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POTENTIAL EFFECT OF KOREA'S FTA WITH ITS TRADING PARTNERS: ESTIMATION BY AUGMENTED GRAVITY MODELS WITH PANEL DATA

DOOWON LEE*

This paper tries to analyze Korea's bilateral trade behavior with its major trading partners, using panel data of 39 countries during the past 21 years. First, a standard gravity model with conventional explanatory variables such as income and geographical distance is estimated. Second, this standard gravity model is augmented by adding new institutional and policy variables of APEC membership and trade liberalization index. Also, this augmented gravity model incorporates country- and time-specific random effects. With this augmented gravity model, many discrepancies between actual trade volume and trade volume estimated by standard gravity model are removed. Furthermore, using this augmented gravity model, the potential trade volume and trade balance after Korea's bilateral FTA are predicted. According to this prediction, Korea would substantially increase its trade volume with most of its existing trading partners. In particular, this increase would be noticeable in Asian countries such as India and Japan. Moreover, after FTA, Korea would improve its trade balance with most of its trading partners including Japan. Next, similar analysis is done with regard to Korea's intra-industry trade (IIT) by augmenting standard gravity model with structural variables. As a result of this analysis, it is predicted that Korea would increase its degree of IIT with most of developing countries. However, the prediction of potential increase of trade volume depends on the assumption that bilateral FTA would eventually bring about trade liberalization between two member countries.

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* Economics Department, Yonsei University, 134 Shinchon-Dong, Sudaemoon-Gu, Seoul 120-749, Korea, (Tel) +82-2-2123-2489, (E-mail) leedw@yonsei.ac.kr

Ⅰ. INTRODUCTION AND LITERATURE REVIEW

As early as the late 1980s, the Korean government has reviewed the possibility of setting up free trade agreement (FTA) with its major trading partners. However, the turmoil and side-effects of agricultural market opening of the Uruguay Round (UR) had suspended this movement until the outbreak of the 1997 financial crisis. After the financial crisis, the Korean government and the academic circle had realized the necessity of transforming the Korean economy into more open and transparent one in order to further integrate Korea's economy with the global one. One of the ways to accomplish this goal was to establish FTA with its major trading partners. Not only this internal motive but also external factors such as rising regionalism in the global economy forced the Korean government to consider seriously about FTA.[1] It was under these circumstances that Korea picked up Chile as its first FTA partner in 1998. Theoretically speaking, Chile was not an ideal FTA partner to Korea because of the lack of similarity in economic structure and the long geographic distance between the two countries. However, Chile was a successfully industrialized country with a modest economic size. Furthermore, it was presumed that having a FTA with Chile would bring about less pain of industrial restructuring, which would be inevitable once FTA is ratified. As a result of six consecutive meetings, Korea and Chile had reached an agreement in October 2002, and it was finally ratified in April 2004 by the Korean National Assembly after couple of failed attempts.[2]

Even though Korea had some difficulty in ratifying its first FTA with Chile, Korea intends to set up more FTAs with its trading partners in the medium- and long-term perspective. In fact, Korea had initiated negotiation with Japan and Singapore already, and has reached an agreement with Singapore in November 2004. Furthermore, as China had agreed to reach an FTA with ASEAN by 2010, the so-called '10 + 3' negotiation would be feasible in the near future. In the longer term perspective, Korea will review the possibility of setting up FTA with more advanced economies such as U.S., EU and EFTA. For more detailed review of the past achievements and future plans of the

[1] By the late 1990s, the only countries that did not have FTA with their trading partners were China, Japan, Korea, Mongolia and few others.

[2] For a more detailed analysis regarding the bilateral trade trend of Korea and Chile after the FTA, refer to Lee and Kang (in Korean, 2005).

Korean FTA, please refer to Cheong (in Korean, 2003).

With these backgrounds in mind, this paper aims to analyze the potential effect of Korea's FTA with its major trading partners on Korea's bilateral trade volume, trade balance and intra-industry trade (IIT). In particular, the second part of this paper will focus on the expected expansion of IIT between Korea and its trading partners after FTA. As a methodology, this paper employs gravity models with augmented variables using panel data set.

The contribution of this paper can be the following aspects. Unlike the previous studies that have used CGE model in estimating the effect of FTA, this paper employs gravity models in order to estimate the potential trade volume and changes in trade balance when FTA is established between the two countries. In particular, unlike the usual gravity models of analyzing two sets of countries, the gravity model employed in this paper is a Korea-specific gravity model, where bilateral trade volume of Korea and its major trading partners are analyzed. This paper also assumes that FTA will bring about more liberalized trade regime with the removal of tariff and non-tariff barriers to Korea's trading partners. In that sense, this paper captures the dynamic effect of FTA. It explores the issue of Korea's bilateral trade with its major trading partners in detail by adding explanatory variables that are not commonly used in the other gravity literatures with the most recent and comprehensive trade data available. More specifically, the empirical part of this paper covers 39 major industrial countries' bilateral trade with Korea between 1983 and 2004. Also, in order to improve the explanatory power of the gravity model, the standard gravity model has been augmented by including institutional, policy and structural variables. In doing so, the augmented gravity model is supposed to correct discrepancies between actual trade volume and trade volume estimated by conventional standard gravity model. By using the estimation result of augmented gravity model, this paper calculates the potential bilateral trade volume and trade balance after FTA. Also, it has extended the above stated efforts to analyze the degree of Korea's IIT with each trading partner. Lastly, based on the results of this paper, it provides some policy implication including comprehensive and more aggressive pursuit of FTA.

The potential effects of Korea's FTA have been studied by many economists during the last several years. Some have used CGE (computable general equilibrium) model, and some have used partial equilibrium models. Also, there were static studies as well as dynamic studies. In particular, many studies have

tried to estimate the effect of Korea's FTA with Japan. Even though the outcome of these studies can differ in many perspectives, we can still draw the following generalized results. First, Korea will suffer from short-term trade balance deterioration, which will be followed by long-term gains. Second, for these long-term gains to be materialized, a comprehensive FTA along with wide-spread trade liberalization is needed, that will result in vigorous industrial restructuring of the Korean economy. Third, gains and losses will be different across industries. Fourth, more than anything else, intra-industry trade (IIT) volume between the two countries will increase substantially.

Let us review the existing literatures with further details. As Frankel and Wei (1998) have emphasized, it is a well-known fact that open regionalism can bring about enhanced welfare to its member and non-member countries as well.[3] Likewise, most literatures predict that Korea would improve its welfare once it sets up FTA with its neighboring trade partners. The Institute of Developing Economies (IDE) of Japan had used CGE model to calculate the expected effect of trade expansion between the two countries once FTA is established in 2000. According to this primitive result, it concluded that Japan's export to Korea would increase by 16.3%, while Korea's export to Japan would increase by 8.3% in the short-term. Cheong (2000) had also used CGE model to predict the static and dynamic effects of Korea-Japan FTA on Korea's trade balance and real GDP growth. The static analysis captured the expected effect of tariff removal in the usual CGE model. Also, the dynamic analysis had assumed an annual productivity growth of 1% for the future 10 years after the establishment of FTA. With this analysis, Cheong concluded that the positive dynamic effect will outweigh the negative static effect in the long term. Cheong (in Korean, 2001) had improved the previous CGE model by incorporating dynamic effects such as 'economies of scale', 'capital accumulation effect' and 'Korean parameters'. It shows that the Korean GDP and consumer welfare level will be improved substantially in the long term perspective. Also, even though Korea's trade imbalance with Japan would be deteriorated when tariff barrier is removed, it would improve substantially when non-tariff barriers are removed. Furthermore, Korea's trade balance with the rest of the world would improve in the long run. In the extreme case when Korea is the only outsider of the worldwide FTA movement, Cheong (in Korean, 2002b) had calculated that Korea will have to pay the opportunity cost of 1.33% of its annual GDP growth and $34.4

[3] For a collection of papers on RTA (regional trade agreement), refer to Frankel (1997).

billion worth of its annual export amount. Cheong (in Korean, 2003) emphasized that Korea could be the biggest beneficiary when Korea-China-Japan FTA is established.

