FDI, Offshore Sourcing and Firm Heterogeneity : Perspectives of New Empirical Challenges*

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Abstract

Traditional trade theory and intra-industry trade theory do not sufficiently explain the recent increase of FDI and intra-industry trade between developed and developing countries. As it is not countries but firms that actually engage in trade and FDI, recent theoretical development of trade and FDI emphasizes that firm-level analysis is essential to explaining the recent growth in trade and FDI, and provides a new theoretical perspective of international trade and FDI with firm heterogeneity. This paper is purposed to review new theoretical and empirical challenges to recent international trade and FDI.

JEL Classification: F10, F14, F20

Keywords: firm heterogeneity, VFDI, HFDI, offshoring, productivity, institutional factors

1. Introduction

Over the period from 1970 though the mid 1980s, worldwide GDP, exports, and foreign direct investment (FDI) increased by 3.1 percent, 5.2 percent, and 4.2 percent per year respectively, and over the period from the mid 1980s through the end of 20th century these grew by 2.5 percent, 5.6 percent, and 17.7 percent, respectively. This increase in trade and FDI reveals the stylized facts: (1) Growth in exports exceeds more proportionately than the growth of the economy, and growth in FDI greatly exceeds growth in exports, (2) FDI occurs not just from developed countries but from developing countries as well, and (3) FDI is engaged in by a small number of large-sized multinational firms with high levels of productivity. Traditional international trade theory is based on the differences in technology between countries (Ricardian model) or in their relative abundance of production

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factors (Heckscher-Ohlin model) as a reason of international trade. In fact, there is no doubt that in the trade situation of today as well a part of the increase in international trade can be explained by "traditional trade theory." In addition to the traditional trade theory, trade in manufactured goods between developed countries, which has increased since the 1970s, is analyzed by "intra-industry trade theory," based on economies of scale in production and consumer's preference of love of variety. However, it seems that traditional trade theory and intra-industry trade theory do not sufficiently explain the rapid increase of FDI and intra-industry trade of parts/components or intermediate goods between developed and developing countries in recent years.

The analysis of traditional theory of international trade and intra-industry trade theory has focused countries, industries, and goods - but not firms. Certainly it is not countries but firms that actually engage in trade and FDI. For this reason, a recent theoretical development of trade emphasizes that firm-level analysis is essential to explaining the recent growth in trade and FDI, and is providing a new theoretical perspective incorporating the heterogeneity of firm into theories of international trade and FDI. We find a number of empirical analyses of the relation between firm heterogeneity and international trade and FDI as well as theoretical development. The purpose of this paper is to review new theoretical and empirical perspectives of recent international trade and FDI.

2 FDI and Firm-specific Factors

Firm-specific factors were examined in empirical analysis of FDI. Horst (1972) focused on firm size and R&D as firm-specific factors determining FDI, and Grubaugh (1987) focused on intangible assets such as advertising and R&D and on product diversification of firms, showing that these had positive effects on FDI. However, such empirical analyses were not necessarily based on theoretical foundations before the time when Markusen (1984) and Helpman (1984) gave theoretical foundation to empirical analysis of FDI. Markusen focused FDI among developed countries and presented that FDI is drawn to locations with good market access, where sales are large enough to cover the fixed costs, in industries where final goods have high transportation /trade costs. This type of FDI is classified as horizontal FDI (HFDI) which substitutes the international trade of commodities between developed countries.

On the other hand, Helpman's analysis of FDI showed that the division of production processes corresponding to the difference in factor prices caused FDI between developed and developing countries with a large difference in relative abundance of production factors. Helpman's model provided a framework for explaining trade in parts and intermediate goods by multinational firms having production facilities in both developed and developing countries. Helpman's model, classified as vertical FDI (VFDI), presented that trade in goods and FDI are complementary. In the presence of factor price difference across countries, a firm may find it optimal to fragment the production process into different stages in different countries, with trade of parts and intermediate goods between different production stages.

These two theories have provided theoretical foundations for empirical studies on the determinants of different

types of FDI. They have led to the following conclusions by using exports as a benchmark: (i) increases in trade costs have a positive effect on HFDI and a negative effect on VFDI, (ii) growth in market size has a positive effect on HFDI, (iii) difference in factor prices has a positive effect on VFDI, (iv) plant-level economies of scale have a positive effect on HFDI, and (v) firm-level economies of scale have positive effects on both HFDI and VFDI.

