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IDE DISCUSSION PAPER No. 516

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March 2015

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Keywords: multinational firms; foreign direct investment; knowledge-capital model
JEL classification: F21; F23

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Yoko Uchida[*] and Kazuhiko Oyamada[**]

March 11, 2015

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Research on multinational firms' activity has been conducted widely since late 1980s. The literature is differentiated into three types: horizontal FDI, vertical FDI, and three-country FDI, represented by export platform FDI. There are other methods of differentiation of the literature by approach, for example, the pure theory approach represented by Krugman and Melitz and the numerical simulation approach represented by Markusen. This paper surveys Markusen type literature by firm type. There is little literature focused on intermediate goods trade, although intermediate goods trade is considered to be strongly related to the production patterns of MNEs. In this paper, we introduce a model to explicitly treat intermediate goods trade and present simulation analysis for empirical estimation.

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1. Introduction

It is widely recognized that developing economies benefit from the development of vertical production networks because the networks enable them to install an appropriate portion of the production stages through cross-border activities of multinational enterprises (MNE), namely, foreign direct investment (FDI). UNCTAD (2014) reports steady growth of FDI and international production. For example, inward FDI grew 8.9% annually from 1990 to 2013, and the stock of inward FDI in 2013 was 2.3 times larger than in 1990. The share of foreign affiliate sales to world GDP also increased from 21.2% in 1990 to 46.5% in 2013.

There is theoretical research that treats MNEs' overseas activities under a general equilibrium framework[1]. The literature is differentiated into three types by FDI motives: horizontal FDI motivated by the reduction of transportation costs (Markusen (1984)), vertical and export platform FDI motivated by the reduction of production costs (Helpman (1984)), and complex integration motivated by the reduction of both export and production costs (Yeaple (2003b)). These models can explain which type of firm arises when the country size and factor endowment are changed, but they cannot explain the phenomenon that the "productivity of exporting firms are extremely high," that is, firm heterogeneity, as noted by Bernard and Jensen (1999). Melitz (2003) explicitly treats firm heterogeneity in the model and explains factors of firm's export activities. After Melitz (2003), most MNEs research takes into consideration firm heterogeneity. Helpman *et al.* (2004) treat heterogeneous firms in the horizontal model, whereas Grossman *et al.* (2006) consider firm heterogeneity in the complex integration model. Hypotheses derived from the theoretical model of firm heterogeneity were empirically tested by Bernard *et al.* (2007) for the case of the United States and by Wakasugi *et al.* (2008) and Todo (2011) for Japan. The empirical literature shows that the productivity of export firms tends to be high. Recent theoretical and empirical research regarding FDI has been conducted based on firm heterogeneity.

How is "firm heterogeneity" treated in the model? Melitz (2003) adds firm heterogeneity and fixed cost for export in the imperfect competition model developed by Krugman (1980) and examine under which condition a firm's exporting activities are changed. In the model, the level of productivity for each firm is determined endogenously under a certain fixed cost.

[1] Firms that make overseas investment are called multinational firms (MNEs). In this paper, we use the term FDI as synonyms for MNEs.

In addition to a series of work based on pure theory starting from Krugman (1980) and Melitz (2003), and later Helpman *et al.* (2004) and Grossman *et al.* (2006) (hereinafter referred to as Melitz type), Markusen conducted a series of MNEs research that treated more complex situations under weak assumptions by utilizing numerical simulation analysis (hereinafter referred to as Markusen type). Markusen (1984, 2002) analyzes how changes of fixed cost and trade cost impact the production pattern of MNEs under certain levels of productivity. This type of analysis is inextricably associated with Melitz type analysis in which the level of productivity changes under a certain level of fixed cost. Melitz type analysis shows what factor affects firm heterogeneity and is useful for analyzing the impact of trade policy on resource allocation among firms. Markusen type analysis, on the other hand, is more suitable for making policy proposals regarding a certain country/area compared to the Melitz type model because it is designed to characterize countries by differences in factor endowments.

One of the most important industrial policies for developing countries is to set up some parts of the production process through FDI to encourage economic development. Therefore, it is essential for developing countries to develop industrial policy to promote FDI effectively. To do so, it is useful to use both Melitz and Markusen type analyses. Whereas Melitz type research is developed extensively both from theoretical and empirical aspects, Markusen type research has not been extended since Ekholm *et al.* (2007), although there are many possibilities to explain MNEs' behavior by Makusen type. Thus, Markusen type research needs to be conducted both theoretically and empirically to determine whether policy implications derived from the Markusen type model are similar to the Melitz type model. If the result is not similar to the Melitz model, the reason should be identified. In this paper, we survey the existing Markusen type literature by firm type to develop a theoretical model and perform empirical investigation. We conduct simulation analysis for empirical estimation based on Oyamada and Uchida (2011).

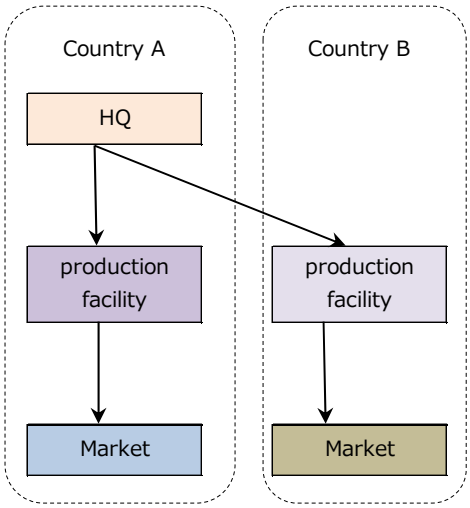
The rest of this paper is organized as follows. Section 2 reviews the Markusen type theoretical and empirical literature. Section 3 presents the simulation analysis based on Oyamada and Uchida (2011). Section 4 provides concluding remarks.

