Erciyes Üniversitesi
İktisadi ve İdari Bilimler Fakültesi Dergisi
ISSN: 1301-3688/e-ISSN: 2630-6409

Araştırma Makalesi | Research Article
Yayın Tarihi: 30 Aralık 2022 | Published: December 30, 2022
doi: 10.18070/erciyesiibd.1057234

THE FACTORS AFFECTING THE INTRA INDUSTRY TRADE BETWEEN THE UNITED KINGDOM AND THE UNITED STATES: AN ARDL MODEL APPROACH

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ABSTRACT

This study is an analysis of the intra industry trade between the United Kingdom and the United States of America in the manufacturing sector. The analysis comprises of the years between 1993 and 2019. The factors influencing the intra industry trade and their impacts are examined. With the help of ARDL approach, cointegration between the variables is tested. According to the results, foreign direct investment, per capita income difference and trade openness are affective in the long run, but in the short run, per capita income difference, GDP difference and trade orientation are affective. Per capita income difference has an impact on the intra industry trade both in the short run and in the long run, demonstrating the Linder's Theory of Overlapping Demands which proposes that the international trade will be stronger between countries with similar per capita income levels.

Keywords: Intra Industry Trade, Theory of Overlapping Demand, Trade Orientation, Per Capita Income Difference, ARDL Model

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JEL:
F11, F13

Geliş: *13 Ocak 2022*
Received: *January 13, 2022*
Kabul: *17 Temmuz 2022*
Accepted: *July 17, 2022*
Yayın Tarihi: *30 Aralık 2022*
Published: *December 30, 2022*

Atıf Önerisi / Cited as (APA):
Toplu Yılmaz, Ö. (2022), The Factors Affecting The Intra Industry Trade Between The United Kingdom and The United States: An ARDL Model Approach, Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 63, 1-7, doi: 10.18070/erciyesiibd.1057234

BİRLEŞİK KRALLIK VE ABD ARASINDAKİ ENDÜSTRİ İÇİ TİCARETİ ETKİLEYEN FAKTÖRLER: ARDL MODELİ YAKLAŞIMI

ÖZ

Bu çalışma, Birleşik Krallık ve Amerika Birleşik Devletleri arasındaki imalat sektöründe endüstri içi ticaretin bir analizidir. Analiz 1993-2019 yıllarını kapsamaktadır. Endüstri içi ticareti etkileyen faktörler ve etkileri incelenmiştir. ARDL yaklaşımı yardımıyla değişkenler arasındaki eşbütünleşme test edilmiştir. Elde edilen sonuçlara göre, uzun dönemde doğrudan yabancı yatırım, kişi başına gelir farkı ve ticari açıklık etkili olurken, kısa dönemde kişi başına gelir farkı, GSYH farkı ve ticaret yönelimi etkili olduğu gözlemlenmiştir. Kişi başına gelir farkı hem kısa vadede hem de uzun vadede endüstri içi ticaret üzerinde bir etkiye sahiptir ve bu da benzer kişi başına gelir seviyelerine sahip ülkeler arasında uluslararası ticaretin daha güçlü olacağını öne süren Linder'in Tercihlerde Benzerlik Teorisini ortaya koymaktadır.

Anahtar Kelimeler: Endüstri İçi Ticaret, Tercihlerde Benzerlik Teorisi, Ticaret Yönelimi, Kişi Başı Milli Gelir Farkı, ARDL Modeli

INTRODUCTION

The United Kindom's largest trading partners are the United States of America (USA), Germany and China in recent years. Since the United Kingdom's decision to leave the European Union (EU) in 2016, its trade relations with the EU have decreased relatively, while its commercial relations with the United States (US) have begun to increase.

The aim of this study is to evaluate the intra-industry trade of the United Kingdom in the manufacture sector with the USA, which is the largest trading partner. The manufacturing sector is one of the sectors in which UK and the USA are the leaders in the world trade. In this context, the issue of whether the trade in the manufacturing sector between the two countries is inter-industry or intra-industry and the factors that determine the trade structure have been analyzed. Within the framework of Linder's theory of similarity in preferences, it is expected that intra-industry trade will increase in the countries with similar demand structures and similar economic structures. This expectation is handled with the ARDL bounds test approach; also, the factors affecting intra-industry trade were examined in the analysis.

