

# INTRA-INDUSTRY TRADE DYNAMICS OF TURKEY

**Pınar Narin EMİRHAN**

*Dokuz Eylül University, Faculty of Business, Department of Economics, Izmir, Turkey.*

*pınar.emirhan@deu.edu.tr*

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## **Abstract**

The purpose of this study is to measure the intra-industry trade levels for various industry and country groups for Turkey and to test the determinants of these calculated levels empirically. Unadjusted Grubel and Lloyd Index (1975) is used to calculate IIT levels in the study and they reveal that overall IIT is quite high (35 percent on average) for Turkey and in some manufacturing industries it even rises to 90 percent. The factors that determine IIT levels in Turkey are tested separately for vertical and horizontal IIT and it has been found that these two types of IIT are determined by different factors as expected.

*Keywords:* Intra-industry Trade; Vertical and Horizontal Differentiation.

*JEL Classification:* F 14

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## **I. Introduction**

Factor Endowment Theory assumes that international trade patterns of countries are determined by relative supplies of factors of production. Every country exports goods which are produced by their abundant factors, therefore international trade is expected to take place among countries with different factor endowments. But over the last two decades, it has been seen that countries with similar factor endowments do more trade than countries with different factor endowments. This deficiency of the Factor Endowment Theory caused a substantial literature to emerge that attempts to explain the current trends in international trade. The new theoretical developments largely emphasize the existence of imperfect competition and scale economies in industrial markets (Krugman, 1979 and 1980; Lancaster, 1980; Helpman, 1981 etc.). The common point in these studies is that, when the assumptions of the Factor Endowment Theory are abandoned, all the researchers are guided to the concept of intra-industry trade (IIT).

There has been a growing interest in the phenomenon of IIT, which is defined as the simultaneous export and import of commodities which are grouped in the same industry. Although this issue was first discussed by Balassa (1966), IIT has not drawn enough attention until a multipurpose index is developed by Grubel and Lloyd (1975). After Grubel and Lloyd, IIT has began to be analyzed in context of many countries and industries.

Besides the increasing importance of IIT in world trade, there are only a few research papers concerning Turkey. Schüller (1995), Çepni and Köse (2000) and Erk and Tekgül (2001) calculated IIT levels for Turkey's total trade whereas Gönel (2001) measured the IIT levels for Turkey's traditional export industry, textiles. Whilst these papers measured IIT levels, none of them attempted to test the determinants of IIT for Turkey. So this paper aims to fulfill this shortage in the literature. The aim of this paper is to analyze the IIT of Turkey and to test empirically the determinants of IIT among countries and across industries.

The paper is structured as follows: Section II describes the data set and outlines the methodological issues, Section III reports the empirical results and Section IV concludes.

## II. The Data and Methodology

In this study, the IIT levels are calculated by using the Unadjusted Grubel-Lloyd Index (1975) which is the most appropriate method for measuring IIT. The Grubel-Lloyd Index measures the share of IIT in an industry:

$$B_i = 1 - \frac{(X_i - M)_i}{(X_i + M_i)}$$

where  $X_i$  and  $M_i$  are exports and imports of industry  $i$  respectively. This index  $B_i$  takes values between 0 and 1, where 1 represents all trade being IIT. This index was adjusted for trade imbalances by Grubel-Lloyd and some other researchers but Vona (1991) suggested that index does not need to be adjusted.

In the literature, it has been accepted that the determinants of vertical IIT and horizontal IIT are different. Vertical IIT is a term that is used to describe the IIT of commodities that are at different qualities; whereas horizontal IIT is used to define IIT of commodities that are at the same qualities. In order to test whether the above proposition is valid in Turkey or not, the determinants of these two types of IIT are tested in different regression equations. For disentangling IIT into vertical and horizontal components, quality differences within exports and imports of an industry are used. Quality differences in trade are measured by export and import unit values per ton. Stiglitz (1987) argued that prices of commodities are reflections of their qualities so, prices can be used as an indicator of quality.

An industry is subject to horizontal IIT when the unit value of exports relative to unit value of imports lies within a specified range. This condition can be shown with the equation

$$1-\alpha \leq (UV_{ij}^x / UV_{ij}^m) \leq 1+\alpha$$

where  $UV_{ij}^x$  is country  $j$ 's unit value of exports in commodity  $i$  and  $UV_{ij}^m$  is country  $j$ 's unit value of imports in commodity  $i$ . When relative unit values lie outside this range, the industry is facing vertical IIT. The condition for vertical IIT is shown as follows:

$$(UV^{x_{ij}} / UV^{m_{ij}}) < 1 - \alpha \text{ or } (UV^{x_{ij}} / UV^{m_{ij}}) > 1 + \alpha$$

where  $\alpha=0,15$ . The transportation and freight costs are usually assumed to account for  $\pm$  15 percent of the value of the product, so  $\alpha$  is taken as 0,15.

