DEMAND AND DETERMINANTS OF FDI: A KNOWLEDGE-CAPITAL APPROACH

by

YONGHO CHOI

B.S., University of Incheon, Republic of Korea, 2004

M.A., University of Incheon, Republic of Korea, 2006

M.A., University of Colorado at Boulder, U.S.A., 2012

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

Department of Economics

2014

This thesis entitled:

DEMAND AND DETERMINANTS OF FDI:
A KNOWLEDGE-CAPITAL APPROACH

written by YONGHO CHOI

has been approved for the Department of Economics

Professor Keith E. Maskus, Chair

Professor Murat Iyigun

Date ____________________

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

Choi, Yongho (Ph.D., Economics)

Demand and Determinants of FDI: A Knowledge-Capital Approach

Thesis directed by Professor Keith E. Maskus

This dissertation seeks to reinforce our understanding of an important role of demand-side in determining foreign direct investment (FDI). To do so, it both theoretically and empirically extends the standard Knowledge-Capital (KC) approach, which is now a widely-adopted comprehensive framework to analyze overseas investment decisions of multinational enterprises (MNEs). It provides theoretical foundation and empirical evidence on main topic of the dissertation that per-capita income is closely related to location and production decisions of MNEs.

Chapter 2 develops a theoretical model to examine the roles of demand-driven factors and provides testable predictions driven from numerical simulation results. Therefore, it plays a role of producing theoretical explanation for a link between per-capita income and overseas investment decisions of MNEs.

Chapter 3 tests the hypotheses from the chapter 2, particularly the Linder hypothesis for FDI, for Korean multinationals experiences. It shows that empirical results from System GMM estimation technique are consistent with the theoretical predictions driven from the chapter 2. It is estimated that a 10% decrease in per-capita income divergences between Korea and an average host country leads to a 8.6% rise in Korean overseas direct investment. There was no change in the main results both across different specifications and for the U.S. FDI experiences.

The final chapter empirically examines the determinants for sectoral FDI and compares their influences in the manufacturing and services sectors. It shows distinct features of each sector makes a difference in relative importance of FDI determinants between the two sectors.

Acknowledgements

I would like to express my sincere gratitude to my main advisor, Professor Keith E. Maskus, for his valuable advice, encouragement, and support in making this dissertation a successful one. I also appreciate Professor James R. Markusen for his guidance and comments. I wish extend my appreciation to all of the committee members, Professor Murat Iyigun, Assistant Professor Xiaodong Liu, Assistant Professor Jin-Hyuk Kim, and Professor David H. Bearce.

I would like to thank Professor Donald Waldman who largely contributes to my academic success. I am always grateful to Patricia Holcomb for her excellent and kind administrative assistance. I cannot forget showing my appreciation for all past and current Korean graduate students in the department of Economics and faculty in Incheon National University.

Finally, I would like to express my deep gratitude to my family. In particular, devotion and love of my wife, Hyekyeong Lee, enable me to complete the Ph.D program successfully. I want to thank my lovely daughter and son, Ashley and Luke, for giving me joy and happiness. My gratitude also goes to my parents and my wife's family, who always support and encourage me with their best wishes.

Contents

Tables

Table

Figures

Figure

Chapter 1

INTRODUCTION

It is well-known that about 70% of world foreign direct investment (FDI) has been directed among developed countries. As the countries are likely to be high in per-capita income, they can be characterized by large demands and therefore they have been a major destination of FDI. This fact would suggest that demand-related reasons, particularly per-capita income, are important for explaining FDI.

In literature on FDI determinants, previous studies have primarily focused on production-side determinants of FDI, such as labor endowments, investment impediments, trade costs, and so on. This dissertation, on the other hand, considers demand-side determinants of FDI, based on the Knowledge-Capital (KC) approach, which is a comprehensive framework adopted widely for analyzing overseas investment decisions of multinational enterprises. To be more specific, the main purpose of the dissertation is to explore, both theoretically and empirically, the relevance between per-capita income and FDI, which has surprisingly little been investigated in the FDI literature. By doing so, the dissertation provides theoretical foundation and empirical evidence on a close relation between per-capita income and overseas investment decisions of MNEs.

The second chapter theoretically explores how demand-driven characteristics, particularly per-capita income, play an important role in direct investment decisions of horizontal multinational firms. First, I incorporate non-homothetic preferences into the existing oligopoly model of horizontal multinational enterprises (Markusen and Venables, 1998), reflecting consumption patterns closer to reality. Then, the simulation results show that production activities of horizontal multinationals crucially depend on growth and similarity of two countries per-capita income level. These predictions provide theoretical foundation for the subsequent two empirical chapters.

Recent theoretical studies, including the chapter 2 and Markusen (2013), introduce non-homotheticity of demand structure into a traditional model with horizontal multinational firms to address the importance of per-capita income for horizontal FDI. Based on their theoretical foundations, the third chapter extends the previous empirical KC model by taking into account demand-driven determinants of horizontal FDI including the Linder hypothesis. To do so, I focus on outward FDI between Korea and a sample of 57 host countries over the period since the 1997-98 Asian financial crisis (1999-2010). The central empirical findings from a dynamic panel data approach (System GMM) clearly suggest that Korean multinationals are likely to invest more in countries that are similar in the level of per-capita income, supporting for the Linder effect for FDI. These main results are robust across different specifications of empirical model and for U.S. data. This chapter contributes to the relevant literature by providing empirical evidence on the Linder effect for FDI and by analyzing FDI experiences of Korea, which is less large in terms of total GDP and per-capita GDP and less abundant in terms of skilled-labor endowments than the U.S.

In final chapter, I empirically compare the influences of FDI determinants considered in the KC models including the Linder effect between manufacturing and services sectors. Using sectoral data on Korean FDI, it is shown that FDI in each sector is driven by national characteristics the KC approaches consider but their influences vary according to distinct features of each sector. The findings include: (1) services FDI is likely to be more market-seeking than manufacturing FDI; (2) services FDI does not tend to be influenced by trade impediments; and (3) while producer services, which include finance, business, and transport industries, are expected to play a role of intermediate goods in production process of manufacturing sector, I do not confirm a complementary relationship between manufacturing and producer services FDI. Given an expansion of services sectors importance and a shift of FDI flows towards services sector, a key contribution of this chapter is to uncover the differences in relative importance of determinants between manufacturing and services FDI.

Chapter 2

DEMAND AND HORIZONTAL MULTINATIONAL FIRM

2.1 Introduction

It is now widely accepted that the Knowledge-Capital (KC) theory of the multinational enterprises (MNEs) and its underlying models (e.g. Markusen and Venables, 1998) fairly account for the existence of multinational firms and their direct investment decisions. The literature has primarily analyzed the relationships between MNEs' activities and relevant conditions such as market size, relative skilled labor endowments, trade costs, investment barriers, and distance. These factors are mainly related to production-side characteristics. Differently speaking, a significant role of demand-side characteristics has surprisingly little been emphasized in the literature.

The well-known Linder hypothesis can be applied for understanding foreign direct investment (FDI) patterns (Fajgelbaum et al., 2011). Linder (1961) hypothesized that the volume of trade between countries which have similarities in demand patterns reaches big figures. Until now, uncountable research has soley concentrated on the Linder effect to understand international trade patterns. Because each firm can have another strategic option to serve foreign markets as direct investment instead of trade, the Linder effect would also matter in expaining FDI patterns.

The purpose of this paper is to explore theoretically how demand-driven factors, particularly per-capita income, play an important role on direct investment decisions of multinationals at aggregate level. In the framework, I first incorporate non-homothetic preferences, explicated in Markusen (2013), into the existing oligopoly model of horizontal multinational enterprises (Markusen and Venables, 1998), reflecting consumption patterns closer to reality. The model indicates that aggregate demand for a homogeneous good of multinational firm industry varies with per-capita income and neutral factor, and that the effect of a change in per-capita income on aggregate demand is greater than that of a change in neutral factor.

I then try to obtain several implications relevant with the demand factors by counterfactual experiments. The first simulation result from the model is that affiliate production by multinational firms becomes more intense as world aggregate demand grows, no matter which cause the growth comes from. It is consistent with earlier empirical evidence (e.g. Carr et al., 2001). More importantly, affiliate production by horizontal multinational firms is expected to depend closely on similar levels of per-capita income as well as relative factor endowments among countries. As per-capita income takes charge of key forces as a demand-side determinant of FDI, the negative impact of a divergence in per-capita income remains even though local economies have an equal and constant total income level. This central result mirrors the existence of the Linder effect for FDI.

Recently, a few research has documented the importance of the similarity in per-capita income among local economies for horizontal multinationals. Markusen (2013) accounts for multiple issues including the central prediction of this paper by introducing non-homotheticity into the demand side of a traditional Heckscher-Ohlin model. To deal with horizontal multinationals, he links non-homotheticity in demands for goods to the monopolistic-competition model of Markusen and Venables (2000). He accordingly provides an illustration that a difference in per-capita income, holding total income equal and constant between two countries, deters multinationals from building production facilities in foreign countries. This result in Markusen (2013) is the same as the central prediction of this paper, but there is a distinction in the result that can be inferred between the monopolistic-competition model he uses and the oligopoly model this paper uses.[1] The oligopoly model can demonstrate a positive impact of world demand growth on FDI, where demand growth comes from either per-capita income improvement or neutral factor accumulation. In the frame-

[1]The monopolistic-competition model manipulates differentiated good for multinational industry and iceberg trade costs, whereas the oligopoly model handles homogeneous good and trade costs added to marginal costs.

work, a larger level of world demand leads to reduce markups and raise firm-scale. There is an incentive for firm-type switching. On the other hand, the monopolistic-competition model cannot document the impact because a larger demand makes no change in markups and firm-scale (i.e. a larger demand results in more entry at fixed firm-scale).

Further, this paper, unlike Markusen (2013), includes some analyses on neutral factor. Both effects of a growth and a difference in neutral factor are qualitatively identical to those in per-capita income. However, the size of each effect is expected to be smaller in the cases of neutral factor. Therefore, this result suggests, in any empirical study, that the negative effect of a divergence in per-capita income can be shown after controlling for the characteristic of population size.

Fajgelbaum et al. (2011) must be another important research relevant with this paper in that the two studies commonly focus on the Linder effect for FDI. They combine a product-quality issue with direct investment decisions of horizontal multinationals. Numerous studies dealing with the product-quality issue generally suggest that a higher per-capita income country is more likely to comsume high average quality goods and specialize in their production. Accordingly, they conclude that horizontal multinationals' activities tend to be larger among countries which reach at a similar level of development as there is a strong positive relationship between per-capita income and good's quality consumed. This product-quality issue clearly distinguishes this paper from their study, but the central finding from the two studies are not largely different. In the setting of this paper assuming homogeneous good, a higher per-capita income country comsumes more goods, whereas consumers in a higher per-capita income country require higher quality varieties in their model. This paper has a simpler setting and shows that the Linder effect matters at aggregate level even though the product-quality issue is removed.

The remainder of this paper is organized as follows. Section 2.2 presents a simple Cournot oligopoly model of horizontal multinationals dealing with homogeneous goods where preferences are non-homothetic. Section 2.3 conducts the so-called impact effects in order to grasp intuition to results in a general equilibrium for demand-driven determinants of FDI. Section 2.4 describes a numerical model of general equilibrium and shows simulation results. Section 2.5 concludes and discusses some details that can be considered in subsequent empirical studies.

2.2 Model

The model is a 2×3×2 traditional Heckscher-Ohlin model. It has two countries, i and j. The countries produce two different homogeneous goods, Y and X. They also have a non-rivaled and non-excludable endowment good Z as given. Good Y is produced with constant returns to scale by a competitive industry. It is used as numeraire. Good X is produced with increasing returns by imperfectly competitive Cournot firms. There are two production factors, S (skilled labor) and L (unskilled labor). S is mobile between industries but internationally immobile.

In this paper, as I solely focus on horizontal motivation among diverse motivations of FDI, it is assumed that all costs of X require factors in the same ratio. Thus, the further assumption is adopted: the X industry utilizes only skilled labor and unskilled labor is utilized only in the Y industry. In this paper, good X has a higher income elasticity of demand than good Y, as I will look at this shortly. A certain validity of this assumption is therefore added by Caron et al. (2012), who find that for goods in 56 broad industries their income elasticity of demand is positively related with skilled-labor intensity in producing them. In addition, when transporting Y between countries no costs are generated, whereas firms exporting X to foreign market should pay transport costs, specified as units of S per unit of X exported.

2.2.1 Demand

Preferences take a variant Stone-Geary utility form with Cobb-Douglas function. This demand structure characterized by nonhomotheticity makes a difference, in both qualitative and quantitative terms, between the effect of per capita income on aggregate demand and the effect of population.

2.2.1.1 Individual Demand

All households have simple identical nonhomothetic preferences, also used in Markusen (2013), as follows.

$$u = (x + z)^{\beta} \cdot y^{1-\beta}, \text{ with } z > 0, \tag{2.1}$$

where x is per-household X consumption, y is per-household Y consumption, and z is a non-country-specific constant. z is assumed as a given endowment good, for example air, for which each household cannot have dealings with others. Thus, it has its own characteristics that are non-rivaled and non-excludable. The preferences of the equation (2.1) allow that households earning insufficient income purchase only good Y, reflecting consumption situation closer to reality (Markusen, 2013).[2]

Let m^h, p_X, p_Y be household h's income, X's price, Y's price, respectively. Then, household budget constraint is:

$$m^h = p_X \cdot x + p_Y \cdot y. \tag{2.2}$$

Maximization of (2.1) subject to (2.2) yields the Marshallian demand function:

$$x^h = \max\left\{0, \frac{\beta \cdot m^h}{p_X} - (1-\beta)z\right\}, \tag{2.3}$$

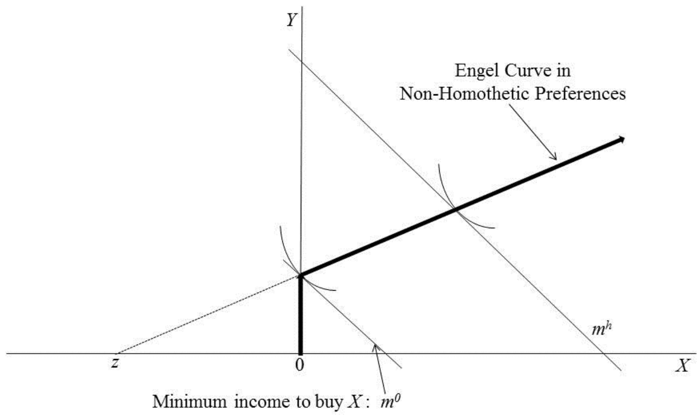
$$y^h = \min\left\{\frac{m^h}{p_Y}, \frac{(1-\beta)(m^h + p_X \cdot z)}{p_Y}\right\}. \tag{2.4}$$

If $x^h = \frac{\beta \cdot m^h}{p_X} - (1-\beta)z > 0$, then $m^h > \frac{(1-\beta)p_X \cdot z}{\beta}$. Hence, we have

$$x^h > 0 \;\text{ if and only if }\; m^h > \frac{(1-\beta)p_X \cdot z}{\beta} \equiv m^0. \tag{2.5}$$

Figure 2.1 illustrates the properties of the assumed non-homothetic preferences. The representative consumer begins to buy X above the threshold income indicated by m^0 defined in the equation (2.5), while she consumes only good Y at low levels of income. This makes demand struc-

[2] Many literatures, e.g. Markusen (1986), generally use the form of $u = x^{\beta} \cdot (y - z)^{1-\beta}$ with $z > 0$ as the Stone-Geary utility function. In this general form, any household having income less than a certain level cannot purchase only good Y.



Notes: This figure is taken from Figure 1 of Markusen (2013).

Figure 2.1: An Engel Curve under Non-homothetic Preferences

ture more realistic, and further implies that aggregate demand depends on the income distribution. Assume in this paper that the equation (2.5) holds with strict inequality for all households.

2.2.1.2 Aggregate Demand

Let H be the number of households. Then, $Z = z \cdot H$ be the economy-wide endowment of z. z is a parameter and Z is strictly proportional to the number of households H. Thus, we have the following expression for aggregate demand X_c for good X.

$$X_c = \sum_{h=1}^{H} x^h = \frac{\beta M}{p_X} - (1-\beta)Z, \text{ where } Z = zH \text{ and } M = \sum_{h=1}^{H} m^h. \tag{2.6}$$

Again, if the equation (2.5) holds for all households, then aggregate demand for X is independent of the income distribution.

In non-homothetic preferences, in order to look at fundamental factors which affect the aggregate demand, I slightly modify the equation (2.6) as follows, with denoting per-capita income as m.

$$X_c = \frac{\beta M}{p_X} - (1-\beta)Z = \frac{\beta}{p_X}(m \cdot H) - (1-\beta)(zH), \text{ where } M = m \cdot H. \tag{2.7}$$

This modified expression for aggregate demand shows that the two variables, the number of households H and per-capita income m, fundamentally determines the aggregate demand X_c.

2.2.1.3 Elasticities of Demand for good X

In this sub-section, I consider three elasticities of demand for good X. First, I compare per-capita income elasticity of demand with neutral factor elasticity of demand. Second, I obtain price elasticity of demand.

Suppose first that a productivity (and therefore per-capita income) increases, holding the number of households H and therefore Z constant. Then, we have per-capita income elasticity of demand with respect to good X as follows.

$$\left.\frac{\frac{dX_c}{X_c}}{\frac{dm}{m}}\right|_{dH=0} = \frac{m}{X_c}\frac{dX_c}{dm} = \frac{m}{m-m^0} > 1, \text{ where } m^0 = \frac{(1-\beta)p_X \cdot z}{\beta}. \tag{2.8}$$

On the other hand, suppose that neutral factor (population) accumulates, holding the per-capita income m constant. Then, neutral factor elasticity of demand is

$$\left.\frac{\frac{dX_c}{X_c}}{\frac{dH}{H}}\right|_{dm=0} = 1. \tag{2.9}$$

Now, Marshallian price elasticity, denoted by ε and defined as positive, is:

$$\varepsilon \equiv -\frac{\frac{dX_c}{X_c}}{\frac{dp_X}{p_X}} = -\frac{p_X}{X_c}\frac{dX_c}{dp_X} = \frac{m}{m-m^0} > 1, \text{ where } m^0 = \frac{(1-\beta)p_X \cdot z}{\beta}. \tag{2.10}$$

Therefore, the per-capita income elasticity of demand and the price elasticity of demand for X are (locally) the same in this structure.

2.2.1.4 Implications of Non-homothetic Preferences

Before presenting the production-side of this model, it needs to be noted that nonhomotheticity gives rise to two important implications. First, the impacts of neutral factor accumulation on aggregate demand vary according to the assumed preference structures (homotheticity vs non-homotheticity). Previous studies, Markusen and Venables (1998) and Markusen (2002), have assumed an identical Cobb-Douglas utility function for the representative individual:

$$u = x^{\beta} \cdot y^{1-\beta}. \tag{2.11}$$

This homothetic utility function gives aggregate demand for good X as follows:

$$X_c = \frac{\beta}{p_X} \cdot M = \frac{\beta}{p_X}(m \cdot H). \tag{2.12}$$

In homothetic preference structure, the neutral factor accumulation yields a proportional increase in the total income M and therefore a proportional increase in the aggregate demand X_c. On the other hand, in nonhomotheticity, the neutral factor accumulation also yields an total income M increase in the same proportion, but it would have a less impact on the aggregate demand due to the second term in equation (2.7), $-(1-\beta)(zH)$. This is one of the most important features from the nonhomothetic preferences, making a distinction in the size of the effect of neutral factor accumulation on aggregate demand between homotheticity and nonhomotheticity.

Second, within nonhomothetic preference structure, the positive impacts of neutral factor accumulation on aggregate demand can be distinguished from those of per-capita income growth in a quantitative term. Nonhomotheticity clearly implies that the effect of per-capita income growth on aggregate demand is greater than that of neutral factor accumulation as shown in the equation (2.7). Due to this discrepancy in effect size, a divergence in per-capita income, relative to a divergence in neutral factor, leads to a larger difference in aggregate demand between two countries, even though two countries have the exactly same level of total income. Therefore, the role of per-capita income is highlighted in determining the level of direct investment done by horizontal multinationals.

In the setting assuming the homotheticity in preferences, the roles of the two fundamental variables are not largely different in determining the level of aggregate demand. No impact differentiation on aggregate demand is in fact expected between population and per-capita income. The effect of doubled population size on aggregate demand, for instance, is exactly identical to that of doubled per-capita income. Moreover, the role of per-capita income has not been introduced yet for being different in the focus. As addressed earlier, the previous studies have mainly focused on production-side determinants in explaining the patterns of overseas investment by multinational firms.

2.2.2 Production

In this paper, the model for the supply-side follows Markusen and Venables (1998) and Markusen (2002), referred to as a general equilibrium oligopoly model of horizontal multinational enterprises. Firms producing good X with increasing returns can supply their products to a foreign market by exporting or by constructing a branch plant in the foreign country.

I will not take into account vertical motivation for direct investment. Vertical multinational firms arise due to benefits from differences in production costs between parent and host countries. This is less likely related to demand factors of my main interest.[3]

2.2.2.1 Y Industry

Let L_l be country l's endowment of L. Production function for Y is given by:

$$Y_l = S_{lY}^{\alpha} \cdot L_l^{1-\alpha},\ l = i, j, \tag{2.13}$$

where S_{lY} and L_l are skilled and unskilled labor used in Y industry in country l, respectively.