In the first part of the study, the theoretical framework of the intra-industry trade is discussed. In the second part, the literature review is summarized. In the third part, the econometric methods and the data are explained. In the fourth part, the model results are analyzed. Lastly, conclusion part summarizes the subject and interprets the results.

THEORETICAL BACKGROUND

According to the classical theories, trade between two nations involve different products; that means the classical trade theories are mainly based on inter industry trade. Adam Smith explained the trade between two nations with absolute advantage theory that foresees specialization in the production and export of the commodity of its absolute advantage. Later David Ricardo introduced the comparative advantage theory. According to the theory the nation should specialise and export the commodity which has smaller absolute disadvantage. Factor endowment theoory (Heckscher-Ohlin theory) is also related with the inter industry trade. This theory explains the gains from trade for a nation by specialisation in the commodity whose production requires the intensive use of the nation's relatively abundant and cheap production factor. Since the trade between the developed countries mostly comprise similar industrial products, the classical theories became insufficient to explain the trade between the developed countries. New theories have emerged to describe the trade in similar product groups, because a large share of the trade between the countries is intra-industry trade (IIT) in differentiated products, which is opposed to inter-industry trade (Salvatore, 1998, p.160). Inter industry trade involves completely different products reflecting the comparative advantage. Intra industry trade occurs with the increased specialisation and economies of scale. Intra industry trade refers to both export and import of the same types of goods or services. In this case, the consumers benefit from different product choices.

Linder's theory of "preference similarity-overlapping demands" (1961) is one of the new theories that refer intra industry trade. The fundamental difference between the classical theories and the Linder Hypothesis is that the classical theories explain the trade of homogeneous goods; a good being either exported or imported, namely inter industry trade between the countries (Ünsal, 2005: 224). Linder's theory considers heterogenous products.

A significant factor supporting the intra industry trade is similar demand structure. According to Linder's preference similarity theory; trade in manufactures is likely to be highest among the countries with similar tastes and income levels. Linder suggested that a nation exports those manufactured products for which a large domestic market exists. The level of economic development is important. Intra-industry trade is high among the countries with similar economic development. Per capita income (GDP) determines the demand structure. Per capita GDP difference indicates the similarity degree of demand. The Linder demand similarity theory states that the closer the per capita income of two countries, the more similar demands, and the higher the probability of intra-industry trade. Trade between the countries will be more intensive, the less per capita income differences are (Linder, 1961, p.17).

In the case of consumers with a high GDP per capita, they are more likely to buy diversified products and differentiated products. Small differences between the GDP per capita of trading countries also constitute an important factor in favor of the intra-industry trade (Łapińska and Kądzielawski, 2019, p.23).

LITERATURE REVIEW

The basis of this study depends on the measurement of Intra industry trade. Intra industry trade formula was developed by Grubel and Lloyd (1975). The formula describes the international trade of differentiated products. The articles about the intra industry trade measurement and the factors affecting the intra industry trade are taken as reference materials for this study. The literature review is presented below in chronological order.

Brüllhart and Elliott (1998) searched the trade flows and expansion of trade in the European Union by examining intra industry trade and adjustment costs. According to the authors, IIT relates negatively to adjustment costs. IIT among EU members experienced a slowdown in the 1980s but then had an upward trend in the 1988-1992 periods. Clark and Stanley (1999) analysed intra-industry trade (IIT) between the United States and developing countries. Economic size and trade orientation of the developing country affect the intra industry trade positively, but distance has a negative impact on IIT. Bhattacharyya (2005) analysed the intra-industry trade of Korea between 1963 and 1995 at the SITC 3 digit level. Vertical intra industry trade increased by the rapid economic development and horizontal intra-industry trade was achieved by the aggregate volume of trade.

Grubel and Lloyd (2007) calculated the intra industry trade of China by using the factor intensity classification of the International Trade Center. The authors found that the level of intra-industry trade is particularly low for unskilled-labor intensive sectors, and high for technology intensive sectors and intermediate for the other types of sectors.