The fact that Korea has a similar industrial structure to that of Japan would make it difficult for Korea to undergo industrial restructuring in the initial phase of FTA. However, once tariff and non-tariff barriers between the two countries are removed, a simple gravity model developed by Sohn and Yoon (in Korean, 2000) predicts that there would be a substantial increase of bilateral trade. More recently, Lee and Park (2004) examined whether East Asian FTAs would be trade creating or diverting. Using extended gravity model with 186 countries' bilateral trade data, they concluded that East Asian FTAs would be trade creating, and they would facilitate multilateral trade liberalization. This result also coincides with the conclusion of Shin, Lee and Park (in Korean, 2004). Also, Lim (2002) had estimated the expected change of Korea's trade with each country using the price elasticity of each country's trade function. It estimates, for example, how much of Korea's export to Japan will increase due to the removal of the Japanese tariff barriers against the Korean export products. Basically, it is a static analysis, which captures the effect of price change on the bilateral trade amount.

This paper is composed of five chapters. The following chapter introduces basic concept of gravity model, and introduces the standard gravity model for Korea's bilateral trade volume with its major trading partners using panel data. The standard model is then augmented by adding several new explanatory variables, which can improve the fitness of the model. Moreover, the augmented model incorporates period-specific and country-specific random effects as well. Once the augmented gravity model is estimated, the actual trade volume and the normal trade volume estimated by the augmented gravity model are compared. Chapter 3 contains implications of FTA for bilateral trade of each country with Korea. Using the augmented gravity model, the potential effect of FTA and trade liberalization that can be materialized after the ratification of FTA is predicted. Chapter 4 introduces gravity models for Korea's IIT with its major trading partners. It also has both standard and augmented models. Chapter 5 is the concluding chapter, which summarizes the findings of this paper, and provides some policy implications.

Ⅱ. GRAVITY MODEL TO ESTIMATE KOREA'S TRADE VOLUME WITH ITS TRADING PARTNERS

The gravity model has been established based on the law of physics. The gravity between two stars increases as the two stars are getting closer to each other. Also, the gravity increases as the size of the two stars are bigger. Likewise, there exists a certain degree of trade gravity between two economies. In particular, this gravity would increase as the product of two economies' income levels (both gross and per-capita) increases. Also, this gravity would decrease as the distance between the two economies increases. Theoretical review of the gravity model had been introduced by many existing literatures such as Poyhonen (1963), Bergstrand (1985, 1989), Helpman and Krugman (1985), and Evenett and Keller (2002). Primitive work of applying gravity model in analyzing international trade can be found in literatures analyzing the European economic integration such as Aitken (1973) and Bayoumi and Eichengreen (1997). Also, more recently, empirical application of the gravity model has been popularly used in predicting trade volume between two economies. For a review of these empirical studies, refer to Glick and Rose (2002), Rose (2004) and Sohn and Yoon (in Korean, 2000).

The standard gravity model employs three explanatory variables in order to estimate the normal bilateral trade volume between two countries. They are two income variables (for example, product of GDPs of two economies and product of per-capita GDPs of two economies) and one variable that measures geographical distance between the two countries. One of the most comprehensive works would be the one by Rose (2004). Using 178 countries' data from the period of 1948 to 1999, Rose (2004) has estimated the effects of many explanatory variables on bilateral trade volume between two countries. In his study, the traditional gravity model with three standard variables is augmented by adding many other variables that represent historical, cultural, geographical, and institutional differences between countries. According to his study, most of the coefficients have signs that are consistent with theoretical hypotheses. In particular, he concluded that countries within the same RTA (regional trade agreement) tend to trade more than the others. Faruqee (2004) has measured the trade effect of EMU (European monetary union) on bilateral trade of member countries using 22 industrial countries' panel data from 1992 to 2002. He concluded that EMU had boosted trade among member countries by roughly

10%. Similar study was done with regard to Korea's bilateral trade with 30 major trading partners by Sohn and Yoon (in Korean, 2000). This study also came up with similar results to that of Rose (2004). In particular, countries with the membership of APEC (Asia Pacific Economic Cooperation), the only FTA Korea has joined so far, tend to trade more with Korea than the other countries.

As it is already mentioned in the previous chapter, this paper tried to analyze the effect of Korea's FTA on the bilateral trade volume and the degree of IIT between Korea and its trading partners using gravity model with panel data. In doing so, this paper has first employed a standard gravity model in order to predict the potential level of bilateral trade between the two countries. As it is explained already, the standard gravity model has three key variables of GDP, per-capita GDP and distance. Let us first establish a standard gravity model for Korea using the bilateral trade data between Korea and its major trading partners. First, I have selected approximately 60 major trading partners of Korea, whose bilateral trade volume with Korea exceed $ 500 mn as of 2004. From this country set, countries that are deemed not to follow conventional trade theories are left out. They are oil producing countries such as Saudi Arabia and Kuwait, and special regions with tax heaven system such as Bahama. Also, a country like Panama, whose major transaction with Korea is receiving freight fare for the canal, is omitted as well. After these countries are left out, I have come up with 39 countries.[4] Second, a standard gravity model has been set up to estimate the normal bilateral trade behavior of Korea with these countries. Trade data of each country are obtained from the UN. Also, distance between Korea and each country are obtained from the web site of 'www.indo.com/distance'.[5] For GDP and GDP per capita data, the author has relied on the *World Economic Outlook* of the IMF home page. The period analyzed in this paper is from 1983 to 2004.

A standard gravity model predicts that total trade volume of two countries depends positively on the product of both countries income levels (both gross

[4] The list of countries in observation is the following: Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Philippines, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, UK, USA, and Vietnam. Israel, Russia, and South Africa are left out as their time series GDP data are incomplete in the IMF web page.

[5] Distance between Korea and each country is measured by the distance between Seoul and each country's capital city. However, Shanghai and L.A. are used instead of capital cities for China and US.

and per-capita) and negatively on the distance between the two countries. It can be written as the following equation:

$$TV(t)_{Korea,j} = \alpha_0 \cdot [Y(t)_{Korea} \cdot Y(t)_j]^{\alpha_1} \cdot [y(t)_{Korea} \cdot y(t)_j]^{\alpha_2} \cdot [D_{Korea,j}]^{\alpha_3} \quad (1)$$

(where $TV_{Korea,j}$ implies trade volume between Korea and country j, Y implies GDP, y implies per-capita GDP, and $D_{Korea,j}$ implies distance between Korea and country j)

Let us now multiply logarithm function to both sides of the above equation. Then, the above equation can be re-written as the following simplified one:

$$\begin{aligned} &\mathrm{Ln}[TV(t)_{Korea,j}] = \alpha_0 + \alpha_1 \cdot \{\mathrm{Ln}[Y(t)_{Korea}] + \mathrm{Ln}[Y(t)_j]\} + \alpha_2 \cdot \\ &\{\mathrm{Ln}[y(t)_{Korea}] + \mathrm{Ln}[y(t)_j]\} + \alpha_3 \cdot \mathrm{Ln}[D_{Korea,j}] + \varepsilon(t)_j \end{aligned} \quad (2)$$

In estimating coefficients for standard gravity model, I have used income data measured at purchasing power parity (ppp) rates.[6] It is because of the fact that GDP data measured at ppp can reflect the overall economic activities of a country better than GDP data measured at nominal exchange rate. This hypothesis coincides with casual observation. For example, the recent ballooning trade volume between Korea and China can be puzzling when China is regarded as a low income country, whose GDP per capita is only $1,268 in 2004. However, it is more understandable when China is regarded as a middle income country, whose GDP per capita is around $5,642.[7] Due to this reason, this paper will use GDP at ppp data from now on. According to the standard gravity model, the expected signs for each coefficient would be (+) for α_1 and α_2, and (-) for α_3. In estimating equation (2), three dependent variables are used. One is total trade volume between Korea and country j at year t, and the other variables are export and import volumes of country j with Korea at year t. The results of these estimations are summarized in Table 1.

