division, Trade and Economic Cooperation Bureau, Ministry of Economy, Trade, and Industry (METI). However, the views expressed in this paper are solely those of the author, and do not present those of the METI.

[5] The industry classification and number of observations by industry are shown in Appendix Tables 1 and 2, respectively.

[6] For details of the definition of and data source for each variable for the TFP calculation, see the Appendix.

Welfare, 2008).[7] Moreover, an international comparative study on sectoral productivity levels undertaken by the EU KLEMS project reports that the productivity level in some service industries in Japan such as trade and business services is only around 40–50 percent of the U.S. level in 1997 and that the relative productivity levels further deteriorated in 2005 compared with the corresponding levels in 1997 for most of the sectors.[8]

Against this background, it has often been argued that improving productivity particularly in the service sector is a priority for the Japanese economy (METI 2007).[9] Inward FDI is expected to raise productivity in the Japanese economy by intensifying market competition and generating knowledge spillovers to domestic firms. However, as discussed in Section 1, the effects of foreign entry on the productivity of domestic firms are still unclear, particularly in the case of service industries.

Let us begin by looking at the share of foreign-owned firms in the Japanese economy using the firm-level data underlying the BSBSA. Table 1 shows the number of foreign-owned firms by industry for the period 2000-2007. In this study, foreign-owned firms are defined as firms with 33.4 percent or more foreign ownership.[10] As can be seen in the table, the number of foreign-owned firms increased until 2005 but then decreased in the following years.[11]

---

[7] For example, Fukao et al. (2007) show that TFP growth in the service sector has been low since the 1970s and that it has further deteriorated since the 1990s. Similarly, Shinada (2003) shows that service sector TFP in the Japanese service sector in the 1990s was substantially lower than in the 1980s. Furthermore, OECD (2001), comparing service sector labor productivity across countries, reports that labor productivity growth in Japan drastically declined in major service industries. For example, labor productivity growth in the wholesale and retail trade industry and the transportation and telecommunication industry stood at 4.4 percent and 4.1 percent, respectively, for the period 1979-89, the highest among the ten major developed countries. However, for the period 1990-97, the corresponding growth rates dropped to 1.0 percent (placing Japan fifth among the ten countries) and 0.5 percent (the lowest among the ten countries), respectively. On the other hand, Morikawa (2007a), using Japanese firm-level data for the period 2000-2004, finds that productivity levels in service industries is not significantly lower than those in manufacturing industries, although the dispersion in productivity within the former is greater than that in the latter.

[8] In contrast, it has been pointed out that for the United States, services industries were the drivers of overall productivity growth (see, e.g., Triplett and Bosworth 2006).

[9] Morikawa (2008), for example, argues that in order to improve service sector productivity, the diffusion of best practice and greater firm- and industry-level dynamism through firm entry and exit is necessary.

[10] In Japan, the Commercial Law prescribes that important matters should be decided by obtaining more than two-thirds of the voting rights at a shareholders' meeting. Therefore, an ownership share of 33.4 percent is critical in order to exercise a veto. For this reason, METI also defines foreign-owned firms as firms with a foreign ownership ratio of 33.4 percent or more. However, the number and share of foreign-owned firms show a similar trend when defining foreign-owned firms as firms with 50 percent or more foreign ownership.

[11] In the dataset used for this study, the number of foreign-owned firms in the service sector is only

INSERT Table 1

Table 2 shows the shares of foreign-owned firms in total employment and in total real value added by industry. Reflecting the fact that foreign-owned firms tend to be larger than domestically-owned firms, the employment and value added shares of foreign-owned firms are much larger than the share of foreign-owned firms in terms of the number of firms. As for the employment share, firms that are 33.4 percent or more foreign-owned account for 5.4 percent of employment in all industries, which splits into 7.6 percent for the manufacturing sector and 3.5 percent for the service sector (Panel (a) of Table 2). As for value added, using the same foreign-ownership ratio, share of foreign firms is much larger at 10.0 percent of total value added in all industries and 14.5 percent and 5.1 percent in the manufacturing and the service sector (Panel (b) of Table 2). The total value added share of foreign firms tends to be larger than the employment share in almost all industries, suggesting that foreign firms tend to have higher value added per employee, i.e., higher labor productivity. Looking at the trend of foreign-owned firms' share in total employment, the share increased until 2005 but decreased thereafter, which is similar to the trend in the number of foreign-owned firms. In the case of value added, the overall share steadily increased until 2005, but then remained more or less unchanged.

INSERT Table 2

Thus, although the trends in the share of foreign-owned firms show somewhat different patterns across sectors and depending on the indicator chosen, it seems safe to say that, particularly in terms of value added, the presence of foreign-owned firms increased during the period 2000-2007. These observations imply that foreign-owned firms tend to have higher labor productivity and a higher growth rate of labor productivity than domestically-owned firms.

---

slightly larger than that in the manufacturing sector. In fact, however, both in Japan and other developed countries, foreign entry is more prominent in the service sector (see, e.g., *Directory of Foreign-Owned Firms in Japan* published by Toyo Keizai Shimposha.). The data used in this paper cover only firms with 50 or more employees. Relatively small foreign-owned firms, which are likely to be firms in the service sector, are not included in this dataset. Furthermore, in the case of several service sectors such as transportation, telecommunication, financial intermediation, insurance, and real estate, most of the firms are not covered in the BSBSA. The BSBSA only covers firms in these sectors if they have an establishment in a sector administrated by METI. Refer to Ito and Fukao (2005) for more comprehensive statistics on foreign-owned firms in Japan.

These conclusions are in line with empirical studies for a variety of countries which show that foreign-owned firms tend to outperform domestic firms. For Japan, studies that provide evidence to this effect include Fukao et al. (2005) and Kimura and Kiyota (2007). In addition, although not shown here to conserve space, the data used in this paper show that foreign-owned firms also outperform domestic firms in terms of a range of other performance measures such as TFP, firm size, wages, and profitability.[12]

3. Empirical Methodology

The previous section suggested that foreign-owned firms outperform domestic firms both in the manufacturing and the service sector. This brings us to the question whether the presence of "superior" foreign-owned firms contributes to productivity improvements among domestically-owned firms through learning and competition effects. This section presents the empirical methodology employed to address this question, that is, to test whether there are positive spillovers from foreign-owned to domestically-owned firms.

As mentioned at the outset, there are several main channels for such spillover effects, including demonstration/imitation effects or spillovers through backward and forward linkages.

In this paper, the baseline specification for the relationship between inward FDI and the productivity growth of domestically-owned firms is as follows:

$$\Delta \mathrm{PROD}_{ijt} = \beta_0 \Delta \mathrm{FRPROD}_{jt} + \beta_1 \mathrm{GAP}_{ijt-1} + \beta_2 \mathrm{FDI\ share}_{jt-1} + \beta_3 \Delta \mathrm{MKT\ share}_{ijt} + \mu_i + \gamma_j + \eta_t + \varepsilon_{ijt} \quad (1)$$

where *i* indexes domestically-owned firms, *j* indexes industries, and *t* indexes years. The dependent variable (*PROD*) is the productivity of domestically-owned firms. *FDIshare* denotes the foreign presence in the industry proxied by the employment share of foreign-owned firms.[13] In line with the majority of existing studies on the spillover effects of foreign entry, the coefficient on the *FDIshare* variable, β_2, here is used as an indicator of the existence and magnitude of spillover effects. Following Haskel et al. (2007), changes in market share

[12] The results can be obtained from the author upon request.

[13] To calculate *FDIshare*, a firm's total number of employees is counted as foreign if the sum of the share held by foreigners is 33.4 percent or more. The variable *FDIshare* is calculated as the total number of workers employed by foreign-owned firms divided by the total number of employees in the industry.