Vogiatzoglou (2007) examined the effects of the European integration process on Greece's intra-EU and extra-EU intra-industry trade (IIT) structure between the years 1981-2002. The study reveals that intra-EU and extra-EU IIT in Greece have diverging trends. IIT of Greece with non-EU partners is higher and has a significant upward trend, whereas the intra-EU IIT of Greece is lower and has a decreasing trend. Başkol (2009) analysed the share of intra-industry trade in Turkey's foreign trade for the period 1969-2009 by using Grubel-Lloyd Index at SITC 3 digit levels. According to the results, intra-industry trade is high in mainly standard-tech products but low in high-tech products. Shahbaz, Leitão and Butt (2012) examined the determinants of intra-industry trade (IIT) between Pakistan and trade patterns in the period 1980-2006. According to the results, trade increases if the transportation costs decrease. Main export markets are found as United States, Saudi-Arabia, United of Kingdom and Germany.

Küçükahmetoğlu and Aydın (2015) investigated the country-specific factors of Turkey's intra-industry trade in commercial services. All variables except foreign direct investment gave the expected results and have impact of IIT. Foreign capital inflow to Turkey replaces services trade and has a reducing effect on Turkey's intra-industry trade rates. Şahin (2016) measured Turkey's intra-industry trade level according to factor density. The results of the study showed that intra-industry trade level is high in raw material intensive, labor intensive and capital-intensive goods. Intra-industry trade was low in easy to imitate science-based and hard to imitate science-based goods. Köse and Meral (2019) analysed the relationship between IIT and exchange rate in the iron and steel industry between Turkey and the USA during the years 1990 - 2017. The authors found one-way relationship between the intra-industry trade and exchange rate in the iron and steel industry of the two countries.

Łapińska, Kądzielawski and Dziuba (2019) analysed the country-specific factors of intra-industry trade between Poland and the European Union partners in clothing and footwear between the years 2004-2017. The geographical distance and trade imbalance are found as limiting factors for the development of intra-industry trade.

Özdemir and Kösekahyaoğlu (2019) calculated the IIT level in the

20 sectors with the highest share in exports, based on Turkey's foreign trade during the 1990-2017 period. 7 of the 20 sectors have a high level of IIT: motor vehicles, tractors, motorcycles, iron and steel, articles of iron and steel, aluminium and aluminium articles, furniture, bedding, lighting devices, rubber and rubber articles, and cotton, cotton yarn. Wang et all. (2019) analysed the intra-industry trade status between China and its 24 partners from 2000 to 2014. According to his analysis trade openness and geographical distance are the crucial determinants of intra-industry trade of forest products. The per capita gross domestic product gap, urbanization, foreign direct investment, forest area, and import and export value of forest products also influence the intra-industry trade. Tatar (2020) calculated the intra-industry trade within the scope of manufacturing industry (SITC-Rev.3) between Turkey and the Economic Cooperation Organization for the period of 2000-2017. Income average, foreign investment, openness and distance variables are considered as independent variables. As a result of the analysis, although the variables of average income and foreign investment were statistically significant, they were theoretically meaningless. Distance was also found to be statistically insignificant. Saygun (2020) investigated the intra industry trade in iron and steel sector between Turkey and the EU countries for the period of 2009-2019. The author revealed that the structure of trade in the iron and steel sector between Turkey EU countries is in the form of IIT. The countries with the highest level in IIT are the Netherlands, Poland, Spain, Italy, Germany, Romania and Denmark.

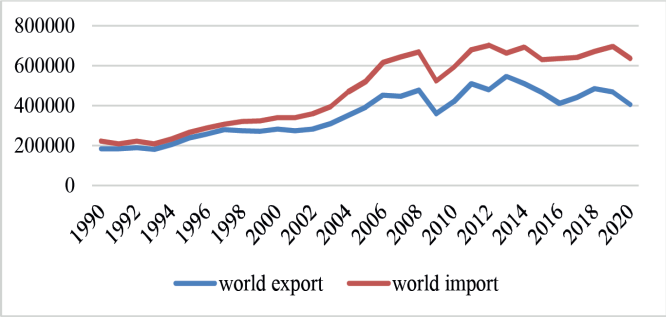
Baysal Kurt and Çoban (2021) measured the intra industry trade between Turkey and EU countries in the manufacturing sector. According to the results, intra- industry trade decreases, as the GDP (gross domestic product) difference, per capita GDP difference, trade openness difference, distance and trade imbalance increase between Turkey and the EU countries.