[6] As the author could not obtain Taiwan's GDP at ppp, official GDP data are used instead for Taiwan.

[7] Refer to World Economic Outlook Database from www.imf.org

[Table 1] Regression Result of Standard Gravity Model (Equation (2))

Dependent Variables:	Total Trade	Export	Import
Constant	6.449***	6.322***	2.666**
	(12.689)	(11.374)	(3.729)
Log of GDP	0.599***	0.601***	0.603***
	(26.961)	(24.716)	(19.286)
Log of GDP per Capita	0.398***	0.405***	0.496***
	(14.526)	(13.512)	(12.870)
Log of Distance	-0.817***	-0.900***	-0.703***
	(-18.227)	(-18.369)	(-11.158)
R^2 (Adjusted R^2)	0.700 (0.699)	0.671 (0.670)	0.561 (0.560)
F-statistic:	664.467	581.666	364.086
Sample Period: 1983-2004, Cross-sections included: 39 countries			

Notes : 1) Numbers in parenthesis are t-values for each coefficient.
2) Coefficients with '*', '**', '***' are statistically significant at 90%, 95%, and 99% respectively.

From the above table, we can easily see that the standard gravity model has a high degree of fitness with the value of R^2 as high as 0.7. Also, all the coefficients have signs that are not only consistent with theoretical hypothesis but also significant statistically.

Next, the author has decomposed the dependent variable into export and import values, and similar results are found with all the signs of coefficients in line with theoretical hypotheses. The only notable difference was that Korea's import is more sensitive to the income levels (in particular to the per-capita income level) of its trading partners than Korea's export is. At the same time, the role of distance in determining Korea's import volume is smaller than the role it plays in Korea's export. It implies that Korea tends to import more from richer countries than from poorer countries, and Korea's import is affected less by geographical distance than Korea's export is. This is understandable considering the fact that Korea's industrial structure is highly upgraded by now, and it needs to import advanced capital goods and core parts from richer countries more and more. Based on the regression result, the actual trade data of Korea as of 2004 are compared to the trade data estimated by equation (2) in the following table. For each country, the estimated trade volume can be interpreted as the normal trade volume between each country and Korea. It means that if a certain country follows normal trade pattern, it would trade as much as the estimated volume with Korea.

[Table 2] Comparison of Actual and Estimated Bilateral Trade Volume

(Units: 1,000$)

	Actual Trade Volume (2004)			Normal Trade Volume Estimated by Equation (2)		
	Total	Export	Import	Total	Export	Import
Argentina	660,643	239,144	421,499	1,719,357	808,153	801,433
Australia	10,816,054	3,378,477	7,437,577	5,536,571	2,811,580	2,554,266
Austria	1,124,212	669,905	454,307	3,377,746	1,713,624	1,561,689
Bangladesh	661,974	620,474	41,500	2,208,447	1,173,149	708,904
Belgium	2,346,463	1,436,222	910,241	3,581,167	1,809,180	1,659,383
Brazil	3,980,049	1,784,642	2,195,407	3,082,007	1,459,422	1,370,940
Canada	5,571,880	3,383,074	2,188,806	6,631,401	3,306,648	3,181,864
Chile	2,641,835	708,287	1,933,548	921,556	434,022	419,518
China	79,348,049	49,763,175	29,584,874	80,691,050	49,107,069	24,730,611
Denmark	1,110,173	638,826	471,347	2,884,992	1,468,309	1,332,736
Egypt	875,217	538,392	336,825	1,563,225	780,408	593,394
Finland	2,136,870	1,696,007	440,863	2,759,132	1,416,593	1,242,057
France	5,126,460	2,643,615	2,482,845	9,514,543	4,805,967	4,420,270
Germany	16,819,799	8,334,232	8,485,567	12,160,919	6,169,997	5,647,771
Greece	1,882,212	1,772,745	109,467	2,571,897	1,297,525	1,142,716
Hong Kong	21,395,290	18,127,112	3,268,178	9,300,406	5,294,573	3,663,024
Hungary	930,676	807,415	123,261	1,900,795	959,916	817,377
India	5,481,960	3,631,978	1,849,982	9,857,107	5,182,703	3,428,952
Indonesia	10,045,872	3,677,740	6,368,132	4,120,926	2,143,090	1,470,648
Ireland	1,505,806	677,214	828,592	2,507,415	1,264,381	1,188,260
Italy	5,907,726	3,407,536	2,500,190	9,203,339	4,648,800	4,278,282
Japan	67,845,800	21,701,337	46,144,463	84,403,478	50,714,279	31,367,168
Malaysia	10,159,119	4,480,435	5,678,684	3,613,933	1,911,271	1,403,014
Mexico	3,405,238	2,993,949	411,289	3,549,816	1,735,205	1,533,387
Netherlands	4,736,132	3,007,224	1,728,908	4,662,107	2,359,847	2,153,911
New Zealand	1,499,450	620,181	879,269	1,463,228	728,392	670,222
Norway	882,902	322,592	560,310	3,242,086	1,656,304	1,521,029
Pakistan	871,400	590,853	280,547	2,327,153	1,213,899	787,621
Philippines	5,499,157	3,379,196	2,119,961	5,151,050	2,841,896	1,731,485
Singapore	10,114,014	5,653,508	4,460,506	3,166,797	1,681,745	1,346,433
Spain	3,370,786	2,808,846	561,940	5,777,627	2,885,997	2,667,430
Sweden	1,494,351	732,096	762,255	3,534,020	1,807,727	1,597,229
Switzerland	1,724,645	513,650	1,210,995	3,018,721	1,522,501	1,407,390
Taiwan	17,156,516	9,844,215	7,312,301	21,060,090	12,337,882	7,876,694
Thailand	5,599,774	3,248,957	2,350,817	5,720,389	3,077,472	2,114,557
Turkey	2,460,265	2,356,221	1,04044	3,134,452	1,585,257	1,253,217
UK	9,309,330	5,515,983	3,793,347	9,792,910	4,952,973	4,559,960
USA	71,631,845	42,849,193	28,782,652	32,516,175	16,428,027	15,858,102
Vietnam	3,928,874	3,255,574	673,300	2,753,625	1,505,466	877,865

Table 2 shows that the estimated normal bilateral trade volume of each country with Korea is not quite different from the actual trade volume. However, there are several cases where the figures estimated by the standard gravity model are significantly different from the actual data. For example, countries such as Chile, Germany, Hong Kong, Indonesia, Malaysia, Singapore, U.S.A. and Vietnam have actual trade volumes that are significantly larger than the ones estimated by the standard gravity model. That is to say, the standard gravity model has under-estimated the bilateral trade volume of Korea with these countries. The most notable case would be Korea's bilateral trade with Singapore, where the estimated trade volume is only 1/3 of the actual trade volume. It implies that there are factors other than income and distance that determine trade volume between Korea and Singapore. And, these missing variables would be the one that can boost trade volume between the two countries. On the other hand, for countries such as Argentine, Austria, Bangladesh, Denmark, India, Italy, Japan, Norway, Pakistan, Sweden and Switzerland the actual trade volume are significantly lower than the estimated trade volumes. In particular, the standard gravity model has estimated that Korea would have substantially larger amount of trade with India and Japan than the actually observed trade volumes. It implies that there can be factors that prevent these two countries from engaging in normal trade practices. These factors can be either policy factors such as trade barriers or institutional factors such as the absence of FTA. Many existing literatures on trade have had a similar result. It implies that there exists a great deal of measures that distort the trade pattern between Korea and Japan. As the average tariff ratios of both countries are quite low already, these distortion measures should be non-tariff barriers (NTB). When FTA is set up between the two countries and NTB are removed, it is very likely that the bilateral trade volume would increase substantially in the near future. Furthermore, the above implication does not capture the dynamic long-term effects of FTA that can come from increased competition, economies of scale and re-distribution of resources. When these dynamic effects are coupled with NTB removal effect, the overall bilateral trade volume between Korea and Japan would surpass the potential bilateral trade volume estimated in Table 2. This aspect will be studied further in Chapter 3.