This study covers only the year 1999 because of lack of data at the industry level. The IIT levels are calculated at the SITC 3 digit level for this year. The industry data which are used at the estimations are only published at the 2 digit level of the International Standard Industry Classification (ISIC) system in Turkey, so these calculated IIT levels at the SITC 3 digit are transformed into ISIC 2 digit level and estimations are done with these data.

In the estimations, OLS and Logit Transformation methods are used. Calculated IIT levels lie in the range of 0 and 1 and without a transformation, the estimated coefficients in the model may take values out of this range. The logistic transformation is done with the following formula:

$$\text{Transformed IIT} = \ln [ \text{IIT} / (1 - \text{IIT}) ]$$

In this study, the determinants of intra-industry trade are tested for various industry specific and country specific variables. These two groups of variables are tested in two different models. Below, the variables that are used in the models are defined respectively.

Among the industry specific variables, product differentiation is the first variable to be analyzed. A positive relationship between product differentiation and IIT levels are expected because product differentiation allows consumers to satisfy their differentiated demands. In order to measure product differentiation, the number of 5 digit industries in each 3 digit industry group is used in the study.

Another industry specific variable that is expected to affect IIT levels positively is scale economies. The existence of increasing returns in production causes increased specialization and a fall in production costs. In the absence of scale economies, all

product varieties could be produced domestically so no IIT would take place. In the literature, a number of methods are proposed to measure scale economies. In this study, the number of workers in each industry is used as a proxy for scale economies.

There is also a close relationship between the market structures and IIT levels. So the last variable to be tested is market structures. As discussed by Brander (1981) and Brander and Krugman (1983), if the number of firms in an industry decreases and an oligopolistic structure starts to dominate the industry, the IIT levels tend to increase. However, several measures have been used to test the existence of an oligopolistic market, the number of firms in each industry is used as a proxy in this study.

Therefore, the model for industry specific variables is as follows:

$$IIT = f(PD, SE, MS)$$

where PD represents product differentiation, SE represents scale economies and MS stands for market structures.

As well as industry specific variables, country specific variables are also expected to affect IIT levels. For this reason, some country specific variables are also tested for Turkey. As argued by Linder (1961), consumers in countries with similar income levels will demand similar products, so these countries will develop similar sets of production. So, as the difference in per capita income levels gets smaller, the share of IIT in total trade is expected to increase. Therefore, the absolute differences in per capita income levels of countries is the first country specific variable to be tested and the expected sign of this variable is negative.

Per capita income levels themselves are also effective on IIT levels because they are used as a proxy for the development levels of countries. The more developed a country is, the greater the importance of the manufacturing industry in national output. Since IIT is larger in manufacturing, the country's IIT is tend to be greater.

There is also a close relationship between countries' IIT levels and their market sizes. The larger the size of a country's market, the larger the demand for differentiated

products and therefore this differentiated demand causes IIT levels to increase. GDP levels of countries' are used to test their market sizes and the expected sign of this variable is positive.

In the literature, it is argued that countries with similar market sizes will trade similar goods. So, there is an expected negative relationship between market size differences among trading partners and their corresponding IIT levels.

Transportation costs act as an important barrier for trade and also for IIT. These costs cause the prices of goods to increase so consumers substitute their demand for differentiated products with standard products. Transportation costs in international trade are lower for countries which are geographically close so the distance between capital cities of the partner countries are weighted with their GDP levels and this measure is used as a proxy for transportation costs:

$$\text{TRANSC}_j = \frac{\sum_k (\text{GDP}_k * \text{DIST}_k)}{\sum_k \text{GDP}_k}$$

where  $\text{GDP}_k$  is the gross domestic product of partner country  $k$  and  $\text{DIST}$  is the direct distance measure in miles between country  $j$ 's capital city and the trading partner  $k$ 's capital city. The expected sign of this variable is negative.

