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Intra-Industry Trade between Turkey and OECD Countries: A Panel Data Analysis

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Abstract: The purpose of the present paper is to measure the extent of Turkey's bilateral intra-industry trade (IIT) with OECD countries, and to test empirically various country-specific hypotheses concerning the determinants of IIT between Turkey and its 28 trade partners in OECD group. The findings reveal that Turkey generally posseses an upward trend and relatively high degree of IIT with these countries. Using panel data the empirical results show that IIT between Turkey and OECD countries are positively related to the country-specific variables, such as per capita income level and economic size, and negatively related to the geographical distance. In contrast to the findings of the much of the IIT studies, the variable of economic integration appears to have decreasing effect on IIT between two sides.

Keywords: intra-industry trade, Turkey, panel data

JEL Classification: F14

Introduction

Much of the studies on trade patterns in recent times have suggested that a significant proportion of trade in manufactured products, particularly those developed industrial countries, comprises intra-industry trade (IIT). Instead of inter-industry specialisation and its resultant trade form in which exchanges manufactured goods for raw materials or primary products, trade among advanced industrial countries appears to take, to a great extent, the form of one manufactured product for another, that is

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intra-industry specialisation which requires two-way trade in a narrow range of products within a given industry. However, a group of developing countries known as newly industrializing countries (NICs) have emerged as significant suppliers of manufactured exports for more than four decades, and also increased the level of IIT in their total trade (Organisation for Economic Co-operation and Development [OECD], 2002).

From the Second World War and onwards there have been a large number of studies examining the phenomenon of intra-industry trade (IIT). Balassa (1966) first mentioned the term of intra-industry trade to describe the simultaneous import and export of goods within the same industry in both trade partners. Since then, a large number of theoretical and empirical studies have appeared to explain this phenomenon. The studies in this field can be classified into two main groups: First group studies have been on theoretical explanations for intra-industry trade's existence (Krugman, 1979, 1980; Lancaster, 1980; Falvey, 1981 and Falvey and Kierzkowski, 1984). The other group has been on the studies related to measuring and empirical analysis of intra-industry trade (Grubel and Lloyd 1975; Havrylyshyn and Civan, 1983; Greenaway and Milner, 1984; Balassa and Bauwens, 1987; Brülhart, 1994). The current study is concerned with the latter group for the case of Turkey.

In this article, we try to examine the extent of Turkey's bilateral IIT with OECD countries, and to test empirically a number of country-specific hypotheses concerning the determinants of IIT between Turkey and the OECD. A novelty of the paper is that it applies the panel data method for the analysis of Turkish IIT with the OECD. In most previous studies, though not many, different econometric methods and geographical contexts have been used (Erlat and Erlat 2003; Lohrmann, 2002; Gönel, 2001). Studying Turkish IIT in the context of the OECD is important because Turkey's international trade has been dominated by the OECD countries for decades, comprising around 60 percent of Turkish foreign trade. (Undersecretariat of Foreign Trade [UFT], 2008).

The Extent of Turkey's Bileteral IIT in the Context of the OECD Countries

In the first subsection, the measure of IIT used in this study is set out. The following subsection analyzes the changes in the levels of Turkey's bileteral IIT and provides an overview of the IIT patterns with her OECD trading partners.

Measurement of Intra-Industry Trade

A variety of alternative measures have been purposed in the literature to estimate the degree of intra-industry trade (IIT). Among them the most widely adopted measure in international economics has been developed by Grubel and Lloyd, which is therefore known as Grubel-Lloyd (the G-L) index. They measured intra-industry trade as a percentage of country's total trade which was assumed to be balanced, that is exports equal imports. For an individual product group or industry *i* the share of IIT formulated as

$$IIT_{GL} = 1 - \frac{\left| x_{ij} - m_{ij} \right|}{(x_{ij} + m_{ij})} \tag{1}$$

