THE DETERMINANTS OF VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE IN TURKEY

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1. Introduction

Over the last two decades, the deficiencies of the Factor Endowment Theory in explaining the international trade flows became more evident and economists began to search for new approaches to explain the current trends in world trade. New international trade theories developed by Krugman (1981), Helpman (1981) and others, pay attention to the growing international trade within the same industry. This two-way trade that takes place within the same industry is called intra-industry trade (IIT) and it has been growing more rapidly than the international flow of goods among different industry groups.

IIT literature shows that there is a clear distinction between horizontal and vertical IIT. Whilst, horizontal IIT is related with trade of products that are at the same quality, vertical IIT is concerned with the two-way trade of products of different qualities. As argued by Abd-el Rahman (1991) and Greenaway, Hine and Milner (1994, 1995), making such a distinction is especially important in empirical studies because the determinants of each type of IIT differs. Horizontal IIT, whose theoretical roots were developed by Lancester (1980), Krugman (1981) and Helpman (1981), is expected to be affected by industry specific factors like scale economies and product differentiation; whereas vertical IIT, developed by Falvey (1981), is expected to be determined by country specific factors.

Besides the growing importance of IIT in world trade, only a few studies have been done on IIT of Turkey yet. The aim of this paper is to analyze the determinants of vertical and horizontal IIT for Turkey and to fulfill this shortage.

The paper is organized as follows: In the second section, the estimation procedure and the variables are described. In the third section, the results of the

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econometric analysis are presented. Finally, the conclusions of the paper are provided in the fourth section.

2. Methodology and Data

In this study, IIT levels are calculated by using Unadjusted Grubel-Lloyd Index (1975). This index is defined as:

$$IIT_j = 1 - \frac{|X_j - M_j|}{(X_j + M_j)}$$

where X_j and M_j are country j's exports and imports respectively. If country's all trade is intra-industry, the index takes the value of one; if it is inter-industry, the index equals to zero.

The IIT levels are calculated by using trade data organized at the 3 digit level of SITC system. Relative export and import unit values per ton are used to divide total IIT into vertical and horizontal components. If the unit value of exports relative to the unit values of imports of a product lies within a specified range, this product is said to be subject to horizontal IIT. When relative unit values lies outside this range, vertical IIT is concerned. So, if the following condition is satisfied, horizontal IIT is valid:

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

where UV^{x}_{ij} is country j's unit value of exports in commodity i and UV^{m}_{ij} is country j's unit value of imports in commodity i. But if the following condition is satisfied than commodity i is subject to vertical IIT:

$$(UV^{x}_{ij} / UV^{m}_{ij}) < 1-\alpha \quad \text{or} \quad (UV^{x}_{ij} / UV^{m}_{ij}) > 1+\alpha$$

where α=0,15.

In the empirical studies the transportation and freight costs are usually assumed to account for $\pm$ 15 percent of the value of the product, so α is taken as

0,15. But in this study, alternatively α is also taken as 0,25. The narrower this range, the smaller the value for horizontal IIT and vice versa.

The year 1999 is chosen for the analysis because of the lack of industry data for the more recent years. In the estimations, both the OLS and the Logistic Transformation Methods are used. Since the value of IIT levels which is our dependent variable lies in the range of 0 and 1, they have to be transformed because otherwise we can obtain estimated coefficients that are not in this defined interval. The logistic transformation is done by the following formula:

Transform- IIT = ln [IIT/ (1-IIT)]

The determinants of vertical and horizontal IIT are tested by using various country and industry specific hypotheses. These hypotheses are as follows:

Cross-Industry Determinants

Hypothesis 1: IIT is an increasing function of product differentiation.

A positive relationship between product differentiation and IIT levels is expected because consumers' demand for variety can be satisfied with imported differentiated products. However, testing product differentiation in empirical studies is quite difficult because there is no satisfactory indicator of degree of product differentiation. In the literature, a number of proxy variables have been suggested. These proxies are Hufbauer Index, the ratio of advertising expenditures in industry's total sales and number of 5 digit industries in each 3 digit industry group. In this study, the number of 5 digit industries that form the 3 digit industries are used as a proxy variable for product differentiation. This variable is shown as PD and the expected sign of the variable is positive for both vertical and horizontal IIT.