(*ΔMKTshare*) are included in order to measure changes in competitive pressure. As argued, for example, by Aitken and Harrison (1999), competition with foreign-owned firms may reduce the market shares of domestically-owned firms and force them to operate on a less efficient scale, resulting in increases in their average costs and lower productivity. *MKTshare* is measured as a firm's sales as a proportion of the industry's total sales. Because the market share variable is also affected by technological differences between industries and may not be a good indicator of market power, the difference variable (*ΔMKTshare*) is used for the analysis. This specification does not take account of the heterogeneity in the correlation between inward FDI and the productivity growth of domestically-owned firms suggested by Agihon et al. (2009). However, following neo-Schumpeterian models of endogenous growth (e.g., Acemoglu et al. 2006), technological distance from the frontier firms in the industry (*GAP*) is included. The idea is that firms lagging behind the technological frontier can improve productivity by adopting advanced technologies available in the market. Thus, firms' productivity growth depends on both the ability to catch up towards frontier firms and the ability of frontier firms to innovate. Therefore, as a proxy for the innovative ability of frontier firms, the productivity growth of frontier firms (*ΔFRPROD*) is also taken into account. Frontier firms are defined as firms whose productivity level is among the top 5 percent in each industry and in each year.[14] The productivity of frontier firms is calculated as the average productivity of frontier firms, and the technological distance from the frontier is measured as the frontier's productivity level minus a firm's productivity level (*FRPROD –PROD*).[15] Both *FRPROD* and *GAP* are expected to take a positive coefficient. Both TFP and labor productivity are used for the productivity variables *PROD* and *FRPROD*, and the productivity measures are in logarithm. μ_i, γ_j, and η_t are fixed effects for firms, industries, and years, respectively. ε_{ijt} is the error term. Firm fixed effects (μ_i) are included to capture unobserved firm heterogeneity related to firm location, size, the sub-industry of operation, managers' characteristics, firm age, etc.

[14] The frontier firms include some foreign-owned firms. If the 33.4 percent foreign ownership ratio is applied, approximately 8 percent of the frontier firms are foreign-owned, while if the majority foreign ownership definition is applied, approximately 5 percent of the frontier firms are foreign-owned. The frontier productivity growth indicates the growth potential of each industry and it seems reasonable to include foreign-owned firms among the frontier firms. However, the variable *FPROD* proxies the productivity growth rate of foreign-owned firms when the frontier firms consist largely of foreign-owned firms. Estimation using the *FPROD* variable calculated excluding foreign-owned firms produces almost the same results as when using the *FPROD* variable calculated including foreign-owned firms.

[15] For frontier firms, the technological distance from the frontier (*GAP*) is set to zero.

4. Estimation Results

4.1 Baseline results

The estimation results of the baseline specification (1) are shown in Table 3. For the baseline estimation, the one-year difference of the productivity and market share variables is used. In order to take endogeneity into account, the *FDIshare* and *GAP* variables are lagged by one year. The results of the TFP specification are presented in panel (a), while the results of the labor productivity specification are presented in panel (b). In both panels, columns (1) – (3) present the OLS results without firm fixed effects, and columns (4) – (5) present the panel fixed-effect estimation results taking firm fixed effects into account.

The results in Table 3 suggest that the FDI spillover effects are negative in many cases when firm fixed effects are controlled for, while the FDI spillover effects tend to be positive when firm fixed effects are not controlled for. These results suggest that only firms which potentially realize higher productivity growth because of firm specific characteristics enjoy positive spillovers from foreign-owned firms in the same industry.

INSERT Table 3

4.2 Heterogeneity of the effects of FDI

The estimation results for the baseline specification indicate that whether domestically-owned firms enjoy positive spillover effects appears to depend on firm specific characteristics. In order to take this heterogeneity in the correlation between inward FDI and the productivity growth of domestically-owned firms into account, the baseline specification is modified as follows:

<Modified specification 1>

$$\Delta \mathrm{PROD}_{ijt} = \beta_0 \Delta \mathrm{FRPROD}_{jt} + \beta_1 \mathrm{GAP}_{ijt-1} + \beta_2 \mathrm{FDI\ share}_{jt-1} + \beta_3 \Delta \mathrm{MKT\ share}_{ijt} + \beta_4 \mathrm{CATCH}_{ijt} \cdot \mathrm{FDIshare}_{jt-1} + \beta_5 \mathrm{CATCH}_{ijt} + \mu_i + \gamma_j + \eta_t + \varepsilon_{ijt} \quad (2)$$

<Modified specification 2>

$$\Delta \mathrm{PROD}_{ijt} = \beta_0 \Delta \mathrm{FRPROD}_{jt} + \beta_1 \mathrm{GAP}_{ijt-1} + \beta_2 \mathrm{FDI\ share}_{jt-1} + \beta_3 \Delta \mathrm{MKT\ share}_{ijt} + \beta_4 \mathrm{GAP}_{ijt-1} \cdot \mathrm{FDIshare}_{jt-1} + \mu_i + \gamma_j + \eta_t + \varepsilon_{ijt} \quad (3)$$

The variable *CATCH* is a dummy variable which takes one for catch-up firms and zero otherwise. Catch-up firms are defined as firms that reduced the gap with the frontier during the preceding year.[16] That is, firms that reduced the distance to the frontier from year *t-1* to year *t* are defined as catch-up firms in year *t*. The modified specification 1 (equation 2) is estimated in order to examine whether catch-up firms enjoy positive spillovers. On the other hand, Aghion et al. (2009) argue that the threat from frontier entrants leads incumbents in sectors that are initially close to the technology frontier to innovate more, and this triggers productivity growth. In sectors close to the frontier, incumbent firms know that they can escape and survive entry by innovating successfully, and so they react with more intensive innovation activities. However, in sectors further from the frontier, the entry threat reduces the expected rents from conducting R&D for incumbent firms, because incumbents have no hope to win against an entrant. Therefore, the FDI spillover effect is heterogeneous across sectors and firms, depending on the distance from the technology frontier. To incorporate Aghion et al.'s (2009) argument, the modified specification 2 (equation 3) includes an interaction term of the *GAP* and *FDIshare* variables. However, in contrast with Aghion et al. (2009), who test for heterogeneity across industries and consider the distance to the world technological frontier by industry, assuming that U.S. industries represent the world technological frontier, this paper considers each firm's technological distance to the national frontier in each industry (*GAP*) instead of the industry-level technological distance to the world frontier. In addition to data constraints, the reason is that this paper focuses on the heterogeneity of FDI spillover effects across firms within an industry. Based on Aghion et al. (2009), firms closer to the national frontier may be expected to be more actively engaged in innovative activities and more likely to enjoy positive FDI spillovers as a result than firms further from the frontier.

Table 4 shows the fixed effect estimation results of the modified specifications 1 and 2. As for catch-up firms, they enjoy positive FDI spillovers and the effect is statistically significant in all cases (columns 1–3 in both panels). On the other hand, the interaction term of technological distance and FDI does not have a statistically significant coefficient in most cases (columns 4–5

[16] The definition of catch-up firms here follows Arnold et al. (2008).

in both panels). The only exception is the TFP specification for the service sector (column 6 of panel a). In this case, only firms closer to the technological frontier can enjoy positive FDI spillovers, which is consistent with the results obtained by Aghion et al. (2009). However, this does not apply to all other cases, so that the evidence on whether firms closer to the technological frontier enjoy positive spillover effects is not conclusive.

As for other explanatory variables, both the variable for frontier productivity growth (*FRPROD*) and that for technological distance from the frontier (*GAP*) have a positive and significant coefficient, as expected. The market share variable (*MKTshare*) also has a positive and significant coefficient, suggesting a positive correlation between market share growth and productivity growth.[17]

INSERT Table 4

4.3 Robustness checks

Estimating the relationship between foreign entry and the productivity of domestic firms raises a number of important econometric issues concerning the possible endogeneity of FDI and the direction of causality. That is, although a considerable number of studies have found a significant correlation between firm productivity and foreign entry, changes in the presence of foreign firms may be endogenous to shocks to firm productivity. Moreover, it is often difficult to determine the direction of causality between the presence of foreign firms and productivity. That is, foreign firms may be attracted to industries with high productivity growth. Alternatively, foreign firms may enter industries with low productivity growth in order to reap greater gains from their competitive advantage. Several previous empirical studies address these issues, for example by employing an instrumental variable (IV) regression approach (e.g., Haskel et al. 2007, Aghion et al. 2009, Vahter 2010) and/or by employing longer time lags (e.g., Haskel et al.

[17] Supplementary analysis of extensions of the models above that include various measures of industry-level competition, such as the Herfindahl index (calculated by industry using the firm-level dataset), the import penetration ratio (calculated using the JIP Database 2009), and regulation weights (taken from the JIP Database) show that the Herfindahl index tends to be negatively correlated with firm productivity, suggesting that competition promotes productivity growth. However, the import penetration ratio is negatively associated with firm productivity growth, while the regulation weight is positively associated with firm productivity growth, suggesting that competition restrains firm productivity growth. Although it is difficult to obtain a conclusive result regarding market competition effects on firm productivity, the estimated coefficients on the FDI variable are mostly consistent.