Let w^S be skilled wage rate and w^L be unskilled wage rate. Then, marginal products of these factors in Y production are

$$w_l^S = \alpha \left(\frac{S_{lY}}{L_l}\right)^{\alpha-1} \text{ and } w_l^L = (1-\alpha)\left(\frac{S_{lY}}{L_l}\right)^{\alpha},\ l = i, j. \tag{2.14}$$

[3] Furthermore, horizontal investment takes up the overwhelming proportion of total direct investment, particularly for the U.S. outward direct investment (Markusen and Maskus, 2002).

Expansion of X industry would lead to the movement of skilled labor from Y to X industry, lowering $\frac{S}{L}$ ratio in Y industry and thus raising skilled labor costs in terms of Y. Consequently, skilled labor supply to X industry increases with its wage rate, increasing some convexity to the model (Markusen and Venables, 1998).

2.2.2.2 X Industry

Let c be the constant marginal production cost, t the transport costs that a national firm exporting X to foreign market should pay, and G the plant-specific fixed costs and F the firm-specific fixed costs. Assume that all of these cost parameters are measured in units of skilled labor and are the same for both countries.

Let X_{ij}^{n} denote the sales of a country i-based national firm in market j. A national firm produces all its products in its base country, and thus it incurs both its firm-specific and plant-specific fixed costs, $G+F$, in its base country. Moreover, it needs transport costs t per unit of X in order to serve foreign market. Thus, one national firm's skilled labor demand in country i is:

$$cX_{ii}^{n} + (c+t)X_{ij}^{n} + G + F, \ i \neq j. \tag{2.15}$$

Let X_{ij}^{m} denote the sales of a country i-based horizontal multinational firm in market j. A multinational firm also needs both fixed costs for sales in its base country. One country i-based multinational firm's skilled labor demand in market i is:

$$cX_{ii}^{m} + G + F. \tag{2.16}$$

To serve foreign market, the country i-based multinational firm should incur plant-specific fixed costs G instead of transport costs in the foreign country j. Thus, one country i-based multinational firm's skilled labor demand in market j is:

$$cX_{ij}^{m} + G, \ i \neq j. \tag{2.17}$$

Let S_i be total skilled-labor endowment of country i. Let N_i^k ($k = n$ or m) be the number of type-k firms in country i. Then, market clearing of skilled labor factor in country i is given by

$$S_i = S_{iY} + (cX_{ii}^n + (c+t)X_{ij}^n + G + F)N_i^n + (cX_{ii}^m + G + F)N_i^m + (cX_{ij}^m + G)N_j^m. \tag{2.18}$$

2.2.3 Equilibrium

Pricing equations and free-entry conditions determine equilibrium in X industry. First, in order to derive pricing equations, I begin with revenues for a country i-based type-k Cournot firm serving market j: $R_{ij}^k = p_j(X_{jc}) \cdot X_{ij}^k$, $k = n$ or m.[4] Since the price elasticity of demand is defined as ε in the equation (2.10) and $\frac{\partial X_{jc}}{\partial X_{ij}^k} = 1$ by Cournot conjectures (i.e. an increase in one unit of X in one's own supply equals an increase in one unit of X in market supply), marginal revenues are:

$$\begin{aligned} \frac{\partial R_{ij}^k}{\partial X_{ij}^k} &= p_j + X_{ij}^k \frac{\partial p_j}{\partial X_{ij}^k} = p_j + X_{ij}^k \frac{\partial p_j}{\partial X_{jc}} \frac{\partial X_{jc}}{\partial X_{ij}^k} \\ &= p_j + p_j \frac{X_{ij}^k}{X_{jc}} \left(\frac{X_{jc}}{p_j} \frac{\partial p_j}{\partial X_{jc}} \right) \frac{\partial X_{jc}}{\partial X_{ij}^k} = p_j \left(1 - \frac{X_{ij}^k}{X_{jc}} \frac{1}{\varepsilon_j} \right). \end{aligned} \tag{2.19}$$

Pricing equations can be written in complementary-slackness form with associated variable. Here, complementary variables are output of firms of each type in brackets. Therefore, the expressions for pricing equations (marginal revenue - marginal cost ≤ 0) are:

$$(X_{ii}^n) : \; p_i \left(1 - \frac{X_{ii}^n}{X_{ic}} \frac{1}{\varepsilon_i} \right) \leq q_i c, \tag{2.20}$$

$$(X_{ij}^n) : \; p_j \left(1 - \frac{X_{ij}^n}{X_{jc}} \frac{1}{\varepsilon_j} \right) \leq q_i (c+t), \tag{2.21}$$

$$(X_{ii}^m) : \; p_i \left(1 - \frac{X_{ij}^m}{X_{ic}} \frac{1}{\varepsilon_i} \right) \leq q_i c, \text{ and} \tag{2.22}$$

$$(X_{ij}^m) : \; p_j \left(1 - \frac{X_{ij}^m}{X_{jc}} \frac{1}{\varepsilon_j} \right) \leq q_j c. \tag{2.23}$$

[4]Hereafter, for the price expression of good X I drop the subscript X.

With transposition of several terms and substitutions of the equation (2.10) and (2.7) for ε and X_c,[5] I yield the expressions for output:

$$X_{ii}^n \geq \frac{p_i - q_i c}{p_i} \cdot \varepsilon_i \cdot X_{ic} = \beta \cdot \frac{p_i - q_i c}{{p_i}^2} \cdot m_i \cdot H_i, \tag{2.24}$$

$$X_{ij}^n \geq \frac{p_j - q_i(c+t)}{p_j} \cdot \varepsilon_j \cdot X_{jc} = \beta \cdot \frac{p_j - q_i(c+t)}{{p_j}^2} \cdot m_j \cdot H_j, \tag{2.25}$$

$$X_{ii}^m \geq \frac{p_i - q_i c}{p_i} \cdot \varepsilon_i \cdot X_{ic} = \beta \cdot \frac{p_i - q_i c}{{p_i}^2} \cdot m_i \cdot H_i, \text{ and} \tag{2.26}$$

$$X_{ij}^m \geq \frac{p_j - q_j c}{p_j} \cdot \varepsilon_j \cdot X_{jc} = \beta \cdot \frac{p_j - q_j c}{{p_j}^2} \cdot m_j \cdot H_j. \tag{2.27}$$

Each of these inequalities holds with equality if the right hand side is greater than zero, otherwise output is zero.

Production regime is the combination of firm types that operate in equilibrium. Zero-profit conditions represent free entry of firms of each type and determine the production regime.

Let η_{ij}^k ($k = n$ or m) denote proportional markups of price over marginal cost. For example, η_{ij}^m is one country i-based multinational firm's markup in market j. That is, $\eta_{ij}^m = \frac{X_{ij}^m}{X_{jc}}\frac{1}{\varepsilon_j}$. I can then obtain markup revenues per unit on a type-k firm as market price times its markup in that market. For instance, marginal markup revenues on a country i-based multinational firm in market j are $p_j\eta_{ij}^m = p_j - q_j c$ from the equation (2.23). Subsequently, total markup revenues on type-k firms can be written as:

$$\text{for a country } i\text{-based national firm : } p_i\eta_{ii}^n X_{ii}^n + p_j\eta_{ij}^n X_{ij}^n, \tag{2.28}$$

$$\text{for a country } j\text{-based national firm : } p_j\eta_{jj}^n X_{jj}^n + p_i\eta_{ji}^n X_{ji}^n, \tag{2.29}$$

$$\text{for a country } i\text{-based multinational firm : } p_i\eta_{ii}^m X_{ii}^m + p_j\eta_{ij}^m X_{ij}^m, \text{ and} \tag{2.30}$$

$$\text{for a country } j\text{-based multinational firm : } p_j\eta_{jj}^m X_{jj}^m + p_i\eta_{ji}^m X_{ji}^m. \tag{2.31}$$

[5]Here, $\varepsilon \cdot X_c = \frac{\beta}{p} \cdot m \cdot H$ since $\varepsilon = \frac{m}{m - m^0}$ in equation (2.10) and $X_c = \frac{\beta}{p}(m \cdot H) - (1-\beta)zH = \frac{\beta}{p}(m - m^0)H$ in equation (2.7), where $m^0 \equiv \frac{(1-\beta)p \cdot z}{\beta}$.

If outputs are positive, then the equations (2.24)-(2.27) and (2.28)-(2.31) can be used for generating the free entry conditions (i.e. profits = total markup revenues - total fixed costs ≤ 0), where complementary variables are the number of firms of each type.

$$(N_i^n):\ \beta\left[\left(\frac{p_i-c}{p_i}\right)^2\cdot m_i\cdot H_i+\left(\frac{p_j-c-t}{p_j}\right)^2\cdot m_j\cdot H_j\right]\leq q_i(G+F), \tag{2.32}$$

$$(N_j^n):\ \beta\left[\left(\frac{p_j-c}{p_j}\right)^2\cdot m_j\cdot H_j+\left(\frac{p_i-c-t}{p_i}\right)^2\cdot m_i\cdot H_i\right]\leq q_j(G+F), \tag{2.33}$$

$$(N_i^m):\ \beta\left[\left(\frac{p_i-c}{p_i}\right)^2\cdot m_i\cdot H_i+\left(\frac{p_j-c}{p_j}\right)^2\cdot m_j\cdot H_j\right]\leq q_i(G+F)+q_jG,\ \text{and} \tag{2.34}$$

$$(N_j^m):\ \beta\left[\left(\frac{p_j-c}{p_j}\right)^2\cdot m_j\cdot H_j+\left(\frac{p_i-c}{p_i}\right)^2\cdot m_i\cdot H_i\right]\leq q_j(G+F)+q_iG. \tag{2.35}$$

2.3 Impact Effects

To grasp intuition to results in the general equilibrium for demand-driven factors, this section conducts the impact effects explicated in Markusen (2002).[6] Here, using the free entry conditions (2.32)-(2.35) derived the above, I analyze how a change in one variable leads to changes in both the aggregate demand and equilibrium regimes.

To easily understand the impact effects, I first need to simplify the free entry conditions (2.32)-(2.35). Let $\beta\left(\frac{p_l-c}{p_l}\right)^2$, $\beta\left(\frac{p_l-c-t}{p_l}\right)^2$, $q_l(G+F)$, and q_lG denote a_l, b_l, d_l, and e_l ($l=i$ or j), respectively. Then, transposition of all terms of fixed costs to the left hand side in the equations (2.32)-(2.35) gives expressions for profits of country l-based type-k firm, denoted by Π_l^k ($l=i$ or j, and $k=n$ or m). Thus, the free entry conditions (2.32)-(2.35) can be simplified as the following profit equations:

$$\Pi_i^n=a_i\cdot m_i\cdot H_i+b_j\cdot m_j\cdot H_j-d_i \tag{2.36}$$

$$\Pi_j^n=a_j\cdot m_j\cdot H_j+b_i\cdot m_i\cdot H_i-d_j \tag{2.37}$$

[6] Given that all other endogenous variables are fixed, this analysis technique demonstrates how a change in one variable yields a change in an equilibrium result. Even though this is not the effects of general equilibrium, the analysis helps predict results in the general equilibrium.

$$\Pi_i^m = a_i \cdot m_i \cdot H_i + a_j \cdot m_j \cdot H_j - d_i - e_j, \text{ and} \tag{2.38}$$

$$\Pi_j^m = a_j \cdot m_j \cdot H_j + a_i \cdot m_i \cdot H_i - d_j - e_i, \tag{2.39}$$

where $a_l, b_l, d_l,$ and e_l ($l = i$ or j) are all strictly positive. For more simplicity of analysis, I add one more assumption that both countries are initially identical. Accordingly, price elasticities, per-capita incomes, the numbers of population (neutral factor), threshold incomes, all kind of prices, all kind of fixed costs, and so forth are initially equal in the two countries. That is, $\varepsilon \equiv \varepsilon_i = \varepsilon_j$, $m \equiv m_i = m_j$, $H \equiv H_i = H_j$, $m^0 \equiv m_i^0 = m_j^0$, $a \equiv a_i = a_j > b \equiv b_i = b_j$, $d \equiv d_i = d_j$, and $e \equiv e_i = e_j$.

For convenience, let $\Pi^n \equiv \Pi_i^n = \Pi_j^n$ denote initial (ex-ante) profits of a national firm, $\Pi^m \equiv \Pi_i^m = \Pi_j^m$ denote initial (ex-ante) profits of a multinational firm, and $\Pi^{n\prime}$ and $\Pi^{m\prime}$ denote ex-post profits of a national and multinational firm, respectively.

2.3.1 Impacts of a Change in World Aggregate Demand (per-capita income vs population)

As the first analysis of impact effects, consider the impacts of a change in world aggregate demand, all other things unchanged.[7] Recall that aggregate demand grows through an increase either in **per-capita income (productivity)** or in **neutral factor (population)**. First, consider the impacts of world aggregate demand growth arising from an equal **per-capita income** increase in both countries. An equal per-capita income increase in both countries would lead to world total income growth and subsequently world aggregate demand (see the equation (2.7)). Figure 2.2 (A) illustrates an Engel curve in the case of a per-capita income growth for a country, and describes how aggregate demand varies with total income arising from a per-capita income growth. The growth of per-capita income leads to an increase in both total income level (from M to M') and aggregate demand (from point A to B).

Now, consider the effect of aggregate demand growth through an increase in per-capita income

[7]Here, I consider the case of an increase in aggregate demand only. The results from a decrease in aggregate demand would be directly opposite to the increase case.

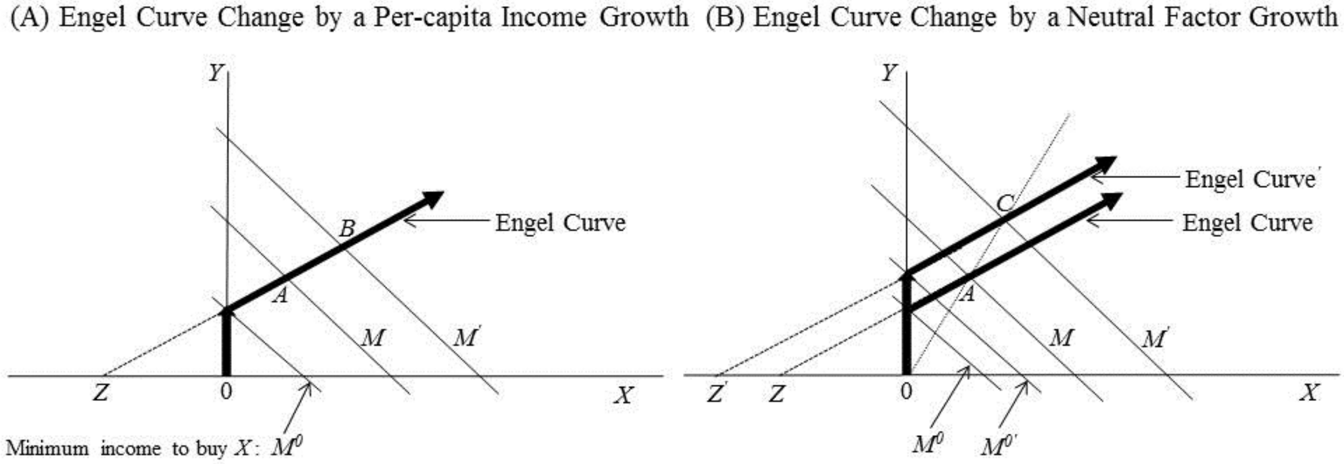


Figure 2.2: Engel Curves in a Per-capita Income Growth (A) vs a Neutral Factor Accumulation (B)

on the profits for country l-based type-k firm specifically. Suppose that an equal per-capita income level for both countries increases by $\Delta m > 0$. Then, the ex-post profits of firm type-k are:

$$\begin{aligned} \Pi^{n\prime} = \Pi_i^{n\prime} = \Pi_j^{n\prime} &= a \cdot H \cdot (m + \Delta m) + b \cdot H \cdot (m + \Delta m) - d \\ &= \Pi^n + (a + b) \cdot H \cdot \Delta m \end{aligned} \tag{2.40}$$

$$\begin{aligned} \Pi^{m\prime} = \Pi_i^{m\prime} = \Pi_j^{m\prime} &= a \cdot H \cdot (m + \Delta m) + a \cdot H \cdot (m + \Delta m) - d - e \\ &= \Pi^m + 2a \cdot H \cdot \Delta m \end{aligned} \tag{2.41}$$

An increase in world aggregate demand through an equal per-capita income growth gives a general result that $\Delta\Pi_i^m = \Delta\Pi_j^m > \Delta\Pi_i^n = \Delta\Pi_j^n > 0$. Because $a > b$ from whether the trade costs exist, the growth of world aggregate demand increases more revenues for multinational firms than for national firms, while there are no changes in fixed costs for the two firm types. This positive influence of world aggregate demand (and market) growth has been found in relevant oligopoly models including this model, but not in monopolistic-competition models (Markusen, 2002). Besides, it has been strongly supported by a wealth of empirical evidences (e.g. Carr et al., 2001). For these respects, I prefer this oligopoly model to a monopolistic-competition model.[8]

Second, consider the impacts of world aggregagte demand growth arising from **neutral factor (population)** accumulation. A neutral factor growth similarly gives rise to an increase in aggregate demand whenever $\frac{\beta \cdot m}{p} - (1-\beta)z > 0$ (see the equation (2.7)). Meanwhile, an increased size in aggregate demand of good X is relatively smaller in this case of neutral factor accumulation than in the above case of per-capita income growth.

Figure 2.2 (B) illustrates that an accumulation of the neutral factor makes a less increase in aggregate demand for a country, relative to the case of a per-capita income growth. As the neutral factor in a country increases, total income as well as Z grow and subsequently aggregate demand also moves along with a ray from the origin through the point A. Note that the slope of the ray from the origin through the point A or C in Figure 2.2 (B) is much steeper than that of the ray from the point A to B in Figure 2.2 (A).

Suppose that an equal level of neutral factor (population) for both countries accumulates by $\Delta H > 0$. Then, the ex-post profits of firm type-k are:

$$\begin{aligned} \Pi^{n\prime} = \Pi_i^{n\prime} = \Pi_j^{n\prime} &= a \cdot m \cdot (H + \Delta H) + b \cdot m \cdot (H + \Delta H) - d \\ &= \Pi^n + (a+b) \cdot m \cdot \Delta H \end{aligned} \tag{2.42}$$

$$\begin{aligned} \Pi^{m\prime} = \Pi_i^{m\prime} = \Pi_j^{m\prime} &= a \cdot m \cdot (H + \Delta H) + a \cdot m \cdot (H + \Delta H) - d - e \\ &= \Pi^m + 2a \cdot m \cdot \Delta H \end{aligned} \tag{2.43}$$

Whenever $\frac{\beta m}{p} - (1-\beta)z > 0$, a less increase in aggregate demand through a neutral factor growth also shows the general result that $\Delta\Pi_i^m = \Delta\Pi_j^m > \Delta\Pi_i^n = \Delta\Pi_j^n > 0$.

[8]On the other hand, a monopolistic-competition model has an advantage in that good X can be differentiated.

2.3.2 Impacts of a Difference in Aggregate Demand (per-capita income vs population)

Next, consider the impacts of a difference in aggregate demand between the two countries, all other things unchanged. In this paper, I assume that country i is always larger in either per-capita income or neutral factor. First, consider the impacts of a difference in aggregate demand arising from a divergence in per-capita income. A divergence in per-capita income between the two countries causes a difference in total income and subsequently makes a (considerable) difference in aggregate demand, represented in the Figure 2.3 (A).

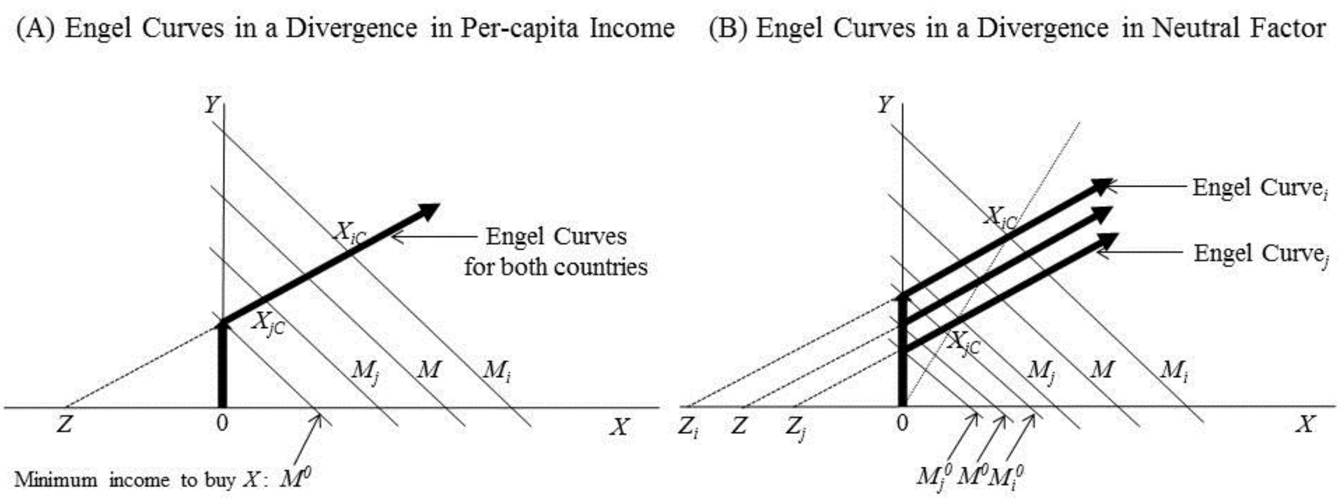


Figure 2.3: Engel Curves in a Divergence in Per-capita Income (A) vs a Divergence in Neutral Factor (B)

Now, consider the effect of a divergence in per-capita income on the profits for each type firm. In this case, as two countries differ in per-capita income, suppose that country i's per capita income level increases by Δm while country j's per capita income level decreases by Δm in order to make all other things including total world income unchanged. Then, the ex-post profits of firm type-k are:

$$\begin{aligned} \Pi_i^{n\prime} &= a \cdot H\left(m_i + \Delta m\right) + b \cdot H\left(m_j - \Delta m\right) - d \\ &= \Pi_i^n + (a-b) \cdot H \cdot \Delta m \end{aligned} \tag{2.44}$$

$$\Pi_j^{n\prime} = a \cdot H\left(m_j - \Delta m\right) + b \cdot H\left(m_i + \Delta m\right) - d \\ = \Pi_j^n + (b - a) \cdot H \Delta m \tag{2.45}$$

$$\Pi^{m\prime} = \Pi_i^{m\prime} = \Pi_j^{m\prime} = a \cdot H\left(m + \Delta m\right) + a \cdot H\left(m - \Delta m\right) - d - e \\ = \Pi^m \tag{2.46}$$

A difference in aggregate demand through a per-capita income divergence gives a general result that $\Delta\Pi_i^n > 0$, $\Delta\Pi_j^n < 0$, and $\Delta\Pi_i^m = \Delta\Pi_j^m = 0$. Because $a > b$ from whether the trade costs exist and there are no changes in fixed costs for two firm types, larger demands in the country i increase country i-based national firm's profits, while smaller demands in the country j decrease country j-based national firm's profits. On the other hand, the profits of multinational firms remain unchanged.