Now, let us augment the standard gravity model by including couple of new explanatory variables that can represent institutional and policy features of each country. By including these new explanatory variables, the standard gravity

model has been transformed into augmented gravity model. First, following the general theme of this paper, the author has included an institutional dummy variable that represents the effect of regional trade agreement (RTA). Currently Korea does not join any ratified formal RTA, except for the FTA with Chile. The only form of regional trade agreement Korea has joined so far would be APEC (Asia Pacific Economic Association), which is a very loose form of RTA. Therefore, a dummy variable of APEC(t), which takes the value of '1' if a country is a member of APEC at year t, is included in equation (3):

$$\begin{aligned}&\mathrm{Ln}[\,TV(t)_{Korea,j}] = \alpha_0 + \alpha_1 \cdot \{\mathrm{Ln}[\,Y(t)_{Korea}] + \mathrm{Ln}[\,Y(t)_j]\} + \alpha_2 \cdot \\ &\{\mathrm{Ln}[\,y(t)_{Korea}] + \mathrm{Ln}[\,y(t)_j]\} + \alpha_3 \cdot \mathrm{Ln}[\,D_{Korea,j}] + \alpha_4 \cdot APEC(t)_j + \varepsilon(t)_j \quad (3)\end{aligned}$$

The coefficient for APEC dummy can measure the membership effect of RTA on Korea's bilateral trade. By including APEC dummy variable, the fitness of the regression is improved with higher R^2 value as it is shown in Table 3. Also, the coefficient for APEC dummy is significantly positive. As the dependent variable is the logarithm of total bilateral trade volume, equation (3) predicts that a country can increase its trade volume with Korea as much as 2.7 times once it joins APEC, *ceteris paribus*. This result coincides with the previous studies that have analyzed the membership effect of RTA on bilateral trade. One interesting finding is that the explanatory power of GDP and distance decreases when APEC variable is included. In particular, the absolute value of coefficient for distance decreases quite substantially, while coefficients for GDP and GDP per capita are rather robust. It implies that Korea would trade more with a distant APEC member country than with a close non-APEC member country. This finding can explain why Korea has increased its trading volume with relatively small and distant Southeast Asian countries in recent years.

Next, in order to explore how trade liberalization policy affects bilateral trade volumes between Korea and its trading partners, trade policy variable of TL (which stands for degree of trade liberalization) that measures openness of trade regime of each country is included. Trade barriers can be largely divided into tariff barriers and non-tariff barriers (NTB). Even though it is difficult to measure the degree of NTB numerically, we can use an index of free trade as a proxy variable that represents the degree of freedom to trade. The one used in this paper is an index of 'the freedom to trade internationally' calculated by the Frasier Institute.[8] This index is calculated by incorporating several

trade-distorting indices that measures the degree of tariff, regulatory trade barriers, gap between actual and expected sizes of trade sector, the difference between official and black market exchange rate, and international capital market controls.[9] It takes the value between 1 and 10. The higher the value is, the more open trade regime it has. As trade barriers exist both in Korea and her trading partner, the sum of trade liberalization indices of Korea and her trading partner at each year is used as an explanatory variable. The coefficient for TL variable can measure the trade liberalization effect on Korea's bilateral trade. As trade liberalizing policy of Korea and her trading partner can increase the bilateral trade volume, the expected sign of the TL variable would be positive. Equation (4) incorporates TL variable with the existing explanatory variables. The result of estimating equation (4) is shown in Table 3.

$$\begin{aligned}&\mathrm{Ln}[\,TV(t)_{Korea,j}] = \alpha_0 + \alpha_1 \cdot \{\mathrm{Ln}[\,Y(t)_{Korea}] + \mathrm{Ln}[\,Y(t)_j]\} + \alpha_2 \cdot \\ &\{\mathrm{Ln}[\,y(t)_{Korea}] + \mathrm{Ln}[\,y(t)_j]\} + \alpha_3 \cdot \mathrm{Ln}[\,D_{Korea,j}] + \alpha_4 \cdot APEC(t)_j + \\ &\alpha_5 \cdot \{TL(t)_{Kotea} + TL(t)_j\} + \varepsilon(t)_j \end{aligned} \tag{4}$$

Even though the general fitness of the model has been improved with TL variable in equation (4), there is a problem in terms of the sign of the coefficient for GDP per capita. Unlike the previous results, now, the coefficient sign for GDP per capita is (-) instead of (+) with some statistical significance. It implies that there is a multi-collinearity problem between TL variable and GDP per capita variable. It is because of the generalized fact that a richer country tends to be more liberalized in its trade regime. Therefore, to avoid this problem, I have omitted GDP per capita variable in equation (5), and has estimated it again:

$$\begin{aligned}&\mathrm{Ln}[\,TV(t)_{Korea,j}] = \alpha_0 + \alpha_1 \cdot \{\mathrm{Ln}[\,Y(t)_{Korea}] + \mathrm{Ln}[\,Y(t)_j]\} + \alpha_3 \cdot \\ &\mathrm{Ln}[\,D_{Korea,j}] + \alpha_4 \cdot APEC(t)_j + \alpha_5 \cdot \{TL(t)_{Kotea} + TL(t)_j\} + \varepsilon(t)_j \end{aligned} \tag{5}$$

When the above equation is estimated using the panel data of 39 countries, all coefficients have signs that are consistent with theoretical hypotheses as it is

[8] Refer to www.freetheworld.com.

[9] The TL indices before 2000 are published every 5 year. For those years whose TL indices are not available, the most recent year's index is used as proxy indices. For example, 1980 index is used for the period of 1980 to 1984. Also, as the TL index of 2004 is not available, 2003 index is used as a proxy for year 2004.

shown in Table 3. In particular, the coefficient of TL is not only positive but also statistically significant at 1% level. It means that Korea tends to trade more with economically large, geographically close, and more open countries, which are members of APEC. This result coincides with most of the existing literatures and conventional trade theories. Even with the inclusion of TL variable, the robustness of the existing variables is mostly intact. However, one notable change is the decreased importance of distance when TL is included. It implies that Korea has a tendency to trade more with more liberalized trade partners despite the long distance. Also, equation (5) has improved the fitness of gravity model with higher R^2 value than equation (2) and (3). It implies that equation (5) can explain the real world situation better than equation (2) and (3). As equation (5) has the most comprehensive explanatory variables that represent income, geographical distance, institutional factor such as APEC membership and policy factor such as TL with signs that coincide with theoretical hypotheses, let us use equation (5) as the bench mark equation for further analysis.

[Table 3] Regression Results of Augmented Gravity Model

	Equation(3)	Equation(4)	Equation (5)	Equation (5)	
Dependent Variables:	Total Trade	Total Trade	Total Trade	Export	Import
Constant	6.225***	6.676***	6.410***	6.201***	2.656**
	(13.740)	(16.295)	(16.852)	(14.316)	(4.628)
Log of GDP	0.551***	0.633***	0.617***	0.624***	0.632***
	(27.440)	(33.293)	(37.264)	(33.100)	(25.274)
Log of GDP per Capita	0.318***	-0.061**			
	(12.735)	(-1.736)			
Log of Distance	-0.576***	-0.440***	-0.469***	-0.573***	-0.289**
	(-13.382)	(-10.981)	(-12.871)	(-13.814)	(-5.263)
APEC Dummy	0.993***	0.834***	0.835***	0.725***	0.944***
	(14.913)	(13.643)	(13.641)	(10.409)	(10.226)
TL		0.322***	0.292***	0.317***	0.369***
		(14.062)	(19.835)	(18.908)	(16.632)
R^2 ,(Adjusted R^2):	0.762 (0.761)	0.807(0.806)	0.806(0.805)	0.769(0.768)	0.674(0.672)
F-statistic:	683.139	712.132	887.316	713.420	440.612
Sample Period: 1983-2004, Cross-sections included: 39 countries					

Notes : 1) Numbers in parenthesis are t-values for each coefficient.
2) Coefficients with '*', '**', '***' are statistically significant at 90%, 95%, and 99% respectively.

