Ryuhei Wakasugi *Editor*

Internationalization of Japanese Firms

Evidence from Firm-level Data

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GENDAI NIHON KIGYO NO KOKUSAIKA: Paneru deta bunseki
edited by Ryuhei Wakasugi

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Kyoto and Kamakura, Japan — Ryuhei Wakasugi
December 12, 2013

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Introduction and Overview

Ryuhei Wakasugi

1 Increase of Exporters and FDI Firms

The number of Japanese exporters continued to increase in the decade after 2000. Figure 1, using data from the Basic Survey of Japanese Business Structure and Activities which covers Japanese manufacturing firms with over 50 employees and more than 30 million yen of capital stock, shows that the number of exporters in the manufacturing sector increased from 3,762 firms in 2000 to 4,518 firms in 2010.[1] Figure 1 also depicts the type of exporters that increased, with firms categorized into deciles by export ratio, which is defined as the ratio of their exports to total sales. This figure reveals an increase of exporters classified in the export ratio categories of 10 % or more. This trend is similar to even non-manufacturing firms, including wholesalers, retailers, and firms in the service sectors.

The line in Fig. 2 shows that the number of Japanese firms making foreign direct investment (FDI) also increased remarkably over 10 years, from 2,592 firms in 2000 to 3,378 firms in 2010. The number of foreign subsidiaries of Japanese firms, depicted as the bars in the figure, increased even more rapidly from 8,872 to 16,457. The average number of subsidiaries per parent firm increased from 3.4

[1]Data is sourced from "The Basic Survey of Japanese Business Structure and Activities" from 2000 to 2010, the Ministry of Economy, Trade and Industry (METI).

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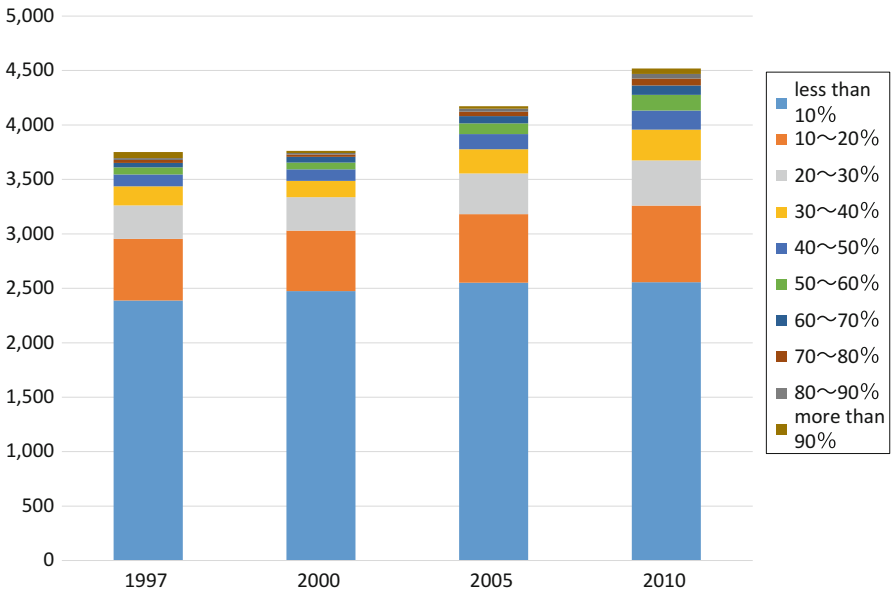

Fig. 1 The number of exporting firms by export ratio (manufacturing firms). *Data source*: "The Basic Survey of Japanese Business Structure and Activities" from 1997 to 2010, the Ministry of Economy, Trade and Industry (METI)

firms in 2000 to 4.9 firms in 2010. Note that the increases are different among regions. The subsidiaries in Asia increased rapidly from 6,082 in 2000 to 11,261 in 2010, especially in China, where these rose from 4,077 in 2005 to 5,631 in 2010. Subsidiaries in the European Union also increased, from 901 in 2000 to 2,127 in 2010, whereas those in the United States did not increase significantly.

The increase in Japanese firms' subsidiaries varied among firms whose stock shares are different. Table 1 presents the proportion of subsidiaries, by classifying them into three categories according to the stock owned by the parent firm: 100 % owned, 50–100 % owned, and 20–50 % owned. The fully-owned subsidiaries, in particular those in Asia and Europe, increased, while those of 20–50 % owned, in particular in Asia, decreased. Firms in the wholesale, retail, and service sectors show a similar trend to the manufacturing firms.

Turning to the performance of internationalized firms, defined as Japanese exporters and FDI firms, it is seen that they are characterized by high premiums in employment size, value added, and total factor productivity (TFP) in comparison with domestic firms, as depicted in Fig. 3. The bars in the figure represent exporters, and the lines represent FDI firms. In comparison with a large number

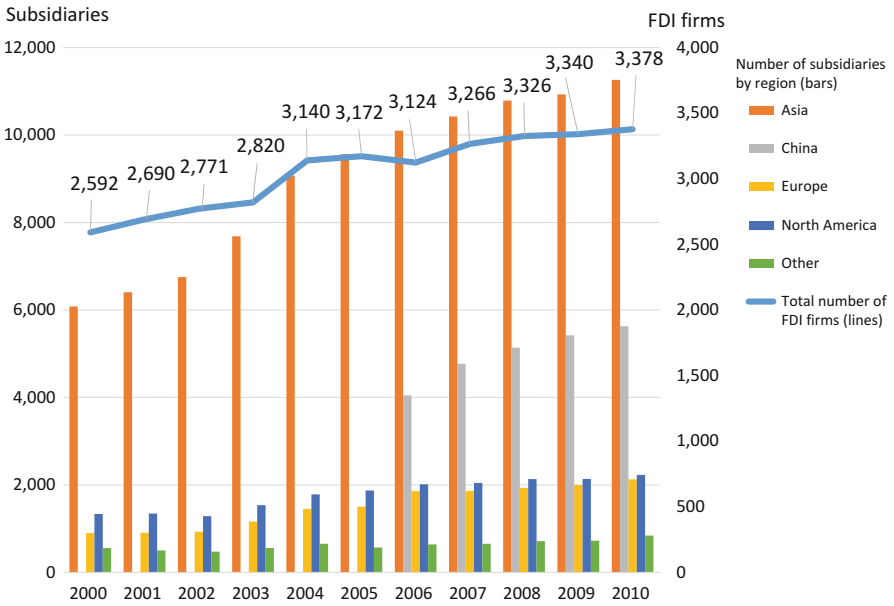

Fig. 2 The number of FDI firms and their overseas affiliates by region (manufacturing firms). *Data source*: "The Basic Survey of Japanese Business Structure and Activities" from 2000 to 2010, the Ministry of Economy, Trade and Industry (METI)

of Japanese manufacturing firms,[2] Japanese internationalized firms are also among "the happy few" as Mayer and Ottaviano (2007) described the higher productivity of European internationalized firms relative to those serving only the domestic market.

2 Research Questions and Book Scope

Since the late 1990s, trade economists have focused on analyzing the productivity heterogeneity of exporters and FDI firms at the firm level. Not only theoretical analyses but also empirical evidence from US and European firms clarified that exporters and FDI firms are heterogeneous in productivity. The seminal papers by Bernard and Jensen (1995, 1999), Melitz (2003), and Helpman et al. (2004) confirmed that firms with relatively high productivity tend to be exporters, the most productive firms engage in FDI, and the least productive firms serve only the

[2]As for total number of manufacturing firms, I referred to *The Basic Survey of Commercial and Manufacturing Structure and Activity* which was only once conducted in 1998 with no firm-size threshold. The survey covered 118,300 firms in all manufacturing industries.

Table 1 The number and share of subsidiaries by ownership and region

Year	Total number of subsidiaries	Subsidies of 100 % owned						Subsidies of 50–100 % owned						Subsidies of 20–50 % owned					
			Asia	China	Europe	North America	Other		Asia	China	Europe	North America	Other		Asia	China	Europe	North America	Other
2000	8,872	35.8	18.9		5.8	8.7	2.4	30.2	22.5		2.4	3.5	1.8	34.0	27.1		2.0	2.9	2.0
2001	9,160	36.9	20.6		5.8	8.5	2.0	31.6	23.8		2.6	3.5	1.7	31.4	25.6		1.5	2.7	1.7
2002	9,442	39.0	23.2		5.9	8.1	1.9	31.4	24.2		2.3	3.1	1.7	29.6	24.1		1.7	2.4	1.4
2003	10,944	43.1	24.9		6.9	9.0	2.4	29.8	23.2		2.3	2.8	1.5	27.1	22.1		1.4	2.2	1.3
2004	12,962	44.1	26.1		6.8	9.1	2.2	31.8	24.3		3.1	2.8	1.6	24.1	19.6		1.3	1.9	1.2
2005	13,505	46.1	28.0		7.0	9.2	1.8	31.0	23.9		2.9	2.9	1.3	23.0	19.0		1.2	1.7	1.0
2006	14,613	50.0	29.5	12.8	8.4	9.8	2.4	29.4	22.8	8.6	3.0	2.5	1.0	20.6	16.8	6.3	1.3	1.5	1.0
2007	14,984	51.6	30.7	14.9	8.4	9.9	2.7	27.8	22.0	9.7	2.6	2.2	1.0	20.6	16.9	7.3	1.4	1.6	0.7
2008	15,570	51.8	31.0	16.1	8.3	9.7	2.8	28.4	22.1	9.7	2.8	2.4	1.0	19.9	16.2	7.2	1.3	1.6	0.8
2009	15,790	53.5	31.9	16.7	9.2	9.7	2.6	27.5	21.9	10.3	2.2	2.3	1.1	19.0	15.4	7.3	1.3	1.5	0.8
2010	16,457	54.5	31.9	17.0	9.7	9.8	3.1	27.0	21.3	10.0	2.2	2.3	1.2	18.5	15.2	7.2	1.0	1.4	0.9

Data source: "The Basic Survey of Japanese Business Structure and Activities" from 2000 to 2010, the Ministry of Economy, Trade and Industry (METI)
Note: The share of Asia includes that of China

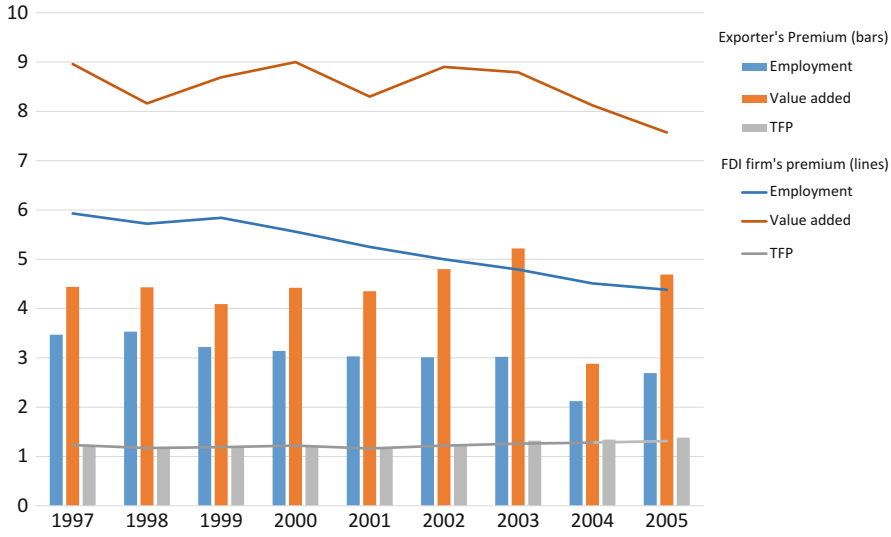

Fig. 3 Premium of Japanese exporters and FDI firms (manufacturing firms, 1997–2005). *Data source*: Author's calculation from the data "The Basic Survey of Japanese Business Structure and Activities" from 1997 to 2005, the Ministry of Economy, Trade and Industry (METI)

domestic market. Many studies have been conducted on US and European firms, whereas Japanese firms have attracted insufficient research attention despite the large number of exporters and FDI firms.

This book aims to analyze the characteristics of Japanese internationalized firms by using the micro-level data of Japanese firms and thereby filling the research gap between US and European firms, and Japanese firms. The book's research scope examines the following questions:

1. Internationalized firms, that is, exporters and FDI firms, are characterized by premiums in firm size, wage rate, and productivity. What are the specific features of Japanese internationalized firms compared with US and European firms?
2. The proportions of exporters and multinational enterprises (MNEs) vary substantially across industries, reflecting industry-specific attributes. What industry-specific factors make the modes of firms' internationalization different among industries?
3. Although the productivity of firms serving foreign markets is on average higher than that of firms serving only the domestic market, the difference in productivity between exporters and FDI firms is not clear. What factors other than productivity should be included as important determinants of the export and FDI behavior of Japanese firms?
4. What are the features of Japanese FDI firms, and how are they different from US and European firms in terms of subsidiary sales, the number of investing countries, and the scale of operations in the home country?

5. The modes of internationalization, export and FDI, are determined not only by productivity, but also by market-specific factors in destination countries. Different modes of internationalization may be chosen by Japanese firms corresponding to their different destination countries, US and European countries and East Asian countries. If so, what market-specific factors make the modes of firms' internationalization different among destination countries?
6. In comparison with US and European firms, Japanese firms do not present clearly that the most productive firms undertake FDI. There may be other reasons more productive firms export while less productive firms undertake FDI. Assuming that FDI is decided under an environment in which firms and managers make matches for production, the question is whether the match quality in the market affects the FDI decision.
7. Intra-firm trade undertaken by MNEs is increasing. How do organizational and institutional factors affect such trade?

3 Features of Internationalized Firms

The firm heterogeneity model of Melitz (2003) predicts that more productive firms engage in exports, while less productive firms serve only the domestic market since exporting requires additional costs. Helpman et al. (2004) extend the model and predict that the most productive firms engage in FDI, the less productive firms engage in exporting, and the least productive firms serve only the domestic market. A number of empirical studies have examined the relationship between firm characteristics and internationalization. They have found a positive correlation between firm performance and its internationalization in line with the standard firm heterogeneity model by Melitz (2003) and Helpman et al. (2004). In chapter "Features of Japanese Internationalized Firms: Findings Based on Firm-Level Data", following these previous studies, Wakasugi, jointly with Todo, Sato, Matsuura, Ito, and Tanaka provides a comprehensive analysis of the internationalization of Japanese manufacturing firms. By using firm-level data on the Japanese manufacturing industry for the period 1997–2005 from "Kigyo Katsudo Kihon Chosa" (the Basic Survey of Japanese Business Structure and Activities),[3] they first examine the characteristics of internationalized Japanese firms, namely firms that engage in exports and/or FDI. Second, we compare internationalization of Japanese firms with that of firms from selected European countries. The empirical results in this chapter are in line with those of previous works: the number of internationalized firms is very small and export firms are larger and more productive than domestic firms, while those that engage in both exports and FDI are even larger and more productive. The overall results show that the characteristics of internationalized

[3]This annual survey is conducted by the Ministry of Economy, Trade and Industry (METI) and it covers all manufacturing, wholesale, retail, and service firms that have 50 or more employees and ¥30 million or more as capital stock.

firms in Japan are mostly similar to those of their European counterparts: (1) exports are dominated by a few top exporters; (2) although the export-to-sales ratios of very few firms exceed 50 %, these firms account for at least half of total exports; (3) internationalized firms perform better in terms of a number of the analyzed indicators than domestic firms; (4) the proportion of foreign-owned firms is higher among exporting than among non-exporting firms; (5) the number of FDI firms (extensive margin) has a larger influence on total sales by overseas subsidiaries than sales per firm (intensive margin). However, the analysis reveals notable differences between Japan and Europe in that productivity differences between domestic firms, exporting firms, and FDI firms are substantially smaller in Japan than in Europe. This finding suggests that variations in productivity alone cannot explain the export and FDI behavior of Japanese firms. The analysis also finds other remarkable differences: the dominance of exports by the top exporters has weakened over time and the proportion of foreign-owned firms among exporters in Japan is much lower than that in European countries.

4 Industry and Firm-Specific Factors

In chapter "Heterogeneity and the Structure of Export and FDI: A Cross-Industry Analysis of Japanese Manufacturing", Tanaka focuses on the fact that the fractions of exporters and MNEs vary substantially across industries. For example, according to Bernard et al. (2007), the number of US firms exporting is nearly 40 % in some manufacturing industries but less than 10 % in others. As shown in this chapter, the variation in the fraction of exporters and MNEs across industries is systematic. First, the fraction of the sum of exporters and MNEs is higher in industries with a larger dispersion of sales. Second, the fraction of MNEs alone is higher in industries with a larger dispersion of sales. Third, relative to all active firms, MNEs are heavily concentrated in research and development (R&D)-intensive industries. This chapter uses a firm heterogeneity model presented by Helpman et al. (2004) and derives the theoretical relationship between firm heterogeneity and the fraction of internationalized firms. The model shows that industries with a larger degree of productivity dispersion have a larger fraction of MNEs, a larger fraction of the sum of exporters and MNEs, and a larger ratio of MNEs to non-MNE exporters, although the effect of an increase in the dispersion of productivity on the fraction of exporters can be either positive or negative. The model also shows that R&D-intensive industries have an advantage in conducting FDI. The empirical analysis in this chapter employs Japanese industry-level data for the 1997–2005 period from the Basic Survey of Japanese Business Structure and Activities. Using reduced-form specification, this chapter empirically analyzes the effect of the measure of firm-size dispersion, R&D intensity, and other variables on the following: (1) the fraction of exporters, (2) the fraction of MNEs, (3) the ratio of MNEs to non-MNE exporters, and (4) the fraction of the sum of exporters and MNEs. The results reveal that industries with a larger degree of productivity dispersion have a larger fraction of MNEs, larger ratio of MNEs to non-MNE exporters, and larger fraction of

the sum of exporters and MNEs. In addition, the results reveal that MNEs are concentrated heavily in R&D-intensive industries. However, they do not confirm the positive relationship between R&D intensity and the fraction of non-MNE exporters against our model's prediction. This suggests a need for a model that is more consistent with the data. The analysis also sheds light on the traditional source of comparative advantage, such as capital intensity and skill intensity. In particular, most of the estimation results show that capital intensity and skill intensity have no significant coefficient on the fraction of internationalized firms. This suggests that these traditional variables are less important in the structure of export and FDI than firm heterogeneity and R&D intensity. This chapter also shows that firm heterogeneity and R&D intensity play crucial roles in the structure of foreign trade and investment. Greater dispersion in productivity across firms within a single industry is associated with more FDI, as predicted in the model, and also with more exports. In addition, R&D-intensive industries have a larger fraction of MNEs.

Recent empirical studies on international trade at the firm level have found that firms engaging in export or FDI are generally more productive and larger than those firms serving only domestic markets. This finding is consistent with the theoretical predictions of heterogeneous firm trade models, most notably those of Melitz (2003) and Helpman et al. (2004), in which only productive firms are able to pay the entry costs associated with export and FDI and hence serve foreign markets. However, many empirical studies have also found that although the productivity of firms serving foreign markets is on average higher than that of firms serving only the domestic market, the productivity distributions of the two types of firm overlap significantly. This evidence implies that non-productivity factors are important determinants of the export and FDI behavior of firms. In chapter "The Role of Non-productivity Factors in the Internationalization of Firms", in investigating the role of unobserved firm heterogeneity rather than productivity heterogeneity in the internationalization of firms, Todo applies a multinomial logit model with random intercepts and random coefficients (a mixed logit model) of export and FDI decisions to firm-level data for Japan, based on Todo (2011). The inclusion of random intercepts and random coefficients on prior firm status in the export and FDI decisions may control for unobserved firm heterogeneity and correct for the biases associated with endogeneity. He then uses the resulting estimation results to examine the quantitative effects of productivity and the unobserved firm-specific random effects. From the mixed logit estimation, this chapter finds that the effect of productivity on the internationalization of firms is statistically significant but economically negligible. The effect of other observable firm characteristics such as firm size, the degree of credit constraints, and access to information is also found to be very small in magnitude. Rather, the internationalization of firms is determined mostly by their previous experience in foreign markets and firm characteristics that are unobserved in standard firm-level data. This chapter further shows that in the case of Japanese small and medium enterprises (SMEs), unobservable non-productivity factors such as the risk and time preferences and the international experience of decision makers affect export and FDI behavior, based on Todo and Sato (2011). These results imply that entry costs represent the major barrier to firm internationalization and that unobserved firm characteristics such as the

international experience of decision-makers are important determinants of entry costs. In addition, because firms are more likely to be concerned about the long-term discounted risk-averse utility from internationalization than the one-time risk-free utility that is assumed in standard heterogeneous firm models of trade, the risk and time preferences of decision-makers influence firm internationalization. These findings clearly indicate why there is a significant productivity distribution overlap between domestic and internationalized firms.

5 Internationalization in Multiple Regions

In chapter "Entry into Foreign Markets Through Foreign Direct Investment", employing firm-level data, Matsuura and Sato examine patterns of Japanese FDI in detail. Starting with an overview of recent trends in Japanese FDI, they point out several empirical constants on Japanese FDI, among others that a small number of MNEs have foreign subsidiaries in multiple countries. MNEs with larger scales of operations in the home country tend to penetrate a greater number of overseas markets, and only such MNEs are able to enter less popular markets. Productivity for larger firms is relatively higher than that for small firms. Hence, patterns of FDI are substantially influenced by firm heterogeneity in productivity. Another important observation is that a substantial proportion of FDI subsidiaries functions as export platforms. Such foreign subsidiaries serve their local markets as well as neighboring markets via exports. This tendency is particularly prominent for foreign subsidiaries located in East Asia. Motivated by these observations, the researchers extend the standard Melitz-type firm heterogeneity model by allowing FDI subsidiaries to deliver goods not only to host countries' markets but also to neighboring countries' markets. Thus, the model highlights that not only market sizes for destination countries but also those for their neighboring countries may affect firms' FDI decisions. Referring to such an extended market concept as "market potential," the model shows that market potential may affect FDI sales in terms of both the number of foreign affiliates (extensive margin) and average FDI sales per firm (intensive margin) through changing the cut-off level of firms' productivity. Indeed, Japanese FDI data show that a positive correlation between destination countries' market sizes and the number of each destination's foreign subsidiaries is quite weak, which suggests that some other factors, including market potential, might play an important role in determining extensive margins of FDI. Finally, using micro data on Japanese FDI sales, they estimate FDI intensive margins (average FDI sales per firm) and extensive margins (number of MNE subsidiaries) to confirm that the inclusion of market potential improves the fitness of the estimated gravity equation. The estimation results show that the market potential has a positive effect on both intensive margins and extensive margins of FDI sales. However, the coefficient for extensive margin is not statistically significant. The estimation coefficients for destination countries' market sizes measured in real gross domestic product (GDP) are always significantly positive for extensive margins. Hence, a possible interpretation is that Japanese firms tend to set up foreign subsidiaries by

initially targeting the markets of destination countries and only later on do they consider exporting from subsidiaries. Another interesting result of the estimation for Japanese FDI sales is that the negative effect of geographical distance on extensive margins is substantially greater than that obtained from the US FDI sales data (Yeaple 2009). This result suggests that the difference is partially attributable to the heavy concentration of Japanese FDI in East Asia.

The theoretical model by Helpman et al. (2004) reveals that various combinations between firms' internationalization strategy and productivity levels are observed, corresponding to different market conditions. While previous empirical studies investigated the relationship between firm-productivity levels and mode of internationalization in the world market as a whole, studies that examine how the modes of Japanese firms' internationalization may vary with different market-specific factors are hard to find. In chapter "Productivity and Modes of Internationalization: Evidence from Japanese Firms" Wakasugi and Tanaka attempt to fill the gap by empirically examining whether Japanese firms' productivity levels relate to their mode of internationalization with regard to exports to, and/or overseas FDI production in, countries of the North (i.e., North America and Europe) and the South (i.e., East Asia). This chapter statistically answers two questions: how extensive is the variation in firms' productivity corresponding to their destinations of internationalization between the North and the South and how significantly does firms' productivity divide the modes of internationalization in the North and the South. The empirical analysis uses firm-level data pertaining to 12,000 Japanese firms to reveal some interesting results: (1) internationalized Japanese firms show higher productivity levels than non-internationalized Japanese firms, regardless of market destinations and the modes of internalization adopted; (2) firms engaged in FDI in the North have higher productivity levels as compared to firms that export to the North; but (3) firms engaged in FDI in the South do not apparently have higher productivity levels than firms that only export to the South. The third result is contrary to the Helpman et al. (2004) model's prediction about an internationalization hierarchy where internationalized firms with higher productivity levels engage in FDI, while those with lower productivity levels export their products. The difference in variable and fixed costs, including transport costs and market sizes between the two regions, may be a source of the different productivity cut-off levels pertaining to FDI engagements by Japanese firms in the North and the South. The fact that wage rates in East Asian countries (the South) are lower than in the North, while they are similar across North America, Europe and Japan, supports this argument.

6 Management and Organization

In chapter "Foreign Direct Investment with Matching Frictions", Sato discusses the FDI decisions of individual firms under an environment in which firms and managers have to make matches for production. More specifically, the author extends the standard Melitz-type firm heterogeneity model by incorporating the

simple search and matching framework proposed by Rauch and Trindade (2003). This extension is motivated by an empirical fact that even though FDI firms are on average more productive than non-FDI firms, this hierarchy is not necessarily so clear, as will be discussed in chapter "Features of Japanese Internationalized Firms: Findings Based on Firm-Level Data". This ambiguous "pecking order" indicates a limit of the standard Melitz-type model for firms' decisions on FDI (e.g., Helpman et al. 2004). The model in this chapter expresses the following insights: (1) unfamiliarity about foreign countries is likely to make the search for efficient managers in foreign countries more difficult than in the home country, (2) consequently, matches in foreign countries tend to be associated with uncertainty about the quality of mangers, (3) when they hire low-quality managers, firms may not fully exert their intrinsic productivity level in foreign production, and (4) worse, even highly productive firms may not find appropriate mangers and may be forced to choose exports rather than FDI. Although the underlying idea of the model is rather simple, the author derives two interesting prognoses, which could shed light on some empirical findings that are not explained well by the standard Melitz-type model. First, predicted distributions of FDI firms are much more akin to real data than those suggested by the basic firm heterogeneity model, namely, there exists a range of firm productivities in which more productive firms may export while less productive firms may undertake FDI. Such a range of firm productivities becomes wider when either matching frictions increase or trade costs decline. Second, the model provides an explanation for the empirical finding of Yeaple (2009) that the ratio of an FDI firm's foreign-affiliate operation size to its home-operation size tends to decrease with distance and increase with the usage of common language, holding other things constant. This finding implies that the unit production cost in the foreign factory would be systematically different from that in the home factory, which never occurs in the standard Melitz model. By contrast, in the model presented in this chapter, the productivity of foreign affiliates depends not only on firms' intrinsic productivity levels but also on match quality. The average match quality is likely to decline in foreign countries in which it is difficult for firms to collect information about appropriate managers as much as they can do in the home country, which implies that the operation size becomes relatively small. Thus, the empirical finding that the ratio of the foreign-affiliate operation size to home operation size tends to decrease with distance and increase with the usage of common language can be readily understood in the model, given that the degree of matching frictions is negatively correlated to geographical proximity between the FDI host and home countries or the usage of a common language.

In the final chapter, Matsuura and Ito focus on increasing intra-firm trade undertaken by MNEs and empirically examine the determinants of intra-firm trade. This chapter sheds light not only on factor prices and trade costs, but also on organizational structure in terms of the ownership of overseas plants and the control over intermediate inputs for further processing. Regarding the relationship between the intra-firm trade and the control over intermediate inputs, Feenstra and Hanson (2005) have pointed out that the decision-making of MNEs on whether to supply intermediate goods from the home country to their foreign affiliates, or to engage

in local procurement, is dependent on the value-added ratio of the affiliate firm and the contract environment in the local market. According to the property rights approach, the control over inputs should be given to local managers when their efforts measured by the value-added ratio are crucial. In this case, as the local procurement of intermediate inputs is optimal by allocating the control right over inputs, intra-firm trade consequently decreases. On the other hand, when local manager efforts are not important, the incentive system implies that both ownership and control should be allocated to the foreign firm. In addition, contractibility might affect the organizational structure. In a poor business environment, MNEs hesitate to give control rights over inputs to local managers since the cost of negotiations would be extremely high. Thus, when local manager efforts are important and the degree of legal enforcement is adequate, the control rights over inputs are given to the local managers. In contrast, when the degree of contractibility in the host country is low or the managers' efforts are not crucial, foreign firms maintain both ownership and control over inputs by dispatching a manager from their headquarters and by increasing intra-firm trade. In line with these hypotheses, this chapter examines how allocating the control right over intermediate inputs affects intra-firm trade, using Japanese foreign affiliate-firm level data. Since organizational structure and intra-firm trade are jointly determined, instrumental variable (IV) estimations are employed. Results of the random effects probit model show that control over input decisions is positively correlated with the value-added ratio of affiliated firms, as predicted. The results of the random effects IV regression on intra-firm trade clearly indicate that granting control rights over input purchases to local managers has a large impact on the procurement of intermediate inputs from Japan, after controlling for endogeneity. This finding contributes to the literature by suggesting that control over input decisions critically affects the intra-firm trade of intermediate inputs. This chapter also considers differences in country-specific institutional qualities and shows that intra-firm procurement is increasing in countries that display poor performance of institutional factors. This result suggests that the improvement of legal institutions is a crucial factor for boosting the purchase of local inputs by MNEs. Further, it is suggested that policymakers should provide an FDI-friendly environment where MNE affiliates can operate for a long period of time. This is because the delegation of decision rights to local residents and the subsequent increase in local procurement is time consuming.

The articles in this book analyze empirically the features of Japanese internationalized firms, using micro-level data on Japanese firms. Such use of firm-level data is essential to investigate the sources of internationalization: firm-specific and industry-specific factors including productivity heterogeneity, management, and organization, and market specific factors. The use of Japanese firm-level panel data in each chapter is a unique advantage of this book.

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Features of Japanese Internationalized Firms: Findings Based on Firm-Level Data

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Abstract By using firm-level data on the Japanese manufacturing industry, we examine and compare the characteristics of internationalized Japanese firms, namely firms that engage in exports and/or foreign direct investment (FDI), with those from

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selected European countries. We find that the productivity of internationalized firms is higher than that of domestic firms, thus confirming the findings of previous studies on Japan and other countries. In addition, we show that the productivity differences between domestic firms, exporters, and FDI firms are substantially smaller in Japan than they are in European countries. This finding suggests that productivity differences alone cannot determine the export or FDI behavior of Japanese firms.

Keywords Exports • Foreign direct investment • Productivity • Self-selection

1 Introduction

A number of empirical studies published since the mid-1990s have used firm-level data in order to show that multinational enterprises display distinct characteristics. Since the seminal paper by Bernard and Jensen (1995) in the United States, such studies have found a correlation between export status and firm characteristics. Bernard et al. (2007) summarize the results of the empirical studies on this topic by observing that "exporters have been shown to be larger, more productive, more skill- and capital-intensive, and to pay higher wages than non-exporting firms." Other studies have also confirmed that firms that have relatively high productivity tend to be exporters, including Bernard and Jensen (1999) for the US, Aw et al. (2000) for Taiwan, and Clerides et al. (1998) for Colombia, Mexico, and Morocco.

The productivity of European exporters has also been shown to be higher than that of non-exporting firms. Mayer and Ottaviano (2007) summarize the results of a research project on the relation between firm productivity and degree of internationalization, titled "European Firms and International Markets" (EFIM).[1] They find that the productivity of Europe-based internationalized firms or firms that serve international markets through exports or foreign direct investment (FDI) is higher than that of firms that only serve the domestic market (domestic firms hereafter). Mayer and Ottaviano (2007) call these internationalized firms "the happy few" in reference to Shakespeare's play *Henry V*.

Recent empirical studies such as the above-mentioned that use firm-level data have fostered the development of a new theory of international trade that assumes heterogeneous firms within industries rather than the representative firm assumed in traditional or new trade theory. This new approach was first developed by Melitz (2003), who incorporates heterogeneity in firm productivity into the new trade theory model of Krugman (1980). Melitz's (2003) model predicts that more productive firms engage in exports, while less productive firms serve only the domestic market, since exporting requires additional costs.

[1]EFIM, a research network, was established in 2006. The EFIM research network consists of the Brussels European and Global Economic Laboratory (Bruegel), the Centre for Economic Policy Research (CEPR), and eight research institutes in EU countries. For details, see Mayer and Ottaviano (2007).

Melitz's model has been extended in various directions. In particular, Helpman et al. (2004) examine not only exports but also horizontal FDI. Assuming that the costs of FDI are greater than those of exporting, the authors conclude that the most productive firms engage in FDI, that less productive firms engage in exporting, and that the least productive firms serve only the domestic market. This theoretical prediction is consistent with the empirical results of previous studies such as Mayer and Ottaviano (2007). Moreover, following Antràs (2003), Antràs and Helpman (2004) incorporate incomplete contract theory into the model of Melitz (2003) in order to model various modes of internationalization, such as FDI and offshoring.[2]

Reflecting these developments in theory and empirics, a number of empirical studies have also examined the relationship between firm characteristics and internationalization in Japan. The stylized facts that these studies have presented can be summarized as follows. First, in Japan as elsewhere, highly productive firms become exporters or multinational enterprises through FDI. Studies that have provided clear evidence of the link between firm productivity and export and/or FDI activities include Head and Ries (2001, 2003), Kimura and Kiyota (2006), and Tomiura (2007). Second, research shows that exports and FDI are complementary. Head and Ries (2001), for instance, show that FDI experience positively influences starting export operations, while Kiyota and Urata (2005) find evidence that export experience positively affects FDI. According to Kiyota and Urata (2005), firms that conduct business overseas through FDI account for only 13.8 % of all Japanese firms, but generate 95.1 % of total export value. This finding implies that the vast majority of firms that conduct FDI are also exporters and that exporters also conduct FDI. Third, it has been shown that firm performance improves because of exporting or conducting FDI. Head and Ries (2002) find that FDI to low-income countries contributes to the upgrading of the skill intensity of Japanese firms. Furthermore, Higuchi and Matsuura (2003) show that after performing FDI, Japanese firms' lower employment levels but raise value added and labor productivity. Moreover, Kimura and Kiyota (2006) find that exports and FDI improve total factor productivity (TFP), while Hijzen et al. (2008) show that offshoring, including FDI, stimulates productivity growth. Similarly, Hijzen et al. (2007) find that FDI increases production, employment, and productivity in parent firms.

Against this background, the purpose of this chapter is twofold. First, this chapter employs firm-level data and analyzes a large set of evidence on internationalized firms in Japan, following Mayer and Ottaviano (2007), in order to verify the findings of previous studies. In addition, we use more recent data over a longer period than those employed by previous studies and obtain several new findings. The second purpose is to explore the differences between Japanese and European internationalized firms by comparing our results with those of Mayer and Ottaviano (2007) on European firms. No such systematic comparison has thus far been presented in the literature.

[2]See Helpman (2006) for an excellent survey on trade theory with firm heterogeneity.

For these purposes, we use data on Japanese firms derived from *Kigyo Katsudo Kihon Chosa* (the Basic Survey of Japanese Business Structure and Activities) for 1997–2005. This survey is conducted annually by the Ministry of Economy, Trade, and Industry (METI) and it covers all firms that have employees of 50 or more and capital of 30 million yen or more. The period 1997–2005 is the longest period for which consistent data on exports are available. Although the survey includes firms in the services sector, we focus on manufacturing firms since they play the most significant role in international trade and FDI. In addition, when necessary, we use data on the overseas subsidiaries of Japanese firms compiled from *Kaigai Kigyo Katsudo Kihon Chosa* (the Basic Survey of Overseas Business Activities), also collected annually by the METI. The details of the data used in this chapter are presented in the Appendix.

Our findings confirm those of previous works that the number of internationalized firms in Japan is very small and that export firms are larger and more productive than domestic firms, while those that engage in both exports and FDI are even larger and more productive again. We also show that the characteristics of internationalized firms in Japan are mostly similar to those of their European counterparts. However, we find several notable differences between Japan and Europe, especially that productivity differences between domestic firms, exporting firms, and FDI firms are substantially smaller in Japan than they are in Europe. This finding suggests that variations in productivity alone cannot explain the export and FDI behavior of Japanese firms.

The remainder of this chapter is organized as follows. In Sect. 2, we present the distribution of the exported values of exporters in Japan. Section 3 describes the features of internationalized firms, particularly the performances of internationalized firms compared with domestic firms. Furthermore, we discuss whether higher productivity causes a firm to internationalize (self-selection bias) or vice versa (learning-by-exporting effect). In Sect. 4, we statistically calculate the productivity cut-off for exports and FDI under the assumption of the Pareto distribution of TFP. In addition, by comparing the features of the Pareto distribution and productivity cut-off levels, we investigate heterogeneous internationalization among industries. Finally, Sect. 5 summarizes our findings.

2 Exporters in Japan

2.1 Heterogeneity of Exporting Firms

2.1.1 Dominance of Top Exporters

We start our examination of Japan's export structure by assessing firms' proportions of total exports and manufacturing employment. Beginning with an international comparison, Table 1 shows the percentage of total manufacturing exports accounted

Table 1 Top exporters' share in total exports, manufacturing sector

Country	Top 1 %	Top 5 %	Top 10 %
Japan	62	85	92
Germany	59	81	90
France	44 (68)	73 (88)	84 (94)
United Kingdom	42	69	80
Italy	32	59	72
Hungary	77	91	96
Belgium	48	73	84
Norway	53	81	91
United States			96

Source: The data for Japan are authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*, those for the United States from Bernard et al. (2007), and those for the European countries from Mayer and Ottaviano (2007)

Note: The figures for Japan, France, Germany, Hungary, Italy and the UK are based on large firms only, while those for Belgium, Norway, and the United States cover all firms. The figures in parentheses for France are those for all firms. The figures for the United States are for 2000, while those for all other countries are for 2003

for by the top exporters ranked in terms of their individual exports in each country. We find that in all countries, the top 10 % of exporters are responsible for the overwhelming majority of total export value, although the degree of dominance among the top 1 and top 5 % varies to a larger extent than in the case of the top 10 %. In Japan, the top 1, 5, and 10 % of exporters account for 62, 85, and 92 % of total export value, respectively.

Further, Fig. 1 illustrates the dominance of exporters in terms of exports and number of employees. On the horizontal axis, exporters are ranked in terms of their exports from left to right, while the vertical axis shows their proportions of exports and employment relative to all exporters. The diagonal line indicates that the exports as well as employment rates among the various firms are identical. Therefore, the further away a curve is located from the diagonal line to the top left, the more the distribution is unequally partial. Figure 1 clearly shows that exports and employment are dominated by the top exporters, although the degree of dominance for employment level is smaller than that for exports.

2.1.2 Dominance Over Time

In contrast to the abovementioned observation, the dominance of top exporters has declined somewhat in recent years. Figure 2 shows that between 1997 and 2005, the proportion of total exports accounted for by the leading exporters fell by between

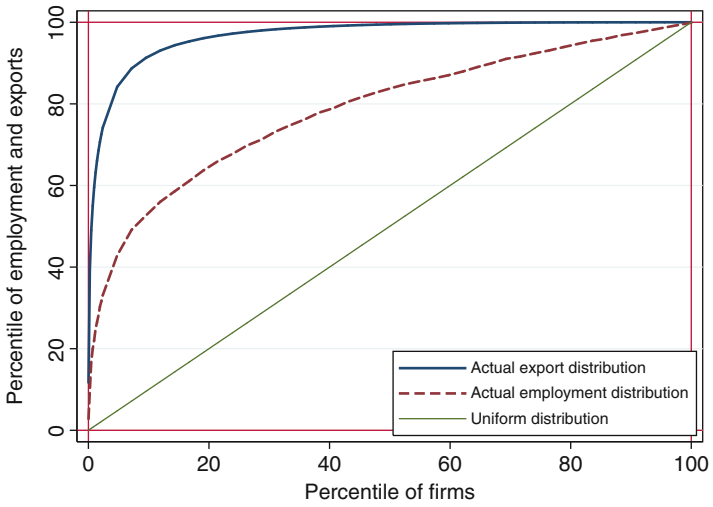
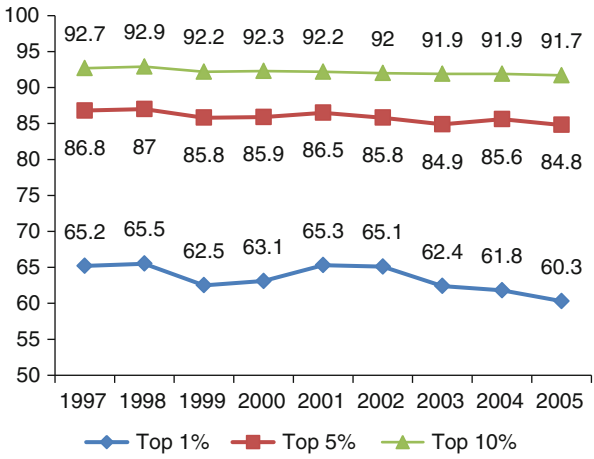


Fig. 1 Top exporters' share in total exports and employment in Japan, 2005. *Note*: The *horizontal axis* shows firms arranged in order of their value of exports (high to low). *Source*: METI, *Basic Survey of Japanese Business Structure and Activities*

Fig. 2 Top exporters' share in total exports: 1997–2005 (Japan, total manufacturing). *Source*: Authors' calculation based on METI, *Basic Survey of Japanese Business Structure and Activities*



1 and 5 % age points. In addition, Fig. 3 presents the change from 1998 to 2004 in the distribution of exporters in terms of their exports. Both figures indicate a slight decline in the dominance of top exporters, suggesting the presence of active new entrants in the export market. However, this declining trend in Japan contrasts with that in France where, according to Mayer and Ottaviano (2007), the dominance of the leading exporters hardly changed from 1998 to 2003.

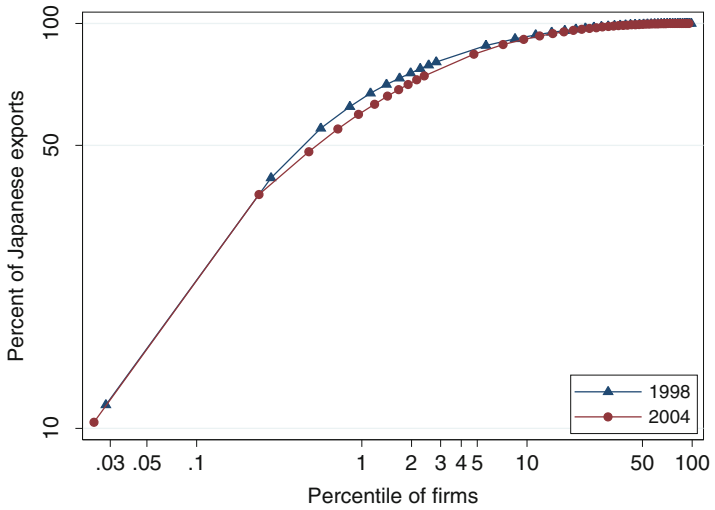


Fig. 3 Top exporters' share in total exports, logarithmic transformation, 1998 and 2004. *Note*: The *horizontal axis* shows firms arranged in order of their value of exports (high to low). *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

2.2 Export Specialization

2.2.1 Exporters and Export Intensity

The proportion of exporters relative to all firms varies by country. Here, we examine the percentage of firms that export and their export intensity, which is defined as the percentage of turnover that they derive from exports. Table 2 shows the relevant figures for Japan, the US, and selected European countries. These figures indicate that less than one-third of firms (30.5 %) in Japan are engaged in exports, which is lower than in all European countries mentioned in the table except the United Kingdom. The relatively low percentage of exporters in Japan comes as little surprise, however, for two reasons. First, the size of the Japanese domestic market is as large as that in Germany, where exporters also account for a low proportion. Second, Japan shares none of the advantages in terms of geographic, cultural, and linguistic proximity to major trading partners and regional integration that European countries enjoy.