This analysis about the effect of per-capita income divergence on multinational firm's activities is closely related to the well-known Linder hypothesis of main interest in this paper. The hypothesis implies that countries with similar per-capita income levels possess similar demands for goods and services. It therefore suggests that understanding how the composition of household demand changes with per-capita income may play a significant role in determining trade patterns. Thus, there have been numerous studies on the Linder effect in order to account for global trade patterns. Yet the Linder effect might also matter in explaining global FDI patterns since each firm can have another strategic option to serve foreign markets as FDI, which replace trade in some circumstances (e.g. the presence of high trade costs). From the result in this sub-section with simulation results in the next section, I find the evidence supporting for the Linder effect in horizontal FDI patterns.

Second, consider the impacts of a difference in aggregate demand arising from a divergence in neutral factor. Recall that the divergence in neutral factor makes a less difference in aggregate demand, compared to the divergence in per-capita income, illustrated in Figure 2.3 (B). In other words, the divergence in neutral factor is likely to keep similarity in aggregate demand.

Now, consider the effect of a divergence in neutral factor on the profits for each type firm. In this case, as two countries differ in neutral factor, suppose that country i's number of population increases by ΔH, while country j's number of population decreases by ΔH in order to make all other things including world total income unchanged. Then, the ex-post profits of firm type-k are:

$$\begin{aligned} \Pi_i^{n\prime} &= a \cdot m\left(H_i + \Delta H\right) + b \cdot m\left(H_j - \Delta H\right) - d \\ &= \Pi_i^n + (a-b) \cdot m \cdot \Delta H \end{aligned} \tag{2.47}$$

$$\begin{aligned} \Pi_j^{n\prime} &= a \cdot m\left(H_j - \Delta H\right) + b \cdot m\left(H_i + \Delta H\right) - d \\ &= \Pi_j^n + (b-a) \cdot m \cdot \Delta H \end{aligned} \tag{2.48}$$

$$\begin{aligned} \Pi^{m\prime} = \Pi_i^{m\prime} = \Pi_j^{m\prime} &= a \cdot m\left(H_i + \Delta H\right) + a \cdot m\left(H_j - \Delta H\right) - d - e \\ &= \Pi^m \end{aligned} \tag{2.49}$$

The changed profits for each type firm are qualitatively similar to the case of a divergence in per-capita income. However, it should be noted again that as per-capita income and neutral factor differ in the size of their effect on aggregate demand, the changed size of the profits that the difference in aggregate demand generates also varies with where the difference in aggregate demand comes from.

So far, a change in either per-capita income or neutral factor makes not only a change in total income but also a change in aggregate demand. To remove the effect of a change in total income on aggregate demand, now consider that a per-capita income increases but a neutral factor decreases for country i, whereas reversely a per-capita income decreases but a neutral factor increases for country j, **holding total income in both countries constant and identical**.

Figure 2.4 illustrates this situation, which implies that the two countries have an identical level of total income, but country i has a larger aggregate demand than country j due to a higher per-capita income in spite of a less level of neutral factor. Therefore, the changed profits for each type firm are also qualitatively similar to the case of a divergence in per-capita income. Country i-based national firms obtain more total revenues, but country j-based national firms lose some total

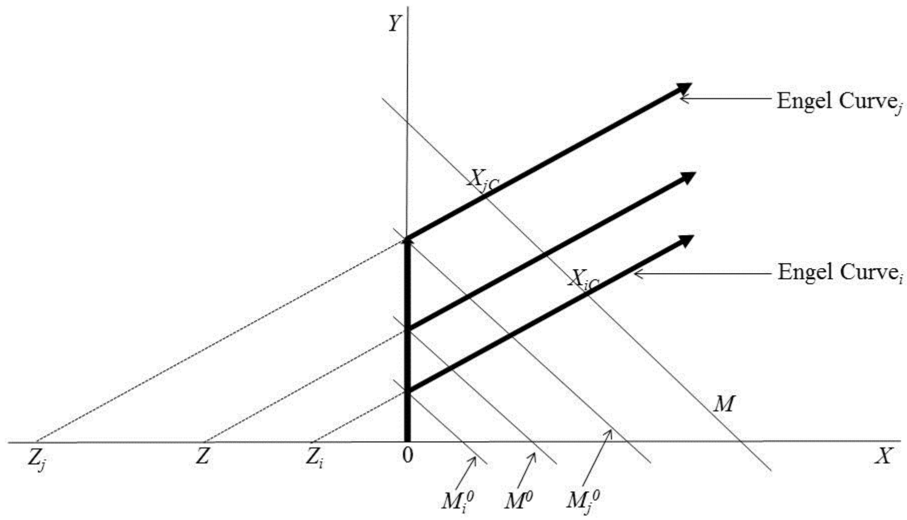


Figure 2.4: Engel Curves in a Reverse Divergence in Per-capita Income and Neutral Factor between Two Countries, Holding Total Incomes for Two Countries Identical and Constant

revenues, holding total costs unchanged. On the other hand, the profits for multinational firms in both countries remain unchanged. The analysis which is exactly the same as here can be found in Markusen (2013). In this paper, it is included to show the importance of a similarity in per capita income for horizontal multinational firms, regardless of whether two countries have an identical total income. Later, this important result is associated with a main empirical specification.

2.4 Simulation

In this section, I first show a benchmark simulation result after describing a numerical general-equilbrium model under non-homothetic preferences. Then, I analyze how various changes in demand-driven characteristics for two countries influence equilibrium regimes.

2.4.1 Benchmark Simulation Result under Non-homothetic Preferences

There are difficulties when one analytically solves the general equilibrium model outlined above because the model has many demensions and many inequalities. Alternatively, I first formulate the model as a nonlinear complementary problem in which there are a set of inequalities and each of these inequalities is expressed with an associated non-negative variable.[9] Then, I exploit MPSGE (mathematical programming system for general equilibrium), a sub-system of GAMS (general algebraic modelling system), developed by Rutherford (1999) in order to solve the model numerically. The numerical model of general equilibrium includes forty-three inequalities each with complementary variables in forty-three unknowns (See Appendix A for the numerical model and the initial calibration of the model).

In the benchmark simulation, I use the values of parameters as follows: non-country-specific z as the endowment good is 30, the transport cost t is 0.15, and the ratio of a multinational firm's fixed costs to national firm's fixed costs is 1.45 ($= \frac{8}{5.5}$) if wages between two countries are the same.

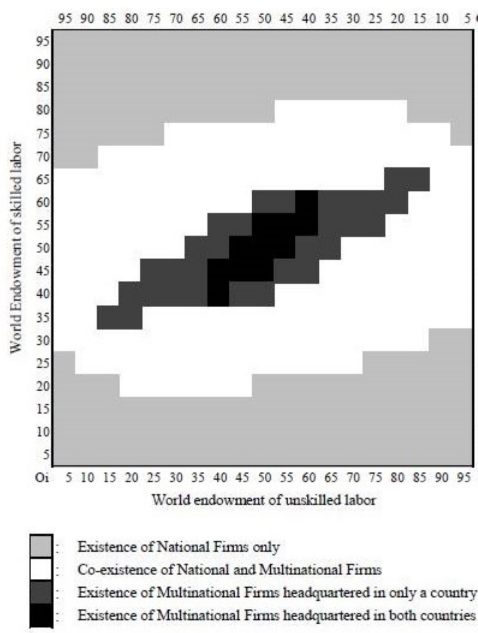


Figure 2.5: Equilibrium Regimes under Non-homothetic Preferences ($z = z_i = z_j = 30$)

Figure 2.5 shows the equilibrium regimes over these parameter values in the world Edgeworth box, in which horizontal axis is the total world endowment of unskilled labor, and vertical axis is the total world endowment of skilled labor.[10] The origin of country i is the southwest (SW) corner

[9] Two possibilities exist. The variable is strictly positive if equality holds for the inequality in equilibrium. On the other hand, it has the value of zero if strict inequality holds in equilibrium.

[10] Each axis is divided into nineteen sections, signifying five-percent difference between adjacent two cells. Each edge of all cells in the square box indicates a distribution of the world endowments of both factors between the two countries.

in the box while the origin of country j is the northeast (NE) corner.[11] Note that any point on the NW-SE diagonal of the box implies that the two countries differ in relative endowments, while any point on the SW-NE diagonal implies that the countries have the same relative endowments but differ in the number of total labor forces.

Figure 2.5 is derived from the assumption that the countries have identical but non-homothetic preferences, where $z_i = z_j = 30$ in the equation (2.1). A color of each cell in the panel represents an equilibrium regime. The figure is similar to the Figure 5.1 of Markusen (2002), which is derived from the assumption that the countries have identical homothetic preferences ($z_i = z_j = 0$), in that only multinational firms are active in general equilibrium around the center of the Edgeworth box, only national firms exist in equilibrium at the edges of the box, and in between are co-existence area of both multinational and national firms. Therefore, regardless of whether assumed preferences are homothetic or non-homothetic, the central findings in Markusen and Venables (1998) and Markusen (2002) are preserved: horizontal multinational firms are more likely found in equilibrium when both market size and relative endowments are similar between the two countries.

2.4.2 Impacts of a Change in World Aggregate Demand in General Equilibrium

First, consider the impacts of a change in world aggregate demand in general equilibrium. As mentioned in the previous section, aggregate demand growth comes through an increase in either per-capita income or neutral factor. I predict that equilibrium regimes by these two demand factors are qualitatively similar in that an increase in either per-capita income or neutral factor gives a more advantage to multinational firms, but quantitatively different each other because the effect of per-capita income growth on aggregate demand is greater than that of neutral factor.

As the first experiment, suppose that world aggregate demand growth comes through an increase in per-capita income. Figure 2.6 (A) shows the equilibrium regimes solved numerically for this first experiment. While all parameter values are the same as in the benchmark case (Figure

[11] From the origin for country i, a movement to the right means an increase in country i's share of the world unskilled-labor endowment, and a shift to the top means an increase in country i's share of the world skilled-labor endowment.

2.5), only scale parameters of per-capita income for two countries equally rise by 33%. As predicted, Figure 2.6 (A) shows that the regions in which only national firms are active shrink, and the area in which multinational firms exist expands. The equally increased per-capita income in the two countries leads to an increase in the world total income, and also extends world aggregate demand. As total markup revenues are differently affected across firm types, multinational firms has an advantage in profits over national firms.

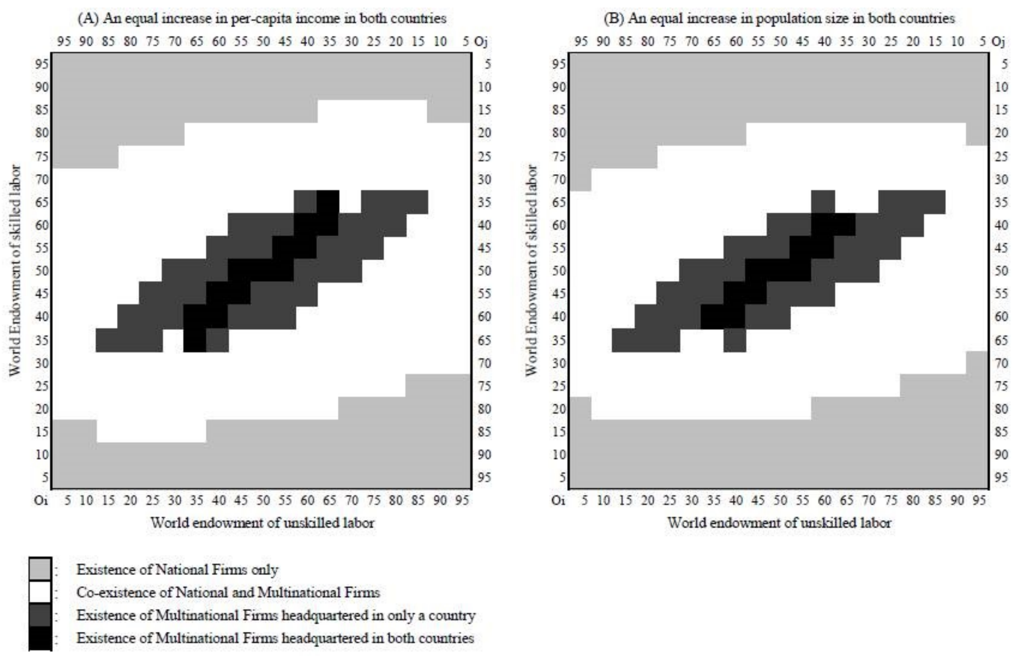


Figure 2.6: Equilibrium Regimes under World Aggregate Demand Growth through Per-capita Income (A) vs Neutral Factor Accumulation (B)

Second, suppose that world aggregate demand growth comes through an accumulation of neutral factor. In previous section, I analyze that a neutral factor accumulation leads to a less increase in aggregate demand, relative to the above case. It is thus conjectured that multinational firms has a less advantage in total markup revenues, compared to the above case. Figure 2.6 (B) shows the equilibrium regimes solved numerically in the case of an equal accumulation of neutral factor. While all parameter values are the same as in benchmark case, only scale parameters of population in the two countries rise by 33%. Note that the level of total income increases by 33% in both cases (per-capita income growth and neutral factor accumulation). As predicted, Figure

2.6 (B) shows a similar change in the equilibrium regimes compared to the Figure 2.6 (A), but the area that support the existence of multinational firms is smaller with Figure 2.6 (B). The equal population growth in the two countries leads to an increase in the world total income. It also increases the threshold income level to buy good X as another important component in determining aggregate demand, forcing an increased size of aggregate demand in the population growth smaller than in the per-capita income growth. Hence, the population growth in the two countries makes a less change in the equilibrium regimes.

2.4.3 Impacts of a Difference in Aggregate Demand in General Equilibrium

Next, I consider how a difference in aggregate demand between the two countries affects the equilibrium regimes. First, I make a divergence of per-capita income between the two countries. As analyzed in earlier section, this creates considerably different aggregate demand between the two local markets. I conjecture that larger demands in the country i reinforce country i-based national firm's profits while smaller demands in the country j reduce country j-based national firm's profits. On the other hand, the profits of multinational firms remain unchanged.

Figure 2.7 (A) shows how equilibrium regimes change from the benchmark result when per-capita income levels between the two countries are not symmetric. Per-capita income level is 33% larger than the benchmark case for country i, but 33% smaller for country j. As expected, the existence area of country i-based national firms makedly expands and that of country i-based national firms signally shrinks. Moreover, the region where multinational firms arise is also remarkably reduced. When comparing between Figure 2.5 (the benchmark case) and Figure 2.7 (A), one finds that the central point, in a sense of the regime where multinational firms exist only, shifts to the southwest. The difference in aggregate demand also changes the point where wages for skilled labor are the same in both countries. On the SW-NE diagonal, the southwest part from the central point indicates that wages for skilled labor in country i with large demands are lower, while northeast part indicates that wages for skilled labor in country j with small demands are lower. Thus, these features discourage the existence of horizontal multinational firms in the northeast part.

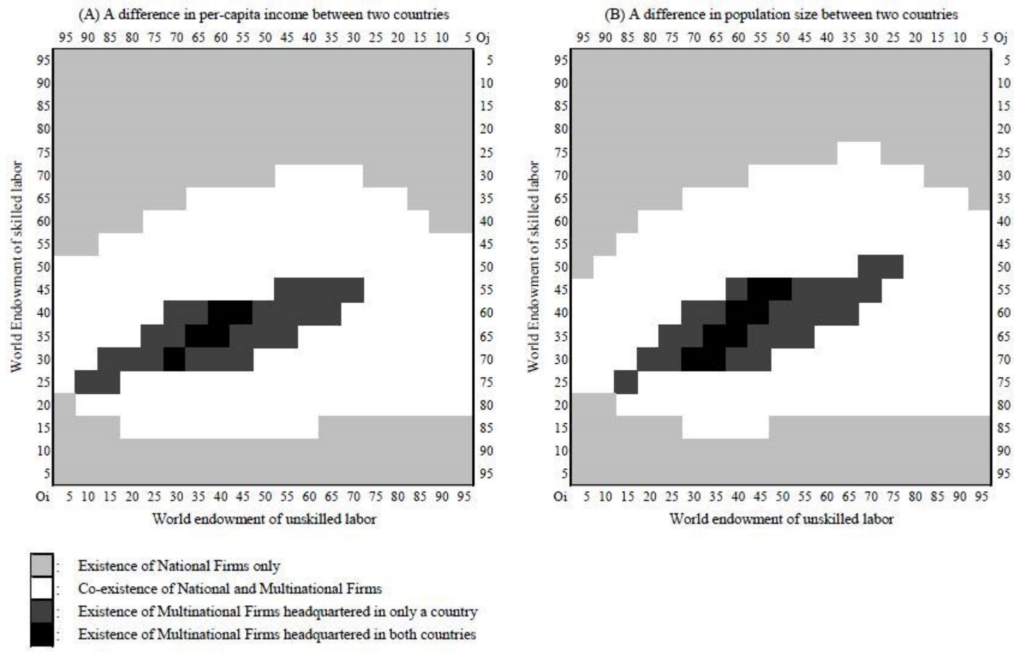


Figure 2.7: Equilibrium Regimes under Difference in Aggregate Demand through Per-capita Income Divergence (A) vs Neutral Factor Divergence (B)

Second, I make a divergence of population size between the two countries. As also analyzed in earlier section, this divergence creates a less different aggregate demand between the two local markets, relative to the above case of the per-capita income divergence. I thus conjecture that a divergence in neutral factor influences equilibrium regimes in a similar manner to the above case, but less affects their changes.

Equilibrium regimes are shown in Figure 2.7 (B) when world distribution of population between the two countries is asymmetric. The number of population is 33% larger than the benchmark case for country i, but 33% smaller for country j. As expected, the region where country i-based national firms operate somewhat expands, but the existence area of country i-based national firms and that of multinational firms slightly decline.

Finally, without any total income change in each country compared to the benchmark case, I make an inverse change in per-capita income and population size for each country. Per-capita income and population size are double and half those in the benchmark case for country i, respectively, while they reversely change for country j. Note that country i is 4 times larger in per-capita income than country j, but 4 times smaller in population size. Figure 2.8 shows that the changed profits for each type firm are also qualitatively similar to the case of a divergence in per-capita income, but some of the effect of a divergence in per-capita income on profits is offset by that of a divergence in neutral factor. It also highlights that a similarity in per-capita income plays a major role on horizontal FDI.

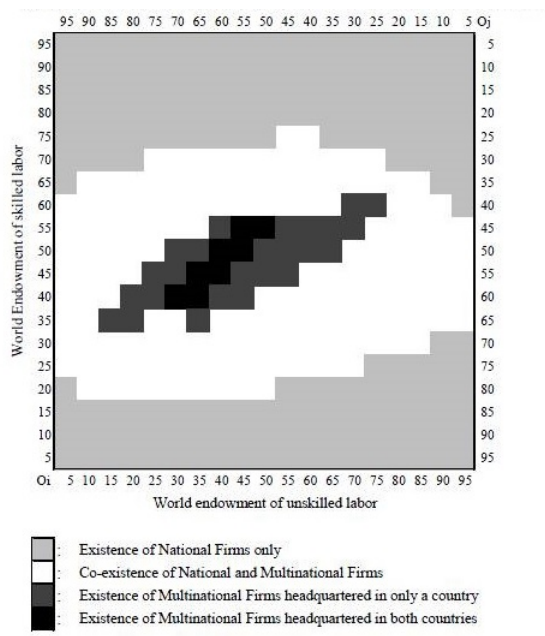


Figure 2.8: Equilibrium Regimes for a Reverse Divergence in Per-capita Income and Neutral Factor between Two Countries, Holding Total Incomes for Two Countries Identical and Constant

2.4.4 Impacts of a Change in Each Production-side Factor in General Equilibrium

The literature includes analyses about the impacts of a difference in wages, a change in the ratio of firm-specific fixed costs to plant-specific fixed costs, and a change in transport costs. Because the impacts of these factors do not depend on demand structure, the results are the same as those in the literature (Markusen and Venables, 1998 and Markusen, 2002). Here, I simply discuss with simulation results.