Hypothesis 2: IIT is an increasing function of economies of scale.

Scale economies cause an increase in specialization and therefore decrease production costs. For this reason, a positive relationship between scale economies and horizontal IIT is expected. This relationship is indeterminate for vertical IIT. To measure scale economies, several measures are proposed in the

literature. Among these, average value-added per employee in a given industry, average value added per firm in the industry and total number of workers in the industry are the most widely used proxies. In this study, all these measures are tested in different models, but the most significant results are obtained for the model which used number of workers as an independent variable, so in the result tables only the equations for this variable are shown. In the equations, scale economies are represented by SE and the data for this variable is gathered from Annual Manufacturing Industry Statistics published by State Statistics Institute of Turkey.

Hypothesis 3: IIT is an increasing function of number of firms in an industry.

There is a close relationship between market structure and IIT levels. In the literature, it has been discussed that in oligopolistic market structures IIT levels are higher. The existence of an oligopolistic structure is tested by using three proxy variables. The first variable is the number of firms in the industry. The second variable is the Four Firm Concentration Ratio, which measures the share of the four biggest firms in total sales. The third and the last variable is the Herfindahl Index. This index equals to the sum of squares of the shares of firms in the industry. In this study, Four Firm Concentration Ratios are used and the expected sign of this variable is positive. Market Structure variable is shown by MS in the equations and the data is obtained from Concentration in Turkish Manufacturing Industry 1996 Statistics. The data are given for the 1992-1996 period in this statistics and to forecast the data for 1999, the annual rate of changes are used.

Hypothesis 4: There is a negative relationship between IIT and the relative export and import unit prices.

If relative export and import unit prices are bigger than 1, it means that the industry's exports are more expensive than its imports. If this ratio is less than 1, the opposite is valid. If the difference between export and import unit prices increases, this can be an indicator of increasing inter-industry trade. This hypothesis will be tested with the variable UP and the expected sign for this variable is negative for bıth vertical and horizontal IIT. The export and import unit

values are calculated by using trade data obtained from Undersecretariat of Foreign Trade.

The model used to test the cross-industry hypotheses defined above is defined as:

$$IIT = \alpha_0 + \alpha_1 PD + \alpha_2 SE + \alpha_3 MS + \alpha_4 UP + e$$

Cross-Country Determinants

Hypothesis 1: The smaller the difference in per capita GDP's of two countries, the larger the share of IIT in these countries' bilateral trade.

Linder (1961) proposed that the more similar the demand structures of two countries, the more intensive is the potential trade between those two countries. Since the demand structures of these countries are similar, the production patterns of these countries are also expected to be similar. Depending on the Linder's arguments, the IIT is expected to be higher between countries with similar income levels because the demand structures of two countries will be similar only if their income levels are similar. To test this hypothesis, the absolute difference between per capita GDP levels of countries are calculated. This variable is represented with PCGDPD in the model. The expected sign of this variable is negative for horizontal IIT and positive for vertical IIT.

Hypothesis 2: The higher the level of development of a country, the larger the share of IIT.

The more developed a country is, the greater the importance of manufacturing industry in that country's economy and consequently the larger the share of IIT. Per capita GDP levels are used to measure countries' development levels in empirical studies. For this reason, PCGDP variable is included in our model. This variable is expected to have positive sign for both vertical and horizontal IIT.

Hypothesis 3: There is a positive relationship between countries' market sizes and IIT.

The larger the size of a country's market, the larger the demand for differentiated products and therefore this differentiated demand causes ITT levels to increase. GDP levels of countries' are used to test market sizes. For both vertical and horizontal IIT this variable is expected to have a positive sign.

Hypothesis 4: IIT is a decreasing function of the market size difference between trading partners.

It is argued that countries with similar market sizes will export and import similar goods. This hypothesis is set to test this argument. The expected sign of this variable is negative because, as the difference between countries' market sizes increases the level of IIT decreases and in the model, this variable is represented by GDPD. All the data concerning GDP are obtained from Human Development Report 2001,published by United Nations.

Hypothesis 5: IIT is a decreasing function of transportation costs.