Next, looking at export intensity in the middle columns of Table 2, clear country-level differences can be observed. While the percentage of firms that rely on exports for at least 5 % of their turnover is similar to that for the percentage of firms that export, there are stark differences in the percentage of firms that derive the majority of their turnover from exports. Whereas this figure is only 1.7 % in Japan, it is at least 5 % in six of the studied European countries and more than 20 % in Italy and Hungary. However, 1.7 % of Japanese firms that derive more than 50 % of

Table 2 International comparison of total manufacturing exports and distribution of exports by type of firm, 2003

Country	Number of firms	Total mfg. exports (billion €)	Percent of exporters	Percent of firms exporting more than				Percent of total exports by firms exporting more than			
				5 % of turnover	10 % of turnover	50 % of turnover	90 % of turnover	5 % of turnover	10 % of turnover	50 % of turnover	90 % of turnover
Japan	12,660	318.0	30.5	16.2	11.4	1.7	0.2	98.0	94.8	47.2	2.6
Germany	48,325	488.7	59.3	46.9	40.3	11.9	1.0	99.5	98.5	73.6	6.0
France	23,691	171.7	67.3	41.2	33.0	9.0	1.4	93.6	95.1	49.2	9.7
United Kingdom	14,976	71.5	28.3	22.5	19.3	8.1	1.5	97.6	93.4	65.7	19.0
Italy	4,159	58.6	74.4	64.9	57.4	25.6	2.9	99.7	98.5	69.1	7.5
Hungary	6,404	30.0	47.5	38.4	34.7	22.2	11.0	99.9	99.6	92.0	69.1
Norway	8,125	16.1	39.2	18.0	14.5	5.2	1.3	98.5	97.4	70.3	28.6
United States			18								

Source: The data for Japan are authors' calculations based on METI, Basic Survey of Japanese Business Structure and Activities, those for the United States are from Bernard et al. (2007), and those for the European countries from Mayer and Ottaviano (2007). The figures for Japan, France, Germany, Hungary, Italy and the UK are based on large firms only, while those for Belgium, Norway, and the United States cover all firms. The total manufacturing exports for Japan were converted to euro using the exchange rate released by Japan Customs

their turnover from exports account for a disproportionate 47.2 % of total exports. Nevertheless, this figure is again (considerably) lower than in European countries, indicating a lower degree of export intensity among exporting firms in Japan.

2.2.2 Increasing Amount of Exporting

Table 3 shows that the total value of Japanese firms' exports increased from 34 billion yen in 1997 to 48 billion yen in 2005, while the percentage of firms that export rose from 24.9 to 31.7 % over the same period. In parallel, the proportion of firms who rely on exports for more than 5, 10, and 50 % of their turnover also increased, the latter from 1 % in 1997 to almost 2 % in 2005, meaning that the proportion of total exports accounted for by such firms climbed from 29.3 to 50.4 %.

2.2.3 Industry Comparison

As shown in Table 4, the percentage of manufacturing firms that export relative to all manufacturing firms in 2005 was 31.4 %. However, this overall figure masks wide variations, with the percentage of exporters ranging from less than 10 % in the publishing and printing, wood products, apparel, and food and beverages industries to approximately 50 % or more in the machinery and equipment, chemicals, and precision instruments industries. Meanwhile, those industries that have the largest export intensity are Japan's major export industries, namely the motor vehicles (14.8 %), machinery and equipment (17.3 %), electrical machinery and apparatus (18.7 %), and precision instruments industries (19.1 %). These findings confirm the large discrepancies in the characteristics of exporting firms across manufacturing subsectors in Japan in line with Bernard et al.'s (2007) findings in the US.

3 Characteristics of Internationalized Firms

3.1 Competitive Advantages of Internationalized Firms

3.1.1 Employee, Value Added, Wage, Capital Intensity and Skill Intensity Premiums

In this subsection, we compare the performances of internationalized firms with those of domestic firms. We begin by examining the export (FDI) ratio—measured as the average value of exporters (or firms that invest overseas) relative to the average value of non-exporters (or firms that do not invest overseas)—for a number of indicators, namely employment, value added, wages, capital intensity, and skill

Table 3 Total manufacturing exports and distribution of exports by type of firm, Japan: 1997–2005

Year	Number of firms	Total mfg exports (trillion yen)	Percent of exporters	Percent of firms exporting more than				Percent of total exports by firms exporting more than			
				5 % of turnover	10 % of turnover	50 % of turnover	90 % of turnover	5 % of turnover	10 % of turnover	40 % of turnover	50 % of turnover
1997	14,104	33.99	24.9	11.5	7.8	1.0	0.2	97.3	93.3	54.5	29.3
1998	14,075	34.72	25.2	12.0	8.3	1.1	0.1	97.6	94.4	59.8	40.3
1999	13,861	33.22	26.3	12.6	8.9	1.1	0.1	97.5	94.7	56.0	24.4
2000	13,486	36.91	27.8	13.7	9.5	1.2	0.1	97.4	94.7	56.6	35.1
2001	13,470	35.30	28.8	14.3	10.1	1.4	0.2	97.3	94.5	61.0	49.1
2002	13,158	37.63	29.8	15.4	11.1	1.6	0.1	97.7	94.8	62.0	48.1
2003	12,660	41.55	30.5	16.2	11.4	1.7	0.2	98.0	94.8	64.5	47.2
2004	13,472	40.54	29.5	15.4	11.0	1.6	0.2	97.8	94.6	60.9	47.8
2005	13,203	47.99	31.7	16.9	12.2	1.9	0.2	98.3	94.8	64.8	50.4

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Table 4 Japanese manufacturing exports by industry, 2005

Industry	Number of firms	Value of exports (100 billion yen)	Percent of exporters	Average ratio of exports to sales
Total manufacturing	13,203	479.95	31.7	13.6
Food products and beverages	1,599	0.96	9.3	4.3
Textiles	281	0.46	22.4	5.9
Wearing apparel	270	0.13	9.3	4.8
Wood and products of wood	142	0.03	9.2	2.7
Furniture	153	0.05	11.8	3.6
Paper and paper products	390	0.32	13.1	5.7
Publishing and printing	827	1.83	7.0	2.7
Leather	29	0.07	31.0	5.4
Rubber products	158	6.31	44.9	12.2
Chemicals and chemical products	930	30.95	52.7	10.4
Coke, refined petroleum and plastic products	759	12.62	31.1	8.4
Other non-metallic mineral products	494	4.43	22.5	11.1
Basic iron and steel	408	3.19	20.1	7.4
Non-ferrous metals	318	8.81	39.9	10.0
Basic metals	988	2.24	26.8	8.8
Machinery and equipment	1,610	71.43	49.6	17.3
Electrical machinery and apparatus	1,986	136.01	41.7	18.7
Motor vehicles	1,155	178.56	36.3	14.8
Precision instruments	380	12.85	61.1	19.1
Other manufacturing	326	8.70	42.6	13.4

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

intensity.[3] Table 5 compares these ratios for Japan with those for a number of European countries. First, it can be seen that the ratios in Japan are greater than one in all cases, demonstrating clear evidence of an export and FDI advantage for Japanese firms. This finding suggests that internationalized firms employ more workers, produce more value added, pay higher wages, and are more capital- and skill-intensive than domestic firms.

Further, the ratios are greater for FDI than they are for exports in a number of countries including Japan. In other words, firms that engage in FDI are larger on average than those that export only. The same pattern also holds for value added. In Japan, for example, FDI firms roughly add nine times more value than non-FDI firms, while exporters add only approximately five times more value than non-exporters. A further observation is that the gap between FDI firms and exporters

[3]We define skill intensity as the number of skilled workers per unskilled worker. Moreover, following previous studies such as Head and Ries (2002), we use nonproduction workers and production workers as proxies for skilled workers and unskilled workers, respectively.

Table 5 Export and FDI premium

Country	Employment premium	Value added premium	Wage premium	Capital intensity premium	Skill intensity premium
Export premium					
Japan	3.02 (3.76)	5.22 (6.06)	1.25 (1.10)	1.29 (1.00)	1.58 (1.30)
Germany	2.99 (4.39)		1.02 (0.06)		
France	2.24 (0.47)	2.68 (0.84)	1.09 (1.12)	1.49 (5.6)	
United Kingdom	1.01 (0.92)	1.29 (1.53)	1.15 (1.39)		
Italy	2.42 (2.06)	2.14 (1.78)	1.07 (1.06)	1.01 (0.45)	1.25 (1.04)
Hungary	5.31 (2.95)	13.53 (23.75)	1.44 (1.63)	0.79 (0.35)	
Belgium	9.16 (13.42)	14.8 (21.12)	1.26 (1.15)	1.04 (3.09)	
Norway	6.11 (5.59)	7.95 (7.48)	1.08 (0.68	1.01 (0.23)	
FDI premium					
Japan	4.79 (8.71)	8.79 (12.52)	1.26 (1.24)	1.53 (1.23)	1.52 (1.52)
Germany	13.19 (2.86)				
France	18.45 (7.14)	22.68 (6.1)	1.13 (0.9)	1.52 (0.72)	
Belgium	16.45 (6.82)	24.65 (11.14)	1.53 (1.2)	1.03 (0.82)	
Norway	8.28 (4.48)	11 (5.41)	1.34 (0.76)	0.87 (0.13)	

Source: For Japan, authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*; for other countries, Mayer and Ottaviano (2007)
Note: Refer to the text for an explanation of how the premia were calculated. Figures in parentheses are the ratio of standard deviations. The figures for Japan, France, Germany, Hungary, Italy and the UK are based on large firms only, while those for Belgium and Norway cover all firms

in terms of the employment and value added premiums is smaller in Japan than it is in European countries. For example, the employment premium for FDI firms in Japan is 18.45 but only 2.24 for exporters, while the equivalent ratios for the value added premium are 22.68 and 2.68 in France. Thus, in France there are substantial differences in the average firm size between firms that conduct FDI and firms that export. Other European countries, with the exception of Norway, show a similar tendency. However, this finding is not the case for Japan in which the employment premium for FDI firms is 4.79 and 3.02 for exporters, while the value added premium is 8.79 and 5.22, respectively.

In addition, we find that both in Japan and in Europe, the wages paid by exporting and FDI firms are higher than their non-exporting or non-FDI counterparts, with the wage premium ranging from 2 % (i.e., a ratio of 1.02, for Germany) to 53 % (for Belgium). With a wage premium of approximately 25 % for both exporters and FDI firms, Japan falls into the middle of this range. Differences in capital and skill intensity may explain these wage differentials. As Table 5 shows, exporting and FDI firms in most countries are indeed more capital-intensive than non-exporting/non-FDI firms. Moreover, exporting and FDI firms in Japan are more skill-intensive than their non-exporting/non-FDI counterparts.

Table 6 Export and FDI premium in Japan (1997–2005)

Year	Employment premium	Value added premium	Wage premium	Capital intensity premium	Skill intensity premium	TFP premium
Export premium						
1997	3.47 (4.10)	4.44 (3.25)	1.20 (1.00)	1.24 (0.82)	1.29 (0.92)	1.20 (0.84)
1998	3.53 (4.23)	4.43 (3.53)	1.20 (1.03)	1.24 (0.79)	1.40 (0.86)	1.16 (1.24)
1999	3.22 (3.34)	4.09 (3.29)	1.19 (1.00)	1.22 (0.80)	1.36 (0.86)	1.17 (1.14)
2000	3.14 (3.59)	4.42 (3.94)	1.20 (1.04)	1.22 (0.84)	1.57 (4.17)	1.21 (1.01)
2001	3.03 (3.50)	4.35 (4.56)	1.21 (1.03)	1.24 (0.88)	1.52 (1.14)	1.16 (0.94)
2002	3.01 (3.41)	4.80 (5.15)	1.23 (1.16)	1.27 (0.88)	1.60 (1.67)	1.23 (1.30)
2003	3.02 (3.76)	5.22 (6.06)	1.25 (1.10)	1.29 (1.00)	1.58 (1.30)	1.32 (1.76)
2004	2.12 (2.27)	2.88 (2.04)	1.20 (1.02)	1.17 (0.79)	1.47 (1.13)	1.34 (1.50)
2005	2.69 (3.21)	4.69 (5.53)	1.25 (1.07)	1.31 (0.91)	1.65 (1.32)	1.38 (1.47)
FDI premium						
1997	5.93 (6.65)	8.96 (7.92)	1.19 (1.05)	1.43 (0.89)	1.20 (1.07)	1.23 (0.92)
1998	5.72 (6.69)	8.16 (6.58)	1.18 (1.07)	1.42 (0.93)	1.31 (0.97)	1.17 (1.18)
1999	5.84 (10.43)	8.69 (10.16)	1.19 (1.04)	1.46 (1.03)	1.28 (0.94)	1.19 (1.10)
2000	5.56 (10.20)	9.00 (9.65)	1.21 (1.20)	1.54 (1.12)	1.65 (4.78)	1.22 (1.13)
2001	5.25 (9.10)	8.30 (7.37)	1.22 (1.17)	1.51 (1.07)	1.47 (1.57)	1.16 (1.00)
2002	5.00 (9.74)	8.90 (15.61)	1.25 (1.33)	1.53 (1.01)	1.51 (1.59)	1.22 (1.17)
2003	4.79 (8.71)	8.79 (12.52)	1.26 (1.24)	1.53 (1.23)	1.52 (1.52)	1.26 (1.06)
2004	4.51 (8.52)	8.12 (11.11)	1.25 (1.20)	1.54 (1.04)	1.59 (1.85)	1.28 (1.31)
2005	4.38 (7.69)	7.57 (8.85)	1.24 (1.17)	1.56 (1.07)	1.58 (1.48)	1.31 (1.47)

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Note: Refer to the text for an explanation of how the premia were calculated. Figures in parentheses are the ratios of standard deviation

3.1.2 Changes in Premiums Over Time

Table 6 presents the changes in the above-mentioned premiums for exporters and FDI firms from 1997 to 2005 in addition to the trends for TFP premium. While the employee premium of exporting and FDI firms was on a downward trend between 1997 and 2005, the skill intensity of these firms was on an upward trend. These trajectories most likely reflect the overseas transfer or offshoring of production activities and the dominance on skill-intensive head office functions at home.

3.1.3 Productivity Premium

Tables 7 and 8 show the differences in productivity between internationalized and domestic firms for exporters and FDI firms compared with non-exporting or non-FDI firms. Three measures of productivity are shown: apparent labor productivity (ALP), which is defined as revenue per worker, ordinary labor productivity, which is defined as value added per worker, and TFP, which is estimated using the method

Table 7 Export premium by industry, 2005

Industry	Apparent labor productivity	Labor productivity (VA/L)	Estimated TFP (Olley-Pakes)
Total manufacturing	1.34 (1.29)	1.48 (1.38)	1.38 (1.47)
Food products and beverages	1.58 (1.12)	1.66 (1.18)	1.45 (1.28)
Textiles	1.53 (1.68)	1.35 (2.59)	1.24 (1.82)
Wearing apparel	2.00 (1.57)	1.52 (1.25)	1.53 (1.51)
Wood and products of wood	1.11 (1.11)	1.10 (0.38)	1.04 (0.53)
Furniture	1.34 (2.00)	1.32 (1.65)	1.28 (1.75)
Paper and paper products	1.09 (0.85)	1.17 (1.25)	1.10 (1.16)
Publishing and printing	1.38 (1.43)	1.06 (0.93)	1.03 (0.98)
Leather	0.98 (0.77)	1.20 (1.25)	0.98 (0.58)
Rubber products	1.27 (0.90)	1.28 (0.92)	1.22 (1.00)
Chemicals and chemical products	0.88 (0.31)	1.36 (0.53)	1.09 (0.97)
Coke, refined petroleum and plastic products	1.78 (2.37)	1.27 (1.58)	1.19 (1.34)
Other non-metallic mineral products	1.20 (1.14)	1.34 (1.62)	1.24 (1.22)
Basic iron and steel	0.90 (0.61)	1.11 (1.06)	1.00 (0.87)
Non-ferrous metals	1.11 (0.70)	1.31 (1.10)	1.24 (1.00)
Basic metals	1.06 (0.90)	1.28 (0.97)	1.23 (1.00)
Machinery and equipment	1.26 (0.92)	1.21 (0.71)	1.15 (0.75)
Electrical machinery and apparatus	1.52 (1.38)	1.43 (1.24)	1.29 (1.26)
Motor vehicles	1.37 (1.06)	1.28 (1.25)	1.21 (1.21)
Precision instruments	1.16 (1.28)	1.20 (0.94)	1.12 (0.88)
Other manufacturing	1.09 (1.11)	1.11 (1.06)	1.05 (0.99)

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Note: The firms considered are manufacturers with more than 50 employees. Figures in parentheses are the ratios of standard deviation

of Olley and Pakes (1996). Table 7 shows that in most cases, the productivity of exporters is higher than that of non-exporters. In the manufacturing sector, exporters are between 34 and 48 % more productive, depending on which measure is chosen. These results are qualitatively similar to those obtained by Mayer and Ottaviano (2007) for France, who find that the productivity of exporters in that country is between 15 and 31 % higher than that of non-exporters. The results in Table 8 for FDI firms paint a similar picture. Again, FDI firms are more productive than non-FDI firms in most cases, by 31–44 % on average.

3.2 Productivity Distribution of Firms

We now examine the relative productivity of internationalized firms compared with their domestic counterparts from another angle. Figures 4 and 5 respectively show the distributions of ALP and TFP for the following four types of firms in

Table 8 FDI premium by industry, 2005

Industry	Apparent labor productivity	Labor productivity (VA/L)	Estimated TFP (Olley-Pakes)
Total manufacturing	1.44 (1.28)	1.44 (1.29)	1.31 (1.47)
Food products and beverages	1.66 (1.15)	1.64 (1.41)	1.39 (1.21)
Textiles	1.61 (0.94)	1.28 (0.71)	1.16 (0.85)
Wearing apparel	1.53 (1.24)	1.31 (1.22)	1.20 (1.12)
Wood and products of wood	1.05 (0.67)	1.04 (0.60)	1.02 (0.81)
Furniture	1.46 (1.81)	1.45 (1.71)	1.40 (1.62)
Paper and paper products	1.34 (1.10)	1.22 (0.99)	1.06 (0.71)
Publishing and printing	1.73 (2.28)	1.25 (1.37)	1.10 (0.92)
Leather	1.61 (1.75)	1.37 (1.87)	1.04 (0.76)
Rubber products	1.48 (1.19)	1.29 (0.97)	1.32 (1.13)
Chemicals and chemical products	1.00 (0.35)	1.27 (0.64)	1.05 (0.94)
Coke, refined petroleum and plastic products	1.42 (1.47)	1.18 (1.59)	1.10 (1.27)
Other non-metallic mineral products	1.24 (0.99)	1.29 (0.94)	1.22 (0.75)
Basic iron and steel	0.99 (0.65)	1.27 (1.55)	1.13 (1.24)
Non-ferrous metals	1.22 (0.81)	1.19 (1.11)	1.08 (0.81)
Basic metals	1.22 (1.04)	1.29 (1.11)	1.24 (1.27)
Machinery and equipment	1.39 (1.10)	1.25 (0.85)	1.17 (0.81)
Electrical machinery and apparatus	1.60 (1.45)	1.44 (1.18)	1.30 (1.35)
Motor vehicles	1.44 (1.12)	1.32 (1.25)	1.19 (1.14)
Precision instruments	1.39 (1.79)	1.29 (1.36)	1.19 (1.18)
Other manufacturing	1.39 (1.55)	1.28 (1.68)	1.19 (1.39)

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Note: The firms considered are manufacturers with more than 50 employees. Figures in parentheses are the ratios of standard deviation

Japan: domestic firms, pure exporters (i.e., firms that only rely on exports to serve overseas markets), pure FDI firms, and export and FDI firms, which are firms that both export and invest abroad. These figures show that the productivity of pure exporters and pure FDI firms is higher than that of domestic firms and that the productivity of export and FDI firms is the highest of all.

To verify whether the differences between these four types of firms are statistically significant, we perform standard t tests for the equality of the mean of the productivity measure between firm types as well as two-sample Kolmogorov–Smirnov tests for the equality of the distribution, following Delgado et al. (2002) and Wagner (2006). The results of the t tests and Kolmogorov–Smirnov tests as well as the descriptive statistics for each of the four types of firms presented in Table 9 indicate that the difference in productivity, measured by either ALP or TFP, between domestic and internationalized firms, between pure exporters and export and FDI firms, and between pure FDI firms and export and FDI firms is statistically significant. These findings are consistent with the theoretical predictions of Melitz (2003) and Helpman et al. (2004) as well as with previous empirical findings.

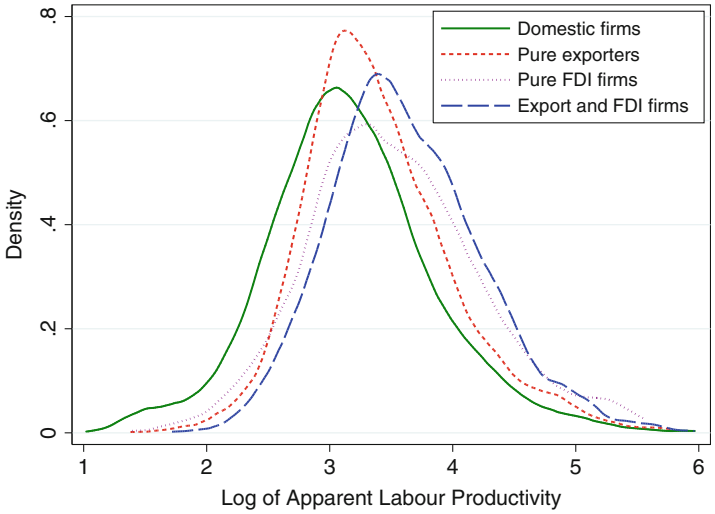


Fig. 4 Productivity distribution of Japanese FDI firms and exporters (APL), 2005. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

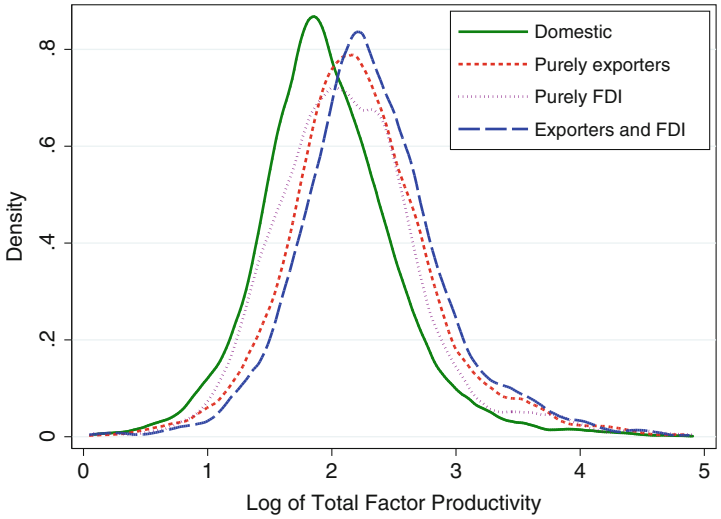


Fig. 5 Productivity distribution of Japanese FDI firms and exporters (TFP), 2005. *Note*: TFP is estimated following the Olley-Pakes method. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

However, there is no statistically significant difference in the TFP distribution between pure exporters and pure FDI firms. In the comparison of the productivity distribution of Japanese firms with that of Belgian firms by Mayer and Ottaviano (2007) presented in Fig. 6, the difference in the productivity premium between

Table 9 Productivity distribution in the Japanese manufacturing sector, 2005

		Domestic firms	Exporters	FDI firms	Export and FDI firms	All
Number of firms		8,226	1,872	791	2,314	13,203
Share of each type		62.30	14.18	5.99	17.53	100.00
Log of ALP	Mean	3.17	3.41	3.52	3.63	3.30
	SD	(0.71)	(0.63)	(0.73)	(0.65)	(0.71)
Log of TFP	Mean	1.97	2.23	2.11	2.31	2.08
	SD	(0.59)	(0.63)	(0.67)	(0.65)	(0.63)

		Domestic firms vs. exporters	Exporters vs. FDI firms	FDI firms vs. export and FDI firms	Exporters vs. Export and FDI firms
Log of ALP	Prob-values of t-test	0.00	0.00	0.00	0.00
	Prob-values of KS-test	0.00	0.00	0.00	0.00
Log of TFP	Prob-values of t-test	0.00	1.00	0.00	0.00
	Prob-values of KS-test	0.00	0.99	0.00	0.00

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Note: ALP stands for apparent labor productivity and is defined as sales per worker. KS-test refers to the two-sample Kolmogorov–Smirnov test. In the t-test, the null hypothesis is that the mean of the first group is equal to the mean of the second group, while the alternative hypothesis is that the mean of the first group is smaller than that of the second group, while in the K–S test, the null hypothesis is that the distributions are equal, while the alternative hypothesis is that the distribution of the second group stochastically dominates the distribution of the first group

Japanese exporters and FDI firms is relatively small. We should interpret this finding with care, however, since the firm size threshold in our dataset may have led to this result. The small difference in the productivity premium in Japan also suggests that the choice of exports or FDI is affected not only by productivity but also by market-specific factors including transport costs for exporting, different fixed costs for exporting and FDI, and host country-specific fixed costs. We should pay attention to this novel finding,[4] especially because the similar productivity level for pure exporters and pure FDI firms is inconsistent with the theoretical prediction of Helpman et al. (2004). Further investigation on this issue would improve our understanding of firms' exporting and FDI behavior.

[4]This is partly because most previous studies do not distinguish between pure FDI firms and export and FDI firms. One exception is Tomiura (2007), who uses a firm-level dataset for Japan taken from a different data source than ours and finds that the productivity of pure exporters is lower on average than that of pure FDI firms. One possible reason for the difference between the findings of Tomiura (2007) and ours is that Tomiura (2007) uses data that incorporates no firm size threshold.

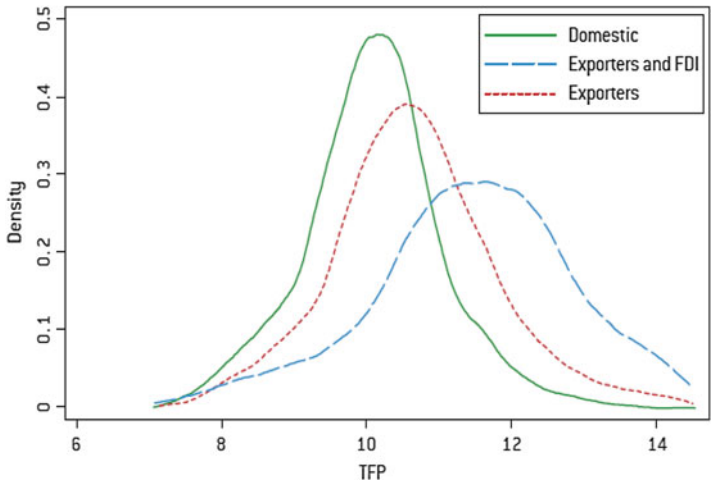


Fig. 6 Productivity distribution of Belgium firms. *Source*: Mayer and Ottaviano (2007), p. 21

Table 10 Percentage of foreign-owned firms among exporters and non-exporters, 2003

Country	Non-exporters	Exporters
Japan	0.7	3.9
Italy	4.0	10.3
Belgium	0.6	12.2
United Kingdom	18.7	27.9
Hungary	11.5	43.6

Source: The data for Japan are from METI, *Basic Survey of Japanese Business Structure and Activities*, while those for the other countries are from Mayer and Ottaviano (2007)

3.3 Exports and Foreign-Owned Firms

Another area of research interest with regard to exporters' characteristics is the role of foreign-owned firms. As shown in Table 10, the proportion of foreign-owned firms is larger among exporters than among non-exporters both in Japan and in Europe. Foreign-owned firms in Japan are defined as firms that have a foreign ownership ratio of 50 % or more (Criscuolo 2005).[5] Notwithstanding the fact that foreign-owned firms by their very nature are more likely to be internationally oriented compared with domestic firms, another reason for the greater internationalization of foreign-owned firms may be that their productivity is higher on average than that of domestic firms.

[5]Note that the foreign ownership cut-off ratio most commonly used in Japan (such as in Japanese government statistics) is 33.3 %. In this chapter, we use the 50 % cut-off ratio for the purposes of international comparison.

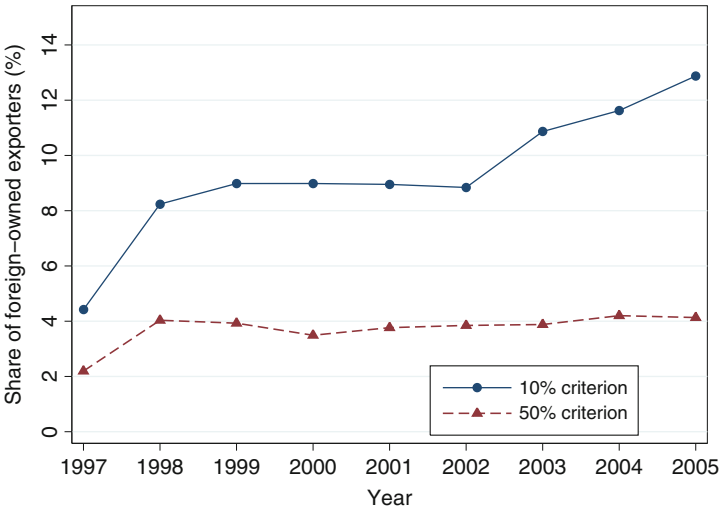


Fig. 7 Foreign ownership of Japanese exporters: 1997–2005. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

However, Table 10 shows that the proportion of foreign-owned exporters is substantially lower in Japan than it is in European countries. Figure 7 indicates that the proportion of foreign-owned exporters, when the 50 % cut-off ratio is used to define foreign-owned firms, remained at a low level without any increasing trend between 1997 and 2005. This smaller proportion of foreign-owned firms may be a direct consequence of the fact that the level of FDI inflows toward Japan is substantially low compared with the FDI flows to other developed countries.[6]

3.4 Internationalized Firms' Productivity Advantages: Self-Selection or Learning by Doing?

This subsection examines why the productivity of internationalized firms is higher than that of domestic firms. Two possible explanations offer themselves. The first is the self-selection hypothesis, according to which only high-productivity firms can start to export or conduct FDI because their revenue is sufficiently large to cover the necessary fixed costs. The second explanation is the learning by doing hypothesis, which claims that the productivity of international firms increases through the acquisition of knowledge on foreign markets or the absorption of foreign technology. Bernard and Jensen (1999), among others, have tested these

[6]Please see Fukao and Murakami (2005), Ito and Fukao (2005), and Kimura and Kiyota (2007).

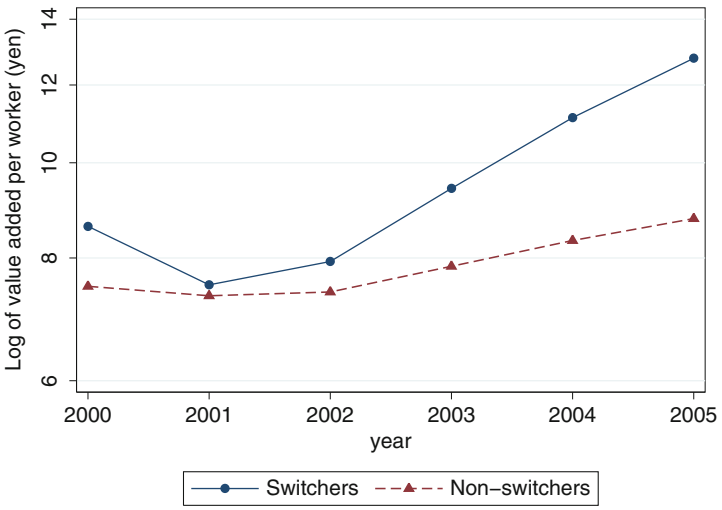


Fig. 8 Comparison of labour productivity performance: Export. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

hypotheses.[7] While the self-selection hypothesis finds wide support in the literature, the verdict on the learning-by-doing hypothesis is mixed. Mayer and Ottaviano (2007), for instance, find no clear evidence of the learning-by-doing hypothesis in European countries.

By contrast, studies of Japan have produced evidence that confirms both the self-selection and the learning-by-doing hypotheses. Kimura and Kiyota (2007), for example, found that high-productivity firms are engaged in exports or FDI and that such firms experience a rise in productivity as a result. Hijzen et al. (2008), meanwhile, showed that conducting offshoring, including FDI, contributes to productivity growth at the firm level. Furthermore, Hijzen et al. (2007) find weak evidence that FDI positively influences productivity. All these studies' findings confirm both the self-selection and the learning-by-doing hypotheses.

Against the background of these findings, we reexamine both hypotheses in Japan graphically. We divide firms into switchers and non-switchers, where the former comprise firms that started and continued to export (or conduct FDI) in 2001 and the latter are firms that neither exported nor conducted FDI from 2000 to 2005. The trend of the average of the logarithm of the labor productivity of firms that began exporting in 2001 and those that did not is depicted in Fig. 8.[8] The figure shows that in 2000, namely before they started exporting, the labor productivity of switchers was already higher on average than that of non-switchers. Moreover, the gap in labor productivity between switchers and non-switchers continued to expand from

[7] A summary of such studies is provided by Greenaway and Kneller (2007).

[8] Altogether, 44 firms were switchers, while 3,976 were non-switchers.

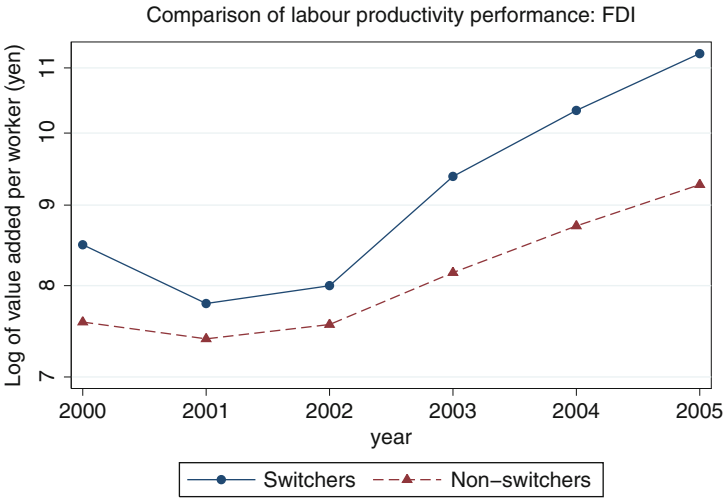


Fig. 9 Comparison of labour productivity performance: FDI. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

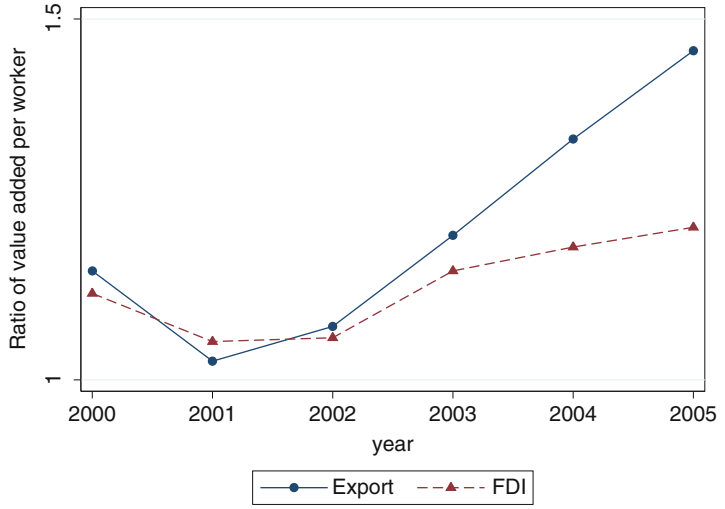


Fig. 10 Comparison of labour productivity performance: Export and FDI. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

2001, the year that switchers started exporting. The FDI trend for switchers and non-switchers is shown in Fig. 9[9] and leads to similar conclusions. Figure 10 shows the trend in the ratio of the average value of the labor productivity[10] of switchers

[9]Altogether, 62 firms were switchers, while 4,871 firms were non-switchers.

[10]Labor productivity is defined as value added per worker.

to that of non-switchers. This graph demonstrates that the gap in labor productivity between switchers and non-switchers increased almost continuously from the year that switchers started to export or conduct FDI. The results of the analysis thus confirm those of previous studies of Japan.

4 Productivity Levels for Exporters and FDI-Led Firms

4.1 Productivity Level by Firm

In this subsection, we reexamine how firms' productivity levels differ depending on whether firms engage in exports and/or FDI, assuming a Pareto productivity distribution (see Helpman et al. 2004). Following Mayer and Ottaviano (2007), we estimate the degree of skewness of the Pareto distribution and the productivity cut-offs for exporters and FDI firms.[11] In addition, we examine the variations in the skewness of the productivity distribution by industry.

The cumulative density function for a Pareto distribution is given by

$$F(X) = 1 - \left(\frac{X_m}{X}\right)^k, \tag{1}$$

where X is the TFP level, X_m is the lower bound for the TFP level in the entire sample, and k, or the "Pareto k," indicates the skewness of the distribution. The larger k, the more the probability density curve is skewed to the left and the larger is the proportion of unproductive firms. In other words, a larger k indicates that a fall in the costs of exports and FDI is associated with a larger number of unproductive firms engaging in exports and FDI.

From Eq. (1), we obtain

$$\ln(1 - F(X)) = k\ln(X_m) - k\ln(X). \tag{2}$$

We then regress ln(1 − F(X)) on lnX, using the ordinary least squares (OLS) estimation, in order to estimate k and the intercept as follows:

$$\ln(1 - F(X)) = \widehat{\alpha} + \widehat{\beta}\ln(X) + \varepsilon, \tag{3}$$

where ε denotes an error term. From these estimates, we can estimate k and X_m as follows:

$$\widehat{k} = -\widehat{\beta}, \tag{4}$$

$$\ln(X_m) = \widehat{\alpha}/\widehat{k}. \tag{5}$$

[11] To simplify the presentation, we do not distinguish between pure FDI firms and export and FDI firms in this section.

Table 11 Pareto k and cut-off by industry for Japan

Industry	Pareto k	R-square	Cut-off (lower bound)
Total manufacturing	1.69	0.85	3.94
Food products and beverages	1.63	0.76	3.24
Textiles	1.96	0.80	3.32
Wearing apparel	1.65	0.82	2.46
Wood and products of wood	2.12	0.75	3.31
Furniture	1.87	0.79	3.09
Paper and paper products	2.06	0.84	3.83
Publishing and printing	1.78	0.81	4.08
Leather	1.93	0.91	3.78
Rubber products	2.05	0.85	4.02
Chemicals and chemical products	1.85	0.82	5.28
Coke, refined petroleum and plastic products	1.92	0.75	3.92
Other non-metallic mineral products	1.87	0.77	3.98
Basic iron and steel	2.18	0.86	4.07
Non-ferrous metals	1.78	0.69	3.63
Basic metals	1.62	0.62	3.22
Machinery and equipment	1.99	0.79	4.55
Electrical machinery and apparatus	1.37	0.92	4.67
Motor vehicles	2.20	0.81	4.62
Precision instruments	1.86	0.81	3.96
Other manufacturing	1.67	0.83	4.23

Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*
Note: The figures are for 2003

Since the distribution of exporters' TFP also follows a Pareto distribution for which k is equal to the k for the entire sample, we know the relation between the mean of TFP among exporters, X^{EX}, and the lower bound of TFP for exporters, $X_m{}^{EX}$, or the export cut-off is thus:

$$\overline{X}^{EX} = kX_m^{EX} / (k-1). \tag{6}$$

A similar relation can be obtained for FDI firms as follows:

$$\overline{X}^{FDI} = kX_m^{FDI} / (k-1). \tag{7}$$

Finally, from the mean of TFP among exporters and FDI firms and estimated k, we can compute the cut-off for exports and FDI.

We apply the procedures above to our firm-level data on the Japanese manufacturing sector in 2003. The first row of Table 11 indicates the estimated Pareto k, R^2 from the OLS estimation of Eq. (3), and the estimated lower bound for the entire sample, X_m. The R^2, 0.85, suggests that our data fit the Pareto distribution well.

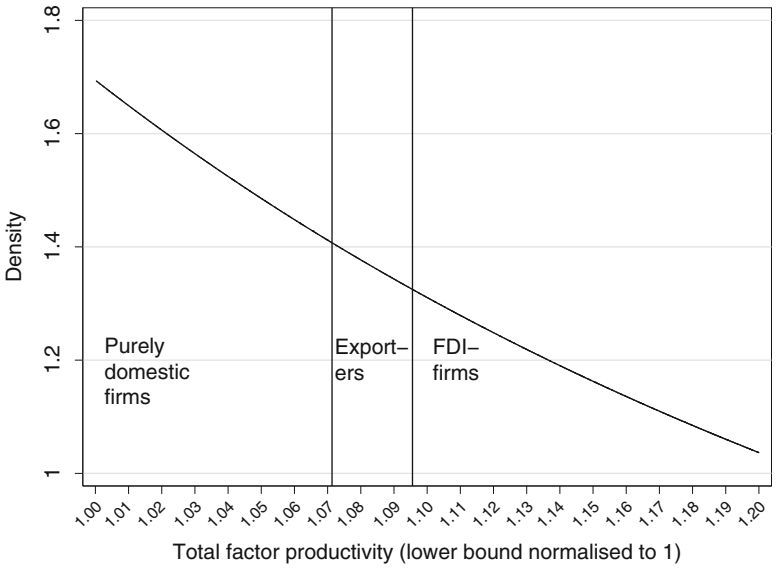


Fig. 11 Distribution of firm productivity. *Note*: TFP distribution, Japan, 2003. Estimation method: Olley-Pakes. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

We normalize X_m to one and depict the Pareto distribution of Japanese firms' TFP in Fig. 11, in which the two vertical lines show the cut-off for exporters and FDI firms. This figure confirms that the productivity of FDI firms is higher [i.e., they are to the right of the second vertical line (FDI cut-off)] than that of exporters and that the productivity of exporters is higher than that of domestic firms.

However, we also find several differences between our results for Japan and those for the European countries reported in Mayer and Ottaviano (2007). First, the estimated k is 1.69 for Japan, while they are 3.03 and 2.55 for Italy and France, respectively.[12] As discussed earlier, the smaller k for Japan implies a larger degree of productivity heterogeneity at the firm level. Our results thus indicate that the proportion of productive firms in Japan is relatively large. Second, after normalizing the lower limit of TFP to one, the export and FDI cut-offs are 1.07 and 1.10, respectively, for Japan. These findings suggest that firms that have a TFP level

[12]By eliminating the firms that have an extremely low level of productivity, we can find an OLS fit $P(\ln TFP > x) = -k \ln TFP + b$ with $k = 2.2$. With $k = 2.2$, the export and FDI cut-off TFPs are 1.16 and 1.18, respectively. Hence, this alternative estimation widens the productivity difference between domestic firms and exporters. However, the relatively small productivity difference between exporters and FDI firms remains.

7 and 10 % higher than the lowest TFP level among all firms can export and conduct FDI, respectively. Since the export and FDI cut-offs for Norway reported in Mayer and Ottaviano (2007) are 1.66 and 1.88, respectively, our results suggest that the productivity differences between domestic firms, exporters, and export and FDI firms are relatively small in Japan.[13] This conclusion is consistent with our previous findings (see Fig. 5) that the distributions of TFP among each of the four types of firms substantially overlap, suggesting that productivity differences alone do not determine the export and FDI decisions of Japanese firms and that other major determinants of exports and FDI may exist.

4.2 Productivity Level by Industry

Table 11 shows Pareto k, the lower bound (not normalized), and R^2 by industry, while Fig. 12 provides a scatter diagram of Pareto k and the lower bound for each industry. We see that Pareto k and the lower bound vary considerably by industry. The smaller the value of Pareto k, the larger is the variance and the greater is the proportion of productive firms. In addition, the larger the productivity cut-off, the higher is average productivity. Therefore, the industries plotted at the top right of the diagram demonstrate higher productivity, whereas those that have a large Pareto k but a small productivity cut-off have room to increase their export ratios by raising productivity—even by a small margin. The electrical machinery and chemicals industries show a small Pareto k and high productivity cut-off (i.e., a large proportion of high productivity), while the leather products and textiles industries have a large Pareto k and low productivity cut-off (i.e., a small proportion of high productivity). These findings suggest a high exporters' ratio in the electrical machinery and chemicals industries but a low exporters' ratio in the leather products and textiles industries. In fact, the exporters' ratios are 41.7 % for electrical machinery, 52.7 % for chemicals, 31 % for leather products, and 9.3 % for textiles. How these industries differ in Pareto k and the lower bound of TFP, however, remains a subject to be examined in future research.

5 Conclusion

This chapter examined the characteristics of internationalized firms in Japan and compared such firms with their European counterparts by using firm-level data. Specifically, by using various indicators of firm characteristics such as productivity, value added, employment, and capital and skill intensity, we assessed what

[13]We also find that there is little difference in cut-off productivity between pure exporters and pure FDI firms.

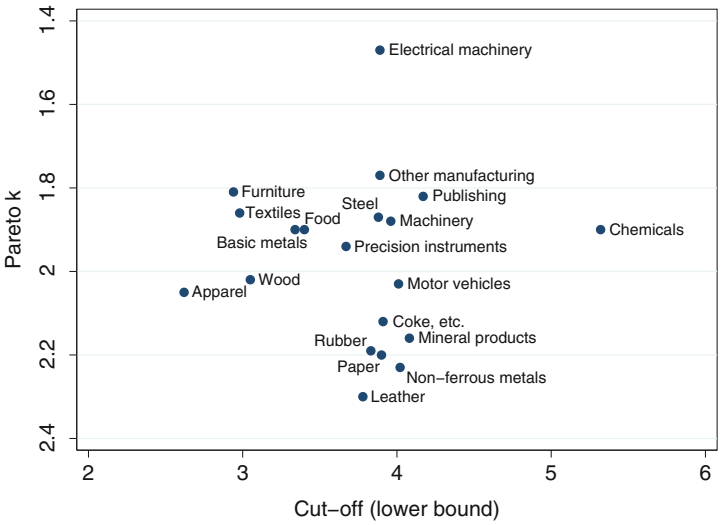


Fig. 12 Pareto k and cut-off for each industry, 2002. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

distinguishes internationalized firms in Japan. The main findings of our study can be summarized as follows.