Brainard (1997), under the hypotheses that FDI was conducted for achieving proximity to locations of demand and exports were conducted for realizing economies of scale through concentration of production (Proximity-Concentration Hypothesis), identified the effects of firm size on the choice of FDI or export by using U.S. industry-level data. He identified the determinants of the choice of exports or overseas production by estimating the ratio of exports to overseas production under the following equation:

$$Y_{i,m} = c_0 + \alpha_1 F_m + \alpha_2 T_{i,m} + \alpha_3 PSC_{i,m} + \alpha_4 FSC_{i,m} + \varepsilon_{i,m} \quad (1)$$

where i represents industry type, m represents the destination of export or FDI, $Y_{i,m}$ represents the ratio of U.S. firms' exports to country m over the total volume of export and overseas production in industry i , F_m represents transportation costs, $T_{i,m}$ represents the tariff rate, PSC_i represents plant size, and FSC_i represents firm size in industry i . Results of empirical analysis show (i) trade barriers (i.e., transportation costs, tariff rates) and size of firm have a negative effect on export ratio, and (ii) plant size has a positive effect on the export ratio. These results are consistent with the theoretical conjecture of HFDI.

Similar research has been conducted for Japanese firms. Wakasugi (1994) analyzed Japanese FDI in the United States, showing that (i) increases in U.S. wages had a negative effect on FDI and (ii) an increase in number of anti-dumping claims had a positive effect on FDI. These results suggest that Japanese FDI in developed countries has two objectives: reducing production costs and tariff jumping. Furthermore, Wakasugi (2007) tested the Proximity-Concentration Hypothesis using Japanese firm-level data. As summarized in Table 1, the results of empirical analysis evidenced that (i) a higher intensity of R&D of firm (that is, increase in the stock of technological knowledge) has a positive effect on the choice of overseas production and (ii) a larger scale of

Dependent variables: FDI/Export	OLS (1)	OLS (2)	OLS (3)	Random Effects
R&D intensity	0.150* (2.05)	0.158* (2.22)	0.151* (2.06)	0.161** (3.28)
Labor productivity	-0.001* (-2.21)	-0.001 (-1.48)	-0.001* (-2.28)	-0.001 (-1.73)
Number of employees	-0.832** (-5.61)	-0.713** (-3.67)	-0.893** (-5.86)	-0.840** (-3.31)
Constant	8.709** (6.91)			
Industry dummy		yes		
Country dummy			yes	
Number of observations	11155	11155	11155	11155

The figures in parentheses are t-statistics.

*and ** indicate 5% and 1% of statistical significance level, respectively.

Source: Wakasugi (2007)

Table 1 Choice of FDI or export of Japanese firms

domestic production has a positive effect on the choice of export. These results are concordant with Brainard's conclusion that firm size has a positive effect on FDI and plant size a positive effect on exports.

With regard to VFDI, there were not many empirical studies supporting Helpman (1984). Brainard (1997) and Carr *et al* (2001) show that (i) differences in income levels and relative abundance of production factor endowment have negative effects on FDI and (ii) increase of trade costs have positive effects on FDI. However, it must be noted that these results could be due to sample selection bias. If in reality most FDI is of the HFDI type, analysis of VFDI may have been overlooked. Yeaple (2003) showed that, by focusing FDI in the countries with a relatively higher abundance of skilled labor, differences in skilled labor intensity of production had significantly positive effects on FDI. The results of estimation by Yeaple provided empirical evidence supporting Helpman's model for VFDI.

VFDI theory also is supported by empirical analysis of multinational firms' choice of locations for FDI. McFadden (1974) proved that if the error term ε_j in estimation of the profit function of firms ($\pi_j = \beta' X_j$) making FDI to location j is due to the Weibull distribution, the probability that a firm would choose the optimal location for maximizing its profits can be expressed as follows:

$$\Pr(ij) = \frac{\exp\{\beta' X(j)\}}{\sum_{s=1}^N \exp\{\beta' X(s)\}} \quad (2)$$

where $\Pr(ij)$ represents the probability of company i to choose location j and $X(s)$ is the vector of explanatory variables representing the location-specific factors such as wage rate, market growth, infrastructure, and abundance of human resources.