2. Theoretical Models of the Markusen Type

2.1 Horizontal FDI

Horizontal FDI arises when multi-plant firms duplicate roughly the same production processes, except headquarter activities, in multiple countries. Horizontal FDI sets up identical assembly plants and produces the same final goods as the home for host market, maintaining headquarters and assembly plants in the home market. Horizontal FDI is common among developed countries (Markusen (1995)) and its motive is to reduce transportation costs. Figure 1 shows a production structure of horizontal FDI. On the top of the figure, HQ indicates headquarter activity, whereas the assembly plant and market are shown in the middle and bottom of the figure, respectively. The production and sales channel of country A is presented in the left side of the figure and that of country B are shown on the right side of the figure. Figure 1 shows that horizontal FDI maintains all three processes, namely headquarters, production, and sales activities for its domestic market, and it duplicates production and sales activities, except headquarters activity, in host countries.

Figure 1: Image of Horizontal FDI



Markusen (1984) was first to model horizontal MNEs' behavior under a general equilibrium framework. The key idea in this paper is the joint-input assumption for knowledge-capital services, such as headquarter activities, including designing the blueprint and the production procedure, and so forth. Knowledge-capital service is joint-input in that it can be used in multiple locations without reducing the value of the

services in the first location. R&D is a good example of knowledge-capital service. R&D requires a large amount of investment until the asset is created. Once it has been created, the asset can be added to multiple locations with small added costs. On the assumption of joint-input, Markusen (1984) explicitly incorporated fixed cost and trade cost in the model, which assumes two countries (home and foreign), two homogeneous goods (*X* and *Y*), and one factor (labor) and analyzes the factors affecting horizontal FDI. From the results of the analysis, horizontal FDI occurs when countries are similar in size and factor endowments. Horstman and Markusen (1992) and Brainard (1993) differentiate firm specific fixed costs, such as knowledge-capital assets, and plant specific fixed costs and show that horizontal FDI arises in cases where the firm specific fixed cost is important relative to the plant level fixed cost and where trade cost is high. Markusen and Venables (1998, 2000) assumed two countries (home and foreign), two homogeneous goods (*X* and *Y*), and two factors (skilled and unskilled labor). There are two types of firm, domestic and horizontal MNEs. Domestic firms have all three activities in the home country and do not maintain production facilities in foreign countries. *Y* is produced with constant return to scale in a competitive industry, using unskilled labor. *X* is produced with increasing returns to scale and imperfect competition using skilled labor[2]. Markusen and Venables (1998, 2000) solved the model on the Edgeworth box repeatedly and show that horizontal FDI is dominant when countries are similar in size and factor endowment. Additionally, they conducted simulation analysis by changing the trade and fixed costs and showed the increase in FDI when trade and fixed costs are reduced.

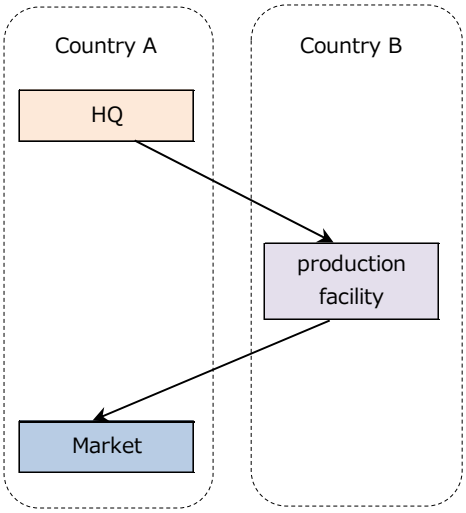
Markusen (1995) provided an extensive survey of FDI and showed that most FDI is horizontal. He also showed that MNEs arise in industries in which production technology is complex, products are new, or the expense of R&D is large relative to sales. Brainard (1997) was first to show empirically that FDI is motivated by market size and similarity in relative endowment, not by differences in factor endowment. She estimated the gravity equation using multinational data from 1989 provided by the Bureau of Economic Analysis (BEA). From the results of the estimation, she showed that FDI has a positive relationship with the trade cost and firm level fixed cost and a negative relationship with the plant level fixed cost. Therefore, FDI occurs by horizontal motives.

[2] Markusen and Venables (1998) assume oligopoly, while Markusen and Venables (2000) assumes monopolistic competition.

2.2 Vertical FDI

Vertical FDI subdivides production processes geographically and has production patterns in which the capital intensive stage of production occurs in the home country, whereas the labor intensive stage of production is located in host where unskilled labor is abundant. Figure 2 shows that vertical FDI has headquarters and markets in the home country but assembly plants in the host country where labor cost is relatively cheap and production of goods is low cost. Vertical FDI occurs mostly between developed and developing countries.

Figure 2: Image of Vertical FDI



At the same time that Markusen's horizontal FDI model was presented, Helpman (1984) presented the vertical FDI model under general equilibrium theory. Helpman (1984) incorporated vertical FDI into a standard model of international trade in differentiated products and showed that vertical FDI occurs when relative factor endowment differs substantially between two countries[3]. Research on vertical FDI has been given little attention because horizontal FDI among developed countries has achieved an overwhelming share of total FDI, whereas vertical FDI between developed and developing countries has accounted for a small share of total FDI (Markusen (2002)). Zhang and Markusen (1999) focused attention on the small amount of FDI

[3] Helpman (1984) assume no trade cost; consequently, FDI does not occur among countries that have similar factor endowment.