Transportation costs act as an important barrier for trade. These costs causes the prices of commodities to increase so consumers substitute their demand for differentiated products with standard products. So IIT levels and transportation costs are inversely related. To measure transportation costs, Balassa and Bauwens (1987), Stone and Lee (1995) and many other researchers weighted the distance between capital cities of the partner countries with their GDP levels:

$$WDIST_J = \frac{\sum_k (GDP_k * DIST_k)}{\sum_k GDP_k}$$

where GDP_k is the gross domestic product of partner country k and 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.

Hypothesis 6: IIT is an increasing function of Foreign Direct Investments (FDI) between trading partners.

Increasing FDI between countries not only helps consumers to satisfy their differentiated demands but also help scale economies to appear in production. Both of these effects cause IIT to increase. The data concerning FDI are taken from Treasury Statistics.

Hypothesis 7: IIT is an increasing function of economic integrations among countries.

When two countries abolish the trade barriers and form a kind of economic integration, both the volume of total trade and the share of IIT in total trade increases. For this reason, in this study a dummy variable is used for the European Union (EU) countries. The expected sign of this variable is positive.

The above hypotheses are tested in the following form:

$IIT= \alpha_0+ \alpha_1 PCGDPD+\alpha_2 PCGDP+\alpha_3 GDP+\alpha_4 GDPD+\alpha_5 WDIST+\alpha 6 FDI+\alpha_7 EU+e$

3. Empirical Results

Different industry and country characteristics are associated with the two types of IIT. So in this study first, cross-industry hypotheses are tested for vertical and horizontal IIT and the results are shown in Table 2 and 3 respectively.

Table 1: Regression Results for Vertical IIT

VARIABLES	α=0,15		α=0,25	
	OLS	LOGIT	OLS	LOGIT
PD	0,126 (1,09)	0,071 (1,68)*	-0,16 (-1,59)	-0,007 (-1,26)
SE.	0,019 (0,168)	0,006 (0,158)	3,61 (1,03)	0,17 (0,87)
MS	0,177 (1,08)	0,057 (0,95)	8,57 (1,58)	0,57 (1,84)*
UP	-0,01 (-1,16)	-0,002 (-0,74)	-0,51 (-2,50)**	-0,03 (-2,01)**
Constant	2,55 (2,95)***	-3,65 (-11,46)***	-0,67 (-0,02)	-2,87 (-1,83)*
R^2	0,012	0,024	0,137	0,08
F	1,16	1,33	2,86**	2,00
Q	0.88	0.32	27.4	1.53
WHITE	9.08	10.22	13.17	8,04

[P]	[0.335]	[0.249]	[0.106]	[0.429]
N	62	62	54	54

Note: *, ** and *** denote 10%, 5% and 1% level of significance respectively. The values in parentheses are t statistics.

The share of vertical IIT in total of 258 - 3 digit SITC industries is approximately 80 percent. So, it is clear that vertical IIT dominates Turkish foreign trade. The regression results show that relative export and import unit prices is the only explanatory variable for vertical IIT. So, it can be said that vertical IIT is not determined by industry characteristics.

However in the case of horizontal IIT, all of the variables are significant when α is taken as 0,15. The signs of the estimated coefficients are also consistent with our expectations except Scale Economies. The overall explanatory power of the equation is highly satisfactory and the standard errors of the equations are low. Also, when we look at the White test results for heteroskedasticity, it doesn't seem a problem for our data set. Broadly speaking, it can be said that industry specific factors are important determinants of horizontal IIT.

Table 2: Regression Results for Horizontal IIT

VARIABLES	α=0,15		α=0,25	
	OLS	LOGIT	OLS	LOGIT
PD	0.10 (3.85)***	0.033 (2.69)**	0.015 (2.23)**	0.0029 (3.72)***
SE	-0.00008 (-3.19)**	-0.00002 (-2.34)*	-0.018 (-0.038)	-0.13 (-1.31)
MS	-0.01 (-6.62)***	-0.005 (-2.73)**	-0.429 (-0.854)	-0.001 (-1.02)
UP	-0.039 (-6.74)***	-0.028 (-11.2)***	-0.02 (-2.32)**	-0.024 (-8.29)***
Constant	4.45 (10.66)***	-3.04 (-15.6)***	4.81 (1.63)	-2.44 (-3.08)***
R^2	0.87	0.94	0.29	0.83
F	18.49***	36.35***	2.76*	20.51***
Q	0.55	0.21	1.19	0.28
WHITE [P]	9.856 [0.275]	8.8169 [0.417]	14.51 [0.069]	4.99 [0.757]
N	11	11	18	18