The economic cooperation among trading partners is another important country specific variable that affects the IIT levels. When trade barriers are abolished among any two countries, both the volume of trade and the share of IIT in total trade is expected to increase. Turkey signed a Customs Union Agreement with the European Union (EU) that went into affect in 1996. EU countries are the most important trade partners of Turkey whose share is about 50 percent of Turkey's total trade. Therefore, IIT is expected to be high for Turkey's trade with EU countries. To test this view, a dummy variable for EU countries is included in our model.

The last country specific factor to be tested in this study is the Foreign Direct Investment (FDI) flows among Turkey and its trading partners. In the literature, there is no consensus about how FDI flows affect IIT. Some writers argue that increasing FDI

both helps consumers to satisfy their differentiated demands and also helps scale economies to appear in production which in return increases IIT. On the contrary, some researchers suggested that FDI flows cause the differentiated demand of consumers to be satisfied by domestic production instead of imports, so it will have a negative impact on IIT. Because of these opposite views, the effect of FDI on IIT is uncertain.

Depending on the above explanations, the country specific variables are tested with the following model:

$$IIT = f(GDP, GDPD, PCGDP, PCGDPD, TRANSC, EU, FDI)$$

where GDP stands for Gross Domestic Product and GDPD stands for differences in GDP levels; PCGDP represents per capita GDPs and PCGDPD represents differences in per capita GDP levels; TRANSC shows transportation costs; EU is the dummy variable used for European Union countries; and finally FDI is the Foreign Direct Investments among countries.

### **III. Estimation Results**

Table 1 shows IIT levels calculated for Turkey's bilateral trade aggregated for all industries (SITC 1-8) and for manufacturing industries (SITC 5-8). Table 1 suggests that IIT for Turkey is higher for developed countries than developing countries and among the developing countries EU countries have the highest calculated levels. The pattern of IIT is consistent with our theoretical expectations. Higher IIT levels are expected for EU members and candidates because both we have a Customs Union Agreement with these countries and these countries are geographically close to Turkey.

The results obtained for all industries and manufacturing industries do not show clear differences. For most of the countries, the IIT levels are higher for manufacturing countries. Only for countries like Greece and Spain, for which the share of agricultural products are higher in our reciprocal trade, IIT levels are higher when all industries are analyzed together.

**Table 1: IIT Levels For Turkey's Bilateral Trade (1999) (%)**

<b>Country</b>	<b>All Industries</b>	<b>Manufacturing Industries</b>
<b>Developed Countries</b>		
Argentina	4,83	10,05
Australia	3,45	9,9
Austria	13,95	15,95
Belgium	15,35	16,36
Brazil	5,13	8,2
Canada	6,9	7,4
Chile	0,2	0,2
Croatia	4,2	4,5
Czech Republic	13,57	17,64
Denmark	11,76	12,65
Finland	3,13	3,12
France	27,34	29,09
Germany	26,35	27,83
Greece	19,9	18,9
Holland	16,65	16,87
Hong Kong	8,78	9,4
Hungary	15,8	18,2
Ireland	5	5,05
Israel	14,5	14
Italy	31,6	31,2
Japan	2,2	2,2
Kuwait	0,2	0,14
Lebanon	1,1	1,9
Malaysia	4,1	6,8
Malta	9,4	10,5
Mexico	7,6	5,3
New Zealand	4,4	8
Norway	2,7	4,2
Oman	0,9	1
Panama	57,4	59,9
Poland	12,8	14,1
Portugal	10,9	11,3
Saudi Arabia	2,6	7,6
Singapore	5,9	6
Slovenia	16	17,3
South Africa	5,54	9,08
South Korea	6,56	3,22
Spain	36,69	35,6
Sweden	2,6	2,6
Switzerland	13,66	13,9
United Arab Emirates	5,6	6,67
United Kingdom	21,37	23,1
United States of America	26,03	23,49
Venezuela	0,7	1

**Table 1: Continues**  
**Developing Countries**

Albania	1,71	2,15
Algeria	0,44	0,4
Azerbaijan	4,72	5,6
Bangladesh	1,28	1,53
Bulgaria	13,71	16,6
China	3,78	3,3
Dominic Republic	0,01	0,01
Egypt	7,9	9,2
Ethiopia	0,7	0,09
Georgia	2,84	4,62
Ghana	0,01	0,05
India	8,55	9,6
Indonesia	5,96	7,5
Iran	2,73	10,5
Jordan	2,9	3,6
Kazakhstan	1,2	2,1
Kenya	0,03	0,05
Kyrgyzstan	3	3
Lithuania	1,9	1,6
Macedonia	3,1	3,3
Moldavia	6,5	6,1
Morocco	1,28	1,77
Nigeria	0,008	0,01
Pakistan	3,9	6,9
Romania	9,7	13,4
Russia	2,6	5,6
Sri Lanka	4	7,4
Sudan	0,4	0,39
Syria	3,1	7,6
Thailand	5,5	6,2
Tunisia	3,5	3
Turkmenistan	5	6,8
Ukraine	3,3	3,4
Uzbekistan	1,9	2,5
Yemen	0,1	0,1