inflow to developing countries and constructed model to explain those circumstances. The model assumes two countries (home and foreign), two homogeneous goods (*X* and *Y*), one intermediate good (*Z*), and two factors (skilled and unskilled labor). Two firm types exist, such as domestic and vertical MNEs. Good *Y* is produced with skilled and unskilled labor under constant returns to scale. Good *X* is produced with increasing returns to scale and imperfect competition. The key idea of this paper is that good *X* is produced in two stages. In the first stage, intermediate good *Z* is produced with skilled labor. In the second stage, final good *X* is assembled by combining intermediate good *Z* and unskilled labor. Based on the simulation analysis, the model predicts that vertical FDI occurs when countries are similar in size and the difference in relative endowment is large, but it does not occur when counties are small and the difference in factor endowment is extremely large. In the case where trade cost is small and a scale economy does not exist, vertical FDI cannot be explained by country size. Yeaple (2003a) showed that the reason previous empirical studies supported horizontal FDI is because they utilize aggregation data. He regards the assumption from Helpman (1984) as "FDI from factor intensive industry goes to the country where said factor is abundant," not "FDI occurs when relative factor endowment is different." Under these assumptions, Yeaple (2003a) estimated the gravity equation using 1994 US multinational data and showed that FDI from labor intensive industries goes to the countries where labor is abundant. Hanson, Mataloni, and Slaugther (2005) analyzed determinants of intermediate trade between headquarters and foreign affiliates using the same data as Yeaple (2003a). Previous empirical literature shows that FDI occurs vigorously if trade cost is high, whereas Hanson, Mataloni, and Slaugther found the opposite outcome, that is, FDI is reduced if trade cost is high. This means that vertical motives have greater effect on the U.S. FDI than horizontal motives.

2.3 The Knowledge-Capital Model

Horizontal and vertical FDI were treated individually until the knowledge-capital model was developed by Markusen (2002). The knowledge-capital model allows for both vertical and horizontal FDI to emerge endogenously under a general equilibrium framework.

There are three assumptions in the knowledge-capital model. The first assumption is that the location of knowledge-capital assets can be geographically fragmented from production facilities (fragmentation). The second assumption is that

knowledge-capital assets are skilled labor intensive compared to production (skill-intensity). The last assumption is that knowledge-capital assets can be supplied by multiple locations at the same time (joint-input). The additional costs of setting up a second plant are relatively small compared to the cost of establishing a new firm with headquarters and production facilities. Vertical FDI is motivated by the first two assumptions and horizontal FDI by the last assumption. The first and the last assumption are different. The first assumption addresses management activities, which are provided by skilled labor, whereas the third assumption addresses blueprints, which can be shared among production facilities without reduction of value.

In Markusen (1997, 2002), there are two countries (home and foreign), which produce two homogeneous goods (*Y* and *X*), using two factors (skilled and unskilled labor) in the model. Good *Y* is unskilled labor intensive and is produced with constant return to scale in a competitive industry. Good *X* is skilled labor intensive and is produced with increasing returns to scale under imperfect competition. There is free entry and exit. Firm level scale economy and plant level scale economy exist. Three firm types also exist: domestic, horizontal and vertical.

Markusen (1997, 2002) conducted numerical simulation analysis by altering the relative factor endowment, market size, trade and fixed cost to examine which firm type arises as a function of the country's characteristics. The simulation results reveal that horizontal FDI is dominant if trade cost is moderately high and the economies are similar in size. The results also show that vertical FDI is dominant when the relative factor endowments are different, the country is relatively small and skilled labor is abundant. Bergstrand and Egger (2007) extended the knowledge-capital model to include a third country and a third international mobile factor, physical capital, in addition to skilled and unskilled labor. In the model, they showed that trade and horizontal FDI can coexist in identical countries.

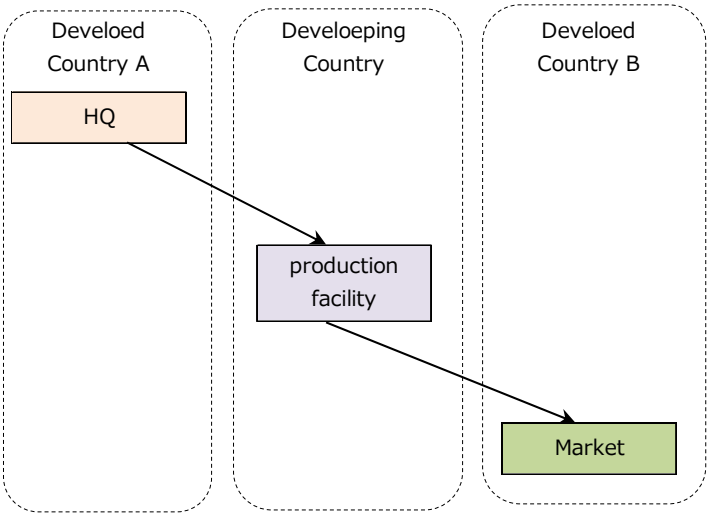
Empirical studies of the knowledge-capital model were conducted by several authors, but the results are mixed. Some studies support the knowledge-capital model, whereas others support the horizontal model. Few studies support the vertical model. Carr *et al.* (2001) predicted that the volume of affiliate sales between countries is a function of a country's characteristics, namely the market size of the home and foreign country, differences in relative factor endowment, and trade and investment costs, based on the hypothesis derived from the simulation analysis of Marksuen (1997). The key variable for estimation is the skill difference variable. They defined skill difference as the share of skilled labor to total labor in the home country minus that in the host

country. Using panel data on the sales of foreign affiliates of U.S. parent firms and on sales of U.S. affiliates of foreign parent firms over the period 1986-1994 provided by the U.S. Department of Commerce. Carr *et al.* (2001) found evidence to support for the knowledge-capital model, demonstrating that affiliate sales increase when the skill difference and market size of both countries are large and decrease when the size of the countries is different. Bloningen *et al.* (2003) used the same data as Carr *et al.* (2001), but they utilized the absolute value of the skill difference variable of Carr *et al*. (2001). Estimation results showed that skill difference is negatively correlated with affiliation sales, which is in favor of horizontal motives. In response to Bloningen *et al.* (2003), Carr *et al.* (2003) argued that estimating the absolute skill difference makes no sense from a theoretical point of view. They claim that the estimation can be interpreted as a test of the choice between horizontal and vertical FDI, but the estimation model is not based on the knowledge-capital model. Markusen and Maskus (2002) compared the knowledge-capital model to the horizontal and vertical models, and the results showed that the horizontal and knowledge-capital models better explain the data than the vertical model. Branconier *et al.* (2005) enlarged the data set to include small and skilled labor abundant countries. The result strongly supports the knowledge-capital model. Tanaka (2011) used U.S. and Japanese data and found that the knowledge-capital model is supported in the pooled sample. However, once each country's data were separately estimated, the data for U.S. supported the horizontal model, and the data for Japan was in favor of the vertical model.