where x_{ij} and m_{ij} are home country's exports of industry *i* to country *j* and home country's imports of industry *i* from country *j*, respectively. Thus, IIT_j index in (1) measures the intensity or proportions of intra-industry trade in industry *i*. If all trade in industry *i* is intra-industry trade, that is, $x_{ij} = m_{ij}$, then $IIT_{ij} = 1$. Similarly, if all trade in industry *i* is inter-industry trade, that is, either x_{ij} or $m_{ij} = 0$, then $IIT_{ij} = 0$. Thus, the index of intra-industry trade takes values from 0 to 1 as the extent of intra-industry trade increases, that is, $0 \leq IIT_{ij} \leq 1$.

The IIT index in (1) can be modified to measure the intra-industry trade in all products with country *j*. Grubel-Lloyd proposed calculating a weighted mean, using the relative size of exports and imports of a particular product group as weights. The formula written as

$$IIT_{GLw} = 1 - \frac{\sum \left| x_{ij} - m_{ij} \right|}{\sum (x_{ij} + m_{ij})} \tag{2}$$

The IIT_j index in (2), as Grubel and Lloyd (1975) pointed out, is a downward-biased measure of IIT in the presence of an imbalance in a country's commodity trade. The greater the imbalance the greater the share of net trade and the smaller the share of IIT. Aquino (1978) and Balassa (1986), among others, have suggested adjusted measures to correct this deficiency. Grubel and Lloyd (1975) proposed to adjust the index by incorporating overall trade imbalance into (2) as follows:

$$IIT_{GLw} = 1 - \frac{\sum \left| x_{ij} - m_{ij} \right|}{\sum (x_{ij} + m_{ij})} \tag{3}$$

where IIT_{GLw} is the adjusted IIT_{GLw} index. Since this adjusted measure of IIT index incorporates the total trade imbalance, it is measured with respect to total balanced trade. This index enables not only the comparison between industries but also between countries. However, to be able to use the index towards countries, it is necessary to take the total of the index calculated for each industry.

$$IIT_{GLadj} = 1 - \frac{\sum \left| x_{ij} / x_j - m_{ij} / m_j \right|}{\sum (x_{ij} / x_j + m_{ij} / m_j)} \tag{4}$$

In the adjusted Grubel-Lloyd index (IIT_{GLadj}), when xj and mj show total exports and imports respectively, (4) is used to correct imbalance in foreign trade. Adjusted IIT in this case should be found by reducing the trade imbalance from total trade volume. The index still takes place between 0 and 1. Since this adjusted measure of GL index incorporates the total trade imbalance, it is, therefore, measured with respect to total balanced trade. In this article, adjusted Grubel-Lloyd index is also used to measure Turkey's IIT as a correct formula because of the imbalance in its foreign trade.

The Shares of IIT in Bilateral Trade (2001-2005)

In the scope of this study, the IIT of Turkey is taken account with respect to the manufacturing industry. The study specifically focuses on Turkey's foreign trade with OECD countries in terms of manufacturing industry. It covers 28 OECD countries which include United States of America (USA), Germany, Austria, Australia, Belgium, Luxembourg, Czech Republic, Denmark, Finland, France, South Korea, Netherland, Great Britain, Ireland, Spain, Sweden, Switzerland, Italy, Iceland, Japan, Canada, Hungary, Mexico, Norway, Poland, Portugal, Slovakia, New Zealand and Greece.

The data is taken for the period of 2001-2005. Because of the lack of data, Belgium and Luxemburg is combined as one country. In this span of time, the IIT index is calculated in the SITC (Standart International Trade Classification) Rev-3, Level-1 product groups. The group is shown in Table 1 below.