The determinants of the above calculated IIT levels are tested for industry and country specific variables. The results of the regression analysis for the determinants of IIT for Turkey are presented in the below tables. Table 2 and Table 3 reports the regression results for industry specific determinants and Table 4 and Table 5 shows the results for country specific determinants.

The estimated coefficients regarding all industries at the ISIC 2 digit level are presented in Table 2. This table shows that when all industries are analyzed together, scale economies is the only factor that has an effect on IIT levels. The results indicate

that when industries have a chance to benefit from scale economies, IIT level in that industry increases. Although the product differentiation variable has the correct sign, it is not statistically significant. If we compare the results obtained from OLS and Logit transformation methods, it is seen that the Logit transformation method gives better results.

**Table 2: Regression Results for 2 Digit ISIC Industries**

Independent Variables	Coefficients	
	OLS	LOGIT
Constant	2,82 (7,78) <sup>***</sup>	-3,77 (-19,44) <sup>***</sup>
Product Differentiation	0,1637 (1,437)	0,057 (1,411)
Scale Economies	0,00003 (1,751) <sup>*</sup>	0,00013 (4,55) <sup>***</sup>
Market Structure	0,0016 (0,959)	0,3001 (0,437)
R <sup>2</sup>	0,148	0,456
F	3,798 <sup>***</sup>	14,21 <sup>***</sup>
Q	0.97	0.33
WHITE	13.15	8.88
[P]	[0,106]	[0,351]
N	83	83

Note: The values in parentheses are t statistics except for White test which are probabilities. In the tables, \* shows that coefficients are significant at 10% level, \*\* at 5% level and \*\*\* at 1% level.

Table 3 reports the regression results for vertical and horizontal IIT. Vertical and horizontal IIT structure of Turkey have been investigated at the sectoral level using data for ISIC 2 digit industries. Comparing coefficients for vertical and horizontal industries, broad differences have been found. For vertical IIT, none of the industry specific variables yielded statistically significant results. Only the product differentiation variable is significant at the 10 percent level of significance which is estimated by using the logit regression method. Also the calculated R<sup>2</sup> is very below than acceptable levels. These results indicate that industry specific variables are totally ineffective for vertical IIT.

When the estimation results for the horizontally differentiated industries are analyzed, it can be seen that all of the variables tested gave statistically significant results. This indicates that horizontal IIT of Turkey is entirely determined by industries'

characteristics. The estimated signs of product differentiation and market structure variables are consistent with our expectations, but scale economies carries a negative sign.

**Table 3: Regression Results for Vertically and Horizontally Differentiated Industries**

Independent Variables	Vertically Differentiated Industries		Horizontally Differentiated Industries	
	OLS	LOGIT	OLS	LOGIT
Constant	2,55 (2,95) <sup>***</sup>	-3,65 (-11,46) <sup>***</sup>	4.45 (10.66) <sup>***</sup>	-3.04 (-15.6) <sup>***</sup>
Product Differentiation	0,126 (1,09)	0,071 (1,68) <sup>*</sup>	0.10 (3.85) <sup>***</sup>	0.033 (2.69) <sup>**</sup>
Scale Economies	0,019 (0,168)	0,006 (0,158)	-0.00008 (-3.19) <sup>**</sup>	-0.00002 (-2.34) <sup>*</sup>
Market Structure	0,177 (1,08)	0,057 (0,95)	-0.01 (-6.62) <sup>***</sup>	-0.005 (-2.73) <sup>**</sup>
R <sup>2</sup>	0,012	0,024	0.87	0.94
F	1,16	1,33	18.49 <sup>***</sup>	36.35 <sup>***</sup>
Q	0.88	0.32	0.55	0.21
WHITE	9.08	10.22	9.856	8.8169
[P]	[0.335]	[0.249]	[0.275]	[0.417]
N	62	62	21	21

The country specific variables are also tested for different industry groups. First of all, these variables are tested for all industries at the SITC 3 digit level. These results are presented in Table 4. When the results obtained from OLS and Logit transformation methods are compared, the calculations based on Logit transformation method seem to have yielded statistically better results, so the evaluations should be based on these results. Although all the estimated coefficients carry the theoretically expected signs, only GDP, GDPPC and GDPPCD variables are statistically significant. It is interesting that IIT levels are not affected by EU memberships.