2007). Because suitable instruments are not readily available, the approach taken here to check the robustness of the results is to use longer time lags.[18]

In the baseline estimation and the modified estimations presented above, one-year lagged values of the variables representing foreign presence are used instead of contemporaneous values in order to address the endogeneity issue. However, for robustness checks, the same models (equations 1, 2, and 3) using a longer time lag are estimated to take account of the possibility that foreign presence may be correlated with productivity shocks in the near future. Moreover, longer lags may be more appropriate if spillovers take time to materialize. The baseline results when taking three-year differences and using three-year lagged values for foreign presence are presented in Table 5. The modified specifications are also estimated with three-year differences and lagged values and the results are shown in Table 6. The results in Table 5 are very similar to those in Table 3, confirming that FDI spillover effects are negative once firm fixed effects are controlled for. The results in columns (1)–(3) in Table 6 are also consistent with those in columns (1)–(3) in Table 4, suggesting that only catch-up firms enjoy positive FDI spillovers. Moreover, these results suggest that negative spillover effects are larger in the service sector than in the manufacturing sector.

On the other hand, as for technological distance and FDI effects, the results in Table 6 are not consistent with those in Table 4. Columns (4)–(6) in Table 6 show that firms further from the frontier enjoy positive FDI spillovers, particularly in the case of the manufacturing sector. This result is at odds with Aghion et al. (2009) and suggests that, in the long run, firms further from the frontier may be able to improve productivity by adopting advanced technology demonstrated by foreign-owned firms. Such demonstration and imitation effects may be larger for firms lagging further behind than firms close to the frontier. However, in the case of the service sector, the interaction term of technological distance and FDI does not have a statistically significant coefficient and the overall effects of foreign presence are still negative.

[18] Possible candidates for an instrument may include inward FDI in the United States or indicators of regulation. However, there are several difficulties in employing these variables as instruments. For example, inward FDI in the United States is not highly correlated with inward FDI in Japan, suggesting that the inward FDI in the United States may not work well as an instrument. In addition, although an instrumental variable should be correlated with foreign entry but not with the productivity of domestic firms, it is extremely difficult to find a proxy for regulations which only affect foreign entry and does not affect productivity of domestic firms. Nevertheless, although employing an IV approach presents considerable difficulties, doing so in the future would be a worthwhile exercise.

INSERT Tables 5 & 6

Finally, as another robustness check, it is examined whether the results depend on how foreign-owned firms are defined, since this is not a straightforward matter. In the analyses so far, foreign-owned firms were defined as firms with 33.4 percent or more foreign ownership following the official Japanese government definition, and therefore, firms in which foreign portfolio investment exceeds this threshold are included as foreign-owned firm.[19] In order to exclude such cases as much as possible, equations (1)–(3) above are estimated using a new *FDIshare* variable which is calculated based on the majority ownership definition (50 percent or more foreign ownership).[20] The results are largely consistent with those in Tables 3–6.[21]

4.4 Further discussion and interpretation of the results

The analysis in this paper suggests that FDI spillover effects on the productivity growth of domestically-owned firms are negative. Negative FDI spillovers are possible when the presence of foreign-owned firms causes significant losses in the market shares of domestically-owned firms and prevents the latter from operating on an efficient scale. The analysis here, however, indicates that FDI spillovers are negative even after controlling for changes in market shares. Possible explanations include the following. First, an increase in the presence of foreign-owned firms may increase demand for highly-skilled workers and reduce the ability of domestically-owned firms to attract highly-skilled workers. As a result, the quality of labor at domestically-owned firms may decline and their productivity growth deteriorate. Second, competition with foreign-owned firms may promote product diversification and/or product switching at domestically-owned firms. Although in the analysis here firms' sales and purchases are deflated using industry-level price deflators, the industry of a firm is defined by the product making up the largest share of sales. Therefore, the effects of product diversification and/or

[19] It should be noted, though, that in Japan (as in many other countries), a substantial share of the stocks issued by listed firms is owned by foreign institutional investors in the form of portfolio investment.

[20] Definitions of foreign-owned firms in official statistics vary across countries. For example, in the United States, foreign-owned firms are defined as firms with 10 percent or more ownership by a single foreigner or foreign firm, while in Japan foreign-owned firms are defined as firms with 33.4 percent or more ownership by one or several foreigners. In some countries, firms are considered as foreign-owned for any foreign ownership share, or for ownership shares of at least 5 percent or 10 percent. However, the majority ownership definition is widely employed worldwide.

[21] The results are shown in Appendix Tables 3–6.

product switching on firm productivity are not fully captured. Third, domestically-owned firms may react to greater competition with excessive levels of investment in order to retain their market share, resulting in lower productivity. The results of this paper suggest that negative FDI spillover effects are particularly large in the case of service sector firms. If firms facing greater competition increase investment such as ICT (information and communication technology) investment and job training for workers in order to improve the quality of services, their productivity level should in theory also improve. However, it is extremely difficult to measure service quality and to calculate productivity reflecting quality changes.[22]

While the results suggest that the overall spillover effects of inward FDI are negative, they tend to be positive for firms with high productivity growth. This suggests that the presence of foreign competitors is favorable for such firms and helps them to further improve their productivity. Moreover, some of the estimation results indicate that, in the case of the manufacturing sector, foreign entry tends to accelerate productivity growth for firms lagging behind the technological frontier in the long run, suggesting that learning effects from advanced foreign-owned firms do exist. If foreign entry accelerates productivity catch-up, then it is likely to contribute to long-run economic growth by affecting firm dynamics. However, it should be noted that the overall effect of inward FDI is still negative and it is therefore necessary to examine what factors contribute to FDI spillovers being positive.

Previous studies such as Javorcik (2004), Javorcik et al. (2004), and Barrios et al. (2009) focus on inter-industry linkages. Although examining the role of inter-industry linkages is beyond the scope of this study, it seems likely that both intra- and inter-industry transaction relationships among firms are important channels of technology diffusion. That in the analysis here the magnitude of negative FDI spillover effects was found to be larger for services than manufacturing firms may reflect the fact that service firms tend to have fewer transaction relationships with other firms, especially when compared with firms in assembly-type industries such as the automobile, electronics, and machinery industries. In fact, the service sector has a higher value-added to output ratio than the manufacturing sector, suggesting that the service sector uses less intermediate inputs than the manufacturing sector and has fewer intra- and inter-industry transaction relationships.[23] This suggests that services firms have less

[22] For a more detailed discussion of the various problems involved in the measurement of productivity in services see, for example, Hartwig (2008) and Inklaar et al. (2008).

[23] Based on the firm-level panel data used in this study, the value-added to output ratio is 28

opportunity to receive spillovers from upstream firms. Moreover, a large part of total demand in the service sector is final demand, while in the manufacturing sector it is intermediate demand.[24] These relatively limited forward and backward linkages with other firms may prevent service sector firms from absorbing advanced technology or know-how from foreign-owned firms.

Finally, even though foreign entry does not have a positive effect on domestically-owned firms' productivity growth, it may nevertheless affect their behavior. Vahter (2010), analyzing Estonian firm-level data employing a specification à la Aghion et al. (2009), concludes that although FDI entry does not have a significant short-term effect on productivity growth, it is positively associated with process innovation at domestically-owned firms. For Japanese firms, Todo (2006) found a positive association between the R&D stock of foreign-owned firms and the productivity of domestically-owned firms, while there was no such association in the case of the capital stock of foreign-owned firms, suggesting that foreign-owned firms' knowledge spills over through their R&D activities. These results imply that FDI spillovers are closely associated with knowledge flows to domestically-owned firms, and positive FDI spillovers may be seen explicitly if focusing on knowledge flows instead of just looking at foreign penetration in terms of employment or sales. Although knowledge flows from foreign-owned to domestically-owned firms are an interesting issue for future research, defining knowledge flows would be extremely difficult for service sectors.

5. Conclusion

This paper examined the FDI spillover effects on productivity growth of domestic firms, using a large-scale Japanese firm-level dataset which covers a large number of service sector firms. The analysis was motivated by the fact that although FDI in the service sector is a potentially important channel of international technology diffusion – especially given that services are often difficult to trade – there has been little empirical research on the effects of such FDI. Yet, such research is essential for a better understanding of FDI spillovers and the formulation of economic and industrial policies.