2.4 The Three-Region Model: Export-Platform FDI and Complex Integration

The models we have introduced so far cannot explain the case where final goods are produced in an export processing zone and then exported to a third country, which is called export-platform FDI. Export-platform FDI has a production pattern in which production process are geographically fragmented into three stages according to the factor intensity, and each stage is located in an appropriate country (figure 4). In particular, the headquarters function is in the home country, the production facility is in the host country where unskilled labor is abundant and tax benefits are captured, and final goods are exported to a third country from the host country. Export-platform FDI can be regarded as an extension of vertical FDI from a two-region to a three-region model.

Figure 4: Image of export-platform FDI



Japanese MNEs' affiliates in Singapore export 75.7 percent of their production, of which 60.5 percent went to the third market and 15.2 percent went to Japan in 2005 (RIETI FDI database 2010). As is evident from the data, MNEs' activity cannot be explained by a two-region framework. Ekholm *et al.* (2007) developed a three country model to explain MNEs' export-platform behavior under a partial equilibrium framework. They assumed three countries (two developed and one developing), two final goods (*X* and *Y*), one intermediate good (*Z*), and one factor (*L*). Good *Y* is produced with constant returns to scale. Good *X* is produced with increasing returns to scale under imperfect competition, and one unit of *Z* is required to produce one unit of *X*. There is a fixed cost for the first plant and for subsequent plants. There are trade costs for *X* and *Z*. Under these assumptions, Ekholm *et al.* (2007) analyzed the conditions under which export-platform FDI arises by changing the trade cost and cost advantage for developing countries. Ekholm *et al.* (2007) divided export-platform FDI into three types, (A) home-country export platform, in which final goods are exported back to the parent, (B) third-country export-platform, in which final goods are exported to a third country, and (C) global export-platform, in which final goods are exported to both the home and third country (figure 5).

The outcome of the theoretical analysis is that when a developed country and a developing country set up a free trade area, the firms inside the area choose a home or global export-platform. The firms outside the area choose a third-country

export-platform. As explained in a previous subsection, Bergstrand and Egger (2007) constructed a three-region model, extending the knowledge-capital model. Yeaple (2003b) presented a complex integration strategy, in which a firm locates production facilities in a developing country to reduce production costs and in a developed country to reduce of transportation costs. Production facilities in developing and developed countries only serve the host market (figure 6). Assuming three countries (two identical developed countries and one developing country), two goods, and two factors, Yeaple (2003b) examined which of the three strategies MNEs adopt according to trade cost and relative wage differences. He (2003b) showed that the conditions for vertical FDI is a relative wage in the developed country that is not very high and moderate trade cost. The conditions for horizontal FDI are low relative wage in the developed country and high trade cost, whereas the conditions for complex integration are high relative wages in the developed country and high trade costs.

Figure 5: Three types of export-platform in Ekholm *et al.* (2007)

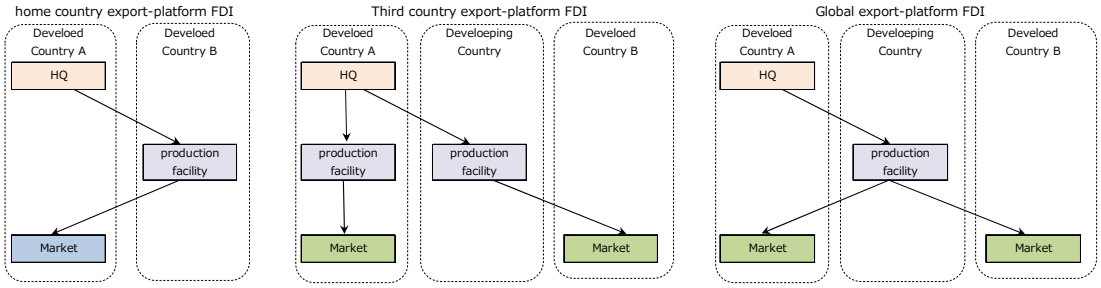
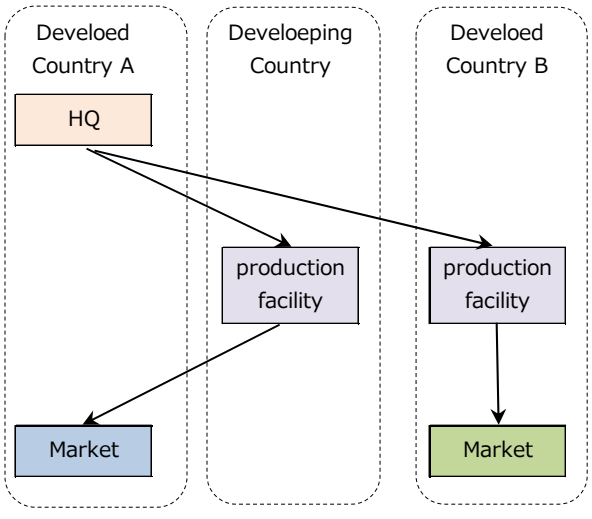


Figure 6: Complex Integration



Utilizing the data on U.S. MNEs during the period from 1984 to 2003 provided by BEA, the empirical part of Ekholm *et al.* (2007) showed that foreign affiliates of U.S. MNEs in North America concentrate on the home-country export-platform, whereas MNEs in Europe concentrate on the third-country export-platform. Blonigen *et al.* (2007) considered the third country effect of U.S. outbound FDI from 1983 to 1998 on the choice of FDI in a special log likelihood setting. They used the proximate market potential (size of the surrounding market) as a key variable for estimation and found a negative relationship between FDI and the proximate market. Similarly, Baltagi *et al.* (2007) estimated the third country effect using the trade cost as a spatial weight and the U.S. outbound FDI stock data from 1989 to 1999. Their evidence supports the importance of third-country effects.