First, consider the impacts of a difference in relative labor endowments. All figures in this paper commonly shows that a large divergence in relative labor endowments discourages the existence of horizontal multinationals, consistent with previous studies. When I look at the NW corner in Figure 2.5 (the benchmark case), abundant skilled labor in country i lowers its wage, and therefore the changed profits for each country-type firm form the following order: $\Delta\Pi_i^n > \Delta\Pi_i^m > 0 > \Delta\Pi_j^m > \Delta\Pi_j^n$. Thus, only national firms are active at NW and SE edges in all figures.

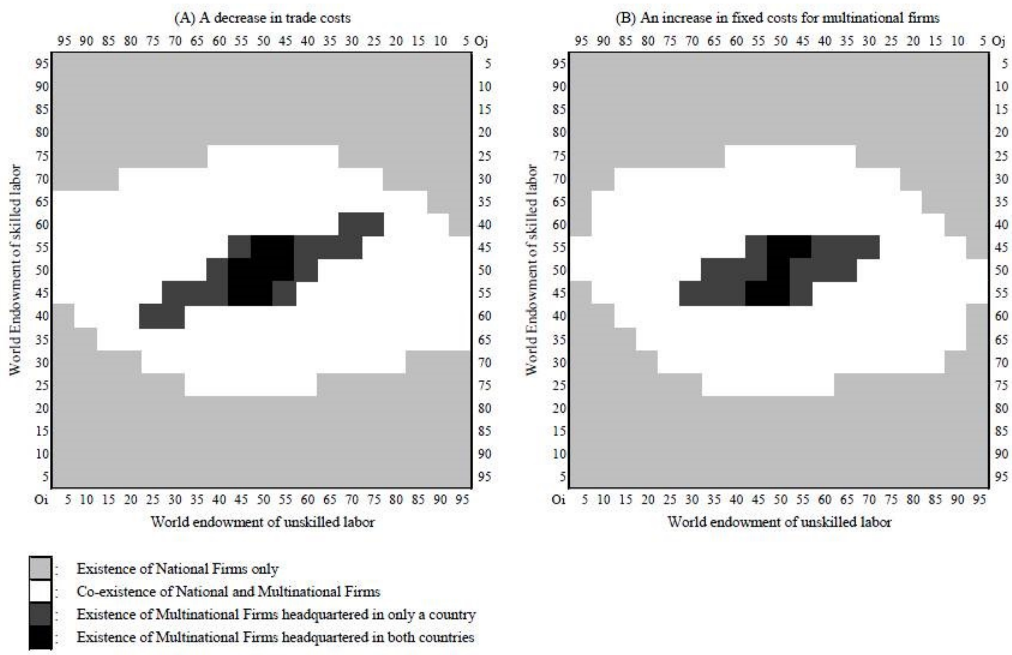


Figure 2.9: Equilibrium Regimes for Changes in Trade Costs and Fixed Costs

Second, consider the impact of a change in trade costs. Figure 2.9 (A) shows how equilibrium regimes are modified when I lower trade costs from 15% of marginal cost to 12%. A decrease in trade costs gives national firms an advantage.

Finally, consider the impact of a change in fixed costs. In Figure 2.9 (B), a ratio of multinational's fixed costs to national firm's fixed costs changes from 1.45 to 1.6. This change implies that investment costs for multinational firms only rise. It relatively improves the profitability of national firms.

2.5 Concluding Remarks

Recently trade literature has adopted nonhomothetic preferences in the demand-side of a traditional model. By doing so, a number of economists not only have acknowledged the importance of demand-side determinants in explaining trade flows and patterns but they have also helped understand diverse phenomena associated with international trade. Due to much more complicated patterns of MNE behavior and FDI, relative to trade, little investigation has concentrated on the demand-side issues in the FDI literature. Only market size variables have mainly been used as a demand-driven determinant of FDI, particularly within the KC framework.

In this chapter, a simple nonhomothetic preference structure was incorporated into the previous oligopoly model of horizontal MNEs underlying the standard KC theory. Connecting the implications from nonhomothetic preferences to the features of horizontal FDI suggests that per-capita income's growth effect and the Linder effect matters for FDI, independent of roles of market size and neutral factor.

These main consequences provide basic guidelines for a subsequent empirical study. First, the effect of world market growth in the previous research can be decomposed into the effects of the two demand factors, per-capita income and neutral factor. As per-capita income plays a leading role in determining aggregate demand, the positive impact of per-capita income growth on horizontal FDI is expected to emerge regardless of whether neutral factor is controlled for. Second, this paper conjectures that a divergence in per-capita income level among countries remarkably reduces horizontal FDI. The negative impact would significantly remain regardless of whether the variable of difference in neutral factor is controlled for. It is also expected to emerge when total income levels for countries are controlled for.

Chapter 3

LINDER EFFECT FOR OUTWARD FDI OF SOUTH KOREA: EVIDENCE FROM A KNOWLEDGE-CAPITAL APPROACH

3.1 Introduction

A large body of literature analyzing patterns of foreign direct investment (FDI) been dominated in the last decades by studies on production-side determinants. Numerous studies have accordingly focused on diverse supply-side reasons - factor endowments, productivity, trade costs, investment barriers, taxes, infrastructure, and so on. For the reason, research on demand-side determinants is scarce in the literature.

For analytical manageability, previous theoretical studies typically assume that a representative comsumer's preferences are homothetic in the demand-side of their models. However, an alternative view that the assumption of homothetic preferences is not appropriate recently rapidly spreads for better understanding of flows and patterns of FDI as well as trade. In particular, traditional trade models where tastes are not homothetic are highly stylized. Empirical evidence supports that preferences in real world are much closer to be non-homothetic.[1]

In this chapter, depending on the implications from the non-homothetic preferences, I empirically explore the influences of demand-driven factors to understand FDI flows and patterns. This empirical study is based on the chapter 2 in this dissertation, which argues the significant relevance between per-capita income and overseas activities of horizontal multinational enterprises (MNEs)

[1] As an example, Hunter and Markusen (1988) provide an empirical demonstration of non-homothetic preferences as their estimates of income elasticity of demand for the bulk of consumption goods are statistically different from one.

by examining the impacts of market size, neutral factor, and per-capita income as demand-driven factors and by comparing their relative importance.

More specifically, this paper focuses on the commonly known Linder effect for FDI by extending the existing empirical knowledge-capital (KC) model (of Carr et al., 2001).[2] Chapter 2 shows that as non-homothetic preferences are introduced into the demand-side of a previous traditional model for horizontal FDI, the impacts of growth and similarity of per-capita income on horizontal MNEs' overseas activities are overwhelming those of population and market size. Thus, the Linder hypothesis is now open to further empirical investigation.[3]

Chapter 2 also suggests that the Linder effect is important (1) regardless of controlling for population variables as per-capita income plays a predominant role in determining aggregate demand level; and (2) after controlling for total income variables as a divergence in per-capita income between two countries, holding total income identical and constant, is expected to discourage horizontal FDI. In addition, the other points to be checked include: whether the inclusion of another determinants, such as infrastructure and institution, affects the Linder effect; whether the Linder effect holds for FDI experiences of diverse countries; and whether there is a difference in the Linder effect across per-capita income levels of host countries. This chapter investigates the above all concerns.

This paper attempts to explain Korean multinational enterprises' (MNEs) experience with 57 host countries over the period after the financial crisis (1999-2010), based on the KC model. Most empirical papers based on the KC theory have mainly used data by the U.S. multinationals. This is primarily due to availability of FDI data suitable for a study's purpose. Relative to other host countries, the U.S. is not only much larger in total income, per-capita income, and population, but also much more abundant in relative skilled labor endowments. The analysis using only U.S. FDI data can be a problem which places a limitation on parameter space and therefore distorts empirical results because the U.S. is one of two countries in every country-pair observation (Carr

[2]Here, the Linder effect for FDI means that the similarity in per-capita income matters for horizontal FDI.
[3]Carr et al. (2001) show that the similarity in market size exerts a positive impact on horizontal FDI.

et al., 2003). For this reason, it might be interesting that this paper applies for outward FDI of Korea, which is less large and less skilled-labor-abundant than the U.S.

This paper adopts an advanced estimator of the generalized methods of moments (GMM) approach, referred to as the system GMM (hereafter, System GMM), given the availability of a dynamic panel data. The System GMM estimator has little been employed in estimating the KC model though the estimator controls for all econometirc issues and concerns to be considered.

This chapter reports robust empirical results on the Linder effect for FDI consistent with the predictions from the chapter 2. As conjectured, the similarity in per-capita income level was significant for Korean investors, implying that the Linder hypothesis holds for FDI at highly aggregated level. It is estimated that a 10% decrease in per-capita income divergences between Korea and an average host country leads to a 8.6% rise in Korean overseas direct investment. There was no change in the main results both across different specifications and for the U.S. FDI data.

The remainder of this paper is organized as follows. Section 3.2 describes the patterns and trends of Korean outward FDI in multiple aspects to help understand empirical analysis later. Section 3.3 sets up the empirical model, considers the estimation methodology, and presents the data. Section 3.4 discusses the estimation results. Section 3.5 concludes.

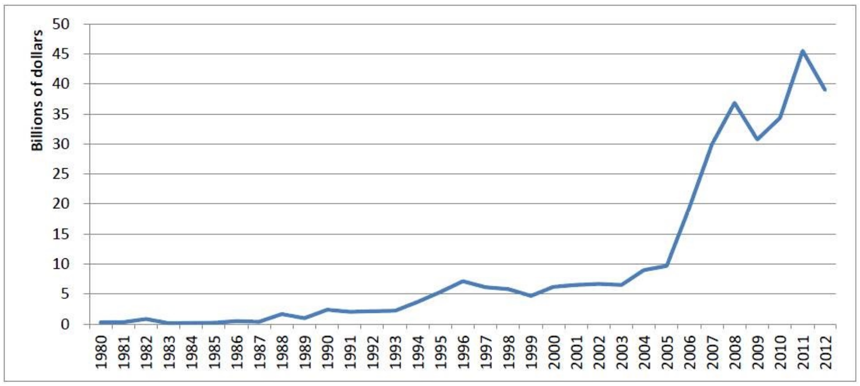
3.2 Patterns and Structural Features of Korean Outward FDI

This section summarizes patterns and structural features of Korea's outward FDI. It presents common views shown in previous studies for Korea's outward FDI.[4]

There has been a number of changes in various aspects of Korea's outward FDI. First, in Korean policy and system toward FDI, Korean government has gradually liberalized FDI since foreign investment began to be institutionalized in 1968. In 1997, it completed to liberalize FDI by allowing multinational firms a simple report without prior government approval. In annual total volume (see Figure 3.1), outward FDI accordingly amounted to US$1 billion in the late 1980s, rose steadily after then, and reached US$7.1 billion in 1996. It dwindled during the financial crisis of

[4]The previous studies include Ha (2010), Chun and Kwon (2007), Lee (2003 and 2004), and Kim and Rhe (2009).

1997-98, but it has turned to a rising streak since 2000 (US$6.2 billion). Since 2005 (US$9.7 billion), it has shown a rapid increase (US$19.4 billion in 2006 and US$36.8 billion in 2008). Therefore, an analysis over the period after both achieving the liberalization of FDI and escaping from the financial crisis impact might be reasonable for Korea.



Source: Export-Import Bank of Korea (http://www.koreaexim.go.kr/kr/work/check/oversea/use.jsp)

Figure 3.1: Trends of Korean Outward FDI

Second, I look at changes of Korean outward FDI in structural features, helping my analysis on the determinants of Korean outward FDI. According to the comparison of outward FDI by Korean multinationals across regions (Table 3.1), Asia ranks first in the cumulative amount of Korean outward FDI. FDI into the Asian region is mainly driven by medium and small businesses, and it is characterized by the highest proportion of FDI into manufacturing industry. Over the period of 1999-2010, it is also about half of the share of total volume of Korean outward FDI. Because almost all countries in the Asian region, excluding Japan, are developing countries, it has a motivation of vertical FDI that exploits low wage rates from abundant unskilled labor endowments in this region.

North America ranked second and Europe ranked third can commonly be characterized by large size of market (demand). FDI to these two regions is expected to be horizontal FDI motivated by incentives to reduce trade costs and by incentives to capture demands as horizontal MNEs construct production facilities in such regions. FDI to other regions (Middle and South America, Middle-East Asia, Africa, and Oceania) is commonly characterized by a relatively low share of FDI

Table 3.1: Trends of Korean Outward FDI across Regions

Regions	1999-2004 Total for 6 years (Millions of dollars)	1999-2004 Share (%)	2005-2010 Total for 6 years (Millions of dollars)	2005-2010 Share (%)	1980-2012 Total for entire years (Millions of dollars)	1980-2012 Share (%)
Asia	18,664	46	70,050	45	132,850	41
North America	9,106	24	29,760	21	75,180	23
Europe	6,015	15	25,083	14	46,133	14
Other America	1,153	3	6,913	4	14,604	4
Others	4,630	12	29,261	18	58,776	18

Source: Export-Import Bank of Korea (http;//www.koreaexim.go.kr/kr/work/check/oversea/use.jsp)

into manufacturing industry and a relatively high share of FDI into natural resource industry. It thus seems to include a significant proportion of a natural resource FDI.

When I look at trends of Korean outward FDI across countries, Table 3.2 presents the bias of Korean outward FDI to the U.S. and China. In the share of the cumulative total amount of FDI, the U.S. and China have attracted 20% and 17% of Korean outward FDI, respectively. Another trend is that there have been diversified in host countries after the beginning of a surge in outward FDI since 2005.

Table 3.2: Trends of Korean Outward FDI across Countries

Countries	1999-2004 Total for 6 years (Millions of dollars)	1999-2004 Share (%)	2005-2010 Total for 6 years (Millions of dollars)	2005-2010 Share (%)	1980-2012 Total for entire years (Millions of dollars)	1980-2012 Share (%)
United States	8,877	22	23,337	14	64,338	20
China	11,295	29	27,300	17	56,687	17
Hong Kong	1,511	4	10,403	6	17,524	5
Vietnam	1,740	4	9,988	6	15,307	5
Australia	510	1	3,147	2	14,450	4
Netherlands	2,202	6	5,404	3	11,255	3
Indonesia	877	2	4,021	2	10,894	3
Canada	229	1	6,423	4	10,842	3
United Kingdom	1,041	3	6,271	4	10,639	3
Malaysia	302	1	8,459	5	10,320	2
Others	10,984	28	56,315	35	105,287	32

Source: Export-Import Bank of Korea (http;//www.koreaexim.go.kr/kr/work/check/oversea/use.jsp)

By industry, Korean outward FDI has mostly been headed for manufacturing and service industries. It is remarkable that declines in FDI into the manufacturing industry and rises in FDI into service industry are a recent trend. Korean overseas investment has actively been made in competitive sub-industries within the manufacturing industry. By firm size, outward FDI was initially begun by large Korean firms, was gradually increased by competitive medium and small businesses, and has finally been extended to individuals as it was completely liberalized. When I look at changes in the owned shares of subsidiary by Korean investors in Ha (2010), the owned share of 100% had decreased from 75% to 50% during the initial period (1980-1995), but after the period its trend has been turned to increase by 70% in 2006-2009. The trend of the owned share of more than 50% shows the opposite of that of 100%. This pattern arises due to regulations on inward FDI in host countries. An analysis by FDI types is not easy due to the limitations of data availability. The main trend seems that greenfield investment has accounted for an absolutely large proportion, but merger and acquisition investment is recently rapidly increasing.

By purpose of outward FDI, two main, horizontal and vertical, incentives for FDI have attracted most Korean outward FDI as well. In both total volume of FDI and FDI into the manufacturing industry, this pattern is similar. A recent distinct difference of trends between horizontal and vertical FDI is that Korean mutinationals are sharply expanding their horizontal investment, but vertical FDI is somewhat on the decline (See Kim and Rhe, 2009).

3.3 Empirical Model, Estimation Approach, and Data

3.3.1 Empirical Model

Basic theoretical foundations of this paper come from the standard KC model incorporating both horizontal and vertical motivations for FDI into a framework. The KC model provides its predictions as follows. Unless parent and host countries have similarities in both market size and relative factor endowment and trade costs are low, two major types of MNEs emerge. First, in the presence of both increasing returns and imperfect competition, horizontal MNEs will be dominant when two countries have similarities in both market size and relative factor endowment but trade costs are sufficiently high. If there is a difference in market size, MNEs in relatively large country would be unwilling to invest in costly capacity in relatively small country. If there is a difference in relative factor endowment, MNEs in relative skilled-labor-abundant country have incentives to outsource unskilled-labor-intensive production activities to countries with relative skilled-labor-abundance. This difference in relative factor endowment is a main ground of the emergence of vertical MNEs, the other major type of MNEs. In vertical FDI, low trade barriers of parent country also matter because the substantial amount of final goods should be returned back to parent country.

Theoretical analyses of the chapter 2 exclude vertical MNEs because vertical FDI mainly seeks benefits from reducing production costs and therefore it is unlikely associated with demand-driven determinants. However, my empirical investigation in this chapter includes vertical motivations since the distinction between horizontal and vertical FDI is possible only in theory yet FDI data by the distinction are not available for most countries including Korea.

The main empirical specification is based on the main regression equation used in Carr. et al (2001) that estimates the standard KC model. However, it can be extended by adding per-capita income variables. The theoretical conjectures of chapter 2 include that **holding total income identical and constant**, a divergence in per-capita income between two countries is expected to discourage horizontal FDI (see Figure 2.8). This implies that independent of variables of total income (or market size), measured by GDP, the similarity in per-capita income are important for horizontal FDI. Therefore, I begin with the following basic estimating equation for FDI from Korea (h) to host country (f) in year t ($t = 1999, 2000, \cdots, 2010$).

$$\begin{aligned} ROFDI_{hft} = {} & \beta_0 + \beta_1 \times (ROFDI_{hft-1}) + \beta_2 \times (Sum\ GDP_{hft}) + \beta_3 \times (GDP\ Diff\ Sq_{hft}) \\ & + \beta_4 \times (HC\ Diff_{hft}) + \beta_5 \times (GDP\ Diff_{hft} \times HC\ Diff_{hft}) \\ & + \beta_6 \times (IB_{ft}) + \beta_7 \times (TC_{ht}) + \beta_8 \times (TC_{ft}) + \beta_9 \times (HC\ Diff\ Sq_{hft} \times TC_{ft}) \\ & + \beta_{10} \times (Sum\ GDPPC_{hft}) + \beta_{11} \times (GDPPC\ Diff\ Sq_{hft}) \\ & + \beta_{12} \times (GDPPC\ Diff_{hft} \times HC\ Diff_{hft}) + \varepsilon_{hft}. \end{aligned} \tag{3.1}$$

$ROFDI_{hft}$: FDI from Korean multinationals to a host country f in year t (US$)

$ROFDI_{hft-1}$: FDI from Korean multinationals to a host country f in year $t-1$ (US$)

$Sum\ GDP_{hft}$: Sum of real GDP of Korea and a host country f (US$)

$GDP\ Diff\ Sq_{hft}$: Square of difference in real GDP between Korea and a host country f

$HC\ Diff_{hft}$: Difference in index of human capital between Korea and a host country f

$GDP\ Diff_{hft} \times HC\ Diff_{hft}$: Product of difference in real GDP and difference in index of human capital

IB_{ft}: Barriers for FDI in a host country f

TC_{ht}: Costs when exporting final goods back from a host country f to Korea

TC_{ft}: Costs when exporting intermediate goods from Korea to a host country f

$HC\ Diff\ Sq_{hft} \times TC_{ft}$: Product of square of difference in index of human capital and costs when exporting intermediate goods from Korea to a host country f

$Sum\ GDPPC_{hft}$: Sum of real GDP per capita of Korea and a host country f (US$)

$GDPPC\ Diff\ Sq_{hft}$: Square of difference in real GDP per capita between Korea and a host country f

$GDPPC\ Diff_{hft} \times HC\ Diff_{hft}$: Product of difference in real GDP per capita and difference in index of human capital

ε_{hft}: Error term

The dependent variable, $ROFDI$, is defined as annual real FDI flows from Korea to a host country. The first explanatory variable, $ROFDI_{hft-1}$, represents a lagged value of the endogenous dependent variable. It captures that when MNEs have invested more in a country in the past year, they tend to invest more in the country in the present year, i.e. so-called self-reinforcing effect, learning-by-doing effect, or agglomeration effect (Noorbakhsh et al., 2001; and Wheeler and Mody, 1992) and the coefficient β_1 is expected to be positive. The second explanatory variable, $Sum\ GDP$, represents the sum of two countries' market size (i.e. the sum of Korean real GDP and host country's real GDP). The coefficient β_2 should be positive as a larger joint market size is expected to increase FDI. The standard KC theory predicts that the similarity in market size is also an important motivation for horizontal FDI and therefore β_3 should be negative in principle. However, the coefficient on market size similarity can be positive as one partner, here Korea, is not sufficiently large in size. In such cases, it is difficult to discriminate theoretically between horizontal and vertical motivations (Chellaraj et al., 2013).