Şahin (2022) analyzed Turkey's intra-industry trade with Germany, and the United States in the machinery and transportation vehicles sector for the period 1990-2019. The author concluded that the effect of intra-industry trade on the selected variables varies between the countries. The effect is negative with the USA, while there is a positive relationship with Germany. The reason of this positive effect is that the level of trade barriers with Germany is relatively low.

DATA AND METHODOLOGY

In this study, the intra industry trade index is measured for the United Kingdom in the manufacturing sector. The trade statistics after 1993 are considered, because 1993 is the year when the recession ended and the economy recovered after the UK left the Exchange Rate Mechanism (ERM) of the European Union (BBCNews)[1]. The end of the recession reflected in the trade figures of the country also (Graph 1): the trade has begun to expand after 1993.

GRAPH 1 | World Merchandise Trade of the United Kingdom (Million dollar)

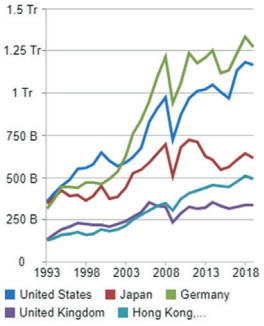


Source: World Bank 2021a

The top five UK trading partners in 2020 were the United States (US), Germany, China (Office for National Statistic [ONS], 2021).

The intra industry trade of the United Kingdom with the United States is examined. The United States and the United Kingdom have always been close trade partners, and they are also biggest countries in the manufacturing sector in the world (Graph 2).

GRAPH 2 | The biggest exporters in manufacturing sector (US $ Thousand)



Source: World Bank 2021a

The analysis comprises of the years between 1993 and 2019. The data are taken from World Bank (2021a, 2021b), and Organisation for Economic Co-operation and Development (OECD 2018, OECD 2020a, OECD 2020b). The description of the dependent and the independent variables and their importance for the intra-industry trade are explained below:

THE DEPENDENT AND EXPLANATORY VARIABLES

The dependent variable is intra-industry trade index (Grubel Lloyd Index-GL), the explanatory variables are trade orientation, trade openness, GDP difference, per capita GDP difference, the change in foreign direct investment.

Intra industry trade

Intra-industry trade is expressed as the value of exports of an 'industry' which is exactly matched by the imports of the same industry (Grubel and Lloyd, 1975:

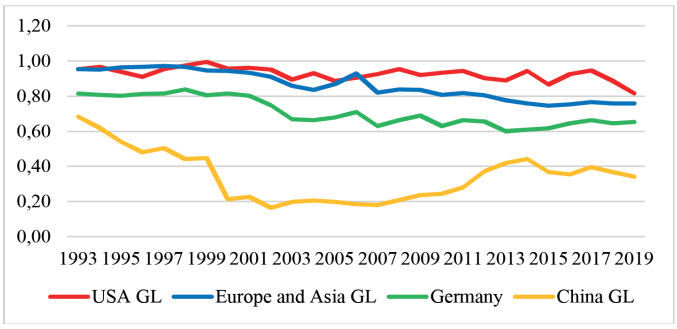
$$GL_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} * 100 = 1 - \frac{|X_i - M_i|}{(X_i + M_i)} * 100 \qquad (1)$$

X_i the exports value of the selected sector (i) ,
M_i the imports value of the selected sector (i)

The measures vary between 0 and 100. When the exports are exactly equal to imports of an industry, GL is 100. When there are exports but no imports, or vice versa, the measure is 0. The larger the value, the higher is the share of the intra industry trade in total trade. The smaller values show the high percentage of inter industry trade in total trade.

The factors that can affect the intra industry trade are GDP difference (GDPDIFF), per capita income difference (PCIdiff), openness (OPEN), trade orientation (TO), foreign direct investment change (FDIC).

GRAPH 3 | Intra Industry Trade of UK with Her Trade Partners



Source: Author Calculations

GDP difference

The formula below shows the index of the relative difference in the size of UK's GDP and its trading partner the United States in period t (Lapinska et al., 2019, p.194).

1 The UK experienced high inflation and worsening economy after the UK had entered the ERM in 1990. The recession lasted two years (1991-1992).

$$\text{GDPdif} = 1 + \frac{\left[w \ln w + (1-w)\ln(1-w)\right]}{\ln 2} \quad (2)$$

$$w = \frac{GDP_{UKt}}{GDP_{UKt} + GDP_{USt}} \quad (3)$$

GDP_{UKt} , – GDP_{USt} : Gross Domestic Product of United Kingdom and its trading partner the United States in the year t.