2.5 Summary of the Survey

MNEs research has been conducted since the late 1980s, and the main research topic has been shifted from horizontal to vertical, reflecting the trend of the world FDI. Recently, some research has investigated the third country in the model, taking into consideration the fact that a considerable portion of affiliate sales go to the third country. Thus, MNEs research has developed to match the actual situation.

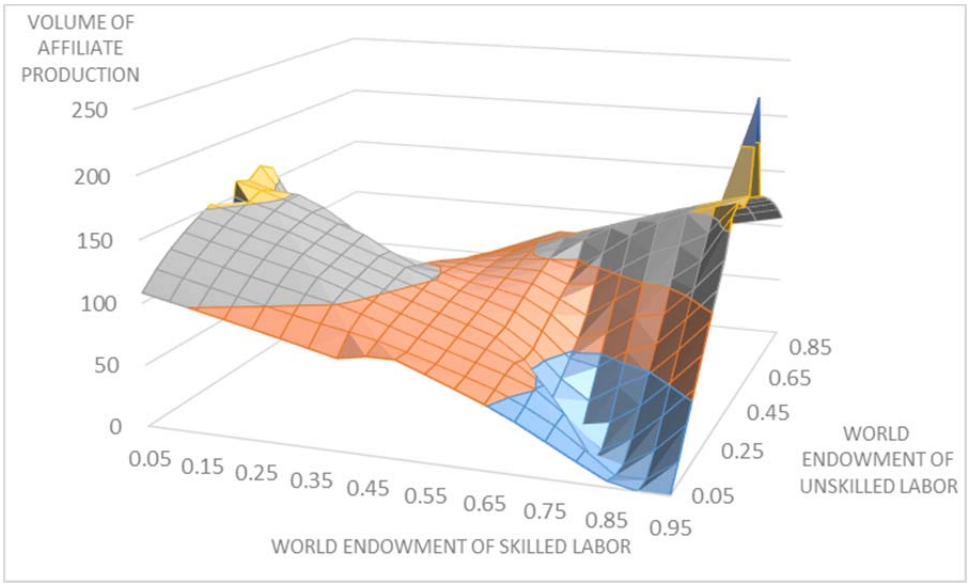
Theoretical models examine the conditions under which each type of firm is active and derive the following hypotheses: (A) horizontal MNEs are active when countries are similar in size and trade costs are high and (B) vertical MNEs are active when countries differ in relative factor endowment and one country is small. Based on these hypotheses, empirical studies have been conducted. The key variable for estimation is the skill difference variable. It has been discussed how this variable should be defined and what type of data should be used. These are important issues because different outcomes might result depending on the choice of the variable. The results from empirical estimation support the hypotheses derived from the theory.

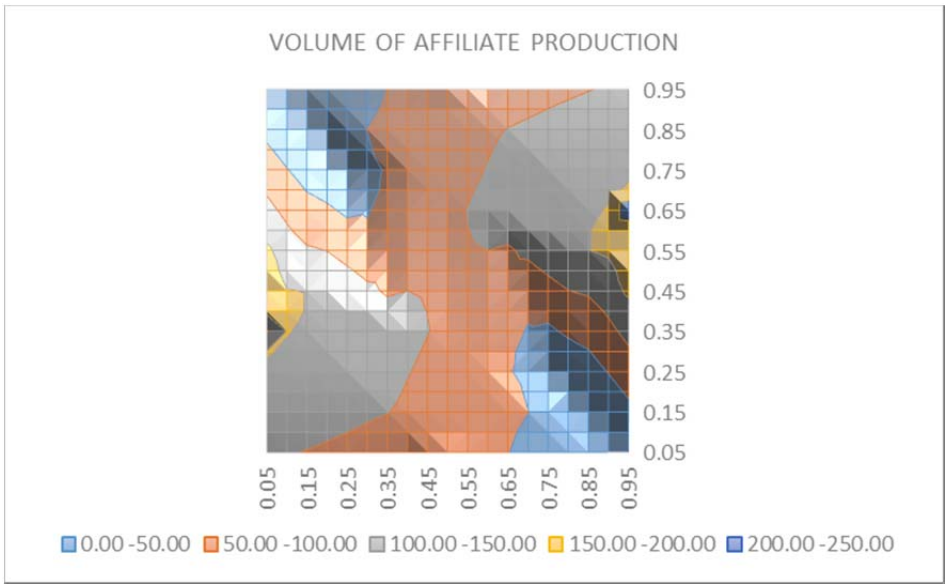
The survey reveals that Markusen type models explain FDI well, but there are few studies focused on intermediate goods trade. Intermediate goods trade is strongly related to the production patterns of MNEs. This is because MNEs install their production facilities overseas, and those facilities import intermediate goods from the home country. Consequently, intermediate goods trade increases with the increase in FDI. In the next section, Oyamada and Uchida (2011), in which intermediate goods are

explicitly treated, is introduced, and some simulation analysis for estimation is also presented.

3. Simulation Analysis for Estimation

Figure 7: Change in volume of affiliate sales when trade costs for final and intermediate goods are 20%