Head *et al* (1995) examined the determinants of location choice in U.S. There are a large number of studies on the determinants of location choice of firms conducting FDI. For Japanese firms, Wakasugi (1997, 2005) conducted empirical analyses of the determinants of location choice for FDI in East Asia and those for FDI in provinces of China, by matching firm-level data with industry- and region-specific factors. Table 2 shows that

	Textile	Chemicals	Iron and nonferrous metal	Machinery	Electric and Electronics	Transportation
Relative wage	−0.001 (−1.175)	−0.002 (−4.192)	−0.001 (−3.837)	−0.002 (−3.663)	−0.002 (−5.274)	−0.001 (−1.563)
GDP growth	0.162 (16.786)	0.086 (7.673)	0.062 (5.818)	0.129 (11.517)	0.095 (11.755)	0.089 (6.220)
Inflation rate	0.020 (2.392)	−0.055 (−5.078)	−0.043 (−4.139)	−0.063 (−5.469)	−0.098 (−10.647)	−0.037 (−2.580)
Infrastructure	−7.622 (−16.433)	−0.135 (−0.323)	−1.123 (−2.625)	−2.364 (−5.564)	−1.554 (−5.005)	−6.807 (−7.693)
Education level	−0.009 (−3.767)	−0.003 (−1.342)	−0.016 (−5.816)	0.006 (2.563)	0.001 (0.289)	0.003 (0.751)
Number of observations	1223	713	720	705	1242	347

The figures in parentheses are t-statistics.

East Asia includes Singapore, Hong Kong, Taiwan, Korea, Malaysia, Thailand, Indonesia, Philippines, China

Source: Wakasugi (1997)

Table 2 Determinants of Location choice of Japanese firms in East Asia

low wages, economic growth, and stable inflation rate were significant factors in location choice for FDI in East Asia. Table 3 shows that not only industry agglomeration and the improvement of infrastructure but also preferential treatment for FDI in special economic zones, abundance of skilled human resources and low wage costs were significant as factors explaining the choice of FDI locations in China.

	Location Choice	
Agglomeration	0.933** (10.495)	0.672** (8.771)
Agglomeration of Japanese firms		0.584** (8.843)
Infrastructure	0.367* (2.891)	0.261* (2.032)
Special economic zone	0.757** (7.741)	0.115 (0.970)
Skilled human capital	0.839** (9.839)	0.225 (1.998)
Wage cost	-0.423** (-3.653)	-0.264* (-2.195)
No. Obs	25675	25675

The figures in parentheses are t-statistics.

* and ** indicate 5% and 1% of statistical significance level, respectively.

Source: Wakasugi (2005)

Table 3 Determinants of Location choice of Japanese firms in China

3 Firm Heterogeneity

Since export and FDI require larger trade costs and fixed costs than domestic production, a firm with high productivity enough to cover these additional costs can conduct export and FDI. Although this had been theoretically pointed out early by Dei (1991), Helpman, Melitz and Yeaple (2004) drew a specification for empirical test from theoretical model. The model by Helpman *et al* assumes the following relation concerning fixed costs and variable trade costs.

$$f_D < f_X < f_X + T < f_I \quad (3)$$

where f_D represents the fixed costs for domestic supply, f_X represents the fixed costs for exporting, T represents variable costs for trade, and f_I represents the fixed costs for overseas production. It is assumed that these are applied commonly to all firms. On the other hand, the marginal cost of production, reflecting the level of productivity, is assumed to differ between firms.

If we assume there is a disparity in productivity between firms within the same industry, firms are categorized into those that supply goods only domestically, those that export goods, and those that conduct overseas production through FDI, depending on their productivity. Figure 1 with the productivity on the horizontal axis and the profitability on the vertical axis shows the relation between productivity and profitability corresponding to three types: domestic supply, export, and overseas production. A productivity level of firm corresponding to its zero profit is defined as the cutoff point for its entry. A firm with higher productivity than cutoff point

develops production in domestic market to export and from export to overseas production. Firm with lower productivity than the cutoff point A in Figure 1 is obliged to exit the market. Those with higher productivity than the cutoff point A will begin domestic supply in domestic market. While firm with productivity between cutoff points A and B will engage in domestic supply only, firm with productivity between points B and C exports goods. However, since firm with productivity to the left of point C can earn larger profit from export than from overseas production, it will not engage in overseas production. Firm with higher productivity than the cutoff point C tends to produce overseas rather than export. This means the industry with larger dispersion of productivity tends to raise the ratio of overseas production. Under the assumption that dispersion of firm size is thought as a proxy of the dispersion of productivity, we can regard the dispersion of firm size as a proxy for firm heterogeneity. In other words, increased dispersion of firm size leads to a rise of the ratio of overseas production.