Table 1: SITC Rev-3 Division Level–1

SITC DIVISIONS
5 Chemical industry and related industrial goods n.e.s.
6 Manufactured Goods Classified Chiefly by Material
7 Machinery and Transport Equipment
8 Miscellaneous Manufactured Articles

The IIT calculation is made according to four divisions in manufacturing industry taking place in Table 1 and the adjusted Grubel-Lloyd index (4). Table 2 provides the values of the adjusted GL index recorded in the bilateral trade of Turkey with her OECD trading partners for the years of 2001-2005. The 28 countries given in the table together account for more than 50 percent of the total value of Turkish exports and imports.

Table 2 demonstrates how Turkey's intra industry trade index varies across her OECD trading partners. The indices range from as low as 0.071 (with Japan) to as high as 0,87 (with Italy). While Italy displays the highest proportion of Turkey's IIT among the OECD countries, it is followed by Austria, Mexico and France with the scores of IIT, 0,77-0,74-0,73 respectively. However, the highest increase in IIT within 2001-2005 period is observed with Mexico. Italy consistently represents the highest shares of IIT with Turkey while Japan, South Korea and Iceland shows the lowest IIT segment of the OECD countries. Sweden, Belgium, Poland, Germany, Portugal, Great Britain, Switzerland and Canada are also a group of countries that appear at the higher end of the scale, having values of more than 0,50. Although countries like Czech Republic, Slovakia and Finland have experienced a downward trend in their shares of IIT, they may still be considered at the higher end in 2005, with the values of 0,58-0,56-0,52 respectively.

At the lower end of the scale, there are also a group of countries such as USA, Denmark, Hungary, Netherland, Norway, Ireland, Canada, Spain, New Zealand and Greece ranking from 0,26 (for Greece) to 0,47 (for Hungary), but Iceland, Japan and South Korea have the lowest values of IIT, as 0,077 - 0,071 and 0,056 respectively in 2005. In the meantime, Turkey's IIT with Iceland, is the most changing trading pair during the period of 2001-2005.

In general, it has been observed that countries at similar stages of development (proxied by per capita incomes) carry out more IIT with each other (Havrlyshyn and Civan, 1983). However, it is clear from the table that Turkey displays relatively high degree of IIT not only with the high income countries but also with the newly industrializing countries as well. In the mean time, there are also some striking

exceptions such as Japan and South Korea, which showed quite low shares of IIT. This is, however, not surprising, since both countries are geographically very far from Turkey, which verifies the related prediction of IIT model that the intensity of IIT is correlated with the geographical distance between the two countries.

Table 2: The Shares of Turkey's Bilateral IIT_{GLadj} Indices with other OECD Countries for the Period of 2001-2005

	2001	2002	2003	2004	2005
USA	0,448	0,301	0,406	0,318	0,391
Germany	0,529	0,539	0,533	0,558	0,592
Austria	0,639	0,584	0,552	0,654	0,773
Australia	0,515	0,329	0,348	0,221	0,336
Belgium/Lüx.	0,576	0,552	0,592	0,609	0,669
Czech	0,715	0,529	0,522	0,515	0,58
Denmark	0,425	0,404	0,352	0,29	0,425
Finland	0,512	0,562	0,656	0,619	0,521
France	0,403	0,709	0,704	0,717	0,731
S. Korea	0,075	0,099	0,071	0,058	0,056
Netherland	0,447	0,435	0,488	0,453	0,436
G. Britain	0,478	0,59	0,557	0,527	0,545
Ireland	0,441	0,463	0,49	0,463	0,478
Spain	0,698	0,729	0,705	0,6	0,692
Sweden	0,553	0,564	0,627	0,575	0,694
Switzerland	0,352	0,451	0,353	0,45	0,509
Italy	0,694	0,786	0,762	0,833	0,87
Iceland	0,349	0,78	0,108	0,147	0,077
Japan	0,099	0,085	0,075	0,078	0,071
Canada	0,294	0,332	0,523	0,403	0,431
Hungary	0,677	0,691	0,691	0,558	0,469
Mexico	0,321	0,293	0,513	0,473	0,743
Norway	0,534	0,638	0,411	0,626	0,443
Poland	0,583	0,656	0,743	0,609	0,609

Portugal	0,228	0,299	0,33	0,396	0,553
Slovakia	0,64	0,411	0,35	0,694	0,56
N. Zealand	0,465	0,327	0,309	0,169	0,39
Greece	0,359	0,29	0,24	0,219	0,263

Source: Authors' calculations based on data of Turkish Statistical Institute (Turkstat).