---

percent for manufacturing firms, while it is 46 percent for services firms. The industry-level data from the 2005 Input-Output Tables show similar figures. At the aggregated level, the gross value-added to domestic output ratio is approximately 30 percent for the manufacturing sector and approximately 60 percent for the service sector.

[24] For example, according to the 2005 Input-Output Tables, the share of final demand in total demand is 44 percent for the manufacturing sector while the corresponding figure for the service sector is 58 percent.

The analysis found no evidence of positive FDI spillover effects on the productivity growth of domestically-owned firms. In fact, the results suggest that the presence of foreign-owned firms tends to be negatively associated with the productivity growth of domestically-owned firms, both in the manufacturing and the service sector. However, the magnitude of the negative effect is larger in the case of the service sector, implying that FDI spillover effects are heterogeneous across sectors and depend on the characteristics of sectors. Various possible sources for the heterogeneity were discussed, and these sources deserve further scrutiny in future research.

While the results suggest that the overall spillover effects of FDI are negative, they tend to be positive for firms with high productivity growth. This finding implies that foreign entry potentially raises industry- or macro-level productivity if firms with low productivity growth potential are forced to exit from the market. Alternatively, the results suggest that to raise industry- or macro-level productivity growth, a policy scheme to encourage less productive firms to improve their productivity should be introduced along with the promotion of inward FDI. On the other hand, in the case of the manufacturing sector, in the long run, firms lagging behind the technological frontier are found to be more likely to see an improvement in productivity through learning from foreign-owned firms. These results imply that foreign entry possibly contributes to long-run economic growth by affecting firm dynamics. However, the overall effect of inward FDI is still negative and further investigation on factors which lead to positive FDI spillovers are desirable.

Lastly, some limitations of this study and remaining issues should mentioned. First, although it is difficult to solve the endogeneity problem mentioned in Section 4, further robustness checks of the estimation results are necessary. Second, as mentioned in Section 2, the coverage of the BSBSA is not sufficiently large, particularly in the case of the service sector and for small-sized firms. Given the importance of the potential effects of foreign entry in the service sector, expanding the industries and firms surveyed and further empirical studies using such an expanded dataset are necessary to gain a deeper understanding of the spillover effects of foreign entry.

References

Acemoglu, Daron, Philippe Aghion, and Fabrizio Zilibotti (2006) “Distance to Frontier, Selection, and Economic Growth,” *Journal of the European Economic Association* 4(1): 37-74.

Aghion, Philippe, Richard Blundell, Rachel Griffith, Peter Howitt, and Susanne Prantl (2009) “The Effects of Entry on Incumbent Innovation and Productivity,” *Review of Economics and Statistics* 91(1): 20-32.

Aitken, Brian J., and Ann E. Harrison (1999) “Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela,” *American Economic Review* 89(3): 605-618.

Arnold, Jens, Beata S. Javorcik, and Aaditya Mattoo (2007) “Does Services Liberalization Benefit Manufacturing Firms? Evidence from the Czech Republic,” *World Bank Policy Research Working Paper* 4109, January, World Bank.

Arnold, Jens, Giuseppe Nicoletti, and Stefano Scarpetta (2008) “Regulation, Allocative Efficiency, and Productivity in OECD Countries,” *OECD Economics Department Working Paper* 616, OECD.

Barrios, Salvador, Holger Görg, and Eric Strobl (2009) “Spillovers Through Backward Linkages from Multinationals: Measurement Matters!,” *IZA Discussion Paper* 4477, October, Institute for the Study of Labor.

Crespo, Nuno, and Maria Paula Fontoura (2007) “Determinant Factors of FDI Spillovers – What Do We Really Know?” *World Development* 35(3): 410-425.

Fukao, Kyoji, Keiko Ito, and Hyeog Ug Kwon (2005) “Do Out-In M&As Bring Higher TFP to Japan? An Empirical Analysis Based on Micro-Data on Japanese Manufacturing Firms,” *Journal of the Japanese and International Economies* 19(2): 272-301.

Fukao, Kyoji, Keiko Ito, Hyeog Ug Kwon, and Miho Takizawa (2006) “Cross-Border Acquisitions and Target Firms’ Performance: Evidence from Japanese Firm-Level Data,” *NBER Working Paper* 12422, August, National Bureau of Economic Research.

Fukao, Kyoji, Joji Tokui, Tomohiko Inui, and Sumio Hamagata (2007) “Bunseki-hen: TFP Seicho-ritsu no Keisoku [The Analytical Part: Measurement of TFP Growth Rates],” *The JIP Database 2006*, Research Institute of Economy, Trade and Industry, downloaded on September 2, 2007, from <http://www.rieti.go.jp/jp/database/d05.html> (in Japanese).

Girma, Sourafel (2005) “Absorptive Capacity and Productivity Spillovers from FDI: A Threshold Regression Analysis,” *Oxford Bulletin of Economics and Statistics* 67(3):

281-306.

Hartwig, Jochen (2008) “Productivity Growth in Service Industries: Are the Transatlantic Differences Measurement-Driven?” *Review of Income and Wealth* 54(3): 494-505.

Haskel, Jonathan E., Sonia C. Pereira, and Matthew J. Slaughter (2007) “Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?” *Review of Economics and Statistics* 89(3): 482-496.

Inklaar, Robert, and Marcel P. Timmer (2008) “GGDC Productivity Level Database: International Comparisons of Output, Inputs and Productivity at the Industry Level,” *GGDC Research Memorandum* GD-104, Groningen Growth and Development Centre, University of Groningen.

Inklaar, Robert, Marcel P. Timmer, and Bart van Ark (2008) “Data for Productivity Measurement in Market Services: An International Comparison,” *International Productivity Monitor* 16(Spring): 71-81.

Ito, Keiko, and Kyoji Fukao (2005) “Foreign Direct Investment and Trade in Japan: An Empirical Analysis Based on the Establishment and Enterprise Census for 1996,” *Journal of the Japanese and International Economies* 19(3): 414-455.

Ito, Yukiko (2007) “Choice for FDI and Post-FDI Productivity,” *RIETI Discussion Paper* 07-E-049, Research Institute of Economy, Trade and Industry.

Javorcik, Beata Smarzynska (2004) “Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages,” *American Economic Review* 94(3): 605-627.

Javorcik, Beata Smarzynska, Kamal Saggi, and Mariana Spatareanu (2004) “Does It Matter Where You Come From? Vertical Spillovers from Foreign Direct Investment and the Nationality of Investors, “*World Bank Policy Research Working Paper* 3449, November, The World Bank.

Kimura, Fukunari, and Kozo Kiyota (2007) “Foreign-owned versus Domestically-owned Firms: Economic Performance in Japan,” *Review of Development Economics* 11(1): 31-48.

Kugler, Maurice (2006) “Spillovers from Foreign Direct Investment: Within or Between Industries?” *Journal of Development Economics* 80(2): 444-477.

Levinsohn, James, and Amil Petrin (2003) “Estimating Production Functions Using Inputs to Control for Unobservables,” *Review of Economic Studies* 70(2): 317-341.

Ministry of Economy, Trade and Industry (METI) (2007) “Towards Innovation and Productivity Improvement in Service Industries,” April, Ministry of Economy, Trade and Industry, available at <www.meti.go.jp/english/report/downloadfiles/0707ServiceIndustries.pdf>

Ministry of Health, Labour and Welfare (2008) *White Paper on the Labour Economy 2008*, Ministry of Health, Labour and Welfare (in Japanese).

Morikawa, Masayuki (2007a) “Is Productivity in the Service Industries Low? An Analysis Using Firm-level Data on the Dispersion and the Dynamics of Productivity,” *RIETI Discussion Paper Series* 07-J-048, Research Institute of Economy, Trade and Industry (in Japanese).

Morikawa, Masayuki (2007b) “What Kinds of Company Have High Productivity? Company Characteristics and TFP,” *RIETI Discussion Paper Series* 07-J-049, Research Institute of Economy, Trade and Industry (in Japanese).

Morikawa, Masayuki (2008) “How to Enhance the Productivity of Service Industries: Suggestions from Recent Studies and Agenda for Future Research,” *RIETI Discussion Paper Series* 08-J-031, Research Institute of Economy, Trade and Industry (in Japanese).

OECD (2001) *Innovation and Productivity in Services*, Organisation for Economic Co-operation and Development.