The GDP difference takes values between 0 and 1. If the differences in GDP between countries are large, then this value approaches the value of 1. When the countries have GDP, then the value is 0.

Per capita income difference

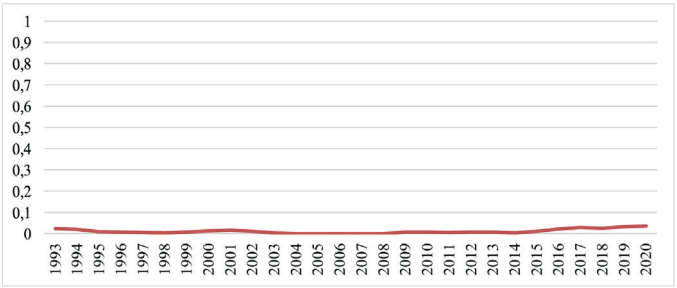
Per capita income difference is measured by using the formula below (Lapinska et al., 2019, 194).

$$\text{PICdif} = 1 + \frac{\left[w \ln w + (1-w)\ln(1-w)\right]}{\ln 2} \quad (4)$$

$$w = \frac{PCI_{UKt}}{PCI_{UKt} + PCI_{USt}} \quad (5)$$

The index found in the above formula takes values between 0 and 1. When the index approaches 1, the differences in per capita income between countries are high. If the index is 0, the countries have the same GDP per capita.

GRAPH 4 | Per capita income difference between the UK and the USA



Source: Author Calculations

To the extent that per capita income determines the demand structure, the demand structures of both countries are similar as the per capita incomes are almost equal (Graph 4).

Trade orientation

The trade barriers are important for the international trade. Trade barrier is a variable that describes the degree of trade orientation i.e., the openness of the economy. This variable is the result of estimating the following equation:

$$\log \frac{X_j}{P_j} = \beta_0 + \beta_1 \log \frac{Y_j}{P_j} + \beta_2 P_j + \beta_3 \log \frac{X_j^m}{Y_j} + \varepsilon_j \quad (6)$$

X_j – the exports value of the country
Y_j – the gross domestic product of the country
P_j – the population of the country j,
X_j^m – the value of exports of manufacturing sector of the country,
ε_j – the random component.

The hypothetical value of per capita exports will be determined. The trade orientation variable is the variation between actual and hypothetical value of per capita exports. If the difference between actual and hypothetical value of per capita exports is positive (negative), that means low (high) restriction (Havrylyshyn and Kunzel, 1997, p.14).

The estimated trade orientation model and the significance of the model are presented below:

$$\log \frac{X_j}{P_j} = -11.33 + 0.69 \log \frac{Y_j}{P_j} + 1.45 P_j + 0.36 \log \frac{X_j^m}{Y_j} \quad (7)$$

t-stat	(-2.864)	(7.505)	(2.727)	(-2.842)
Prob.	[0.0088]	[0.0000]	[0.0120]	[0.0092]

	Prob(F-stat)
Heteroscedasticity test	0.65.00
Serial Correlation LM test	0.7522
Ramsey-reset test	0.8266
Jarque-Bera Normality test	0.3223
R-squared	0.9282
Adjusted R-squared	0.9188
Prob(F-stat)	0.0000

The t-statistic and prob. values are presented in parentheses. All the variables are significant and the model is also significant considering the diagnostic tests (heteroscedasticity test, serial correlation LM test, Ramsey-reset test, Normality test).

Openness

A high trade openness is a crucial factor in international trade. Trade openness is measured by the ratio below:

(Total exports + Total imports) / Gross Domestic Product (8)

Foreign direct investment

Foreign direct investment refers to direct investment flows in the reporting economy. The United Kingdom's direct investments in the manufacturing sector of the United States are taken from the OECD. Foreign direct investments have both negative values and positive values in the observed years. The change of the FDI from year to year has been taken into account and added to the model.