The Model

What follows is a discussion of various hypotheses relating country-spesific determinants of IIT and results of the panel data regression analysis. The regression analysis is carried out at one-digit level industry groups. It should be stressed that we are not attempting to test any specific theory of IIT but rather ascertaining a number of determinants of IIT in manufactured commodities especially in the context of OECD. Thus, we are specifically concerned with the influences of various country-specific factors on the intensity of Turkey's IIT with her OECD trading partners. Furthermore, we also intend to test the empirical validity of hypotheses derived from the related country-specific determinants.

The Determinants of the Intra-Industry Trade and Related Hypotheses

The Similarity in Per Capita Income Level

Linder studies IIT in terms of demand structure and argues that demand structures changes as per capita income level changes. Thus, he tries to explain that countries which have similar per capita income level have much more IIT (Linder, 1961, 91-94). Bergstrand (1990) reached similar conclusion that similar per capita income level leads to IIT because of both supply and demand (Bergstrand, 1990, 1225-1227). Indeed, as per capita income increases, after meeting compulsory spendings including consumption ones, pleasure and preferences come to fore when industrial products are used. This type of change leads to IIT between countries as it provides an increase in demand towards different qualities of same product. In the meantime, as the production quality increases, export quality rises but imports quality relatively decreases. Indeed Germany and Japan contribute much for the development of IIT as they export quality products and import their lower counterparts (Grubel and Lloyd, 1975, 100). However, if income difference between two countries is low, then the rate of IIT would be also low because the demands of two countries are so similar.

Therefore, the intensity of IIT will be positively correlated with the similarity in per capita income between the trading partners. Then, the related hypothesis is that the higher the average per capita income level, the greater is expected IIT.

Economic Size

The intensity of IIT will be positively correlated with the economic size of partner countries. Economic size is measured by the total GDP (Gross Domestic Product, in current dollars) of the trade partners.

Bergstand showed that differences between economic sizes (population, Gross National Product) affect IIT. According to his argument, as the differences between economic sizes of countries rise, the extent of IIT declines (Bergstrand, 1990, 1228). Hummels ve Levinshon (1995) in their study used foreign trade data in the period of 1962-1983 and tested the hypotheses related to factor endowment which is tested earlier by Helpman 1987. They realised that when the difference between per capita income level and market size of countries increases, the IIT also declines. (Hummels and Levinshon, 1995, 814-828). Consequently, it is set out that small countries have a decreasing effect on IIT. In this type of countries, relatively smaller scale of the domestic market is one of the basic preventing reasons in benefitting from the scale economies in producing goods. However, it is possible that small countries may direct to a kind of specialization in which product differentation is limited. In this countries quality differentation is more important than product differentation. Therefore, a small country can reach scale economies in specializing in production of goods which requires only special features or special inputs in their manufacturing.

Then, the related hypothesis is that the larger the size of a country as measured by GDP, the higher level of IIT.

Economic Integrations

The studies of economic integrations on IIT is primarily emphasized on the issues like whether they increase the degree of IIT, or the determination of the extent and the direction of IIT before and after the integration. There is a strong empirical support that countries that have lowered or eliminated their barriers on trade with each other in relation to their trade with the rest of the world will have relatively high levels of IIT. For instance, Grubel and Lloyd found that the avarage level of IIT for the member states of the European Community (EC) rose from 54 per cent in 1959 to 67 per cent in 1967 (Grubel and Lloyd, 1975). It is not only one example that regional integration has led to intra-industry specialization. Balassa (1979) examined the

effects of Latin America Free Trade (LAFTA) and Central American Common Market (CACM) integrations on IIT. He found that the level of IIT occuring between the members of LAFTA and CACM was higher than trade between these countries and the rest of the world. Balassa also found another evidence that the formation of the European Economic Community (EEC), European Free Trade Association (EFTA) and LAFTA had a positive and highly significant effect on the extent of IIT (Balassa, 1987).