As the main concern of this paper is to examine the effect of RTA on trade, the coefficient for APEC dummy and TL in equation (5) are the central parameter of interest. In equation (5), not only these variables have statistically significant coefficients, but also there are robust with coefficient values unchanged regardless of the structure of estimation models.

When the dependent variable is replaced by export and import volumes, similar results are found. Once again, as it was noticed form equation (2), import is more sensitive to income data than export is. Also, the effect of distance, APEC membership and TL changed. In short, Korea's import is more sensitive to income, APEC membership and the degree of trade liberalization of its trading partners than Korea's export is.

Now, in order to improve the model by controlling the time and country specific effect, I have decomposed the error term, $\varepsilon(t)_j$ of equation (5), into three components including two sets of error components that represent country-specific (u_j) and period-specific (v_t) random effects in equation (6). As the standard gravity model already has a time-invariant explanatory variable of $D_{Korea,j}$, which is country-specific, we can say that $D_{Korea,j}$ reflects fixed effect for each country. The regression result of equation (6) is summarized in Table 4.

$$\mathrm{Ln}[TV(t)_{Korea,j}] = \alpha_0 + \alpha_1 \cdot \{\mathrm{Ln}[Y(t)_{Korea}] + \mathrm{Ln}[Y(t)_j]\} + \alpha_3 \cdot \mathrm{Ln}[D_{Korea,j}] + \alpha_4 \cdot APEC(t)_j + \alpha_5 \cdot \{TL(t)_{Kotea} + TL(t)_j\} + u_j + v_t + \varepsilon(t)_j \quad (6)$$

[Table 4] Regression Results of Augmented Gravity Model - Equation (6)

Variables:	Constant	Log of GDP	Log of Distance	APEC Dummy	TL
Coefficients:	8.145**	0.650***	-0.592**	0.214**	0.223***
	(8.056)	(0.029)	(-5.072)	(3.714)	(10.811)
	Random Effects (Cross)			Random Effects (Period)	
Argentina	-0.348	Malaysia	1.083	1983	-0.058
Australia	1.068	Mexico	-0.308	1984	-0.008
Austria	-0.701	Netherlands	0.234	1985	-0.031
Bangladesh	-0.239	New Zealand	-0.206	1986	-0.051
Belgium	-0.269	Norway	0.235	1987	0.049
Brazil	0.233	Pakistan	-0.379	1988	0.135
Canada	0.441	Philippines	-0.250	1989	0.107
Chile	0.757	Singapore	1.323	1990	-0.013
China	-0.802	Spain	-0.694	1991	0.013

Denmark	-0.298	Sweden	-0.194	1992	0.002
Egypt	-0.013	Switzerland	0.220	1993	0.006
Finland	-0.308	Taiwan	-0.011	1994	0.023
France	-0.090	Thailand	0.004	1995	0.109
Germany	0.392	Turkey	-0.743	1996	0.115
Greece	-0.243	UK	0.193	1997	0.097
Hong Kong	0.858	USA	1.261	1998	0.017
Hungary	-1.477	Vietnam	-0.729	1999	0.008
India	-0.463			2000	-0.055
Indonesia	0.560			2001	-0.187
Ireland	-0.526			2002	-0.174
Italy	-0.294			2003	-0.093
Japan	0.721			2004	-0.011
Weighted Statistics			Unweighted Statistics		
R^2, (Adjusted R^2):		F-statistic	R^2, (Adjusted R^2):		F-statistic
0.661 (0.660)		416.657			
Sample Period: 1983-2004, Cross-sections included: 39 countries					

Notes : 1) Numbers in parenthesis are t-values for each coefficient.
2) Coefficients with '*', '**', '***' are statistically significant at 90%, 95%, and 99% respectively.

When time and country specific random effects are incorporated, the robustness of major explanatory variables does not change much except for the APEC dummy variable. It implies that the membership effect of APEC diminishes as country-specific random effects are considered. In particular, countries, whose bilateral trade volume used to be over- or under-estimated by equation (2) and (5), have country-specific random effect that could correct this discrepancy. Using the regression result of equation (6), let us estimate the normal trade volume between Korea and each trading partner for the year 2004, and compare it to the actual trade volume in Table 5. In doing so, the dependent variable in equation (6) is decomposed into export and import volumes as well.

Like the result of Table 2, for most of the countries, the estimated trade volume does not differ much from the actual trade volume. However, the normal trade volume estimated by the augmented gravity model of equation (6) could explain better about Korea's trade with its trading partners than the one estimated by the standard gravity model. More specifically, equation (6) has better estimation than equation (2) for 28 countries including Hong Kong, India, Indonesia, Singapore and USA. In particular, for most of those countries which

[Table 5] Comparison of Actual and Estimated Trade Volume

(Units: 1,000$)

	Actual Trade Volume (2004)			Normal Trade Volume Estimated by Equation (6)		
	Total	Export	Import	Total	Export	Import
Argentina	660,643	239,144	421,499	1,055,662	579,450	361,402
Australia	10,816,054	3,378,477	7,437,577	12,185,704	3,771,929	8,227,222
Austria	1,124,212	669,905	454,307	1,176,255	643,055	510,946
Bangladesh	661,974	620,474	41,500	1,650,924	1,953,109	25,869
Belgium	2,346,463	1,436,222	910,241	2,162,253	1,148,095	1,003,649
Brazil	3,980,049	1,784,642	2,195,407	4,018,061	1,148,064	2,120,542
Canada	5,571,880	3,383,074	2,188,806	9,063,700	5,008,290	4,001,270
Chile	2,641,835	708,287	1,933,548	3,135,752	1,409,594	1,615,767
China	79,348,049	49,763,175	29,584,874	36,293,068	14,884,072	16,414,683
Denmark	1,110,173	638,826	471,347	1,337,919	706,159	620,952
Egypt	875,217	538,392	336,825	1,169,514	806,902	350,260
Finland	2,136,870	1,696,007	440,863	1,268,562	566,820	619,495
France	5,126,460	2,643,615	2,482,845	6,473,115	3,155,320	3,286,802
Germany	16,819,799	8,334,232	8,485,567	15,536,112	7,912,862	7,674,418
Greece	1,882,212	1,772,745	109,467	1,342,439	1,210,015	130,882
Hong Kong	21,395,290	18,127,112	3,268,178	18,595,895	16,944,757	2,264,623
Hungary	930,676	807,415	123,261	390,131	330,664	77,546
India	5,481,960	3,631,978	1,849,982	7,024,268	5,246,109	2,070,833
Indonesia	10,045,872	3,677,740	6,368,132	10,857,355	4,556,654	6,038,851
Ireland	1,505,806	677,214	828,592	1,044,112	502,639	510,886
Italy	5,907,726	3,407,536	2,500,190	4,762,260	2,162,567	2,508,914
Japan	67,845,800	21,701,337	46,144,463	78,663,739	31,221,033	46,761,193
Malaysia	10,159,119	4,480,435	5,678,684	10,388,544	3,941,714	6,158,313
Mexico	3,405,238	2,993,949	411,289	3,392,934	2,298,111	713,013
Netherlands	4,736,132	3,007,224	1,728,908	4,625,545	3,042,192	1,608,561
New Zealand	1,499,450	620,181	879,269	1,300,442	737,200	544,767
Norway	882,902	322,592	560,310	1,692,388	512,513	1,108,731
Pakistan	871,400	590,853	280,547	1,568,069	1,069,317	527,822
Philippines	5,499,157	3,379,196	2,119,961	4,567,354	3,370,651	1,332,719
Singapore	10,114,014	5,653,508	4,460,506	11,669,533	7,863,252	3,903,132
Spain	3,370,786	2,808,846	561,940	2,433,040	1,815,254	618,623
Sweden	1,494,351	732,096	762,255	1,997,434	946,915	1,001,839
Switzerland	1,724,645	513,650	1,210,995	2,551,322	955,266	1,490,579
Taiwan	17,156,516	9,844,215	7,312,301	13,612,686	8,290,936	5,338,431
Thailand	5,599,774	3,248,957	2,350,817	5,983,780	4,150,357	1,952,989
Turkey	2,460,265	2,356,221	1,04044	1,375,826	1,195,680	186,150
UK	9,309,330	5,515,983	3,793,347	9,288,914	5,730,924	3,553,176
USA	71,631,845	42,849,193	28,782,652	98,672,228	55,553,308	42,999,563
Vietnam	3,928,874	3,255,574	673,300	1,918,472	1,733,371	312,838