In the paper, $HC\ Diff$ is the difference in the index of human capital between Korea and a host country. Korea is relatively skilled-labor-abundant compared with host countries in most cases of my sample, and it thus has a higher value of human capital index than most host countries (see Table B.1 in Appendix B).[5] The difference becomes larger as the host country is more human-capital-abundant. The standard KC theory suggests that horizontal FDI more likely occurs when two countries are similar in this relative factor endowments, but vertical FDI is more likely encouraged as Korean MNEs have more opportunity to reduce production costs when a difference in the relative factor endowments rises. Thus, the expected sign for β_4 becomes ambiguous. If the $HC\ Diff$ variable mainly captures horizontal motivation for FDI, β_4 should be negative. On the other hand, if Korean FDI largely depends on vertical motivation, β_4 would be positive. The fifth term is the product of $GDP\ Diff$ and $HC\ Diff$. Awokuse et al. (2012) explain that this variable is included to capture that given a market size difference, larger difference in skilled-labor endowment would decline horizontal FDI relative to increased vertical FDI. Therefore, the expected sign for β_5 is also ambiguous for Korean FDI.

The sixth variable is IB (Investment barriers), indicating perceived impediments of investing in a host country. As any investment impediments are expected to lower all types of FDI, β_6 should be negative. The next two variables are related to trade costs. Higher trade costs in Korea (parent country) discourage vertical FDI because higher costs make importing of the final products back to Korea more costly. Thus, β_7 is expected to be negative. On the other hand, higher trade costs in a host country foster horizontal FDI because MNEs should prefer affiliate production to costly export. Thus, β_8 is expected to be positive. The variable $HC\ Diff\ Sq \times TC$ is an interaction

[5] In the Table B.1 of Appendix B presenting basic statistics of variables, it can be identified that Korea is a human-capital-abundant country.

term between squared human capital differences and trade costs in a host country. As mentioned just before, a higher level of trade costs that Korean firms have to pay when exporting to the host country extends incentives for horizontal FDI, and the incentives for horizontal FDI expand when a difference in human capital is smaller. Thus, this variable captures the idea that given a level of trade costs in the host country, the effects of the trade costs on horizontal FDI rely on a difference in human capital. In other words, the direct positive effects of the trade costs on horizontal FDI decrease as a difference in human capital grows. The coefficient β_9 is therefore expected to be negative.

The next explanatory variable, $Sum\ GDPPC$, represents the sum of Korean real GDP per capita and host country's real GDP per capita. The coefficient β_{10} should be positive as a theoretical result of this paper (Figure 2.6 (A)) clearly shows that the larger world aggregate demand due to a growth of individual income is, the more horizontal mutinational's activities are. The findings on the Linder effect lie at the center of this paper. Theoretical results on asymmetric per-capita income between the two countries commonly highlights the Linder effect that is also an important motivation for horizontal FDI (i.e. the similarity in per-capita income raises horizontal FDI) and therefore β_{11} should be negative. The final term in equation (3.1) is the product of $GDPPC\ Diff$ and $HC\ Diff$. It is well known that horizontal FDI is more active among developed countries and vertical FDI is more brisk between developed and developing countries. Between Korea and a developed country, values of both variables, $GDPPC\ Diff$ and $HC\ Diff$, are small, but they would have a large positive figure between Korea and a developing country. The sign of β_{12} thus depends on a FDI motivation that the interaction variable captures. Most studies to estimate the KC model include geographical distance in the regression equation. In this paper, however, I exclude this time-invariant variable due to the use of a GMM estimation approach.

Alternatively, one may regard that the effects of market size variables in the previous empirical KC model, by the definition of GDP, can be decomposed into those of variables of two fundamental factors, per-capita income and neutral factor. In theoretical considerations of the chapter 2, it is analyzed that when comparing between the effects of these two variables on aggregate demand in a country, their roles are qualitatively similar, but per-capita income plays a leading role in determining aggregate demand in a country.[6] Thus, the theoretical results conjecture that the similarity in per-capita income level encourages horizontal FDI regardless of controlling for variables of neutral factor, measured by the number of population. Accordingly, I estimate an alternative specification, which adds population variables to the equation (3.1) instead of excluding GDP variables.

To check whether the main results driven from the specification (3.1) are robust, another examination is to identify whether the inclusion of FDI-related determinants, such as infrastructure and institution, changes the Linder effect of my central interest. In addition, this paper also considers an inquiry of whether the Linder effect holds for FDI experiences of the other country, the U.S., different from Korea.

3.3.2 Estimation Approach

3.3.2.1 Econometric Issues

Empirical analysis of this paper has the following characteristics. First, the dependent variable $ROFDI$ is dynamic in nature (Awokuse et al., 2012). In this case, its lagged variable as a explanatory variable is in general included. Second, it is pre-determined, but it is not completely exogenous, so that its instrument variable is essential to estimation. Third, I need to control for some fixed effects that can be present across host countries. Fourth, an estimation approach using instrument variables is also appropriate because some of independent variables can have endogeneity problem including reverse causality. Fifth, I should consider heteroscedasticity and autocorrelation for the error term. Finally, the number of time series is small, but the number of analyzed host countries is large.

For the reasons with availability of panel data, the empirical analysis of this paper can use a GMM estimator. An estimator of System GMM in general shows a good performance in terms of bias and precision than that of Differenece GMM because the former uses additional instruments.

[6] This point is also found in previous papers such as Markusen (2013) and Fieler (2011).

I will again discuss this point shortly. Therefore, many applied studies with dynamic panel settings use it (e.g. Carkovic and Levine, 2005).

A GMM approach is a method in which it basically finds estimated parameters that minimize a weighted objective function. While an one-step estimator produces the estimated parameters using an initial weight matrix, a two-step estimator implements an additional procedure where the estimated results driven from the one-step process are used to minimize the weighted objective function again. It is well known that the two-step estimator is superior in terms of asymptotical properties to the one-step estimator (Min and Choi, 2009). Therefore, the two-step estimator of System GMM with robust errors considered for heteroscedasticity is employed to yield main estimation results.

3.3.2.2 Detailed Discussion on System GMM Estimator

Consider the following estimating equation:

$$\begin{aligned} &FDI_{jt} - FDI_{jt-1} = (\alpha - 1)FDI_{jt-1} + \beta' X_{jt} + \varepsilon_{jt} \\ &\Leftrightarrow FDI_{jt} = \alpha FDI_{jt-1} + \beta' X_{jt} + \varepsilon_{jt}, \end{aligned} \tag{3.2}$$

where FDI is my FDI measure as the dependent variable, X is the set of independent variables other than the lagged FDI, ε is an error term (before difference process), and subscript j and t are (host) country and year, respectively. I assume that the error term ε consists of the unobserved country-specific effects υ and the pure error term u.

By first-differencing, the unobserved country-specific fixed effects υ is removed.

$$\begin{aligned} &FDI_{jt} - FDI_{jt-1} = \alpha(FDI_{jt-1} - FDI_{jt-2}) + \beta'(X_{jt} - X_{jt-1}) + (\varepsilon_{jt} - \varepsilon_{jt-1}) \\ &\Leftrightarrow \Delta FDI_{jt} = \alpha \Delta FDI_{jt-1} + \beta' \Delta X_{jt} + \Delta\varepsilon_{jt}, \text{ and } \Delta\varepsilon_{jt} = (\upsilon_j - \upsilon_j) + (u_{jt} - u_{jt-1}) = \Delta u_{jt}. \end{aligned} \tag{3.3}$$

Two types of endogeneity are required to be controlled for. First, some FDI determinants may be endogenously determined with FDI. To control for this type of endogeneity, their lagged levels can be used as instruments. This makes the endogenous variables pre-determined, and thus they are not correlated with the error term $\Delta\varepsilon_{jt}$. Second, the error term $\Delta\varepsilon_{jt}$ after differencing may be correlated with ΔFDI_{jt-1}, the lagged variable of dependent variable as a regressor. To avoid this endogeneity problem, ΔFDI_{jt-1} is also instrumented with its past levels. If I assume that the error term ε_{jt} before differencing is serially uncorrelated, and that independent variables are not correlated with future values of the error term, a GMM estimator for dynamic panel employs two moment conditions as follows.

$$E\left[FDI_{jt-k} \cdot \Delta\varepsilon_{jt}\right] = 0, \text{ for } t = 3, \cdots, T \text{ and } k \geq 2. \tag{3.4}$$

$$E\left[X_{jt-k} \cdot \Delta\varepsilon_{jt}\right] = 0, \text{ for } t = 3, \cdots, T \text{ and } k \geq 2. \tag{3.5}$$

This estimator based on the moment conditions is generally referred to as Difference GMM estimator.

However, it is documented that this difference estimator may have statistical weaknesses. When independent variables are persistent over time, the used instruments can become weak predictors for the endogenous variables (Blundell and Bond, 1998). These weak instruments not only can lead to biased coefficients in small sample, but they can also asymptotically cause an increase in the variance of the estimated coefficients.

To avoid the biases and imprecision with the difference estimator, Blundell and Bond (1998) suggest that additional moment conditions are available. If I adopt an assumption on a stationarity of the initial observation, the lagged differences of the endogenous variables can be used as extra instruments. Thus, the following additional moment conditions are:

$$E\left[(FDI_{jt-k} - FDI_{jt-k-1}) \cdot \varepsilon_{jt}\right] = E\left[(FDI_{jt-k} - FDI_{jt-k-1}) \cdot (\upsilon_j + u_{jt})\right] = 0, \text{ for } k = 1 \tag{3.6}$$

$$E\left[(X_{jt-k} - X_{jt-k-1}) \cdot \varepsilon_{jt}\right] = E\left[(X_{jt-k} - X_{jt-k-1}) \cdot (\upsilon_j + u_{jt})\right] = 0, \text{ for } k = 1. \tag{3.7}$$

This estimator based on the moment conditions (3.4) - (3.7) is referred to as System GMM estimator. In this paper, I use this System GMM estimator for the dynamic panel to produce unbiased and efficient estimates.

The consistency of the System GMM estimator relies on the validity of the used instruments. To examine the validity of the used instruments, I conduct a Hansen test of overidentifying conditions. Note that when heteroscedasticity is considered through robust error, Hansen statistics instead of Sargan statistics are used for testing overidentifying restrictions (Min and Choi, 2009). Furthermore, the number of the used instruments should be equal to or less than than the number of countries. If it is greater than the number of countries, the analysis can have a problem for the reliability issue of the above test of overidentifying restrictions.

Another test is associated with the assumption of no serial correlation of the error term ε_{hft} (before difference process). By Arellano-Bond statistics, I assess whether the error term ε_{hft} is serially correlated. Note that if the error term ε_{hft} (before difference process) is not serially correlated, then there may exist a first-order serial correlation in the differenced error term, but the differenced error term should not present a second-order serial correlation (Awokuse et al., 2012). All tests and considerations conducted in this paper support that the analysis is statistically significant. I do not address this issue hereafter again.

3.3.3 Data

My analytical sample is a balanced panel data of 57 countries over the period 1999-2010.[7] Data on the dependent variable are annual data of Korean outward FDI flows and are from the Export-Import Bank of Korea. These raw data represent a nominal measure and are reported in thousands of U.S. dollars. The data were converted to a real measure in millions of 2005 dollars

[7] The list of 57 host countries includes 13 Asian countries (Bangladesh, China, Hong Kong, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Singapore, Taiwan, Thailand, and Vietnam), 2 North American countries (Canada and United States), 26 European countries (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine, and United Kingdom), and 16 other countries (10 Other American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, and Peru), 2 Oceanian countries (Australia and New Zealand), 2 Middle-east Asian countries (Israel and Jordan), and 2 African countries (Egypt and South Africa)).

using a deflator from the World Bank.

Data on real GDP, population, and human capital used in constructing several variables are from Penn World Table 8.0 database. According to the definition, GDP per capita is calculated by dividing real GDP by the number of population. Annual real GDP and population are measured in millions of 2005 U.S. dollars and in millions of people, respectively, and thus real GDP per capita used is measured in one 2005 U.S. dollar. As a proxy for skill endowments, this paper uses an index of human capital indicating the amount of human capital per worker. The index is created based on information on both the average years of schooling from Barro-Lee (2012) and the return to education from Psacharopoulos (1994). A number of studies estimating the KC model have used occupation data from International Labour Organization (ILO) to measure relative skilled-labor endowments. ILO data have shortcomings in that they are available for considerably limited countries and years.

Data on trade costs and investment barriers are taken from the Economic Freedom of the World (EFW) database of the Fraser Institute. As a proxy for trade costs, the index of regulatory trade barriers is employed. In the case of investment impediments, I use the index labeled as foreign ownership/investment restrictions. As both indexes have published for every 5 year before 2000, linear interpolation is conducted to obtain data in 1999. Both indexes commonly range from zero to 10, with 10 indicating the least trade costs and the lowest investment barriers, respectively. To construct my measures from these two indexes, I use the formula: $(10 - index) \times 10$. Thus, my measures commonly have a zero-to-100 scale and indicate that a higher value means a larger trade costs and a higher investment barriers.[8]

3.4 Empirical Results

I first estimate the equation (3.1) of the main specification with confirming the standard empirical KC model as a preliminary analysis (Table 3.3). I then run additional regressions for relevant specifications to check the robustness of the main results. For each specification, estimation

[8]See Appendix A.3 for summary statistics and correlation matrix on main estimation analysis.

results by the one-step estimator of the System GMM approach are included.[9]

3.4.1 Main Estimation Results

Table 3.3 shows estimation results by the System GMM both for the standard empirical KC model (Columns (1) and (2)) and for the main specification in this paper (Columns (3) and (4)). In Columns (1) and (2), I confirm the standard KC theory for Korean overseas direct investment as almost all estimated coefficients have their expected signs.

The Columns (3) and (4) of Table 3.3 fall under the main empirical results for which the standard empirical KC model is re-estimated with per-capita income variables to examine the Linder effect predicted theoretically. Most coeffecients show that it is likely that the results are consistent with the predictions from the KC theory. One-year-lagged endogenous variable ($L.ROFDI$) shows that its coeffecients are always positive and statistically significant. Past activities by Korean multinationals have a siginificant positive impact on current (and future) FDI. Human capital difference variable also shows significant positive coefficients, implying a vertical motive. The interaction variable between human capital difference and market size difference has a significantly negative impact, consistent with empirical results of previous studies such as Awokuse et al. (2012) and Chellaraj et al. (2013). The coefficients on investment barriers are always negative, as expected, but insignificant.

The next three variables after $GDP\ Diff \times HC\ Diff$ present more reinforced significance with no change from the expected signs in Columns (3) and (4), relative to Columns (1) and (2). Trade costs for Korea are clearly associated with the vertical FDI. As the effect of Korea's trade costs is significantly negative, I again confirm vertical motivations that Korean investors have had. The coefficient on trade costs for host countries is significantly positive, but the coefficient on the interaction term between squared human capital difference and trade costs for host countries is significantly negative. These results imply that higher trade costs in host countries extend

[9] As mentioned earlier, the one-step estimator is less efficient than the two-step estimator, but it is turned out that there are no significant differences in results between the two estimators. I therefore discuss the results through two-step estimator only.

Table 3.3: Main System GMM regression Results

		Dependent Variable: ROFDI			
		Standard KC model		Main (extended) model	
Explanatory Variables	Expected Sign	(1) One-step	(2) Two-step	(3) One-step	(4) Two-step
L.ROFDI	+	0.747***	0.747***	0.586***	0.585***
		(0.0839)	(0.0838)	(0.107)	(0.107)
Sum GDP	+	$5.50e-05^{*}$	$5.50e-05^{*}$	-6.33e-06	-7.89e-06
		(3.06e-05)	(3.06e-05)	(3.95e-05)	(3.78e-05)
GDP Diff Sq	- / +	3.08e-12	3.08e-12	$1.26e-11^{***}$	$1.27e-11^{***}$
		(3.41e-12)	(3.41e-12)	(4.36e-12)	(4.36e-12)
HC Diff	- / +	164.2**	165.9**	210.2***	203.4***
		(83.54)	(82.37)	(77.04)	(77.87)
GDP Diff × HC Diff	- / +	-2.71e-05	-2.69e-05	$-1.03e-04^{***}$	$-1.05e-04^{***}$
		(2.93e-05)	(2.93e-05)	(3.58e-05)	(3.67e-05)
Host Investment Barriers	-	-2.993	-3.001	-3.863	-3.775
		(2.144)	(2.150)	(2.403)	(2.391)
Home Trade Costs	-	-2.273	-2.287	-10.78^{***}	-10.66^{***}
		(1.492)	(1.497)	(3.177)	(3.167)
Host Trade Costs	+	2.333	2.327	4.959*	4.874*
		(2.254)	(2.325)	(2.724)	(2.756)
HC Diff Sq × Host Trade Costs	-	-3.417^{*}	-3.389^{*}	-5.704^{***}	-5.524^{**}
		(1.760)	(1.800)	(2.165)	(2.161)
Sum GDPPC	+			0.00733***	0.00730***
				(0.00218)	(0.00219)
GDPPC Diff Sq	-			$-1.10e-07^{*}$	$-1.06e-07^{*}$
				(6.37e-08)	(6.11e-08)
GDPPC Diff × HC Diff	- / +			0.00974**	0.00963*
				(0.00485)	(0.00508)
Number of Observations		529	529	529	529
Number of Countries		57	57	57	57
Number of Instrument Variables		53	53	49	49
Arellano-Bond Statistics (1)		-1.92	-1.90	-2.18	-1.85
Arellano-Bond Statistics (2)		-0.18	-0.18	-0.13	-0.12
Hansen Statistics		49.06	49.06	48.95	48.95

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

horizontal incentives, but the horizontal incentives shrink as a difference in human capital grows (i.e. vertical incentives are larger).

The results for the impacts of both GDP and GDP per capita variables are of central interest in the paper. First, the two per-capita income variables, $Sum\ GDPPC$ and $GDPPC\ Diff\ Sq$, have the significant expected influences on Korean overseas investment. A rise in the sum of two countries' per-capita incomes exerts significant positive effects on Korean investors. More importantly, a larger divergence in individual income levels between Korea and host countries discourages

Korean overseas investment. This central result of this paper implies that the Linder hypothesis holds for FDI. It also supports that Korean investors have much horizontal (market-seeking) incentives. The last variable, $GDPPC\ Diff \times HC\ Diff$, has significant positive coefficient, indicating a vertical motivation. Second, there are large changes in both sign and significance for the coefficients on $Sum\ GDP$ and $GDP\ Diff\ Sq$ between the two specifications. For the specification of the standard KC model (Column (1) and (2)), the coefficients on both variables seem to be consistent with the predictions from the KC theory, although the coefficients on $GDP\ Diff\ Sq$ are insignificantly positive. However, they show surprising results clearly inconsistent with the basic KC theory for the extended specification. This implies that a growth and a similarity of market size (or total income) are unlikely to have stable effects on FDI. On the other hand, the influences on the per-capita income growth and similarity variables are likely stable across different specifications as shown in Table 3.5 and 3.6 shortly.

Overall, most variables in the extended empirical model strongly influence Korean overseas investment, as expected. In particular, I find that the Linder hypothesis for Korean outward FDI holds at highly aggregate level.

To investigate economic significance of the estimated Linder effect, I consider the following partial derivative of Korean outward FDI with respect to per-capita GDP difference in the equation (3.1):

$$\frac{\partial ROFDI}{\partial GDPPC\ Diff} = 2 \times \beta_3 \times GDPPC\ Diff + \beta_5 \times HC\ Diff. \tag{3.8}$$

The total impact of individual income divergences is determined by two terms. The first term captures that FDI activities are greatest when the countries are similar in individual income level. By the second term, on the other hand, human capital differences also affect the effect of individual income divergences as the theory suggests. Here, in order to facilitate interpretation of economic significance, I compute implied elasticity at the sample average of relevant variables. The elasticity computed from the main results (Column (4) of Table 3.3) indicates that a 10% decrease in per-capita income divergences leads to a 8.6% rise in Korean overseas direct investment. In other words, if per-capita income divergences between Korea and host country shrink by US$330, the host country attracts, on average, more direct investment from Korea by US$22 million.

One may question whether the existence of the Linder effect varies according to per-capita income levels of host countries. For investigation, I divide the sample used to produce Table 3.3 into the two subsamples, develpoed-country subsample and developing-country subsample, by whether the per-capita income level of each host country is greater than that of Korea. Then, I estimate the regression equation (3.1) for each of these two subsamples.

Table 3.4: System GMM Regression Results for Two Subsamples by Per-capita Income Level

Explanatory Variables	Expected Sign	(1) Entire Countries	(2) Developed Countries	(3) Developing Countries
L.ROFDI	+	0.585***	0.535***	0.613***
		(0.107)	(0.105)	(0.0828)
Sum GDP	+	-7.89e-06	-7.58e-05	2.05e-04
		(3.78e-05)	(5.70e-05)	(1.45e-04)
GDP Diff Sq	- / +	$1.27e-11$***	$3.33e-11$***	3.50e-12
		(4.36e-12)	(1.20e-11)	(1.05e-11)
HC Diff	- / +	203.4***	692.8**	31.79
		(77.87)	(311.2)	(238.8)
GDP Diff × HC Diff	- / +	$-1.05e-04$***	$-5.22e-04$**	-9.01e-05
		(3.67e-05)	(2.14e-04)	(9.28e-05)
Host Investment Barriers	-	-3.775	-3.492	-5.670
		(2.391)	(4.276)	(3.724)
Home Trade Costs	-	−10.66***	−17.97*	-6.326
		(3.167)	(9.800)	(4.317)
Host Trade Costs	+	4.874*	1.226	-2.046
		(2.756)	(7.319)	(2.112)
HC Diff Sq × Host Trade Costs	-	−5.524**	−71.49**	4.025
		(2.161)	(34.00)	(3.482)
Sum GDPPC	+	0.00730***	0.0147**	0.00150
		(0.00219)	(0.00593)	(0.00521)
GDPPC Diff Sq	-	$-1.06e-07$*	$-3.18e-07$*	9.27e-07
		(6.11e-08)	(1.80e-07)	(7.81e-07)
GDPPC Diff × HC Diff	- / +	0.00963*	0.000878	-0.0252
		(0.00508)	(0.0247)	(0.0260)
Number of Observations		529	213	269
Number of Countries		57	26	30
Number of Instrument Variables		49	25	29
Arellano-Bond Statistics (1)		-1.85	-1.67	-1.13
Arellano-Bond Statistics (2)		-0.12	-1.22	0.36
Hansen Statistics		48.95	20.03	27.35

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

Column (2) of Table 3.4 displays the estimation results for the develpoed-country subsample where host countries have a higher per-capita income level than Korea, and Column (1) for the developing-country subsample. These two columns shows quite large differences in sign and significance of coefficients. Overall, the results for the develpoed-country subsample are similar to those for the previous integrated sample (Column (1)), while the results for the developing-country subsample are not. Blonigen and Wang (2004) argue that the effect of each underlying factor on FDI to developing countries is considerably different from that on FDI to developed countries. Here, it is also found that consideration on the issue pointed out by Blonigen and Wang (2004) matter for relevant studies.