Even if there are studies which argue that economic integration of the European Union (EU) decrease the extent of IIT (Greenaway, 1987; Greeaway and Hine, 1991; Globerman and Dean, 1990), much of the studies in this context, however, have emphasized on the favourable effect of the EU integration on IIT (Brülhart, 1998; Brülhart and Elliot, 1998; Aturupane, Djankov and Hoekman, 1999).

The related hypothesis is that the higher the degree of economic integration between countries, the higher the proportion of IIT to total trade.

Geographical Distance

Intra-industry trade is negatively correlated with the distance. The distance between countries can be viewed as indicative of relative cultural and social proximity as well as reflecting transport costs. The greater the geographical distance between any two countries, the smaller the level of IIT likely to take place between them. While distance acts like an artificial barrier to trade, intra-industry trade is especially promoted by closeness (Grimwade, 2000, 103).

The related hypothesis is that the greater the georaphical distance between countries, the lower the degree of IIT.

Empirical Analysis

Data and Model Spesification

The model includes 28 trade partners of Turkey in the OECD. Data on country-specific factors includes the years of 2001-2005. Data on economic size (GDP) and avarage per capita GDP is from the International Financial Statistics Database of International Monetary Fund (IMF). The distance between Ankara (capital of Turkey) and the capital cities of 28 countries of the OECD is calculated from the website of www.mapcrow.info. In this study a panel data regression analysis is carried out as an econometric method. In particular, if there were a number of countries and determinants, it would, then, be much more appropriate to use panel data regression analysis.

This analysis includes 28 OECD countries and five years (2001-2005), giving 140 observations. The determinants of this study are per capita income level, the difference among per capita income level, distance between countries and the membership to the EU as a dummy variable. In accordance with these determinants, the basic model of panel-data regression analysis is as follows:

$$IIT_{Tj} = \alpha + \beta_1 APC_{Tj} + \beta_2 DPC_{Tj} + \beta_3 WDIST_{Tj} + \beta_4 EU_T + U_{Tj} \quad (5)$$

Where IIT_{Tj} is IIT_{GLadj} data calculated according to the adjusted Grubel-Loyd index in the period of T (2001-2005) between Turkey and the selected country j (The indices in Table 2).

APC_{Tj} is average per capita income level in the period of T (2001-2005) between Turkey and the country j. The estimated value of this variable is positive. When average per capita income rises, the demand for differentiated products increases, and thereby rising IIT.

DPC_{Tj} is average per capita income differences in the period of T between Turkey and the country j. According to APC_{Tj} data, the calculation is made by taking the relative differences within absolute values with the data of Turkey in the same period. The expected effect of DPC_{Tj} tends to affect IIT negatively.

EU_T is the dummy variable related to the membership of OECD countries to the EU (the customs union) in the period of T. The expected effect from EUT is positive due to favourable impact of economic integrations on IIT.

$WDIST_{Tj}$ the weighted average of the directed distance between Ankara and the selected country j. In the calculation of the weighted average the method used by many authors likes Stone and Lee (1995); Balassa and Bauwens (1987) is shown in equation 6 below.

$$WDIST_{Tj} = \frac{DIST_J * GDP_{Tj}}{\sum GDP_T} \quad (6)$$

Here,

$DIST_j$ is the distance between the capital cities of Turkey and the country j

$GDPT_j$ is the GDP value of the country j in the period of T

ΣGDP_T is the total GDP value of the 28 countries selected in the period of T

$WDIST_{Tj}$ is the negative impact expected from the variable T_j.