have drawn our attention in Table 2, the augmented gravity model has better estimation than the standard gravity model. Bilateral trade volumes of countries such as Chile, Germany, Hong Kong, Indonesia, Malaysia, Singapore, and U.S.A. were underestimated by the standard gravity model in Table 2. According to Table 5, however, estimations for all of these countries are greatly improved without any exception. It implies that these countries have expanded their trade with Korea thanks to joining APEC and reducing trade barriers despite the fact that they are small and distant from Korea. Also, for most of those countries whose bilateral trade volume was overly estimated by the standard gravity model, equation (6) has better estimation. In particular, the standard gravity model has overly estimated bilateral trade volume of Korea with Japan and India. However, after taking account of high trade barriers of these two countries, the absence of regional trade agreement, and country specific random effect, the estimation error for Japan and India has been corrected in Table 5. It implies that Korea can increase its trade volume with these countries once trade barriers are removed as a result of FTA. The effect of trade liberalization that can arise from FTA will be analyzed further in Chapter 3.

One noticeable exception in Table 5 would be China. Unlike the result of Table 2, equation (6) has greatly under-estimated Korea's bilateral trade with China. The discrepancy is particularly large in estimating Korea's export volume to China. This discrepancy can arise from the fact that many exporting products from Korea to China are not destined to China, but are re-processed in China and re-exported to advanced countries such as U.S.A. or Japan. As equation (6) tends to capture the effects of explanatory variables on export from Korea to final destination, it would be inevitable for equation (6) to under-estimate Korea's export to China substantially.

As it is mentioned, dependent variable in equation (6) is replaced by Korea's bilateral export and import trade volumes in order to estimate Korea's normal bilateral export and import trade volumes with its major trading partners. These estimation results are compared to the actual data in Table 5 as well. As it was expected, there are more discrepancies between the estimated normal export/import trade volume and the actual data than those between estimated total trade volume and actual data. For some countries, equation (6) for exp/imp expected that Korea would have trade surplus/deficit while the reality was the opposite. However, most of the discrepancies are observed in those economies with relatively small trade volume such as Greece. Also, we can find noticeable

discrepancies in Korea's trade with natural resource rich countries such as Argentine, Brazil, and New Zealand.

Ⅲ. IMPLICATION OF TRADE LIBERALIZATION AFTER FTA

Let us now examine how the augmented gravity model can be used in predicting the potential trade volume between Korea and its major trading partners after FTA is established. Once FTA is established, the so-called membership effect will take place. Also, setting up FTA will eventually bring about more liberalized trade regime between member countries. Therefore, in order to predict the potential trade volume after FTA, we need to assume that each trading partner joins the same regional trading agreement with Korea and its trade regime is more liberalized with higher TL index. Also, Korea's trade regime with this country will be more liberalized as well. In predicting the potential trade volume after FTA, equation (6) is used. Having a FTA with Korea implies that a country joins a regional trade agreement with Korea. As APEC is the only RTA Korea has joined so far, it implies that the value of APEC dummy in (6) would become '1' once FTA is established between a certain country and Korea. Furthermore, as a result of FTA, trade can be liberalized between the two member countries, and TL index can have a larger value. For example, if Korea sets up FTA with Japan, the Korea-Japan TL index, which is 13.9 as of 2004, can be increased.[10] In this paper, let us assume that a country's TL after trade liberalization can be increased up to 8.0, which is the average TL index of OECD countries. Therefore, in the case of Korea-Japan FTA, the TL index in equation (6) can be increased up to 16. Table 6 shows the result of predicting potential trade volume after FTA as of 2004 with these new values for APEC dummy and TL index for selected countries. Also, potential trade balance is predicted as well in Table 6. Many countries in Table 6 are already APEC member countries, so they are already enjoying membership effect in their trade with Korea. For these countries, the potential increase of trade volume after FTA in Table 6 captures the trade liberalization effects only.

[10] TL indices for Korea and Japan in 2004 were 7.1 and 6.8 respectively.

[Table 6] Potential Effects of FTA on Korea's Bilateral Trade Volume Predicted by Equation (6) (unit $1,000)

		Actual Trade Volume (2004)	After FTA Potential Trade Volume*	Actual Export (2004)	After FTA Potential Export*	Actual Trade Balance (2004)	After FTA Potential Trade Balance*
Asia	China	79,348,049	48,810,269	49,763,175	22,422,187	20,178,301	2,929,922
	Japan	67,845,800	124,124,116	21,701,337	58,663,155	-24,443,126	-2,256,741
	India	5,481,960	15,036,609	3,631,978	15,698,772	1,781,996	12,660,630
	Taiwan	17,156,516	16,495,314	9,844,215	10,813,265	2,531,914	4,845,804
EU	France	5,126,460	9,715,247	2,643,615	5,778,619	160,770	1,853,920
	Germany	16,819,799	23,317,549	8,334,232	14,491,530	-151,335	5,327,673
	Italy	5,907,726	7,634,730	3,407,536	4,338,655	907,346	1,226,022
	UK	9,309,330	13,941,371	5,515,983	10,495,551	1,722,636	6,252,781
Latin	Argentina	660,643	2,091,461	239,144	1,557,928	-182,355	1,050,990
	Brazil	3,980,049	8,145,515	1,784,642	3,186,356	-410,765	171,987
	Chile	2,641,835	3,799,780	708,287	1,838,431	-1,225,261	32,278
	Mexico	3,405,238	4,639,163	2,993,949	3,542,025	2,582,660	2,687,176
USA	USA	71,631,845	125,450,618	42,849,193	77,430,331	14,066,541	28,006,323
ASEAN	Indonesia	10,045,872	15,547,109	3,677,740	7,486,324	-2,690,392	49,622
	Malaysia	10,159,119	13,843,016	4,480,435	5,862,652	-1,198,249	-1,411,213
	Philippines	5,499,157	6,483,550	3,379,196	5,471,580	1,259,235	3,838,626
	Thailand	5,599,774	8,196,134	3,248,957	6,412,534	898,140	4,068,641

From Table 6, several stylized facts can be found. First, there would be huge increase of total trade volume for most of the countries after FTA. The most visible example can be India. As India can reap both membership effect and trade liberalization effect, it would have potential trade volume approximately three times larger than the current one. Other than India, most of European countries' trade with Korea will increase substantially as they will gain from the membership effect if they set up FTA with Korea. On the other hand, the potential increase of trade volume in Japan, ASEAN countries, and Latin American Countries would come from more liberalized trade regime. In the case of China, the potential trade volume after FTA is smaller than the actual trade volume due to the same reason stated above. However, the potential Sino-Korea trade volume in Table 6 is about 30% larger than the normal trade volume estimated in Table 5. In implies that FTA can bring about 30% increase of trade volume between Korea and China for those commodities whose final destination are Korean and Chinese local market.