MODEL ESTIMATION

Unit Root test

First of all, ADF (Augmented Dickey-Fuller) developed by Dickey and Fuller (1981) and Phillips Perron (PP) unit root tests developed by Phillips Perron (1989) determined the stationarity of the variables and their level of integration. The following (fixed and trendless) model is used to test whether the time series contains a unit root:

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{k} \delta \Delta Y_{t-1} + \varepsilon_t \quad (9)$$

The hypothesis of the unit root test is as follows:
$H_0 : \delta \geq 0$: There is a unit root for the series
$H_1 : \delta < 0$:There is a unit root for the series. The series is stationary
Appropriate lag length was found with the Vector Auto regressive-VAR model. Appropriate delays were determined using the Akaike (AIC) and Schwarz (SIC) statistical criteria

ARDL test

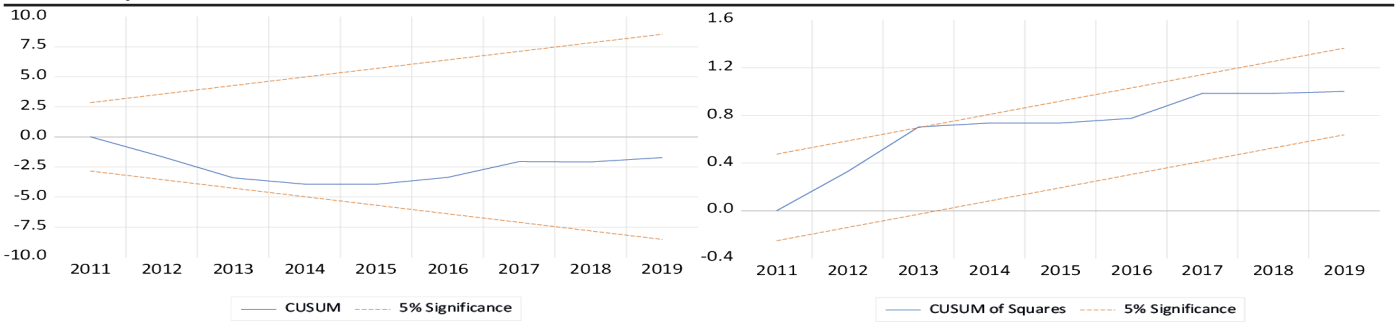
ARDL test, developed by Pesaran and Shin (1995) brings a new approach to the problem of testing the existence of a relationship between a dependent variable and independent variables when it is not known whether the variables are stationary at the level or at the first difference. ARDL model investigates whether there is a cointegration relationship between variables when some variables are [I(1)] or some are [I(0)] (Uzgören ve Akalın, 2016: 49). ARDL test can not be applied when the series are [I(2)]. ARDL regression model and the hypotheses are formulated as below: (Pesaran and Shin, 1995, p. 2):

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \varphi_i y_{t-i} + \beta^1 x_t + \sum_{i=0}^{q-1} \beta_i^* \Delta x_{t-i} + u_t \quad (10)$$

$H_0 : \alpha 1 = \alpha 2 = 0$ (Null hypothesis: the long-run relationship does not exist)
$H_1 : \alpha 1 \neq \alpha 2 \neq 0$ (Alternative hypothesis: the long run relationship exists)

In this model, long run relationship of the series exists when the

GRAPH 5 | Cusum and Cusum of Squares



F-statistic value exceeds the critical value bands. When the long-run relationship exists, error correction model (ECM) is estimated. ECM is used to determine the time period which a dependent variable returns to equilibrium after a change in other variables. The sign of the coefficient of "CointEq" has to be negative and significant. Short run relationship of the series exists when the F-statistic value exceeds the critical value bands.

HYPOTHESES

Based on the theoretical knowledge about the intra industry trade, following hypotheses are formulated and tested:

H1: Trade orientation is negatively correlated with the intensity of intra-industry trade. As trade orientation measures the trade barrier; a negative trade orientation has positive effect in the intra industry trade.

H2: Trade openness is positively related with the intra industry trade.

H3: GDP per capita difference is negatively correlated with the intensity of intra-industry trade. The smaller the difference in per capita income, the greater the extent of intra-industry trade (Vogiatzoglou, 2007, p.35).

H4: There is a negative relationship between UK's intra industry trade and GDP difference. The smaller the difference in country (economic) size, the greater the extent of intra-industry trade (Vogiatzoglou, 2007, p.35).