First, our results indicate that firms in Japan are similar to those in Europe in the following respects:

1. Exports are dominated by a few top exporters. The top 10 % of exporters account for more than 90 % of total exports.
2. The export-to-sales ratios of very few firms exceed 50 %. However, these firms account for at least half of total exports.
3. Internationalized firms perform better in terms of a number of the analyzed indicators than domestic firms.
4. The proportion of foreign-owned firms is higher among exporting than among non-exporting firms.
5. The number of FDI firms (extensive margin) has a larger influence on total sales by overseas subsidiaries than sales per firm (intensive margin).

Second, the following features with regard to Japanese internationalized firms are notable:

1. The dominance of exports by the top exporters has weakened over time.
2. The proportion of exporting firms among all manufacturing firms is very low in Japan and—of the countries considered—above only that in the United Kingdom. However, the proportion of exporting firms is rising.
3. Fewer firms have a high export-to-sales ratio in Japan than in Europe.

4. The difference in performance between exporters and FDI firms in Japan is small compared with European countries.
5. The skill intensity of internationalized firms relative to domestic firms is increasing.
6. The proportion of foreign-owned firms among exporters in Japan is much lower than that in European countries.
7. Firms that started to export or conduct FDI had higher productivity prior to doing so than non-export/FDI firms. Moreover, the difference in productivity between these two groups has increased over time.
8. The influence of distance on overseas subsidiary sales is larger for Japanese firms than it is for European firms.
9. The differences in productivity between domestic firms, exporters, and FDI firms are small. This finding suggests that factors other than productivity prevent firms from becoming exporters and/or FDI firms. In particular, the difference between the TFP levels of pure exporters and pure FDI firms is not statistically significant.

Although this study provides a comprehensive picture of Japanese internationalized firms, it has two limitations. First, the results of the study are based on descriptive statistics and simple estimations; we did not use sophisticated econometric methods. Second, this chapter does not deal with offshoring, although Tomiura (2005, 2007), Hijzen et al. (2008), and Wakasugi et al. (2008) analyzed offshoring by Japanese firms. These aspects deserve further study.

Acknowledgments This study was conducted as part of the "International Trade and Firms" project undertaken at the Research Institute of Economy, Trade, and Industry (RIETI). The authors would like to thank RIETI for allowing us the opportunity to conduct this study, and the METI in Japan for providing valuable firm-level datasets. The authors are also grateful to the participants of the workshop on "Trade and the Euro" in Bern and the seminar at RIETI for their helpful comments and suggestions. The opinions expressed and arguments made in this chapter are the sole responsibility of the authors and do not necessarily reflect those of RIETI, the METI, or any institution the authors are related to.

Appendix: Data Sources and Variable Construction

Firm-Level Data

The data on firms' exports and FDI activities as well as the variables used for the calculation of TFP at the firm-level in Sects. 2, 3, and 5 were derived from *Kigyo Katsudo Kihon Chosa* (KKKC) for 1997–2005. This annual national survey conducted by the METI in Japan, which is mandatory for all firms that have 50 or more employees and whose paid-up capital is over 30 million yen, covers the mining, manufacturing, wholesale, retail, and food and beverage industries. We transformed nominal values into real values using appropriate deflators from the Japan Industry Productivity (JIP) Database 2008, which provides comprehensive

data at the three-digit industry level for Japan for 1970–2005. We used KKKC with legal permission, while the JIP database 2008 is downloadable from RIETI (http://www.rieti.go.jp/en/).

Labor Input

Labor input is defined as the total number of employees of all kinds, including full-time employees, part-time employees, and temporarily dispatched workers. We did not adjust the number of employees on the basis of work hours or education level since these data were unavailable.

Value Added

We calculated value added as total sales minus intermediate inputs, that is, the sum of the cost of goods sold and general and administrative expenses minus wages, rental costs, depreciation, and taxes. Total sales and intermediate inputs were deflated using the output and input deflators of the JIP Database 2008, respectively. Since wage payments to temporary workers received from recruitment companies are recorded under outsourcing expenses, which are part of the cost of sales, we defined payments to temporary workers as the average ratio of payments to non-regular employees over regular employees in Japanese manufacturing industries (0.578) multiplied by both the number of temporary workers and the average payments to the regular employees of each firm.

Capital Stock

Real capital stock was calculated by using the perpetual inventory method. While firms report the book values of fixed tangible assets, this is transformed into real values using the ratio of the real values of fixed tangible assets to their book values at the three-digit industry level provided by Tokui et al. (2007). The investment goods deflator used for deflating the value of investment flows and the depreciation rate were also taken from the JIP Database 2008.

TFP

We estimated TFP for each sampled firm by using firm-level data from 1997 to 2005. The direct calculation of TFP using the estimated coefficients of capital stock and labor in the Cobb–Douglas function form suffers from endogeneity. As the

benchmark of TFP, the estimated labor and capital proportions are 0.78 and 0.18, respectively, when estimating the Olley–Pakes production function using investment as a proxy for productivity shocks. We also used an alternative method by employing intermediate inputs or the purchase of inputs as a proxy, as proposed by Levinsohn and Petrin (2003); however, since the results changed greatly by this choice of proxy, we relied on the result of the Olley–Pakes procedure.

Exports and FDI

We used the real value of exports deflated by the output deflator of the JIP Database 2008 and defined exporters as firms that reported positive export values. For FDI firms, we used data from KKKC and defined firms that have at least one subsidiary or affiliate in foreign countries as FDI firms. In the survey, Japanese firms' subsidiaries in foreign countries are defined as overseas firms in which the Japanese parent holds an equity stake of over 50 %, while foreign affiliates are overseas firms in which the Japanese parent holds between 20 and 50 % of the equity. Hence, FDI firms in this study are firms that hold 20 % or more of the equity of an overseas firm.

Sources and Data Construction for Sect. 4

Firm-level variables were derived from the *Kaigai Jigyo Katsudo Kihon Chosa*, an annual survey conducted by the Ministry of Economics and International Trade.[14] The dataset used was a panel and the number of observations was 65,430 affiliate-years (cumulative total from 1995 to 2004).[15]

Country-level variables such as real GDP and exchange rates were derived from the Penn World Tables (PWT6.2). Distance data were taken from Haveman's International Trade Data.[16] Data on WTO membership were constructed based on information provided on the WTO's website.[17]

Sales of FDI firms were constructed as follows. We summed the sales of foreign affiliates recorded in the panel by parent firm and country. Thus, for example, the

[14]The survey covers all Japanese firms that had affiliates abroad as of the end of the fiscal year (March 31). A foreign affiliate of a Japanese firm is defined as a firm that is located in a foreign country in which a Japanese firm had an equity share of 10 % or more.

[15]A more detailed description of the procedure for constructing the panel data can be found in Kiyota et al. (2008).

[16]See http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradedata.html.

[17]See http://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm.

number of firms operating in country i is the number of parent firms that have foreign affiliates in country i rather than the number of foreign affiliates in country i. Average sales were derived by dividing total sales in country i by the number of parent firms.[18]

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[18]Because the sales data in the database are recorded in Japanese yen, we converted them into international dollar values using the price level data in PWT6.2. The price level of GDP in PWT, P, is given by $P = 100 \times (PPP / \text{the exchange rate})$. Thus, after conversion into US dollar values, sales data were multiplied by 100 / P.

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Heterogeneity and the Structure of Export and FDI: A Cross-Industry Analysis of Japanese Manufacturing

Ayumu Tanaka

Abstract The fraction of exporters and multinational enterprises (MNEs) varies substantially across industries. We extend the firm heterogeneity model presented by Helpman et al. (Am Econ Rev 94(1):300–316, 2004) to derive testable predictions about the prevalence of these internationalized modes. The model indicates that intra-industry firm heterogeneity and R&D intensity play large roles in inter-industry variation of the fraction of internationalized firms. We investigate whether these factors affect the structure of export and foreign direct investment (FDI) using Japanese industry-level data. We obtain results that are consistent with the model. First, industries with larger productivity dispersion have a larger fraction of MNEs and a larger fraction of the sum of exporters and MNEs. Second, MNEs are heavily concentrated in R&D-intensive industries.

Keywords Exports • Firm heterogeneity • Foreign direct investment • Multinationals

1 Introduction

Recent empirical research in international trade and foreign direct investment (FDI) provides firm-level evidence that firms that export or conduct FDI are relatively few. However, the fractions of exporters and multinational enterprises (MNEs) vary substantially across industries, and almost all industries have at least one exporter or MNE. Within each industry, the fraction of firms that export or conduct FDI ranges rather widely. For example, according to Bernard et al. (2007), the number of firms exporting is nearly 40 % in some US manufacturing industries but less than 10 % in others.

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These facts indicate that cross-industry differences are important to understand the structure of export and FDI. We explore why some industries have more exporters or MNEs than other industries. We focus on two cross-industry differences. First, industries differ in the degree of firm heterogeneity—many previous studies pointed out that firms differ within an industry—and second, industries differ in R&D intensity. We show that both factors contribute to substantial variation in the fraction of exporters and MNEs.

In this chapter, we use a firm heterogeneity model presented by Helpman et al. (2004) to derive the theoretical relationship between firm heterogeneity and the fraction of internationalized firms. The firm heterogeneity model of Helpman et al. (2004) assumes that firms differ in productivity and must incur the fixed costs of exporting and FDI. They predict that only firms with enough productivity to cover the fixed cost of exporting can export. Since the fixed cost of FDI is larger than that of exporting, firms that conduct FDI must be more productive than firms that only export.

Based on the model of Helpman et al. (2004), we show that industries with a larger degree of productivity dispersion have a larger fraction of MNEs, a larger fraction of the sum of exporters and MNEs, and a larger ratio of MNEs to non-MNE exporters, although the effect of an increase in the dispersion of productivity on the fraction of exporters can be either positive or negative. In addition, we show that R&D-intensive industries have an advantage in conducting FDI. Our approach resembles Antràs and Helpman (2004, 2008), who focused on the prevalence of such organizational forms as foreign outsourcing and FDI; Helpman et al. (2004) focused on the relative magnitude of exports and FDI sales.

We also use Japanese industry-level data to examine the model's implications. Many previous empirical studies have confirmed that exporters are more productive than non-exporters (Bernard and Jensen 1999), and that MNEs are more productive than firms that only export (Tomiura 2007). Such firm-level evidence supports the standard firm heterogeneity models of Melitz (2003) and Helpman et al. (2004). Helpman et al. (2004) also provide empirical evidence at the industry level that industries with larger productivity dispersion have smaller relative export sales over FDI sales as predicted by their theoretical model. However, no evidence exists that confirms the large role of firm heterogeneity and R&D intensity in the variation of fractions of internationalized firms across industries.

The results support the predictions of our heterogeneous firm model that firm heterogeneity and R&D play key roles in the structure of international trade and FDI. First, industries with a larger degree of productivity dispersion have a larger fraction of MNEs, larger ratio of MNEs to non-MNE exporters, and larger fraction of the sum of exporters and MNEs. Second, MNEs are concentrated heavily in R&D-intensive industries. However, the positive relation between R&D intensity and the fraction of non-MNE exporters are not confirmed against our model's prediction.

The remainder of this chapter is divided into five sections. In Sect. 2, we briefly describe the Japanese manufacturing data used in this chapter and show that the

variation of the fraction of exporters and MNEs is systematic. In Sect. 3, we use a version of Helpman et al. (2004) to derive predictions about the prevalence of internationalized modes. In Sect. 4, we introduce our estimation approach. In Sect. 5, we present the results of our empirical analysis. The summary and conclusion are presented in the final section.

2 A First Glance at the Data

There is tremendous variation in the fraction of exporters and MNEs across industries, as Bernard et al. (2007) and Tomiura (2007) have shown. In addition, this section reveals that this variation is systematic. First, the fraction of the sum of exporters and MNEs is higher in industries with a larger dispersion of sales. Second, the fraction of MNEs also is higher in industries with a larger dispersion of sales. Third, relative to all active firms, MNEs are heavily concentrated in R&D-intensive industries. This section unveils these patterns in the Japanese manufacturing industry-level data. The facts in this section motivate the theoretical model and more rigorous empirical analysis in the following sections.

This study uses the industry-level data for the period 1997–2005 based on the confidential firm-level data collected by the Ministry of Economy, Trade, and Industry (METI). METI conducts annual surveys called the Basic Survey of Japanese Business Structure and Activities (BSJBSA), which covers all firms with 50 employees or more and capital of 30 million yen or more. We focus on firms whose main business is manufacturing and exclude those whose main business is weapons and munitions because Japanese government prohibits the export of such products. Thus, 57 manufacturing industries were identified for our study. Table 4 provides three-digit METI industry codes and descriptions. In this section, we use the data averaged over 9 years, 1997–2005.

Figure 1 illustrates that the fraction of the sum of exporters and MNEs in all active firms is higher in industries with a larger dispersion of the logarithm of sales in a cross section of 57 manufacturing industries. The x-axis measures the standard deviation of the logarithm of sales as the degree of dispersion of sales, and the y-axis the fraction of non-MNE exporters.

Figure 2 plots the fraction of MNEs across industries. The x-axis again measures the standard deviation of logarithm of sales. The figure reveals that industries with a larger dispersion of sales have higher fractions of MNEs. Figure 3 shows how the fraction of MNEs varies with the ratio of R&D expenditures to sales and demonstrates the third strong pattern: the fraction of MNEs is higher in R&D-intensive industries.

Fig. 1 Dispersion and fraction of exporters and MNEs. *Note:* The data are on Japanese manufacturing firms, averaged over 1997–2005. *Data source:* The Ministry of Economy, Trade, and Industry (METI), the basic survey of Japanese business structure and activities

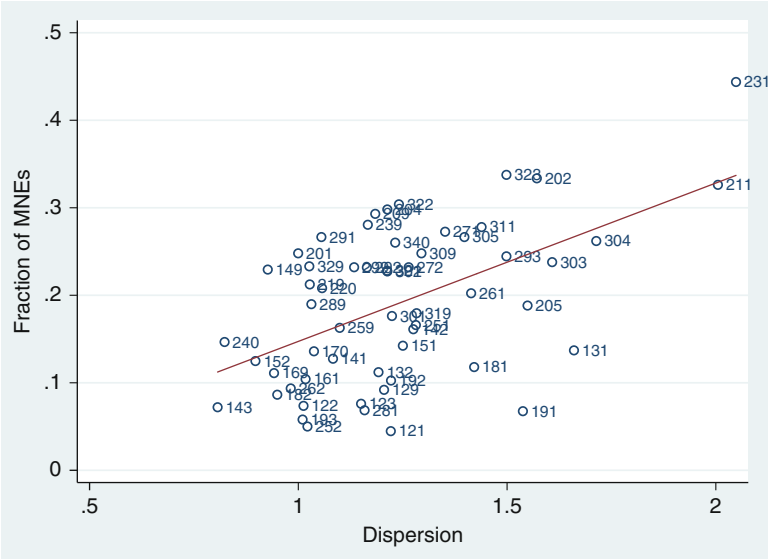

Fig. 2 Dispersion and fraction of MNEs. *Note:* The data are on Japanese manufacturing firms, averaged over 1997–2005. *Data source:* The Ministry of Economy, Trade, and Industry (METI), the basic survey of Japanese business structure and activities

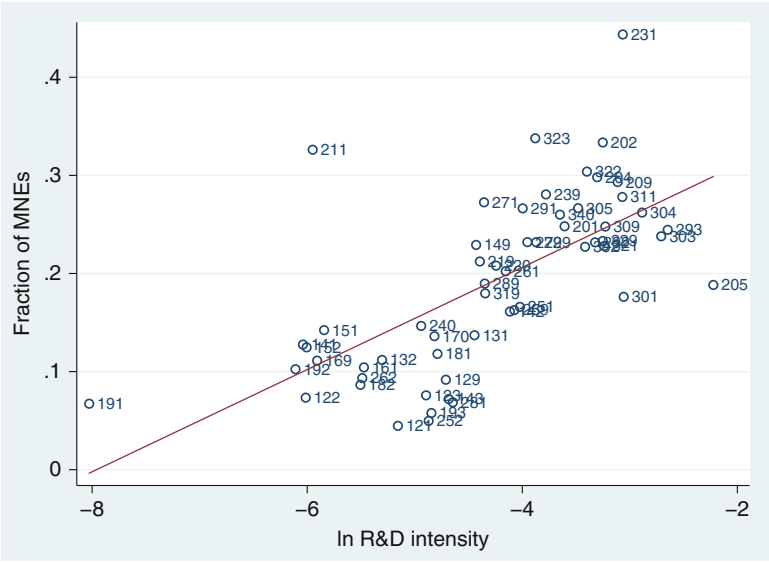

Fig. 3 R&D intensity and fraction of MNEs. *Note:* The data are on Japanese manufacturing firms, averaged over 1997–2005. *Data source:* The Ministry of Economy, Trade, and Industry (METI), the basic survey of Japanese business structure and activities

3 Model

To explain why the fraction of exporters and MNEs systematically varies, we use a framework based on Helpman et al. (2004) and establish the relationship between intra-industry firm heterogeneity and the fraction of exporters and MNEs. We specify the model, which is a simplified version of Helpman et al. (2004),[1] and extend it to generate predictions about the fraction of exporters and MNEs.

3.1 Setup

J countries are indexed by j, and S industries are indexed by s. A continuum of heterogeneous firms produces differentiated goods in each country and sector. The preferences are identical everywhere and given by a Cobb-Douglas aggregate over industry-specific CES consumption indices C_{js}:

[1]Our model and approach differ from those of Helpman et al. (2004) in several respects. We simplify the model, as Yeaple (2009) did. First, the model is not closed via a free-entry condition. Second, we do not solve for the full general equilibrium of the model. Rather, we present a partial-equilibrium analysis. We, therefore, take a reduced-form approach in our empirical analysis.

$$u_j = \prod_s C_{js}^{\theta_s}, C_{js} = \left[\int_{\omega \in \Omega_{js}} x_{js}(\omega)^{\alpha} d\omega \right]^{\frac{1}{\alpha}}, 0 < \alpha < 1 \tag{1}$$

where $x_{js}(\omega)$ is the quantity of goods consumed, Ω_{js} is the set of goods available in industry s in country j, and the parameter α determines the elasticity of substitution across products, which is $\sigma = 1/(1-\alpha) > 1$. Parameter θ_s indicates the total expenditure share of each industry and satisfies $\sum_s \theta_s = 1$. Then, country j's demand for product in industry s is

$$x_{js}(\omega) = \frac{p_{js}(\omega)^{-\sigma} \theta_s Y_j}{P_{js}^{1-\sigma}} \tag{2}$$

where Y_j is the gross national expenditure in country j, $p_{js}(\omega)$ is the price of good ω in industry s in country j, and P_{js} is the price index in industry s in country j, given by

$$P_{js} = \left[\int_{\omega \in \Omega_{js}} p_{js}(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}. \tag{3}$$

Next, we temporarily consider a particular industry s and drop index s.[2] Each firm is capable of producing a single good using a single input called labor whose price in country j is w_j. Firms are heterogeneous in terms of their productivity φ. The empirical distribution of φ in each country $F(\varphi)$ is assumed to be Pareto with the shape parameter k; that is,

$$F(\varphi) = 1 - \left(\frac{b}{\varphi} \right)^k, \varphi \geq b \geq 0 \tag{4}$$

where b is a minimum value in an industry's productivity distribution. We assume that $k > \sigma + 1$, which ensures that the distribution of productivity draws have finite variances. k is an inverse measure of variance,[3] since the variance of Pareto distribution is given by

$$V(\varphi) = \frac{b^2 k}{(k-1)^2 (k-2)}, \text{for} k > 2. \tag{5}$$

The smaller the parameter k, the larger is the variance of productivity. The Pareto assumption is consistent with the evidence (see Helpman et al. 2004; Wakasugi et al. 2008). Note that we assume productivity distributions differ among industries.

[2]We omit to describe the mechanism how a firm chooses to enter an industry.

[3]We assume that k is given and do not consider what determines k. Recent studies suggest that demand structure is one of determinants of k. Syverson (2004) reveals high-substitutability industries exhibit less productivity dispersion.

After a firm observes a productivity draw from distribution $F(\varphi)$, it bears the fixed costs of domestic production rf^D if it chooses to enter the market. These are the costs of setting up production facilities, including a research institute in home country. r is an industry-specific measure of R&D intensity, and $r > 1$. A firm in an R&D-intensive industry must incur larger fixed costs due to R&D expenditure.

In this chapter, we consider R&D intensity as industry specific because we use industry-level data in the empirical analysis. The range of R&D intensity is to some extent given for individual firms in an industry. For example, a firms in the pharmaceuticals and medicinal chemicals industry must incur more R&D expenditure because of the nature of products it produces than a firm in the meat and meat products industry.

In serving foreign markets, a firm faces a proximity-concentration trade-off. If the firm chooses to export, it bears additional fixed costs f^X per foreign market, faces domestic wage w_h, and incurs iceberg transport cost $\tau_i > 1$. On the other hand, if it chooses to serve a foreign market by FDI, it bears additional fixed costs f^I in every foreign market. In this case, the firm may avoid transport cost and face local labor cost w_i. These fixed costs are assumed to be industry specific.

A firm from country h that sells its product will face marginal costs of

$$c(\varphi) = \begin{cases} \frac{zw_h}{\varphi} & \text{if it sells in home country } h \\ \frac{z\tau_i w_h}{\varphi} & \text{if it exports to a foreign country } i \\ \frac{zw_i}{\varphi} & \text{if it produces in a foreign country } i \end{cases} \tag{6}$$

where z is an industry-specific inverse measure of R&D intensity; that is, $z'(r) < 0$, and $z \in (0, 1)$. We assume that marginal cost for producing R&D intensive products is lower than that for less R&D intensive products.[4] A firm in an R&D-intensive industry must invest more in developing a blueprint for a new product. Once it obtain a blueprint, it can produce relatively easily and supply its products to both domestic and foreign markets without additional fixed R&D expenditure.

A firm facing demand curve (2) will optimally charge a price of $p(\varphi) = c(\varphi)/\alpha$. The profit from the domestic market is

$$\pi^D = (zw_h)^{1-\sigma} A_h \varphi^{\sigma-1} - rf^D \tag{7}$$

where $A_h = (1-\alpha)\alpha^{\sigma-1}\theta Y_h P_h^{\sigma-1}$ is the markup-adjusted demand level in an industry and country h. We regard $\varphi^{\sigma-1}$ as a productivity index, since $\sigma > 1$.

Setting $\pi^D = 0$, we define the entry cutoff for domestic production as

$$\varphi^D = \left(\frac{rf^D}{(zw_h)^{1-\sigma} A_h} \right)^{\frac{1}{\sigma-1}} \tag{8}$$

[4]Our model is static and do not consider the dynamic decision of R&D investment, which Ederington and McCalman (2008), Aw et al. (2008), Lileeva and Trefler (2007), and Costantini and Melitz (2007) examine.

Firms with productivity below this cutoff ($\varphi < \varphi^D$) do not enter the industry, but firms with productivity above the cutoff ($\varphi \geq \varphi^D$) enter the industry and sell their products in their home countries.

Similarly, the additional profit from exports to country i is

$$\pi^X = (z\tau_i w_h)^{1-\sigma} A_i \varphi^{\sigma-1} - f^X \tag{9}$$

and the additional profit from FDI in country i is

$$\pi^I = (zw_i)^{1-\sigma} A_i \varphi^{\sigma-1} - f^I \tag{10}$$

Setting $\pi^X = 0$, we define the export cutoff as

$$\varphi^X = \left[\frac{f^X}{(z\tau_i w_h)^{1-\sigma} A_i} \right]^{\frac{1}{\sigma-1}} \tag{11}$$

We also define the FDI cutoff as

$$\varphi^I = \left[\frac{f^I - f^X}{A_i z^{1-\sigma} \left[w_i^{1-\sigma} - (\tau_i w_h)^{1-\sigma} \right]} \right]^{\frac{1}{\sigma-1}} \tag{12}$$

where setting $\pi^X = \pi^I$. Following Helpman et al. (2004), we assume $\left(\frac{w_i}{w_h}\right)^{\sigma-1} f^I > \tau_i^{\sigma-1} f^X > r f^D$, which ensure $\varphi^D < \varphi^X < \varphi^I$ if $A_h = A_i$.

The optimal strategy of internationalization in an industry depends on each firm's productivity. First, firms with productivity levels between entry cutoff and export cutoff ($\varphi \in (\varphi^D, \varphi^X)$) only supply their products to domestic markets and neither export nor conduct FDI. These firms are "purely domestic." Second, firms with productivity levels between the export cutoff and FDI cutoff ($\varphi \in (\varphi^X, \varphi^I)$) are "exporters," who supply their products to domestic markets and export them to foreign markets. Firms with productivity levels above the FDI cutoff ($\varphi > \varphi^I$) are "MNEs," who invest in a foreign country. Therefore, exporters are more productive than purely domestic firms, and MNEs, in turn, are more productive than exporters.

3.2 Prevalence of Internationalized Modes

In this section, we consider the relationship between the inter-industry variation of the fraction of internationalized firms and productivity dispersion. Helpman et al. (2004) derived the relationship between the relative magnitude of exports and local FDI sales and productivity dispersion and predicted that industries with

higher dispersion levels of firm productivity have lower ratios of exports to FDI sales. They tested this prediction using US data with European firm-level data. Their results support the theoretical model's predicted link between intra-industry firm-level heterogeneity and relative export sales. However, except their own study, little evidence supports their prediction at the industry level.

Our approach is slightly different from Helpman et al.'s (2004) and more closely resembles that of Antràs and Helpman (2004, 2008). We establish the relationship between inter-industry variation of the fraction of internationalized firms and intra-industry productivity dispersion. While Helpman et al. (2004) focused on the relative magnitude of export sales, we focused on the fraction of each internationalization mode of firms for two reasons. First, we do not have FDI local sales data per country, which is necessary to construct the relative magnitude of export sales. Second, we can easily obtain richer predictions than Helpman et al. (2004) by forecasting not only the relative fraction of exports over FDI but also the fractions of MNEs, and exporters and MNEs. Given the Pareto assumption (4), the fraction of purely domestic firms in all active firms can be written as

$$\delta^D = \frac{F(\varphi^X) - F(\varphi^D)}{1 - F(\varphi^D)} = 1 - \left(\frac{\varphi^D}{\varphi^X}\right)^k \tag{13}$$

where we exclude exited firms. Hence, the fraction of the sum of exporters and MNEs is

$$\delta^N = \frac{1 - F(\varphi^X)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^X}\right)^k \tag{14}$$

Since $\varphi^D < \varphi^X$, an increase in this fraction is driven by a decrease in k, which is generated by an increase in the dispersion of productivity. Next, the fraction of MNEs is

$$\delta^I = \frac{1 - F(\varphi^I)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^I}\right)^k \tag{15}$$

Since $\varphi^D < \varphi^I$, a decrease in k increases the fraction of MNEs. Similarly, the fraction of exporters equals

$$\delta^X = \frac{F(\varphi^I) - F(\varphi^X)}{1 - F(\varphi^D)} = \left(\frac{\varphi^D}{\varphi^X}\right)^k - \left(\frac{\varphi^D}{\varphi^I}\right)^k \tag{16}$$

The first term means the fraction of internationalized firms (exporters and MNEs), and the second term that of MNEs. Both increase when k decreases. Therefore, the effect of an increase in productivity dispersion on the fraction of exporters

is ambiguous.[5] However, we can derive the effect of an increase in productivity dispersion on MNEs per exporters. This ratio of MNEs to non-MNE exporters is

$$\delta^{IX} = \frac{\delta^I}{\delta^X} = \frac{1}{\left(\frac{\varphi^I}{\varphi^X}\right)^k - 1} \tag{17}$$

This ratio increases when k decreases.

In addition, we examine the change of R&D intensity, which is relevant in the next section's empirical analysis. From (11), (12), and $z'(r) < 0$,

$$\frac{\partial \varphi^X}{\partial r} < 0 \quad \text{and} \quad \frac{\partial \varphi^I}{\partial r} < 0. \tag{18}$$

Firms in R&D-intensive industries have lower cutoffs for both exporting and FDI. This suggests that R&D-intensive industries have a larger fraction of exporters and MNEs. In order to verify this intuition, we derive the following relationship from (8), (11), and (12):

$$\frac{\partial \left(\frac{\varphi^D}{\varphi^X}\right)}{\partial r} > 0, \quad \frac{\partial \left(\frac{\varphi^D}{\varphi^I}\right)}{\partial r} > 0, \quad \text{and} \quad \frac{\partial \left(\frac{\varphi^I}{\varphi^X}\right)}{\partial r} = 0. \tag{19}$$

Therefore, from (14), (15), and (17), we get

$$\frac{\partial \delta^I}{\partial r} > 0, \quad \frac{\partial \delta^N}{\partial r} > 0, \quad \text{and} \quad \frac{\partial \delta^{IX}}{\partial r} = 0. \tag{20}$$

These results indicate that more R&D-intensive the industry have a greater number of FDI and internationalized firms relative to all active firms as compared to less R&D-intensive industries. However, R&D intensity has no effect on the ratio of MNEs to non-MNE exporters. As a result, we obtain

$$\frac{\partial \delta^X}{\partial r} > 0 \tag{21}$$

[5]Taking derivative of δ^X with respect to k, we obtain $\frac{\partial \delta^X}{\partial k} = \frac{\partial \delta^N}{\partial k} - \frac{\partial \delta^I}{\partial k} = \left(\frac{\varphi^D}{\varphi^X}\right)^k \ln\left(\frac{\varphi^D}{\varphi^X}\right) - \left(\frac{\varphi^D}{\varphi^I}\right)^k \ln\left(\frac{\varphi^D}{\varphi^I}\right)$, where both of the first and second terms are negative since $0 < \left(\frac{\varphi^D}{\varphi^I}\right)^k < \left(\frac{\varphi^D}{\varphi^X}\right)^k$ and $\ln\left(\frac{\varphi^D}{\varphi^I}\right) < \ln\left(\frac{\varphi^D}{\varphi^X}\right) < 0$. The sign of this derivative, therefore, is negative if a decrease in k raises the fraction of the sum of exporters and MNEs more than that of MNEs. In such a case, a decrease in k leads to an increase in the fraction of non-MNE exporters.

because an increase in R&D intensity must lead to an increase in the fraction of non-MNE exporters when the ratio of MNEs to non-MNE exporters remains unchanged but the fraction of MNEs increases.

In summary, our analysis in this section can derive two sorts of predictions on the prevalence of exporters and multinationals:

1. An industry with a larger dispersion of productivity, that is, a smaller shape parameter of productivity distribution k, has a larger fraction of MNEs δ^I, a larger fraction of the sum of exporters and MNEs δ^N, and a larger ratio of MNEs to non-MNE exporters δ^{IX}.
2. An industry with larger R&D intensity r has a larger fraction of non-MNE exporters δ^X, a larger fraction of MNEs δ^I, and a larger fraction of the sum of exporters and MNEs δ^N. R&D intensity is not related to the ratio of MNEs to non-MNE exporters δ^{IX}.

4 Empirical Specifications

In this section, we examine the model's prediction, using Japanese industry-level data[6] for the period 1997–2005 from the METI survey (BSJBSA), which we describe in Sect. 2. Our aim is to empirically analyze the effect of our measure of firm-size dispersion, R&D intensity, and other variables on the following: (1) the fraction of exporters, (2) the fraction of MNEs, (3) the ratio of MNEs to non-MNE exporters, and (4) the fraction of the sum of exporters and MNEs. We clarify the effect of the productivity dispersion on the fraction of exporters in our empirical analysis, although the model predicts that the effect can be either positive or negative.

We estimate the following reduced-form specification:

$$\begin{aligned}\delta_{srt} = {} & \mu + \chi_{sr} + \lambda_r \cdot year_t + \beta_1 \ln DISPERSE_{st} \\ & + \beta_2 \ln RDINT_{st} + \beta_3 \ln KAPINT_{st} + \beta_4 \ln SKINT_{st} \\ & + \beta_5 \ln ADINT_{st} + \varepsilon_{srt}\end{aligned} \tag{22}$$

where μ is constant, $\delta_{srt} \in (\delta^X, \delta^I, \delta^{IX}, \delta^N)$, and s, r, and t are indexes of industries, regions, and years, respectively. Each firm in the survey reports its value of export sales per region (Asia, North America, Europe, and other regions)[7] and its number

[6] We do not have access to firm-level data for this study, although we have information about the number of foreign affiliates, dispersion of sales, and other industry-level variables. Appendix explains the data and variables we use in this chapter in more detail.

[7] List of countries by regions are given in Table 5.

Table 1 Descriptive statistics

Variable	N	Min	Mean	Max	S.D.
Non-MNE exporters/All	513	0.00	0.14	0.42	0.10
Exporters/All	513	0.00	0.29	0.89	0.19
MNEs/All	513	0.03	0.20	0.56	0.10
MNEs/Non-MNE exporters	513	0.38	1.85	12.50	1.44
Exporters and MNEs/All	513	0.05	0.34	0.89	0.18
ln DISPERSE	513	−0.47	0.19	0.82	0.21
ln KAPINT	513	0.97	2.86	5.51	0.76
ln RDINT	512	−10.29	−4.37	−2.12	1.21
ln SKINT	505	−8.44	−2.21	−1.07	1.08
ln ADINT	513	−7.89	−5.40	−2.76	1.11

of foreign affiliates per region.[8] Then, for each region each firm can be classified as one of three types: "purely domestic," "non-MNE exporter," or "MNE." We have the number of firms of these three types per region by industry for 1997–2005 and can calculate δ_{srt}. We approximate δ^{IX} as MNEs/(non-MNE exporters +1) because some pairs of industries and regions have no exporters. $DISPERSE_{st}$ is our measure of the extent of productivity dispersion across firms within industry s in year t. We use the standard deviation of the logarithm of firm sales across all firms within an industry as a measure of the dispersion of firm productivity, following Helpman et al. (2004) and Yeaple (2006). $RDINT_{st}$ is the ratio of R&D expenditures to sales (R&D intensity). Our hypothesis is that $\beta_1 > 0$ in the regression of the fraction of MNEs (δ^I) and the fraction of the sum of exporters and MNEs (δ^N), as well as the ratio of MNEs to non-MNE exporters (δ^{IX}). We also predict that $\beta_2 > 0$ in the regression of δ^I and δ^N.

χ_{sr} is the pair of industry s and region r-specific effects, λ_r is an indicator variable for region r, and $year_t$ is an indicator variable for year t. Since cutoffs are functions of trade costs,[9] wages, and market sizes, these variables also affect the fractions of internationalized firms that we estimate. Since these factors are specific to a country or a country-and-industry pair, proxying them is difficult because we do not have the number of internationalized firms per country. We, therefore, added the fixed effects of an industry-and-region pair and the interaction of region dummies with year dummies to the estimation equations in order to alleviate the effects of trade costs, wages, and market sizes.

Finally, we included capital intensity ($KAPINT_{st}$), the number of skilled workers per total employment (skill intensity, $SKINT_{st}$), and the ratio of advertisement expenditures to sales (advertisement intensity, $ADINT_{st}$) in regression to control for the omitted industry characteristics. All of these variables were constructed from the METI survey. The descriptive statistics for all variables are shown in Table 1.

[8]The Middle East, Central and South America, Africa, and Oceania are all classified as "the other regions" in our data.

[9]While we have import tariff data, we do not have any data on variable trade costs of Japanese firms when they export their goods.

5 Results

We first discuss the results shown in Table 2 where we estimated the coefficients by the fixed effect model in columns (1),(3), (5), and (7) and by the random effect model in columns (2), (4), (6), and (8). The dependent variables in columns (1)–(2), (3)–(4), (5)–(6), and (7)–(8) are the fractions of non-MNE exporters, MNEs, MNEs per non-MNE exporters, and the sum of exporters and MNEs, respectively. Since $\delta_N = \delta_X + \delta_I$, the coefficient estimates in columns (7)–(8) equal the sum of the coefficients in columns (1)–(2) and (3)–(4). The p-values of the Hausman test indicate that the random effects estimates are not much different from fixed effects estimates and that the null hypothesis of exogeneity of the industry-and-region pair effects cannot be rejected. Furthermore, the p-values of the Breusch and Pagan Lagrange Multiplier test for random effects show that the random effects model is desirable compared with ordinary least squares (OLS). Random effect estimates are supported when we use other specifications in this chapter.

First, the coefficients on the log of dispersion are positive in all eight columns and statistically significant in all columns except columns (1) and (5). These estimated signs show that industries with higher dispersion of productivity have a larger fractions of MNEs and a larger fractions of the sum of exporters and MNEs. All of these estimated signs are consistent with the theoretical predictions. Since the estimated signs are significantly positive in columns (3)–(4) and (7)–(8), the results support our main prediction that industries with higher dispersion have more MNEs and internationalized firms relative to all active firms.

Although the coefficient on the log of dispersion in column (5) is not significant, the estimated signs in columns (5) and (6) are consistent with the theoretical implications derived in Sect. 3 that predicted that industries with a higher level of productivity dispersion have a larger ratio of MNEs to non-MNE exporters.

In addition, the positive coefficients on dispersion in columns (1)–(2) suggest that industries with a larger dispersion of productivity have a larger fraction of non-MNE exporters, although the coefficient in column (1) is not significant. This corresponds to the Ricardian type of comparative advantage that a more productive industry has more exporters.

In summary, the results show that industries with a higher degree of dispersion have a higher fraction of both MNEs and sum of exporters and MNEs. They are also consistent with our theoretical prediction that industries with a higher degree of dispersion have a higher fraction of non-MNE exporters, and higher ratio of MNEs to non-MNE exporters.

Second, the coefficients on R&D intensity are positive and significant in columns (3)–(4). This implies that R&D plays an important role in FDI, as predicted by the theory. In other words, the knowledge from R&D gives firms in R&D-intensive industries an advantage in producing their products in foreign countries because they can apply their knowledge to their production even in different locations.

The coefficients on R&D intensity in columns (5)–(6) are insignificant. This result accords with our prediction that R&D does not affect the ratio of MNEs to

Table 2 Heterogeneity and the fractions of internationalized firms (Japan, 1997–2005)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Exporters		MNEs		MNEs/Exporters		Exporters and MNEs	
Estimation method	FE	RE	FE	RE	FE	RE	FE	RE
ln DISPERSE	0.048	0.051*	0.069***	0.083***	0.694	0.826**	0.117***	0.128***
	[0.032]	[0.029]	[0.024]	[0.023]	[0.494]	[0.365]	[0.029]	[0.030]
ln RDINT	−0.001	0.008***	0.005*	0.008***	0.052	−0.068	0.004	0.011**
	[0.003]	[0.003]	[0.003]	[0.002]	[0.071]	[0.054]	[0.005]	[0.004]
ln KAPINT	−0.004	−0.002	0.003	0.003	0.031	−0.048	−0.002	0.000
	[0.009]	[0.008]	[0.007]	[0.006]	[0.111]	[0.089]	[0.011]	[0.010]
ln SKINT	0.000	0.001	0.000	0.001	−0.034	−0.038	0.001	0.001
	[0.000]	[0.001]	[0.000]	[0.000]	[0.035]	[0.035]	[0.001]	[0.001]
ln ADINT	−0.001	−0.002	−0.006**	−0.006***	−0.084**	−0.033	−0.007**	−0.008***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.041]	[0.033]	[0.003]	[0.002]
Observations	2016	2016	2016	2016	2016	2016	2016	2016
Number of clusters	57	57	57	57	57	57	57	57
Within R-squared	0.075	0.064	0.039	0.038	0.036	0.032	0.095	0.091
Between R-squared	0.019	0.255	0.227	0.279	0.000	0.130	0.204	0.268
Overall R-squared	0.020	0.229	0.206	0.258	0.002	0.103	0.183	0.252
p-value								
BPL test		0.000		0.000		0.000		0.000
Hausman test		1.000		1.000		1.000		0.790

Notes: Robust standard errors are shown in brackets. Dependent variables in column (1)–(2), (3)–(4), (5)–(6), and (7)–(8) are the fraction of non-MNE exporters, the fraction of MNEs, the ratio of MNEs to non-MNE exporters, and the fraction of the sum of exporters and MNEs, respectively. The interaction of region dummies with year dummies and constant are suppressed. *** Significant at 1 %. **5 %. *10 %

non-MNE exporters since R&D raises the fractions of both non-MNE exporters and MNEs. Moreover, the positive coefficients on R&D intensity in columns (7)–(8) are consistent with our prediction that R&D-intensive industries have larger fraction of the sum of exporters and MNEs.

In column (2) the coefficient on R&D intensity is positive and significant, as predicted by our model. On the other hand, in column (1) it is negative, which is puzzling. We need to reexamine our model in a future study. In particular, we should reconsider our assumption that the marginal cost of an R&D-intensive product is lower regardless of exporting and production in foreign countries.

Third, such control variables as capital intensity and skill intensity are not significant in all columns. It is interesting that these traditional Heckscher-Ohlin types of comparative advantage do not affect the structure of exporting and FDI.

Fourth, in the meantime, the coefficients of advertisement intensity are significant in some columns. In particular, they are significantly negative in columns (3)–(4) and (7)–(8). Our theory does not provide any explanation, but this result suggests that Japanese manufacturing has an advantage in less advertisement-intensive products such as intermediate goods which producers, and not consumers, purchase.

5.1 Robustness Check

In this section, we use alternative specifications as a robustness check. We examine whether dispersion affect the fraction of exporters including multinational exporters. While we used the fraction of non-MNE exporters as a dependent variable in previous analyses, we now examine our predictions by using the fraction of the sum of non-MNE exporters and multinational exporters as a dependent variable.

The estimation results are shown in Table 3. The results are almost similar to those in Table 2 but differ in two ways. First, the coefficients of the dispersion and R&D intensity are positive and highly significant—consistent with our model's prediction—while in Table 2 fixed effect estimates are not significant. Second, skill intensity and advertisement intensities turn out to be significant in column (2). These changes result from the incorporation of multinational exporters into the fraction of exporters, and therefore imply that multinational exporters tend to be more R&D intensive and more skill intensive than non-MNE exporters.

6 Concluding Remarks

In this chapter, we examined the link between firm heterogeneity and the prevalence of exporting and FDI. In addition, we extend the standard heterogeneity model of Helpman et al. (2004) to explain the roles of R&D in export and FDI, though the

Table 3 The fraction of exporters (Japan, 1997–2005)

	(1)	(2)
Dep. var.	Exporters	
Estimation method	FE	RE
ln DISPERSE	0.131***	0.148***
	[0.044]	[0.046]
ln RDINT	0.012*	0.026***
	[0.007]	[0.007]
ln KAPINT	0.003	0.007
	[0.020]	[0.017]
ln SKINT	0.001	0.002*
	[0.001]	[0.001]
ln ADINT	−0.007	−0.010**
	[0.005]	[0.005]
Observations	2016	2016
Number of clusters	57	57
Within R-squared	0.227	0.218
Between R-squared	0.392	0.476
Overall R-squared	0.342	0.437
p-value		
BPL test		0.000
Hausman test		0.130

Notes: Robust standard errors are shown in brackets. The dependent variable is the fraction of exporters including multinational exporters. The interaction of region dummies with year dummies and constant are suppressed. *** Significant at 1 %. **5 %. *10 %

Helpman et al. (2004) model cannot capture it. In particular, we develop a model where the marginal cost of the R&D-intensive product is lower, although a firm that invests in R&D incurs larger fixed costs.

Our model yields two testable implications. First, industries with larger productivity dispersion have (1) a larger fraction of firms that conduct FDI, (2) a larger ratio of MNEs to non-MNE exporters, and (3) a larger fraction of the sum of exporters and MNEs. Second, R&D-intensive industries have an advantage in exporting and FDI. Most empirical results accord with both implications of the model. However, our empirical analysis do not provide sufficient evidence for our prediction that R&D-intensive industries have a larger fraction of non-MNE exporters. This suggests a need for a model that is more consistent with the data.

Our results also shed light on the traditional source of comparative advantage, such as capital intensity and skill intensity. In particular, most of our estimation results show that capital intensity and skill intensity have no significant effect on

the fraction of internationalized firms. This suggests that these variables are less important in the structure of export and FDI than firm heterogeneity and R&D intensity.

We conclude that firm heterogeneity as well as R&D intensity play crucial roles in the structure of foreign trade and investment. Greater dispersion in productivity across firms within a single industry is associated with more FDI, as predicted in our model, and also with more exporting. In addition, R&D-intensive industries have a larger fraction of MNEs.

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Appendix

In this appendix, we describe our data sources.

Our industry-level data are from the Basic Survey of Japanese Business Structure and Activities (BSJBSA), which is an annual survey conducted by the Ministry of Economy, Trade, and Industry (METI). METI requires all firms in Japan with more than 50 employees and more than 30 million yen in capital to respond to the survey. While the number of target enterprises is 38,688, the number of enterprises that submitted a response in 2006 is 30,752—the survey aimed to obtain data on the previous financial year, 2005. The response rate is therefore 79.5 %. The response rate in our sample period, 1997–2005, is stable. The survey covers both manufacturing and non-manufacturing industries, but our study focused on manufacturing firms only. The number of firms whose main business is manufacturing is 12,763. These firms in the BSJBSA account for 76.8 % of product sales in 1998, compared with the result from the Basic Survey of Commercial and Manufacturing Structure and Activity, which has no firm-size threshold, and was conducted only once, in 1998, by METI. Although this suggests that our data set potentially underevaluates firm heterogeneity, we do not have any data source that provides the data of dispersion.