Shinada, Naoki (2003) “Decline in Productivity in Japan and Disparities Between Firms in the 1990s: An Empirical Approach Based on Data Envelopment Analysis,” *Development Bank of Japan Research Report* 38, April, Economic and Industrial Research Department, Development Bank of Japan.

Todo, Yasuyuki (2006) “Knowledge Spillovers from Foreign Direct Investment in R&D: Evidence from Japanese Firm-level Data,” *Journal of Asian Economics* 17(6): 996-1013.

Triplett, Jack E., and Barry P. Bosworth (2004), *Productivity in the U.S. Services Sector: New Sources of Economic Growth*, Washington, D.C.: Brookings Institution Press.

Vahter, Priit (2010) “Does FDI Spur Innovation, Productivity and Knowledge Sourcing by Incumbent Firms? Evidence from Manufacturing Industry in Estonia,” *Research Paper Series* 2010/09, The University of Nottingham.

Appendix: Variable construction and data sources

Output: Except for the commerce sector, gross output is defined as firms' total sales. For the commerce sector, gross output is measured as sales minus expenses for purchased materials. Gross output is deflated by the output deflator taken from the JIP Database 2009 for years 2000 to 2006. For 2007, the output deflator was extrapolated using the growth rate of various price indexes from 2006 to 2007 published by the Bank of Japan. The output price index was used for manufacturing industries, and the corporate service price index was used for service industries.

Intermediate inputs: For the commerce sector, intermediate inputs are calculated as (Cost of sales + Operating costs) – (Wages + Depreciation costs + Expenses for purchased materials). The intermediate inputs of other sectors are defined as (Cost of sales + Operating costs) – (Wages + Depreciation costs). Intermediate inputs are deflated by the intermediate input deflator taken from the JIP Database 2009 for years 2000 to 2006. For 2007, the intermediate input deflator was extrapolated using the growth rate of various price indexes from 2006 to 2007 published by the Bank of Japan. The input price index was used for manufacturing industries. For service industries, the intermediate input deflator for 2007 was calculated using the output deflator and the 2006 JIP Input-Output Table.

Labor input: Labor input is calculated as each firm's total number of workers multiplied by the sector's working hours taken from the JIP Database 2009 for years 2000 to 2006. For 2007, the data on working hours by sector are extrapolated using the growth rate of working hours from 2006 to 2007 taken from the *Monthly Labor Survey* published by Ministry of Health, Labour and Welfare.

Capital Stock: For capital stock, the only data available are the nominal book values of tangible fixed assets. Using these data, the net capital stock of firm *i* in industry *j* in constant 2000 prices is calculated as follows:

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

where BV_{it} represents the book value of firm *i*'s tangible fixed assets in year *t*, INK_{jt} stands for the net capital stock of industry *j* in constant 2000 prices, and IBV_{jt} denotes the book value of

industry *j*'s capital. INK_{jt} is calculated as follows. First, the data on the book value of tangible fixed assets in 1975 from the Financial Statements Statistics of Corporations published by Ministry of Finance were taken as a benchmark. Then, the book value of year 1975 was converted into the real value in constant 2000 prices using the investment deflator taken from the JIP Database 2009. Second, the net capital stock of industry *j*, INK_{jt}, for succeeding years was calculated using the perpetual inventory method. The sectoral depreciation rate used was taken from the JIP Database 2009.

Table 1. Number of foreign-owned firms

(Upper row: No. of firms; Lower row: %)

			2000	2001	2002	2003	2004	2005	2006	2007	2000-07 average
1-48	All industries		407	441	450	437	533	560	494	466	474
			(1.74)	(1.85)	(1.93)	(1.93)	(2.22)	(2.38)	(2.08)	(1.88)	(2.00)
1-30	Manufacturing		202	222	213	230	266	264	243	235	234
			(1.76)	(1.93)	(1.90)	(2.13)	(2.31)	(2.33)	(2.18)	(2.02)	(2.07)
33-48	Services		205	219	236	206	267	296	250	231	239
			(1.74)	(1.79)	(1.96)	(1.75)	(2.15)	(2.43)	(2.00)	(1.77)	(1.95)
	37	Wholesale trade	141	149	151	131	158	171	142	124	146
			(2.68)	(2.89)	(3.02)	(2.72)	(3.18)	(3.53)	(3.01)	(2.56)	(2.95)
	38	Retail trade	23	22	27	21	33	39	32	32	29
			(0.79)	(0.73)	(0.94)	(0.75)	(1.12)	(1.33)	(1.11)	(1.07)	(0.98)
	40-42	Business services	11	15	17	17	25	28	21	22	20
			(1.41)	(1.67)	(1.80)	(1.66)	(2.20)	(2.35)	(1.76)	(1.70)	(1.84)
	44	Information services	27	28	33	26	31	35	33	27	30
			(2.12)	(2.06)	(2.37)	(1.89)	(2.01)	(2.37)	(2.25)	(1.67)	(2.08)

Note: Figures in parentheses are the share of foreign-owned firms in the total number of firms.

Table 2. Share of foreign-owned firms in total employment and in total value added

(a) Share in employment (33.4 % or more foreign-owned) (%)

			2000	2001	2002	2003	2004	2005	2006	2007	2000-07 average
1-48	All industries		3.56	3.81	4.20	6.11	6.31	6.77	6.09	5.69	5.36
1-30	Manufacturing		5.59	6.01	5.44	8.82	9.05	9.06	8.99	7.88	7.60
33-48	Services		1.56	1.76	3.14	3.79	4.07	4.94	3.96	4.06	3.49
	37	Wholesale trade	2.82	3.21	3.57	3.04	3.52	4.31	3.61	4.85	3.61
	38	Retail trade	0.66	0.40	2.20	3.34	2.66	4.03	3.23	2.80	2.49
	40-42	Business services	0.67	2.30	2.99	2.91	5.77	6.73	4.11	3.33	3.88
	44	Information services	3.27	3.88	5.23	7.06	5.35	5.59	6.46	4.65	5.25

(b) Share in total value added (33.4% or more foreign-owned) (%)

			2000	2001	2002	2003	2004	2005	2006	2007	2000-07 average
1-48	All industries		5.16	6.15	5.52	10.00	10.97	12.89	12.19	12.90	10.02
1-30	Manufacturing		7.64	9.04	6.45	14.55	15.20	18.39	19.27	18.24	14.52
33-48	Services		2.22	3.17	4.64	5.23	6.38	7.08	4.38	6.01	5.08
	37	Wholesale trade	5.21	5.14	5.29	5.00	5.94	7.99	7.43	10.31	6.51
	38	Retail trade	1.33	0.98	2.45	3.72	4.06	5.43	5.27	4.68	3.57
	40-42	Business services	0.35	6.26	7.59	7.89	7.20	7.25	2.39	6.28	5.85
	44	Information services	4.16	4.60	10.88	12.00	10.53	10.59	13.45	11.59	9.95

Table 3. Estimation results

(a) Dependent variable: TFP growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.862***	0.880***	0.815***	0.952***	0.960***	0.923***
	(0.007)	(0.007)	(0.016)	(0.002)	(0.003)	(0.004)
GAP*ijt-1*	0.169***	0.174***	0.162***	0.788***	0.767***	0.816***
	(0.006)	(0.011)	(0.007)	(0.007)	(0.012)	(0.008)
FDI share*jt-1*	0.941***	1.155***	0.659***	-0.130***	0.039	-0.256***
	(0.139)	(0.179)	(0.199)	(0.046)	(0.060)	(0.062)
d.MKTshare*ijt*	6.391***	6.456***	6.630***	3.827***	4.051***	4.032***
	(1.086)	(2.069)	(1.255)	(0.860)	(1.315)	(0.697)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	142,136	69,570	72,566	142,136	69,570	72,566
F statistic	269.9	699.8	89.0	3344.3	4961.6	1359.7
R-squared	0.795	0.855	0.647	0.881	0.905	0.757

(b) Dependent variable: Labor productivity growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.343***	0.381***	0.323***	0.705***	0.728***	0.710***
	(0.014)	(0.024)	(0.019)	(0.008)	(0.014)	(0.011)
GAP*ijt-1*	0.192***	0.196***	0.187***	0.742***	0.736***	0.763***
	(0.007)	(0.011)	(0.009)	(0.008)	(0.013)	(0.009)
FDI share*jt-1*	0.091	0.221*	-0.088	-0.267***	-0.166***	-0.247***
	(0.092)	(0.118)	(0.110)	(0.044)	(0.056)	(0.061)
d.MKTshare*ijt*	2.424***	3.744***	1.811***	1.538***	2.737***	1.181***
	(0.445)	(1.133)	(0.442)	(0.396)	(0.784)	(0.374)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	142,515	69,595	72,581	142,515	69,595	72,581
F statistic	31.3	34.9	35.1	180.8	171.1	180.9
R-squared	0.141	0.144	0.138	0.407	0.408	0.408

Note: Heteroskedasticity-robust standard errors (clustered within a sector and year for equations (1)-(3)) are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level, respectively.