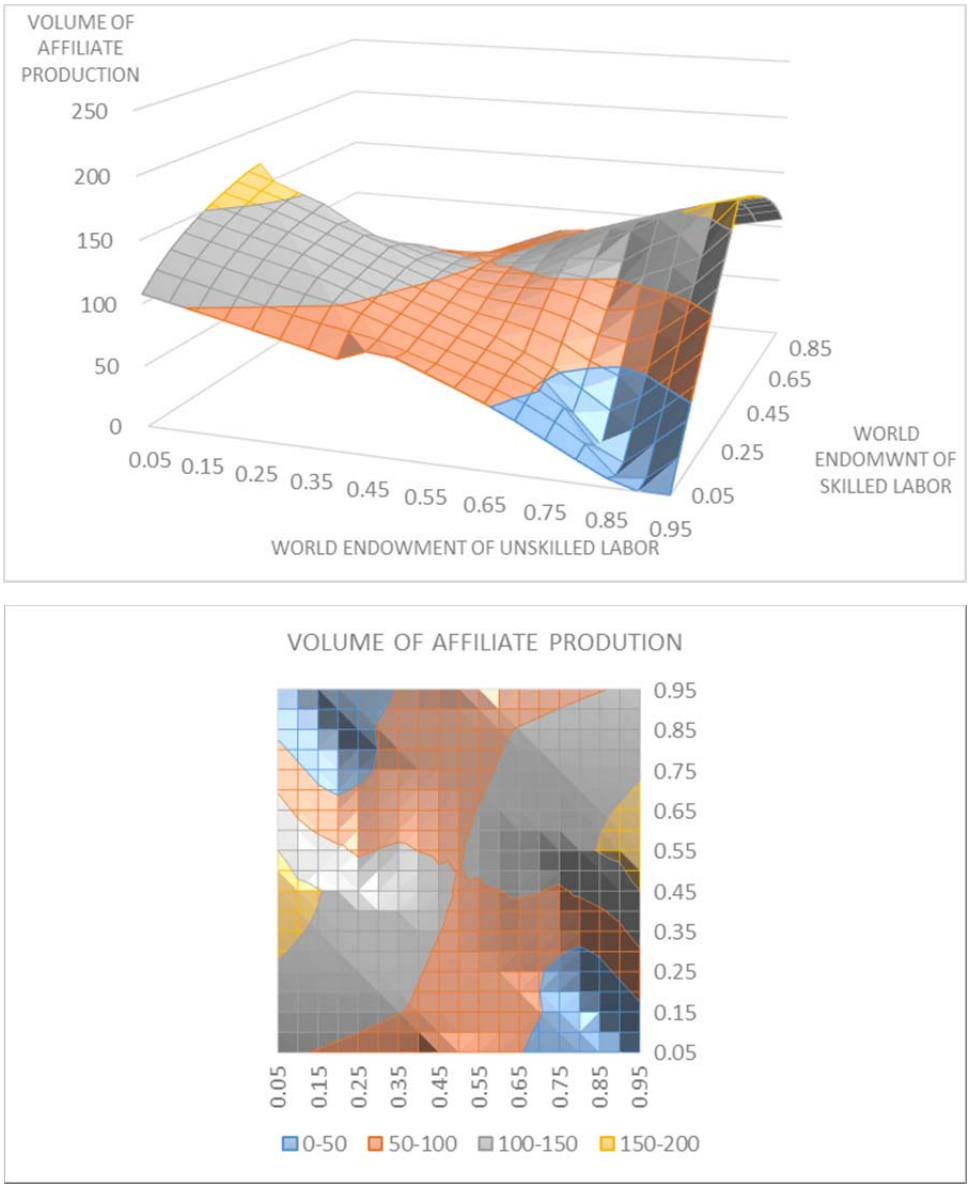
Oyamada and Uchida (2011) developed the knowledge-capital model with a traded intermediate, extending Zhang and Markusen (1999). The model assumes two

countries (home and foreign), two homogeneous goods (*X* and *Y*), one intermediate good (*Z*), and two factors (skilled and unskilled labor). There are three firm types, domestic, horizontal and vertical MNEs, and three assumptions, fragmentation, skilled labor intensity and joint-input are defined. Good *Y* is produced with skilled and unskilled labor under constant returns to scale. Good *X* is produced with increasing returns to scale and imperfect competition. Good *X* is produced in two stages. In the first stage, intermediate good *Z* is produced with skilled labor in the home country. In the second stage, final good *X* is assembled by combining intermediate good *Z* and unskilled labor. The model is solved by the Edgeworth box. The simulation results show that (A) vertical MNEs are vigorous when the difference in relative factor endowment is large. (B) If trade costs for the intermediate goods are small, the result is the same as obtained in Markusen (1997), in which intermediate goods are not addressed. (C) If trade costs for final good are small, horizontal MNEs exits. Consequently, only domestic and vertical MNEs exist. (D) Trade costs for final goods play more important roles in firm type than intermediate goods. (E) Horizontal MNEs are more likely to exist when countries are similar in size and factor endowment. Vertical MNEs are more likely to exist when countries differ in size and the trade costs for the final good are small.

There is no appropriate data that indicates the firm type. There is, however, data that provides the volume of affiliate sales. Therefore, we plot volume of affiliate sales over the Edgeworth box to obtain a prediction about affiliate production, as in Markusen (2002). The *X* axis is the world endowment of unskilled labor, and the *Y* axis is that of skilled labor. The volume of affiliate production is on the *Z* axis. The origin for one country is at the left lower corner and that for the other country is at the right upper corner. The volume of affiliate sales includes sales by horizontal and vertical MNEs but does not include sales by a domestic firm. Figure 7 shows the simulation result of the base case where trade costs for both the final and intermediate goods are 20 percent. The upper figure is a three-dimensional picture of the volume of affiliate production in the two country economy, which corresponds to figure 2 in Oyamada and Uchida (2011). The lower figure is a contour plot of the three-dimensional picture. We usually obtain a symmetric solution, and the picture drawn based on the simulation result is symmetric. However, we obtain an unsymmetrical solution this time. This is because we obtained infeasible solutions for some places when we solved for the model 391 times. In the base case in figure 7, there are 8 places we cannot solve for, one of which is a high volume of affiliate production on the right edge. Ignoring the

values on the right edge, the shape of the figure is a saddle pattern. The volume of affiliate sales is high along the diagonal, in which countries are similar in relative endowment but differ in size. The highest volume is marked when one of the two countries is small and skilled labor is abundant.