H5: There is a complementary or substitutive relationship between foreign direct investment (FDI) and the intra industry trade. A foreign direct investment in the country can reduce the foreign trade volume or may increase the intra industry trade (Küçükahmetoğlu and Aydın, 2015, p.334). Negative relationship shows a substitution relationship, a positive relationship indicates a complementary relationship between the intra industry trade and the FDI.

RESULTS

UNIT ROOT TEST

Table 1 shows the test of stationarity at level and first difference of the variables. Critical values in a sample of 25 observations at 95% confidence level are -1.9544 in AFD test and -1.9538 in PP test, respectively. Two variables, namely FDIC and TO are stationary at level, the other variables are stationary when their first differences are taken. In this situation, ARDL test can be applied.

TABLE 1 | Unit Root Test Results

	ADF		PP		
Variables	Level	First difference	Level	First difference	Order of integration
GL	-0.8943	-6.1118	-1.2544	-6.6967	I(1)
	(0.3185)	(0.0000)	(0.1873)	(0.0000)	
OPEN	1.5259	-5.4552	2.817	-5.4882	I(1)
	(0.9650)	(0.0000)	(0.9980)	(0.0000)	
FDIC	-3.4599	-5.6443	-3.4599	-8.9685	I(0)
	(0.0013)	(0.0000)	(0.0013)	(0.0000)	
TO	-2.5314	-7.5081	-2.4100	-8.3374	I(0)
	(0.0136)	(0.0000)	(0.0181)	(0.0181)	
PCIDIFF	0.2238	-3.4203	-0.0798	-3.3539	I(1)
	(0.7436)	(0.0014)	(0.6470)	(0.0017)	
GDPDIFF	0.8489	-2.9222	0.3402	-3.5029	I(1)
	(0.8876)	(0.0054)	(0.7763)	(0.0011)	

As seen in Table 2, the appropriate lag length was determined as 2 with the VAR model.

TABLE 2 | Selection of Optimal Lag length

Lag length	LR	FPE	AIC	SC	HQC
0	NA	2.37	-16.64	-16.35	16.57
1	100.69*	1.41	-19.57	-17.51*	-19.02
2	48.34	6.87*	-20.96*	-17.13	-19.95*

**indicates lag order selection by criterion*

ARDL COINTEGRATION TEST

Estimated model is checked by diagnostic tests: Serial Correlation, Heteroscedasticity, Ramsey-Reset and Cusum and Cusum Square tests (Table 3). All residuals have constant variance (heteroscedasticity test). According to Ramsey-reset test, there is no specification error. Breusch-Godfrey Serial Corelation test indicates, there is no serial autosorrelation. According to Jarque-Bera Normality test the residuals are normally distributed. The Cusum and Cusum of Squares show that the lines are inside the confidence bounds; there is no structural change in the model regression (Graph 2). R-squred of 90% reveals that 90% of the data fit the regression model.

TABLE 3 | Diagnostic Tests

	Prob(F-stat)
Heteroscedasticity Breusch-Pagan test	0.2039
Ramsey-Reset test	0.6288
Serial Correlation LM test	0.2723
Jarque-Bera Normality test	0.9563
R-squared	0.9035
Adjusted R-squared	0.7534

According to Pesaran et al. (2001), there are 5 cases provided for testing the cointegrating bound test:

In this study the 3rd case is selected:

Case 3: (unrestricted intercepts; no trends) $a0 \neq 0$ and $a1 = 0$.

Lag length criteria is determined as 2 by using Akaike information criterion). Ardl test results are summarised in Table 4.

TABLE 4 | ARDL Test Results

Variable	Coeff.	t-Stat	Prob.
C	0.72	3.04	0.014
GL(-1)	-0.98	-5.04	0.0007
GDPDIFF(-1)	1.11	1.65	0.1318
OPEN(-1)	-0.06	-3.87	0.0038
TO(-1)	-0.66	-1.66	0.1308
PCIDIFF(-1)	-7.69	-2.74	0.0228
FDIC(-1)	0.01	2.82	0.0197

D(GDPDIFF)	0.27	0.48	0.6385
D(GDPDIFF(-1))	-1.34	-2.31	0.0461
D(OPEN)	-0.01	-0.38	0.7118
D(TO)	-0.28	-1.49	0.1697
D(TO(-1))	0.50	2.72	0.0234
D(PCIDIFF)	-3.26	-1.33	0.2141
D(PCIDIFF(-1))	12.44	4.99	0.0007
D(FDIC)	0.00	0.15	0.8816