U_{Tj} is the error item of the model.

The data is processed with panel data regression in the equation 5. In the analysis of Panel Data, the basis of the choice between Fixed Effects Model (FEM) and Random Effects Model (REM) can be found in Hsiao (1986) and Greene (1997). Hsiao recommends FEM when the sample is especially withdrawn from a special

field (Hsiao, 1986: 24). Greene (1997) also supports this model. When there is a comparative analysis among countries and the analysis covers all the countries, or the sample selected is from a big group, then FEM is, still, the most appropriate alternative (Greene, 1997, 623).

The Results of the Analysis

The results of the analysis based on Fixed Effect Model take place in Table 3.

Table 3: The Results of Fixed Effect Model

Variable (expected value)	Coefficient	Std. Error	t-Statistic	Prob
C	0.731168	0.060856	12.01477	0.0000
APC (+)	4.50E-0.5	9.77E-0.6	4.609692	0.0000
DPC (-)	-5.75E-0.5	1.22E-0.5	-4.712749	0.0000
WDIST (-)	-9.24E-0.5	4.32E-0.5	-2.136182	0.0349
EU (+)	-0.192891	0.053555	-3.601713	0.0005

NOTES: (1) Independent Variable : IIT (2) Method: Panel Least Squares (3) Sample: 2001 2005 (4) Cross Section: 28 (5) Total panel (balanced) observations: 140 (6) R-Square= 0.822405 (7) Probability (f-stat)= 0.000000 (8) Durbin-Watson stat = 2.312925.

The model is in general significant when assesing the model in Table 3. The value of R-square statistics is high enough. Durbin-Watson statistics shows that there is no otocorroletion in the model. When considering the values of the coefficients, the sign of APC variable is positive as expected, and it is statistically significant. Therefore, the result obtained from this model supports the general view that when per capita income increases, the demand for differentiated products increases, and thereby rising IIT.

DPC variable is negative as usual and statistically significant. This is also evident that this outcome leads to income differences among countries and causes demand differences, and thereby affecting IIT unfavourably.

WDIST variable is also statistically significant and the value expected from this variable is negative. This result is also in accordance with the view that the distance among countries increases the transportation costs and declines IIT.

EU as dummy variable is statistically significant but the value is negative contrary to the expectation. It can be deduced an outcome that the membership to Customs Union between Turkey and the EU affects the IIT in a negative way. The main reason may be that the income level of Turkey is different from the average income

level of the EU countries and concomitantly the demand structures of the two sides are differentiated.

Conclusion

Although intra-industry trade is, by and large, considered a phenomenon observed in the context of developed industrialised countries, it is also found to be significant in Turkey's international trade in which the OECD countries have the large part of it. As shown in this study, it appears that the foreign trade of Turkey with the OECD is, to a large extent, intra-industry trade. Despite some declines in IIT shares of Turkey with a group of the OECD countries over the period of 2001-2005, it is generally observed an upward and relatively high degree of IIT trend between Turkey and these countries.

An emprical analysis using the method of panel data regression was made in determining the influences of various country-specific factors on the intensity of Turkey's IIT with her OECD trading partners. The analysis shows that the factors of average per capita similarity, economic size by GDP income similarity, geographical distance are positively correlated with the intra-industry trade of Turkey. All the values are statistically significant. Hence, these outcomes of the study also confirm the empirical validity of hypotheses in relation to these factors of the theory of IIT. Only one of the values is out of the expected values, which is namely the membership to economic integration. The value for the membership to the EU (common custom tariff) as the dummy variable is negative contrary to theoretical expectations. This result may be explained with the conditions peculia to Turkey. Besides, the differences in average income structure between Turkey and the countries of the EU affect unfavourably demand structure between two sides, and therefore lead to decreasing effect on the intra-industy trade.

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