3.4.2 Robustness Checks

The main results of Table 3.3 are strengthened by additional regressions in Table 3.5 and 3.6, which consider three alternative specifications. In Columns (1) and (2) of Table 3.5, I estimate an equation in which GDP variables are excluded from the main specification of the equation (3.1).[10] Further, the effects of GDP variables in the standard KC specification may be decomposed to those of two variables, GDP per-capita and population, according to the definition of GDP. Columns (3) and (4) of Table 3.5 show the results for the estimating equation reflecting this idea.

When I compare the results in all columns of Table 3.5 with those in Columns (3) and (4) of Table 3.3, the influences of $GDPPC$ variables on Korean overseas investment barely change in both the statistical significance and the expected signs, as predicted. I again confirm that the key hypothesis is reasonable i.e. FDI is likely to be greater between countries similar in individual income levels. The comparison implies that the Linder effect for FDI is important regardless of controlling for either total income variables or population variables. The other variables commonly show that their coefficients all still keep their expected signs but for some of them statistical significance varies across specifications. In Columns (3) and (4) of Table 3.5, a rise in $Sum\ POP$

[10] This equation can be regarded as GDP per capita variables replace GDP variables in the standard KC specification because per-capita income plays a leading role. Therefore, I refer to this specification as replaced model.

Table 3.5: System GMM regression Results for No Controlling for GDP Variables and for Controlling for Population Variables

		Dependent Variable: ROFDI			
		Replaced model		Decomposed model	
Explanatory Variables	Expected Sign	(1) One-step	(2) Two-step	(3) One-step	(4) Two-step
L.ROFDI	+	0.864***	0.864***	0.693***	0.694***
		(0.0481)	(0.0481)	(0.0485)	(0.0484)
Sum GDPPC	+	0.00735***	0.00736***	0.00730***	0.00729***
		(0.00221)	(0.00222)	(0.00238)	(0.00236)
GDPPC Diff Sq	- / +	$-6.30e-08$*	$-6.58e-08$*	$-8.24e-08$*	$-9.23e-08$*
		(3.57e-08)	(3.43e-08)	(4.21e-08)	(3.62e-08)
HC Diff	- / +	56.12	56.04	12.83	15.96
		(107.1)	(107.7)	(60.00)	(66.46)
GDPPC Diff × HC Diff	- / +	0.0157***	0.0157***	0.0115***	0.0117***
		(0.00563)	(0.00565)	(0.00415)	(0.00425)
Host Investment Barriers	-	−4.402**	−4.402**	−5.155*	−5.162*
		(2.043)	(2.042)	(2.632)	(2.649)
Home Trade Costs	-	−9.964***	−9.960***	−12.24***	−12.24***
		(3.172)	(3.163)	(4.361)	(4.512)
Host Trade Costs	+	4.100*	4.091*	2.144	2.162
		(2.234)	(2.232)	(2.940)	(3.055)
HC Diff Sq × Host Trade Costs	-	−5.452**	−5.435**	-2.909	-2.991
		(2.442)	(2.461)	(1.782)	(2.084)
Sum POP	+			1.773***	1.779***
				(0.364)	(0.376)
POP Diff Sq	-			3.75e-05	3.06e-05
				(0.000270)	(0.000279)
POP Diff × HC Diff	- / +			1.300***	1.300***
				(0.159)	(0.158)
Number of Observations		529	529	529	529
Number of Countries		57	57	57	57
Number of Instrument Variables		56	56	48	48
Arellano-Bond Statistics (1)		-2.03	-1.94	-1.95	-1.92
Arellano-Bond Statistics (2)		-0.17	-0.17	-0.18	-0.16
Hansen Statistics		52.44	52.44	50.27	50.82

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

or $POP\ Diff \times HC\ Diff$ increases Korean outward FDI.

Another specification examination is to check the significant presence of changes in the results of interest by adding two FDI-related factors, infrastructure and institution, into the main estimating equation. Table 3.6 allows for a comparison of the estimation results from between the alternative specification and the main specification. Overall, it shows that the sign and the significance for coefficient estimates of interest are preserved.

Table 3.6: System GMM Regression Results, Controlling for Infrastructure and Institution

Explanatory Variables	Expected Sign	Dependent Variable: ROFDI Main model (1) One-step	(2) Two-step	Model with infrastructure and institution (3) One-step	(4) Two-step
L.ROFDI	+	0.586***	0.585***	0.775***	0.763***
		(0.107)	(0.107)	(0.327)	(0.324)
Sum GDP	+	-6.33e-06	-7.89e-06	$-2.99e-04$**	$-3.08e-04$***
		(3.95e-05)	(3.78e-05)	(1.18e-04)	(1.14e-04)
GDP Diff Sq	- / +	$1.26e-11$***	$1.27e-11$***	$3.50e-11$***	$3.72e-11$***
		(4.36e-12)	(4.36e-12)	(1.14e-11)	(1.21e-11)
HC Diff	- / +	210.2***	203.4***	402.8**	395.1*
		(77.04)	(77.87)	(194.9)	(229.4)
GDP Diff × HC Diff	- / +	$-1.03e-04$***	$-1.05e-04$***	$-2.93e-04$***	$-3.06e-04$***
		(3.58e-05)	(3.67e-05)	(1.11e-04)	(1.13e-04)
Host Investment Barriers	-	-3.863	-3.775	−11.56**	−10.86**
		(2.403)	(2.391)	(4.273)	(4.439)
Home Trade Costs	-	−10.78***	−10.66***	10.23	11.49
		(3.177)	(3.167)	(8.456)	(8.204)
Host Trade Costs	+	4.959*	4.874*	5.254	4.144
		(2.724)	(2.756)	(3.628)	(3.661)
HC Diff Sq × Host Trade Costs	-	−5.704***	−5.524**	−20.46**	−19.26**
		(2.165)	(2.161)	(8.974)	(9.556)
Sum GDPPC	+	0.00733***	0.00730***	0.0744***	0.0695***
		(0.00218)	(0.00219)	(0.0264)	(0.0245)
GDPPC Diff Sq	-	$-1.10e-07$*	$-1.06e-07$*	$-1.77e-06$**	$-1.71e-06$*
		(6.37e-08)	(6.11e-08)	(8.46e-07)	(9.57e-07)
GDPPC Diff × HC Diff	- / +	0.00974**	0.00963*	0.0683**	0.0640**
		(0.00485)	(0.00508)	(0.0269)	(0.0251)
Infrastructure				2.312	0.189
				(3.471)	(3.497)
Institution				−43.76**	−38.58***
				(17.16)	(14.72)
Number of Observations		529	529	340	340
Number of Countries		57	57	47	47
Number of Instrument Variables		53	53	37	37
Arellano-Bond Statistics (1)		-1.92	-1.90	-2.07	-1.69
Arellano-Bond Statistics (2)		-0.18	-0.18	-0.15	-0.21
Hansen Statistics		49.06	49.06	24.65	24.65

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

The last investigation in the chapter is look at whether the Linder effect holds for an analysis using the U.S. data. Before the discussion on the regression results, it should be noted that there are differences in used data as home countries are different (Korea vs the U.S.). First, while so far FDI flows data in Korean FDI estimations are used due to data availability, affiliate sales data are employed for the U.S. Second, while human capital data as a proxy for labor endowments are used for Korea, skilled labor endowments are employed for the U.S. Finally, the period analyzed for Korea is 1999-2010 while years for the U.S. analysis are 1997-2008.

Column (3) and (4) of Table 3.7 are the results for the U.S. and Column (1) and (2) are identical to main results of Column (3) and (4) of Table 3.3. Due to the differences in used data, the sizes of estimated coefficients are different between home countries. However, the sign and the significance do not vary between home countries.

Table 3.7: System GMM Regression Results for U.S. Affiliate Sales

Dependent Variable: ROFDI					
		Model for Korean FDI		Model for US Affiliate Sales	
Explanatory Variables	Expected Sign	(1) One-step	(2) Two-step	(3) One-step	(4) Two-step
L.ROFDI	+	0.586***	0.585***	1.138***	1.139***
		(0.107)	(0.107)	(0.0161)	(0.0163)
Sum GDP	+	-6.33e-06	-7.89e-06	-0.0183	-0.0265
		(3.95e-05)	(3.78e-05)	(0.0985)	(0.101)
GDP Diff Sq	- / +	$1.26e-11$***	$1.99e-08$***	$1.99e-08$***	$3.72e-11$***
		(4.36e-12)	(4.36e-12)	(4.82e-09)	(4.88e-09)
HC Diff	- / +	210.2***	203.4***	$1.511e+07$**	$1.565e+07$**
		(77.04)	(77.87)	(6.055e+06)	(6.102e+06)
GDP Diff × HC Diff	- / +	$-1.03e-04$***	$-1.05e-04$***	-1.767***	-1.791***
		(3.58e-05)	(3.67e-05)	(0.532)	(0.528)
Host Investment Barriers	-	-3.863	-3.775	3,994	3,799
		(2.403)	(2.391)	(4,197)	(4,250)
Home Trade Costs	-	-10.78***	-10.66***	$-74,965$***	$-71,598$***
		(3.177)	(3.167)	(23,359)	(23,662)
Host Trade Costs	+	4.959*	4.874*	$14,455$**	$14,230$**
		(2.724)	(2.756)	(6,585)	(7,243)
HC Diff Sq × Host Trade Costs	-	-5.704***	-5.524**	$-430,366$***	$-423,298$***
		(2.165)	(2.161)	(140,444)	(161,148)
Sum GDPPC	+	0.00733***	0.00730***	-19.41	-18.65
		(0.00218)	(0.00219)	(12.80)	(13.33)
GDPPC Diff Sq	-	$-1.10e-07$*	$-1.06e-07$*	$-9.19e-04$*	$-8.81e-04$*
		(6.37e-08)	(6.11e-08)	(4.74e-04)	(5.00e-04)
GDPPC Diff × HC Diff	- / +	0.00974**	0.00963*	282.5***	268.2***
		(0.00485)	(0.00508)	(84.37)	(88.71)
Number of Observations		529	529	432	432
Number of Countries		57	57	46	46
Number of Instrument Variables		53	53	44	44
Arellano-Bond Statistics (1)		-1.92	-1.90	-2.19	-2.24
Arellano-Bond Statistics (2)		-0.18	-0.18	-1.31	-1.29
Hansen Statistics		49.06	49.06	41.31	41.31

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

Taken as a whole, I confirm that empirical evidence from this chapter is likely consistent with the predictions from the chapter 2. Moreover, the main estimation results are robust across different specifications of empirical model and for the U.S. data.

3.5 Summary and Concluding Remark

A conventional wisdom on FDI is that the majority of World FDI flows has been concentrated to developed countries. As the countries are likely to have a high per-capita income level indicating large demands for goods and services, the relation between per-capita income and FDI is open to academic research. By this motivation the chapter 2 and this chapter commonly looked at the impacts of demand-side factors on aggregate demands and therefore MNEs' overseas investment decisions.

In the framework of the chapter 2, theoretical foundation on the link between per-capita income and horizontal FDI are formally established by combining a simple nonhomothetic preferences to the existing horizontal MNE model underlying the standard KC theory. The chapter 2 suggests that the Linder effect exists for FDI, independent of roles of market size and neutral factor.

The paper empirically investigated testable hypotheses involving the Linder effect for FDI of central interest. Korean overseas investment experiences for 57 host countries over the period after the financial crisis were applied to the empirical KC model extended and motivated by the theoretical predictions of the chapter 2 for horizontal FDI. Similarity in per-capita income level was important for Korean investors, implying that the Linder hypothesis holds for FDI at highly aggregated level. Specifically, a 10% decrease in per-capita income divergences between Korea and an average host country leads to a 8.6% rise in Korean overseas direct investment. There was no change in the main results both across different specifications and for the U.S. FDI experiences.

This paper can be extended in at least two directions. First, there is a need to identify whether the Linder hypothesis holds for sectoral, industrial or firm level. Second, another implication from nonhomothetic preferences is that aggregate demand also depends on income distribution (or income inequality). In the paper, I exclude this topic by adding a related assumption. To my knowledge, the FDI papers have not focused on the issue.

Chapter 4

SECTORAL DIFFERENCES IN FDI DETERMINANTS: A KNOWLEDGE-CAPITAL APPROACH

4.1 Introduction

A remarkable feature of global economy is that services sector and services foreign direct investment (FDI) are on the rise. The share of GDP in services sector has globally grown: 57% in 1980, 62% in 1990, 68% in 2000, and 71% in 2010.[1] In particular, sharp shifts towards services sector in terms of the sectoral (manufacturing versus services) share of world inward FDI stock are also detected: 41% vs 49% in 1990, 34% vs 60% in 2002, and 25% vs 64% in 2011.[2] So far, on the other hand, research on FDI determinants has mainly focused on aggregate FDI and manufacturing FDI (Ramasamy and Yeung, 2010). Given an expansion of the services sectors importance in terms of both GDP and FDI, a study comparing FDI determinants in manufacturing and services sectors holds important policy implications.

This paper analyzes sectoral differences in FDI determinants. Based on the knowledge-capital (KC) framework and its extended version focusing on demand, it examines the determinants for sectoral FDI and compares their influences in the manufacturing and services sectors. As the fundamental motivations for multinational enterprises (MNEs) to launch upon a foreign affiliate are largely similar across sectors, a basic theory of FDI in aggregate level and manufacturing sector, including the KC model, could be applied to account for FDI in services (Dunning and McQueen,

[1]The raw numbers are abstracted from the World Development Indicator (WDI) of the World Bank.

[2]The sectoral shares in the years are obtained from the World Investment Report (various years) of the United Nations Conference on Trade and Development (UNCTAD).

1982; Ramasamy and Yeung, 2010; and Nefussi and Schwellnus, 2010). Using Korean MNEs experiences after 1997-1998 financial crisis, this paper displays that national characteristics the KC models consider commonly drive FDI in each sector but differences in their influences depend on distinct features of sectors.

The paper contributes to the literature on FDI determinants in several ways. First, it considers parent-country-specific characteristics. The basic approach of this paper, the KC model, enables me to include parent-country-specific characteristics as a part of several variables. Most previous literature explaining the location decision of MNEs in services has ignored parent-country-specific characteristics. Recently, the standard KC model has been extended by the chapter 2 and 3, which uncover that the similarity of per-capita income between parent and host countries matters for horizontal FDI, so-called Linder effect for FDI, by introducing non-homotheticity into the demand-side of horizontal FDI model. The paper proposes main results through the augmented KC model.

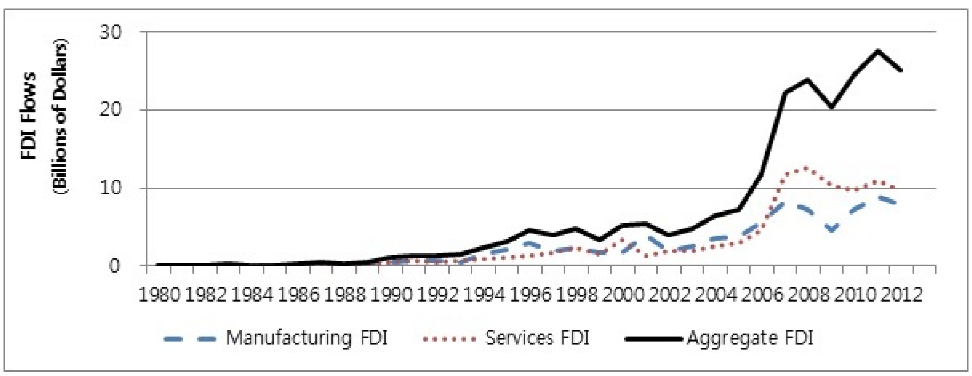
Second, the paper examines the hypothesis that the degree of importance of each FDI determinant varies between manufacturing and services sectors. More specifically, I concentrate on the following concerns: (1) are services FDI more demand-seeking than manufacturing FDI? (2) are trade impediments important for manufacturing FDI only? (3) are manufacturing FDI and producer service FDI complementary? To derive more convincing conclusions on these concerns, I perform a comparison of relative importance of determinants between the two sectors through standardized coefficients.

The main findings from this analysis can be summarized as follows. First, services FDI is likely to be more demand-seeking than manufacturing FDI. Second, services FDI does not tend to be influenced by trade impediments. These two arguments arise because some services are non-tradable, implying that a facility providing the services should be located in the region where they are consumed. The results are consistent with previous studies on FDI in services such as Kolstad and Villanger (2008). Third, while producer services, which include finance, business, and transport industries, are expected to play a role of intermediate goods in manufacturing processes, I do not confirm a complementary relationship between manufacturing and producer service FDI, conflicting with Kolstad and Villanger (2008) and Ramasamy and Yeung (2010).

The remainder of this paper is organized as follows. Section 4.2 describes some stylized facts on recent patterns and trends for Korean outward FDI. Section 4.3 briefly reviews the KC theory and discusses some issues when one analyzes FDI determinants for services sector. In Section 4.4, I present the empirical model, describe used data, discuss estimation methodology, and report the principal empirical results. Finally, the paper ends with summary in Section 4.5.

4.2 Some Stylized Facts

Today the services sector is the most growing sector for FDI worldwide. This trend is also true for Korea. Figure 4.1 shows the sectoral trends of Korean outward FDI over time. It shows that FDI in manufacturing and services have similar trends up to 2006 while there appears a marked difference in terms of sectoral share of total FDI after 2006. Given that services FDI is increasingly important in recent years, understanding its determinants is essential to successful policies for FDI.



Source: Export-Import Bank of Korea (http://www.koreaexim.go.kr/kr/work/check/oversea/use.jsp)

Figure 4.1: Sectoral Trends of Korean Outward FDI

Table 4.1 illustrates the distribution of cumulative Korean outward FDI between manufacturing and services sectors for selected twenty host countries. It clearly shows that Korean multinationals have been interested in services sector in developed countries while they have relatively focused on manufacturing sector in less developed countries. For developed countries, the ratio of manufacturing FDI over services FDI is likely less than one, while it is much greater than one for most developing countries.

Table 4.1: Sectoral Distribution of Korean Outward Cumulative FDI for Selected Countries

Countries	Total FDI	Manufacturing FDI	Services FDI (Millions of dollars)	Manufacturing FDI/Services FDI
United States	46,771	11,365	27,472	0.41
China	45,165	35,721	9,054	3.95
Hong Kong	15,194	2,488	12,628	0.20
Vietnam	9,559	5,309	2,519	2.11
United Kingdom	9,415	982	4,064	0.24
Netherlands	9,057	2,215	4,683	0.47
Australia	8,206	223	1,495	0.15
Canada	7,578	643	1,046	0.62
Indonesia	7,212	3,879	1,219	3.18
Brazil	5,353	2,734	901	3.03
Singapore	5,183	1,593	3,412	0.47
Japan	4,728	770	3,957	0.19
Malaysia	4,497	2,148	770	2.79
Germany	4,008	2,074	1,934	1.07
India	3,253	2,793	455	6.14
Philippines	3,095	2,329	741	3.14
Ireland	2,384	704	1,680	0.42
Mexico	2,351	933	487	1.92
Panama	2,132	62	2,021	0.03
Russia	2,073	1,143	613	1.86

Source: Export-Import Bank of Korea (http;//www.koreaexim.go.kr/kr/work/check/oversea/use.jsp)

4.3 KC Theory and Some Issues on an Analysis on Services FDI

4.3.1 Knowledge-Capital Model

The knowledge-capital theory of the multinational enterprises by Markusen (2002) and Carr et al. (2001) provides basic theoretical foundations in this study. I briefly review the model in this section.

The model makes three fundamental assumptions: (1) headquartering activity, which is knowledge-based and knowledge-generating, can be geographically divided from production activity and it is provided to foreign affiliates at sufficiently low cost; (2) the headquartering activity is more skilled-labor-intensive than production activity; (3) multiple foreign affiliates can simultaneously exploit the headquartering services. The assumption (1) and (2) are associated with vertical FDI motivation, implying that MNEs in skilled-labor-abundant parent country are in charge of headquartering activity and production plants in unskilled-labor-abundant host country take charge of production activity to minimize production costs. The assumption (3) motivates horizontal FDI to seek foreign market access.