Figure 1 Choice of domestic supply, export or FDI under firm heterogeneity

We find a several empirical examinations to support these theoretical hypotheses in Bernard *et al* (2007) and so on. Helpman *et al* (2004) showed, using the data on exports and overseas production by U.S. firms, that the ratio of overseas production to export (i) decreases corresponding to the plant-level economies of scale, (ii) falls with an increase of trade costs, and (iii) increases with an expansion of disparity of productivity. Mayer and Ottaviano (2007), on the basis of firm-level data of European firms, empirically examined the distribution of firms conducting export and FDI along with productivity as well as the decision of export and FDI corresponding to the cutoff points of productivity. As illustrated in Figure 2, they reveal that corresponding to the level of total factor productivity (TFP), firms supplying the domestic market only, exporting firms, and firms conducting overseas production are Pareto distributed with the cumulative distribution function (CDF) of skewness k as follows:

$$F(X) = 1 - \left[\frac{X}{X_m} \right]^{-k}, \quad X \in [X_m, \infty] \quad (4)$$

where X presents the productivity of firm, k the shape parameter of CDF. The firms with a productivity cutoff

between the point A and B supply only in domestic market, the firms between B and C export, and the firms beyond the point C conducts FDI. The number of firms decreases along with a rise of productivity. This indicates that export and FDI are conducted by "Happy Few" firms.

Figure 2 Distribution of domestic firms, exporters and FDI makers under firm heterogeneity

As for Japanese firms, Tomiura (2007) presented an empirical result that firms exporting and conducting FDI tend to be of higher productivity, on the basis of a large size firm-level data. On the other hand, Wakasugi (2007) estimated the ratio of overseas production to exports for Japanese manufacturing firms with 50 or more employees. As shown in Table 1, the rate of overseas production increased with rising concentration of R&D and fell with growth in company size. However, in these results labor productivity had a negative sign, indicating that the range of overseas production did not increase with level of productivity. It suggests that there is room for further empirical investigation of the relation of productivity with trade and overseas production.

4 Offshoring and International Transaction

Mattel Corp sells "Barbie Doll" in the price of \$10 in the United States which is assembled in Indonesia, Malaysia and China with plastic and hair from Taiwan and Japan, and molds and paints from US. It is reported that the exported value of the doll from Hong Kong is \$2, the earnings for Mattel is \$1 and other value added for marketing in US is \$7. This corporate strategy of global outsourcing shows the recent development of expansionary trade in parts and intermediate goods. Feenstra (1998) argues that "looking within MNC's alone does not give full perspective on what is happening." Data of FDI and the local production of subsidiaries underestimate the importance of global sourcing.

The features of outsourcing by firms are not sufficiently dissected. To supplement factual analysis of global sourcing, Ito, Tomiura and Wakasugi (2007) surveyed 5000 Japanese firms with 50 or more employees, concerning outsourcing. As shown in Table 4, the purchase of parts and intermediate goods from overseas

increased from 34 percent in 2001 to 40 percent in 2006. In the global purchases, firms which conduct offshore sourcing with contracts specifying tasks grew 16 percent in 2001 to 21 percent in 2006. As such, one-fifth of Japanese firms are engaged in offshore sourcing even in a narrow sense. This does not seem to be a low level.

		Foreign Purchase	Offshore outsourcing
Total	2001	0.34	0.16
	2006	0.40	0.21
Apparel	2001	0.46	0.34
	2006	0.55	0.39
Machinery	2001	0.38	0.21
	2006	0.49	0.32
Electric and electronics	2001	0.41	0.24
	2006	0.48	0.32
Transportation	2001	0.30	0.17
	2006	0.36	0.23
Precision machinery	2001	0.54	0.21
	2006	0.62	0.27

Source: Ito, Tomiura and Wakasugi (2007)

Table 4 Foreign purchase and offshore sourcing of Japanese firms by industry

Offshore sourcing takes two types of transaction: intra-firm and arm's length transaction. There are many studies on which type of transaction, arm's length or within firms, is chosen for an efficient resource allocation in domestic market. From the view of "transaction cost approach" Coase and Williamson (1985) asserted that the transaction inside firm occurs more likely for saving the transaction cost, (i) if the assets and investments are relation-specific, (ii) if the transaction is uncertain, (iii) if the transaction occurs frequently. From "property-rights approach" Grossman and Hart (1986) revealed that the ownership is a source of power to avoid the inefficient resource allocation when contracts are incomplete.

Applying a property-rights approach to outsourcing, Antràs (2003) provided a new interpretation on whether offshore sourcing is conducted under the intra-firm transaction within MNCs or arm's-length transaction. Antràs drew two facts from offshore sourcing of U.S. firms as follows: (i) the comparison among industries shows that intra-firm importing was conducted in capital-intensive goods such as chemicals, while arm's-length importing was conducted for labor-intensive goods such as textiles; (ii) the comparison among source countries of import shows that intra-firm importing was conducted with capital-abundant countries such as Switzerland, while arm's-length importing was conducted with labor-abundant countries such as Egypt. As argued by Grossman and Hart (1986) and Hart and Moore (1990), the benefits of integration outweigh its costs in capital-intensive industries. According to the trade theory by Helpman and Krugman (1985), capital-abundant countries (i.e. Switzerland) capture a larger share of import in capital-intensive goods.