Determinants of vertical and horizontal IIT are also tested for some country specific hypotheses. In the IIT literature it is commonly discussed that IIT is related with only developed countries with high income levels and differentiated consumer demands. But recently, researchers have started studying IIT of developing countries and it is found that the importance of IIT is constantly increasing for developing countries. Also in some papers, it is argued that the determinants of IIT differs for developed and developing countries. To test for these arguments, the country groups are distinguished in the estimations. The regression results for vertical and horizontal IIT are shown in Table 3 for developed countries and Table 4 reports the regression results for developing countries.

In the case of both developed and developing countries, again vertical and horizontal IIT offer contrasting results. Also, results differ for developed and developing country cases. When the results for developed countries are analyzed, it is seen that GDP levels and transportation costs are important determinants of both types of IIT. For developing countries GDP is again important for vertical and horizontal IIT but transportation costs are only explanatory in vertical IIT cases. For horizontal IIT, transportation costs are only significant at 10 percent level of significance. GDP per capita and GDP per capita differences among countries bear importance only for vertical IIT for both country groups. But the estimated sign of the GDP per capita variable is negative for developing countries which is not compatible with our expectations. The GDPD variable which is used to test the effects of differences in GDP levels on IIT is statistically significant only for vertical IIT of developing countries. In the other models it is not significant.

The dummy variable for EU countries and FDI variables are only tested for developed countries because none of the developing countries are EU members and also there is no flow of direct investments from these countries to Turkey. The estimated coefficients for the EU variable are significant for both IIT types but the estimations for vertical IIT are facing heteroskedasticity problem. So EU dummy can only be used to explain horizontal IIT. FDI variable is not significant for both types.

If the general validity of the regressions are analyzed for developed countries, it is seen that the explanatory power of the equations are about 30 percent, which is an acceptable ratio for cross section data. But when we come to the developing countries cases the coefficient of determinations are very low especially for horizontal IIT. Standard errors of regressions are generally low, so statistically the results are acceptable. And when the results for OLS and LOGIT Transformation methods are compared, it is very obvious that LOGIT Transformation method gives better results.

Table 3: Regression Results for Developed Countries

VARIABLES	VERTICAL IIT				HORIZONTAL IIT			
	α=0,15		α=0,25		α=0,15		α=0,25	
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
GDP	0.016 (2.78)***	0.002 (3.44)***	0.08 (2.29)**	0.001 (2.58)***	0.004 (5.09)***	0.001 (2.81)***	0.007 (5.87)***	0.002 (3.99)***
GDPD.	-0.646 (-0.29)	-0.1896 (-0.96)	0.001 (0.01)	0.099 (0.43)	0.081 (0.25)	0.224 (0.01)	-0.566 (-1.14)	-0.41 (-1.95)
GDPPC	21.5 (1.88)*	2.252 (1.98)**	22.87 (1.85)*	3.046 (2.26)**	0.328 (0.18)	1.344 (0.69)	1.07 (0.37)	0.496 (0.38)
GDPPCD.	-12.933 (-2.14)**	-1.197 (-2.19)**	-13.58 (-2.31)**	-1.534 (-2.39)**	-0.049 (-0.06)	-0.759 (-0.82)	-0.602 (-0.44)	-0.074 (-0.11)
FDI	0,013 (0,35)	0,0008 (0,26)	0,004 (0,13)	0,0005 (0,13)	0,0037 (0,67)	0,0045 (1,21)	0,005 (0,58)	0,002 (0,77)
WDIST	-0.1001 (-2.77)***	-0.011 (-3.42)***	-0.08 (-2.29)**	-0.01 (-2.79)***	-0.02 (-5.59)***	-0.01 (-3.26)***	-0.04 (-6.10)***	-0.013 (-3.90)***
EU	4.80 (3.34)***	1.51 (1.39)	3.77 (3.53)***	0.77 (0.72)	1.50 (2.76)**	2.24 (1.78)*	1.87 (2.34)**	0.51 (0.36)
Constant	5.83 (0.33)	-12.84 (-1.98)**	6.79 (-1.32)	-19.29 (-2.52)**	-0.14 (-0.22)	0.054 (0.01)	-1.09 (0.62)	-6.155 (-0.86)
R^2	0.204	0.256	0.181	0.266	0.531	0.363	0.548	0.334
F	2.74**	3.35**	2.51**	3.34***	8.72***	4.42***	9.26***	4.31***
Q	9.93	0.88	9.63	1.04	1.45	0.92	2.23	0.94
WHITE [P]	25,9 [0.00]	16,3 [0.09]	26,9 [0.00]	11,0 [0.63]	6,05 [0.81]	14,6 [0.145]	8,80 [0.55]	10,6 [0.39]
N	44	44	44	44	44	44	44	44