Figure 8: Change in volume of affiliate sales when the trade cost for the final good is 20% and that for intermediate good is 1%



In figure 8, we simulate the effect of lowering the trade costs for intermediate goods from 20 percent to 1 percent in both countries. Comparing figure 8 with figure 7,

the total volume of affiliate production slightly increases along the diagonal from the left lower corner to the right upper corner. The reason is that the horizontal firm increases due to crowding the domestic firm out of production. Firms prefer to set up affiliates in host countries utilizing cheap trade cost for intermediate goods and sale final goods from the host country to avoid expensive trade costs for the final good.

Figure 9: Change in volume of affiliate sales when the trade cost for the final good is 1% and that for the intermediate good is 20%

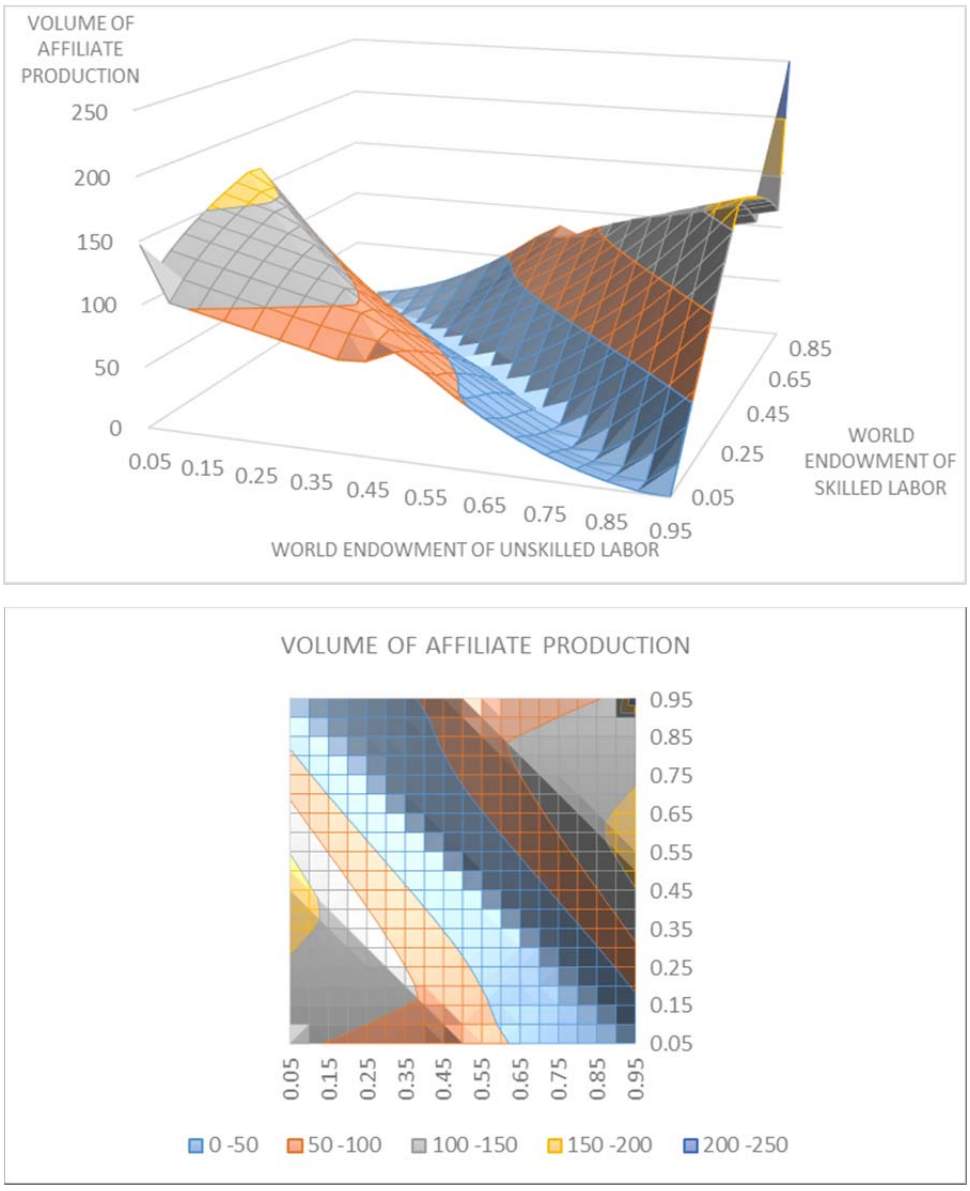


Figure 9 shows the pattern of affiliate production when the trade cost for the

final goods is lowered to 1 percent, but the trading cost for the intermediate good remains at 20 percent. As is apparent from the figure, the production pattern has been changed dramatically. Affiliate production around the center of the Edgeworth box decreases. This is because the firm chooses to export the final good to utilize the low trade cost for the final good and to decrease intermediate good export to avoid high trade cost for the intermediate good. Thus, domestic and vertical firms arise, which lead to decreased affiliate production.

Figure 10: Change in the volume of affiliate sales when the trade costs for both the final and intermediate goods are 1%

