THE JOURNAL OF THE KOREAN ECONOMY, Vol. 7, No. 1 (Spring 2006), 155-178

Impact of Implementing Economic Integration between Iran and Korea on their Intra-Industry Trade (IIT)*

Seyed Komail Tayyebi** · Shirin Arbabian***

The emerging global economy differs from the international economy in that resources are becoming more mobile and intra-industry trade (IIT) is becoming more important (Atkinson, 1998). Intra-industry trade means components are being traded across borders rather than finished goods only. In the light of globalization, thus, increasing openness and economic integration are likely to be associated with trade patterns, and with increasingly competitive product markets in previously protected industries as well.

This paper strikes to calculate the extent of Iran-Korea intra-industry trade and examine the relevant determinants of the IIT, by specifying an econometric framework, in order to explore the impact of implementing economic integration between two nations on the bilateral trade relations. The empirical analysis is conducted using a panel data set of trade partners from 1996 to 2001. The main results of the estimation regression highlight the great significance of a gravity variable set including GDP, Linder characteristic, and trade imbalance and as well as a dummy trade integration play a key role in the Iran-Korea IIT.

As estimation of the free trade agreement between Iran and Korea is rather reliable, integration seems to have an important impact on the nature of trade flows of two countries in the future.

JEL Classification: C33, F14, F15

Keywords: Iran-Korea trade relation, intra-industry trade, trade integration, gravity model

---

* Received September 17, 2005. Accepted May 3, 2006.

** Author for correspondence, Faculty of Administrative Sciences and Economics, Department of Economics, University of Isfahan, Isfahan, Iran, 81746, E-mail: komail@econ.ui.ac.ir

*** Faculty of Administrative Sciences and Economics, Department of Economics, University of Isfahan, Isfahan, Iran, 81746, E-mail: arbabian_sh@yahoo.com

1. INTRODUCTION

The world trade patterns have changed very markedly in the past few decades. International trade is no longer dominated by the simple nineteenth century Ricardian model of exchange of British cloth for Portuguese wine or the Heckscher-Ohlin explanation of inter-industry trade patterns. One of the most important trends in the world trade has been the emergence and growth of intra-industry trade, particularly between developed countries. Intra-industry trade (IIT) is defined as the simultaneous import and export of goods within the same industry. Since a substantial amount of world trade occurs in similar products, a vast theoretical and empirical literature has emerged on this subject.

A number of studies have discussed the conceptual and statistical problems involved in trying to measure IIT. Some of the notable works are those of Balassa (1963), Grubel and Lloyd (1975) and Aquino (1978). Economists have also centered on questions that have important implications for economic policy. These issues revolve around the impact of trade liberalization on the levels of intra-industry trade and the cost of adjustments following removal of trade barriers between trading partners.

The concept of intra-industry trade and the economic integration have been closely associated since the formation of the EEC in 1950s. The rise of the post-industrial economy has been accompanied by an increasing importance of intra-industry trade relative to inter-industry trade. What this means is that many traded goods and services are resources for further production at a new location. This is an element in the definition of the global economy because as inputs are moved around the globe it makes it more difficult to determine the national origin of the traded goods. Automobile parts, for instance, are being moved around the globe and it is difficult to determine the nationality of a car by its brand name, for instance (Atkinson, 1998).

The experience of a trade agreement between Iran and Korea provides an opportunity to examine whether a freer trade relationship would be promoting more intra-industry trade between two countries. In this study, we compute first the 6-digit level of IIT for Iran and Korea to recognize the movement in trade patterns between two countries. Then, by measuring 1-digit level of IIT for Iran and its major OECD partners (including Korea), we examine the hypothesis in which the implementation of free trade agreements between Iran and Korea may foster intra-industry trade of the trading partners. This, in turn, can be on the basis of a model specification, which relies on the gravity theory.

The plan of the paper is as follows. A theoretical review of IIT is presented in section 2, while the relevant IIT indicators for Iran-Korea are computed and the results are analyzed in section 3. In section 4, a panel IIT model based on gravity theory is specified and the estimates of determinants are analyzed. This analysis consists of the Iran's major OECD partners and Korea as well. Finally, some concluding remarks are presented in section 5.

2. THEORETICAL REVIEW OF INTRA-INDUSTRY TRADE

Since three decades, the theory of intra-industry trade has been presenting a specific interest as far as simultaneous exports and imports of similarly goods represent a large and increasing share of trade. Thus, trade structure cannot be predicted only by the traditional theory of trade. As a matter of fact, Ricardian and Hecksher-Ohlin types of model explain the nature of trade by supply side differences. Following these models, one would expect that trade only appears between countries characterized by different factor endowments. Nevertheless, world trade is essentially dominated by trade between developed countries with similar economic structures and factors endowments.

In models of monopolistic competition, the preference for variety on the demand side combined with the presence of economies of scale on the production side play a crucial role in the appearance of intra-industry trade. All countries have a preference for the variety.