Table 4 provides a list of industries with their fraction of exporters and MNEs. Table 5 shows a list of countries by regions.

The variables used in this chapter are as follows.

1. Dispersion: the standard deviation of the logarithm of firm sales across all firms within an industry in each year.
2. Capital intensity: fixed tangible asset per worker.
3. R&D intensity: the ratio of research and development expenditure to total sales.

Table 4 The fraction of exporters and multinationals (Japan, 2005)

Industry code	Description	# of firms	Fraction of Non-MNE Exporters	Fraction of MNEs	Fraction of Exporters	Fraction of Exporting MNEs	Fraction of Non-exporting MNEs
121	Meat and meat products	260	1.9	5.0	3.5	1.6	3.4
122	Fish and fish products	198	3.5	9.1	9.6	6.1	3.0
123	Grain mill products	43	7.0	9.3	9.3	2.3	7.0
129	Other food products	900	4.9	11.0	8.7	3.8	7.2
131	Beverages and tobacco products	155	11.6	17.4	21.3	9.7	7.7
132	Prepared animal feeds	43	2.3	16.3	14.0	11.7	4.6
141	Spinning	23	8.7	13.0	13.0	4.3	8.7
142	Weaving	77	10.4	24.7	26.0	15.6	9.1
143	Dyeing	75	4.0	5.3	6.7	2.7	2.6
149	Other textiles	106	15.1	24.5	33.0	17.9	6.6
151	Knitted and crocheted fabrics and articles	197	3.6	23.9	9.1	5.5	18.4
152	Other wearing apparel	73	6.8	12.3	9.6	2.8	9.5
161	Sawmilling and planing of wood	120	3.3	14.2	8.3	5.0	9.2
169	Other products of wood	22	9.1	13.6	13.6	4.5	9.1
170	Furniture	153	3.9	17.0	11.8	7.9	9.1
181	Paper and paper products	102	6.9	15.7	13.7	6.8	8.9
182	Corrugated paper and paperboard	288	5.2	12.5	12.8	7.6	4.9
191	Publishing of newspapers	83	1.2	6.0	2.4	1.2	4.8
192	Publishing	134	6.0	11.9	9.7	3.7	8.2
193	Printing	610	3.0	6.6	7.0	4.0	2.6
201	Chemical fertilizer and inorganic chemistry	108	11.1	32.4	38.0	26.9	5.5
202	Organic chemistry	190	24.2	38.4	56.3	32.1	6.3
204	Soap and detergents	129	20.9	35.7	51.9	31.0	4.7

205	Pharmaceuticals and medicinal chemicals	228	29.4	21.1	46.9	17.5	3.6
209	Other chemical products	274	29.2	37.6	60.9	31.7	5.9
211	Refined petroleum products	24	29.2	29.2	54.2	25.0	4.2
219	Other petroleum products	25	28.0	40.0	64.0	36.0	4.0
220	Plastic products	710	10.6	28.0	29.2	18.6	9.4
231	Rubber tires and tubes	11	27.3	45.5	72.7	45.4	0.1
239	Other rubber products	147	15.6	32.7	42.9	27.3	5.4
240	Leather and fur	29	20.7	24.1	31.0	10.3	13.8
251	Glass and glass products	120	14.2	21.7	30.8	16.6	5.1
252	Cement, lime and plaster	189	1.6	5.8	4.8	3.2	2.6
259	Other non-metallic mineral products	185	19.5	18.9	35.1	15.6	3.3
261	Basic iron and steel	195	11.8	20.5	22.1	10.3	10.2
262	Casting of iron and steel	213	10.3	14.6	18.3	8.0	6.6
271	Non-ferrous metals	55	20.0	29.1	43.6	23.6	5.5
272	Casting of non-ferrous metals	263	16.3	26.6	39.2	22.9	3.7
281	Structural metal products	301	5.6	9.0	9.3	3.7	5.3
289	Other fabricated metal products	687	15.6	25.9	34.5	18.9	7.0
291	Machinery for metallurgy	255	27.5	35.3	58.8	31.3	4.0
292	Other special purpose machinery	443	25.1	28.0	48.3	23.2	4.8
293	Office machinery	141	14.9	26.2	35.5	20.6	5.6
299	Other general purpose machinery	771	23.7	30.9	49.9	26.2	4.7
301	Industrial electricity machinery	427	15.2	24.4	35.4	20.2	4.2
302	Household electrical appliances	130	13.1	30.0	37.7	24.6	5.4
303	Communication equipment	247	17.4	30.4	40.1	22.7	7.7
304	Applied electronic apparatus	218	20.6	28.9	45.0	24.4	4.5
305	Electronic components	707	16.5	32.1	43.8	27.3	4.8
309	Other electrical equipment	257	24.9	27.2	47.5	22.6	4.6
311	Motor vehicles	916	9.0	35.9	36.1	27.1	8.8

(continued)

Table 4 (continued)

Industry code	Description	# of firms	Fraction of Non-MNE Exporters	MNEs	Exporters	Exporting MNEs	Non-exporting MNEs
319	Other transport equipment	239	15.9	23.8	36.8	20.9	2.9
321	Medical equipment	110	34.5	25.5	55.5	21.0	4.5
322	Optical instruments	75	29.3	36.0	61.3	32.0	4.0
323	Watches and clocks	15	6.7	40.0	46.7	40.0	0.0
329	Other precision instruments	180	39.4	27.8	65.6	26.2	1.6
340	Other manufacturing	326	21.8	27.9	42.6	20.8	7.1
	Total	13202	14.2	23.5	31.7	17.5	6.0

Table 5 List of countries by region

Region	Code	Name	Region	Code	Name
Asia	101	India	Middle East	207	Afghanistan
Asia	102	Pakistan	Middle East	208	Bahrain
Asia	103	Bangladesh	Middle East	209	Qatar
Asia	104	Sri Lanka	Middle East	210	Syria
Asia	105	Myanmar	Middle East	212	Oman
Asia	106	Malaysia	Middle East	299	Other Middle East
Asia	107	Singapore	Middle East	299	Yemen
Asia	108	Thailand	Middle East	299	Jordan
Asia	109	Indonesia	Middle East	299	Gaza
Asia	110	Macao	Europe	301	United Kingdom
Asia	111	Philippines	Europe	302	France
Asia	112	Laos	Europe	303	Germany
Asia	113	Hong Kong	Europe	304	Belgium
Asia	114	Taiwan	Europe	305	Ireland
Asia	115	Vietnam	Europe	306	Switzerland
Asia	116	South Korea	Europe	307	Portugal
Asia	117	Nepal	Europe	308	Netherlands
Asia	118	Brunei	Europe	309	Italy
Asia	119	China	Europe	310	Luxembourg
Asia	199	Other Asia	Europe	311	Spain
Asia	199	Cambodia	Europe	312	Greece
Asia	199	Maldives	Europe	313	Malta
Asia	199	East Timor	Europe	314	Austria
Asia	199	Bhutan	Europe	315	Norway
Asia	199	North Korea	Europe	316	Former Yugoslavia
Asia	199	Mongolia	Europe	316	Serbia
Middle East	201	Iran	Europe	316	Montenegro
Middle East	202	Israel	Europe	316	Bosnia and Herzegovina
Middle East	203	Kuwait	Europe	316	Republic of Macedonia
Middle East	204	Lebanon	Europe	316	Croatia
Middle East	205	Saudi Arabia	Europe	316	Slovenia
Middle East	206	United Arab Emirates	Europe	317	Denmark

(continued)

Table 5 (continued)

Region	Code	Name	Region	Code	Name
Europe	318	Iceland	Europe	401	Moldova
Europe	319	Sweden	Europe	402	Poland
Europe	320	Turkey	Europe	403	Czech Republic
Europe	321	Finland	Europe	404	Slovakia
Europe	322	Cyprus	Europe	405	Hungary
Europe	399	Monaco	Europe	406	Albania
Europe	399	Andorra	Europe	407	Romania
Europe	399	Azores (Portugal)	Europe	408	Bulgaria
Europe	399	Gibraltar (U. K.)	Europe	499	Estonia
Europe	399	San Marino	Europe	499	Latvia
Europe	399	Liechtenstein	Europe	499	Lithuania
Europe	399	Vatican City	Europe	499	Other Eastern Europe
Europe	399	Other Western Europe	North America	501	United States
Europe	401	CIS	North America	502	Canada
Europe	401	Russia	North America	599	Saint Pierre and Miquelon (France)
Europe	401	Azerbaijan	North America	599	Other North America
Europe	401	Armenia	Central and South America	601	Mexico
Europe	401	Uzbekistan	Central and South America	602	Panama
Europe	401	Kazakhstan	Central and South America	603	El Salvador
Europe	401	Kyrgyzstan	Central and South America	604	Brazil
Europe	401	Tajikistan	Central and South America	605	Argentina
Europe	401	Turkmenistan	Central and South America	606	Paraguay
Europe	401	Georgia	Central and South America	607	Chile
Europe	401	Ukraine	Central and South America	608	Peru
Europe	401	Belarus	Central and South America	609	Dominican Republic

(continued)

Table 5 (continued)

Region	Code	Name	Region	Code	Name
Central and South America	610	Venezuela	Central and South America	699	Turks and Caicos Islands (U. K.)
Central and South America	611	Bolivia	Central and South America	699	Barbados
Central and South America	612	Bahamas	Central and South America	699	Cuba
Central and South America	613	Colombia	Central and South America	699	Haiti
Central and South America	614	Guatemala	Central and South America	699	Virgin Islands (U.S.)
Central and South America	615	Ecuador	Central and South America	699	Netherlands Antilles
Central and South America	616	Nicaragua	Central and South America	699	French West Indies
Central and South America	617	Costa Rica	Central and South America	699	Grenada
Central and South America	618	Trinidad and Tobago	Central and South America	699	St Lucia
Central and South America	619	Bermuda (U. K.)	Central and South America	699	Antigua and Barbuda
Central and South America	620	Puerto Rico (U.S.)	Central and South America	699	British Virgin Islands
Central and South America	621	Honduras	Central and South America	699	Dominica
Central and South America	622	Suriname	Central and South America	699	Montserrat (U. K.)
Central and South America	623	Jamaica	Central and South America	699	St. Christopher and Nevis
Central and South America	624	Guyana	Central and South America	699	Anguilla (U. K.)
Central and South America	625	Cayman Islands (U. K.)	Central and South America	699	Saint Vincent and the Grenadines
Central and South America	626	Uruguay	Central and South America	699	French Guiana
Central and South America	699	Other Central America	Central and South America	699	Falkland Islands (U. K.)
Central and South America	699	Belize	Africa	701	Egypt
Central and South America	699	Canal Zone	Africa	702	Morocco

(continued)

Table 5 (continued)

Region	Code	Name	Region	Code	Name
Africa	703	Zimbabwe	Africa	799	Benin
Africa	704	Liberia	Africa	799	Mali
Africa	705	Tanzania	Africa	799	Burkina Faso
Africa	706	Sudan	Africa	799	Cape Verde
Africa	707	Nigeria	Africa	799	Canary Islands (Spain)
Africa	708	Cote d'Ivoire	Africa	799	Chad
Africa	709	Madagascar	Africa	799	Central African Republic
Africa	710	Kenya	Africa	799	Equatorial Guinea
Africa	711	Ethiopia	Africa	799	Republic of the Congo
Africa	712	Zambia	Africa	799	Burundi
Africa	713	Uganda	Africa	799	Angola
Africa	714	Ghana	Africa	799	Sao Tome and Principe
Africa	715	Cameroon	Africa	799	St. Helena (U. K.)
Africa	716	Democratic Republic of the Congo	Africa	799	Djibouti
Africa	717	Rwanda	Africa	799	Somalia
Africa	718	Gabon	Africa	799	Seychelles
Africa	719	Sierra Leone	Africa	799	Mozambique
Africa	720	Gambia	Africa	799	Mauritius
Africa	721	Mauritania	Africa	799	Réunion (France)
Africa	722	Senegal	Africa	799	Namibia
Africa	723	Swaziland	Africa	799	Republic of South Africa
Africa	724	Libya	Africa	799	Lesotho
Africa	725	Guinea-Bissau	Africa	799	Malawi
Africa	726	Niger	Africa	799	Botswana
Africa	727	Tunisia	Africa	799	British Indian Ocean Territory
Africa	799	Other Africa	Africa	799	Comoros
Africa	799	Ceuta and Melilla (Spain)	Africa	799	Eritrea
Africa	799	Algeria	Oceania	801	Australia
Africa	799	Western Sahara	Oceania	802	Fiji
Africa	799	Togo	Oceania	803	New Zealand

(continued)

Table 5 (continued)

Region	Code	Name	Region	Code	Name
Oceania	804	New Caledonia	Oceania	899	Pitcairn Islands (U. K.)
Oceania	805	Papua New Guinea	Oceania	899	Nauru
Oceania	806	Samoa	Oceania	899	French Polynesia
Oceania	899	Other Oceania	Oceania	899	Guam (U.S.)
Oceania	899	Other Australia	Oceania	899	American Samoa
Oceania	899	Cook Islands (NZ)	Oceania	899	Northern Mariana Islands (U.S.)
Oceania	899	Tokelau (NZ)	Oceania	899	Marshall Islands
Oceania	899	Niue (NZ)	Oceania	899	Palau
Oceania	899	Vanuatu	Oceania	899	Micronesia (FSM)
Oceania	899	Solomon Islands	Oceania	899	Tuvalu
Oceania	899	Tonga	Oceania	899	Other American Oceania
Oceania	899	Kiribati			

4. Skill intensity: skilled workers per total employment. "Skilled workers" is defined as workers in the headquarter section, while total employment includes both skilled workers and "unskilled workers," defined as workers in the operations section.
5. Advertisement intensity: the ratio of advertisement expenditure to total sales.

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The Role of Non-productivity Factors in the Internationalization of Firms

Yasuyuki Todo

Abstract Using firm-level data for Japan, this chapter examines the determinants of export and foreign direct investment (FDI) decisions. We contribute to the literature by employing a mixed logit model to incorporate any unobserved firm heterogeneity and by paying special attention to the quantitative significance of the determinants. We find that although the effect of productivity on export and FDI decisions is positive and statistically significant, this effect is economically negligible. The quantitatively dominant determinants of the export and FDI decision are instead the prior status of firms in terms of internationalization and unobserved firm characteristics. This finding suggests that foreign market entry costs, which vary substantially in size across firms, play an important role in the export and FDI decision. Using a unique dataset for small and medium enterprises, we further show that such non-productivity factors of firm internationalization that are unobserved in standard firm-level data include the risk and time preferences and international experience of decision makers.

Keywords Exports • FDI • Internationalization • Japan • Mixed logit • Productivity

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1 Introduction

Recent empirical studies on international trade at the firm level have found that firms engaging in export or foreign direct investment (FDI) are generally more productive and larger than those firms serving only domestic markets.[1] This finding is consistent with the theoretical predictions of heterogeneous firm trade models, most notably those of Melitz (2003) and Helpman et al. (2004), in which only productive firms are able to pay the entry costs associated with export and FDI and hence serve foreign markets. This apparent consistency between theory and empirics has helped to deepen our understanding of the process of firm internationalization.[2]

However, it is often observed that productivity is not the sole determinant of the export and FDI behavior of firms. Figure 1 depicts the distribution of the log of total factor productivity (TFP) for four types of Japanese firms.[3] These are (1) firms serving only the domestic market ("domestic firms"), (2) firms engaging in export but not in FDI ("pure exporters"), (3) firms engaging in FDI but not in export ("pure FDI firms"), and (4) firms engaging in both export and FDI ("export and FDI firms"). As shown, firms serving only the domestic market are generally less productive than exporters and FDI firms. However, the distributions of the four types of firms overlap greatly. In other words, many productive firms do not serve foreign markets, whereas many unproductive firms are engaged in export and FDI. Bernard et al. (2003, Fig. 2A) and Mayer and Ottaviano (2007, Fig. 4) also find this phenomenon to hold for US and Belgian firms, respectively. More formally, Bernard and Jensen (2004) apply ordinary least squares estimation of a linear probability model of export decisions to U.S. plant-level data, finding that a 100% increase in TFP increases the probability of exporting by only 1.7% points. Bernard and Wagner (2001) find similar-sized effects of labor productivity on export decisions using German data. Greenaway and Kneller (2004) note that for UK firms, firm characteristics such as productivity are

[1] Existing works on this issue include the works of Clerides et al. (1998) for Columbia, Mexico, and Morocco; Bernard and Jensen (1999, 2004) and Bernard et al. (2003) for the US; Head and Ries (2003) and Tomiura (2007) for Japan; Barrios et al. (2003) for Spain; Greenaway and Kneller (2004) for the UK; Mayer and Ottaviano (2007) for various European Union (EU) countries; Damijan et al. (2007) for Slovenia; and Eaton et al. (2011) for France. Useful surveys of this literature can be found in the works of Bernard et al. (2007), Greenaway and Kneller (2007), and Wagner (2007, 2012).

[2] Throughout this chapter, the internationalization of firms is defined as engaging in export, foreign direct investment, or international sourcing (offshoring).

[3] The figure is taken from Wakasugi et al. (2008), who employ the same firm-level data for Japanese firms used in the current analysis.

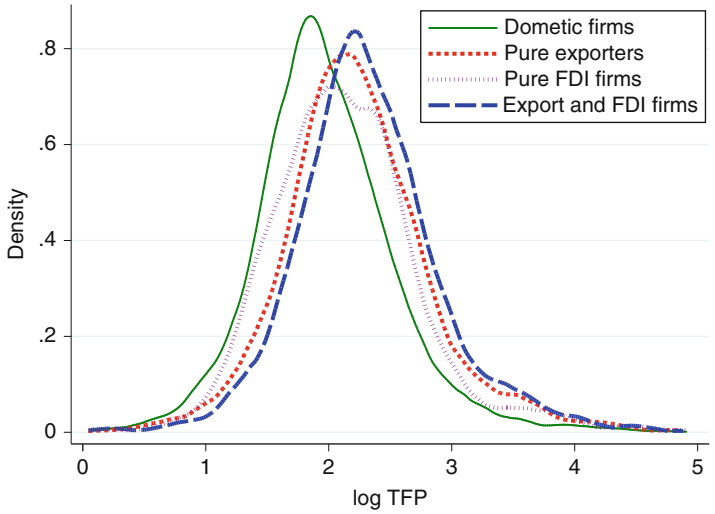


Fig. 1 Distribution of TFP across Japanese firms. *Notes*: This figure is taken from Fig. 5 in Wakasugi et al. (2008), showing the distribution of the log of TFP for Japanese manufacturing firms in 2005

"quantitatively far less important than experience" (p. 361). Together, this evidence suggests that productivity plays a statistically significant but quantitatively limited role in determining the internationalization of firms.

Eaton et al. (2011) suggest one method of reconciling this evidence with trade theory that involves incorporating firm-specific entry costs of export into a heterogeneous firm model. Using the method of simulated moments, Eaton et al. (2011) estimate the model parameters and find great variation in entry costs across firms. Their study usefully highlights the significant contribution of firm heterogeneity in unobserved characteristics combined with the contribution of heterogeneity in productivity in the export decision.

To further investigate the role of unobserved firm heterogeneity rather than productivity heterogeneity in the internationalization of firms, this chapter adopts an alternative approach, applying a multinomial logit model with random intercepts and random coefficients (a mixed logit model) for the export and FDI decision to firm-level data for Japan, based on Todo (2011). The inclusion of random intercepts and random coefficients on prior firm status in the export and FDI decision may control for unobserved firm heterogeneity and correct for the biases associated with endogeneity. We then use the resulting estimation results to examine the quantitative effects of productivity and the unobserved firm-specific random effects. From the mixed logit estimation, we found that the effect of productivity is negligible in magnitude, although unobserved firm characteristics have a large effect.

We then examine the unobserved firm characteristics that determine the internationalization of firms, based on the work of Todo and Sato (2011), who use a unique firm-level dataset for Japanese small and medium enterprises (SMEs)

containing information on the risk and time preferences and overseas experience of the president of each SME. The authors find that these characteristics of presidents largely influence the decisions of SMEs to engage in internationalization, confirming a large effect of unobserved firm characteristics that are not included in standard firm-level data.

2 Empirical Methodology

To examine the role of unobservable factors in the internationalization of firms, we first estimate how export and FDI decisions are made by explicitly incorporating unobservable factors into the estimation model. Theoretically, we assume that in each period, firms determine whether to engage in export and/or FDI, following Helpman, Melitz and Yeaple (2004). There are three types of firms in our analysis: firms serving only the domestic market (domestic firms), firms engaging in export but not in FDI (exporters), and firms engaged in FDI (FDI firms) that may or may not export.[4] Helpman et al. (2004) distinguish between export and FDI decisions in that the initial costs of FDI exceed those of exports. Furthermore, exports from Japan are typically associated with FDI, as they stem from Japanese parent firms to their overseas subsidiaries, and such exports are qualitatively different in nature from exports unrelated to FDI. Therefore, it is necessary to distinguish between FDI and exports unrelated to FDI to undertake an empirical analysis of the internationalization decisions of firms.

However, many existing studies, including Bernard and Jensen (1999), Bernard and Wagner (2001), and Bernard and Jensen (2004), principally focus on binary choices, i.e., whether to export or perform FDI. Most existing studies using Japanese firm-level data, including Kiyota and Urata (2008), Kimura and Kiyota (2006), and Ito (2007), adopt a similar approach. Notable exceptions that consider multiple firm choices include the works of Head and Ries (2003) and Tomiura (2007). However, neither of these studies employs formal multiple-choice regression models. The present study uses a mixed logit model that enables us to consider simultaneous export and FDI decisions, as theoretically examined in Helpman et al. (2004).

In our analysis, we assume that firms choose one of three statuses based on their expected profits (or revenues less costs) as determined by the following factors. First, we assume that revenues depend on the productivity of firms, as measured by their TFP, following Helpman et al. (2004). Second, we assume that firm size, as measured by the amount of employment, may determine revenues, possibly because of the existence of increasing returns to scale. Third, as suggested by Melitz (2003) and Helpman et al. (2004), the costs of export and FDI can include initial fixed costs, such as research into foreign markets and the construction of sales networks.

[4] As an experiment, we distinguished between firms engaging in FDI but not in exports and firms engaging in both FDI and exports. However, our central findings remained unchanged.

Therefore, the costs of export (or FDI) are lower for firms that are already engaged in exporting (FDI). Fourth, these initial costs of export and FDI depend on each firm's level of information regarding foreign markets, which in turn depends on the extent of the internationalization of firms as measured by the foreign ownership ratio. Fifth, information spillovers to foreign markets from experienced firms in the same region and industry also affect the initial export and FDI costs. Therefore, the costs of export (FDI) also depend on the number of other firms in the same region and industry engaging in export (FDI).[5] Sixth, whether a firm is able to finance the initial export and FDI costs also affects its decision. In this study, we represent credit constraints using the ratio of long-term debt to total assets.[6] Finally, because the initial costs of entry to export and FDI may be firm specific, as suggested by Eaton et al. (2011), firm profits should also depend on other firm-specific unobserved factors.

Using these arguments, we assume that the expected profits of firm i in year t from state j, which is serving only the domestic market (D), engaging in export but not in FDI (E), or engaging in FDI (F), are given by the following:

$$\pi_{ijt} = X_{i(t-1)}\beta_j + Z_{ij(t-1)}\delta + D_{i(t-1)}\gamma_j + \alpha_{ij} + \varepsilon_{ijt}, \tag{1}$$

where $X_{i(t-1)}$ is a vector of variables representing firm characteristics in the previous year, such as the level of productivity, employment, and credit constraints, and $Z_{ij(t-1)}$ denotes the characteristics of state j for firm i. In particular, to examine the effects of information spillovers from other internationalized firms, Z includes a variable that is equal to the number of firms of state j in the same region and industry as firm i when $j = E$, F and zero when $j = D$. The variables $D_{i(t-1)} = (d_{iE(t-1)}, d_{iF(t-1)})$ are dummies indicating that firm i engages in export and FDI, respectively, in year t–1 to account for the effects of initial costs on the export and FDI decision. Finally, the firm-choice specific random effect, α_{ij}, represents any unobserved firm heterogeneity in entry costs, and ε_{ijt} is the error term.

The assumption that ε_{ijt} are *iid* distributed Type-1 extreme value leads to the random-effects multinomial logit model. By assuming correlation between the random effects, we can relax the Independence from Irrelevant Alternatives (IIA)

[5]Using firm-level data from Mexico, Aitken et al. (1997) first investigated whether spillovers from other firms promote exports, finding evidence of spillovers from multinational enterprises but not from exporting firms. Using UK data, Greenaway et al. (2004) obtain similar results. Conversely, Bernard and Jensen (2004) use US data and Barrios et al. (2003) examine Spanish data, both finding positive spillover effects.

[6]Manova (2008) employs cross-country data and finds that equity market liberalization increased exports more in credit-constrained sectors than in other sectors, concluding that credit constraints are an important determinant of international trade flows. Muûls (2008) re-examines a similar issue using firm-level data for Belgium and employing a bankruptcy risk measure provided by Coface, a credit insurance company, as a measure of the extent of credit constraints. Muûls (2008) concludes that credit constraints indeed affect the export decisions of Belgian firms.

assumption that is imposed in standard multinomial logit models. Under the IIA assumption, the exclusion of one choice from the choice set should not change the estimated coefficients of other choices. However, as the exact structure of the three choices in our model is unclear, we are uncertain whether the IIA assumption is satisfied. Therefore, incorporating random effects in our estimation leads to more reliable estimation results.

An additional problem of the logit estimation based on Eq. (1) is that the inclusion of the lagged status of the firm ($D_{i(t-1)}$) as a regressor leads to correlation between the error term and lagged status. Following Johannesson and Lundin (2001), we correct for possible biases associated with this correlation by allowing random variation in the coefficient on lagged status. Accordingly, we obtain the following mixed logit model for estimation:

$$\Pr[y_{it} = j] = \frac{\exp\left(\alpha_{ij} + X_{i(t-1)}\beta_j + Z_{ij(t-1k)}\delta + D_{i(t-1)}\gamma_{ij}\right)}{\sum_{k=D,E,F} \exp\left(\alpha_{ik} + X_{i(t-1)}\beta_k + Z_{ik(t-1)}\delta + D_{i(t-1)}\gamma_{ik}\right)}, \tag{2}$$

where we assume that the parameters for $j = D$ are zeroes for identification purposes. We also allow for correlation between the values for α and γ. Note that γ_{ij} has the subscript ij rather than simply j to indicate that the size of the coefficient varies across firms.

In Eq. (2), we assume that the estimates for β and δ do not vary in magnitude across firms. However, the coefficients for firms that are serving only the domestic market in the previous year are likely to differ from those for firms that are already serving foreign markets through export or FDI. Suppose, for example, that a domestic firm increases its productivity while an exporter lowers its productivity by the same amount. The increase in the probability that the domestic firm exports in the next year is then likely to be larger than the decrease in the probability that the exporter remains an exporter, as the exporter has already paid the initial costs of exporting. In Eq. (2), we incorporate the effect of the initial costs of internationalization by including dummy variables for prior internationalization status. However, it remains possible that the coefficient on the covariates differs in size across previously domestic and internationalized firms. To account for this possibility, an alternative specification incorporates terms of interaction between the covariates and the dummy variable for internationalized firms in the previous year. Based on the above argument, we would expect that the coefficients on the terms of interaction between the dummy for prior internationalization and productivity, firm size, and the number of internationalized firms in the same region and industry would be negative, whereas the coefficient on the term of interaction between the dummy and the debt-to-asset ratio would be positive.

3 Data

For the estimation in this analysis, we employ a firm-level data set for Japanese firms based on the *Kigyo Katsudo Kihon Chosa* (KKKC, Basic Survey of Japanese Business Structure and Activities). This survey arises from an annual census conducted by the Ministry of Economy, Trade, and Industry (METI) of all firms with at least 50 employees and paid-up capital of at least 30 million yen. Participation in the survey is compulsory. We use data from the 1997–2005 period, as the data gathered during this period contain information on exports collected and reported in a consistent manner.

The KKKC data include information on exports and the number of affiliates in foreign countries. We define firms as engaging in exporting if their reported exports are positive.[7] To identify firms engaging in FDI, we supplement information in the KKKC data with data on Japanese firm affiliates in foreign countries, which are also collected annually by METI, *Kaigai Jigyo Katsudo Kihon Chosa* (KJKKC, Basic Survey of Overseas Business Activities). The KJKKC survey collects data on foreign affiliates from their parent firms in Japan.[8] The survey covers all Japanese firms that had affiliates abroad as of the end of the fiscal year (March 31), and a foreign affiliate of a Japanese firm is an affiliate that is located in a foreign country in which a Japanese firm had an equity share of 10% or more. Because the KJKKC is not mandatory, the response rate for firms is typically approximately 60%. We define as FDI firms those firms that report a positive number of foreign affiliates in the KKKC data or information on one or more foreign affiliates in the KJKKC data. Furthermore, following the theoretical model used by Helpman et al. (2004), we exclude vertical FDI (i.e., FDI for exporting parts and components to the parent firm in the home country) from our definition of FDI because although export and horizontal FDI are complementary channels that are used to serve foreign markets, the determinants of the decision for vertical FDI should differ from those for export and horizontal FDI. Therefore, we assume that Japanese firms engage in vertical FDI if all their overseas subsidiaries export at least 75% of their total sales to Japan in the KJKKC data set, and we exclude these firms from the set of FDI firms.

Although the KKKC data include firms operating in the service sector, we exclude these firms and instead focus on firms in the manufacturing sector. We also remove firms for which the information that is necessary for estimation is unavailable. This process results in 92,659 firm-year observations.

[7]This definition implies that when firms did not report their exports, we define these firms as firms that do not engage in exporting.

[8]In the survey, 'foreign subsidiaries' are overseas firms in which the Japanese parent holds an equity stake of more than 50%, whereas 'foreign affiliates' are overseas firms in which the Japanese parent holds between 20 and 50% of equity. However, we do not distinguish between foreign subsidiaries and affiliates in this study.

Table 1 Mean and standard deviation (in parentheses) of variables by firm status

Variables	Domestic firms	Exporters	FDI firms	All firms
Log of TFP	1.765 (0.501)	1.941 (0.512)	1.999 (0.522)	1.836 (0.517)
Log of employment	4.975 (0.755)	5.298 (0.938)	6.059 (1.225)	5.230 (0.985)
Foreign ownership (%)	0.581 (6.452)	4.880 (18.731)	2.923 (9.960)	1.665 (10.048)
Debt-to-asset ratio	0.269 (0.238)	0.225 (0.185)	0.219 (0.162)	0.253 (0.219)
Number of exporters in the same prefecture and industry (1,000)	0.022 (0.042)	0.053 (0.066)	0.054 (0.065)	0.032 (0.053)
Number of FDI firms in the same prefecture and industry (1,000)	0.015 (0.027)	0.032 (0.040)	0.035 (0.040)	0.021 (0.033)
Number of firms	61,209	13,691	17,759	92,659
Share in total (%)	66.06	14.78	19.17	100

Notes: This table includes the mean and standard deviation (in parentheses) of each variable by firm type. The observations are for firms that are in operation in the following year during the 1997–2004 period and are classified according to their status in the following year

The variables used for estimation are constructed as follows.[9] TFP is given by the following:

$$\ln TEP = \ln Y - \beta_L \ln L - \beta_K \ln K,$$

where Y, L, and K are real value added, the number of workers, and the capital stock, respectively. Because the KKKC data do not provide information on the composition of workers according to the level of human capital or information on work hours, we cannot adjust the amount of labor by either the level of human capital or work hours. Using the method developed by Olley and Pakes (1996), we estimate β_L and β_K to be 0.7822 and 0.1754, respectively. The KKKC survey reports each firm's ratio of foreign ownership. The debt-to-asset ratio is the ratio of long-term debt to total assets. The variables used to examine spillover effects include the number of firms engaging in export (FDI) in the same region and the same industry. We define "regions" by prefecture: there are 47 prefectures in Japan with an average area of approximately 8,000 square kilometers. We classify "industries" using the System of National Accounts (SNA) industry classification at the two-digit level. The total number of industries in the manufacturing sector is 20.

Table 1 provides the mean and standard deviation for each variable by firm type. As shown, FDI firms are generally more productive and larger than exporters, whereas exporters are more productive and larger than domestic firms. This finding concurs with those of existing studies. We also find that exporters and FDI firms

[9]When constructing the data set, we relied heavily on Stata programs provided by Matsuura (2004).

Table 2 Share of firms in each status by prior status

	(1)	(2)	(3)
	Previous status		
Current status	Domestic firm	Exporter	FDI Firm
Domestic firm	0.9612	0.0904	0.0251
Exporter	0.0251	0.8379	0.0343
FDI firm	0.0137	0.0717	0.9405
Number of observations	61,209	13,691	17,759

Notes: Domestic firms are firms that serve only the domestic market. Exporters are firms engaging in export but not in FDI, and FDI firms are firms engaging in FDI

have smaller debt-to-asset ratios than domestic firms. Examining the third and fourth rows from the bottom, we also observe that exporters and FDI firms tend to agglomerate in the same region and industry.

Table 2 details the share of firms by status (domestic, exporting, or engaging in FDI) in the previous year. Column (1) indicates that 96% of previously domestic firms remain domestic, whereas 2.5 and 1.4% become exporters and FDI firms, respectively. Similarly, 84% of exporters remain as exporters, and 94% of FDI firms engage in FDI in the following year. This evidence suggests that status is highly sticky and that few firms change their status over time.

4 Econometric Results

4.1 Benchmark Results

Column (1) in Table 3 provides the results from the mixed logit model represented by Eq. (2). As shown, the first row indicates that the effect of the number of internationalized firms of the same status in the same prefecture and industry is positive and statistically significant at the 1% level. This finding suggests that spillovers of information on foreign markets from neighboring internationally experienced firms affect firm decisions regarding internationalization.

Because the other covariates are firm specific but invariant to choice, the coefficient of each of these variables varies according to the status chosen. First, the level of TFP positively affects the probability of engaging in export, along with firm size (measured by the number of workers), the ratio of foreign ownership, and prior experience in export and FDI (the left-hand side sub-column labeled "Export" in column (1) of Table 3). These results are qualitatively consistent with existing theoretical and empirical studies. In addition, the debt-to-asset ratio has a negative and significant effect on the export decision. This finding suggests that credit-constrained firms are less likely to engage in export, as they cannot easily finance the initial export costs.

Table 3 Benchmark results from the random-effects multinomial logit model

Variables	(1)		(2)	
Number of exporters/FDI firms in the same prefecture and industry	5.185 (0.432)**		9.031 (0.636)**	
	Export	*FDI*	*Export*	*FDI*
Intercept: mean	−6.483	−9.229	−7.073	−9.805
	(0.202)**	(0.232)**	(0.301)**	(0.373)**
Intercept: SD	3.114	3.130	1.858	1.847
	(0.277)**	(0.358)**	(0.081)**	(0.104)**
Dummy for exporters: Mean	7.559	5.215	8.653	6.306
	(0.113)**	(0.153)**	(0.415)**	(0.485)**
Dummy for exporters: SD	9.478	8.209	3.061	2.879
	(0.562)**	(0.839)**	(0.090)**	(0.143)**
Dummy for FDI firms: mean	5.587	10.262	6.640	3.544
	(0.239)**	(0.215)**	(0.456)**	(0.138)**
Dummy for FDI firms: SD	11.902	12.813	3.466	12.557
	(1.122)**	(1.033)**	(0.159)**	(0.976)**
Log of TFP	0.083	0.068	0.148	0.084
	(0.047)+	(0.053)	(0.066)*	(0.082)
Log of employment	0.259	0.636	0.307	0.705
	(0.029)**	(0.031)**	(0.046)**	(0.053)**
Debt-to-asset ratio	−0.538	−0.341	−0.596	−0.309
	(0.122)**	(0.144)*	(0.172)**	(0.214)
Foreign ownership (%)	0.009	−0.005	0.012	−0.002
	(0.002)**	(0.003)+	(0.003)**	(0.006)
Interaction with a dummy for internationalized firms				
Number of exporters/FDI firms in the same prefecture and industry			−7.506 (0.901)**	
	Export	*FDI*	*Export*	*FDI*
Log of TFP			−0.164	−0.108
			(0.097)+	(0.112)
Log of employment			−0.100	−0.134
			(0.066)	(0.072)+
Debt-to-asset ratio			0.183	−0.005
			(0.272)	(0.315)
Foreign ownership (%)			−0.004	−0.005
			(0.005)	(0.007)
	92,659		92,659	
	−22,148.61		−22,105.88	

Notes: *Statistical significance at the 5% levels; **statistical significance at the 1% levels; +statistical significance at the 10% levels

Second, the number of workers, past experience in exporting and FDI, and the level of debt (the FDI sub-column) also determine the probability of engaging in FDI. Again, these findings are largely consistent with those of existing studies. However, the TFP level has no significant effect on the FDI decision, despite the theoretical prediction of Melitz (2003) and Helpman et al. (2004) that productivity is the major determinant of the FDI decision.

We next incorporate terms of interaction between the covariates and the dummy for internationalized firms to account for possible differences in the size of the effect of the covariates for domestic firms and internationalized firms, as argued in Sect. 2. The results, which are presented in column (2) of Table 3, indicate that the interaction terms with the number of exporters/FDI firms in the same region and industry, the level of TFP, and the amount of employment have a negative effect on the export and FDI decision. Conversely, the interaction term that includes the debt-to-asset ratio has a positive effect on the export decision. These results are consistent with our presumption that the effect of the covariates is smaller for already internationalized firms, although many of these effects are not statistically significant. Accordingly, the coefficient on the covariates is larger (in absolute terms) in column (2) than in column (1).

4.2 Numerical Exercises

The question arises as to how well the econometric model fits the data. As shown in column (1) of Table 2, 96.1% of domestic firms remained domestic in the following year, 2.5% became exporters, and 1.4% became FDI firms. Using these estimation results, we compute the probability that a hypothetical "average domestic firm", whose covariates equal the means for domestic firms, remains domestic, or becomes an exporter or FDI firm. The predicted probability that the average domestic firm remains domestic in the next year is 98.9%, whereas the probability that the firm engages in export and FDI in the next year is 0.73 and 0.36%, respectively. These results suggest that our econometric model explains the actual export and FDI decision reasonably well, although the prediction tends to overvalue the probability of remaining domestic.[10]

Now suppose that a firm's characteristics, such as its level of productivity and employment, improve. We can then compute the change in the predicted probability

[10]When we assume that the coefficients on the dummies for previous status, the values of γ in Eq. (2), are not stochastic but rather constant across firms, the predicted probabilities are closer to the actual probabilities. The respective predicted probability that the average domestic firm becomes an exporter or an FDI firm is 2.34 and 1.22%, as compared to the actual probabilities of 2.51 and 1.37%. However, as discussed in Sect. 2, assuming random coefficients on the dummies is necessary to correct for possible biases from the correlation between the error term and the dummies for prior status. Nevertheless, our main results do not change using the alternative specification.

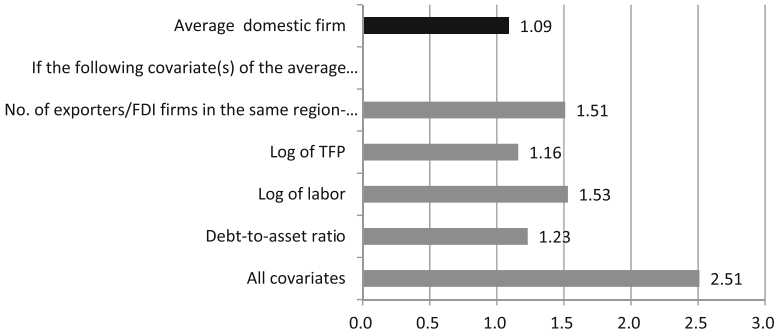


Fig. 2 Predicted probability (%) that the average domestic firm becomes an exporter or FDI firm in the following year. *Notes*: Domestic firms are firms that serve only the domestic market. Exporters are firms engaging in export but not in FDI, and FDI firms are firms engaging in FDI. The average domestic firm is a hypothetical firm whose covariates equal the mean for domestic firms

that the average domestic firm internationalizes (i.e., engages in export or FDI) based on this improvement. The change in the predicted probability reflects the quantitative size of the effects of the determinants of export and FDI.

For illustrative purposes, Fig. 2 depicts the predicted probability of internationalization for the average domestic firm when each or all the covariates improves by one standard deviation (we include the predicted probability without any improvement at the top of the table for reference). According to Table 1, because of the improvement by one standard deviation, the characteristics of the average domestic firm become better than the average for exporters and FDI firms. For example, when the log of TFP improves by one standard deviation (0.501), TFP becomes 2.266 ($= 1.765 + 0.501$), which is substantially larger than the average TFP for exporters (1.941) or FDI firms (1.999).

Figure 2 indicates that the numerical change in the predicted probability of engaging in export and FDI because of improvements in the average domestic firm's characteristics is generally small and often negligible. For example, the third bar from the top in Fig. 2 indicates that when the log of TFP improves by one standard deviation (i.e., TFP improves by 50%), the predicted probability that the average domestic firm becomes an exporter or an FDI firm increases from 1.09 to 1.16%. Therefore, although the positive effect of the productivity level on the export and FDI decision is statistically significant, it is negligible in magnitude. The increase in the probability of internationalization is also negligible when the extent of credit constraint improves or when the debt-to-asset ratio declines (the fifth bar in Fig. 2).

The spillover effect, as measured by the effect of the number of exporters/FDI firms in the same region and industry (the second bar), and the effect of firm size (the fourth bar) are larger in magnitude than the effect of productivity and credit constraints. The results for the spillover effect thus suggest that relocating the average domestic firm to a prefecture with 30–40 internationalized firms in the same industry (a one standard deviation increase) leads to an increase in the probability

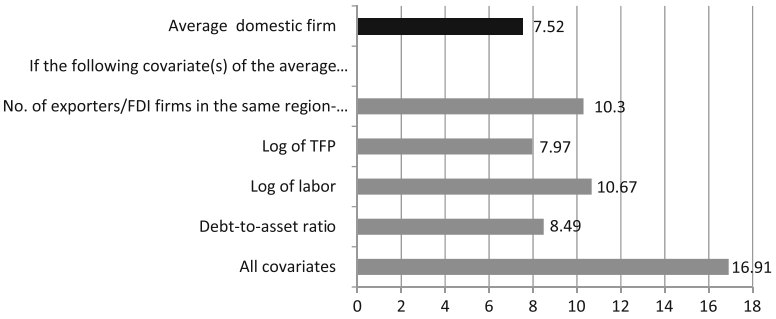


Fig. 3 Predicted probability (%) that the average domestic firm becomes an exporter or FDI firm after 8 years. *Notes*: Domestic firms are firms that serve only the domestic market. Exporters are firms engaging in export but not in FDI, and FDI firms are firms engaging in FDI. The average domestic firm is a hypothetical firm whose covariates equal the mean for domestic firms

of engaging in export or FDI by 0.4% points. In addition, a one standard deviation (76%) increase in the number of workers increases the probability of engaging in export or FDI by approximately 0.4% points. Nonetheless, the quantitative effects of spillovers and firm size remain small.

The small numerical effect of the covariates may have arisen because we considered what would occur only 1 year after the change in the covariates. Therefore, we now examine the long-term effects of the change in the covariates by computing the predicted probability 8 years after the improvement in firm characteristics.[11] The third bar from the top in Fig. 3 indicates that when the level of TFP improves by 50% (i.e., one standard deviation), the predicted probability that the average domestic firm engages in export or FDI 8 years following the improvement is 8.0%, compared with 7.5% in the absence of such an improvement. Therefore, the effect of such a substantial productivity improvement on the export and FDI decision of the average domestic firm is negligible, even in the long term. The long-term effect of credit constraints is also negligible.

The effect of spillovers and the firm size is again larger in magnitude. When relocating to a prefecture with more internationalized firms in the same industry by one standard deviation (30–40 firms), the probability of the average domestic firm engaging in export or FDI increases by 2.8% points. Similarly, when the number of workers increases by one standard deviation (a 76% increase), the probability of the average domestic firm engaging in export or FDI increases by 3.2% points. Thus, the spillover and scale effects may not be "negligible" in the long term, despite remaining quite small.

In contrast, our results suggest that the export and FDI decision relies heavily on each firm's status in the previous year. Figure 3 indicates that even after 8 years, the predicted probability of the average domestic firm remaining domestic is 92.5%,

[11] We consider a 9-year period, as our data set covers the 1997–2005 period.