Table 4. FDI spillovers and catch-up firms

(a) Dependent variable: TFP growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.956***	0.963***	0.934***	0.952***	0.960***	0.923***
	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)
GAP*ijt-1*	0.620***	0.601***	0.646***	0.790***	0.758***	0.832***
	(0.009)	(0.015)	(0.010)	(0.008)	(0.013)	(0.009)
FDI share*jt-1*	-0.229***	0.006	-0.556***	-0.081	-0.129	0.371**
	(0.049)	(0.063)	(0.067)	(0.096)	(0.117)	(0.161)
CATCH*ijt-1* *FDI share*jt-1*	0.434***	0.385***	0.509***			
	(0.042)	(0.049)	(0.062)			
CATCH*ijt-1*	0.252***	0.262***	0.235***			
	(0.003)	(0.005)	(0.003)			
GAP*ijt-1* *FDI share*jt-1*				-0.025	0.082	-0.401***
				(0.054)	(0.062)	(0.107)
d.MKTshare*ijt*	3.201***	3.160***	3.498***	3.821***	4.108***	4.040***
	(0.707)	(1.068)	(0.616)	(0.860)	(1.321)	(0.704)
Observations	142,136	69,570	72,566	142,136	69,570	72,566
F statistic	3611.1	5022.1	1630.3	3298.0	4867.5	1333.5
R-squared	0.905	0.924	0.805	0.881	0.905	0.758

(b) Dependent variable: Labor productivity growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.760***	0.791***	0.757***	0.704***	0.725***	0.710***
	(0.008)	(0.014)	(0.010)	(0.008)	(0.014)	(0.011)
GAP*ijt-1*	0.585***	0.574***	0.605***	0.749***	0.742***	0.765***
	(0.009)	(0.015)	(0.010)	(0.008)	(0.014)	(0.010)
FDI share*jt-1*	-0.329***	-0.150**	-0.499***	-0.107	-0.058	-0.161
	(0.048)	(0.060)	(0.068)	(0.095)	(0.116)	(0.135)
CATCH*ijt-1* *FDI share*jt-1*	0.342***	0.319***	0.422***			
	(0.041)	(0.048)	(0.067)			
CATCH*ijt-1*	0.260***	0.263***	0.251***			
	(0.003)	(0.005)	(0.003)			
GAP*ijt-1* *FDI share*jt-1*				-0.097	-0.064	-0.066
				(0.063)	(0.074)	(0.105)
d.MKTshare*ijt*	1.096***	1.935***	0.823**	1.525***	2.707***	1.183***
	(0.339)	(0.677)	(0.334)	(0.396)	(0.782)	(0.375)
Observations	142,515	69,595	72,581	142,515	69,595	72,581
F statistic	607.6	661.7	478.3	182.5	168.6	177.2
R-squared	0.524	0.523	0.525	0.407	0.408	0.408

Notes: Firm fixed effects are controlled for. Year and industry dummies are included. Heteroskedasticity-robust standard errors are in parentheses with ***, **, and * indicating significance at the 1, 5, and 10 percent level, respectively.

Table 5. Estimation results (3-year lagged)

(a) Dependent variable: lnTFP$_{ijt}$ - lnTFP$_{ijt-3}$

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD$_{jt}$	0.880***	0.894***	0.839***	0.990***	1.003***	0.957***
	(0.007)	(0.008)	(0.015)	(0.003)	(0.003)	(0.006)
GAP$_{ijt-3}$	0.246***	0.259***	0.231***	1.053***	1.088***	1.002***
	(0.009)	(0.017)	(0.010)	(0.009)	(0.014)	(0.009)
FDI share$_{jt-3}$	1.037***	1.282***	0.592*	-0.329***	-0.110	-0.748***
	(0.175)	(0.200)	(0.339)	(0.059)	(0.075)	(0.082)
d3.MKTshare$_{ijt}$	5.307***	6.261***	5.169***	2.932***	2.739***	3.465***
	(1.007)	(1.678)	(1.228)	(0.652)	(1.008)	(0.465)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	91,385	45,602	45,783	91,385	45,602	45,783
F statistic	432.3	1137.8	119.9	3624.2	5803.7	1288.0
R-squared	0.826	0.874	0.689	0.92	0.939	0.8

(b) Dependent variable: lnLP$_{ijt}$ - lnLP$_{ijt-3}$

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD$_{jt}$	0.372***	0.396***	0.349***	0.862***	0.895***	0.828***
	(0.014)	(0.028)	(0.016)	(0.010)	(0.017)	(0.013)
GAP$_{ijt-3}$	0.281***	0.288***	0.272***	1.023***	1.066***	0.972***
	(0.010)	(0.015)	(0.014)	(0.010)	(0.016)	(0.011)
FDI share$_{jt-3}$	0.048	0.181	-0.216	-0.236***	-0.075	-0.478***
	(0.103)	(0.126)	(0.146)	(0.057)	(0.071)	(0.079)
d3.MKTshare$_{ijt}$	2.191***	3.076***	1.599***	1.152***	2.012***	1.237***
	(0.454)	(0.960)	(0.534)	(0.341)	(0.599)	(0.354)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	91,644	45,643	45,801	91,644	45,643	45,801
F statistic	73.31	69.57	101.9	264.2	277.7	240.6
R-squared	0.248	0.246	0.228	0.543	0.572	0.504

Note: Heteroskedasticity-robust standard errors (clustered within a sector and year for equations (1)-(3)) are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level, respectively.

Table 6. FDI spillovers and catch-up firms (3-year lagged)

(a) Dependent variable: lnTFP*ijt* - lnTFP*ijt-3*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD*jt*	0.988***	0.998***	0.962***	0.990***	1.003***	0.958***
	(0.002)	(0.003)	(0.005)	(0.003)	(0.003)	(0.006)
GAP*ijt-3*	0.866***	0.900***	0.819***	1.039***	1.073***	0.999***
	(0.012)	(0.021)	(0.011)	(0.008)	(0.013)	(0.009)
FDI share*jt-3*	-0.530***	-0.257***	-1.083***	-0.738***	-0.427***	-0.900***
	(0.064)	(0.079)	(0.095)	(0.111)	(0.126)	(0.184)
CATCH*ijt-3* *FDI share*jt-3*	0.717***	0.572***	1.015***			
	(0.065)	(0.075)	(0.099)			
CATCH*ijt-3*	0.239***	0.241***	0.230***			
	(0.004)	(0.007)	(0.004)			
GAP*ijt-3* *FDI share*jt-3*				0.222***	0.162***	0.100
				(0.060)	(0.063)	(0.111)
d3.MKTshare*ijt*	2.656***	2.408***	3.166***	2.961***	2.807***	3.466***
	(0.587)	(0.933)	(0.409)	(0.653)	(1.018)	(0.463)
Observations	91,385	45,602	45,783	91,385	45,602	45,783
F statistic	4001.5	6234.5	1529.2	3579.1	5631.2	1268.4
R-squared	0.932	0.947	0.833	0.920	0.939	0.800

(b) Dependent variable: lnLP*ijt* - lnLP*ijt-3*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD*jt*	0.884***	0.910***	0.856***	0.865***	0.900***	0.829***
	(0.009)	(0.015)	(0.012)	(0.010)	(0.017)	(0.014)
GAP*ijt-3*	0.837***	0.877***	0.794***	1.010***	1.052***	0.967***
	(0.013)	(0.022)	(0.013)	(0.008)	(0.013)	(0.011)
FDI share*jt-3*	-0.399***	-0.253***	-0.629***	-0.614***	-0.355***	-0.696***
	(0.062)	(0.077)	(0.087)	(0.116)	(0.132)	(0.177)
CATCH*ijt-3* *FDI share*jt-3*	0.614***	0.557***	0.753***			
	(0.064)	(0.073)	(0.101)			
CATCH*ijt-3*	0.255***	0.245***	0.255***			
	(0.004)	(0.007)	(0.005)			
GAP*ijt-3* *FDI share*jt-3*				0.244***	0.172**	0.170
				(0.076)	(0.080)	(0.132)
d3.MKTshare*ijt*	0.861***	1.479***	0.983***	1.169***	2.062***	1.235***
	(0.312)	(0.561)	(0.311)	(0.341)	(0.604)	(0.354)
Observations	91,644	45,643	45,801	91,644	45,643	45,801
F statistic	506.3	578.0	375.2	293.4	312.4	242.6
R-squared	0.614	0.631	0.589	0.543	0.572	0.504

Notes: Firm fixed effects are controlled. Year and industry dummies are included. Heteroskedasticity-robust standard errors are in parentheses, with ***, **, and * indicating significance at the 1, 5, and 10 percent level, respectively.