**Table 4: Regression Results for Country Based Variables**

Independent Variables	Estimated Coefficients	
	OLS	LOGIT
Constant	3,031 (1,600)	-4,499 (-12,363)***
GDP	0,0028 (0,636)	0,0014 (1,676)*
GDPD	0,0029 (0,703)	-0,001 (-0,465)
GDPPC	0,0007 (2,444)***	0,0002 (3,903)***
GDPPCD	-0,0008 (-2,15)**	-0,0002 (-2,767)***
TRANSC	-0,035 (-1,212)	-0,007 (-1,294)
EU	6,22 (1,718)*	0,3001 (0,437)
FDI	0,033 (1,585)	0,0009 (0,822)
R <sup>2</sup>	0,30	0,312
F	5,569***	5,253***
Q	8.12	1.52
WHITE	4,75	9,55
[P]	[0,942]	[0,654]
N	79	79

Table 5 shows the regression results for vertical and horizontal IIT for country specific variables. The estimated parameters from OLS and LOGIT Transformation procedures show that, similar to the results in industry specific variables, the country specific determinants of vertical and horizontal IIT are totally different. The level of vertical IIT which is concerned with commodities at different qualities, is affected by countries' development levels (GDPPC) and the income differences among countries (GDPPCD), whilst horizontal IIT levels are determined by countries' market sizes (GDP), transaction costs (TRANSC) and FDI flows among countries. The sign of the estimated coefficient for FDI is positive so it can be said that FDI levels have a positive impact on horizontal IIT of Turkey. The R<sup>2</sup> in the regression equations are not high, but since these are cross section estimates, the equations provide an acceptable fit to the data.

**Table 5: Regression Results For Country Based Variables and For Vertically and Horizontally Differentiated Industries**

Independent Variables	Vertically Differentiated Industries		Horizontally Differentiated Industries	
	OLS	LOGIT	OLS	LOGIT
Constant	2,405 (1,315)	-4,673 (-13,21)***	0,626 (2,27)**	-5,726 (-16,20)***
GDP	0,0005 (0,103)	0,001 (1,394)	0,002 (3,684)***	0,0017 (2,187)**
GDPD	0,0037 (0,913)	-0,0002 (-0,29)	-0,0007 (-1,232)	-0,0004 (-0,478)
GDPPC	0,0007 (2,47)***	0,00024 (4,39)***	0,00002 (0,386)	0,00004 (0,576)
GDPPCD	-0,0008 (-2,215)**	-0,0002 (-3,34)***	-0,000004 (-0,07)	-0,0000007 (-0,009)
TRANSC	-0,021 (-0,748)	-0,006 (-1,103)	-0,014 (-3,36)***	-0,01 (-2,15)**
EU	5,831 (1,667)*	0,475 (0,702)	0,389 (0,738)	0,026 (0,043)
FDI	0,024 (1,193)	0,0005 (0,134)	0,009 (2,97)***	0,0019 (0,547)
R <sup>2</sup>	0,23	0,334	0,47	0,163
F	4,188***	6,376***	10,53***	2,75**
Q	7.84	1.51	1.18	1.34
WHITE	4,54	8,45	24,4	8,47
[P]	[0,95]	[0,67]	[0,01]	[0,67]
N	79	79	79	79

## V. Conclusion

In this paper, we have analyzed the IIT dynamics of Turkey for various country and industry groups. It has been found that the share of IIT in Turkey's bilateral trade is highest for European Union member countries and these countries are followed by EU candidates. Therefore, when these countries become full-members of the EU, Turkey's IIT with these countries can be expected to increase.

Our results have demonstrated that the determinants of vertical and horizontal IIT are completely different from each other. While the industry specific variables are very influential on horizontal IIT levels, they do not have any impact on vertical IIT. On the other hand, vertical IIT levels are affected by country specific variables and the country specific variables have only a limited affect on horizontal IIT.

The findings of this study are subject to inevitable limitations. For more reliable results, this exercise should be repeated for different time intervals and the change in the calculated IIT levels should be analyzed. Another difficulty arises from the limited data for industry based variables. Industry based statistics are only published at 2 digit ISIC level in Turkey, so this limits the scope of empirical studies. However, besides these shortcomings, a general view of Turkey's IIT structure is given with this study.

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