Second, the effect of FTA on trade balance is generally positive as well. For most of the countries, Korea's trade balance would be either improved or remained the same. In particular, Korea's trade balance with Japan would improve substantially due to the large increase of Korea's export to Japan after FTA. As Japan is already a member country of APEC, this effect would come solely from the more liberalized trade regime of Japan after FTA. One good example to verify the credibility of Table 6 would be to examine the trade behavior between Korea and Chile after its FTA in April 2004. Table 6 predicts that Korea-Chile trade volume would increase roughly 44% with improved trade balance in favor of Korea. In fact, this is almost exactly what happened between Korea and Chile after the ratification of FTA. According to Korea International Trade Association, Korea has increased its export to Chile by 66% on the annual base between January and September of 2005, while it increased its import from Chile by 9% during the same period.

In conclusion, Korea can enjoy substantial amount of gains from increased trade volume along with improved trade balance once it signs FTA with most of the 16 countries listed in Table 6. As of 2004, the total trade volume with the above 16 countries will increase from the current volume of roughly $321 billion to $447 billion. With these 16 major trading partners, Korea has recorded trade surplus of approximately $15.8 billion in 2004. However, according to our estimation, Korea could have enjoyed trade surplus of roughly $71.3 billion if Korea had set up FTA with all the 16 countries.

Ⅳ. GRAVITY MODEL TO ESTIMATE INTRA-INDUSTRY TRADE

As previous literatures had already pointed out, lion's share of the FTA gains would come from dynamic effects such as economies of scale and increased competition. According to conventional trade theories, these dynamic gains can result in increased intra-industry trade (IIT) rather than increased inter-industry trade. It is under this theoretical consideration that Korea's FTA with its trading partners would bring about more IIT. This would be particularly true for a country like Japan, which has an abnormally low level of IIT with Korea even though its industrial structure is similar to that of Korea. In part, it is due to the deliberate attempt of the Korean government to protect its domestic industries. Also, it is partly due to the existence of non-tariff barriers Japanese market still maintains. A general review of IIT pattern of Korea and Japan is

made by Lee and Kim (1994).

This paper will estimate the potential level of IIT between Korea and its major trading partners using gravity model of IIT in manufacturing sector. Not only the gravity model has been used in explaining about the overall trade volume of two countries, bat it has been used in explaining the bilateral IIT activities in recent years. In particular, after the theoretical development of models that can relate the income level and economic structures to the degree of IIT between two countries, more frequent usage of gravity model is found in economic literatures related to IIT. These theoretical works include Helpman (1981) and Helpman and Krugman (1985). According to these theoretical works, the degree of IIT is negatively correlated with the differences in industrial structures between two trading nations. Based on these theoretical frameworks, there were several attempts to estimate the degree of bilateral IIT using gravity models such as Kim and Oh (2001), and more recently Song (2003). Following the similar logics of the previous chapter, let us now set up a gravity model that can explain about IIT between Korea and its trading partners. In this study, a cross sectional analysis using bilateral trade data of manufacturing industries of 2004 is performed.[11]

First, in measuring the degree of intra-industry trade in industry z, the Grubel-Lloyd Index is used, which is defined as the following equation.

$$IIT_{i,j}(z) = 1 - \{ |X_i^j(z) - M_i^j(z)| / [X_i^j(z) + M_i^j(z)] \} \tag{7}$$

(where $X_i^J(z)$ (and $M_i^J(z)$) are export (and import) of industry z from country i to j, and country i is Korea)

Second, I have calculated weighted average IIT index across manufacturing industries for each country's trade with Korea weighted by each industry's trade portion, and estimated a simple standard gravity model in equation (8). Manufacturing industries are decomposed into 35 sectors using SITC 2-digit classification of the United Nations. The result of equation (8) is shown in Table 7.

$$IIT_{Korea,j} = \beta_0 + \beta_1 \cdot \{ \mathrm{Ln}[Y(t)_{Korea}] + \mathrm{Ln}[Y(t)_j] \} + \beta_2 \cdot \{ \mathrm{Ln}[Y(t)_{Korea}]$$

[11] As IIT is more frequent in manufacturing industry's trade, manufacturing industry's trade data is used only.

$$+ \mathrm{Ln}[\,Y(t)_j]\} + \beta_3 \cdot \mathrm{Ln}[\,D_{Korea,j}] + \gamma(t)_j \quad (8)$$

The regression result of equation (8) has signs that were expected. However, unlike the result of equation (2), the explanatory power of GDP diminishes while that of GDP per capita remains significantly positive. It reflects the well-known fact that IIT occurs more frequently between two high income countries regardless of their overall economic size.

Having the above equation as the standard model, I have augmented the standard gravity model by adding variables I have used in the previous chapter. In equation (9), I have added APEC dummy variable and TL index variable in order to see whether FTA membership and the degree of trade liberalization have any significant effect on Korea's IIT with its trading partners. In doing so, I have omitted per-capita GDP in order to avoid the multi-co-linearity problem. When these two variables are added, the general fitness of the model is improved with higher value of R^2. Even though each coefficient has sign that was expected, the significance of coefficients is different across variables. In particular, the degree of trade liberalization has positively affected IIT with high statistical significance, while APEC membership does not have any statistical significance. Once again, this result contradicts with the result of equation (5), where same explanatory variables are used in estimating total trade volume. Like the result of equation (8), it re-confirms that generalized fact that IIT occurs more often between countries, whose trade regime is liberalized.

Also, it is a well known fact that IIT is largely dependent on the economic structures of two countries. In particular, the more similar the structures of two economies are, the more IIT will occur. Therefore, I have introduced two more variables in equation (10) that can reflect the economic structures. They are trade complementary index (TCI) and export similarity index (ESI). TCI measures how complementary Korea's export structure is to country j's import structure. TCI will have a higher value when industries where Korea has comparative advantages coincide with industries where country j has comparative disadvantages. As Heckscher-Ohlin trade theory would predict, countries with higher TCI would have more inter-industry trade with Korea. On the contrary, ESI measures how similar Korea's export structure is to country j's export structure. The more similar they are, the higher value ESI would have. Both TCI and ESI have values between 0 and 1. Theories on IIT predict that country with higher ESI would have more intra-industry trade with Korea, while

countries with higher TCI would have more inter-industry trade with Korea. Therefore, coefficients for ESI and TCI are expected to have (+) and (-) signs respectively.[12]

$$IIT_{Korea,j} = \beta_0 + \beta_1 \cdot \{\mathrm{Ln}[\,Y(t)_{Korea}] + \mathrm{Ln}[\,Y(t)_j]\} + \beta_3 \cdot \mathrm{Ln}[D_{Korea,j}] + \beta_4 \cdot APEC(t)_j + \beta_5 \cdot TL(t)_j + \gamma(t)_j \quad (9)$$

$$IIT_{Korea,j} = \beta_0 + \beta_1 \cdot \{\mathrm{Ln}[\,Y(t)_{Korea}] + \mathrm{Ln}[\,Y(t)_j]\} + \beta_3 \cdot \mathrm{Ln}[D_{Korea,j}] + \beta_4 \cdot APEC(t)_j + \beta_5 \cdot TL(t)_j + \beta_6 \cdot ESI(t)_{Korea,j} + \beta_7 \cdot TCI(t)_{Korea,j} + \gamma(t)_j \quad (10)$$

$$ESI_{ij} = \sum \min(X_i, X_j) \quad (10\text{-}1)$$

(where X_i is the export ratio of each commodity out of country i (which is Korea)'s total export amount, and X_j is the export ratio of each commodity out of country j's total export amount)

$$TCI_{ij} = \frac{X_i' M_j}{||X_i|| * ||M_j||} \quad (10\text{-}2)$$

(where X_i is proportion vector of country i (which is Korea)'s export structure, and M_j is proportion vector of country j's import structure. $||X_i|| = \sum_{i=1}^{n} X_i^2$)

As it is shown in the above table, all the explanatory variables turned out with expected signs in equation (10). In particular, robustness of distance variable and trade liberalization index variable did not change much across equations, which are similar to the results of previous chapter. The variables that represent trade structure have coefficients, whose signs are consistent with theoretical expectation in equation (10). Even though their statistical significance are rather small, it implies that countries with similar export structure to Korea tend to have more IIT with Korea, while countries with complementary trade

[12] Due to lack of data, 36 countries are used in the regression with TCI and ESI variables. Countries that are removed are Taiwan, Vietnam, and Bangladesh. Also TCI and ESI are calculated using SITC 2-digit data of each country in 2002. For Thailand, 2001 data are used instead of 2002 data.

structure to Korea have less IIT. From now on, let use equation (10) in estimating the normal level of bilateral IIT between Korea and its trading partners as well as the potential level of IIT after FTA in the same method used in Chapter 3. The result of this comparison for 16 countries selected is summarized in Table 8.