However, only a small number of them are domestically produced. This happens because of the presence of increasing returns to scale, which favors the concentration of production by limiting the optimal number of varieties, which may be produced in each country. Lancaster (1980) and Krugman (1979, 1980) maintain that intra-industry trade expansion is a result of product differentiation in markets with monopolistic competition and increasing returns to scale. According to these authors, trade in differentiated products is most likely to place between countries with similar factor endowments and which have a high level of per inhabitant income. Helpman and Krugman (1985) incorporate factor endowments, decreasing costs and horizontal product differentiation in a model, which generates both intra- and inter-industry trade. To illustrate that, they take a standard model assuming two countries, the North and the South, two production factors, labor and capital, and two goods. Fixed supplies of labor and capital are mobile within industries but immobile between countries. Production functions are identical in the two countries. The first product is differentiated and the other one homogeneous. The former is produced using relatively capital-intensive techniques; the latter is produced using relatively labor-intensive technology. Moreover, they assume insignificant transport costs, no trade impediments, and leveling factor prices. They assume that a North country is relatively capital-abundant and a South country is relatively labor-abundant. Therefore, the South country will export the homogeneous good while both countries will produce and export differentiated products. In this intra-industry trade model, scale economies and monopolistic competition determine the trade of differentiated capital-intensive products.

This type of intra-industry trade coexists with inter-industry trade in a labor-intensive homogeneous products lead by cross-country differences in relative factors endowments. The volume of intra-industry trade evolves when allocation of resources changes between trading partners. Following the traditional Stolper Samuelson effect, intra-industry trade induces a high level of adjustments costs. In contrast, for the intra-industry trade, human capital is portable across firms and in this case, adjustment costs are assumed to be much smaller than for inter-industry trade.

2.1. Measurement of Intra-Industry Trade

Balassa (1963) proposed the first measure of intra industry trade that measured the degree of trade overlap-simultaneous import and export of goods-within an industry. He suggested that it be measured by the extent to which exports of a given good are offset by imports of an equivalent good. Algebraically, if X_i is the value of the exports of commodity i by a country, and M_i is the value of the "matching" imports then the Balassa index is

$$B_j = \frac{\left|X_i - M_i\right|}{(X_i + M_i)}.$$

This index ranges from 0 to 1, with 0 representing "perfect" trade overlap, and therefore pure intra industry trade, while 1 represents pure inter industry trade. In other words, if there is no intra-industry trade, then there are neither exports $(X_i = 0)$ nor imports $(M_i = 0)$, that is, B_j = 1. However, if there is "perfectly matching" intra industry trade then $(M_i = X_i)$ and B_j = 0. In order to calculate intra-industry trade at the country level, Balassa took a simple average for each B_j; $B = \frac{1}{n}\sum B_j$, where n is number of industries. This can be generalized to a weighted index: $B = \sum_j w_j B_j$, where w_j denotes the industry j's share of total trade.

The Balassa index has not found much favor, because an index, which measured intra-industry trade that gave pure trade overlap a value of zero, was not intuitively appealing. Most studies use the Grubel and Lloyd (*GL*) index, which, is a simple modification of the Balassa formula. The index is defined as

$$GL = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} = 1 - \frac{|X_i - M_i|}{(X_i + M_i)} = 1 - B_j.$$

This index assigns pure intra-industry trade a value of 1 and pure inter-industry trade a value of 0. As with the Balassa index, the Grubel-Lloyd index has been calculated as a weighted average to measure the degree of intra-industry trade at the country level. This class of index has been criticized for suffering from categorical/sub-group aggregation issues. These issues have two basic forms that bias the index toward 1: the grouping of two products in the same industry which should not be classified together; and trade imbalance.

The principal difficulty with Balassa index (and indeed other measures) is the problem of ambiguously defining the term “industry”. Invariably, the index is measured at a particular level of statistical aggregation, which may be the appropriate level for some activities but not the others. There is not a priori reason why one particular level of aggregation is necessarily more appropriate than any other; although a number of researchers have argued that the third digit of *SITC* (or its equivalent in national classifications) is a suitably disaggregated level for empirical analysis. Even at the third digit however, it is quite possible to find activities with different production functions grouped into the same category. The consequence of this misclassification can be referred “categorical aggregation”. One solution for solving this problem is probably to regroup the basic data such that only activities with similar production function and/or end use are grouped together. The absence of a unique criterion for regrouping makes this option problematic. Trade imbalance can occur when sub-groups are not appropriately aggregated. This problem arises when the net trade-gross trade ratio is characterized by opposite trade imbalances for the sub-groups (Greenaway *et al*., 1994).