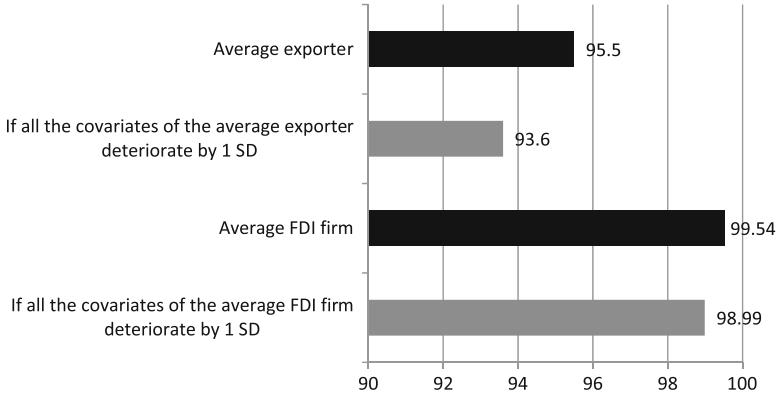


Fig. 4 Predicted probability (%) that the average exporter/FDI firm is an exporter or FDI firm in the following year. *Notes*: The average exporter (FDI firm) is a hypothetical firm whose covariates equal the mean for exporters (FDI firms)

and the probability remains as high as 83.1%, even when all firm characteristics improve by one standard deviation. In other words, firms that are currently domestic tend to remain domestic in the long term, and this pattern is not greatly affected by improvements in the observed firm characteristics.

To highlight the stickiness of firm status on internationalization, we perform two additional numerical experiments. First, we examine how the probability that the hypothetical firm whose covariates are equal to the mean for domestic firms in each status in the next year varies depending on the current firm status. We find that if the firm is currently a domestic firm, then the predicted probability of remaining domestic in the next year is 98.9% (the top bar in Fig. 2). However, if the firm with the same characteristics is currently an exporter (an FDI firm), then the firm's probability of remaining internationalized is 95 (99) %.

Second, we compute the probability that the "average exporter" whose covariates are equal to the mean for exporters and the "average FDI firm" defined similarly are in the same status in the next year, and we examine how the probability changes when all the covariates decrease by one standard deviation. Figure 4 summarizes the results. A comparison of the first and second bars from the top suggests that the probability that the average exporter remains internationalized changes by only 2% points, even when all the covariates decrease. The third and fourth bars present comparable stickiness in the status of FDI firms.

In addition to the internationalization status of a firm, a major determinant of the export and FDI decision is the unobserved characteristics of the firm as represented by the random intercept in the export and FDI decision equations (γ_{iE} and γ_{iD} in Eq. (2), respectively). To observe this relationship, we repeat our numerical experiments and compute the probability that the average domestic firm is internationalized in the next year, assuming that the intercept in both the export and FDI decision equations increases by one standard deviation. The results presented in Fig. 5 indicate that

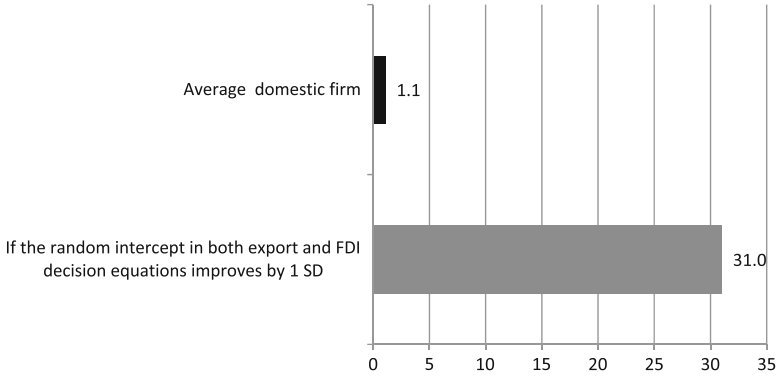


Fig. 5 Predicted probability (%) that the average domestic firm becomes an exporter or FDI firm in the following year. *Notes*: Domestic firms are firms that serve only the domestic market. Exporters are firms engaging in export but not in FDI, and FDI firms are firms engaging in FDI. The average domestic firm is a hypothetical firm whose covariates equal the mean for domestic firms

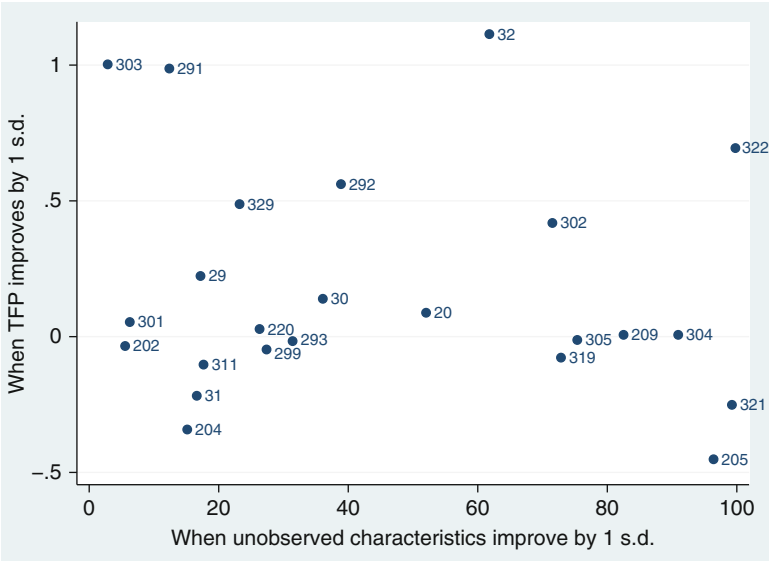
the probability of becoming an internationalized firm (either an exporter or a FDI firm) increases by 30% points because of the change in a firm's unobserved characteristics. Compared with the small changes in probability of less than 1.5% points from the change in all observed characteristics (Fig. 2), a change of 30% points is substantial. Therefore, we conclude that firm characteristics that are not captured by our covariates (including productivity level and firm size) greatly affect the internationalization of Japanese firms.

4.3 Results for Each Industry

We also examine whether our conclusions arise from the feature that our sample comprises firms drawn from a variety of industries. A particular problem of the above analysis is that when we computed the effect of a change in unobserved firm characteristics, as measured by the random coefficients in Eq. (2) increasing by one standard deviation, the change may reflect variation across industries. Accordingly, our results may have simply indicated the effect of variations across industries on internationalization rather than the effect of variations across firms within the same industry. If this alternative interpretation holds, then we would have overvalued the role of unobserved firm characteristics.

Therefore, we perform similar numerical experiments for each of six major two-digit industries serving foreign markets (i.e., chemicals, coke and petroleum products, machinery and equipment, electrical and electronic equipment, transportation equipment, and precision machinery) and for each of the three-digit industries in these six two-digit industries. Figure 6 summarizes the results, showing the marginal increase in the predicted probability that the average domestic firm in

a



b

Code	Two-Digit Industry	Code	Three-Digit Industry
20	Chemicals and chemical products	201	Chemical fertilizer, inorganic chemical products
		202	Organic chemical products, chemical fiber
		204	Oil and fat products
		205	Pharmaceuticals
		209	Other chemical products
21	Coke and petroleum products	211	Refined petroleum products
		219	Other coke and petroleum products
		220	Plastic products
29	Machinery and equipment	291	Machinery for metal processing
		292	Special-purpose machinery
		293	Machinery for office use
		299	Other machinery
30	Electrical and electronic equipment	301	Electrical equipment for industrial use
		302	Domestic appliances
		303	Wiring and wiring devices
		304	Computer products
		305	Electronic products
		309	Other electrical equipment
31	Transportation equipment	311	Motor vehicles and parts
		319	Other transportation equipment
32	Precision machinery	321	Medical and dental instruments and supplies
		322	Optical instruments and photographic equipment
		323	Watches and clocks
		329	Other precision machinery

Fig. 6 (**a**) Marginal predicted probability (%) that the average domestic firm becomes an exporter or FDI firm in the following year: results from selected two- and three-digit industries. *Notes*: In the figure, each point with a two- or three-digit industry code indicates the increase in the predicted probability that the average domestic firm in the industry becomes internationalized in the following year when unobserved firm characteristics or the log of TFP improve by one standard deviation in the industry. Several three-digit industries are not included, as the number of observations is too small for estimation. (**b**) Describes the two- and three-digit industries

each industry becomes internationalized in the following year if the log of TFP or unobserved characteristics improves by one standard deviation. Note that in this figure, we define the average domestic firm as the hypothetical firm whose covariates are the average of the firms in each industry. We also define the standard deviations of the log of TFP and unobserved characteristics for each industry.

Figure 6 indicates wide variation across industries. For example, a change in unobserved firm characteristics by one standard deviation increases the probability of internationalization by nearly 100% points in two of the three-digit industries (321 and 322) in the precision machinery industry. In stark contrast, the same change increases the probability by less than 20% points in only two of the two-digit industries and six of the three-digit industries.

Despite the industry variation, however, we find that changes in unobserved firm characteristics always have a far greater effect on the internationalization of firms than any changes in productivity. An increase in the log of TFP by one standard deviation leads to an increase in the predicted probability of internationalization by a maximum of 1% point and in most cases by less than 0.5% points. Therefore, the industry-level analysis supports the main findings from the economy-wide analysis that unobserved firm characteristics play a greater role in internationalization than productivity.

4.4 Summary of the Empirical Results

The results from the mixed logit estimations and numerical simulations on the determinants of the export and FDI decision can be summarized and discussed in line with the literature as follows. First, the results confirm the findings of existing empirical studies that productivity has a positive influence on the export and FDI decision.[12] For example, Eaton et al. (2008) find that approximately 57% of the variation in the entry of French firms into foreign markets is attributable to their productivity (efficiency). Other studies using standard econometric methods find a relatively smaller effect of productivity (Bernard and Jensen 2004; Bernard and Wagner 2001; Greenaway and Kneller 2004). However, we should emphasize that although this study also identifies the positive effect of productivity on internationalization, this effect is substantially smaller than that found in these existing studies.

Second, we find that a dominant determinant of export and FDI is the stickiness of export and FDI status. Even when a firm that serves only the domestic market substantially improves its observed characteristics (such as productivity) such that its characteristics are better than the average level of internationalized firms, the

[12]In the benchmark estimation in Table 3, we find that the effect of TFP on the FDI decision is insignificant. However, when we exclude the log of employment from the set of covariates, the effect of TFP becomes highly significant, as noted in Sect. 4.1.

probability that the domestic firm will engage in export or FDI does not increase substantially, even in the long term. By contrast, if the average domestic firm happens to become an exporter or an FDI firm without any change in the other observed firm characteristics, the firm can continue serving foreign markets with a probability of more than 95%. Importantly, the stickiness of export and FDI status is most likely the result of the importance of initial costs in the export and FDI decision, which is consistent with the theoretical assumptions of trade models with heterogeneous firms, including those in the works of Melitz (2003) and Helpman et al. (2004).

However, the stickiness of the export and FDI status found in this study is even more substantial than in other works. For instance, Eaton et al. (2007) document active entries to and exits from export markets using Columbian data, concluding that one-third to one-half of all exporters are new entrants and that another one-third to one-half exit after only 1 year of exporting. Using generalized methods of moments (GMM) estimation, Bernard and Jensen (2004) similarly find that experience in exporting during the previous 2 years increases the probability of exporting by only 51%. Greenaway and Kneller (2004) find that exporting experience in the previous year also raises the probability of exporting by 83 %, an effect that is larger than that found by Bernard and Jensen (2004) but smaller than that found in this study.

Finally, and most notably, the use of mixed logit models, which is the major contribution of this study, enables us to conclude that the unobserved characteristics of firms are another major determinant of the export and FDI decision. This result is consistent with the findings of Eaton et al. (2011), although they adopt a different empirical approach to this question. The variation in entry costs across firms may then arise because of differences in the ability of firms to gather information on foreign markets, their geographic location, and their degree of risk aversion.

5 What Are the Non-productivity Factors of the Internationalization of Firms?

The empirical analysis in the previous section noted the importance of non-productivity firm characteristics unobserved in standard firm-level data. The next question, then, is as follows: What are these unobservable factors? Todo and Sato (2011) provide insight into this question. Using a unique firm-level data set for Japanese SMEs that contains information on risk and time preferences and the prior international experience of the president of each SME, Todo and Sato (2011) examine whether these factors determine internationalization among SMEs.

To incorporate these factors into internationalization decisions, Todo and Sato (2011) extend the theoretical consideration in Sect. 2, assuming that each firm maximizes its one-time profit without any uncertainty. It is now assumed that foreign demand fluctuates and that firms maximize their long-term discounted sum of risk-averse utility. The model of Todo and Sato (2011) then predicts that firms

are more likely to enter the foreign market when presidents have prior experience in foreign countries because such international experience can reduce costs of entry into foreign markets. In addition, firms with myopic or risk-averse presidents expect smaller long-term utility gains from internationalization and thus tend to be internationalized.

To test these predictions, Todo and Sato (2011) use firm-level data based on a confidential survey on "Internationalization and Enterprise Activities" (hereafter called "the survey on internationalization") to SMEs conducted by the Small and Medium Enterprise Agency of Japan in December 2009. The survey on internationalization is unique in the following three respects. First, this survey questioned the president of each firm about his/her international experience: "Have you studied, worked, or lived abroad?" Second, it asked each president a question regarding his/her risk preference: "If there were an investment opportunity that presents a 50% probability of earning 1 million yen and otherwise earning nothing, what is the most that you would pay for this investment?" Based on the answer to this question, we construct a categorical variable ranging from one to six to indicate the degree of risk preference. Finally, the survey asked a question regarding time preference: "What is the minimum amount that you would prefer receiving one year and one month from now rather than receiving 100,000 yen one month from now?" Based on the answer to this question, we constructed a binary variable to approximate whether the president is forward-looking or myopic. Estimating risk and time preferences from hypothetical questions is standard in the economic literature, but it has not been performed in the context of the internationalization of firms.

From a full-information maximum likelihood (FIML) method applied to a probit model, Todo and Sato (2011) find that productivity has a positive and significant effect on the internationalization decisions of SMEs. In addition, the characteristics of firm presidents that have not been examined in previous studies (i.e., international experience, risk preference, and time preference) show a positive, statistically significant, and economically large effect. The estimation result suggests that if a president has studied, lived, or worked abroad, then the probability of internationalization is approximately 19% points higher. If the president's preference changes from being the most risk-averse to the most risk-taking, then the probability that the firm is internationalized increases by 10% points. If a myopic president becomes forward-looking, then the probability increases by 7% points. Combining the results from Todo (2011) and Todo and Sato (2011), we confirm a significant role of firm heterogeneity that is unobservable in standard firm-level data, such as risk and time preference and the prior international experience of decision makers, in firm internationalization.

Another important finding of Todo and Sato (2011) is that once SMEs have begun to export, their exit from export markets is determined not by the productivity level or risk or time preference of the president but largely by the size of these SMEs' previous exports. This result confirms the finding of Sect. 4 that entry costs largely influence the internationalization decision.

6 Conclusion

This chapter highlights the importance of non-productivity firm characteristics that are unobserved in standard firm-level data in firm internationalization based on the econometric analysis of Todo (2011). We show that such non-productivity factors include the risk and time preferences and international experience of decision makers, based on Todo and Sato (2011), using a unique dataset for SMEs. These results imply that that entry costs represent the major barrier to firm internationalization and that unobserved firm characteristics such as the international experience of decision makers are important determinants of entry costs. In addition, because firms are more likely to be concerned about long-term discounted risk-averse utility from internationalization rather than the one-time risk-free utility that is assumed in standard heterogeneous firm models of trade, the risk and time preferences of decision makers influence firm internationalization. These findings clearly indicate why there is a significant productivity distribution overlap between domestic and internationalized firms, as shown in Fig. 1.

Another implication of this chapter is that the negligible effect of productivity and the stickiness of firm status appear to be more prominent in Japan than in other countries. In other words, unproductive Japanese firms currently serving foreign markets through export or FDI are more likely to continue to serve foreign markets in the future, whereas productive firms with no experience in foreign markets have only a small opportunity to enter foreign markets. Peek and Rosengren (2005), Nishimura et al. (2005), and Caballero et al. (2008) reach similar conclusions for firms in Japanese markets in which unproductive firms or "zombies" remain in business because of the provision of additional credit from large Japanese banks to avoid bankruptcy. This process effectively discourages the entry of new firms, and productive firms are more likely to exit than unproductive firms. The findings of the current study suggest that similar anti-market forces may also limit the entry of Japanese firms into foreign markets.

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Entry into Foreign Markets Through Foreign Direct Investment

Toshiyuki Matsuura and Hitoshi Sato

Abstract This chapter investigates patterns of Japanese foreign direct investments (FDIs) using firm-level data on Japanese multinational enterprise (MNE) foreign subsidiaries. First, we present an overview of Japanese FDI and find stylized facts. For example, subsidiary sales and the number of investing countries are related to the scale of operation in Japan. Many foreign subsidiaries are engaged in export to neighboring countries and are categorized as export-platform-type FDI. Second, we present a model that extends the framework of Helpman et al. (Am Econ Rev 94(1):300–316, 2004) and accounts for overseas subsidiaries supplying goods to neighboring countries. Third, based on this model, we estimate the gravity model of MNE foreign subsidiary sales and find that the impact of the subsidiary's distance from the host country on the number of subsidiaries (extensive margin) is very large compared to previous studies that used data from U.S. MNEs. In addition, the estimation models that use market potential instead of host country GDP have a higher explanatory power, suggesting that market potential plays an important role in explaining FDI patterns. In contrast, although the effect of market potential on average subsidiary sales (intensive margin) is significantly positive, its effect on the number of subsidiaries is negative and insignificant.

Keywords FDI • Gravity models • Japanese MNEs • Market potential • Platform-FDI

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1 Introduction

Since the 1990s, foreign direct investment (FDI) flows have been rapidly increasing worldwide, making growth in FDI flows significantly higher than that of exports.[1] As shown in Fig. 1, FDI outflows in Japan also follow a similar trend, suggesting that FDI is the most important mode of globalizing Japanese corporate activities. FDI involves corporate decision making to locate all or part of the production process abroad. It affects not only the trade structure but also the home and host countries' economies. Using data on Japanese foreign subsidiaries, this chapter analyzes Japanese companies' FDI patterns.

Previous studies on FDI categorized FDI according to its motivation, i.e., horizontal FDI, which aims to access the host country market, and vertical FDI, which intends to exploit the international division of labor by utilizing differences in factor endowments. However, in recent years, the analysis was expanded to include two additional points. First, industry-firm heterogeneity recently attracted the attention of many researchers. Because firm-level micro data became available for academic

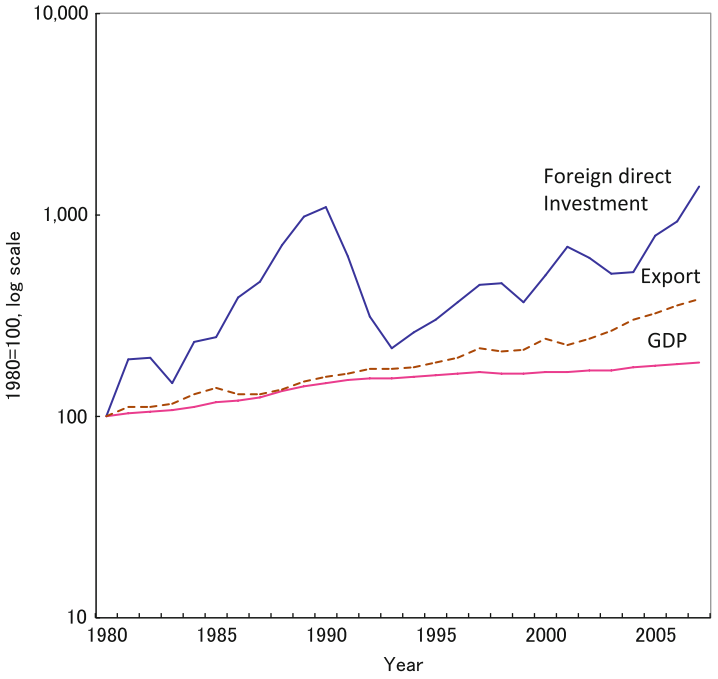

Fig. 1 Trends in Japanese GDP, exports, and FDI outflows. The 1980 values are normalized to 100 and transformed into a logarithmic scale. Source: authors' calculations using UNCTAD data

[1]For example, see Chap. 1 in Navaretti and Venables (2004).

studies, many researchers confirmed a large difference in terms of productivity between multinational enterprises (MNEs) and domestic firms. Inspired by these observations, Helpman et al. (2004) presented a new FDI theory that considers firm heterogeneity in terms of productivity. Empirical analyses supporting the validity of the theory has been increasing, particularly in France and the United States. These studies also considered the effect of globalization on the distribution of firms, which is a new issue in the literature.

The second point is exports to third countries by MNE subsidiaries. In the conventional framework, namely horizontal and vertical FDI, only the host and home countries are assumed to be involved. However, these frameworks ignore the fact that many MNE subsidiaries engage in exporting. For example, MNE subsidiaries in European countries with small markets, such as Ireland, tend to export their products to continental Europe rather than supplying only to host country markets. Similarly, MNE subsidiaries in East Asia are also export-oriented. Ekholm et al. (2007) referred to such FDI as export-platform FDI and presented a theoretical model and examined its empirical validity, using data from the United States.

Thus far, these two points were independently analyzed and not integrated into a single study. Further, most empirical analyses were based on data from the United States or European countries. Previous studies have not used the data from Japanese companies. This chapter uses Japanese firm-level data to present Japanese companies' FDI trends. We then build a framework that integrates these points and checks its empirical validity for Japanese MNE subsidiaries.

The chapter is structured as follows. Section 2 presents an overview of Japanese companies' FDI trends. Section 3 presents a theoretical framework that integrates the aforementioned points. Section 4 introduces the estimation results of the gravity model. Finally, Sect. 5 presents the conclusion and future agenda of this chapter.

2 Overview of Japanese FDI

First, we present an overview of the FDI of Japanese firms. This chapter uses the "Survey of Overseas Business Activity," a firm-level survey conducted by the Research and Statistics Department of the Japanese Ministry of Economy, Trade and Industry.[2] This survey obtains basic information on the activities of Japanese firms' overseas affiliates and includes various items regarding the characteristics of affiliates, such as their year of establishment, breakdowns by sales and purchases, employment, costs, and research and development (R&D).

[2]This survey includes parent companies, which are Japanese corporations that, as of end of March, own or have previously owned overseas subsidiaries, excluding those in the financial and insurance industries or the real estate industry. Overseas subsidiaries are defined as foreign affiliates in which Japanese firms have invested capital of 10 % or more or as foreign firms in which Japanese foreign subsidiaries have invested capital of 50 % or more.

Fact 1: In the 1980s, when Japanese firms began overseas production, their FDI destinations were diversified. However, since 1993, their FDI destinations have become concentrated, probably the result of relocations from Southeast Asia to China.

We use firm-level data from 1995 to 2006 to investigate Japanese firms' overseas production and focus only on foreign subsidiaries that engage in manufacturing. Some Japanese MNEs own more than two affiliates in each host country. In such a case, we consolidate the data from multiple subsidiaries of the same parent company into a single entity.

Table 1 presents the number of investing firms by year and region. The data suggest that major FDI destinations were not constant.[3] In the 1980s, the United States was one of the most popular destinations, with 456 firms investing in the country. As for other popular destinations, 251 and 330 MNEs invested in Asian NIEs and ASEAN 4, respectively.[4] In particular, after the Plaza Accord in 1985, the number of Japanese firms actively investing in the United States increased, with 103 firms investing in the country in 1988. The primary motivation for firms to invest in the United States during this period was to avoid trade conflicts. This type of FDI is a typical example of horizontal FDI.[5]

In the 1990s, China became the most popular destination for Japanese FDI, with 807 firms investing in the country during the period. Following China, 539 and 294 firms invested in ASEAN 4 and the United States, respectively. An examination of annual changes shows that, while FDI in China and ASEAN 4 increased from 1993 to 1995, the number of investing firms subsequently decreased because of the Asian financial crisis. Furthermore, FDI in China markedly increased after 2000, with 530 firms initiating investments in China from 2000 to 2006. This increase was apparent particularly during the period immediately after China became a member of the WTO. From 2002 to 2004, more than 100 firms invested in China each year. In contrast, 124 firms invested in ASEAN 4 from 2000 to 2006.

Figure 2 presents trends in the Herfindahl index (HHI) for the concentration of Japanese FDI destinations in 12 countries and regions. An examination indicates that the HHI reflects a gradual decrease in long-term trends, and the peaks reflect FDI booms in different periods. A peak in 1981 reflects the investment boom after the implementation of voluntary export restrictions on Japanese automobiles shipped to U.S. A peak is observed during 1987–1988, after the rapid appreciation

[3]This table aggregates the number of investing firms by referring to the entry year of foreign affiliates that were active from 1995 to 2006.

[4]Asian NIEs represent South Korea, Taiwan, Hong Kong, and Singapore. ASEAN 4 includes Thailand, Malaysia, Indonesia, and the Philippines.

[5]Blonigen (1997) investigated Japanese FDI in the United States from 1975 to 1992 and demonstrated that an appreciation of the yen accelerated Japanese FDI. He found that industries with a higher R&D intensity have been investing extensively since the appreciation of the yen enabled Japanese firms to acquire managerial resources through mergers and acquisitions or capital participation with U.S. firms.

Table 1 The number of Japanese firms setting up foreign subsidiaries by region and year

Year	North America	U.S.	Canada	Central & South America	ASEAN4	NIEs	China	Other Asia	Middle East	Europe	OECD Europe	Rest of Europe	Oceania	Africa
1980	25	23	2	3	10	21	0	0	2	12	12	0	3	1
1981	29	28	1	4	5	17	1	1	1	7	7	0	0	0
1982	19	18	1	5	6	17	0	4	0	10	10	0	3	0
1983	20	17	3	4	11	15	1	3	0	15	15	0	0	1
1984	34	34	0	5	11	24	4	2	1	12	12	0	3	0
1985	34	31	3	1	8	16	15	8	0	17	17	0	2	0
1986	71	62	9	6	22	52	11	4	2	16	16	0	0	0
1987	85	80	5	5	54	84	13	1	1	25	24	1	3	0
1988	107	103	4	8	96	59	28	3	0	29	28	1	3	2
1989	71	60	11	2	107	46	20	4	0	47	47	0	5	1
1990	61	53	8	5	83	40	40	8	0	49	48	1	7	0
1991	37	33	4	7	43	32	50	3	1	30	28	2	5	0
1992	18	12	6	4	29	20	73	4	1	22	20	2	6	0
1993	20	17	3	4	29	30	116	4	0	20	19	1	4	2
1994	28	27	1	6	81	39	176	8	0	19	18	1	4	0
1995	47	42	5	7	92	37	211	25	2	25	25	0	3	3
1996	54	47	7	8	91	36	57	36	2	17	16	1	2	6
1997	34	31	3	10	62	16	42	26	0	21	19	2	1	1
1998	19	18	1	5	17	17	22	10	1	13	12	1	3	2
1999	17	14	3	3	12	18	20	15	1	17	17	0	0	1
2000	15	14	1	4	22	19	41	5	0	15	13	2	1	2
2001	15	15	0	6	31	29	84	6	0	19	17	2	0	1
2002	20	18	2	4	20	27	125	11	0	13	12	1	1	0

(continued)

Table 1 (continued)

Year	North America	U.S.	Canada	Central & South America	ASEAN4	NIEs	China	Other Asia	Middle East	Europe	OECD Europe	Rest of Europe	Oceania	Africa
2003	10	9	1	2	19	13	107	10	0	9	8	1	1	1
2004	10	9	1	0	11	17	109	12	0	15	15	0	2	0
2005	12	10	2	0	14	4	51	16	1	9	8	1	2	2
2006	6	4	2	5	7	7	13	14	0	10	6	4	1	1
1980s	495	456	39	43	330	351	93	30	7	190	188	2	22	5
1990s	335	294	41	59	539	285	807	139	8	233	222	11	35	15
After 2000	88	79	9	21	124	116	530	74	1	90	79	11	8	7

Notes: Authors' calculation of the "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan). All industries except for the financial, insurance, and real estate industries are covered. The table figures are counted as one when a firm invests in a certain region in a certain year, allowing the same firm to be counted multiple times. United States and Canada are subcategories of North America. ASEAN4 represents Thailand, Malaysia, Indonesia, and the Philippines. NIEs include Korea, Taiwan, Hong Kong, and Singapore. Europe includes not only EU countries but also non-EU countries such as Central and Eastern European and CIS countries. OECD Europe and the rest of Europe are the subcategories of Europe

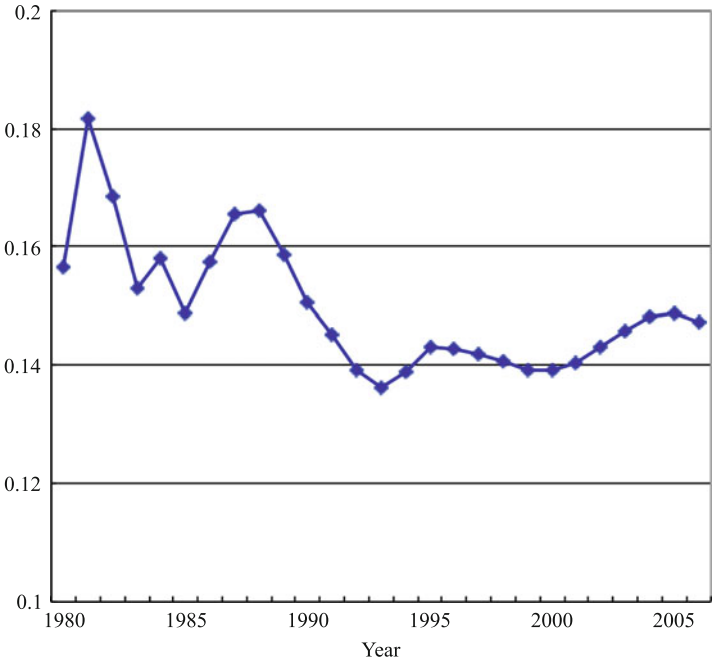

Fig. 2 HHI for FDI destinations. Source: Authors' calculations from the "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan)

of the yen following the Plaza Accord, reflecting a surge in investments in NIES countries and the United States. However, U.S. share as an investment destination gradually declined, whereas that of ASEAN 4 increased. As a result, the concentration in FDI destinations declined. The increase in the HHI during 1993–1995 and 2001–2005 reflects the surge in investments in China. However, after the 1990s, the degree of concentration stabilized and FDI destinations were dispersed worldwide. Next, the distribution of Japanese MNEs is further examined.

Fact 2: A large difference exists in the number of destination countries among Japanese MNEs. Only a few MNEs invest in multiple countries.

First, we investigate the distribution of the number of FDI destination countries. Table 2 provides basic statistics on the number of destination countries per MNE. The maximum number of FDI destination countries per Japanese MNE varied greatly each year, ranging from 25 to 30 countries. In contrast, the average number is two to three, suggesting that the distribution of FDI destination countries is a right-heavy tailed distribution.

An examination of a time-series variation reveals that the average number of FDI destination countries gradually increased from 1.2 in 1985 to 2.9 in 2005. Furthermore, the maximum number of destination countries has increased from 24

Table 2 Basic statistics for the number of invested countries per firm

Year	Mean	S.D.	Min	Max
1985	1.159	2.134	1	24
1990	2.088	2.804	1	25
1995	2.891	3.350	1	28
2000	3.386	3.863	1	31
2005	2.895	3.329	1	38

Notes: Authors' calculation based on the "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan). Foreign subsidiaries are restricted for manufacturing plants

in 1985 to 38 in 2005, reflecting the fact that Japanese MNEs have aggressively invested in multiple countries during these two decades. However, a comparison of basic statistics from 2000 to 2005 indicates that although the maximum number of destination countries increased, the average number of destination countries decreased from 3.4 to 2.9, implying an increase in the dispersion of destination countries.

Fact 3: Countries with small market size have a small number of MNE affiliates.

Figure 3 plots the number of Japanese MNEs and the sizes of the destination markets in terms of GDP in 2000.[6] The most popular destination was the United States, in which 543 Japanese MNEs invested. China was second, with 474 companies doing business in the country. The chart also suggests that only a few firms are able to penetrate markets using FDI in countries with a small market size.

Fact 4: Among MNEs, firms investing in popular destination countries are relatively small, in terms of both sales and employment in the home country.

As confirmed in Fig. 3, some countries attract several Japanese MNE subsidiaries whereas others have very little FDI. What types of firms invest in popular destinations? In other words, are there differences between the characteristics of firms investing in countries with relatively little FDI and other MNEs? The y-axis in Fig. 4 depicts the average parent firm size of Japanese firms investing in the *n*th most popular market, with *n* indicated on the x-axis. Market popularity is measured as the rank in terms of the number of Japanese MNEs investing in the destination country. Panels a and b use sales and employment in Japan, respectively, as indicators of parent firm size, revealing a negative correlation between the destination country's popularity and parent firm size.

[6]We obtained GDP from the World Development Indicator (the World Bank).

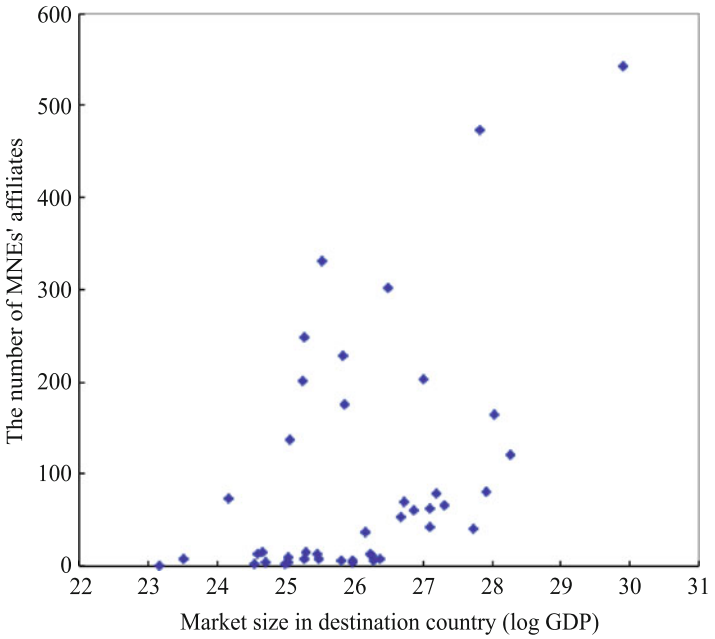

Fig. 3 Number of Japanese MNE affiliates vs. destination market size. Sources: "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan) and the World Development Indicators

Fact 5: Firms investing in multiple countries have larger sales in the home country.

Next, we investigate parent firm size according to the number of investing countries. As Table 2 confirms, the average number of destination countries was 3.39 and the maximum number was 31 in 2000. The y-axis in Fig. 5 depicts the average parent firm size in Japan of firms that invest in at least k markets, with k presented on the x-axis. As Fig. 4, we use sales (Panel a) and employment (Panel b) in Japan as indicators of parent firm size. Both charts indicate that the number of investing countries has a positive correlation with parent firm size, suggesting that larger domestic firms tend to invest in multiple countries.

Fact 6: Most MNE subsidiaries in Asia are categorized as export-platform type subsidiaries.

Finally, we examine the export intensity of foreign subsidiaries.[7] We refer to foreign subsidiaries with higher than average export intensity as export-platform

[7]In this table, for foreign subsidiaries in Europe, sales within European markets are regarded as domestic sales.

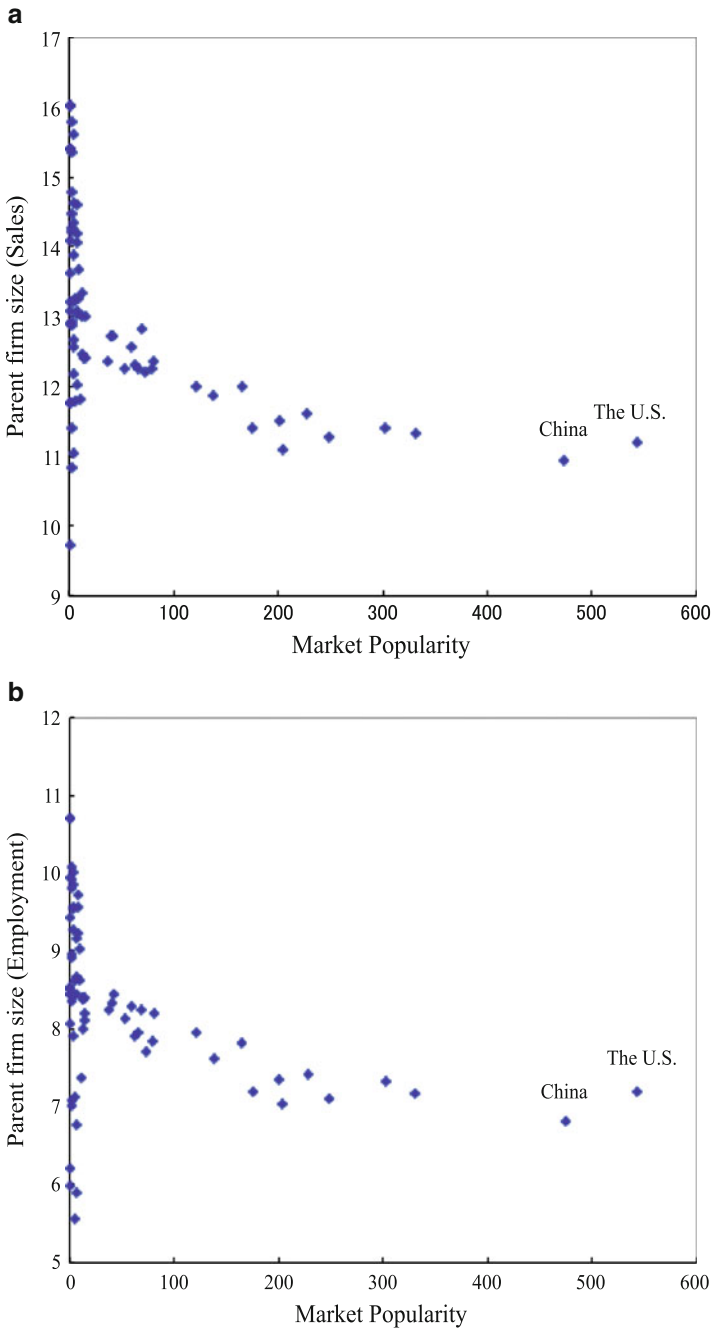

Fig. 4 Destination popularity vs. parent firm size. Panels a and b use sales and employment in Japan, respectively, as indicators of parent firm size. Source: "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan)

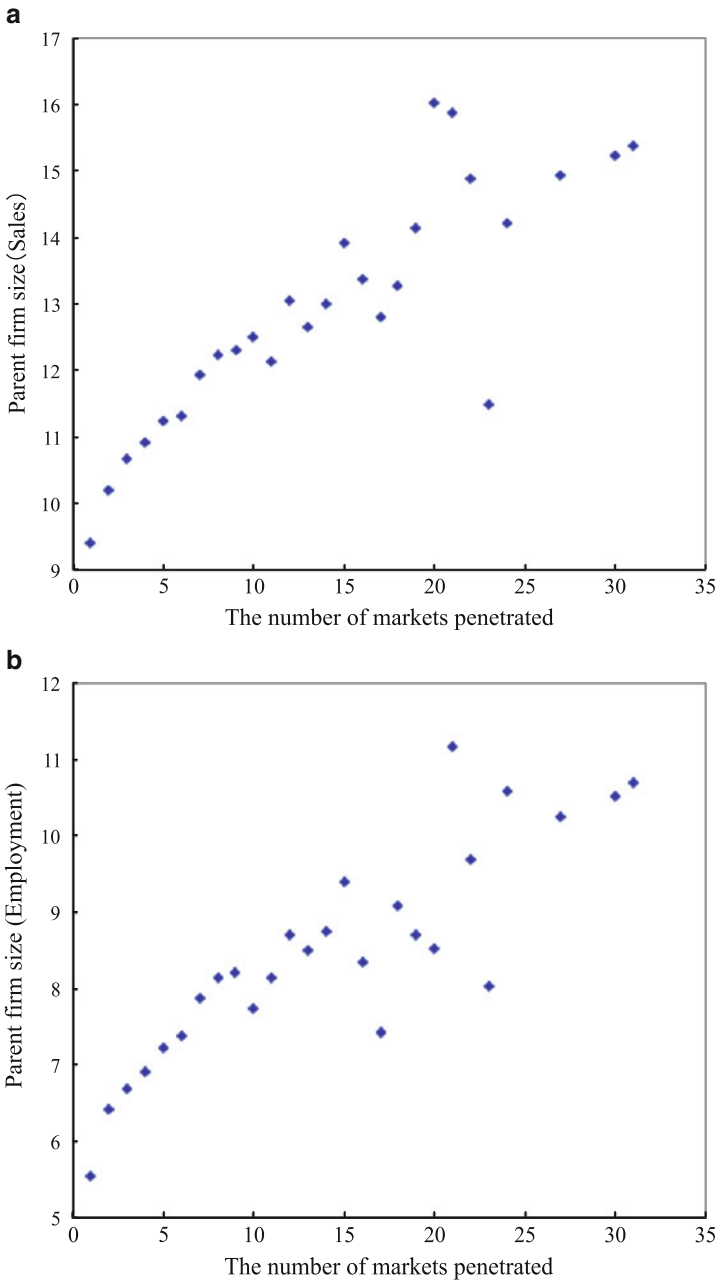

Fig. 5 Number of markets penetrated vs. parent firm size. Panels a and b use sales and employment in Japan, respectively, as indicators of parent firm size. Source: "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan)

Table 3 Share of export-platform type subsidiaries

Industries	North America	Europe	Asia	Total
Textiles	0.15	0.10	0.59	0.43
Chemicals	0.29	0.34	0.46	0.48
Machinery	0.23	0.29	0.54	0.29
Electrical machinery	0.18	0.17	0.51	0.27
Telecommunication equipment	0.27	0.23	0.58	0.20
Transport equipment	0.23	0.22	0.39	0.46
Precision instruments	0.30	0.33	0.65	0.17
Manufacturing n.e.c.	0.27	0.25	0.48	0.50

Notes: Authors' calculation based on the "Survey of Overseas Business Activities" (Ministry of Economy, Trade and Industry of Japan). Export-platform type subsidiaries are defined as those that export ratio is above industry average

type foreign subsidiaries. Table 3 indicates the ratio of this type of subsidiary by region and industry, which reveals large regional differences in this ratio. Notably, 40 % of foreign subsidiaries in Asia are categorized as export-platform type subsidiaries across all industries. In addition, even in North America (the United States and Canada), approximately 30 % of the subsidiaries in chemical, information communication equipment, and precision machinery manufacturing industries are categorized as export-platform type subsidiaries. This statistic may imply that the location choice for MNEs depends on the attractiveness of a host country as an export platform.

3 Theoretical Framework

This section presents a theoretical FDI framework in order to obtain a sense of empirical predictions. The model incorporates two characteristics of FDI—heterogenous firms and export-platform FDI—that are now broadly observed as important to understanding MNEs. The model follows a standard horizontal FDI model presented by Helpman et al. (2004) in which firms varying in productivity may choose either export or FDI to serve foreign markets. We extend the model to a multiple country setting that allows firms to export to third countries from their foreign subsidiaries as per Head and Mayer (2004) and Lai and Zhu (2006).[8]

Consider the world economy composed of N countries. All countries share the same preferences over differentiated varieties of goods. The representative consumer in country i maximizes the following Dixit and Stiglitz (1977) type utility function:

[8]Head and Mayer (2004) and Lai and Zhu (2006) considered MNEs that choose the location of production sites. However, MNEs are homogenous in their settings.

$$U_i = \left[\sum_{j=1}^{N} \int_0^{n_j} q_{ij}(z)^{(\sigma-1)/\sigma} dz \right]^{\sigma/(\sigma-1)} \tag{1}$$

where $q_{ij}(z)$ represents consumption of variety z supplied from country j to country i, n_j represents the number of the varieties supplied by country j, and $\sigma > 1$ represents a single elasticity of substitution between varieties. This utility function leads to the following iso-elastic demand for good z:

$$q_{ij}(z) = \frac{p_{ij}(z)^{-\sigma} E_i}{\sum_{j'=1}^{N} \int_0^{n_{j'}} p_{ij'}(z')^{1-\sigma} dz'}, \tag{2}$$

where $p_{ij}(z)$ denotes the price of variety z supplied from country h to country i and E_i is the total expenditure of country i.

Because the production of differentiated goods involves a fixed cost, each firm specializes in a different variety of goods. Profit-maximizing firms in country j perceive the demand function with constant elasticity σ and set prices at a constant markup over the marginal cost $c_j(z)$:

$$p_{ij}(z) = \frac{\sigma}{\sigma - 1} d_{ij} \tau_{ij} c_j(z), \tag{3}$$

where $d_{ij} \geq 1$ represents the iceberg type transportation cost for delivering from country j to country i and $\tau_{ij} \geq 1$ represents ad valorem tariffs imposed by country i on the goods from country z. Transportation costs and tariffs for domestically supplied goods do not exist, i.e., $d_{ii} = 1$ and $\tau_{ii} = 1$ for all i.