Unless parent and host countries have similarities in both market size and relative factor endowment and trade costs are low, two major types of MNEs emerge. First, in the presence of both increasing returns and imperfect competition, horizontal MNEs will be dominant when two countries have similarities in both market size and relative factor endowment and trade costs are sufficiently high. If there is a difference in market size, MNEs in relatively large country would be unwilling to invest in costly capacity in relatively small country. If there is a difference in relative factor endowment, MNEs in relative skilled-labor-abundant country have incentives to outsource unskilled-labor-intensive production activities to countries with relative skilled-labor-abundance. This difference in relative factor endowment is a main ground of the emergence of vertical MNEs, the other major type of MNEs. In vertical FDI, low trade barriers of parent country also matter because the substantial amount of final goods should be returned back to parent country.

Recently, the standard KC model has been extended by studies devoting special attention to the demand-side determinants. Chapter 2 and 3 in this dissertation uncover that the similarity of per-capita income between parent and host countries matters for horizontal FDI by introducing non-homotheticity of aggregate demands into horizontal FDI model. The paper therefore uses this augmented KC model to estimate main results.

4.3.2 Some Issues on an Analysis on Services FDI

A main purpose of this paper is to examine the determinants for sectoral FDI and to compare their influences in the manufacturing and services sectors. A natural question is that basic theories to explain aggregate FDI and/or manufacturing FDI are different from those to explain services FDI? The answer is likely to achieve a consensus in the literature. A MNE's decision on overseas expansion depends on main motivations - demand-seeking (horizontal) and efficiency-seeking (vertical) incentives for FDI, no matter which industry it engages in. Thus, basic theories of FDI determinants including the KC model are appropriate for analyzing manufacturing FDI as well as services FDI, and the bulk of determinants are likely similar for the two sectors (Dunning and McQueen, 1982; Ramasamy and Yeung, 2010; and Nefussi and Schwellnus, 2010).

The differences in the degree of importance among the determinants, however, are expected between manufacturing and services sectors due to idiosyncratic features of each sector. The existing studies, such as Boddewyn et al. (1986), Ramasamy and Yeung (2010), and Kolstad and Villanger (2008), argue that services sector has several peculiar features distinguished from manufacturing sector. First, FDI in services accompanies different types of risks than that in manufacturing sector. For example, some services FDI into a country, where the services are highly sensitive, exerts unexpected influences due to differences in culture and language between parent and host countries. Second, some services industries, such as national security, telecommunication, and electricity industries, are much less open than the manufacturing and other services industries in general.

Finally and importantly, some services are non-tradable, implying that a facility providing the services should be located in the region where they are consumed. Thus, service FDI is likely attributable to greater demand, relative to manufacturing FDI. This important feature provides two testable hypotheses of interests: (1) is services FDI more demand-seeking than manufacturing FDI?; (2) are trade impediments important for manufacturing FDI only due to non-tradability in services industries? Here, a comparison of relative importance of determinants within each sector through standardized coefficients helps identify me whether empirical evidence is consistent with the proposed hypotheses.

Recent literature on services FDI points out that producer services play a role of intermediate goods in manufacturing processes. I accordingly explore the issue, i.e. (3) does an increase in past manufacturing FDI positively affect current producer service FDI?

4.4 Empirical Model, Data, Estimation Methodology, and Empirical Results

Estimating equation, data and estimation methodology used in this paper are basically the same as the chapter 3.

4.4.1 Empirical Model

The first empirical specification is based on the main regression equation used in Carr et al. (2001) estimating the fundamental KC model. Then, I estimate the augmented model proposed by the chapter 2 and 3, which shows that per-capita income variables play an important role as demand-driven factors and therefore horizontal FDI determinants. My central estimating equations for FDI from the Korea to host country j in year t are given by:

$$\begin{aligned} ROFDI_{hft} = \beta_0 &+ \beta_1 \times (ROFDI_{hft-1}) + \beta_2 \times (Sum\ GDP_{hft}) + \beta_3 \times (GDP\ Diff\ Sq_{hft}) \\ &+ \beta_4 \times (HC\ Diff_{hft}) + \beta_5 \times (GDP\ Diff_{hft} \times HC\ Diff_{hft}) \\ &+ \beta_6 \times (IB_{ft}) + \beta_7 \times (TC_{ht}) + \beta_8 \times (TC_{ft}) + \beta_9 \times (HC\ Diff\ Sq_{hft} \times TC_{ft}) \\ &+ \beta_{10} \times (Sum\ GDPPC_{hft}) + \beta_{11} \times (GDPPC\ Diff\ Sq_{hft}) \\ &+ \beta_{12} \times (GDPPC\ Diff_{hft} \times HC\ Diff_{hft}) + \varepsilon_{hft}. \end{aligned} \tag{4.1}$$

The dependent variable, $ROFDI$, is defined as real FDI flows to a sector done by Korean MNE into a host country. In each regression it can be aggregate FDI, manufacturing FDI, or service FDI. The first explanatory variable, $ROFDI_{jt-1}$, is a lagged endogenous dependent variable. It captures that when MNEs have invested more in a country in the past year, they tend to invest more in the country in present year, i.e. so-called self-reinforcing effect or agglomeration effect (Noorbakhsh et al., 2001; and Wheeler and Mody, 1992) and the coefficient β_1 is expected to be positive. The second explanatory variable, $Sum\ (of)\ GDP$, represents the sum of Korea real GDP and host country real GDP. The coefficient β_2 is in general expected to be positive as the larger market size attracts more horizontal FDI in the standard KC theory. On the other hand, the similarity in size is also an important motivation for horizontal FDI, and β_3 should be negative in principle. However, the coefficient on market size similarity can be positive as one partner, here Korea, is not sufficiently large in size. In such cases, it is difficult to discriminate theoretically between horizontal and vertical motivations (Chellaraj et al., 2013).

In this dissertation, $HC\ Diff$ is the difference in the index of human capital between Korea and host country. Korea is relatively human-capital-abundant compared with host countries in most cases of my sample, and it thus has a higher value of human capital index than most host countries. The difference becomes larger as the host country is more unskilled-labor-abundant. Thus, β_4 is expected to be positive because vertical FDI more likely occurs as the Korean MNEs have more opportunity to reduce production costs when skill difference rises. The fifth term is the product of $GDP\ Diff$ and $HC\ Diff$. Awokuse et al. (2012) explain that this variable is included to capture that given market size, larger difference in skilled-labor endowment would decline horizontal FDI relative to increased vertical FDI and β_5 should be negative.

The sixth variable is $Host\ Investment\ Barriers$, indicating perceived impediments of investing in a host country. As any investment impediments are expected to lower FDI, β_6 should be negative. The next two variables are $Home\ Trade\ Costs$ and $Host\ Trade\ Cost$. Higher trade costs in the Korea (home country) discourage vertical FDI because higher costs make importing of the final products back to the Korea more costly. Thus, β_7 is expected to be negative. On the other hand, higher trade costs in the host country foster horizontal FDI because MNEs should prefer foreign affiliate production to costly export. Thus, β_8 is expected to be positive. The next variable $HC\ Diff\ Squared \times Host\ Trade\ Costs$ is an interaction term between squared human capital differences and trade costs in the host country. Given a level of skill difference, higher trade costs in the host country expand horizontal FDI. Given a level of trade costs in the host country, larger skill difference decline horizontal FDI relative to increased vertical FDI. Given these trade-offs, the coefficient β_9 is expected to be negative as host countrys trade costs are less important when skill difference is large.

To obtain main results, this paper estimates an augmented model by per-capita income variables. Recently, with an emphasis of non-homotheticity of aggregate demand, previous chapters in this dissertation both theoretically and empirically shows that per-capita income variables play an important role as demand-driven factors and therefore horizontal FDI determinants.

The variable, $Sum\ (of)\ GDPPC$, represents the sum of Korea real per-capita GDP and host country real per-capita GDP, implying total demand size of two countries. Thus, the coefficient β_{10} should be positive. The next variable, $GDPPC\ Diff\ Squared$, examines the Linder hypothesis for horizontal FDI that as a similar per-capita income level between two countries implies similar demands for goods and services, the similarity in per-capita income is positively correlated to horizontal FDI. β_{11} is expected to be negative. The final term is the product of $GDPPC\ Diff$ and $HC\ Diff$. This variable is included to capture that given demand difference, larger difference in human capital would decline horizontal FDI but increase vertical FDI. The sign of β_{12} thus depends on a FDI motivation that this interaction variable captures.

Most studies to estimate the KC model include geographical distance in the regression equation. Further, I can consider controlling for variables to capture cultural distance and language difference. In this paper, however, I exclude these time-invariant factors due to the use of the GMM estimation approach.

4.4.2 Data

My analytical sample is a balanced panel of 57 countries over the period 1999-2010.[3] Data on the dependent variables are annual flow data for aggregate FDI, FDI in manufacturing sector, and FDI in services sector from Korea to host countries. They are from the Export-Import Bank of Korea. These raw data represent a nominal measure and are reported in thousands of U.S. dollars. The data were converted to a real measure in millions of 2005 dollars using a deflator from the

[3]The list of 57 host countries includes 13 Asian countries (Bangladesh, China, Hong Kong, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Singapore, Taiwan, Thailand, and Vietnam), 2 North American countries (Canada and United States), 26 European countries (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine, and United Kingdom), and 16 other countries (10 Other American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, and Peru), 2 Oceanian countries (Australia and New Zealand), 2 Middle-east Asian countries (Israel and Jordan), and 2 African countries (Egypt and South Africa)).

World Bank.

Data on real GDP, population, and human capital used in constructing several variables are from Penn World Table 8.0 database. According to the definition, GDP per capita is calculated by dividing real GDP by the number of population. Annual real GDP and population are measured in millions of 2005 U.S. dollars and in millions of people, respectively, and thus real GDP per capita used is measured in one 2005 U.S. dollar. As a proxy for skill endowments, this paper uses an index of human capital indicating the amount of human capital per worker. The index is created based on information on both the average years of schooling from Barro-Lee (2012) and the return to education from Psacharopoulos (1994). A number of studies estimating the KC model have used occupation data from International Labour Organization (ILO) to measure relative skilled-labor endowments. ILO data have shortcomings in that they are available for considerably limited countries and years.

Data on trade costs and investment barriers are taken from the Economic Freedom of the World (EFW) database of the Fraser Institute. As a proxy for trade costs, the index of regulatory trade barriers is employed. In the case of investment impediments, I use the index labeled as foreign ownership/investment restrictions. As both indexes have published for every 5 year before 2000, linear interpolation is conducted to obtain data in 1999. Both indexes commonly range from zero to 10, with 10 indicating the least trade costs and the lowest investment barriers, respectively. To construct my measures from these two indexes, I use the formula: (10 - index)10. Thus, my measures commonly have a zero-to-100 scale and indicate that a higher value means a larger trade costs and a higher investment barriers.

4.4.3 Estimation Methodology

Empirical analysis of this paper has the following characteristics. First, the dependent variable is dynamic in nature (Awokuse et al., 2012). In this case, its lagged variable as an explanatory variable is in general included. Second, it is pre-determined, but it is not completely exogenous, so that its instruments are essential to estimation. Third, I need to control for some fixed effects that can be present across host countries. Fourth, an estimation approach using instrument variables is also appropriate because some of independent variables can have endogeneity problem including reverse causality. Fifth, I should consider heteroscedasticity and autocorrelation for the error term. Finally, the number of time series is small, but the number of analyzed host countries is large.

For the reasons with availability of panel data, the empirical analysis of this paper can use a GMM estimator. An estimator of System GMM in general shows a good performance in terms of bias and precision than that of Differenece GMM because the former uses additional instruments. Therefore, many applied studies with dynamic panel settings use it (e.g. Carkovic and Levine, 2005).

A GMM approach is a method in which it basically finds estimated parameters that minimize a weighted objective function. While one-step estimator produces the estimated parameters using an initial weight matrix, two-step estimator implements an additional procedure where the estimated results driven from the one-step process are used to minimize the weighted objective function again. It is well known that the two-step estimator is superior in terms of asymptotical properties to the one-step estimator (Min and Choi, 2009). Therefore, the two-step estimator of System GMM with robust errors considered for heteroscedasticity is employed to yield main estimation results.[4]

4.4.4 Empirical Results

This section begins with estimation results for the pure KC model. I then turn to estimation results for augmented model as a main result to consider more demand-driven effects, such as the Linder effect. Therefore, a comparison of estimation results between the pure KC and augmented models allows me to decide which specification is better for eliciting demand-driven impacts. More importantly, I investigate whether services FDI are more demand-seeking than manufacturing FDI and whether trade impediments are important for manufacturing FDI only. Finally, I examine the hypothesis, also tested recently in Kolstad and Villanger (2008) and Ramasamy and Yeung (2010), that producer services FDI is positively related to manufacturing FDI in the past as producer

[4]See the chapter 3 for detailed discussion on System GMM estimator.

services play a role of intermediate goods in manufacturing processes.

4.4.4.1 Estimation Results for the Pure KC Model

Table 4.2: System GMM Regression Results for the Pure KC Model

Explanatory Variables	Expected Sign	(1) Aggregate FDI	(2) Manufacturing FDI	(3) Services FDI
L.ROFDI	+	0.747***	0.735***	0.759***
		(0.0838)	(0.0711)	(0.0607)
Sum GDP	+	$5.50e-05$*	9.86e-06	1.77e-05
		(3.06e-05)	(1.71e-05)	(1.94e-05)
GDP Diff Sq	- / +	3.08e-12	2.21e-12	3.33e-12
		(3.41e-12)	(1.37e-12)	(2.31e-12)
HC Diff	- / +	165.9**	97.69**	73.15*
		(82.37)	(47.37)	(39.03)
GDP Diff × HC Diff	- / +	-2.69e-05	$-6.26e-05$**	1.06e-05
		(2.93e-05)	(2.67e-05)	(1.31e-05)
Host Investment Barriers	-	-3.001	−4.771*	-0.623
		(2.150)	(2.726)	(1.382)
Home Trade Costs	-	-2.287	-1.237	-0.303
		(1.497)	(1.353)	(0.827)
Host Trade Costs	+	2.327	6.283**	-0.155
		(2.325)	(3.060)	(1.055)
HC Diff Sq × Host Trade Costs	-	−3.389*	−2.525*	−1.523**
		(1.800)	(1.351)	(0.688)
Number of Observations		529	374	416
Number of Countries		57	51	55
Number of Instrument Variables		53	47	47
Arellano-Bond Statistics (1)		-1.90	-1.77	-2.30
Arellano-Bond Statistics (2)		-0.18	-0.73	-0.71
Hansen Statistics		49.06	41.35	39.23

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

Table 4.2 provides the System GMM estimation results for the pure KC model. Columns (1), (2), and (3) report estimates for aggregate FDI, manufacturing FDI, and services FDI as the dependent variable, respectively. I focus on two concerns from the results. The first one of interest is that horizontal incentives captured by *Sum (of) GDP* and *GDP Diff Squared* are not significant for almost all columns, except *Sum (of) GDP* for aggregate FDI. This result can arise either because Korean multinationals take interests in horizontal incentives from demands or because the use of market size variables to capture aggregate demand is not sufficient. As the latter is more plausible, I add per-capita income variables in the next regression to re-examine the effects of growth and similarity of aggregate demand on FDI.

The second point of interest is whether there is a difference in significance of *Host Trade Costs* variable between manufacturing and services sectors. The estimation results clearly shows that the coefficient of *Host Trade Costs* is positive and significant at 5% level for manufacturing FDI while it is positive but not significant for services FDI potentially due to less tradability in services sector. Therefore, I confirm that services FDI is not influenced by trade impediments as some services are not tradable, consistent with Kolstad and Villanger (2008).

4.4.4.2 Main Estimation Results from the Augmented Model

Table 4.3 provides my main results using the augmented specification. Relative to earlier specification of the basic KC model, per-capita income variables are included to capture demand-seeking motive better as proposed by the chapter 2 and 3.

The first observation is that there are large differences in sign and significance of estimated coefficients for *Sum (of) GDP* and *GDP Diff Squared* between Table 4.2 and 4.3. As per-capita income variables are added in Table 4.3, the sign of the coefficients of *Sum (of) GDP* shifts to unexpected one. On the other hand, *Sum (of) GDPPC* and *GDPPC Diff Squared* show the expected impacts on FDI. This is another evidence suggesting that per-capita income variables play an important role of demand-driven factors and horizontal FDI determinants as real demand structure is close to non-homothetic preferences. The other important point associated with market-seeking incentives is that *Sum (of) GDPPC* and *GDPPC Diff Squared* in Columns (2) and (3) of Table 4.3 have the expected signs, but their significance varies between the two columns. This implies that while demand-seeking incentives are likely important for services FDI, they are relatively less important for manufacturing FDI. This result can also be supported by the earlier observation from raw numbers in Table 4.1, which clearly shows that the ratio of manufacturing FDI over services FDI is much higher for most developing countries than for developed countries. Because services FDI tends to be more demand-seeking than manufacturing FDI, the first hypothesis can be accepted.

Consistent with Table 4.2, Table 4.3 shows that the coefficient of *Host Trade Costs* is positive and significant at 5% level for manufacturing FDI while it is positive but not significant for services FDI. Therefore, I confirm again that trade impediments do not matter for services FDI due to non-tradability of some services, concurring with Kolstad and Villanger (2008). I accept the second hypothesis.

Table 4.3: System GMM Regression Results for the Augmented Model

Explanatory Variables	Expected Sign	(1) Aggregate FDI	(2) Manufacturing FDI	(3) Services FDI
L.ROFDI	+	0.585***	0.733***	0.734***
		(0.107)	(0.0764)	(0.0613)
Sum GDP	+	-7.89e-06	-5.28e-06	-1.36e-05
		(3.78e-05)	(2.08e-05)	(2.76e-05)
GDP Diff Sq	- / +	$1.27e-11$***	$3.04e-12$*	$6.60e-12$**
		(4.36e-12)	(1.81e-12)	(3.02e-12)
HC Diff	- / +	203.4***	77.49*	115.4**
		(77.87)	(39.94)	(56.60)
GDP Diff × HC Diff	- / +	$-1.05e-04$***	$-7.37e-05$**	-8.63e-06
		(3.67e-05)	(2.90e-05)	(1.68e-05)
Host Investment Barriers	-	-3.775	$-5..339$*	-0.817
		(2.391)	(2.918)	(1.240)
Home Trade Costs	-	-10.66***	-3.375*	-7.294**
		(3.167)	(1.835)	(3.009)
Host Trade Costs	+	4.874*	6.347**	1.874
		(2.756)	(2.916)	(1.358)
HC Diff Sq × Host Trade Costs	-	-5.524**	-4.654**	-1.803**
		(2.161)	(1.938)	(0.897)
Sum GDPPC	+	0.00730***	0.00218	0.00435**
		(0.00219)	(0.00140)	(0.00183)
GDPPC Diff Sq	-	$-1.06e-07$*	4.11e-08	$-8.60e-08$*
		(6.11e-08)	(5.24e-08)	(4.94e-08)
GDPPC Diff × HC Diff	- / +	0.00963*	0.00760**	0.00260
		(0.00508)	(0.00387)	(0.00211)
Number of Observations		529	374	416
Number of Countries		57	51	55
Number of Instrument Variables		49	50	50
Arellano-Bond Statistics (1)		-1.85	-1.77	-2.29
Arellano-Bond Statistics (2)		-0.12	-0.71	-0.65
Hansen Statistics		48.95	42.59	43.64

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

The other observation from Table 4.3 is that vertical motivations for services FDI are definitely exposed through *HC Diff* and *Home (Korea) Trade Costs*. As information and communication technologies (ICTs) have improved the tradability of services, offshoring and outsourcing of various services are on an increasing trend (Ramasamy and Yeung, 2010). Thus, detecting vertical motivations for services FDI is not striking.

Standardized coefficients are shown in Table 4.4 to see how the degree of importance of FDI determinants considered in this paper differs across aggregate, manufacturing and services FDI.[5] I am interested in several points which generally support the two hypotheses examined shortly before. First, lagged FDI is commonly most important in all regressions. One-year prior FDI most strongly prompts current FDI. Second, Korean multinationals which engage in manufacturing sector are likely to seek vertical incentives from human capital differences and horizontal incentives from host country trade costs. Third, for FDI in services, on the other hand, the variables to capture market-seeking incentives rank highly. Moreover, vertical incentives from human capital differences for FDI in services are also detected as more advanced ICTs are available. Fourth, all variables of trade costs in services FDI do not reveal high relative importance in the order list according to a distinctive feature of services sector.

Table 4.4: Standardized Beta Coefficients

	Aggregate FDI		Manufacturing FDI		Services FDI	
Ranking	Variable	Standardized Coefficient	Variable	Standardized Coefficient	Variable	Standardized Coefficient
1	(1)	0.54	(1)	0.71	(1)	0.65
2	(3)	0.35	(9)	-0.26	(3)	0.35
3	(9)	-0.16	(5)	-0.21	(10)	0.16
4	(5)	-0.16	(12)	0.20	(4)	0.12
5	(10)	0.16	(8)	0.18	(9)	-0.09
6	(12)	0.14	(6)	-0.17	(2)	-0.08
7	(4)	0.12	(3)	0.17	(11)	-0.07
8	(8)	0.08	(4)	0.08	(12)	0.06
9	(6)	-0.07	(10)	0.08	(7)	-0.06
10	(7)	-0.05	(2)	-0.03	(8)	0.05
11	(11)	-0.05	(7)	-0.03	(6)	-0.03
12	(2)	-0.02	(11)	0.03	(5)	-0.02

Note: (1) Lagged FDI, (2) Sum of GDP, (3) GDP Diff Square, (4) HC Diff, (5) GDP Diff × HC Diff, (6) Host Investment Barriers, (7) Home Trade Costs, (8) Host Trade Costs, (9) HC Diff Square × Host Trade Costs, (10) Sum of GDPPC, (11) GDPPC Diff Square, and (12) GDPPC Diff × HC Diff

[5]It should be noted that I cannot directly compare the estimates between manufacturing and services FDI regressions because standardized beta coefficients point out the degree of relative importance among determinants within a regression equation.