The source of the problem is that the *GL* index at any given level of aggregation is a weighted average of the indices for the next most disaggregated groups. We may show this formally as follows: let *i* be the aggregated group, so that X_i and M_i are the exports and imports in that group. Suppose there are n commodities/ sub-groups within *i*, with the exports and imports in the subgroup being X_{ij} and M_{ij} respectively. Then we may write the *GL* index for the aggregated group of *i* as

$$B_i = 1 - \frac{\left|X_i - M_i\right|}{(X_i + M_i)} = 1 - \frac{\left|\left(X_{1i} - M_{1i}\right) + (X_{2i} - M_{2i})\right|}{(X_{1i} + M_{1i} + X_{2i} - M_{2i})}. \quad (1)$$

If $X_{1i} - M_{1i}$ and $X_{2i} - M_{2i}$ have the same sign, then $\left|\left(X_{1i} - M_{1i}\right) + (X_{2i} - M_{2i})\right| = \left|\left(X_{1i} - M_{1i}\right)\right| + \left|(X_{2i} - M_{2i})\right|$, and $B_i = w_{1i}B_{1i} + w_{2i}B_{2i}$, where $B_{ij} = 1 - \frac{\left|X_{ij} - M_{ij}\right|}{(X_{ij} + M_{ij})}$ is the *GL* index for subcategory j, and $w_{ij} = 1 - \frac{\left|X_{ij} - M_{ij}\right|}{(X_i + M_i)}$ is the share of subcategory j trade in category i trade.

If however, $X_{1i} - M_{1i}$ and $X_{2i} - M_{2i}$ have the opposite sign, then $\left|\left(X_{1i} - M_{1i}\right) + (X_{2i} - M_{2i})\right| < \left|\left(X_{1i} - M_{1i}\right)\right| + \left|(X_{2i} - M_{2i})\right|$, and so $B_i > w_{1i}B_{1i} + w_{2i}B_{2i}$.

In other word, if the country in question is a net exporter (importer) in both sub-groups the weighting effect of the ratio is maintained, but if the country is a net exporter of one good and a net importer of the other good, the weighting effect is lost and the *GL* index will take on a different value (Greenaway and Milner, 1994).

Various methods have been suggested for modifying the *GL* index to meet this problem. Greenaway and Milner discuss such problems in greater depth and show the index can be corrected by replacing the original net trade-gross trade ratio with the following one

$$\frac{\sum_{i=1}^{n}\left|X_{ij}-M_{ij}\right|}{(X_j+M_j)},$$

where i is the sub-group i within industry j. This adjustment removes the trade imbalance bias that results from countries being a net exporter in one sub-group of an industry and a net importer in another sub-group as well as the simple aggregation bias. We are left with the following index of intra-industry trade

$$GL'_j = 1-\frac{\sum_{i=1}^{n}\left|X_{ij}-M_{ij}\right|}{(X_j+M_j)}. \qquad (2)$$

Generally speaking, if a country is a net exporter/importer in both goods, $GL = GL'$, but if a country is a net exporter in one good and a net importer in another, $GL < GL'$; $0 \le GL' \le GL \le 1$.

In general, we use the *GL* index in order to calculate the part of balanced trade, overlapped between exports and imports, in all trade in a given industry *k* between the country *i* and *j*.

$$GL_{ij,k} = \left[1-\frac{\left|X_{ij,k}-M_{ij,k}\right|}{(X_{ij,k}+M_{ij,k})}\right]\times 100, \qquad (3)$$

where $GL_{ij,k}$, X_{kij} , and M_{kij} represent respectively *GL* intra-industry trade, exports and imports between countries *i* and *j* in the industry *k*.[1] By construction, this indicator displays the trade imbalance as part of inter-industry trade flows and trade overlap representing intra-industry trade. Thus, two distinct theoretical concepts are used to explain a same flow.

3. GL INTRA-INDUSTRY TRADE (IIT) FOR IRAN AND KOREA

In recent years, Iran and South Korea have made attempts for expanding their bilateral trade relations. In February 2005, the South Korea's Chambers of Commerce and the Iran's Chamber of Commerce, Industries, and Mines (ICCIM) talked in a meeting in Tehran to explore ways of expanding economic and trade ties between the two countries' private sectors. At the meeting, both sides pointed out that they would do their utmost to take steps for a higher level of the bilateral trade relations (Iran-Daily, 2005).[2] Accordingly, they emphasized on close cooperation between the two countries that pave the way for capital mobility, technology transfer and financial management, which are necessary for trade expansion.

For the Iran's part, authorities underscored the country's needs to attract foreign capital in its private sector, and called on Korean companies to look more closely at the Iranian market. They also pointed out that Iran's economic policies are moving towards privatization, and downsizing the government would provide a suitable opportunity for bilateral cooperation between two countries.

The ICCIM (2005) has reported that the trade volume between Iran and South Korea was about $4 billion in 2004, while Iran's export to South Korea stood at

---

1) Some other methodologies used to measure the extent of intra-industry trade (IIT) are, for example, the Balassa index, Aquino adjusted measure, and the Grubel-Lloyd summary measure.

2) Published by the Islamic Republic News Agency, IRNA, 2005, www.iran-daily.com.

$1.8 billion in 2003. Also Iran's exports to South Korea showed a growth of 38% in 2004 in terms of the value compared to the amount for the previous year, while the rise was due to an increase in export of crude oil. South Korea's export to Iran amounted to $1.7 billion in 2003, showing a 44% rise compared to the figure for the previous year. According to this report, facilitating export and import, removing non-tariff barriers for imports of all goods and reforming the laws on supporting investments and reducing income tax rate from 65% to 25% were among the measures taken by the Iranian government in recent years.