Substituting the price in (3) into (2), we express the demand for each variety such that:

$$q_{ij}(z) = \frac{\sigma - 1}{\sigma} \left(d_{ij} \tau_{ij} c_j(z) \right)^{-\sigma} P_i^{\sigma-1} E_i, \tag{4}$$

where $P_i \equiv \left[\sum_{j'=1}^{N} \int_0^{n_{j'}} \left(d_{ij'} \tau_{ij'} c_{j'}(z') \right)^{1-\sigma} dz' \right]^{1/(1-\sigma)}$ represents the price index.

Consider firms in country j that may choose export or FDI to supply goods to country i. Following Melitz (2003) and Helpman et al. (2004), firms in country j must incur an additional fixed cost f_{ij}^X to export to country i. This fixed cost can be interpreted as an investment for developing sales networks and/or modifying product designs according to country i's product standards. Denoting the marginal cost of firms in country j by $c_j(z) = c_j/\varphi$, where c_j is common across all firms in country j and φ represents each firm's productivity, each firm in country j earns the following export profits by exporting to country i:

$$\pi_{ij}^X(\varphi) = B_i \left[\frac{d_{ij} \tau_{ij} c_j}{\varphi} \right]^{1-\sigma} - f_{ij}^X, \tag{5}$$

where $B_i \equiv P_i^{\sigma-1}E_i/\sigma$ is country i's market size. B_i is exogenously given for each firm in a monopolistic competition. Firms in country j can export to country i as long as π_{ij}^X are nonnegative.

We now turn to FDI. In particular, firms are allowed to engage in export-platform FDI: namely, firms in country j can supply goods to country i through FDI in country i and to third countries by exporting from the subsidiaries in country i. As the previous section showed, export-platform FDI is broadly observed among Japanese firms. Suppose that a firm from country j sets up a subsidiary in country i and serves both country i's market and county k's market. Assuming that the fixed entry cost for country k's market occurs in country j, the profits earned from country k's market are given by

$$\pi_{ki}^X(\varphi) = B_k\left[\frac{d_{ki}\tau_{ki}c_i}{\varphi}\right]^{1-\sigma} - f_{kj}^X. \tag{6}$$

If $\pi_{ki}^X \geq \pi_{kj}^X$ holds, then the firm chooses to export from the subsidiary in country i instead of directly exporting from country j to serve country k's market. Let a set of country k and country i such that $\pi_{ki}^X \geq \pi_{kj}^X$ holds be denoted by Ω_i. In other worlds, Ω_i represents a set of countries that the firm serves using the subsidiary set up in country i (thus, countries belonging to Ω_i depend on the firm's productivity).

Similar to exports, FDI requires additional fixed costs. Let the fixed cost that firms in country j must incur for establishing a subsidiary in country i be f_{ij}^I, which is assumed to be greater than the initial fixed cost for exports, f_{ij}^X. Total profits for the firm in country j that sets up a production site in country i and serves not only country i but also all countries in Ω_i are given by

$$\Pi_{ij}^I = \left[\frac{c_i}{\varphi}\right]^{1-\sigma}\sum_{k\in\Omega_i} B_k(d_{ki}\tau_{ki})^{1-\sigma} - f_{ij}^I - \sum_{k\neq i,k\in\Omega_i} f_{kj}^X. \tag{7}$$

Alternatively, when the firm serves all of these markets through exports, total profits are expressed by

$$\Pi_j^X = \left[\frac{c_j}{\varphi}\right]^{1-\sigma}\sum_{k\in\Omega_i} B_k(d_{kj}\tau_{kj})^{1-\sigma} - f_{ij}^X - \sum_{k\neq i,k\in\Omega_i} f_{kj}^X. \tag{8}$$

As long as $\Pi_{ij}^I \geq \Pi_j^X$ holds, the firm chooses FDI. The productivity level $\hat{\varphi}_{ij}$ at which FDI yields the same profits as exports is given by

$$\hat{\varphi}_{ij} = \left[\frac{f_{ij}^I - f_{ij}^X}{B_i\left[c_i^{1-\sigma} - (d_{ij}\tau_{ij}c_j)^{1-\sigma}\right] + \Phi_{ij}}\right]^{1/(\sigma-1)}, \tag{9}$$

where

$$\Phi_{ij} \equiv c_i^{1-\sigma}\sum_{k\in\Omega_i,k\neq i} B_k(d_{ki}\tau_{ki})^{1-\sigma} - c_j^{1-\sigma}\sum_{k\in\Omega_i,k\neq i} B_k(d_{kj}\tau_{kj})^{1-\sigma}.$$

In Φ_{ij}, the first term, $c_i^{1-\sigma}\sum_{k\in\Omega_i,k\neq i}B_k(d_{ki}\tau_{ki})^{1-\sigma}$, is interpreted as markets in which exports from the FDI subsidiary in country i are more profitable than exports from the home plant in country j. The second term, $c_j^{1-\sigma}\sum_{k\in\Omega_i,k\neq i}B_k(d_{kj}\tau_{kj})^{1-\sigma}$, represents the same markets evaluated on the basis of exporting from country j. Thus, Φ_{ij} represents the net additional markets obtained by replacing direct exports from country j with exports from the FDI plant in country i.

Equation (9) suggests that, holding other things constant, when the difference in the initial fixed cots, $f_{ij}^I - f_{ij}^X$, is smaller, the market size for country i is larger, production cost in country i, c_i, is smaller, and additional market potential in country i, Φ_{ij}, is greater, less productive firms tend to choose FDI in country i instead of exporting.

If we ignore the possibility that firms can serve third countries through subsidiary plants, the choice between FDI and exports is based on a comparison of the net profits from serving country i's market (Helpman et al. 2004; Yeaple 2009). Then, the threshold productivity at which FDI and exports yield the same profits is

$$\hat{\varphi}_{ij} = \left[\frac{f_{ij}^I - f_{ij}^X}{B_i\left[c_j^{1-\sigma} - (d_{ij}\tau_{ij}c_j)^{1-\sigma}\right]}\right]^{1/(\sigma-1)}. \tag{10}$$

A comparison of Eqs. (9) and (10) reveals that ignoring subsidiaries' exports to the third countries overstates the threshold productivity levels. The empirical section of this chapter shows that disregarding host countries' market potential may cause serious omitted bias in the estimations of FDI sales.

Letting $G(\varphi)$ denote the cumulative density function of firms' productivity and n_j denote the total number of firms in country j, the number of country j's firms that choose FDI in country i is expressed by

$$n_{ij} = [1 - G(\hat{\varphi}_{ij})]\, n_j, \tag{11}$$

which is decreasing in the threshold productivity $\hat{\varphi}_{ij}$.

In summary, the model discussed so far implies that holding other things constant, the number of country j's firms that choose FDI in country i, n_{ij}, increases as

- the gap between the initial fixed costs of FDI and exports, $f_{ij}^I - f_{ij}^X$, decreases;
- the market size of country i, B_i, decreases;
- the production cost in country i, c_i, falls; and,
- country i's net foreign markets obtained through FDI, Φ_{ij}, increases.

Next, consider total foreign affiliate revenue earned by country j's firms with subsidiaries in country i. Letting $g(\varphi)$ denote the density function of productivity, the average productivity of such firms is given by

$$\tilde{\varphi}_{ij}(\hat{\varphi}_{ij}) = \frac{1}{1 - G(\hat{\varphi}_{ij})}\int_{\hat{\varphi}_{ij}}^{\infty}\varphi^{1-\sigma}g(\varphi)d\varphi. \tag{12}$$

Thus, the marginal cost of the firms is, on average, $\tilde{c}_{ij} \equiv c_i/\tilde{\varphi}_{ij}$, and total revenue earned from country k through exports from the subsidiaries in country i is

$$R_{ki}^{j} = n_{ij}\left(d_{ki}\tau_{ki}\tilde{c}_{ij}\right)^{1-\sigma} P_k^{\sigma-1} E_k \tag{13}$$

Aggregating R_{ki}^{j} over all k yields total foreign affiliate revenue earned by country j's firms from their subsidiaries in country i:

$$R_i^j = \sum_{k\in\Omega_i} n_{ij}\left(d_{ki}\tau_{ki}\tilde{c}_{ij}\right)^{1-\sigma} P_k^{\sigma-1} E_k = \sigma n_{ij} c_i^{1-\sigma} \tilde{\varphi}_{ij}^{\sigma-1} \sum_{k\in\Omega_i} B_k \left(d_{ki}\tau_{ki}\right)^{1-\sigma}. \tag{14}$$

Hence, the average affiliate sale per firm, $r_i^j = R_i^j/n_{ij}$, is given by

$$r_i^j = \sigma c_i^{1-\sigma} \tilde{\varphi}_{ij}^{\sigma-1} \sum_{k\in\Omega_i} B_k \left(d_{ki}\tau_{ki}\right)^{1-\sigma}. \tag{15}$$

Equation (15) shows that, holding other factors constant, average affiliate sales per firm increases as

- the production cost in the host country, c_i, decreases;
- the average productivity level of FDI firms, $\tilde{\varphi}_{ij}$, increases; and,
- the market potential in country i, $\sum_{k\in\Omega_i} B_k \left(d_{ki}\tau_{ki}\right)^{1-\sigma}$, increases.

The next section empirically tests all of these characteristics for the number of FDI firms (the extensive margin of FDI sales) and the average FDI sales per firm (the intensive margin of FDI sales).

The model sheds some light on the characteristics of Japanese firms' FDI. For instance, on the one hand, the positive correlation between the host countries' GDP and the number of FDI firms (Fig. 3) is consistent with the prediction of Eqs. (9) and (11): the number of FDI firms increases as the host country's market size increases. On the other hand, the weak correlation in Fig. 3 suggests that some other factors may play an important role in determining the number of FDI firms. Our theoretical framework suggests that one such factor is market potential.

Figure 4 shows that average FDI sales per firm tends to be low in host countries in which a large number of Japanese firms operate. This observations is also consistent with the theoretical framework. Equation (11) implies that higher productivity levels help firms satisfy threshold productivity levels in a larger number of countries. Thus, as shown in Fig. 5, the positive correlation between FDI firms' average domestic sales and the number of countries in which they operate is consistent with this theoretical framework.

4 Estimation for the Gravity Model

In this section, we estimate a gravity model as described in Sect. 3 for the number of Japanese MNE subsidiaries and their sales. The dependent variables (LHS) are the sum of subsidiary sales by country and region (Sales), the number of subsidiaries (Number), average subsidiary sales (AverageSales), and the ratio of subsidiary sales to sales in the home country (ln (Sales / Domestic Sales)). As explanatory variables, we use host country GDP, distance from Japan (Distance), and market potential (MP).[9] We depict the following combinations of the explanatory variables and since we have four dependent variables, we estimate twelve equations.

$$LHS = \beta_0 + \beta_1 \ln(GDP) + \beta_2 \ln(Distance) + \mu, \tag{16}$$

$$LHS = \beta_0 + \beta_1 \ln(GDP) + \beta_2 \ln(Distance) + \beta_3 \ln(ForeignMP) + \mu, \tag{17}$$

$$LHS = \beta_0 + \beta_2 \ln(Distance) + \beta_3 \ln(ForeignMP) + \mu. \tag{18}$$

We use GDP as a variable to indicate local market demand. For distance from Japan, we use the geographical distance between Tokyo and the capital of the destination country. Equation (16) presents the traditional gravity model formula. To maintain consistency with the theoretical framework, average productivity of MNEs (or the cut-off level of productivity) should be included in Eq. (16). However, productivity data are not available in our data set. Therefore, (Sales/Domestic Sales) is also used as a dependent variable. In this specification, assuming that domestic sales are proportional to productivity level, the latter is negated. Equations using ln (Number) and ln (AverageSales) as dependent variables correspond to extensive and intensive margins, respectively. An examination of the coefficients of market size and distance in these equations enables a comparison of their effects on extensive and intensive margins.

Estimation Eqs. (17) and (18) are derived from the equation presented in Sect. 3. In Eq. (17), in addition to distance (ln (distance)) and GDP (ln (GDP)), we include third country market potential. In Eq. (18), instead of ln (GDP), we use the market potential indicator, which includes the size of the host country's economy. To estimate market potential, several studies used a Harris-type market potential indicator derived by summing up all countries' GDP discounted by geographical distances. However, recently, Redding and Venables (2004) and Head and Mayer (2004) proposed new methodologies to directly estimate market potential, as presented by Φ_{ij} in Eq. (9). We employ the market potential indicator estimated by Head and Mayer (2004), which was published on the CEPII website. Because Head and Mayer (2004) market potential indicator is only available from 1995 to 2003, our estimation periods are restricted to these years. Our data set covers 39

[9]The data for distance are obtained from CEPII's Gravity Dataset, which is publicly available at the CEPII web site (http://www.cepii.fr/anglaisgraph/bdd/gravity.htm). Basic statistics of the data used for estimation and correlations for explanatory variables are reported in Appendix.

destination countries and 351 samples. Equations are estimated using a random effect model. Moreover, we control the year fixed effect in each equation.[10]

Table 4 summarizes the estimation results. Columns [1]–[3] present the results corresponding to Eq. (16). The results are similar to those reported by Yeaple (2009) and Mayer and Ottaviano (2007). In column [1], the coefficient for GDP is 1.14 and that for distance is −1.08. A comparison of the size of coefficients in columns [2] and [3], which correspond to extensive margin and intensive margin, respectively, shows that extensive margin plays a major role in explaining variations in the sum of subsidiary sales by country. For example, while the elasticity of GDP to total sales for MNEs' subsidiaries is approximately 1 in column [1], that to the number of firms (extensive margin) in column [2] is approximately 0.64. With respect to sales per firm (intensive margin) in column [3], the elasticity of GDP is approximately 0.38. The effect of distance from Japan is more pronounced in the case of extensive margin. The coefficient of distance in the model with the number of subsidiaries (extensive margin) is −1.30, and the coefficient of distance in the equation with sales per MNE is 0.19. The latter effect mitigates the negative effect of distance on total sales of foreign subsidiaries (column 1). This result suggests that firms investing in countries far from Japan have relatively higher productivity and is consistent with the observation in Sect. 2 and the theoretical framework in Sect. 3. Compared with Yeaple (2009), who estimated the same gravity model using data from U.S.-owned foreign subsidiaries, distance has significantly large coefficients. Whereas the coefficients of distance for total sales of subsidiaries and the number of subsidiaries for Japanese MNEs are −1.1 and −1.3, respectively, Yeaple (2009) found coefficients of −0.49 for sales and −0.31 for the number of subsidiaries. In addition, the coefficient of sales per subsidiary for the United States is −0.17; our corresponding estimate is insignificant. These points require further analysis but may reflect the fact that Japanese MNEs are actively engaged in intra-firm intermediate goods trade associated with a vertical division of labor between a parent firm and foreign subsidiaries. Moreover, the productivity dispersion for Japan may be smaller than that for the United States.[11]

In Table 4, columns [4]–[6] and [7]–[9] correspond to Eqs. (17) and (18), respectively. For the distance coefficients, the major findings presented in columns [1]–[3] do not change significantly. That is, in the equation including the number of foreign subsidiaries, distance has a large negative coefficient; however, the equation that includes average sales reflects a slightly positive coefficient. In contrast, when market potential is included, the elasticity of market size differs for an equation with average sales and for an equation including the number of foreign subsidiaries. First,

[10]Since host-country specific factors such as distance are not included in a fixed effect model, we use a random effect model. We conduct a Breush–Pagan test and confirm that a random effect model performs better than pooling regression.

[11]If productivity dispersion is small, most firms respond to market size and distance in a similar manner. As a result, coefficients for extensive margin become sensitive. Note that a smaller productivity dispersion means a larger skew in parameter k for productivity distribution G.

Table 4 Gravity estimation for total FDI sales, extensive margins, and intensive margins

Independent variables	[1] Sales	[2] Number of firms	[3] Sales per firm	[4] Sales	[5] Number of firms	[6] Sales per firm	[7] Sales	[8] Number of firms	[9] Sales per firm	[10] Sales	[11] Number of firms	[12] Sales per firm
ln(distance)	−1.082*	−1.305**	0.191	−1.116*	−1.307**	0.168	−1.094*	−1.463**	0.331	−0.588	−0.630+	−0.313
	[−2.24]	[−4.39]	[0.72]	[−2.39]	[−4.35]	[0.71]	[−2.08]	[−4.16]	[1.33]	[−1.49]	[−1.86]	[−0.90]
ln(GDP)	1.140**	0.641**	0.380**	1.140**	0.638**	0.390**				0.549**	0.547**	
	[4.90]	[5.30]	[2.88]	[5.06]	[5.23]	[3.27]				[2.81]	[3.23]	
Third country market potential				0.523**	0.022	0.393**					0.647**	
				[2.83]	[0.25]	[3.82]					[4.46]	
Market potential							0.315*	0.017	0.259**			0.451**
							[2.31]	[0.30]	[3.36]			[4.25]
Constant	2.443	6.690*	2.086	−4.610	6.442+	−3.374	11.990*	15.980**	1.513	−11.633*	−20.347**	−14.332**
	[0.44]	[2.07]	[0.68]	[−0.77]	[1.89]	[−1.07]	[2.12]	[4.68]	[0.53]	[−2.53]	[−4.56]	[−3.62]
R^2(within)	0.091	0.267	0.071	0.105	0.267	0.088	0.057	0.245	0.056	0.126	0.144	0.114
R^2(between)	0.403	0.552	0.133	0.454	0.554	0.318	0.304	0.320	0.276	0.173	0.405	0.388
R^2(overall)	0.381	0.548	0.119	0.430	0.549	0.266	0.286	0.318	0.226	0.164	0.358	0.339
N	351	351	351	351	351	351	351	351	351	351	351	351
Year dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Numbers in squared brackets are t-statistics. **, *, and + indicate significance at the 1 %, 5 %, and 10 % levels, respectively

when the number of foreign subsidiaries is included, as indicated in column [5], GDP is positive and significant, but third country market potential is insignificant. In contrast, in column [6], for the equation with average sales, both GDP and third country market potential significantly influence average sales. Similarly, in columns [8] and [9], market potential significantly affects only average sales and not the number of foreign subsidiaries. These results do not necessarily adhere to the theoretical model presented in Sect. 3. However, they may imply that because large MNEs already developed a foreign subsidiary network before our sample period (1995–2003), firms that started investing in this period may have been relatively small and tended to supply their product only to the destination market rather than exporting to a third country.

R^2 (overall) indicates that columns [4]–[6] have the highest R^2, suggesting that Eq. (17), which considers third country market demand, is more significant than Eq. (16), which is based on a traditional gravity model. R^2 in columns [4]–[6] is greater than that in columns [7]–[9] probably because the models in columns [7]–[9] assume that the effect of market demand does not differ on the basis of country market size and market demand. In fact, columns [4]–[6] have different coefficients and different statistical significance for GDP and third country market potential.

The estimation results in columns [10]–[12] use the ratio of subsidiary sales to parent sales as dependent variables. Based on the discussion in Sect. 3, we derive the following theoretical model, which corresponds to the results in columns [10] to [12]:

$$\frac{R_{ij}}{R_j} = \left[\frac{c_i}{c_j}\right]^{1-\sigma} \frac{\sum_{k\in\Omega} B_k (d_{ki}\tau_{ki})^{1-\sigma}}{\sum_{k\in\Omega} B_k (d_{kj}\tau_{kj})^{1-\sigma}}. \tag{19}$$

From a theoretical perspective, marginal cost in host country c_i, host country market size, GDP, and market potential are major determinants of the ratio of subsidiary sales to parent sales. In our estimation results, both GDP and market potential have positive significant coefficients. These results are consistent with our theoretical predictions. In contrast, the coefficients for distance from Japan are negative but not statistically significant. Because no direct equivalent to Eq. (19) exists, these results cannot be interpreted from the theoretical model.

5 Concluding Remarks

This chapter provides an overview of recent trends in FDI by Japanese firms and empirically examines the determinants of intensive and extensive margins, using firm level data. On the one hand, the data reveal that Japanese firms' FDI show many characteristics that are commonly observed in other countries' firm level FDI data. Such characteristics include the following: (a) host countries with large market size attract a larger number of FDI firms and (b) MNE firms with many destination countries tend to exhibit large scale operations in home countries.

On the other hand, the data exhibit some interesting trends for Japanese FDI. The United States and China are the two primary FD destinations. However, Japanese firms set up subsidiaries in these destinations in completely different periods. Whereas Japanese firms' FDI tended to be concentrated in the United States during the 1980s, the weight of their FDI shifted to ASEAN countries in the 1990s. Since the 2000s, China has been a primary destination for Japanese FDI. The number of destination countries per firm and the number of FDI firms with multiple destination countries have increased since the 1980s. However, since 2000, although the maximum number of destination countries per firm continued to increase, the average number of destination countries declined. In other words, the disparity in the number of FDI destinations increased. Finally, we confirmed that a substantial portion of Japanese FDI is export-platform FDI. In particular, more than half of the subsidiaries in ASEAN countries export to third countries.

Based on these empirical regularities, particularly the importance of export-platform FDI for Japanese MNEs, we propose a theoretical framework in which firms determine FDI by considering that FDI subsidiaries deliver goods not only to host countries' markets but also to neighboring countries' markets. Then, we estimate FDI intensive margins and extensive margins, using micro data on Japanese firms. Our theoretical framework indicates that exports from FDI subsidiaries to third markets may affect both intensive and extensive margins of FDI sales. Accordingly, we include distance-adjusted third country market size (market potential) in the gravity equations. Our estimation confirms that the inclusion of market potential improves the fitness of the estimated equation. Furthermore, as the theoretical framework suggests, the market potential has a positive effect on both intensive margins and extensive margins of FDI sales. However, with respect to extensive margins, the estimation is not statistically significant. This estimation result may suggest that Japanese firms tend to set up foreign subsidiaries by initially targeting markets of destination countries and only later on do they consider exporting from subsidiaries.

Another interesting result is that the effect of distance on extensive margins is substantially large compared with the results of Yeaple (2009), who estimates a gravity model, using U.S. FDI sales data. The difference between ours and Yeaple (2009)'s may be partially attributed to the fact that Japanese FDI is heavily concentrated in Asia.

Issues exist that should be further examined. First, the theoretical framework articulates that firms' productivity influences their decision making regarding FDI and FDI sales. However, our data is not sufficient to directly address the relationship between the productivity of FDI firms' headquarters and the extensive and intensive margins in FDI. Because this prediction is critical to our theoretical framework, collecting further data and checking the robustness of the prediction is important. Second, clarifying why the market potential affects the intensive and extensive margins differently is important because our empirical exercise shows that the effect of market potential on the extensive margins is positive, but not statistically significant. Finally, the degree of fitness of our empirical model is not satisfactory. R^2 is approximately 0.40 for FDI sales, 0.55 for extensive margins, and 0.10 for

intensive margins. These results may be attributed to the fact that our empirical model does not fully account for the production fragmentation broadly observed in FDI in the Asian region. These issues remain open for future research on Japanese MNEs.

Appendix

Basic statistics

Variables	Mean	S.D.	Max	Min
Sales	7.50	2.24	12.24	0.98
FDI sales/Domestic sales	−9.73	1.64	−5.87	−16.40
FDI sales per firm	8.87	1.10	12.25	2.75
Number of FDI firms	3.37	1.56	6.55	0.00
ln(distance)	8.98	0.58	9.82	7.05
ln(GDP)	12.83	1.13	16.14	10.99
Third country market potential	14.39	1.27	17.83	12.50
Market potential	16.33	1.73	21.93	13.87

Notes: All figures are expressed in logarithm. Third country market potential and Market potential are obtained from the CEPII database: http://www.cepii.fr/anglaisgraph/bdd/marketpotentials.htm

Correlations for explanatory variables

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
[1] Sales	1							
[2] FDI sales/Domestic sales	0.7858	1						
[3] FDI sales per firm	0.7729	0.8258	1					
[4] Number of FDI firms	0.8944	0.5489	0.41	1				
[5] ln(distance)	−0.3602	−0.261	0.0463	−0.5516	1			
[6] ln(GDP)	0.5465	0.3233	0.3184	0.5637	−0.1388	1		
[7] Third country market potential	0.1862	0.4251	0.3721	0.0085	0.0292	−0.0598	1	
[8] Market potential	0.5188	0.5661	0.4282	0.4479	−0.3161	0.053	0.5888	1

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Productivity and Modes of Internationalization: Evidence from Japanese Firms

Ryuhei Wakasugi and Ayumu Tanaka

Abstract Firms decide to enter international markets, either through exports, or by engaging in foreign direct investments (FDI), based on not only their productivity advantages, but also market and firm-specific factors. This paper empirically investigates what modes of internationalization are chosen by Japanese firms internationalizing in US/European countries and East Asian countries, with a focus on the difference in market-specific factors between regions as well as the productivity heterogeneity between firms. Our analysis, using firm-level data pertaining to 12,000 Japanese organizations, confirms that internationalized firms have higher productivity relative to non-internationalized firms. Further, it reveals that firms engaged in FDI in the U.S. and/or Europe have higher productivity as compared to firms that export to these market destinations. However, this result does not hold for Japanese firms that operate in markets in East Asian markets. The estimated results indicate that the mode of internationalization chosen by a firm is not uniquely determined by its productivity levels, but also reflects market specific-factors in destination countries.

Keywords Export • FDI • Internationalization • North • Productivity • South

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1 Introduction

Firms determine their mode of internationalization, i.e.., exports and/or foreign direct investment (FDI), based on a heterogeneous set of factors that include their productivity levels, firm-specific cost factors and the market-specific factors of destination countries. Japanese firms reflect the above through a variety of export and FDI combinations in North America, Europe and East Asian countries. Further, average firm productivity levels differ between those that have internationalized in US-European countries and those that have internationalized in East Asian countries.

Theoretical studies by Melitz (2003), Helpman, Melitz and Yeaple (HMY; Helpman et al. 2004), and Helpman (2006) that assume horizontal FDI, show that firm productivity is a source to determine whether exports or FDI are the chosen modes of internationalization under given variable and fixed costs and market-size conditions. Their theoretical findings indicate an internationalization-hierarchy based on firm-productivity levels: firms with the lowest productivity levels operate only in domestic markets; firms with higher productivity levels export their goods, and firms with the highest productivity levels switch their mode of internationalization from exports to FDI. This theoretical prediction on firms' internationalization mode choice based on their productivity ranks given by the HMY model is supported by empirical results that use firm-level data from the U.S. (Bernard et al. 2006; Bernard and Jensen 1999, 2007; Yeaple 2009), Europe (Mayer and Ottaviano 2007), France (Eaton et al. 2004), Ireland (Lawless 2009), and Taiwan (Aw and Lee 2008). Aw and Lee (2008) specifically examine the internationalization of Taiwanese firms that operate in US and China. They find that the productivity-based internationalization hierarchy between FDI and exports holds for firms that invest in China, but also that the productivity level of firm that invests in North America is higher relative to firm that invests in China. In general, the productivity of firms internationalizing to both countries is the highest as compared to firms that internationalize in other market destinations. Their analysis suggests that differences in wages, transportation and fixed costs among destination countries influences the pattern of internationalization adopted.

Many Japanese firms export to, or engage in FDI in countries with diverse market-specific factors, including different cost structures and market sizes. Head and Ries (2003), Kimura and Kiyota (2006), and Tomiura (2007) have found a strong correlation between productivity levels and type of internationalization for Japanese firms. Similarly, Wakasugi et al. (2008) has demonstrated a pattern to Japanese firms' internationalization that corresponds with their productivity levels.

While the above empirical studies investigate the relationship between firm-productivity levels and mode of internationalization in the world market as a whole, studies that examine how the modes of Japanese firms' internationalization may vary with different market-specific factors are hard to find. This paper aims to fill this gap by examining how Japanese multinational firms may vary their mode of internationalization between markets in US and Europe (hereafter North) and

those in East Asian countries (hereafter South).[1] Our empirical analysis confirms that internationalized Japanese firms have higher productivity levels relative to than domestic firms. However, while our results do affirm the HMY prediction on mode of firm-internationalization based on productivity levels with regard to firms that engage in trade relationships with the North, the results do not hold for Japanese firms that operate in the South. Firms engaged in FDI in the South reveal lower productivity levels as compared to firms that export to the South.

The data used for this analysis is sourced from a survey conducted by the Japanese Ministry of Economy, Trade and Industry, the "Basic Survey of Japanese Business Structure and Activities in 2005." The survey covers 12,000 Japanese manufacturing firms, with more than 30 million yen in capital stock and more than 50 employees.

This paper is organized as follows: Sect. 2 shows whether the productivity premium of internationalized firms differs between North and South. Section 3 presents a theoretical framework to examine different internationalization strategies adopted by firms in the context of varied productivity levels and destination markets. Section 4 statistically examines the correspondence between firms' chosen modes of internationalization and their productivity levels. Section 5 takes forward the empirical examination of internationalization strategies adopted by Japanese firms. Section 6 concludes.

2 Productivity Premium of Internationalization: Statistical Evidence

In order to compare the productivity premium between Japanese firms that internationalize in the North with those that internationalize in the South, we construct nine categories of countries and internationalization modes (Table 1). Each cell in Table 1, corresponding to the combination of domestic supply as well as exports and FDI directed to the two regions, shows the number of internationalized firms and their share in parentheses in terms of the number. This analysis assumes that the FDI category of internationalized firms includes those that engage only in FDI along with those that engage in both exports and FDI. The exports category on the other hand refers to internationalized firms that only export their products.

Table 1 shows that 62 % (7,699 firms) of Japanese manufacturing firms supply only to the domestic market while the rest are internationalized. The following statistics apply to the internationalized firms: 7 % (873 firms) export to and 10 % (1,190 firms) engage in FDI only in the South; 2 % (201 firms) export to and 1 % (147 firms) engage in FDI only in the North; and 6 % (764 firms) export to both the North and the South, while 8 % (996 firms) engage in FDI in both the North and the

[1] Countries classified by North and South are listed in Appendix.

Table 1 Distribution of Japanese internationalizing firms in North and South, 2005

		North (the United States and Europe)			
		Domestic	Export	FDI	Total
South (East Asia)	Domestic	7,699	201	147	8,047
		(61.57)	(1.61)	(1.18)	(64.36)
	Export	873	764	181	1,818
		(6.98)	(6.11)	(1.45)	(14.54)
	FDI	1,190	453	996	2,639
		(9.52)	(3.62)	(7.97)	(21.11)
	Total	9,762	1,418	1,324	12,504
		(78.07)	(11.34)	(10.59)	(100.00)

Figures in parentheses present percent

South. In the aggregate, 21 % of all internationalized firms are engaged in FDI in the South and 11 % of all internationalized firms are engaged in FDI in the North.

Theoretical literature, cited above, indicates that the productivity cut-off that distinguishes between internationalized firms that export or engage in FDI vary according to destination market-specific factors. These include differences in wage rate, transportation cost, other variable or fixed costs, and the market size. In this section we investigate whether differences in market-specific factors between the North and the South affect the productivity cut-off levels that determine the modes of internationalization in Japanese multinational firms. For this, the analysis uses total factor productivity (TFP) of Japanese firms as the relevant productivity variable. The TFP is estimated from the Olley and Pakes production function for the period 1997–2005.[2]

Figures 1 and 2 depict the probability distributions of firm-level TFPs with regard to three modes of market supply: supplying only to the domestic market, exporting to other countries, and engaging in FDI. The difference between the figures is that while Fig. 1 presents the TFP probability distribution of domestic firms along with internationalized firms that export to and engage in FDI in the North, Fig. 2 consolidates similar data for domestic firms and internationalized firms that trade in the South. Figure 1 shows that the productivity distributions of firms move to the right, corresponding to higher productivity levels, as they graduate from domestic firms to exporters, and finally to engaging in FDI in the North. This is consistent with previous empirical findings with regard to internationalized US and European (e.g., Bernard et al. 2006; Bernard and Jensen 2007; Mayer and Ottaviano 2007) firms, and the theoretical prediction of the HMY model. However the probability distribution of firms exporting to and engaging in FDI in the South (Fig. 2) shows that the productivity distributions of Japanese exporters and FDI firms operating in East Asian markets almost overlap.

[2]TFP data used for the analysis in this paper is sourced from Wakasugi et al. (2008).

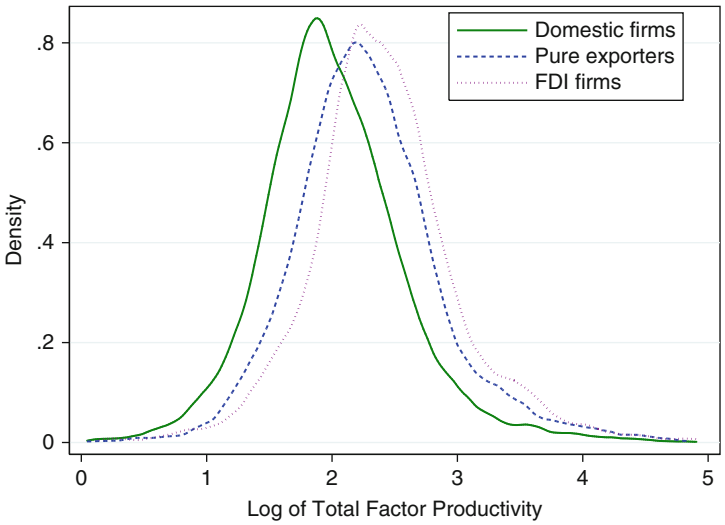

Fig. 1 Productivity distribution of Japanese FDI firms and exporters (TFP, North America & Europe, 2005). *Note*: TFP is estimated by the Olley-Pakes method. Source: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

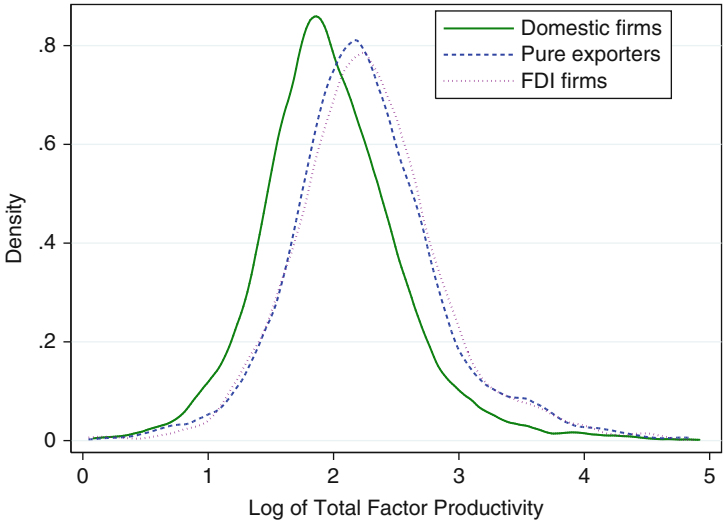

Fig. 2 Productivity distribution of Japanese FDI firms and exporters (TFP, Asia, 2005). *Note*: TFP is estimated by the Olley-Pakes method. *Source*: Authors' calculations based on METI, *Basic Survey of Japanese Business Structure and Activities*

Table 2 Average productivity of Japanese internationalizing firms

	Non-international	Export	FDI
North (the United States and Europe)	8.83	10.07	11.89
South (East Asia)		10.98	10.50

As described in Table 2, we calculate the average productivity of firms corresponding to each mode of internationalization. The summary results are:

1. The average productivity level of internationalized firms, regardless of their internationalization modes, exceeds the average productivity level of firms that supply only to the domestic market.
2. The average productivity level of firms engaged in FDI in the North significantly exceeds the average productivity level of exporters to the North.
3. The average productivity level of firms engaged in FDI in the South however is not higher than the average productivity level of exporters to the South.

The different productivity premiums between internationalized firms that operate in the North and the South suggest that region-specific factors, including wages, transportation costs, fixed costs, and market size may be important additional determinants of aggregate operation costs, and therefore the modes of internationalization adopted by firms. The fact that wage rates in East Asian countries (the South) are lower than in the North, while they are broadly similar across North America, Europe and Japan, supports this argument.

3 Productivity Cut-Off for Internationalization

We introduce an analytical framework in this section that follows the HMY model (Helpman et al. 2004) to discuss how firm-productivity levels differently sort the modes of internationalization adopted by Japanese firms for trade with the North and the South. Suppose that firms supply differentiated goods to markets under the demand function derived from the following CES type utility function

$$u = \left[\int_{l \in D} x(l)^{\alpha} dl \right]^{1/\alpha}, \quad 0 < \alpha < 1 \tag{1}$$

where $x(l)$ is demand for goods l, D is a set of the goods that can be purchased, and α presents a parameter to determine the elasticity of substitution ε between goods. We define $\varepsilon = 1/(1-\alpha)$ where $\varepsilon > 1$.

The demand of goods l in country j is expressed by the following equation

$$x_j(l) = \frac{p_j(l)^{-\varepsilon} Y_j}{{P_j}^{1-\varepsilon}} \tag{2}$$

where Y_j is the total expenditure of country j, $p_j(l)$ is the price of goods l, and P_j is the price index of country j that is given by the following equation

$$P_j = \left[\int_{l \in D} p_j(l)^{1-\varepsilon} dl \right]^{1/(1-\varepsilon)} \tag{3}$$

We assume that firms produce differentiated goods using labor as the only factor of production input. Similar to the HMY model, we further assume that there are three different channels through which firms obtain profits: the supply for domestic market, exports, and overseas production under a given production technology. In addition, we suppose that the export channel is accompanied by both variable costs, including transportation costs, and fixed costs, while fixed costs for firms engaged in FDI are larger than those that export. No transportation costs are associated with firms engaged in FDI. Given the above, we denote each fixed cost of domestic production, production for export and overseas production as f_i^D f_j^X, and f_j^I, respectively. Following a standard assumption in existing studies that we have cited, we also assume $f_i^D < f_j^X < f_j^I$.

We next define the marginal cost of production in country v, C_v, by $C_v = w_v a$, where a is the labor input per unit produced, and w_v is the wage rate of country v for $v = i, j$. We assume that the wage rate in FDI destinations is not higher than that of the home country, i.e., $w_i \geq w_j$. We also assume that the productivity parameter a is randomly given by a Pareto distribution. Therefore, the reciprocal number of the input coefficient $1/a$ expresses the labor productivity of the firm. In the case of exports to country j, the marginal cost of exports is denoted as $C_j = \tau_j w_j a$ since the marginal cost incorporates transportation cost τ_j, defined as an iceberg transport cost. We assume $\tau_j > 1$.

Under the above assumptions, the price of goods that firms supply in country v is:

$$p_v(a) = \frac{C_v}{\alpha} \tag{4}$$

The profits of firms, corresponding to the above-explained three production modes are given as follows:

For firms that supply only to the domestic market in country i, profits are

$$\pi_i^D(a) = (1-\alpha) \left(\frac{w_i a}{\alpha P^D{}_i} \right)^{1-\varepsilon} Y^D{}_i - f_i^D \tag{5.1}$$

For firms that export to country j, profits are

$$\pi_j^X(a) = (1-\alpha) \left(\frac{\tau_j w_i a}{\alpha P^X{}_j} \right)^{1-\varepsilon} Y^X{}_j - f_j^X \tag{5.2}$$

For firms that engage in overseas production through FDI in country j, profits are

$$\pi_j^I(a) = (1-\alpha)\left(\frac{w_j a}{\alpha P^I{}_j}\right)^{1-\varepsilon} Y^I{}_j - f_j^I \tag{5.3}$$

By denoting $\theta = a^{1-\varepsilon}$ and $B_v^h = (1-\alpha)(\alpha P_v^h)^{\varepsilon-1} Y_v^h$, for $h = D, X, I$, and $v = i, j$, Eqs. (5.1)–(5.3) can be rewritten as Eqs. (6.1)–(6.3) respectively

$$\pi_i{}^D(a) = \left(\frac{1}{w_i}\right)^{\varepsilon-1} B_i^D \theta - f_i^D \tag{6.1}$$

$$\pi_j^X(\theta) = \left(\frac{1}{w_i \tau_j}\right)^{\varepsilon-1} B_j^X \theta - f_j^X \tag{6.2}$$

$$\pi_j^I(\theta) = \left(\frac{1}{w_j}\right)^{\varepsilon-1} B_j^I \theta - f_j^I \tag{6.3}$$

We assume next that the non-negative profit condition that is applicable to Eqs. (6.1)–(6.3) defines the productivity cut-off for each supply mode. Therefore, productivity-cutoff for domestic production θ^D is denoted as $\theta^D = \frac{f_i^D}{B^D{}_i}(w_i)^{\varepsilon-1}$, the productivity cut-off for export θ^X is denoted as $\theta^X = \frac{f_j^X}{B^X{}_j}(w_i\tau_j)^{\varepsilon-1}$, and the productivity cut-off for overseas production θ^I is denoted as $\theta^I = \frac{f_j^I}{B^I{}_j}(w_j)^{\varepsilon-1}$, respectively.

If the variable costs for overseas production through FDI are not higher than for export, but the fixed costs applicable to overseas production are higher than those applicable to in-country production for exports, i.e., $w_i\tau_i > w_j$ and $f_j^I > f_j^X$, the productivity cut-off θ^I is higher than θ^X. In this case, firms may switch from export to overseas production with a rise of productivity levels. The switching point for overseas production through FDI, $\tilde{\theta}$, is defined by $\tilde{\theta} = \left(f_j^I - f_j^X\right) / \left(B_j^I\left(\frac{1}{w_j}\right)^{\varepsilon-1} - B_j^X\left(\frac{1}{w_i\tau_j}\right)^{\varepsilon-1}\right)$. It is obvious from the above that the productivity cut-off levels for domestic supply (θ^D), export (θ^X), and overseas FDI (θ^I or $\tilde{\theta}$) are not uniquely ordered. This is because each productivity cut-off level is determined by variable and fixed costs in the destination country and its market size.

In the standard HMY model, firms engaged in FDI have higher productivity levels than the exporting firms. In this case, $\theta^D < \theta^X < \tilde{\theta}$. However, the productivity levels of firms engaged in FDI in a low-wage country may be lower than that of firms that only export to the same country, or firms supplying products to only the domestic markets. This leads to two possible cases: $\theta^D < \theta^I < \theta^X$ or $\theta^I < \theta^D < \theta^X$. Therefore this theoretical model sets the stage for an empirical examination, below, of how factors other productivity level may determine a firm's mode of internationalization among different destinations.

4 Internationalization Modes in North and South

In this section we empirically investigate how the productivity-cutoff for mode of internationalization differs for firms that engage in trade with North as compared to those that engage in trade with the South. The following equation provides the structure to the estimations:

$$\ln TFP_{i,t} = \alpha + \sum_{s=1}^{8} \beta_s D_{i,s,t} + \gamma_1 \ln\left(K_{i,t}/L_{i,t}\right) + \gamma_2 \ln\left(SL_{i,t}/L_{i,t}\right) + \gamma_3 \ln\left(Age_{i,t}\right) + \sum_m \delta_m H_{i,m,t} + \varepsilon_{i,t} \quad (7)$$

where $s = 1, 2 \cdots, 8$; $m = 1, \cdots, n$; $t = the\ year\ of$ 2005. The dependent variable, $\ln TFP_{i,t}$ in Eq. (7) is the logarithm of firm i's TFP. TFP, as mentioned above, is calculated by Wakasugi et al. (2008) following the method developed by Olley and Pakes (1996).

With regard to the explanatory variables, $D_{i,s,t}$ is a dummy variable that indicates the following internationalization modes and market destinations:

1. $D_{i,1} = 1$, $D_{i,s} = 0$ *for* $s \neq 1$, indicates firms that export only to the North
2. $D_{i,2} = 1$, $D_{i,s} = 0$ *for* $s \neq 2$, indicates firms that export only to the South
3. $D_{i,3} = 1$, $D_{i,s} = 0$ *for* $s \neq 3$, indicates firms that export to both the North and the South
4. $D_{i,4} = 1$, $D_{i,s} = 0$ *for* $s \neq 4$, indicates firms that engage in local FDI production only in the North
5. $D_{i,5} = 1$, $D_{i,s} = 0$ *for* $s \neq 5$, indicates firms that engage in local FDI production only in the South
6. $D_{i,6} = 1$, $D_{i,s} = 0$ *for* $s \neq 6$, indicates firms that engage in local FDI production in the North and export production for the South
7. $D_{i,7} = 1$, $D_{i,s} = 0$ *for* $s \neq 7$, indicates firms that engage in local FDI production in the South and export production for the North
8. $D_{i,8} = 1$, $D_{i,s} = 0$ *for* $s \neq 8$, indicates firms that engage in local FDI production in both the North and the South.

In addition to the dummy variables, $K_{i,t}/L_{i,t}$ in Eq. (7) represents the capital labor ratio; $SL_{i,t}/L_{i,t}$ represents the ratio of skilled workers, defined as the ratio of workers in the headquarter office to total workers; $Age_{i,t}$ represents the time period that the firm has been operational. Following Aw and Lee (2008), the above variables are included to control for firm-specific factors. Further, $H_{i,m,t}$ is the dummy variable for industry m to which firm i belongs, α is the constant term, and $\varepsilon_{i,t}$ is the error term. In this equation, the coefficient of each dummy variable, β, represents the productivity premium of internationalized exporting firms overseas FDI producing firms in the North and the South in comparison with the productivity of firms that produce for domestic markets only.