Antràs (2003) provided empirical evidences in both cases of across-industries and across-countries. His estimation was based on the following equation.

$$S_m^I = \alpha_0 + \alpha_1 \ln \left[\frac{K_m}{L_m} \right] + \alpha_2 \Phi_m + \varepsilon_m \quad (5)$$

where S_m^I represents the share of intra-firm transactions. $\left[\frac{K_m}{L_m} \right]$ represents the capital-labor ratio, Φ_m the vector of other control variables, and ε_m the error term. If m represents industry, the estimation is conducted across industries, while if m represents source country of import, the estimation is conducted across countries. In both cases of estimation, Antràs (2003) showed positive signs of the coefficient, $\alpha_1 > 0$.

However, statistical data for Japanese manufacturing sectors are not concordant with the results of empirical examination of US firms by Antràs (2003). Table 5 shows the ratio of intra-firm transactions at Japanese firms with overseas subsidiaries. The table presents: (1) in comparison across industries, even in the labor-intensive industry such as textile the ratio of intra-firm transactions is high at 47 percent. This level is roughly the same in the capital-intensive industries such as electrical-machinery and transportation-machinery. In addition, the ratio in the chemicals industry is rather low at 32 percent. As such, the hypothesis that the ratio of intra-firm transactions is higher in capital-intensive industries is not confirmed. (2) The ratio of inter-firm transactions did not increase at least over several years. For explaining such features of Japanese MNCs, it can be predicted that intra-firm imports are larger (i) in the industry sectors with a lower degree of standardization and a higher intensity of R&D and capital intensive sectors, (ii) from capital abundant countries, and (iii) in case of larger resources devoted to product development.

	1999	2000	2001	2002	Average
Manufacturing total	0.46	0.35	0.36	0.28	0.36
Textile	0.55	0.41	0.37	0.56	0.47
Chemicals	0.32	0.33	0.28	0.34	0.32
Machinery	0.87	0.59	0.52	0.59	0.63
Electric and electronics	0.58	0.47	0.51	0.21	0.44
Transportation	0.43	0.43	0.47	0.49	0.46
Precision	0.97	0.61	0.67	0.42	0.67

Source: Wakasugi (2007)

Table 5 Ratio of intra-firm import to total import of Japanese firms

Antràs and Helpman (2004) incorporated "intra-industry heterogeneity" of the model by Melitz (2003) in productivity and constructed property-rights model of the multinational firm. They asserted that across industries, the share of intra-firm imports of components is higher in industries with higher productivity dispersion and that the effects of falling transport costs on the relative prevalence of intra-firm trade versus arm's length trade occur. Feenstra and Hanson (2005) revealed that the condition of efficient outsourcing is determined by not only the ownership of outsourcees but also the control on the management of purchasing parts and intermediate goods. The fact that new type of trade through offshoring is affected by firm size, firm ownership structure, business characteristics, and market institutional factors shows a new development of research subject that has not sufficiently been examined in traditional trade theory.

5 Conclusion: Institutional Factors

Antràs (2003) argues that offshore sourcing of sophisticated activities is suited to arm's length transaction in the market of high contractibility, and in-sourcing transaction or no outsourcing in the market of low contractibility. This means that the contractual institution affects the choice of intra-firm or arm's length outsourcing. Antràs and Helpman (2006) asserts that if the improvement of contractual institution affects disproportionately the contractibility, it can reduce the relative prevalence of intra-firm on offshore sourcing. They reveal that better contractual institution raises the prevalence of offshoring.

If the contractibility ensured by transaction in the market is a key factor to determine firm's choice of offshoring, the institutional factor of the market eventually determines trade volume and comparative advantage. It must be noted that comparative advantage of trade is determined not only by the difference in technology, the relative abundance of production factors or the advantage of scale economy, but also by institutional factors in the market. Nunn (2007) presents evidences that market institutional factors have an even larger impact than the relative price of production factors for determining comparative advantage. Outsourcing by firms will not advance in regions with weak protection of intellectual property rights. Also, it is difficult for regions with insufficient standards for ensuring product safety to be chosen as destinations of firms' FDI and outsourcing. For the most part, the relation of international trade with such institutional factors as legal and financial system has not been addressed in the past. Empirical analysis on the relation between institutional factors of the market and international trade will be a new subject.

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