It is, therefore, useful to compute the degree of intra-industry trade for two countries in order to explore the role of intermediate tradable goods that can play significantly in a potential free trade implementation. We employ (3) to compute GL index by using data on bilateral trade at the 6-digit from the Harmonized System (HS). These data were extracted from PC-TAS CD-ROM for the period 1996-2001. Table 1 indicates GL index values, on average, for a variety of 20 products, which were available in this period.

The figures in table 1 show that Iran and Korea had the maximum levels of trade overlap, on average, in products coded by 400220 (butadiene rubber) and 390410 (polyvinyl chloride), while they had minimum values of IIT, on average, in products coded by 590210 (tire cord fabric made of nylon) and 847192 (digital process units), respectively. Table 1 also indicates the distribution of IIT indices on average in the period 1996-2001. According to the results, out of total 20 items, 12 items have had the comparatively high levels of IIT ($GL > 10$), while the remaining ones (8 items) have had the comparatively low levels of IIT ($GL < 10$). Thus, the results show that intra-industry trade intensity has been more pronounced between two countries, because the comparatively high levels of IIT for more product items can be attributed to the interests of both countries for expanding their trade relations and economic integration implementation.

The next section will thus examine the impact of any integrated trade implementation on fostering trade flows through IIT improvement.

Table 1 Measures of *GL* Intra-Industry Trade, on Average, for Iran and Korea in the 6-digit Level during 1996-2001 (%)

Code	Product	Average of IIT	Distribution of IIT
271000	Petroleum oils& oils obtained	3.523	$GL < 10$
291732	Dactyl orthophthalates	10.103	$GL > 10$
293490	Heterocyclic compounds	14.607	$GL > 10$
294190	Antibiotics	7.970	$GL < 10$
300490	Medicaments	16.939	$GL > 10$
390410	Polyvinyl chloride	32.965	$GL > 10$
392690	Articles of plastics or of other materials	16.809	$GL > 10$
400219	Styrene- butadiene rubber/carboxyl styrene-butadiene rubber	19.506	$GL > 10$
400220	Butadiene rubber	34.589	$GL > 10$
401699	Articles of vulcanized rubber	10.728	$GL > 10$
590210	Tire cord fabric made of nylon	1.503	$GL < 10$
730890	Structures &parts of Structures	19.774	$GL > 10$
847191	Digital process units	1.073	$GL < 10$
847330	Parts & accessories of automatic data processing machines	8.168	$GL < 10$
850431	Transformers electric power handling capacity	17.585	$GL > 10$
850440	Static converters	8.509	$GL < 10$
851740	Apparatus, for carrier-current line systems	24.087	$GL > 10$
854211	Monolithic integrated circuits	10.001	$GL > 10$
854441	Electric conductors	5.620	$GL < 10$
870870	Wheels including parts and accessories for motor vehicles	19.328	$GL > 10$

Source: PC-TAS CD-ROM (2003), and Compiled by the authors.

4. IMPACT OF TRADE INTEGRATION ON IRAN'S IIT

The high level of a country's IIT with its major trading partners can be attributed to a number of country-specific factors including, its close geographical proximity, similar level of per capita income, similar level of development, similar consumer tastes, language, culture, institutional and political and transport links. Basically, the theoretical arguments of the subject have been developed in the literature by Gray (1973), Grubel and Lloyd (1975), Lancaster (1980), Krugman (1980), Balassa (1986), Marvel and Ray (1987), Bano (1991) and others. These results fit almost perfectly such theoretical profile outlined here.

It is often stated that the increases in trade in past decades are mostly intra-industry, where we see two-way trade in the same industry. This phenomenon started in industrialized countries almost three decades ago (Globerman, 1992; Canali, 1996; Menon, 1994). Australia, Japan and the newly industrialized nations of the Asia-Pacific region experienced rapid growth in their intra-industry trade (Wakasugi, 1997). This trend is also observed in other regional integration efforts, such as Latin America, West Africa, and Sub-Saharan Africa (Oyejide, 1997). There are empirical works suggesting that steps toward regional integration so far have been almost adjustment cost free (Gonzales, 1995). These claims rest on the fact that most of the increase in trade has been intra-industry, which is assumed to result in small adjustment.

However, integration leads to economic restructuring, not only across industries but also within an industry. As Nickell (1987) pointed out, there are considerable costs associated with changing jobs during this restructuring. An adjustment occurs since the factors used in the production of a good are specific, and cannot be used in the production of other goods without transformation. Intra-industry-type changes in trade are conventionally treated as free of adjustment costs in the literature. Menon and Dixon (1996), Hamilton and

Kniest (1991), and Greenaway *et al*. (1994) all argue that adjustment costs associated with trade liberalization are lower if most of the increase in trade is intra-industry. The critical assumption in their argument is that jobs in the same industry require similar skills.