Table 3 Productivity premium of export and FDI

	Dependent variable: log of TFP for 2005
Dummy variables for	
Export to only North	0.112*
	[0.038]
Export to only South	0.132**
	[0.020]
Export to both North and South	0.236**
	[0.022]
FDI in only North	0.222**
	[0.045]
FDI in North and Export to South	0.280**
	[0.041]
FDI in only South	0.117**
	[0.017]
Export to North & FDI in South	0.267**
	[0.027]
FDI in both North & South	0.413**
	[0.019]
Log(K/L)	−0.051**
	[0.003]
Log(Skilled L/L)	0.089**
	[0.006]
Log(age)	−0.120**
	[0.008]
Constant	2.147**
	[0.057]
Observations	12283
Adj R-squared	0.258

Robust standard errors in brackets
Industry dummies are suppressed
*Significant at 5 %; **significant at 1 %

Equation (7) is estimated using the ordinary least squares (OLS) method with firm-level data pertaining to 12,000 Japanese manufacturing firms for the year 2005. Table 3 presents estimated coefficients for each mode of firm-internationalization that are positive and have high statistical significance. The results are summarized as follows:

1. The productivity levels of all internationalized firms, irrespective of mode of internationalization and market destination, are significantly higher than the productivity of firms that produce only for the domestic market.
2. The productivity of firms engaged in overseas FDI production in both the North and the South is significantly higher than the productivity of firms that export to the two regions.

3. The productivity of firms that internationalize in both the regions, North and South, is higher than the productivity of firms that internationalize in only one region. This intuitively appealing result holds regardless of the mode of internationalization adopted by the firm.
4. Firms engaged in FDI in the North have higher productivity as compared to firms that export to the North. However, in a notable result that is contrary to the HMY model's theoretical prediction, the productivity of firms engaged in FDI production in the South is lower than the productivity of firms that export to the South.

5 Choice of Internationalization Modes

In this section, we use the multinomial logit model to statistically examine how productivity levels relate to the mode of internationalization adopted by Japanese firms with respect to external markets in the North and the South. Following Table 1 above, we categorize Japanese firms according to the internationalization modes they have adopted, as follows: (1) firms that produce exclusively for domestic markets; (2) firms that only export to the North; (3) firms that export only to the South; (4) firms that export to both the North and the South; (5) firms that engage in overseas FDI production only in the North; (6) firms that engage in overseas FDI production only in the South; (7) firms that export to the South and engage in overseas FDI production in the North; (8) firms that export to the North and engage in overseas FDI production in the South; and (9) firms that engage in overseas FDI production in both the North and the South.

A firm's choice of internationalization mode is assumed to result from its profit-maximization strategy: it chooses the optimal mode of internationalization among multiple potential choices so as to maximize its profit under a given condition. We denote the profit of firm i that chooses the mode s, π_{is}, as

$$\pi_{i,s} = \alpha_{0,s} + \beta \cdot TFP_s + \sum_j \gamma_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s} + \varepsilon_{i,s} \tag{8}$$
$$s = 0, 1, 2, \cdots, 8, \quad m = 1, 2, \cdots, n$$

where $\pi_{i,s}$ is the profit of firm i under the internationalization strategy s, and $\alpha_{0,s}$ is the constant term. β represents the parameter that indicates how the firm's *TFP* affects the choice of its internationalization mode $s = 0, 1, 2, \cdots, 8$. $Z_{i,j,s}$ denotes variables that control for firm-specific factors such as the capital-labor ratio, skilled labor intensity, and the firm's operating terms. In addition, $\gamma_{j,s}$ is the parameter corresponding to each variable; $H_{i,m}$ is a dummy variable indicating the industry m to which firm i belongs; δ_m is the parameter indicating the degree to which industrial characteristics affect the mode of internationalization adopted; and $\varepsilon_{i,s}$ is an error term that conforms to the Weibull distribution.

With the above as given, we use the multinomial logit model denoted in Eq. (9) to estimate the probability that firm i chooses internationalization strategy s as follows:

$$P_i^s = \frac{\exp\left[\alpha_{0,s} + \beta \cdot TFP_s + \sum_j \gamma_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s}\right]}{\sum_{s=0}^{8} \exp\left[\alpha_{0,s} + \beta \cdot TFP_s + \sum_j \gamma_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \delta_{m,s} H_{i,m,s}\right]} \tag{9}$$

When we further assume that the profit-level of domestic market producers as a standard profit level, the probability of firm i choosing internationalization mode s can be rewritten as follows:

$$P_i^s = \frac{\exp\left[\tilde{\alpha}_{0,s} + \tilde{\beta} \cdot TFP_s + \sum_j \tilde{\gamma}_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \tilde{\delta}_{m,s} H_{i,m,s}\right]}{1 + \sum_{s=1}^{8} \exp\left[\tilde{\alpha}_{0,s} + \tilde{\beta} \cdot TFP_s + \sum_j \tilde{\gamma}_{j,s} Z_{i,j,s} + \sum_{m=1}^{n} \tilde{\delta}_{m,s} H_{i,m,s}\right]} \tag{10}$$

Then we estimate the coefficients pertaining to Eq. (10) using the Maximum Likelihood method in Table 4. We summarize the significant results from Table 4 as follows:

1. TFP positively relates to the probability of choosing every mode of internationalization with statistical significance,
2. The estimated coefficient of TFP for FDI engagement in the North is higher than that for export to the North,
3. The estimated coefficient for FDI engagement in the South however is lower than that for export to the North, and even close to that for export to the South.

The results of the above estimation exercise reiterate the findings in Sects. 2 and 4 that more productive internationalized Japanese firms tend to export to the South rather than engage in FDI, while the opposite holds for internationalized Japanese firms that operate in Northern country markets through exports and/or FDI. In addition, our estimated results show that the aggregate productivity of firms internationalizing in multiple regions is higher than that of firms internationalizing in a single region, regardless of their modes of internationalization.[3]

[3] Aw and Lee (2008) empirically investigate Taiwanese firms that internationalize in two different regions: the U.S. and China. Their findings suggest that the productivity of firms investing in China is higher than an exporter's productivity, the productivity of firms investing in North America is higher than that for firms investing in China, and the productivity of firms internationalizing to both countries is the highest. But their examination is not exhaustive, and analyzing two very different market types. That is, their analysis is based on only a small number of firms operating in limited industries. Also, their analysis is not clear when it comes to identifying what factors actually affect the relationship between productivity and the mode of internationalization.

Table 4 Choice of internationalization modes and productivity, 2005

	Modes of internationalization							
Explanatory variables	Export to only North	Export to only South	Export to both North and South	FDI in only North	FDI in only South	FDI in North and Export to South	Export to North and FDI in South	FDI in both North and South
Log(TFP(−1))	0.563***	0.358***	0.784***	0.857***	0.315***	0.839***	0.880***	1.435***
	[0.151]	[0.075]	[0.081]	[0.176]	[0.066]	[0.156]	[0.101]	[0.077]
Log(K/L(−1))	0.189**	0.087***	0.153***	0.204***	0.167***	0.358***	0.397***	0.664***
	[0.095]	[0.026]	[0.029]	[0.060]	[0.024]	[0.062]	[0.041]	[0.033]
Log(Skilled L/L(−1))	0.182*	0.238***	0.469***	0.132	0.196***	0.620***	0.431***	0.584***
	[0.094]	[0.049]	[0.054]	[0.107]	[0.042]	[0.109]	[0.068]	[0.051]
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes
Constant	−26.836***	−3.543***	−3.811***	−4.836***	−27.583***	−27.589***	−27.273***	−6.902***
	[0.830]	[0.618]	[0.627]	[0.746]	[1.112]	[1.112]	[1.200]	[1.037]
Observations	11,279							
Pseudo R-squared	0.107							

Standard errors in brackets

Notes: Industry dummies are suppressed

Both-Domestic is the base outcome

All firm characteristics are lagged 1 year, that is, they are for year $t-1$

*Significant at 10 %; **significant at 5 %; ***significant at 1 %

6 Conclusion

The theoretical model by Helpman et al. (2004) suggests that various combinations between firm's internationalization strategy and productivity levels are observed, corresponding to the different market conditions. Motivated by the HMY model's predictions and subsequent theoretical and empirical work on the topic, this paper empirically examines whether Japanese firm's productivity levels relate to their mode of internationalization with regard to exports to, and/or overseas FDI production in countries of the global North (North America and Europe) and the global South (East Asian countries). The analysis uses firm-level data pertaining to 12,000 Japanese firms to reveal some interesting results: (1) internationalized Japanese firms show higher productivity levels than non-internationalized Japanese firms, regardless of market destinations and the modes of internalization adopted; (2) firms engaged in FDI in the North have higher productivity levels as compared to firms that export to the North; but (3) firms engaged in FDI in the South do not apparently have higher productivity levels than firms that only export to the South. The third result is contrary to the HMY model's prediction about an internationalization hierarchy where internationalized firms with higher productivity levels engage in FDI while those with lower productivity levels export their products. It is our contention that differences in variable and fixed costs, including transport costs, and market sizes between the two regions may be a source of the different productivity cut-off levels pertaining to FDI engagements by Japanese firms in the North and the South. The fact that wage rates in East Asian countries (the South) are lower than in the North, while they are broadly similar across North America, Europe and Japan, supports this contention.

A caveat to our empirical estimations in this paper is that they indicate only relation patterns between productivity levels and the mode of internationalization adopted by Japanese firms that engage in international trade, i.e.., exports and/or FDI, with Northern and Southern countries. They neither indicate any a causal relationship between firm productivity levels and the mode of internationalization adopted by them, nor do they definitively identify any market specific factors that may additionally influence firms' internationalization strategy apart from their productivity levels. These issues remain relevant for future research.

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A.1 Appendix: List of Countries

North America	East Asian countries
Canada	Brunei
USA	Cambodia
Europe	China
Albania	Hong Kong
Austria	Indonesia
Belgium	Korea
Bulgaria	Laos
CIS countries	Malaysia
Cyprus	Mongolia
Czech	Philippines
Denmark	Taiwan
Finland	Thailand
Former Yugoslavia	Vietnam
France	
Germany	
Greece	
Hungary	
Iceland	
Ireland	
Italy	
Luxembourg	
Marta	
Netherlands	
Norway	
Poland	
Portugal	
Romania	
Slovakia	
Spain	
Sweden	
Switzerland	
Turkey	
United Kingdom	

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Foreign Direct Investment with Matching Frictions

Hitoshi Sato

Abstract Firm-level data often show different modes of market access by firms with same productivity levels, which presents a knife-edge scenario in the standard Melitz-type firm heterogeneity model. Further, the standard Melitz-type model fails to explain another empirical regularity: the foreign affiliates' sales relative to those generated by parent firms in their home market decrease with distance between the host and home countries. This chapter examines the foreign direct investment (FDI) decisions of individual firms with a simple framework, where firms and managers have to make matches for production. We find that the predicted distributions of FDI firms are much more akin to real data than those suggested by the basic firm heterogeneity model; namely, there exists a range of firm productivity in which more productive firms may export, whereas less productive firms may undertake FDI. Such a range of firm productivity becomes wider when either matching frictions increase or trade costs decline. Furthermore, the model predicts that the FDI sales relative to those generated by FDI firms in their home market decrease in the degree of matching frictions, which sheds some light on the empirical finding about the FDI sales relative to home sales by multinationals.

Keywords FDI • Firm heterogeneity • Matching

1 Introduction

By exploiting detailed firm-level data, several empirical studies have revealed that firms engaged in international activities such as foreign direct investment (FDI)

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and exports are rare, greater in their operational scale, and more productive than those remaining in home markets.[1] These empirical regularities are supported by theoretical contributions by Melitz (2003), Bernard et al. (2003), and Yeaple (2005), among others. In particular, for its simplicity, the Melitz model has been broadly applied to various trade issues.[2] Helpman et al. (2004) extend the Melitz model to incorporate FDI as a mode of internationalization for firms. They show a hierarchy among firms: only the more productive firms are internationalized, where the most productive firms choose FDI to serve foreign markets.

This hierarchy among firms is also empirically observable. FDI firms on *average* are more productive than non-FDI firms, as shown in Figs. 4 and 5 in Chap. 2. However, the hierarchy is not necessarily clear. This is particularly true for Japanese firms: the productivity advantage of FDI firms over exporting firms is quite small. Even for the most productive firms, while several firms choose FDI, an equally large number of firms choose exports. This ambiguous "pecking order" casts doubt on the simple model of firm decision making on FDI found in Helpman et al. (2004). Indeed, empirically examining the data for U.S. multinational firms, Yeaple (2009) points out that the Helpman et al. (2004) model fails to provide explanations for these empirical findings, which include that the unit cost serving foreign markets appears to rise with respect to distance.

Motivated by the gap between the empirical observations discussed above and the standard theory of firm decision making on FDI, this chapter examines the FDI decisions of individual firms by using the standard Melitz-type firm heterogeneity model in a simple search and matching framework proposed by Rauch and Trindade (2003). The model is based on the premise that firms have to search for "managers" who adroitly manage production with product expertise and knowledge about local business environments.[3] Unfamiliarity about foreign countries is likely to make searching for such managers in foreign countries more difficult than in the firms' home country. Consequently, matches in foreign countries tend to be associated with uncertainty about the quality of managers. As a result of matching with low quality managers, firms may not completely realize their intrinsic productivity level in foreign production. Worse, even highly productive firms may not find appropriate managers and be forced to choose exports rather than FDI.

Allowing for matching frictions between firms and managers is important in at least two respects. First, the model can reproduce firm distributions much more akin to those observed in empirical data. The productivity of foreign affiliates

[1]For example, see Bernard and Jensen (1995, 1999) for U.S. firms, Mayer and Ottaviano (2007) for European firms, Wakasugi et al. (2008) and Kimura and Kiyota (2007) for Japanese firms. Moreover, it is widely known that firms owning foreign production facilities are more productive than those engaged in only exports (e.g., Tomiura (2007) and Yeaple (2009)).

[2]Bernard et al. (2007) extend the Melitz model by using it in the Heckscher–Ohlin framework. Bustos (2007) incorporates technology adoption into the Melitz model and shows that exporters tend to adopt more advanced technology.

[3]Here "mangers" can be broadly interpreted as business partners with whom firms operate foreign subsidiaries. Thus, in this paper, FDI can take the form of a joint venture, M&A, or a green-field FDI.

is determined by both the firm intrinsic productivities and the quality of their matches with managers. Thus, although the chance of successful FDI progressively increases as firm intrinsic productivity increases, the foreign affiliates of firms with relatively high intrinsic productivity may fail if they have very low quality managers. Similarly, these matching frictions may provide relatively unproductive firms with a very high quality match and enable them to enter foreign markets through FDI. This mechanism contributes to more realistic firm distributions; namely, there exists a range of firm productivity in which more productive firms may export, while less productive firms may undertake FDI. Such a range of firm productivity becomes wider when either matching frictions increase or trade costs decline.

Second, the model provides an explanation for Yeaple (2009)'s empirical finding that the unit production cost of serving foreign markets tends to increase with trade costs. In the model, the productivity of foreign affiliates depends on not only the firm intrinsic productivity levels but also the match quality. The average match quality is likely to decline in foreign countries, where it is difficult for firms to collect information about appropriate managers as much as they can in the home country. Thus, the empirical finding that the ratio of foreign-affiliate operation size to home operation size tends to decrease in distance and increase in the usage of common language can be easily understood in the model, given that the degree of matching frictions is negatively correlated to geographical proximity between the FDI host and home countries or the usage of common languages.

This is not the first study that attempts to reconcile the implication derived from the standard Melitz model with the empirical fact that firms do not enter foreign markets according to an exact pecking order based on firm productivity. Eaton et al. (2011) modify the Melitz model by allowing firms to receive stochastic shocks over foreign demands and fixed market entry costs. By doing so, their model can generate a more realistic distribution of internationalized firms. However, their main focus is to demonstrate the extent to which the heterogeneity of underlying firm productivity explains the variation across firms in terms of market entry and sales. Rauch and Trindade (2003) is the closest to the present study. They emphasize the impact of declining information costs when searching for business partners in foreign countries on factor demand. However, they neither deal with firm heterogeneity nor the issue of overlapped productivity range.

The rest of this chapter is organized as follows. The following section describes the model and Sect. 3 discusses its properties. Section 4 provides a numerical example of the model. Section 5 concludes with a discussion of issues that should be studied in depth.

2 The Model

This section presents a two-country model containing two sectors and a continuum of heterogeneous firms. One sector (sector Z) competitively produces homogenous, numeraire goods from labor. The other sector (sector Y) produces a continuum of

differentiated varieties. In this sector, each firm has to search for a manager first. Then, the matched pairs of the firms and managers produce differentiated goods in a monopolistically competitive manner.

2.1 Preferences

The world consists of two countries, Home (H) and Foreign (F) indexed by $l, l' = H, F$ and $l \neq l'$. Each country is populated by many identical households who own as a whole L_l units of labor. Preferences are common across the two countries. The representative household maximizes the following quasi-linear utility function:

$$U = q_0 + \ln C, \tag{1}$$

where q_0 denotes consumption of homogenous goods and C is the consumption index for differentiated goods. Letting $q(i)$ be the consumption of variety i of the differentiated goods, the consumption index is defined by the standard CES sub utility function:

$$C = \left[\int_{i \in \Omega} q(i)^{(\sigma-1)/\sigma} di \right]^{\sigma/(\sigma-1)}, \tag{2}$$

where Ω is the set of available varieties. The varieties of differentiated goods are substitutable with the elasticity of substitution $\sigma = 1/(1-\alpha) > 1$.

Under the quasi-linear preferences in (1), total expenditure over the differentiated goods is L_l. Thus, the iso-elastic demand function for each variety i is given by

$$q(i) = \frac{p(i)^{-\sigma} L_l}{P^{1-\sigma}}, \tag{3}$$

where $p(i)$ represents the price of variety i and P represents the aggregate price index for the differentiated goods:

$$P = \left[\int_{i \in \Omega} p(i)^{1-\sigma} di \right]^{1/(1-\sigma)}. \tag{4}$$

2.2 Production Technology

The homogeneous good is produced with labor only under constant returns to scale and perfect competition. It is freely traded and taken as a numeraire. The home firm produces w_H units of homogenous good per one unit of labor, whereas the foreign firm produces w_F units of homogenous good per one unit of labor. This analysis

focuses on equilibria in which both countries produce homogenous goods, which implies that the wage rates are w_H for home and w_F for foreign firms, respectively. Without loss of generality, it is also assumed that $w_H \geq w_F = 1$.

There is a continuum of firms that differs in their productivity levels. Following Rauch and Trindade (2003), firms cannot manufacture products themselves. They must employ "managers" who operate the manufacturing process of differentiated goods. The production of each variety is, thus, a joint venture by the way of pairing of a firm and a manager.

Managers are also heterogeneous. Each manager has some specialty for a certain product and cannot operate the production of each differentiated good equally well. Thus, the matching quality between a firm and a manager affects the productivity of the differentiated good. More specifically, it is assumed that the productivity level of a variety is given by $A_l \varphi z^{1/(\sigma-1)}$ where A_l denotes the effectiveness of one unit of labor in sector Y in country l, φ denotes the firm-specific productivity levels, and $z \in [0,1]$ denotes the quality index of matching between a firm and a manager. The total cost function of variety i produced in country l, thus, takes the form of

$$TC = \frac{w_l}{A_l \varphi z^{1/(\sigma-1)}} q(i). \tag{5}$$

In what follows, I will call φ the "intrinsic" productivity of firms to distinguish it from "realized" productivity, $\varphi z^{1/(\sigma-1)}$.

It is assumed that firms know their intrinsic productivity levels, φ, which is randomly drawn from a distribution with the cdf of G and the pdf of g, before matching with a manager. If a firm matches with an ideal manager, $z = 1$ is realized and the firm intrinsic productivity becomes realized productivity. Otherwise, the realized productivity is below the firm intrinsic productivity. Assuming that matching frictions exist, each firm draws match quality z from a uniform distribution with its support $[\lambda, 1]$. The lowest boundary of the support z represents the matching efficiency.

It is assumed that firms are internationally mobile, but managers are not. Thus, firms have to employ local managers for local production, which implies that when a firm sets up a foreign plant, it has to also search for a manager in that foreign country. In this context, many factors, such as geographical proximity, cultural similarity (e.g., language), and telecommunication technology, may affect λ. It is natural that firms can find suitable managers more easily in their country of origin than in foreign countries, by exploiting their familiarity with the business environment in their own country. Based on this premise, it is assumed that λ equals 1 for domestic matching. In other words, firms can always match with the best managers for domestic production.

Once a firm and a manager form a match, they immediately know the match quality z, and then decide whether they will maintain the relationship. If they maintain the relationship, they make an arrangement for production and profit sharing. It is assumed that once they proceed to the arrangement stage, they can reach an efficient agreement, whereby joint surplus is maximized. The successful

match of firm i and manager j in country l, hence, sets the price at $p(i) = w_l/[\alpha A_l \varphi z^{1/(\sigma-1)}]$, facing with the iso-elastic demand in Eq. (3). The gross match surplus $\Pi(\varphi, z)$ generated by this pair is given by

$$\Pi(\varphi, z) = z M_l w_l^{1-\sigma} [A_l \varphi]^{\sigma-1}, \tag{6}$$

where $M_l \equiv L_l P_l^{\sigma-1}/(\sigma \alpha^{1-\sigma})$ is the mark-up adjusted residual demand and exogenous for firms and managers.

2.3 Matching and Bargaining

Events proceed sequentially in the following order. After knowing the intrinsic productivity level of φ, each firm starts to search for an appropriate manager. It is assumed that international matching occurs first. If FDI is more profitable than exports, firms in country l start to search for managers in country l'. International matching is associated with informational uncertainty. Hence, some firms successfully spot appropriate managers while other firms fail to do so. Once the international matching stage is completed, firms start to search for local managers for domestic production. After the domestic matching stage is completed, production and sales occur and revenues are distributed to all related economic agents. Firms that could not match with managers of acceptable quality in the international matching stage serve the foreign markets as exporters instead of multinationals.[4]

Given this sequence of events, we can now describe the matching of domestic production. Since it is assumed that firms can find their ideal managers without any friction for domestic production, $z = 1$ is always realized. A domestic match generates (gross) profits from the local market, Π_{Dl}, given by

$$\Pi_{Dl}(\varphi) = M_l w_l^{1-\sigma} [A_l \varphi]^{\sigma-1}. \tag{7}$$

To focus on the FDI decisions of individual firms, the fixed costs for exports are abstracted from the model. Thus, firms located in country l can export the differentiated goods to country l' and incur iceberg-type transportation costs: $\tau_{l'} > 1$ units need to be shipped for one unit to arrive in country l'. When the good produced in country l is shipped to country l', the marginal cost of serving country l' is $\tau_{l'} w_l/\varphi$. The match surplus from exports from country l to country l', Π_{Xl}, is given by

[4] I do not consider the possibility that firms cannot meet any managers. This possibility introduces additional matching frictions, such as unemployed managers and recruitment firms. The introduction of such matching frictions into the model may be an interesting extension. However, it seems unnecessary for the current purpose of the model. To avoid the issue of unemployed managers and recruitment firms, I simply assume a hypothetical matching market-maker who can arbitrarily adjust the mass of managers matching with firms.

$$\Pi_{Xl}(\varphi) = M_{l'} T_{l'} w_l^{1-\sigma} [A_l \varphi]^{\sigma-1}, \tag{8}$$

where $T_{l'} \equiv \tau_{l'}^{1-\sigma}$ is a transformed measure of the transportation costs.

Firms and managers that form matches bargain over their match surplus, following the Nash bargaining rule. Without loss of generality, it is assumed that any pair of firms and managers will evenly share the match surplus. The match surplus generated by domestic production is evenly split between the partners. Since the international matching market is closed at this stage, each party's status-quo payoff is zero. Each partner, thus, obtains

$$\frac{\Pi_l(\varphi)}{2} \equiv \frac{\Pi_{Dl}(\varphi) + \Pi_{Xl}(\varphi)}{2} \tag{9}$$

from domestic production.

Turning now to international matching for FDI, the model differentiates FDI from exports by emphasizing that firms have to search for appropriate local managers to run foreign affiliates.[5] Given that the match between a firm from country l and a manager in country l' generates quality z, the gross profits from FDI, Π_{Il}, are given by

$$\Pi_{Il}(\varphi, z) = M_{l'} z w_{l'}^{1-\sigma} [A_l \varphi]^{\sigma-1}, \tag{10}$$

where it is assumed that multinational enterprises (MNEs) bring their own technologies across the borders.

The same Nash bargaining rule and the share apply to international matching. Since firms can export, their status-quo payoff is $\Pi_{Xl}(\varphi)/2$. At this stage, the manager can expect matching with a domestic firm in the next stage. In domestic matching, the best match is assured (i.e, $z = 1$), but the matched firm intrinsic productivity level is random. Thus, the manager status-quo payoff is $E\left[\Pi_{Xl'}(\varphi) + \Pi_{Dl'}(\varphi)\right]/2$ where E denotes the operator of expectation. For successful international match, the profits of FDI are not less than the sum of the firm status-quo payoffs and the manager status-quo payoffs: i.e.,

$$\Pi_{Il}(\varphi, z) \geq \frac{\Pi_{Xl}(\varphi)}{2} + \frac{E[\Pi_{Xl'}(\varphi) + \Pi_{Dl'}(\varphi)]}{2}. \tag{11}$$

Since the model does not require free entry, all generated profits must be distributed to the households. For this purpose, it is assumed that a hypothetical fund collects profits from all firms and managers and redistributes them to the households as shareholders of firms and managers. Due to the quasi-linear preferences, these incomes are absorbed by the homogenous goods sector, Z.

[5] In reality, it is observed that firms send managerial-class employees to foreign affiliates instead of hiring those locally. However, these behaviors seem to be limited to only the early stage of FDI.

3 Properties of the Model

This section examines properties of the model. In what follows, I will focus on home firm FDIs (foreign firm FDIs are a mirror-image of home firm FDIs).

3.1 Threshold Match Quality

Imposing equality on the condition in Eq. (11), a home firm with φ has the threshold match quality of $z_H^*(\varphi)$ below which home firms prefer exports over FDIs, such that

$$z_H^*(\varphi) = \underbrace{\frac{T_F \omega}{2}}_{\text{FDI-profitability effect}} + \underbrace{\frac{1 + T_H m_H}{2}\left[\frac{A_H \varphi}{A_F \tilde{\varphi}}\right]^{1-\sigma}}_{\text{relative bargaining-power effect}}, \tag{12}$$

where $\omega \equiv (w_F/w_H)^{\sigma-1} = w_H^{1-\sigma}$ is a transformed measure of the relative foreign wage, $m_H \equiv M_H/M_F$ is the relative home market size, and $\tilde{\varphi}$ is the average productivity level of foreign firms.

Equation (12) identifies two effects that govern the threshold match quality: profitability of FDI relative to exports ("FDI-profitability effect"), and relative bargaining power between the firm and the manager ("relative bargaining power effect"). The first term on the right-hand side of Eq. (12) represents the FDI-profitability effect. This is simply the ratio of the marginal production costs of exporting to FDI. As foreign tariffs τ_F and/or home wages w_H increase, FDI becomes more profitable than exports, which leads to a lower threshold match quality.

The next term represents the relative bargaining-power effect since it is the ratio of the foreign manager status-quo payoff to FDI (gross) surplus. As either home tariffs τ_H increase, the relative home market size m_H decreases, or the average productivity level in foreign $A_F\tilde{\varphi}$ decreases, foreign managers lose their bargaining power since the status-quo payoffs decreases. Thus, in either case, the threshold match quality falls.

It should be noted that firm heterogeneity affects the threshold match quality of $z_H^*(\varphi)$ not through the FDI-profitability effect but through the relative bargaining-power effect. Intuitively, when matches with a highly-productive home firm are realized, it becomes less attractive for a foreign manager to wait for opportunities to work with a local firm. As a result, the foreign manager is willing to accept a relatively lower share of FDI surplus, which lowers the threshold match quality.

3.2 Local Manager as a Entry Cost

Letting $s(\varphi,z)$ denote a foreign manager's payoffs, the matched home firm obtains $\pi_{IH}(\varphi,z) = \Pi_{IH}(\varphi,z) - s(\varphi,z)$ from FDI. The Nash solution gives $\pi_{IH}(\varphi,z)$ and $s(\varphi,z)$, respectively, as follows:

$$\pi_{IH}(\varphi,z) = \left[\frac{2z+T_F\omega}{4}\right] M_F[A_H\varphi]^{\sigma-1} - \frac{[M_HT_H+M_F][A_F\tilde{\varphi}]^{\sigma-1}}{4}, \tag{13}$$

$$s(\varphi,z) = \left[\frac{2z-T_F\omega}{4}\right] M_F[A_H\varphi]^{\sigma-1} + \frac{[M_HT_H+M_F][A_F\tilde{\varphi}]^{\sigma-1}}{4}. \tag{14}$$

Since the net profits of home firms from exports are given by $\pi_{XH}(\varphi) = M_FT_F\omega[A_H\varphi]^{\sigma-1}/2$, we can immediately establish the following result from Eq. (13).

Proposition 1. *As long as $\lambda > T_F\omega/2$, FDI is always viable, and FDI is more profitable than exports for high-productivity firms.*

Proof. See Appendix.

The result that FDI is more profitable than exports for highly-productive firms itself is not new. However, the model provides a novel perspective on the FDI fixed costs that is deeply related to local managers' status-quo payoffs. In particular, the model emphasizes the profitability of local firms where local managers may alternatively work.[6] Notice that the foreign managers' payoffs include fixed payments (the second term on the right-hand side of Eq. (14)). The source of these fixed payments is, of course, the outside option for managers: they may work with domestic firms instead of MNEs. Thus, changes that raise the value of the outside option, such as improvements of the average productivity of foreign firms ($A_F\tilde{\varphi}\uparrow$), a lower trade cost for exporting to home ($T_H\uparrow$), and an increase in the relative market size ($m_H = M_H/M_F\uparrow$), lead to an increase in the fixed costs for FDI, which makes FDI difficult for home firms with low intrinsic productivity levels relative to exports.

As a simple application of the model, it may be interesting to consider FDI between developed and developing countries. In such FDIs, firms in developed countries set up foreign affiliates for exploiting the inexpensive production factor in developing countries. It is simple to presume that $w_H > w_F$, where home is developed and foreign is developing. However, the model suggests that if we assume that foreign local firms are technologically behind those in the home country,

[6]The literature on firm heterogeneity and international trade typically assumes that $f_I > \tau^{\sigma-1}f_X$ where f_I and f_X are fixed costs for FDI and exports, respectively, and τ is the usual iceberg-type transportation cost. See, for example, Helpman et al. (2004). In reality, there exists various types of fixed costs for MNEs to run foreign affiliates. The model obviously abstracts many of them. However, adding these fixed costs to the model does not essentially alter the model.

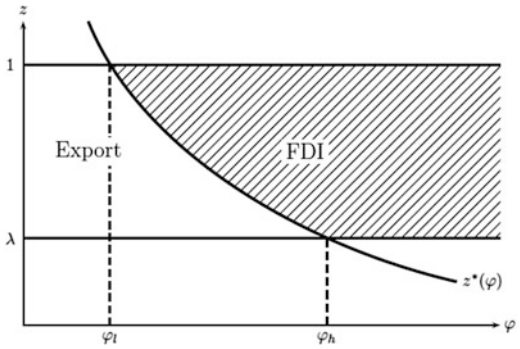

Fig. 1 Two threshold productivities. Firms with an intrinsic productivity greater than φ_h always choose FDI, irrespective of the match quality. Similarly, firms with an intrinsic productivity lower than φ always choose exports. In the range of the intermediate productivities, FDI firms and exporting firms coexist, even if they have exactly the same productivities in the home market

then it may lower the level of status-quo payoffs for foreign managers, which encourages relatively unproductive home firms to undertake FDI. This prediction seems consistent with empirical regularities.

3.3 Threshold Productivity

We can explicitly observe the relationship between FDI difficulty and the bargaining position of foreign managers by considering the threshold productivity levels. The threshold match quality $z_H^*(\varphi)$ in Eq. (12) decreases in φ. Since the worst match quality is λ, home firms with $z_H^*(\varphi) \leq \lambda$ always choose FDI, irrespective of match quality. In contrast, some home firms with very low productivity levels will not be able to undertake FDI even if they match with the best managers (i.e., $z_H = 1$). Thus, two threshold productivity levels, φ_l and φ_h, can be established by solving $z_H^*(\varphi_l) = 1$ and $z_H^*(\varphi_h) = \lambda$ in Eq. (12), respectively, and as depicted in Fig. 1,

- home firms with $\varphi \leq \varphi_l$ always export;
- Firms with $\varphi \in (\varphi_l, \varphi_h)$ can undertake FDI only when match quality with foreign managers is sufficient $z \geq z_H^*(\varphi)$. Otherwise, they choose exports;
- Firms with $\varphi \geq \varphi_h$ always undertake FDI,

where

$$\varphi_l^{\sigma-1} = \frac{1 + T_H m_H}{2 - T_F \omega} \left[\frac{A_F \tilde{\varphi}}{A_H}\right]^{\sigma-1} \quad \text{and} \quad \varphi_h^{\sigma-1} = \frac{1 + T_H m_H}{2\lambda - T_F \omega} \left[\frac{A_F \tilde{\varphi}}{A_H}\right]^{\sigma-1}. \tag{15}$$

The size of the productivity range (φ_l, φ_h), where q firm's FDI decision making depends on match quality z_H, is measured by

$$\varphi_h^{\sigma-1} - \varphi_l^{\sigma-1} = \frac{2(1-\lambda)(1+T_H m_H}{(2-T_F\omega)(2\lambda - T_F\omega)} \left[\frac{A_F\tilde{\varphi}}{A_H}\right]^{\sigma-1}. \tag{16}$$

The properties of the two threshold productivity levels φ_l and φ_h are recorded in the following proposition.

Proposition 2. *There exist two threshold productivity levels, φ_l and φ_h. Firms with intrinsic productivity levels below φ_l serve the foreign market via exports, whereas firms with intrinsic productivity levels above φ_h serve the foreign market via FDI. In the middle range of (φ_l, φ_h), firms may serve the foreign market via either exports or FDI.*

The two threshold productivities exhibit the following properties:

1. *They are increasing in the relative home market size (m_H), average foreign firms' productivities ($A_F\tilde{\varphi}$), inverse of trade costs (T_H and T_F), and relative foreign wage (ω).*
2. *The distance between these two threshold productivity levels becomes wider when (i) matching efficiency decreases ($\lambda \downarrow$), (ii) relative home market size is greater ($m_H \uparrow$), (iii) trade cost for exporting to foreign countries decreases ($T_F \uparrow$), (iv) trade cost for exporting to home decreases ($T_H \uparrow$), and (v) relative foreign wages increase ($\omega \uparrow$).*

These results are quite intuitive. When λ decreases, it becomes more difficult for firms to find acceptable managers for FDI. Thus, even relatively productive firms may fail to undertake FDI, which leads to a wider productivity range where firms with higher productivity levels may export whereas those with lower productivity levels may undertake FDI. A lower trade cost for exporting to foreign or a lower relative home wage, decreases the profitability of FDI relative to exports. Again, matching becomes difficult even for relatively highly productive firms; moreover, this results in a wider productivity range where FDI firms and exporting firms coexist. By contrast, a lower trade cost for exporting to home or a greater relative home market increases the difficulty of successful matches, as this increases the bargaining power of local managers.

Foreign managers are uniformly distributed between λ and 1. Hence, for range (φ_l, φ_h), the probability of a successful match for FDI is expressed by

$$Prob(z \geq z^*(\varphi)) \equiv \delta_H(\varphi) = \frac{1 - z^*(\varphi)}{1-\lambda}. \tag{17}$$

For a given φ, the average match quality $\tilde{z}(\varphi)$ is simply expressed by $\tilde{z}(\varphi) = [1 + z^*(\varphi)]/2$. Since $z^*(\varphi)$ is decreasing in φ, the probability of a successful match increases as φ increases and the average match quality $\tilde{z}(\varphi)$ decreases. These results are recorded as the following proposition.

Proposition 3. *For home firms with $\varphi \in (\varphi_l, \varphi_h)$, the probability of successful matching increases in φ. The average quality of international matches decreases as*

the firm intrinsic productivity level increases, until it reaches φ_h. Then, the average quality of international matches is constant at $(1+\lambda)/2$ for firms with not less than φ_h.

The intuition of this proposition is readily understood by referring to the threshold match quality $z^*(\varphi)$. Equation (12) shows that as firm intrinsic productivity increases, the threshold match quality decreases by the weakening of the relative bargaining-power effect.

3.4 FDI Sales

Letting N_H and N_{IH} denote the total mass of home firms and the total mass of home FDI firms, respectively, the realized average productivity of home FDI firms, $\tilde{\varphi}_{IH}^{\sigma-1}$, is expressed by

$$\tilde{\varphi}_{IH}^{\sigma-1} = \frac{N_H}{N_{IH}} \left[\int_{\varphi_l}^{\varphi_h} \tilde{z}(\varphi) \varphi^{\sigma-1} g(\varphi) d\varphi + \int_{\varphi_h}^{\infty} \left[\frac{1+\lambda}{2} \right] \varphi^{\sigma-1} g(\varphi) d\varphi \right], \tag{18}$$

where the total mass of home FDI firms is given by

$$N_{IH} = N_H \left[(1 - G(\varphi_h)) + \int_{\varphi_l}^{\varphi_h} \left[\frac{1 - z_H^*(\varphi)}{1-\lambda} \right] g(\varphi) d\varphi \right]. \tag{19}$$

Letting φ_{IH}^H be these FDI firms' average productivities in the home market, the relative average productivity of foreign-affiliate production to home production is given by

$$\left[\frac{\tilde{\varphi}_{IH}}{\tilde{\varphi}_{IH}^H} \right]^{\sigma-1} = \frac{\int_{\varphi_l}^{\varphi_h} \tilde{z}(\varphi) \varphi^{\sigma-1} g(\varphi) d\varphi + \int_{\varphi_h}^{\infty} \left[\frac{1+\lambda}{2} \right] \varphi^{\sigma-1} g(\varphi) d\varphi}{\int_{\varphi_l}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi}, \tag{20}$$

which is less than 1 and increases in λ.[7]

FDI average sales per firm is given by $\sigma M_F (A_H \tilde{\varphi}_{IH})^{\sigma-1}$ and the total FDI sales is $R_{IH} = \sigma M_F (A_H \tilde{\varphi}_{IH})^{\sigma-1} N_{IH}$. Hence, the total FDI sales, relative to the sales that the FDI firms generate in their home market, is given by

$$\frac{R_{IH}}{R_{IH}^H} = \frac{M_F}{M_H} \left[\frac{w_F}{w_H} \right]^{\sigma-1} \left[\frac{\tilde{\varphi}_{IH}}{\tilde{\varphi}_{IH}^H} \right]^{\sigma-1}. \tag{21}$$

From Eq. (21), the following proposition can be derived.

[7] As λ marginally increases, the average match quality for firms with productivity greater than φ_h clearly improves.

Proposition 4. *Holding other things constant, the relative foreign affiliates' sales to the sales that parent firms generate in their home market decrease as matching efficiency, λ, decreases.*

Equation (21) implies that without matching frictions, data on the sales of FDI subsidiaries in a foreign country relative to the home sales of their parent firms can be fully explained by the foreign country's relative market size and the relative production cost. However, this is not likely to hold. Using U.S. firm data, Yeaple (2009) found that FDI sales relative to home sales has a negative coefficient with respect to geographical distance and a positive coefficient with respect to the binary variables for English usage in the host countries. The empirical analysis on Japanese MNEs in Chap. 5 of this book also finds that FDI sales relative to home sales have a negative coefficient with respect to geographical distance. Although there is no direct evidence about the correlation between the relative FDI sales and the degree of matching frictions, it is likely that common language usage and/or geographical proximity decrease the matching frictions between host and home countries.

4 Numerical Examples

This subsection illustrates how the model predicts the distribution of FDI firms with numerical examples. In doing so, we need to set several parameter values. The baseline parameter values used in the examples are reported in Table 1. The elasticity of substitution between differentiated goods is set to $\sigma = 5$. The distribution of firm intrinsic productivity is specified as a Pareto distribution with $\varphi \in [1, \infty)$ and the degree of firm heterogeneity, k, is set to 6. For the size distribution of firms to have a finite mean, we need $k > \sigma - 1$.[8] Trade cost τ_l is set to 2 for both home and foreign countries, which implies that $T_l = 0.0625$.

Table 1 Parameter values and some key variables

Elasticity of substitution between varieties	$\sigma = 5$
Shape parameter	$k = 6$
Trade cost	$T_l = 0.0625$ $(\tau_l = 2)$
Matching efficiency (informational frictions)	$\lambda = 0.1, 0.6, 1$
Average productivity for domestic production	$\tilde{\varphi} = 1.32$
Upper threshold productivity	$\varphi_h = 1.29(\lambda = 0.4),\ 2.19(\lambda = 0.9)$
Lower threshold productivity	$\varphi_l = 1.13$

[8] Mayer and Ottaviano (2007) report that it is 3.03 and 2.55 for Italy and France. Wakasugi et al. (2008) estimate that k is approximately 1.7 for Japanese firms. This estimate appears significantly small. There is a possibility that the data set used in their study might suffer from a lack of data, especially for small firms. Eaton et al. (2011) find that $k/(\sigma - 1)$ is approximately 1.5 for French firms. Here, we use this ratio for setting $k = 6$.

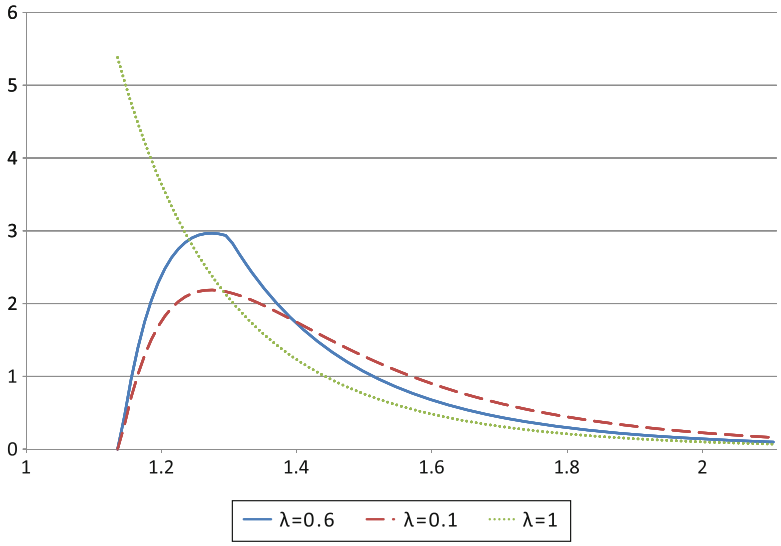

Fig. 2 Probability density functions for FDI firms

Figure 2 illustrates conditional probability density functions of FDI firms for three different cases: $\lambda = 1, 0.6$, and 0.1.[9] In the case of $\lambda = 1$, there are no matching frictions for FDI such that the pdf is of a Pareto distribution (dotted curve in the figure). Existing firm productivity levels start at $\varphi = 1$ and the model gives the cutoff productivity level of $\varphi_l = 1.32$, above which firms can always undertake FDI.

Once we introduce matching frictions into the model, the pdfs change dramatically. The curve expressed by a solid line is the case of $\lambda = 0.6$. The shape is much more akin to that of empirically obtained data from Japanese firms. With uncertainty about foreign manager quality, even relatively productive firms may fail FDI. In this case, firms with productivities between 1.13 and 1.29 may export or undertake FDI. Here two elements govern the FDI firm distribution: firm intrinsic productivity φ and match quality z. As shown in the total cost function, FDI firm efficiency is determined by these two elements. In particular, the extent to which firms match with appropriate managers is crucial for firms with low φ. However, obtaining high match quality is difficult. Thus, even though there are many firms who might undertake FDI near the threshold productivity level φ_l, only a limited number of firms can do so. In contrast, highly productive firms do not need to be concerned about match quality. Thus, in high productivity regions in the figure, the effect of the distribution of firm productivity φ becomes dominant.

[9]The conditional probability density function of FDI firms is relegated to the Appendix.

5 Concluding Remarks

Firm-level data often suggest that firms with very similar productivities select different modes of internationalization although the most productive firms still tend to choose FDI for entering foreign markets. This paper examines the FDI decisions of individual firms with a simple framework, whereby firms and managers have to make matches for production. We find that predicted firm distributions are much more akin to those suggested by real data; namely, there exists a range of firm productivity in which more productive firms may export while less productive firms may undertake FDI. Such a range of firm productivity becomes wider when either matching frictions increase or trade costs decreases. Furthermore, matching frictions hurt production efficiency more for productive firms than for less productive firms.