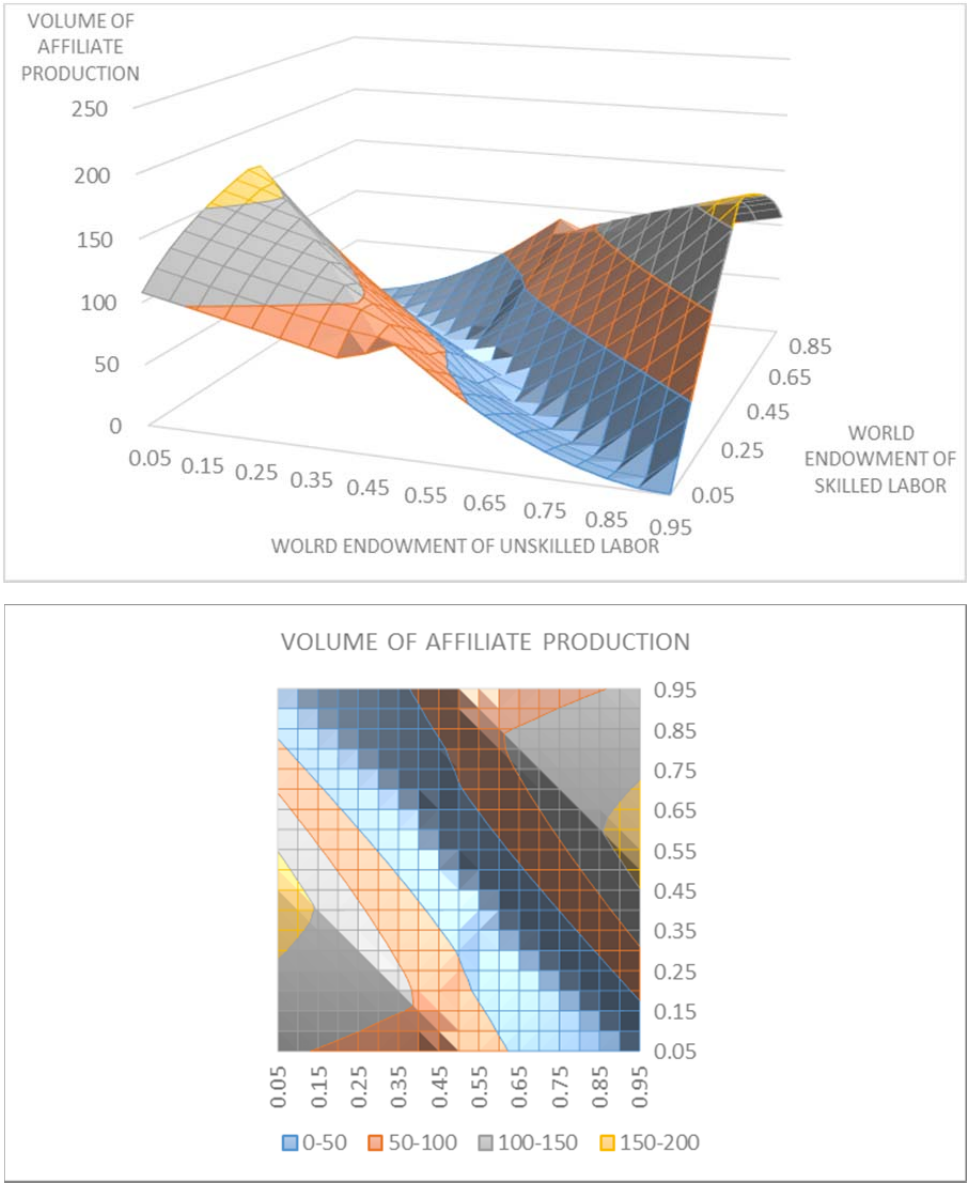


Figure 10 captures the situation where the trade costs for both the final and intermediate goods are lowered to 1 percent. There is minimal difference between figure 9 and 10. This means that lowering the trade cost for the intermediate good has no effect on affiliate production if the trade cost for the final goods is already lowered.

From the three dimensional picture and contour plot of affiliate sales, we obtain the following predictions for estimation. (A) The volume of affiliate sales is high when the country is small and skilled labor is abundant. (B) The volume of affiliate sales increases when the trade cost for the intermediate good is lowered. (C) The volume of affiliate sales decreases when the trade cost for the final good is lowered. (D) A reduction of the trade cost for the intermediate good is not effective for increasing affiliate sales if the trade cost for the final good is already lowered.

4. Concluding Remarks

MNE research has been conducted since the late 1980s, and the main research topic has been shifted from first horizontal to vertical, reflecting the trend of the world FDI. Recently, some research has addressed a third country, taking into consideration the fact that a considerable portion of affiliate sales go to a third country. Thus, MNE research has been developed to match the actual situation.

Theoretical models examine the conditions under which each type of firm is active and derive the following hypotheses: (A) horizontal MNEs are active when countries are similar in size and the trade cost is high and (B) vertical MNEs are active when countries differ in relative factor endowment and one country is small. Based on these hypotheses, empirical studies have been conducted. The key variable for estimation is the skill difference variable. It has been discussed how the variable should be defined and what type of data should be used. Those are important issues because different outcomes result depending on the choice of the variable and the data. The results from the empirical estimation support the hypotheses derived from the theory.

The survey reveals that Markusen type models explain FDI well, but there are few studies focused on intermediate goods trade. Intermediate goods trade is strongly related to the production patterns of MNEs. This is because MNEs install their production facilities overseas, and those facilities import intermediate goods from the

home country. Consequently, intermediate goods trade increases with an increase in FDI. Oyamada and Uchida (2011) constructed a Markusen type theoretical model that addresses intermediate goods trade. By utilizing this model, we conducted a simulation analysis to derive a testable hypothesis for the empirical estimation in the latter part of this paper. The hypothesis is that the volume of affiliate sales and the trade cost for the intermediate good are negatively related when the trade cost for the final good is moderately high. To test the hypothesis, the data on the trade cost for intermediate and final goods are required. However, these data are difficult to obtain. Previous studies, such as Carr *et al.* (2001), used the cost index defined as the national protectionism or efforts to prevent importation of competitive products taken from the World Competitiveness Report as the trade cost, but the data are not distinguished into intermediate and final goods. Other possible data for use are the world tariff data provided by the World Trade Organization (WTO). The data consist of the most favored nation (MFN) applied and bound tariff at the Harmonized System (HS) code for all WTO member countries[4]. If we sort the data by intermediate or final goods, then we can obtain tariff data for both intermediate and final goods. Other data for estimation can be obtained as follows:

Volume of Affiliate Sales: Foreign Direct Investment Database, Research Institute of Economy, Trade and Industry

GDP: World Development Indicators, World Bank

Skilled-Labor Abundance: Yearbook of Labor Statistics, International Labor Organization

Investment Cost: World Competitiveness Report, World Economic Forum.

The estimation of the model has not been conducted because collecting trade costs for intermediate good is still underway. It is time consuming work, but it is worth collecting because nobody has performed this estimation.

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[4] *http://tariffdata.wto.org/default.aspx*

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