Intra-industry trade (IIT), however, can result from completely different causes. The factors causing two-way trade of final goods in the same industry, i.e. horizontal IIT, are totally different from those that lead to trade of goods in the same industry but at different stages of production, i.e. vertical IIT. In general, the exchange of similar products as a consequence of scale economies, product differentiation or reciprocal dumping is considered as horizontal IIT. Vertical IIT, on the other hand, is identified as the exchange of different products in the same industry, due to vertical disintegration of production process based on varying factor intensities within an industry.

Bhagwati and Dehejia (1994), Leamer (1996) and Antweiler and Trefler (1997) refer to the importance of disintegration of production internationally, which creates vertical IIT, during an economic integration process. Given the importance attached to vertical IIT, intra-industry trade should be separated into its vertical and horizontal parts to get a better judgment on adjustment costs. Analyzing only the overall inter-industry trade will underestimate the implied magnitude of adjustment in labor markets and the implied adjustment costs.

Incidentally, Greenaway *et al*. (1995) warn about the consequences of failing to separate these two types of IIT in interpreting the empirical results. The idea that integration implies small adjustment in labor markets relies on models that allow trade only in final goods. Such models result in only horizontal IIT, and use it to represent the overall IIT. By allowing trade in intermediate goods, the model in this paper will be better able analyze the adjustment effects of integration.

4.1. Determinants of Intra-Industry Trade

The key determinants for the IIT model are drawn from the theoretical and empirical literature. Following Balassa (1986) and Bergstrand (1990), the IIT model we estimate may include of a number of explanatory gravity variables as below

$$IIT = f(AGNI, LIN, APOP, DIS, IMB, DUM), \tag{4}$$

where IIT : Intra industry trade for any pair of countries, $AGNI$: Average of Gross National Income Per Capita for any pair of countries, LIN : Linder variable, which stands for a gap between income per capita of two countries, $APOP$: Country size (average of populations), DIS : Geographical distance between two trading partner countries, IMB : Trade imbalance between the two countries, and DUM : A set of dummy variables, indicating whether the two countries share a past colonial links, or intend to implement a preferential trade agreement (PTA), etc.

Due to the definition of the Grubel – Lloyd IIT (GL), it is re-defined as IIT_{ij} , which is an average of GL between country *i* and country *j* in industry *k*, specified in (5)

$$IIT_{ij} = \frac{1}{K}\sum_{k=1}^{K} GL_{ij,k}, \tag{5}$$

where K is the total number of industries available in two countries.

$AGNI$ is here measured on a bilateral basis using the average GDP (in current US$) of the declaring country *i* and its partner *j*, following the methodology put forward by Bergstrand (1990), where it has a positive effect on the dependent variable. $APOP$ stands for the average market size of two countries, which is proxied by population of each country. It is assumed that a lower difference in per capita income leads to intra-industry trade. Per capita income may influence the pattern of trade through both demand and supply side. Per capita income represents an indicator of demand structure; a greater equality in per capita income implies that demand structure becomes more similar in the two trading countries. In this way, the potential for intra-industry trade increases. Thus, the extent of IIT is hypothesized as being positively related to the similarity in per capita income of the trading partners, implying similarity in their demand partners. Thus, *LIN*, which stands for Linder effect, tests this using the difference in GDP per capita between countries *i* and *j* and it would be expected a negative relationship between this variable and *IIT*.

As Clark (1993) discusses, *IIT* is biased by the degree of imbalance. Accordingly, we use trade imbalance, *IMB*, as a variable to control for bias in the estimation, defined as

$$IMB_{ij} = \frac{|X_{ij} - M_{ij}|}{(X_{ij} + M_{ij})}, \tag{6}$$

where X_{ij} is defined as total exports of country *i* to country *j*, and M_{ij} is defined as total imports of country *i* from country *j*. Hence the variable represents net trade as a share of total trade, and will take a value of zero at the lower extreme, when there is no imbalance and a value of one if there are either no exports or imports to a country. Ultimately, *DUM* denotes a dummy variable, which is used for testing a hypothesis that integration schemes such as the Iran and Korea in the light of a conductive free trade agreement (*FTA*) might be positively correlated with intra-industry trade reflecting increased possibilities of intra-industry trade within block integration. The dummy variable captures one if there is a plan of trade integration between two partners, otherwise zero. The scenario conducted here is a possible implementation of *FTA* between Iran and Korea.

4.2. The Empirical Model

It is now to specify a stochastic gravity model to investigate effect of integration between Iran and Korea on their inter-industry trade flows over the period 1996-2001. According to the specified explanatory variables in (4) and to the definition of *IIT* in (5), a type of the generalized gravity model is defined as follows

$$IIT_{ij} = \alpha_0 + \sum m\beta_m Z_{ijm} + U_{ij}, \qquad (7)$$

where IIT_{ij} is the average of *GL* intra-industry trade index between Iran (country *i*) and each of its 23 major OECD trading partners, including Korea, (country *j*), which have *IIT* with Iran. Z_{ijm} is a set of explanatory variables (*m* variables), that are the conventional factors influencing intra-industry trade and which are discussed above. U_{ij} is the disturbance term.