Appendix Table 1. List of industries

		JIP2006
1-48	All industries	1-108
1-30	Manufacturing	8-59
1	Food products and beverages	8-13
2	Textiles	15
3	Lumber and wood products	16, 17
4	Pulp, paper, and paper products	18-19
5	Printing	20
6	Chemicals and chemical fibers	23-27
7	Paint, coating, and grease	28
8	Pharmaceutical products	29
9	Miscellaneous chemical products	28
10	Petroleum and coal products	30,31
11	Plastic products	58
12	Rubber products	22
13	Ceramic, stone and clay products	32-35
14	Iron and steel	36,37
15	Non-ferrous metals	38,39
16	Fabricated metal products	40,41
17	Metal processing machinery	42
18	Special industry machinery	43
19	Office and service industry machines	45
20	Miscellaneous machinery	44
21	Electrical machinery and apparatus	46
22	Household electric appliances	47
23	Communication equipment	49
24	Computer and electronic equipment	48,50
25	Electronic parts and devices	51,52
26	Miscellaneous electrical machinery	53
27	Motor vehicles and parts	54,55
28	Other transportation equipment	56
29	Precision machinery	57
30	Miscellaneous mfg. industries	21, 59
33-48	Services	60-107
33	Construction	60
34	Electricity, gas, and water supply	62,63,64
35	Transport and storage	74,77
36	Telecommunications and broadcasting	78,79,90
37	Wholesale trade	67
3701	General merchandise	
3702	Textile products	
3703	Apparel accessories and notions	
3704	Agricultural, animal and poultry farm and aquatic products	
3705	Food and beverages	
3706	Building materials	
3707	Chemicals and related products	
3708	Minerals and metals	
3709	General machinery and equipment	
3710	Motor vehicles	
3711	Electrical machinery	
3712	Miscellaneous machinery and equipment	
3713	Fixtures and house furnishings	
3714	Drugs and toiletries	
3715	Other products	
38	Retail trade	68
3801	General merchandise	
3802	Dry goods, apparel, and apparel accessories	
3803	Food and beverages	
3804	Motor vehicles and bicycles	

3805	Furniture, fixture, and household utensil	
3806	Appliance stores	
3807	Drugs and toiletry stores	
3808	Fuel stores	
3809	Stores, n.e.c.	
39	Financial intermediation and real estate	69,71
40	Advertising	85
41	Rental of office equipment and goods	86
42	Other business services	87,88
43	Entertainment	89
44	Information services	91,92,93
4401	Information services and internet-based services	91
4402	Computer programming	91
4403	Motion pictures	92,93
45	Eating and drinking places	94
46	Accommodation	95
47	Personal services	96,97
48	Services, n.e.c.	66,80,81,82,84
31	Agriculture, hunting, forestry, and fishing	1,2,5,6
32	Mining and quarrying	7

Appendix Table 2. Number of observations by industry and year

(Number of firms)

		2000	2001	2002	2003	2004	2005	2006	2007	2000-07 average
1-48	All industries	23,324	23,803	23,308	22,607	23,995	23,549	23,703	24,738	23,628
1-30	Manufacturing	11,478	11,478	11,225	10,815	11,502	11,315	11,161	11,661	11,329
33-48	Services	11,782	12,258	12,024	11,738	12,447	12,185	12,494	13,031	12,245
33	Construction	348	430	416	372	401	369	390	320	381
34	Electricity, gas, and water supply	103	101	103	105	113	109	111	121	108
35	Transport and storage	57	116	123	127	139	110	129	104	113
36	Telecommunications and broadcasting	12	22	29	51	58	61	76	57	46
37	Wholesale trade	5,268	5,163	5,006	4,816	4,961	4,844	4,714	4,849	4,953
38	Retail trade	2,906	3,014	2,882	2,783	2,959	2,940	2,874	2,995	2,919
39	Financial intermediation	114	129	124	123	129	131	124	129	125
40	Advertising	136	137	134	136	161	155	169	188	152
41	Rental of office equipment and goods	230	230	250	262	275	285	297	291	265
42	Other business services	415	531	559	626	700	750	729	814	641
43	Entertainment	428	387	355	303	300	279	315	347	339
44	Information services	1,276	1,360	1,392	1,376	1,543	1,478	1,467	1,620	1,439
45	Eating and drinking places	324	394	404	402	439	406	415	472	407
46	Accommodation	23	46	47	49	49	55	54	52	47
47	Personal services	124	168	148	161	162	149	449	484	231
48	Services, n.e.c.	18	30	52	46	58	64	181	188	80
31	Agriculture, hunting, forestry, and fishing	8	13	16	16	12	16	15	13	14
32	Mining and quarrying	56	54	43	38	34	33	33	33	41

Appendix Table 3. Estimation results (Based on the majority ownership definition)

(a) Dependent variable: TFP growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.857***	0.871***	0.817***	0.952***	0.959***	0.923***
	(0.008)	(0.008)	(0.016)	(0.002)	(0.003)	(0.004)
GAP*ijt-1*	0.170***	0.178***	0.162***	0.787***	0.768***	0.815***
	(0.006)	(0.011)	(0.007)	(0.007)	(0.011)	(0.008)
FDI share*jt-1*	0.247	0.254	0.299	0.001	-0.076	-0.037
	(0.169)	(0.253)	(0.211)	(0.067)	(0.122)	(0.074)
d.MKTshare*ijt*	6.486***	6.766***	6.614***	3.739***	3.898***	3.992***
	(1.031)	(1.926)	(1.211)	(0.797)	(1.139)	(0.673)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	143,058	70,224	72,834	143,058	70,224	72,834
F statistic	232.9	442.5	89.82	3332.2	4866.4	1365.4
R-squared	0.793	0.852	0.645	0.881	0.905	0.756

(b) Dependent variable: Labor productivity growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.339***	0.362***	0.324***	0.710***	0.733***	0.711***
	(0.014)	(0.024)	(0.018)	(0.008)	(0.014)	(0.011)
GAP*ijt-1*	0.192***	0.195***	0.188***	0.741***	0.734***	0.764***
	(0.007)	(0.011)	(0.009)	(0.008)	(0.012)	(0.009)
FDI share*jt-1*	-0.007	0.030	0.107	0.182***	0.293**	0.053
	(0.123)	(0.250)	(0.110)	(0.067)	(0.118)	(0.078)
d.MKTshare*ijt*	2.443***	3.717***	1.851***	1.504***	2.632***	1.179***
	(0.430)	(1.035)	(0.435)	(0.377)	(0.694)	(0.367)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	143,441	70,251	72,849	143,441	70,251	72,849
F statistic	31.12	32.6	35.75	183.2	175.7	182.2
R-squared	0.14	0.141	0.138	0.406	0.407	0.408

Note: Heteroskedasticity-robust standard errors (clustered within a sector and year for equations (1)-(3)) are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level, respectively.