This study also addresses the extent to which informational frictions (e.g., lack of information about foreign skilled labor markets) hurt industry efficiency by hindering productive firms to become multinationals. There exist issues that should be considered further; however, these are left for future research. In particular, the model highlights two distinct elements that affect firms' FDI decision making: trade costs and matching frictions (e.g., lack of information about the foreign skilled labor markets). The interaction between these two elements should be more deeply considered. In particular, effects on FDI sales are important. For example, the gravity estimation of FDI sales in Wakasugi et al. (2008)) reveals that the variation of the extensive margin of FDI sales can be largely explained by the distance between two countries. Geographical distances between two countries can be broadly interpreted as a proxy for transportation costs as well as that for informational frictions in skilled labor (managers or business partners). Thus, it is interesting to examine the extent to which the informational frictions highlighted in this paper influence FDI sales.

6 Appendix

6.1 Proof of Proposition 1

Both the payoff schedules $\pi_{IH}(\varphi, z)$ and $\pi_{XH}(\varphi)$ are monotonically increasing in $\varphi^{\sigma-1}$. Thus, the slope of π_{IH} is steeper than that of π_{XH} only when $(2z+T_F\omega)/4 > T_F\omega/2$. The worst match quality is given by $\underline{z} = \lambda$. Thus, we can establish the sufficient condition for FDI viability such that $\lambda > T_F\omega/2$.

Then, the difference between a firm's FDI payoff and export payoff, $\pi_{IH}(\varphi, z) - \pi_{XH}(\varphi)$, is given by

$$\pi_{IH}(\varphi, z) - \pi_{XH}(\varphi) = \left[\frac{2z - T_F\omega}{4}\right] M_F \varphi^{\sigma-1} - \frac{[M_H T_H + M_F]\tilde{\varphi}^{\sigma-1}}{4}, \qquad (22)$$

which is increasing in $\varphi^{\sigma-1}$.

6.2 The Conditional Pdf for FDI Firms

For simplicity, it is assumed that the two countries are symmetric. Also, the effectiveness of one unit of labor is set at 1 ($A_H = A_F = 1$). The conditional pdf for FDI firms, $h(\varphi)$, is given by

$$h(\varphi) = \begin{cases} \Gamma^{-1}\left[\frac{1-z^*(\varphi)}{1-\lambda}\right] k\varphi_l^k \varphi^{-k-1} & \text{if} \quad \varphi \in [\varphi_l, \varphi_h], \\ \Gamma^{-1} k\varphi_l^k \varphi^{-k-1} & \text{if} \quad \varphi \in [\varphi_h, \infty), \end{cases} \tag{23}$$

where $\Gamma = \frac{A_1}{k}\left[\varphi_l^{-k} - \varphi_h^{-k}\right] + \frac{A_2}{k+\sigma-1}\left[\varphi_h^{-k-\sigma+1} - \varphi_l^{-k-\sigma+1}\right] + \left[\frac{\varphi_h}{\varphi_l}\right]^{-k}$, $A_1 = k\varphi_l^k\left[\frac{1}{1-\lambda} - \frac{T}{2(1-\lambda)}\right]$, and $A_2 = \frac{(1+T)\tilde{\varphi}^{\sigma-1}}{2(1-\lambda)} k\varphi_l^k$.

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Intra-Firm Trade and Contract Completeness: Evidence from Japanese Foreign-Affiliated Firms

Toshiyuki Matsuura and Banri Ito

Abstract The issue on growth and its variations of the intra-firm trade of intermediate inputs are of great interest in international economics. Recently, many economists have stepped forward to explain this issue. However, traditional trade theory cannot explain the choice between intra-firm trade with vertical integration and international outsourcing. Thus, researchers are motivated to incorporate the concepts from industrial organization and contract theory to explain the organizational structure of firms. Using micro data at the affiliate-firm level, this chapter examines the determinants of intra-firm trade by shedding light not only on factor prices and trade costs but also on organizational structure in terms of the ownership of overseas plants and the control over intermediate inputs for further processing. Since organizational structure and intra-firm trade are jointly determined, we adopt instrumental variable (IV) regressions into our analysis and treat the choice of purchasing managers as an endogenous variable. The results suggest that the control over input decisions critically affects the intra-firm trade of intermediate inputs.

Keywords Incomplete contracts • Intra-firm trade • Organizational structure • Ownership and control

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1 Introduction

In recent decades, the nature of international trade has changed dramatically. Growth of world trade has been driven largely by the rapid growth of trade in intermediate inputs, such as components and equipment. For example, Yeats (2001) found that 30 % of world trade in manufacturing comes from intermediate inputs. Hummels et al. (2001) and Yi (2003) demonstrate that a large part of the growth in international trade is explained by the vertical fragmentation of production that involves a sequential, vertical trading chain stretching across countries, with each country specializing in particular stages of a good's production sequence.

A large part of trade in intermediate inputs is accounted for by intra-firm trade by multinational enterprises (MNEs). According to Slaughter (2000), more than 50 % of US exports are undertaken by US MNEs. Hanson et al. (2005) report that intermediate inputs account for 93 % of exports by US MNEs to their overseas affiliates. Intra-firm trade varies across both industries and countries. As explained by Hanson et al. (2005), intra-firm trade for further processing by US affiliates is common within the machinery, transport equipment, and electronic industries. US affiliates located in countries with relatively low trade costs and wages, such as Mexico and Canada, are engaged in processing inputs through intra-firm trade.

Recently, several economists have stepped forward to explain the growth of intra-firm trade and its various intermediate inputs. However, traditional trade theory cannot explain the choice between intra-firm trade with vertical integration and international outsourcing. Therefore, researchers are motivated to incorporate the concepts from industrial organization and contract theory that explain the organizational structure of firms.

This chapter identifies the determining factors affecting intra-firm trade using Japanese manufacturing MNE-affiliate data. We examine the determinants of intra-firm trade by shedding light not only on factor prices and trade costs but also on organizational structure in terms of the ownership of overseas plants and the control over intermediate inputs for further processing.

This chapter is organized as follows. Section 2 introduces previous studies related to the determinants of intra-firm trade; Sect. 3 explains the estimation model and data; Sect. 4 discusses the estimation results; and Sect. 5 presents a summary of the findings and policy implications.

2 Related Literature

Our study builds on several related research projects of intra-firm trade. The first body of literature is the research on trade costs and factor prices. For example, Hanson et al. (2005) investigated affiliate demand for imported inputs based on firm-level, cross-sectional data for US MNEs in 1994. They found that trade costs between the United States and host countries, relative wages of less-skilled workers, and corporate tax rates in the host countries have a significant effect on intra-firm trade.

The study on the determinants of intra-firm trade is closely related to the study on local procurement. For example, Belderbos et al. (2001) examined the determinants of local procurement for Japanese electronics manufacturing affiliates. Using affiliate-level, cross-sectional data for 1999, they found that the quality of infrastructure, the size of the local supporting industry, and the local content regulations have a significant effect on local procurement. Kiyota et al. (2008) used a Japanese foreign affiliate-level panel data set to estimate the translog factor demand function. They concluded that affiliate experience, as measured by length of operation, positively impacted local procurement in Asian countries.

The second body of literature is theoretical or empirical research, which combines traditional trade theory with the choice of organizational structure. For example, Grossman and Helpman (2004) and Feenstra and Hanson (2005) took into account the property rights theory and an incentive system approach to explore the trade-off between vertical integration through foreign direct investment (FDI) and foreign outsourcing. According to the property rights theory, relationship-specific investment is distorted because an enforceable agreement can only take place after investment. When the economic rent of investment is distributed through an ex post Nash bargaining solution, each party's incentive to invest depends on the ownership of the asset that determines the residual rights of control. Generally, to minimize the loss of surplus due to investment distortion, ownership should be given to the agent who is most important in raising the surplus. Therefore, if the agent's effort toward the overall surplus is important, the property rights approach suggests that foreign outsourcing is better than vertical integration. On the other hand, under the incentive system approach, a principal's optimal incentive contract is designed to induce efforts by managers. When perfect monitoring of managers' efforts is not possible, a first-level effort cannot be achieved. If vertical integration through FDI reduces monitoring cost, it is preferred compared to an arms-length transaction, namely, foreign outsourcing.

Grossman and Helpman (2004) developed a model in which the firms choose their modes of organization and the locations of their subsidiaries or suppliers. They sorted firms with different productivity levels into different organizational structures. Feenstra and Hanson (2005) investigated the ownership and control structure of Chinese firms engaged in processing inputs for export. They considered two trade modes: pure assembly and import and assembly. In the former regime, foreign buyers both own and supply inputs to plants in China. In the latter regime, Chinese plants import inputs on their own accord and then process and sell the finished goods to foreign buyers. According to the property rights approach, the control over inputs should be given to the local managers when their effort is crucial. In this case, the ownership of a plant in China and the control over inputs are split. In contrast, when manager efforts are not important, the incentive system implies that both ownership and control should be allocated to the foreign firm. Feenstra and Hanson used Chinese custom data, which included annual imports and exports of processed goods, according to an eight-digit harmonized system (HS) code product; the origin or destination by city district in China; the destination country and customs regime (pure assembly or import and assembly); and ownership type

(foreign- or Chinese-owned). They showed that the combination of foreign plant ownership and Chinese management over inputs is most common and consistent with the property rights approach.

The third body of literature is research about institutional quality and international trade. Concerned with relationship-specific investment and international trade, the importance of country-specific institutional differences has received a great deal of attention recently. For example, Levchenko (2007) developed a simple model within a framework of incomplete contracts and presented institutional differences as one source of comparative advantage. He also provides empirical evidence that institutional differences are an important determinant of trade flows. Similarly, Nunn (2007) examined institutional comparative advantage using a new measure of institutional intensity. He focused on relationship-specific investments and constructed a measure of the proportion of intermediate inputs that is relationship specific by product. Global trade patterns were found to be well-explained by contract enforcement rather than by country endowments of physical capital and skilled labor.

Our contribution is two-fold. First, we use affiliate-level micro data, which enables us to control for various characteristics of overseas affiliates, including organizational structure. Previous studies, such as Hanson et al. (2005) and Kiyota et al. (2008), also used micro data, but they did not incorporate organizational structure. Since organizational structure and intra-firm trade are jointly determined, we use IV estimations. Second, we also consider the differences in country-specific institutional qualities, which lead to policy implications.

3 Research Design

As an indicator of intra-firm trade at the affiliate level, we used the ratio of imports from company headquarters to total purchases by Japanese foreign affiliates. Affiliate-level data have advantages in terms of information on technology, organizational structure, and business environment in the host countries. We use data from the *Kaigai jigyo katsudo kihon* (*doko*) *chosa* (The Survey on Overseas Business and Activities), which is a confidential survey by Japan's Ministry of Economy, Trade, and Industry. We compute the intra-firm trade ratios; the results are shown in Tables 1 and 2.

Table 1 indicates some regional differences. While the intra-firm trade ratio for the affiliates in North America, South America, and Europe was approximately 35 % in 1995, the ratio for the affiliates in China, the Association of Southeast Asian Nations (ASEAN) and other Asia was relatively higher. Asian countries, particularly China have attracted many Japanese MNEs because of low labor costs and low trade costs (close proximity to Japan). However, the intra-firm trade ratio for China and ASEAN gradually declined by 1998 and 2001, implying that the improvement of the local business environment enabled the MNE affiliates to increase local procurement and reduce intra-firm trade.

Table 1 Distribution of the intra-firm trade ratios by region

By region	1995	1998	2001
North America	0.371	0.344	0.328
South America	0.324	0.341	0.314
Europe	0.349	0.319	0.346
Oceania	0.418	0.25	0.215
ASEAN	0.406	0.36	0.337
NIES	0.385	0.374	0.331
China	0.562	0.487	0.406
Other Asia	0.465	0.434	0.366

Table 2 Distribution of intra-firm trade ratios by industry

Industry	1995	1998	2001
Textile	0.241	0.155	0.293
Chemicals	0.279	0.302	0.274
Primary metals	0.407	0.474	0.346
Metal products	0.399	0.419	0.379
General machinery	0.435	0.368	0.372
Electronics	0.438	0.418	0.416
Transport equipment	0.424	0.387	0.349
Precision instruments	0.483	0.457	0.475

Table 2 presents the wide variations among industries. While intra-firm trade ratio for light manufacturing (i.e., textiles) is approximately 15–30 %, the ratio for general machinery, electronics, transport equipment, and precision instruments exceeds 35 %. Processing these products involves various production stages that can be separated; because each stage has different factor intensities, firms may have the incentive to locate labor-intensive activities in low-wage countries. Among these industries, general machinery and transport equipment show a considerable decrease in the intra-firm trade ratio (from 0.43 to 0.35–37 %), while the ratio of electronics and precision instruments is stable for the period.

Various factors may be responsible for the determination of intra-firm trade ratios. However, we focus on contractibility and the residence of the persons in charge of input control. Statistical descriptions suggest that both factors are likely to affect the intra-firm trade ratio. Figure 1 illustrates the relationship between the mean value of the intra-firm input purchase ratios of the foreign affiliates and their parent firms, and contractibility in the host countries. As a proxy for contractibility, we use the Rule of Law Index compiled from global governance indicators, which increases the quality of the legal environment and categorizes the host countries into five 20-percentile increments, according to the Rule of Law Index. The bar chart shows that the intra-firm trade ratio is negatively related with contractibility in the host countries, suggesting low transaction costs at arm's-length transactions in countries where the Rule of Law Index is high.

The bar chart in Fig. 2 shows the mean ratio of intra-firm input purchase of the foreign affiliates and their parent firms in terms of the residence of the purchasing manager. Although the mean ratio in 1995 is almost the same between

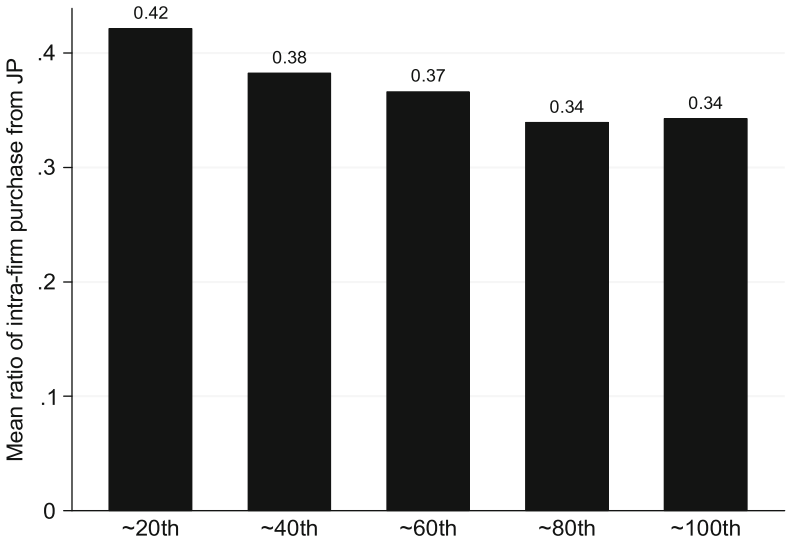

Fig. 1 Intra-firm trade ratios and contractibility in the host countries. *Note*: The *horizontal axis* denotes categories in terms of percentiles of the Rule of Law Index

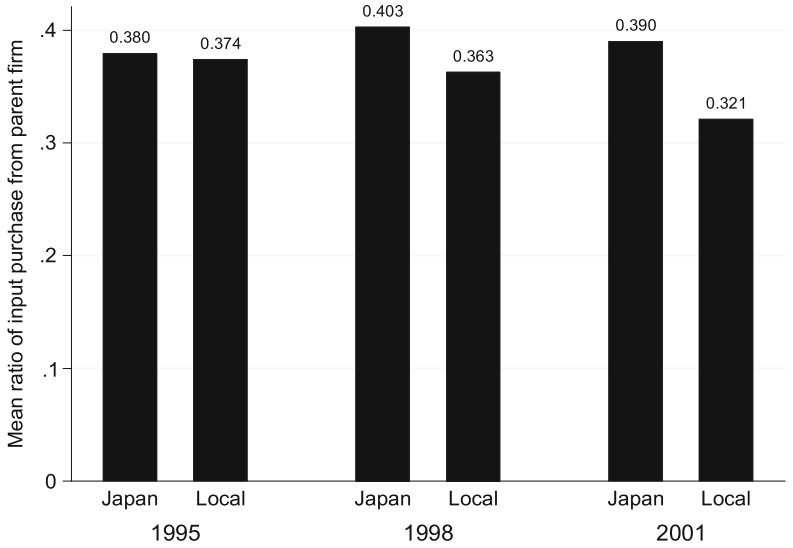

Fig. 2 Intra-firm trade ratios by the residence of the purchasing manager and year. *Note*: "Local" indicates that the residence of the purchasing manager is local, while "Japan" indicates that the purchasing manager is dispatched from Japan

the two measures, there is a significant difference in 1998 and 2001. This statistical difference suggests that an affiliate with a local purchasing manager is likely to procure intermediate inputs from local suppliers. We further explore the relationship between these differences in organizational structure and intra-firm trade, as well as other determining factors, in the following section.

3.1 Determinants of Intra-Firm Trade: The Hypotheses

In this subsection, we discern the determining factor for the intra-firm trade ratio. In the analysis, we divide the possible explanatory factors into three groups, namely, (1) trade costs and factor prices, (2) institutional quality, and (3) organizational structure, measured by the residence of the managers in charge of input control.

First, we note market-specific factors, including the trade cost and factor price, in the host country. Using import data as inputs at the firm level, Hanson et al. (2005) found that vertical production networks of US MNEs are sensitive to less-skilled labor costs and trade costs between the United States and host countries. As shown in Tables 1 and 2, Japanese MNEs also appear to engage in the processing of imported intermediate inputs in China and other countries in ASEAN, where labor and trade costs are lower. The final products derived from such imported inputs are associated with various production processes and include labor-intensive industries. Following the earlier empirical evidence, we test the following hypothesis on the effect of unskilled wages and trade costs on intra-firm trade:

Hypothesis I Lower trade costs and unskilled wages encourage intra-firm trade.

Second, we note the importance of contracts as an institutional factor in the host country. If the legal system in the host country is weak, the transaction cost is high when dealing with local suppliers at arm's-length. In this case, where the cost of a lawsuit is high, the MNEs choose vertical integration in the market to avoid holdup costs, so that intermediate inputs are supplied by intra-firm trade. Hence, the hypothesis to identify the factors affecting intra-firm trade is presented as follows:

Hypothesis II The improvement of contractibility in the host country induces lower costs for affiliates to transact with local suppliers and, in turn, decreases the input ratio of intra-firm trade.

Third, as seen in the previous section, the residence of the managers in charge of input control has an impact on intra-firm trade. A similar pattern was found and examined by Feenstra and Hanson (2005), who used distinct Chinese customs trade data. In their study, the search for and processing of inputs in China required specific investment by foreign firms and the appointment of a local Chinese manager. Thus, the effort of local managers was not controlled by foreign firms. As mentioned in Sect. 2, the allocation of control rights over inputs depends on the importance of the local manager's effort. If a local manager's effort is essential, then the control rights over inputs should be given to him/her; however, if relationship-specific investment

by foreign firms is indispensable in the processing process (e.g., human capital investment), then the foreign firms and their dispatched managers from company headquarters should be in charge of input control. In addition, contractibility might affect the organizational structure. In a poor business environment, MNEs hesitate to give control rights over inputs to local managers since the cost of negotiations would be extremely high. In sum, when local manger efforts are important and the degree of legal enforcement is adequate, the control rights over inputs are given to the local managers. In contrast, when the degree of contractibility in the host country is low or the manager's effort is not crucial, foreign firms maintain both ownership and control over inputs by dispatching a manager from headquarters and increasing intra-firm trade. Following Feenstra and Hanson (2005), the importance of local manager efforts is measured by the value-added ratio of each affiliate in our empirical analysis. Therefore, the third hypothesis is summarized as follows:

Hypothesis III Affiliate firms with a high value-added ratio are likely to be given input control and to purchase inputs from local firms in arm's-length transactions.

Note that the allocation of control rights over inputs and the degree of intra-firm trade are jointly determined. We treat the delegation of control rights over inputs as an endogenous variable and use an IV regression technique.

3.2 Determinants of Intra-Firm Trade: Empirical Specification

Based on the previous theoretical conjecture, we test empirically how firm-specific and market-specific factors affect the intra-firm procurement ratio of affiliated firms. The equation for the estimation is specified as follows:

$$\begin{aligned} m_{aijt} = {} & \alpha_0 + \beta_1 pm_{aijt} + \beta_2 asize_{aijt} + \beta_3 local_{aijt} + \beta_4 share_{aijt} \\ & + \beta_5 psize_{ijt} + \beta_6 KL_{ijt} + \beta_7 pRD_{ijt} + \beta_8 agg1_{jt} + \beta_9 agg2_{jt} \\ & + \beta_{10} unsw_{jt} + \beta_{11} sw_{jt} + \beta_{12} dist_{jt} + \beta_{13} rule_{jt} + \alpha_t + \varepsilon_{aijt}, \end{aligned}$$

where a denotes the foreign affiliates of Japanese firms i, i is the index for the affiliates' parent firm, j denotes the host country, and t is the year. α_0 represents a constant, α_t represents the time trend, and ε_{aijt} is the error term.

The dependent variable m is the ratio of the intra-firm input purchases of foreign affiliate, a, from the parent firm. To examine how it is affected by organizational structure, we use the ownership share, *share*, and a dummy variable, *pm* (which takes the value 1 if the location of the purchasing manager in charge of input control is local, and 0 otherwise) as qualitative information on the control rights over input purchases.

Other affiliate's characteristics, *asize*, and *local* indicate the number of employees in the affiliate and the local sales ratio, respectively. We also control for parent firm characteristics, such as the number of employees, *psize*, capital–labor ratio, *KL*, and R&D intensity, *pRD*.

Affiliate firms may procure inputs from other Japanese-affiliated firms in the host country, instead of purchasing from their parent firms. Thus, the model includes two agglomeration variables for the existence of Japanese-affiliated firms in the host country, taking into account transactions with other Japanese affiliates: the number of affiliates with the same parent firm in the host country, $agg1$, and the number of Japanese affiliates in the host country, $agg2$.

unsw and *sw* denote the average wage per employee of unskilled and skilled workers, respectively, in the host country. These variables are based on wage payment data recorded in the affiliate, firm-level data. Due to the limited availability of wage data, we defined average wages in the textile, wood pulp, leather, printing, and food industries as the wages of unskilled workers, and that in the electrical, transport equipment, and precision instrument industries as the wages of skilled workers.

For trade costs, we use the distance between capital city in the host country and Tokyo, *dist*, compiled from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). As a proxy measure of contractibility, we adopt the Rule of Law Index, *rule*, in the global governance indicators provided by the World Bank Institute.[1] We also take into account year, industry, and region-specific factors for the intra-firm input purchases. Hence, the estimated equation includes year dummy, two-digit industry dummy, and region dummy variables.

Organizational structure and intra-firm procurement are simultaneously determined. Hence, we treat the purchasing manager dummy as an endogenous variable. Since the IV regressions assume that the endogenous variables are continuous and inappropriate for use with discrete variables, we apply a two-step procedure described by Wooldridge (2002). Since our data in this chapter involves an MNE affiliate-level panel data set, we control for both affiliate- and firm-specific attributes in the regression analysis. First, we estimate a random effects probit model using a set of regressors from the equation for the intra-firm procurement ratio and additional instruments, and obtain the predicted probabilities, taking into account the unobserved, firm-specific effects of the affiliates. Second, we estimate the random-effects two-stage least squares (2SLS) model, using the fitted probabilities as instruments.[2,3]

[1]The index is based on hundreds of variables and reflects the views of thousands of citizens, survey respondents, and experts worldwide (Kaufmann et al. 2007). The original index ranges from −2.5 to 2.5, where a higher score represents a country with a higher level of contractibility.

[2]Although the estimator holds consistency, irrespective of whether the equation in the first stage is linear, the two-step procedure yields more efficient estimates than applying the 2SLS model (Wooldridge 2002).

[3]In both steps, we do not use the fixed effects model because of our 3-year sample period and many affiliates only appear once in our data set. Therefore, we rely on a random effects model to have enough observations. Note that the random-effects estimators in the second step are obtained by the generalized, two-stage, least-squares (G2SLS) model proposed by Balestra and Varadharajan-Krishnakumar (1987).

As mentioned in Hypothesis III, theoretical conjecture implies that the level of specific investments affects the allocation of control rights over input purchases. For additional instruments used in the first-step estimation, we adopt the value-added ratio and R&D intensity at the affiliate level as proxies for the investment level and specificity, respectively. The affiliate firm's age is also included in the instruments to control for possible historical effects on control rights decisions. We estimate the following random effects probit model, using the additional instruments in the first step, and compute the predicted probabilities.

$$y^*_{aijt} = \mathbf{X}\beta + \gamma\mathbf{Z} + e_{aijt},$$

$$y = \begin{cases} 1: & local \;\; if \;\; y^* > 0 \\ 0: & \text{Japan} \; if \;\; y^* \leq 0 \end{cases},$$

where X is a set of regressors in (1) and Z is a set of additional instruments, including three variables: value added over the total sales of an affiliate firm, *va*; R&D intensity, *aRD*; and an affiliate firm's age, *age*. The error term is assumed to include the unobserved individual effects at the affiliate-firm level and an idiosyncratic error. In addition, the random effects probit model assumes that the individual effects are normally distributed and independent of the error term and regressors.

$$e_{aijt} = a_{aij} + u_{aijt} \tag{3}$$

Table 3 shows the data descriptions and the summary statistics for each variable. The ratio variables are converted to percentage so that the estimation results can be interpreted easily.

3.3 Data Issues

We use the micro database of *Kaigai jigyo katsudo kihon* (*doko*) *chosa* (*The Survey on Overseas Business and Activities*; hereafter, SOBA) constructed by the Ministry of Economy, Trade, and Industry (METI). The aim of this survey is to obtain basic information on the activities of the foreign affiliates of Japanese firms. The survey covers all Japanese firms with affiliates abroad and consists of two parts: the Basic Survey, which is more detailed and carried out every three years, and the Trend Survey, which is comparatively less detailed and carried out between the Basic Surveys. The major items in SOBA are the year of establishment, breakdown of sales and purchases, employment, costs, and R&D. Micro-data related to SOBA is available after 1995. However, the volume of intra-firm trade is not included the Trend Survey. Thus, our samples are restricted to 1995, 1998, and 2001. A more detailed description of the data is provided in Appendix.

Table 3 Data descriptions and summary statistics

Variable	Data description	Mean	Std. Dev.	Min	Max
m	Intra-firm imports from Japan/total purchase (%)	34.9	32.39	0	100
pm	The nationality dummy of person in charge of input control (Japan = 0: Local = 1)	0.63	0.48	0	1
va	Affiliate's value added/sales (%)	38.36	19.76	0	99.97
aRD	Affiliate's R&D intensity (%)	0.38	1.82	0	49.88
age	Affiliate's age (year)	11.71	8.91	0	48
asize	N of affiliate's employee (100 persons)	4.44	8.56	0	159.29
local	Affiliate's Local sales ratio (%)	63.58	37.46	0	100
share	Ownership share (%)	79.48	25.09	0	100
psize	N of parent firm's employee (100 persons)	71.75	122.02	0.55	711.7
pRD	Parent firm's R&D intensity (%)	30.86	30.93	0	510.76
KL	Parent firm's Capital–Labor ratio	3.52	3.28	0	40.52
agg1	N of affiliates invested by same parent firm in the host country	3.01	4.44	1	33
agg2	N of Japanese affiliates in the host country	43.09	49.34	1	227
unsw	Average wage of unskilled worker in the host country	0.79	0.95	0	5.27
sw	Average wage of skilled worker in the host country	0.93	0.98	0	4.88
dist	Distance (100 km)	58.14	37.2	11.58	183.74
rule	Rule of Law index (0–5)	3.09	0.87	1.59	4.58

4 Estimation Results

4.1 Results of the Models on the Residence of the Purchasing Manager

We first estimate the random effects probit model on the purchasing manager dummy, using regressors in the second step and additional instruments, such as the value-added ratio of the affiliate firm, and gain the fitted probabilities by instrument in the IV regression. The results of the estimation of the random effects probit model are presented in Table 4. Columns (1), (2), and (3) present the results with and without industry and region dummy variables. Our data set is an unbalanced panel data set because the total number of observations is 3,006, while the total number of firms is 2,318. In the bottom row of Table 4, we present the likelihood ratio test statistics, where the variance of the individual effects is zero, and they reject the null hypotheses and support the random effects probit model.

The coefficients of the value-added ratio are positive and significant, as predicted. The results are consistent with the theoretical prediction that granting input control to a local manager is optimal when the role of the affiliate is important to the value of the relationship. The marginal effect of the value-added ratio on the predicted probabilities is 0.003, meaning that the probability of choosing a local manager

Table 4 Results of the models on the purchasing manager

Dependent variable: *pm*, the nationality dummy of person in charge of input control (Japan = 0; Local = 1)	[1]		[2]		[3]	
Additional instruments	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
va	0.009	0.003	0.008	0.003	0.008	0.003
	[0.002]**		[0.002]**		[0.002]**	
aRD	0.068	0.024	0.063	0.022	0.062	0.022
	[0.025]**		[0.025]*		[0.025]*	
age	0.018	0.007	0.019	0.007	0.02	0.007
	[0.004]**		[0.004]**		[0.004]**	
asize	−0.018	−0.006	−0.018	−0.006	−0.018	−0.006
	[0.004]**		[0.004]**		[0.004]**	
local	0.002	0.001	0.003	0.001	0.003	0.001
	[0.001]*		[0.001]**		[0.001]**	
asize	−0.012	−0.004	−0.012	−0.004	−0.012	−0.004
	[0.002]**		[0.002]**		[0.002]**	
psize	−0.001	0.000	−0.001	0.000	−0.001	0.000
	[0.000]*		[0.000]*		[0.000]*	
KL	−0.004	−0.001	−0.003	−0.001	−0.003	−0.001
	[0.001]**		[0.001]**		[0.001]**	
pRD	0.025	0.009	0.008	0.003	0.005	0.002
	[0.011]*		[0.012]		[0.012]	
agg1	0.001	0.000	0.01	0.003	0.007	0.002
	[0.009]		[0.009]		[0.009]	
agg2	−0.001	0.000	−0.002	−0.001	−0.002	−0.001
	[0.001]		[0.001]*		[0.001]	
unsw	0.127	0.045	0.125	0.044	0.067	0.024
	[0.054]*		[0.054]*		[0.063]	
sw	0.276	0.098	0.267	0.094	0.179	0.063
	[0.074]**		[0.074]**		[0.087]*	
dist	0.001	0.000	0.001	0.000	−0.007	−0.003
	[0.001]		[0.001]		[0.002]**	
rule	−0.143	−0.051	−0.153	−0.054	−0.123	−0.043
	[0.070]*		[0.071]*		[0.073]	
Year dummy (1998)	−0.064	−0.023	−0.06	−0.021	−0.031	−0.011
	[0.112]		[0.113]		[0.115]	
Year dummy (2001)	0.088	0.031	0.093	0.033	0.12	0.042
	[0.114]		[0.115]		[0.117]	
Industry dummy	No		Yes		Yes	
Regional dummy	No		No		Yes	
Constant	0.963		0.999		1.257	
	[0.270]**		[0.291]**		[0.305]**	

(continued)

Table 4 (continued)

Dependent variable: *pm*, the nationality dummy of person in charge of input control (Japan = 0; Local = 1)	[1]		[2]		[3]	
Additional instruments	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
# of observation	3,006		3006		3006	
# of firms	2,318		2318		2318	
Log likelihood	−1,786.5		−1743.9		−1733.3	
Likelihood ratio test statistics for ρ=0	chibar2(01) = 36.79 Prob ≥ chibar2 = 0.000		chibar2(01) = 28.85 Prob ≥ chibar2 = 0.000		chibar2(01) = 26.75 Prob ≥ chibar2 = 0.000	

Note: Standard errors in parenthesis
*Significance at the 5 % levels; **significance at the1 % levels

increases 3 % when the percentage of the value-added ratio increases by 10 points. Although it was predicted that investment specificity is negatively related to granting control over input purchases to a local manager, the estimated coefficient for the R&D intensity of the affiliated firm that is used as a proxy for investment specificity is both positive and significant, which is contrary to expectations. The calculated marginal effect is 0.022, so the probability of choosing a local manager increases 2.2 % when the percentage of R&D intensity increases by 1 point. At the same time, the affiliate's experience in the host country is also positively correlated with choosing a local manager.

The coefficients of both the affiliate and parent firm size variables are negatively significant. The capital–labor ratio of the parent firm has a negative effect on the probability of choosing a local manager. However, the effects of these firm characteristics are quite marginal, considering the magnitude of the unit. The two variables indicating the agglomeration of Japanese firms in the host county are not significantly different from zero. The effects of both skilled and unskilled workers are positive. The correlations in terms of the rule of law and distance are not clear. When all dummy variables are introduced, the Rule of Law Index is not correlated with who has control over purchasing inputs, while the distance to the host country is negatively correlated with who has control, as expected.

4.2 Results of the Estimations on Intra-Firm Trade

In the second step, we estimate the random effects 2SLS, using the fitted probabilities obtained from a probit estimation as an IV. The results are displayed in Table 5. To clarify the difference between the cases, where the purchasingmanagerdummy is

Table 5 Results of estimations for the intra-firm trade ratio

Dependent variables: m, intra-firm imports from Japan/total purchase (%)	(1) OLS	(2) 2SLS	(3) G2SLS random effects IV regression	(4) OLS	(5) 2SLS	(6) G2SLS random effects IV regression	(7) OLS	(8) 2SLS	(9) G2SLS random effects IV regression
pm	−2.419	−24.02	−22.394	−2.469	−26.725	−22.875	−2.856	−24.009	−21.473
	[1.285]	[7.853]**	[9.129]*	[1.237]*	[8.594]**	[9.441]*	[1.238]*	[8.478]**	[9.421]*
asize	−0.311	−0.405	−0.398	−0.365	−0.47	−0.453	−0.365	−0.453	−0.442
	[0.070]**	[0.081]**	[0.083]**	[0.071]**	[0.082]**	[0.083]**	[0.070]**	[0.080]**	[0.082]**
local	0.006	0.022	0.021	−0.011	0.012	0.009	−0.021	−0.003	−0.005
	[0.017]	[0.019]	[0.019]	[0.018]	[0.020]	[0.020]	[0.018]	[0.020]	[0.020]
share	0.219	0.14	0.146	0.197	0.11	0.124	0.19	0.113	0.122
	[0.025]**	[0.039]**	[0.042]**	[0.025]**	[0.041]**	[0.043]**	[0.025]**	[0.041]**	[0.043]**
psize	0.011	0.006	0.006	0.012	0.006	0.007	0.013	0.009	0.009
	[0.006]	[0.007]	[0.007]	[0.006]	[0.007]	[0.007]	[0.006]*	[0.007]	[0.007]
KL	−0.025	−0.054	−0.052	0.009	−0.018	−0.014	0.01	−0.013	−0.011
	[0.019]	[0.022]*	[0.023]*	[0.020]	[0.023]	[0.023]	[0.020]	[0.023]	[0.023]
pRD	0.977	1.139	1.127	0.55	0.629	0.615	0.507	0.553	0.547
	[0.186]**	[0.210]**	[0.211]**	[0.216]*	[0.220]**	[0.216]**	[0.217]*	[0.216]*	[0.214]*
agg1	−0.402	−0.438	−0.435	−0.392	−0.367	−0.371	−0.474	−0.466	−0.467
	[0.157]*	[0.165]**	[0.164]**	[0.154]*	[0.172]*	[0.168]*	[0.156]**	[0.170]**	[0.168]**
agg2	0.053	0.045	0.046	0.039	0.023	0.025	0.019	0.005	0.007
	[0.012]**	[0.013]**	[0.013]**	[0.015]*	[0.017]	[0.017]	[0.018]	[0.019]	[0.019]
unsw	0.097	0.872	0.814	0.441	1.258	1.133	−0.697	−0.126	−0.189
	[0.970]	[1.048]	[1.055]	[0.903]	[1.034]	[1.024]	[1.080]	[1.164]	[1.156]
sw	3.208	4.854	4.731	4.071	5.79	5.519	1.396	2.586	2.447
	[1.334]*	[1.494]**	[1.527]**	[1.284]**	[1.484]**	[1.487]**	[1.486]	[1.657]	[1.655]

dist	−0.112	−0.106	−0.106	−0.101	−0.09	−0.092	−0.238	−0.277	−0.273
	[0.022]**	[0.023]**	[0.023]**	[0.021]**	[0.024]**	[0.023]**	[0.040]**	[0.046]**	[0.046]**
rule	−5.972	−6.411	−6.378	−6.889	−7.373	−7.288	−6.469	−6.672	−6.639
	[1.233]**	[1.310]**	[1.304]**	[1.195]**	[1.296]**	[1.275]**	[1.267]**	[1.325]**	[1.310]**
Year dummy (1998)	−3.494	−3.254	−3.272	−4.921	−4.665	−4.702	−3.897	−3.584	−3.62
	[2.131]	[2.217]	[2.203]	[2.062]*	[2.182]*	[2.142]*	[2.093]	[2.185]	[2.161]
Year dummy (2001)	−7.11	−5.878	−5.971	−7.747	−6.377	−6.583	−6.813	−5.523	−5.668
	[2.148]**	[2.270]**	[2.271]**	[2.077]**	[2.255]**	[2.225]**	[2.112]**	[2.258]*	[2.247]*
Industry dummy	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Regional dummy	No	No	No	No	No	No	Yes	Yes	Yes
Constant	42.194	60.865	59.46	50.826	71.528	68.226	57.476	76.974	74.625
	[4.841]**	[8.346]**	[9.248]**	[5.098]**	[8.983]**	[9.533]**	[5.407]**	[9.502]**	[10.200]**
# of observations	3,006	3,006	3,006	3,006	3,006	3,006	3,006	3,001	3,006
# of firms			2,318			2,318			2,318
R2	0.07			0.15	0.04		0.16	0.07	
p-value of exogeneity test		0.003			0.002			0.008	

Notes: Standard errors in parenthesis
*Significance at the 5 % levels; **significance at the 1 % levels

treated exogenously and the firm-specific attributes are not controlled, the results of the pooled OLS without IV regression and the pooled 2SLS are also displayed.

The purchasing manager dummy is not correlated with the ratio of intra-firm procurement in the OLS without industry dummies; however, there is a negative correlation with significance at the 5 % level in the models that include the industry dummies. Interestingly, the estimator is changed drastically by the IV regression. As shown in columns (2) and (3), the coefficient of the purchasing manager dummy becomes strongly significant and negative. The results do not change, even if the industry and region dummy variables are added into the estimated equation, as displayed in columns (5), (6), (8), and (9). The Durbin–Wu–Hausman tests of exogeneity of the purchasing manager dummy variable in the 2SLS model reject the null hypothesis of no endogeneity. The coefficient estimated by G2SLS is −22. This result suggests that the delegation of decision rights to local managers for purchasing inputs lowers the ratio of the intra-firm procurement of the affiliate firm from its parent firm by at least 22 percentage points. This effect is large compared to the effects of other factors.

As a proxy for factor prices in the host country, two variables—the wages of unskilled and skilled workers—are included in the model. It was predicted that the vertical fragmentation of production is common among countries with unskilled workers and low wages, and that the coefficients of *unsw* and *sw* are negative and positive, respectively. Although the former variable is not significant, the latter variable is strongly and positively significant in the models without region dummy variables. After controlling for region-specific factors, the significance disappears. As expected, the coefficient of the distance variable is strongly significant and negative, indicating that the greater the transportation cost, the lower the intra-firm trade.

Another issue is how the Rule of Law Index, as a proxy for contractibility in a host country, influences intra-firm transactions. Since a high score reflects that the costs of a lawsuit are low, it is expected that the Rule of Law Index is negatively related to the intra-firm procurement ratio. The coefficient of *rule* is negative and significant, as predicted. If we rely on the results of the G2SLS random effects IV regression model, the marginal effect of *rule* is computed as −6 to −7. This indicates that a one-score increase in the Rule of Law Index decreases the ratio of intra-firm procurement by 6–7 percentage points.

Table 5 also shows the results of other firm- and country-specific factors. With regard to firm size, parent firm size and intra-firm procurement seem to be almost unrelated, while affiliate firm size is negatively related to the procurement ratio from the parent firm. The estimated equation also includes the ownership share to control for the commitment level of the parent firm. As expected, ownership share is positively correlated with intra-firm procurement.[4] The local sales ratio and

[4]Although one might expect that the estimated result may be affected by the threshold of ownership share, the result did not change, even if the estimated sample was restricted to majority-owned firms.

the parent firm's capital–labor ratio show a positive and negative sign, respectively, while the significance disappears after controlling for the industry-specific factors. The coefficient of the parent firm's R&D intensity is found to be significantly positive for the procurement ratio, even after controlling for the industry and region dummies. This result suggests that vertical fragmentation is more common among R&D-intensive firms in the home country. The number of affiliate firms invested by the same parent firm in the host country was found to decrease the level of procurement from the parent firm. On the other hand, the total number of Japanese-affiliated firms seems to be positively correlated with procurement from the parent firm, while the statistical significance is not observed in the model that includes the industry dummies. One possible explanation for these results is that the input procurement from the parent firms is likely to be replaced by other affiliates in the host country, while a vertical fragmentation of production processes is concentrated in countries where there is a concentration of Japanese MNEs.

5 Concluding Remarks

The issue of growth and its variations of the intra-firm trade of intermediate inputs are of great interest in international economics. This chapter examines the determinants of intra-firm trade by shedding light not only on factor prices and trade costs but also on organizational structure in terms of the ownership of overseas plants and the control over intermediate inputs for further processing. Our empirical analysis uses micro data at the affiliate-firm level. Since organizational structure and intra-firm trade are jointly determined, we adopt an IV regression and treat the choice of purchasing manager as an endogenous variable. To the best of our knowledge, our empirical analysis is the first to control for organizational structure to explain intra-firm trade.

We implement a two-step procedure related to the empirical analysis proposed by Wooldridge (2002). First, we estimate a random effects probit model on the choice of purchasing manager, using a set of regressors in the equation to explain the intra-firm procurement ratio and additional instruments. Second, we estimate the equation for intra-firm trade by a random effects IV regression, using the fitted probabilities gained from the first step as an IV. In the results of the random effects probit model, the control over input decisions is positively correlated with the value-added ratio of affiliated firms. This finding is consistent with Feenstra and Hanson (2005), who demonstrate that disaggregated ownership and control over inputs makes sense when it is optimal to gain investment incentives for both features. Using Chinese data, they find that foreign factory ownership and local input control are more common in high value-added industries. The results of the random effects IV regression on intra-firm trade clearly indicate that granting control rights over input purchases to local managers has a large impact on the procurement of intermediate inputs from Japan, after controlling for endogeneity. This chapter contributes to the literature by suggesting that the control over input decisions critically affects the intra-firm trade of intermediate inputs. We also take into account differences

in country-specific institutional qualities. Introduction of the Rule of Law Index variable is another unique feature of our estimations.

This discussion is also closely related to policy issues in developing countries. As highlighted by Javorcik (2004), local procurement by MNE's is one of the channels of technology spillover from the MNEs. Therefore, host governments in developing countries wish to increase local procurement rather than intra-firm trade. From this perspective, several important policy implications for countries seeking to efficiently increase procurements from local firms can be obtained from our analysis. First, countries have to improve their institutional quality. Since intra-firm procurement is increasing in countries constituting poor performance of institutional factors, the improvement of legal institutions is a crucial factor for boosting the purchase of local inputs by the MNEs. Second, policymakers should provide an FDI-friendly environment where MNEs' affiliates can operate for a long period of time. This is because the delegation of decision rights to local residents and the subsequent increase in local procurement is time consuming.

Appendix: Data Description

This chapter uses the SOBA micro database, which is a firm-level survey by the Research and Statistics Department, Ministry of Economy, Trade and Industry, in the Government of Japan. This survey obtains basic information on the activities of the overseas affiliates of Japanese firms. The parent companies constitute Japanese corporations, which own or have owned overseas affiliates in the past, as of the end of March (excluding companies in the finance and insurance industry and the real estate industry). The survey includes various items on affiliate characteristics, such as the first year of establishment, the breakdown of sales and purchases, employment, costs, and R&D.

Furthermore, to control for parent firm characteristics, we link the affiliate survey, SOBA, with the firm-level survey, *Kigyo Katsudo Kihon Chosa* (Basic Survey of Japanese Business Activities and Structures; hereafter, BSJBSA) by Japan's Ministry of Economy, Trade, and Industry. This survey was first conducted in 1991 and then conducted annually after the 1994 survey. This survey covered all firms with more than 50 employees and capitalization of at least 30 million yen in mining, manufacturing, wholesale and retail trade, and some service sectors.

We omitted the manufacturing affiliates whose primary activities were not regarded as "production" from our sample. Since SOBA does not request a breakdown of shipments, the industry classifications are not always reliable. In fact, there are many affiliates who belong to the manufacturing sector, but they have an extremely low value-added ratio. Probably, these affiliates mainly engage in wholesale activities, but they report their industry classification as the manufacturing sector. Fortunately, the survey includes qualitative inquiries about their current and future primary activities, such as "production," "research and development," "wholesale," and "retail." We restrict our sample to the affiliates belonging to the manufacturing sector and report their current primary activities as "production."

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