Any attempt for estimating equation (7), which assuming intercept (α_0) is homogeneous for trading-partner pairs, yields biased results, since countries are often different in historical, cultural as well as political structures. It is evident that the crucial source of the bias is as a result of failure to applying Ordinary Least Squares (OLS) methods to deal with the heterogeneity among bilateral trade relationships (Tayyebi, 2005). We will implement this through *F*-test. Thus, one of the solutions to control for heterogeneity is the use of *Panel Data* procedure, which allows intercepts of the model to be specific to each trading pairs. Generally formed, the *IIT* model in Panel Data is as follows

$$IIT_{ij,t} = \alpha_0 + \alpha_t + \alpha_{ij} + \sum m\beta_m Z_{ijm,t} + U_{ij,t}, \quad t = 1,\ 2,\ \ldots,\ T, \qquad (8)$$

where $IIT_{ij,t}$ is intra-industry trade between country *i* and country *j* in year *t*, and $Z'_{ijm,t}$ is the (1 × *m*) row vector of explanatory variables in year *t*. In this model, intercept contains three parts; the first one is the same to all years and individuals including country pairs, α_0, the other becomes specific to year *t* and the same to all individuals, α_t, while the third refers to specific individuals, but the same to all years, α_{ij}. It is the so-called individual effect (a country pair fixed effect), which is allowed to be different across partner pairs, namely $\alpha_{ij} \neq \alpha_{ji}$. The estimation results obtained by OLS, therefore, show serious problems of biasness due to the restriction that country pair intercept terms equal zero (Baltagi, 2005).

Table 2 reports estimation results for the IIT model in (8), obtained by Panel Data, for 134 observations consisting of cross-section countries on Iran and its 23 trading partners over the time period from 1996 to 2001. The results summarized in the table, are based upon methods of pooling data (OLS), fixed effects (FE) and random effects (RE).[3] As the values of *F*-test shows [F_{Leamer} = 10.461, (p = 0.000)], the null hypothesis of the same individual effects cannot be acceptable, implying that OLS results are biased and, more specifically, there exists heterogeneity for each pair of trade partners. It expresses that the problem of heterogeneity may be controlled by concerning on different individuals effects,

[3] The Panel Data procedure consists of three estimation sets; first, between groups (BG) that captures differences between individuals, but ignores information within them. Second, fixed effects (FE) estimates in which it is assumed the slope of the gravity equation is the same for all partner pairs, but there are specific intercepts for each of them (individual effects) that would be correlated or uncorrelated with explanatory variables (Hsiao, 2003). The third estimation set relies on random effects (RE) estimates where there exist intercepts ($\alpha_{ij}s$), affiliating the same distribution function with average α and variance $O^2\alpha$, that are uncorrelated with the explanatory variables. Since individual effects (α_{ij}) are included in the regressions, we decide whether they are treated effectively as fixed or random effects. In order to distinguish between the FE and RE method, the Hausman test is applicable for the null hypothesis in which the explanatory variables and individual effects are uncorrelated. The fixed effects estimates are consistent with both the null and alternative hypotheses, whereas the random effects estimates are only compatible with the null hypothesis.

Table 2 Estimation Results for the IIT Model

Explanatory Variables	Pooling Data	FE Estimates	RE Estimates
Constant	–2.306 (–2.778)	-	–4.118 (–2.154)
LIN	0.016 (0.544)	–0.541 (–1.930)	–0.0161 (–0.253)
LIJ	0.004 (2.723)	0.049 (3.961)	0.006 (2.042)
IMB	–0.418 (–1.851)	–0.451 (–2.049)	–0.302 (–1.634)
DUM	–0.037 (–1.032)	0.0617 (2.131)	0.063 (1.067)
R^2	0.091	0.652	0.544
Number of observations	134	134	134
F_{Leamer}	10.461 (p = 0.000)		
Hausman -Statistic	19.734 (p = 0.000)		

Note: Values of *t*-ratio are represented in parentheses. Also the probability of null hypothesis acceptance for F_{Leamer}-statistic and Hausman statistic is available in parentheses.

additionally, the value of R^2 (0.09), does not allow OLS to generate strong results in explaining IIT changes.

Compared with the power of model fitting, the results clarify the reasons that FE and RE methods have been concerned with individual intercepts, which enable us to explain heterogeneity between each pair of countries, they are relatively powerful in goodness of fit rather than OLS (Pooling Data). In addition, the Hausman statistic (H = 19.73) approves that FE results are more reliable than those obtained by RE.[4] Since in an error-components setup, heteroscedaticity can arise because the variance $\sigma^2_{\alpha ij}$ of α_{ij} varies with an individual (pair country), or the variance σ^2_{uij} of u_{ij} varies with an individual, both $\sigma^2_{\alpha ij}$ and σ^2_{uij} vary with an individual (Hsiao, 2003), we apply the estimation process by panel data based on a heteroscedaticity-robust version in order to ensure the reliability of the results (Wooldridge, 2006). The estimates have been, thus, finalized by the model selection and data transformation.