[Table 7] Regression Results of Gravity Models for IIT

Explanatory Variables	Expected Signs	Equation 8 (Standard)	Augmented Models	
			Equation 9	Equation 10
Constant		-0.088	-0.409	0.270
		(-0.128)	(-0.639)	(0.355)
Log of GDP	+	0.026	0.041*	0.012
		(1.125)	(1.817)	(0.438)
Log of GDP per Capita	+	0.074**		
		(2.484)		
Log of Distance	-	-0.171***	-0.131***	-0.126***
		(-4.291)	(-3.198)	(-2.887)
APEC Dummy	+		0.053	0.060
			(0.912)	(1.029)
TL	+		0.082***	0.061*
			(3.059)	(1.883)
ESI	+			0.389
				(1.519)
TCI	-			-0.297
				(-0.886)
No. of Obs.		39	39	36
R^2		0.4064	0.4831	0.473
Adjusted R^2		0.3555	0.4223	0.364

Note : 1) Numbers in parenthesis are t-values for each coefficient.
2) Coefficients with '*', '**', '***' are statistically significant at 90%, 95%, and 99% respectively.

Table 8 shows that the normal IIT indices estimated by equation (10) are almost identical to the actual IIT indices for most of the countries. Generally speaking, most industrialized countries have relatively high degree of IIT, when developing countries in Latin America have lower degree of IIT. When FTA is signed, equation (10) predicts that most countries would increase their IIT with Korea substantially. This is particularly true for three largest Asian economies of China, India, and Japan. It can imply that, when the FTA is signed with the removal of trade-distorting measures including both tariff and non-tariff barriers,

IIT volume between the two countries would greatly increase. Comparing this result from the previous chapter's result, we can conclude that the potential increase of Korea's trade volume with India and Japan would come largely from the increased degree of IIT in manufacturing sector. Therefore, in order to reap this gain, it is essential that FTA must bring about removal of trade distorting measures including non-tariff barriers. In fact, countries like Japan and China are having IIT indices, which are already very high. Potentially, however, they can have even higher degree of IIT once they join FTA with Korea and liberalize their trade regime further. As both countries are already members of APEC, the increase of IIT would come solely from more liberalized trade regime.

[Table 8] Comparison of Actual, Normal and Potential IIT (2004)

		Actual IIT	Normal IIT Estimated by Equation (10)	Potential IIT After FTA Predicted by Equation (10)
Asia	China	0.578	0.627	0.708
	Japan	0.489	0.559	0.683
	India	0.272	0.268	0.477
EU	France	0.327	0.295	0.407
	Germany	0.435	0.311	0.424
	Italy	0.393	0.243	0.373
	UK	0.355	0.315	0.427
Latin	Argentina	0.107	0.093	0.281
	Brazil	0.121	0.119	0.314
	Chile	0.009	0.101	0.153
	Mexico	0.172	0.283	0.369
USA	USA	0.434	0.366	0.431
ASEAN	Indonesia	0.333	0.387	0.484
	Malaysia	0.603	0.402	0.481
	Philippines	0.704	0.381	0.477
	Thailand	0.302	0.418	0.504

For advanced economies such as USA and Europe, there would be little increase of IIT even after FTA. It is due to two factors. First, most of them are already fully liberalized countries with high degree of TL. Therefore, there would be little room to increase IIT with further trade liberalization. Second, according to the estimation of equation (10), the membership effect is relatively low in vis-a-vis that of equation (5). Due to these two reasons, these countries would not be able to increase their IIT with Korea substantially.

V. CONCLUDING REMARKS

This paper tries to figure out the effects of Korea's FTA on its bilateral trade volume with its major trading partners using standard and augmented gravity models. For this purpose, this paper first tries to find out which gravity model would explain best about Korea's bilateral trade relationship with its major trading partners in Chapter 2, using panel data of 39 countries' bilateral trade with Korea during the past 21 years. In doing so, the standard gravity model, which regresses Korea's bilateral trade volume over income and distance variables, is estimated first. Afterward, this standard model has been augmented by adding several new variables that reflect policy and institutional factors. As it was expected, the augmented gravity model had better explanatory power with improved fitness vis-a-vis the standard gravity model. In terms of explanatory power, overall income level, distance, APEC dummy and TL variables were the major determinants of Korea's bilateral trade volume. Finally, the augmented gravity model incorporates country- and period-specific random effects in equation (6). In Chapter 3, effects of FTA and trade liberalization on Korea's bilateral trade volume are predicted using the augmented gravity model developed in Chapter 2. Furthermore, similar exercises are carried out in predicting Korea's bilateral trade balance after FTA. According to this prediction, there would be huge increase of trade volume if Korea sets up FTA with large Asian economies such as Japan and India. Not only they are geographically close to Korea with relatively large GDP size, but also there would be much room for increased trade once they liberalize their trade regime after FTA. Moreover, after FTA, Korea would be able to improve its trade balance with most of its trading partners including Japan. Of course, these predicted results reflect the potential gains from trade, which can be realized only when the membership effect of FTA and trade liberalization effect are fully materialized. In Chapter 4, similar analysis is performed with regard to Korea's IIT with its major trading partners. In this analysis, not only policy and institutional variables of trade liberalization and APEC membership are considered, but also structural variables such as ESI and TCI are included in the augmented gravity model. The estimated result predicts that Korea would increase its IIT with most of the developing countries including China, India, and Japan after FTA.

Even though this paper does not introduce any new theoretical framework, it contributes the study on international trade with its improved methodology and

empirical results. First, this paper confirms the validity of gravity equation in estimating Korea's bilateral trade behavior. Second, the discrepancy between actual and predicted trade volumes can provide useful information on the relationship between each country and Korea. Third, this paper can be a good starting point for researchers and policy makers who are interested in FTA policy of Korea. Last, by including analysis on intra-industry trade, this paper reminds people of the importance of intra-industry trade in FTA policy.

One of the important policy implications we can draw from this paper is that gains from trade after FTA can be realized only when trade is liberalized with the removal of both tariff and non-tariff barriers. Therefore, it is essential to pay more attention in removing non-tariff barriers when negotiations on FTA are carried out. Another important policy implication of this paper is to emphasize the potential increase of trade volume after FTA in large Asian economies such as India and Japan. Even though most of the other literatures have also predicted that there would be increase of trade volume after FTA with these economies, the magnitude of such increase was rather smaller compared to what this paper has predicted. As this paper captures the increase of trade volume after FTA, one can interpret the result of this paper as the estimation of potential trade volume after FTA and trade liberalization. With this regard, the large Asian economies such as China, Japan, and India have the greatest potential of increasing its trade both in inter-industry and intra-industry with Korea after FTA. As trade volume increases after FTA, there would be huge gains from trade to reap. Furthermore, this paper anticipates improved trade balance in favor of Korea after FTA for most countries including Japan. With positive results such as these, this paper advocates comprehensive and aggressive pursuing of FTA with Korea's major trading partners, especially those in Asian region.

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