Tablo 4: Regression Results for Developing Countries

VARIABLES	VERTICAL IIT				HORIZONTAL IIT			
	α=0,15		α=0,25		α=0,15		α=0,25	
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
GDP	0.0032 (2.145)**	0.0028 (2.45)**	0.004 (3.39)***	0.004 (3.21)***	0.001 (2.05)**	0.003 (1.96)*	0.002 (2.226)**	0.003 (1.50)
GDPD	-0.0034 (-1.92)*	-0.0028 (-2.11)**	-0.004 (-2.89)***	-0.0038 (-2.66)**	-0.001 (-1.78)*	-0.003 (-1.66)	-0.002 (-1.94)*	-0.0026 (-1.23)
GDPPC	-3.38 (-1.72)*	-4.25 (-2.82)***	-0.002 (-2.47)**	-0.001 (-1.77)*	-0.0003 (-0.86)	-0.0003 (-0.34)	-0.0008 (-1.38)	-0.001 (-0.93)
GDPPCD	-0.001 (-1.61)	-0.001 (-2.25)**	-0.0019 (-2.35)**	-0.002 (-1.91)*	-0.0002 (-0.62)	-0.00005 (-0.06)	-0.0007 (-1.28)	-0.0013 (-1.21)
WDIST	-0.0003 (-1.03)	-0.0005 (-2.65)**	-0.0005 (-2.28)**	-0.0008 (-3.69)***	-0.0002 (-1.69)*	-0.0006 (-1.81)*	-0.0003 (-1.72)*	-0.0006 (-1.54)
Constant	-27.28 (-1.49)	-40.98 (-2.96)***	15.87 (2.99)***	6.80 (1.29)	3.03 (1.12)	-3.17 (-0.54)	6.96 (1.76)*	3.40 (0.47)
R^2	0.345	0.472	0.442	0.37	0.21	0.114	0.19	0.07
F	3.81***	5.77***	5.22***	4.15***	2.35*	1.54	2.25*	1.36
Q	1.96	1.49	1.53	1.52	0.78	1.53	1.14	2.01
WHITE [P]	19,6 [0.03]	14,9 [0.135]	10,4 [0.313]	8,86 [0.45]	9,26 [0.413]	9,76 [0.37]	5,46 [0.79]	13,7 [0.132]
N	35	35	35	35	35	35	35	35

4. Conclusion

The aim of this study was to test the determinants of vertical and horizontal IIT for Turkey by using various industry and country specific hypothesis. To accomplish this aim, in the second part of the study the data and the method of the study are described. In the third part, the estimation results are presented. When these results are studied, a number of inferences can be drawn:

(i) Horizontal IIT is determined by industry specific characteristics, whereas vertical IIT is determined by country specific characteristics.

(ii) In case of developed countries, country specific determinants of vertical and horizontal IIT are important, whereas for developing countries country specific determinants does not bear any importance.

These results are similar to the results obtained for many developed countries. So we can conclude that Turkey is following a path that is similar to the ones developed countries followed. But to make more precise evolutions, a time-series analysis should be done for Turkey and the changes in IIT levels in time should be observed.

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