Results reported in table 2 obtained by FE indicate that GDP (proxied by *LIJ*, which is the logarithm value of $GDP_i \times GDP_j$) coefficient has the positive signs, and as expected, is statistically significant at the 5% significance level. It means that the size of economies approximated by *LIJ* has a positive and significant incidence on intra-industry trade of Iran and its trading partners. As a matter of fact, on the one hand, a large market increases opportunities to a higher rate of trade flows between countries; on the other hand, a large income raises the demand for differentiation.

The coefficient of Linder variable (*LIN*) is statistically significant at 10% significance level, even though found insignificant by OLS and RE, and has the true sign in the estimated model by FE. The finding implies the bigger is the difference of economical size; the lower is the intra-industry trade. As the variable declines and the income convergence occurs, the potential for intra-industry trade increases.

Estimated significantly coefficient of trade imbalance, *IMB*, reveals the fact that intra-industry trade of Iran with its major trading partners is biased to trade deficit by a degree of about 0.45%. However, the dummy variable *DUM*, which proxies for a scenario of free trade agreement between Iran and Korea in the

---

[4] In technical words, Hausman-statistic tests for the null hypothesis that the explanatory variables and individual effects can be uncorrelated. The fixed effects estimates are consistent with the both null and alternative hypotheses, whereas the random effects estimates are only compatible with the null hypothesis. Therefore, RE method is preferred if the null hypothesis holds, otherwise FE method can be applicable (Baltagi, 2005).

estimation process, affects significantly and positively Iran intra-industry trade, implying the implementation of decreasing tariff barriers between two countries seem to intensify substantially trade flows.

To estimate effects of geographical distance (DIS_{ij}) on Iran's IIT and its major trading partners, since it is impossible to use directly this variable through estimation process of the FE method, we regress estimated individuals effects (IE_{ij}) obtained by estimating panel data IIT model. The new estimated equation is as follows

$$\begin{aligned} \hat{E}_{ij} &= -25.611 - 0.252 \times 10^{-3} DIS_{ij} & \qquad \bar{R}^2 &= 0.049, \\ t &= (-81.751)\ (-0.229 \times 10^{-3}) & \qquad DW &= 1.69. \end{aligned} \tag{9}$$

Estimation results obtained indicate that the coefficient of distance variable is not statistically significant, and thus there is no important sign of transportation costs being as an obstacle on expanding trade relations between Iran and its major trade partners. Our results support findings obtained by Chen (2004), in which border effects can be expected to disappear in the future of global trade.

5. CONCLUSIONS

This paper has first reviewed theoretically and practically the importance of intra-industry trade (IIT), and then has calculated the extent of Iran-Korea IIT. The results have shown that intra-industry trade intensity is more pronounced between two countries, because the comparatively high levels of IIT for a number of products can be attributed to the interests of both countries for expanding their trade relations and economic integration implementation.

To examine the impact of implementing conductive trade integration, we have specified an econometric framework of IIT based upon gravity theory. Using data for the period 1996-2001 on a sample of Iran's OECD trading partners including South Korea, this study has identified major gravity determinants of IIT through estimation process of a panel IIT model. The main results have highlighted the great importance of the country-specific variables, such as the criteria of economic condition (GDP), income per capita gap (Linder variable) and, trade imbalance and liberalizing trade play a key role in trade expansion.

As estimation of the free trade agreement between Iran and Korea is rather reliable, integration seems to have an important impact on the nature of trade and particularly for these nations. It seems that attempts to free up trade between the nations, through trade integration, can generate many conditions of economic capacity, market size, and convergence, which are causative factors of intra-industry trade. Thus, this implies that many industries, in the process of integration, take advantage from scale economies and a high potential of goods differentiating, and we can assume a revealing increase of intra-industry trade. Ultimately, with no significant distance effect, the implication is that freer trade policy towards further market integration between two countries should stimulate their IIT of more products.

REFERENCES

Antweiler, W. and D. Trefler, "Increasing Returns and All That: A View from Trade," Working Paper, University of British Columbia and University of Toronto, 1997.

Aquino, A., "Intra-Industry Trade and Inter-Industry Specialization as Concurrent Sources of International Trade in Manufactures," *Weltwirtschaftliches Archiv*, 114, 1978, pp. 275-296.

Atkinson, G., "Regional Integration in the Emerging Global Economy: The Case of NAFTA," *The Social Science Journal*, 35, 1998, pp. 159-168.

Balassa, B., "An Empirical Demonstration of Classical Comparative Cost Theory," *Review of Economics and Statistics*, 4, August 1963, pp. 231-238.

______________, "Intra-Industry Specialization: A Cross-Country Analysis," *European Economic Review*, Vol. 30, 1986, pp. 27-42.

Baltagi, B. H., *Econometric Analysis of Panel Data*, 3rd ed., New York: John Weily & Sons, Ltd., 2005, p. 302.