4.4.4.3 Analysis on Producer Service FDI

The related literature has paid special attention to the issue of whether producer services play a role of intermediate goods in manufacturing processes. Here, producer services include finance, business, and transport industries, according to Nordås (2001). This idea that past manufacturing FDI positively affects services FDI and/or producer service FDI is testable empirically.

Table 4.5: System GMM Regression Results for Producer Services FDI

Explanatory Variables	Expected Sign	(1) Services FDI	(2) Producer Services FDI	(3) Other Services FDI
L.ROFDI	+	0.734***	0.856***	0.463***
		(0.0613)	(0.138)	(0.0611)
L.Manufacturing ROFDI	+		-0.00820	0.0993***
			(0.0413)	(0.0122)
Sum GDP	+	-1.36e-05	-1.35e-05	-7.63e-06
		(2.76e-05)	(1.97e-05)	(1.40e-05)
GDP Diff Sq	- / +	$6.60e-12$**	$4.24e-12$**	$3.05e-12$*
		(3.02e-12)	(2.04e-12)	(1.74e-12)
HC Diff	- / +	115.4**	94.78**	42.90
		(56.60)	(40.89)	(37.44)
GDP Diff × HC Diff	- / +	-8.63e-06	-5.58e-06	1.45e-05
		(1.68e-05)	(1.76e-05)	(1.10e-05)
Host Investment Barriers	-	-0.817	-1.140	-0.423
		(1.240)	(1.659)	(0.358)
Home Trade Costs	-	-7.294**	-5.239*	-4.843**
		(3.009)	(2.742)	(2.325)
Host Trade Costs	+	1.874	2.353*	0.802
		(1.358)	(1.354)	(0.693)
HC Diff Sq × Host Trade Costs	-	-1.803**	-1.283	-0.944
		(0.897)	(1.058)	(1.030)
Sum GDPPC	+	0.00435**	0.00323**	0.00304**
		(0.00183)	(0.00160)	(0.00149)
GDPPC Diff Sq	-	$-8.60e-08$*	$-7.73e-08$**	$-5.23e-08$*
		(4.94e-08)	(3.28e-08)	(2.73e-08)
GDPPC Diff × HC Diff	- / +	0.00260	0.00102	0.00288*
		(0.00211)	(0.00221)	(0.00166)
Number of Observations		416	267	320
Number of Countries		55	40	45
Number of Instrument Variables		50	38	38
Arellano-Bond Statistics (1)		-2.29	-2.34	-1.90
Arellano-Bond Statistics (2)		-0.65	-0.26	0.29
Hansen Statistics		43.64	30.83	35.25

Notes: ( ) Standard Error, *** p<0.01, ** p<0.05, * p<0.1

Table 4.5 is accordingly made by adding lagged manufacturing FDI as another explanatory variable into the augmented specification. Column (2) in Table 4.5 shows that the coefficient on past manufacturing FDI exhibits unexpected sign with no significance. This result does not confirm a complementary relationship between manufacturing and producer service FDI, conflicting with Kolstad and Villanger (2008) and Ramasamy and Yeung (2010). Furthermore, although I do not report the regression results from using different lagged years for the past manufacturing FDI variable, the positive relationship is not found. Therefore, the third hypothesis is unlikely able to be accepted.

However, there remains cautious in making a concrete conclusion on the issue. It is widely perceived that Korea has world-class manufacturing sector but its services sector is far behind even many developing countries in terms of labor productivity (Park and Shin, 2012). This conventional wisdom may provide the reason that my results do not support the general prediction. Korean manufacturing multinationals can likely use more efficient producer services from other countries in overseas production process. If this is true, Korean (past) manufacturing and (current) services FDI can be uncorrelated.

4.5 Summary

This paper investigates sectoral differences in the determinants of Korean outward FDI. To compare the influences of the determinants in the manufacturing and services sectors, I analyze the standard knowledge-capital model and its expanded version focused on demand-seeking motivations. The use of KC approach is likely possible because manufacturing FDI and services FDI does not quite vary in that the two fundamental incentives, horizontal and vertical incentives, primarily affect overseas expansion of multinationals in these two sectors.

In the empirical estimations, it is demonstrated that the specification augmented by per-capita income variables is appropriate to elicit demand-driven impacts better. As expected, services FDI is likely more demand-seeking than manufacturing FDI, and it does not tend to be largely affected by trade impediments, showing the differences between the two sectors. Although past manufacturing FDI is expected to lead current producer service FDI which facilitates production of manufacturing goods, Korean manufacturing FDI is not complementarily related to Korean producer service FDI.

Bibliography

[1] Arellano, Manuel and Stephen Bond, 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," Review of Economic Studies, 58:2, pp. 277-297.

[2] Arellano, Manuel and Olympia Bover, 1995, "Another Look at the Instrumental Variable Estimation of Error-Components Models," Journal of Econometrics, 68:1, pp. 29-51.

[3] Baltagi, Badi H., Econometric Analysis of Panel Data (third edition), Chichester, UK: John Wiley & Sons.

[4] Awokuse, Titus O., Keith E. Maskus, and Yiting An, 2012, "Knowledge Capital, International Trade, and Foreign Direct Investment: A Sectoral Analysis," Economic Inquiry, 50:3, pp. 707-723.

[5] Barro, Robert J. and Jong-Wha Lee, 2012, "A New Data Set of Educational Attainment in the World, 1950-2010," NBER Working Paper, #15902.

[6] Bergstrand, Jeffrey H. and Peter Egger, 2007, "A Knowledge-and-Physical-Capital Model of International Trade Flows, Foreign Direct Investment, and Multinational Enterprises," Journal of International Economics, 73:2, pp. 278-308.

[7] Blonigen, Bruce A., 2005, "A Review of the Empirical Literature on FDI Determinants, Atlantic Economic Journal, 33:4, pp. 383-403.

[8] Blonigen, Bruce A., Ronald B. Davies, and Keith Head, 2003, "Estimating the Knowledge Capital Model of the Multinational Enterprise: Comment, The American Economic Review, 93:3, pp. 980-994.

[9] Blonigen, Bruce A. and Miao Wang, 2004, "Inappropriate Pooling of Wealthy and Poor Countries in Empirical FDI Studies," NBER Working Paper, #10378.

[10] Blundell, Richard and Stephen Bond, 1998, "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," Journal of Econometrics, 87, pp. 115-143.

[11] Brainard, S. Lael, 1997, "An Empirical Assessment of the Proximity-Concentration Trade-off between Multinational Sales and Trade," The American Economic Review, 87:4, pp. 520-544.

[12] Carkovic, Maria and Ross Levine, 2005, "Does Foreign Direct Investment Accelerate Economic Growth?" in T. H. Moran, E. H. Graham, and M. Blomstrm (Eds.), Does Foreign Direct Investment Promote Development? New Methods, Outcomes, and Policy Approaches, Peterson Institute, pp. 195-220.

[13] Caron, Justin, Thibault Fally, and James R. Markusen, 2012, "Skill Premium and Trade Puzzles: a Solution Linking Production and Preferences," NBER Working Paper, #18131.

[14] Carr, David L., James R. Markusen, and Keith E. Maskus, 2001, "Estimating the Knowledge-Capital Model of the Multinational Enterprise," The American Economic Review, 91:3, pp. 693-708.

[15] ______, 2003, "Estimating the Knowledge Capital Model of the Multinational Enterprise: Reply," The American Economic Review, 93:3, pp. 995-1001.

[16] ______, 2004, "Competition for Multinational Investment in Developing Countries: Human Capital, Infrastructure, and Market Size, in Robert Baldwin and L. Alan Winters (eds.), Challenges to Globalization: Analyzing the Economics, Chicago, IL: University of Chicago Press for NBER, pp. 383-410.

[17] Chellaraj, Gnanaraj, Keith E. Maskus, and Aaditya Mattoo, 2013, "Labor Skills and Foreign Investment in a Dynamic Economy: Estimating the Knowledge-capital Model for Singapore," Review of Development Economics, 17:4, pp. 627-643.

[18] Cheng, Leonard K. and Yum K. Kwan, 2000, "What are the Determinants of the Location of Foreign Direct Investment? The Chinese Experience, Journal of International Economics, 51:2, pp. 379-400.

[19] Choi, Yongho, 2013a, "Demand and Horizontal Multinational Firm," mimeo, University of Colorado.

[20] ______, 2013b, "Linder Effect for Outward FDI of South Korea: A Knowledge-Capital Approach," mimeo, University of Colorado.

[21] ______, 2013c, "Nonhomothetic Preferences, Linder Effect, and FDI: Theory and Evidence from a Knowledge-Capital Approach, University of Colorado at Boulder Working Paper #13-15.

[22] Chun, Bong-Geol and Cheol-Woo Kwon, 2007, "FDI Determinants of Korean Firms," BOK Economic Review, 302, pp. 252-290 (in Korean).

[23] Davidson, Russell and James MacKinnon, 1993, Estimation and Inference in Econometrics, Oxford University Press.

[24] Dunning, John H. and Matthew McQueen, 1982, "Multinational Corporations in the International Hotel Industry, Annals of Tourism Research, 9:1, pp. 69-90.

[25] Fajgelbaum, Pablo, Gene M. Grossman, and Elhanan Helpman, 2011, "A Linder Hypothesis for Foreign Direct Investment," NBER Working Paper #17550.

[26] Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer, 2013, "The Next Generation of the Penn World Table," NBER Working Paper #19255.

[27] Fieler, Ana Ceclia, 2011, "Non-homotheticity and Bilateral Trade: Evidence and a Quantitative Explanation," Econometrica, 79, pp. 1069-1101.

[28] Gwartney, James, Robert Lawson, and Joshua Hall, 2012, 2012 Economic Freedom Dataset, published in Economic Freedom of the World: 2012 Annual Report, Fraser Institute.

[29] Ha, Byeong-Ki, 2010, "Trends and Structural Features of South-Korean Outward FDI," KIET Issue Paper #2010-265 (in Korean).

[30] Hunter, Linda and James R. Markusen, 1988, Per-capita Income as a Determinant of Trade, in Robert Feenstra (Ed.), Empirical Methods for International Economics, MIT Press, Cambridge, pp. 89-109.

[31] Kim, Jung Min and Dong Kee Rhe, 2009, "Trends and Determinants of South Korean Outward Foreign Direct Investment," The Copenhagen Journal of Asian Studies, 27:1, pp. 126-154.

[32] Kolstad, Ivar and Espen Villanger, 2008, "Determinants of Foreign Direct Investment in Services, European Journal of Political Economy, 24:2, pp. 518-533.

[33] Lee, Hongshik, 2004, "Expansion Strategies of South Korean Multinationals," KIEP Working Paper #04-05.

[34] ______, 2003, "The Decision to Invest Abroad: The Case of Korean Multinationals," KIEP Working Paper #03-12.

[35] Li, Xiaoying and Xiaming Liu, 2005, "Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship, World Development, 33:3, pp. 393-407.

[36] Linder, Staffan Burenstam, 1961, An Essay on Trade and Transformation, Stockholm: Almqvist and Wiksell.

[37] Lipsey, Robert E., 2004, Home- and Host-Country Effects of Foreign Direct Investment, in Robert E. Baldwin and L. Alan Winters (eds.), Challenges to Globalization: Analyzing the Economics, Chicago and London, University of Chicago Press, pp. 333-379.

[38] Markusen, James R., 2013, "Putting Per-Capita Income back to Trade Theory," Journal of International Economics, 90:2 pp. 255-265.

[39] ______, 2002, Multinational Firms and the Theory of International Trade, Cambridge, MA: MIT Press.

[40] ______, 1986, "Explaining the Volume of Trade: An Eclectic Approach," The American Economic Review, 76:5, pp. 1002-1011.

[41] Markusen, James R. and Keith E. Maskus, 2002, "Discriminating among Alternative Theories of the Multinational Enterprise," Review of International Economics, 10:4, pp. 694-707.

[42] Markusen, James R. and Anthony J. Venables, 1998, "Multinational Firms and the New Theory," Journal of International Economics, 46:2, pp. 183-203.

[43] ______, 2000, "The Theory of Endowment, Intra-industry and Multi-national Trade," Journal of International Economics, 52:2, pp. 209-234.

[44] Min, In-Sik and Pil-Seon Choi, 2009, STATA Panel DATA Analysis, The Korean Association of STATA (in Korean).

[45] Nefussi, Benjamin and Cyrille Schwellnus, 2010, "Does FDI in Manufacturing Cause FDI in Business Services? Evidence from French Firm-level Data, Canadian Journal of Economics, 43:1, pp. 180-203.

[46] Noorbakhsh, Farhad, Alberto Paloni, and Ali Youssef, 2001, "Human Capital and FDI Inflows to Developing Countries: New Empirical Evidence," World Development, 29:9, pp. 1593-1610.

[47] Nordås, Hildegunn Kyvik, 2001, "Information Technology and Producer Services A Source of Economic Development: The South African Case," SNF Working Paper 50/01, Foundation for Research in Economics and Business Administration, Bergen.

[48] Park, Donghyun and Kwanho Shin, 2012, "Performance of the Service Sector in the Republic of Korea: An Empirical Investigation, Asian Development Bank Economics Working Paper Series #324.

[49] Psacharopoulos, George, 1994, "Returns to Investment in Education: A Global Update," World Development, 22:9, pp. 1325-1343.

[50] Ramasamy, Bala and Matthew Yeung, 2010, "The Determinants of Foreign Direct Investment in Services, The World Economy, 33:4, pp. 573-596.

[51] Roodman, David, 2006, "How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata," Center for Global Development, Working Paper Number 103.

[52] Rutherford, Thomas F., 1999, "Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax," Computational Economics, 14, pp. 1-46.

[53] The World Bank, 2012, World Development Indicators.

[54] UNCTAD, various years, World Investment Report.

[55] Wheeler, David and Ashoka Mody, 1992, "International Investment Location Decisions: The Case of US Firms," Journal of International Economics, 33, pp. 5776.

[56] Zhang, Kevin Honglin and James R. Markusen, 1999, "Vertical Multinationals and Host-Country Characteristics, Journal of Development Economics, 59:2, pp. 233-252.

Appendix A

Chapter 2: Numerical Model and Its Initial Calibration

Table A.1 shows the system of inequalities each with complementary variables in detail. In this paper, p_Y (Y's price) is a numeraire (i.e. $p_Y = 1$).

Table A.1: Inequalities each with complementary variables

Inequalities	Complementary variable	Number of inequalities
Pricing inequalities	*Activity*	*Number*
$p_{Yi} \leq c_{Yi}$	Y_i	2
$p_{Ui} \leq c_{Ui}$	U_i	2
$p_i(1-\eta_{ii}^n) \leq q_i c$	X_{ii}^n	2
$p_j(1-\eta_{ij}^n) \leq q_i(c+t)$	X_{ij}^n	2
$p_i(1-\eta_{ii}^m) \leq q_i c$	X_{ii}^m	2
$p_j(1-\eta_{ij}^m) \leq q_j c$	X_{ij}^m	2
$p_{FCi}^k \leq FC_i^k$	N_i^k	4
Market clearing inequalities	*Price*	*Number*
$\sum_i$ *demand* $Y_{ic} \leq \sum_i$ *supply* Y_i	p_Y	1
demand $U_i \leq$ *supply* U_i	p_{Ui}	2
demand $X_{jc} \leq \sum_{k,i}$ *supply* X_{ij}^k	p_j	2
demand $N_i^k \leq$ *supply* N_i^k	p_{FCi}^k	4
demand $L_i \leq$ *supply* L_i	w_i^L	2
demand $S_i \leq$ *supply* S_i	w_i^S	2
Income balance	*Income*	*Number*
expenditure $cons_i =$ *income* $cons_i$	*income* $cons_i$	2
demand $N_i^k = mkrev_i^k$	*income* $entrev_i^k$	4
Auxiliary constraints	*Markup*	*Number*
$\eta_{ij}^k = (Cournot\ formula)_{ij}^k$	η_{ij}^k	8

Notes: c_{Ui} and p_{Ui} are the production cost and the price of a unit of utility in country i, respectively. FC_i^k and p_{FCi}^k are the production cost and the price of a unit of fixed costs for a country i-based type-k firm, respectively. N_i^k is the activity that produces fixed costs for a country i-based type-k firm and also the number of those firms active in equilibrium. $mkrev_i^k$ is total markup revenues of a country i-based type-k firm.

Table A.2 exhibits the figures used in the calibration of the model at the center of the

Edgeworth box, in which the two countries are identical and multinational firms are active only. In the matrix,[1] columns display the activities of both production and consumption, and rows display markets. $COLSUM$ means that zero profit or product exhausition conditions hold for all activities as each of column sums is zero, and $ROWSUM$ means that market clearing conditions hold for all markets as each of row sums is zero.

Table A.2: Calibration of the model at the center of the Edgeworth box

	Production								Consumption			
	YI	YJ	XMI	XMJ	NMI	NMJ	WI	WJ	CONSI	CONSJ	ENTM	ROWSUM
CYI	100						-100					0
CYJ		100						-100				0
CXI			100				-130		30			0
CXJ				100				-130		30		0
FCM					20	20					-40	0
LI	-50								50			0
SI	-50		-80		-15	-5			150			0
LJ		-50								50		0
SJ		-50		-80	-5	-15				150		0
UTILI							230		-230			0
UTILJ								230		-230		0
MKI			-10	-10							20	0
MKJ			-10	-10							20	0
COLSUM	0	0	0	0	0	0	0	0	0	0	0	0

Notes: Row sums are all zero, implying that market clearing conditions hold for all markets. Column sums are all zero, implying that zero profit conditions hold for all activities. Positive entries are receipts (e.g. sales revenues for firms, factor sales to firms by consumers, etc). Negative entries are payments (e.g. factor payments to consumers, markup revenues to entrepreneurs, etc).

[1]Positive entries denote receipts. For instance, the value 100 in the cell of (CYI, YI) is sales revenues for firms producing good Y in country i, and the value 150 in the cell of (SI, $CONSI$) is skilled labor's sales of consumers to all firms. Negative entries denote payments. For example, the value -50 in the cell of (LI, YI) is total payments to consumers by firms producing good Y in country i for using unskilled labor, and the value -10 in the cell of (MKI, XMI) is markup revenues to entrepreneurs of country i-based multinationals.

Appendix B

Chapter 3: Summary Statistics and Correlation Matrix

Table B.1 and Table B.2 provide summary statistics and correlation matrix on main estimation analysis, respectively.

Table B.1: Summary statistics

Variable	Observations	Mean	Standard Error	Minimum	Maximum
ROFDI	588	246.80	688.83	0	5748.28
L.ROFDI	580	221.05	641.25	0	5748.28
Sum GDP	684	2011569	1939941	856614	1.46e+07
GDP Diff Sq	684	3.73e+12	1.77e+13	5.71e+07	1.48e+14
HC Diff	684	0.45	0.42	-0.39	1.47
GDP Diff × HC Diff	684	208678	949944	-6764941	3977816
Host Investment Barriers	671	27.45	14.26	0	72
Home Trade Costs	684	27.25	3.52	21	33
Host Trade Costs	670	27.06	12.55	2	56
HC Diff Sq × Host Trade Costs	670	12.62	20.02	3.77e-06	97.68
Sum GDPPC	684	43286.88	15292.06	19712.18	107233.30
GDPPC Diff Sq	684	1.29e+08	3.06e+08	4060.83	3.15e+09
GDPPC Diff × HC Diff	684	5234.09	9847.78	-21471.57	33731.74
Sum POP	684	135.20	222.05	46.03	1366.35
POP Diff Sq	684	50931.05	250849.40	0.00	1612866
POP Diff × HC Diff	684	-50.97	240.59	-1667.49	91.51
GDP Diff	684	178879	1923951	-1.22e+07	1302009
GDPPC Diff	684	3274.54	14772.92	-56131.92	15740.77
POP Diff	684	-41.28	222.03	-1269.99	47.86

Table B.2: Correlation Matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ROFDI	1.00												
(2) L.ROFDI	0.80	1.00											
(3) Sum GDP	0.68	0.67	1.00										
(4) GDP Diff Sq	0.65	0.64	0.91	1.00									
(5) HC Diff	-0.13	-0.13	-0.19	-0.24	1.00								
(6) GDP Diff × HC Diff	-0.14	-0.16	-0.03	0.26	-0.14	1.00							
(7) Host Investment Barriers	0.01	0.05	-0.09	-0.01	0.28	-0.11	1.00						
(8) Home Trade Costs	-0.05	0.03	-0.03	-0.01	-0.02	-0.02	-0.06	1.00					
(9) Host Trade Costs	-0.08	-0.06	-0.03	-0.07	0.50	-0.04	0.66	-0.04	1.00				
(10) HC Diff Sq × Host Trade Costs	-0.06	-0.05	-0.03	-0.07	0.87	-0.04	0.31	-0.01	0.56	1.00			
(11) Sum GDPPC	0.17	0.15	0.18	0.19	-0.59	0.12	-0.38	-0.10	-0.69	-0.57	1.00		
(12) GDPPC Diff Sq	0.03	0.03	0.01	0.07	0.27	0.09	0.06	-0.07	0.13	0.27	0.18	1.00	
(13) GDPPC Diff × HC Diff	0.01	0.02	0.06	0.04	0.75	-0.02	0.42	-0.04	0.64	0.88	-0.76	0.11	1.00