Appendix Table 4. FDI spillovers and catch-up firms (Based on the majority ownership definition)

(a) Dependent variable: TFP growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.956***	0.961***	0.934***	0.952***	0.959***	0.923***
	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)
GAP*ijt-1*	0.621***	0.607***	0.646***	0.788***	0.773***	0.813***
	(0.009)	(0.015)	(0.010)	(0.007)	(0.012)	(0.008)
FDI share*jt-1*	-0.073	0.064	-0.242***	0.124	0.333	-0.172
	(0.072)	(0.121)	(0.086)	(0.152)	(0.259)	(0.169)
CATCH*ijt-1* *FDI share*jt-1*	0.293***	0.313***	0.349***			
	(0.062)	(0.102)	(0.077)			
CATCH*ijt-1*	0.264***	0.276***	0.244***			
	(0.003)	(0.004)	(0.003)			
GAP*ijt-1* *FDI share*jt-1*				-0.081	-0.266	0.089
				(0.100)	(0.170)	(0.112)
d.MKTshare*ijt*	3.155***	3.124***	3.490***	3.736***	3.883***	3.995***
	(0.665)	(0.942)	(0.602)	(0.796)	(1.135)	(0.673)
Observations	143,058	70,224	72,834	143,058	70,224	72,834
F statistic	3525.9	4748.8	1630.2	3288.7	4741.3	1338.9
R-squared	0.904	0.923	0.803	0.881	0.905	0.756

(b) Dependent variable: Labor productivity growth *ijt*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d.FRPROD*jt*	0.762***	0.782***	0.757***	0.710***	0.731***	0.711***
	(0.008)	(0.014)	(0.010)	(0.008)	(0.014)	(0.011)
GAP*ijt-1*	0.585***	0.575***	0.606***	0.744***	0.747***	0.760***
	(0.009)	(0.015)	(0.010)	(0.008)	(0.014)	(0.009)
FDI share*jt-1*	0.042	0.300**	-0.165*	0.364**	1.086***	-0.180
	(0.073)	(0.121)	(0.091)	(0.156)	(0.288)	(0.175)
CATCH*ijt-1* *FDI share*jt-1*	0.198***	0.240**	0.231***			
	(0.062)	(0.096)	(0.083)			
CATCH*ijt-1*	0.270***	0.275***	0.259***			
	(0.003)	(0.004)	(0.003)			
GAP*ijt-1* *FDI share*jt-1*				-0.149	-0.695***	0.183
				(0.127)	(0.251)	(0.143)
d.MKTshare*ijt*	1.101***	1.937***	0.845**	1.503***	2.633***	1.181***
	(0.326)	(0.611)	(0.332)	(0.377)	(0.695)	(0.367)
Observations	143,441	70,251	72,849	143,441	70,251	72,849
F statistic	607.3	663.5	474.7	181	171.2	178.9
R-squared	0.522	0.521	0.523	0.406	0.407	0.408

Notes: Firm fixed effects are controlled for. Year and industry dummies are included. Heteroskedasticity-robust standard errors are in parentheses with ***, **, and * indicating significance at the 1, 5, and 10 percent level, respectively.

Appendix Table 5. Estimation results (3-year lagged, Based on the majority ownership definition)

(a) Dependent variable: lnTFP*ijt* - lnTFP*ijt-3*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD*jt*	0.875***	0.887***	0.839***	0.992***	1.003***	0.957***
	(0.008)	(0.009)	(0.015)	(0.003)	(0.003)	(0.006)
GAP*ijt-3*	0.246***	0.261***	0.230***	1.050***	1.086***	0.999***
	(0.009)	(0.016)	(0.010)	(0.009)	(0.014)	(0.009)
FDI share*jt-3*	0.590***	0.665*	0.621**	0.157*	0.198	0.023
	(0.226)	(0.391)	(0.273)	(0.090)	(0.161)	(0.097)
d3.MKTshare*ijt*	5.427***	6.721***	5.062***	2.910***	2.903***	3.389***
	(0.957)	(1.600)	(1.171)	(0.615)	(0.934)	(0.462)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	92,052	46,081	45,971	92,052	46,081	45,971
F statistic	352.7	681.2	125.4	3598.6	5710.5	1295.1
R-squared	0.824	0.872	0.686	0.92	0.939	0.798

(b) Dependent variable: lnLP*ijt* - lnLP*ijt-3*

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD*jt*	0.369***	0.382***	0.351***	0.869***	0.897***	0.832***
	(0.014)	(0.026)	(0.016)	(0.010)	(0.016)	(0.013)
GAP*ijt-3*	0.279***	0.284***	0.272***	1.024***	1.066***	0.974***
	(0.010)	(0.015)	(0.014)	(0.010)	(0.015)	(0.011)
FDI share*jt-3*	0.048	0.292	0.069	0.211**	0.311**	0.060
	(0.175)	(0.338)	(0.137)	(0.093)	(0.158)	(0.102)
d3.MKTshare*ijt*	2.295***	3.308***	1.593***	1.226***	2.223***	1.197***
	(0.451)	(0.948)	(0.523)	(0.345)	(0.602)	(0.358)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	No	No	No	Yes	Yes	Yes
Observations	92,313	46,123	45,989	92,313	46,123	45,989
F statistic	68.57	67.15	93.39	269.5	282.9	246.5
R-squared	0.247	0.244	0.226	0.543	0.572	0.505

Note: Heteroskedasticity-robust standard errors (clustered within a sector and year for equations (1)-(3)) are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level, respectively.

Appendix Table 6. FDI spillovers and catch-up firms (3-year lagged, Based on the majority ownership definition)

(a) Dependent variable: lnTFP$_{ijt}$ - lnTFP$_{ijt-3}$

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD$_{jt}$	0.988***	0.998***	0.960***	0.992***	1.003***	0.958***
	(0.002)	(0.003)	(0.005)	(0.003)	(0.003)	(0.006)
GAP$_{ijt-3}$	0.864***	0.900***	0.815***	1.039***	1.074***	0.988***
	(0.012)	(0.020)	(0.011)	(0.009)	(0.015)	(0.009)
FDI share$_{jt-3}$	-0.189*	-0.153	-0.271**	-0.731***	-0.812***	-0.871***
	(0.098)	(0.170)	(0.106)	(0.175)	(0.271)	(0.218)
CATCH$_{ijt-3}$ *FDI share$_{jt-3}$	0.690***	0.973***	0.592***			
	(0.102)	(0.189)	(0.106)			
CATCH$_{ijt-3}$	0.254***	0.253***	0.247***			
	(0.004)	(0.007)	(0.004)			
GAP$_{ijt-3}$ *FDI share$_{jt-3}$				0.614***	0.735***	0.596***
				(0.119)	(0.196)	(0.143)
d3.MKTshare$_{ijt}$	2.670***	2.641***	3.109***	2.942***	2.920***	3.429***
	(0.561)	(0.886)	(0.420)	(0.615)	(0.932)	(0.462)
Observations	92,052	46,081	45,971	92,052	46,081	45,971
F statistic	3960.7	6133.2	1521.9	3552.4	5542.8	1282.8
R-squared	0.932	0.947	0.831	0.92	0.939	0.798

(b) Dependent variable: lnLP$_{ijt}$ - lnLP$_{ijt-3}$

	(1) All	(2) Mfg.	(3) Services	(4) All	(5) Mfg.	(6) Services
d3.FRPROD$_{jt}$	0.887***	0.906***	0.857***	0.869***	0.896***	0.833***
	(0.009)	(0.015)	(0.012)	(0.010)	(0.016)	(0.014)
GAP$_{ijt-3}$	0.839***	0.876***	0.796***	1.013***	1.050***	0.964***
	(0.013)	(0.022)	(0.013)	(0.010)	(0.016)	(0.011)
FDI share$_{jt-3}$	-0.039	-0.047	-0.061	-0.589***	-0.791***	-0.624***
	(0.100)	(0.169)	(0.110)	(0.171)	(0.275)	(0.209)
CATCH$_{ijt-3}$ *FDI share$_{jt-3}$	0.533***	0.943***	0.336***			
	(0.099)	(0.176)	(0.111)			
CATCH$_{ijt-3}$	0.268***	0.257***	0.270***			
	(0.004)	(0.007)	(0.005)			
GAP$_{ijt-3}$ *FDI share$_{jt-3}$				0.661***	1.001***	0.530***
				(0.137)	(0.241)	(0.165)
d3.MKTshare$_{ijt}$	0.968***	1.796***	0.964***	1.242***	2.229***	1.218***
	(0.324)	(0.586)	(0.323)	(0.345)	(0.600)	(0.359)
Observations	92,313	46,123	45,989	91,644	45,643	45,801
F statistic	498	572.7	376.6	293.4	312.4	242.6
R-squared	0.613	0.63	0.589	0.543	0.572	0.504

Notes: Firm fixed effects are controlled. Year and industry dummies are included. Heteroskedasticity-robust standard errors are in parentheses, with ***, **, and * indicating significance at the 1, 5, and 10 percent level, respectively.