Bano, S., *Intra-Industry International Trade: The Canadian Experience*, Aldershot: Avebury, 1991.

Bergstrand, J., "The Heccksher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bi-lateral Intra-Industry Trade," *The Economic Journal*, 100, 1990.

Berry, S., Vittorio Grilli, F. Lopez-de-Silanes, "The Automobile Industry and the Mexico-US Free Trade Agreement," NBER Working Paper, No. 4152, 1992.

Bhagwati, J. and V. Dehejia, "Freer Trade and Wages of the Unskilled –Is Marx Striking Again?" in Jagdish Bhagwati and Marvin Kosters (eds.), *Trade and Wages: Leveling Wages Down*?, Washington, D.C.: The American Enterprise Institute Press, 1994, pp. 36-75.

Canali, G., "Intra-Industry Trade of Agricultural and Food Products in NAFTA and EU Member Countries: Some Relevant Issues," *Rivista Internazionale di Scienze Sociali*, 104, 1996, pp. 159-171.

Chen, N., "Intra-National Versus International Trade in the European Union: Why Do National Borders Matter?" *Journal of International Economics*, 63, 2004, pp. 93-118.

Clark, D. P., "Recent Evidence on Determinants of Intra-Industry Trade," *Weltwirtschaftliches Archiv,* 129, 1993.

Globerman, S., "North American Trade Liberalization and Intra-Industry Trade," *Weltwirtschaftliches Archiv*, 128, 1992.

Gonzales, J., "Intra-Industry Trade between the United States and the Major Latin American Countries: Measurement and Implications for Free Trade in the Americas," *International Trade Journal*, 9, 1995, pp. 519-536.

Gray, P. H., "Two-way International Trade in Manufactures: A Theoretical Underpinning," *Weltwirtshaftliches Archiv*, 109, 1973, pp. 19-39.

Greenaway D., R. Hine, and C. Milner, "Country-Specific Factors and the Pattern of Horizontal and Vertical Intra-Industry Trade in the UK," *Weltwirtschaftliches Archiv*, 130, 1994.

______________, "Vertical and Horizontal Intra-industry Trade: A Cross Industry Analysis for the United Kingdom," *The Economic Journal*, 105, 1995.

Grubel, H. G. and P. J. Lloyd, *Intra-Industry Trade*, London: The Macmillan Press, Ltd., 1975.

Hamilton, C. and P. Kniest, "Trade Liberalization, Structural Adjustment and Intra-Industry Trade: a Note," *Weltwirtschaftliches Archiv*, 127, 1991, pp. 356-367.

Helpman, E. and P. R. Krugman, *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and International Economy*, Cambridge, Mass.: MIT Press, 1985.

Hsiao, C., *Analysis of Panel Data*, 2nd ed., NY: Cambridge University Press, 2003.

Islamic Republic News Agency, IRNA, 2005, www.iran-daily.com.

Krugman, P. R., "Increasing Returns, Monopolistic Competition and International Trade," *Journal of International Economics*, 9, 1979, pp. 469-479.

______________, "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70, 1980, pp. 950-959.

Lancaster, K., "Intra-Industry Trade under Perfect Monopolistic Competition," *Journal of International Economics*, 10, 1980, pp. 151-175.

Leamer, E., "In Search of Stolper-Samuelson Effects on U.S. Wages," NBER

Working Paper, No. 5427, 1996.

Marvel, P. M. and E. J. Ray, "Intra-Industry Trade: Sources and Effects on Protection," *Journal of Political Economy*, 95, 1987, pp. 1278-1291.

Menon, J. and P. Dixon, "How Reliable are Intra-industry Trade Measures as Indicators of Adjustment Costs," Centre of Policy Studies and the Impact Project, Working Paper, G-119, 1996.

Menon, J., "How Important is Intra-Industry Trade in Australia's Rapid Trade Growth?" Centre of Policy Studies and the Impact Project Working Paper G-110, 1994.

Nickell, S. J., "Dynamic Models of Labor Demand," in O. Ashenfelter and R. Layard (eds.), *Handbook of Labor Economics*, 2, Amsterdam: North-Holland, 1987, pp. 473-522.

Oyejide, A., *Regional Integration and Trade Liberalization in Sub-Saharan Africa: Framework, Issues and Methodological Perspectives*, Vol. 1, New York: St. Martin Press, 1997.

Tayyebi, S. K., "Trade Integration in ASEAN: An Application of the Panel Gravity Model," in Harvie C., F. Kimura and H. H. Lee (eds.), *New East Asian Regionalism*, *Causes*, *Progress and Country Perspectives*, USA: Edward Elgar, 2005, pp. 109-127.

Wakasugi, R., "Missing Factors of Intra-Industry Trade: Some Empirical Evidence Based on Japan," *Japan and the World Economy*, 9, 1997, pp. 33-62.

Wooldridge, J. M., *Introductory Econometrics, a Modern Approach*, 3rd ed., USA: Thomson South-Western, 2006.