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Stat.	Value	Signif.	I(0)	I(1)
F-statistic	9.720041		Finite sample n=30	
k	5	10%	2.578	3.858
Actual sample size	24	5%	3.125	4.608
		1%	4.537	6.37

F-statistic (9.720041) is greater than the upper bound critical values (3.858, 4.608, 6.37). The null hypothesis is not accepted; long-run relationship exists between the variables. Based on the AIC, the selected lag length is (1,2,1,2,2,1).

TABLE 5 | Long-Run Form (Case 3: constant, no trend)

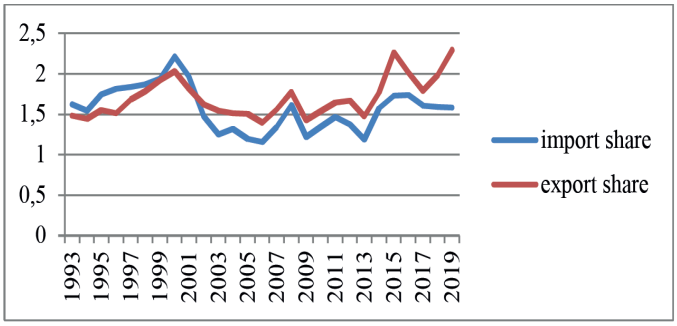
Variable	Coeff.	t-Stat.	Prob.
GDPDIFF	1.13	1.78	0.1071
OPEN	-0.07	-4.88	0.0009
TO	-0.68	-1.72	0.1189
PCIDIFF	-7.84	-2.83	0.0197
FDIC	0.01	2.73	0.0232

Trade openness (OPEN), foreign direct investment (FDIC) and per capita income difference (PCIDIFF) are found as significant at the 95% confidence level (Table 5). The regression model is estimated as follows:

$$GL_{it} = \beta_0 + \beta_1 + \beta_3 OPEN_{it} + \beta_4 PCIDIFF_{it} + \beta_5 FDIC_{it} + \varepsilon_{it} \qquad (11)$$

Trade openness has a negative sign. This may be the reason of the trade share of the manufacturing sector in the United Kingdom. The import and export share of the manufacturing sector is small ranging between 1% and 2.5% (Graph 6). The export and import shares are the ratios of the export and import values of manufacturing sector between the United Kingdom and the United States.

GRAPH 6 | UK's Import and Export Share of Manufacturing Sector



The coefficient of PCIDIFF (per capita income difference) has a negative sign. As expected in H3, per capita income difference is negatively correlated with the intensity of intra-industry trade. Smaller per capita income difference stimulates higher intra industry trade (Table 5).

The coefficient of FDIC (Foreign direct investment change) has a positive sign in the estimated model which implies a complementary relationship between FDI and intra industry trade. FDI has an increasing effect on intra industry trade (Table 5).

After obtaining the long-run relation, the next step is to estimate the short-run Error-correction Model (ECM). Error Correction Model (ECM) can be derived from ARDL model which integrates short run adjustments with long run equilibrium.

The short-run estimation results are summarised in Table 6. F-statistic (9.720041) is greater than the upper bound critical values (3.35, 3.79, 4.68), so there exists short-run relationship. Trade openness and foreign direct invetsment change are insignificant in the short-run. GDP difference, per capita income difference, and trade orientation with lags 1 are significant at the 95% confidence level. This shows that there is short-term causality from these variables to the intra industry trade.

According to the results, the error correction coefficient (CointEq) is negative and significant. The error correction coefficient determines the time required to reach equilibrium from the short term to the long term and is calculated as 1/CointEq coefficient. It is found as $1/0.98 \approx 1$ according to the table. In this case, the short-term deviations will be reflected in the long-term balance after 1 year.

TABLE 6 | Short-run estimation results

Variable	Coeff.		t-Stat.	Prob.
C	0.73		9.35	0.0000
D(GDPDIFF)	0.27		0.92	0.3817
D(GDPDIFF(-1))	-1.34		-4.19	0.0024
D(OPEN)	-0.02		-0.54	0.5999
D(TO)	-0.28		-2.32	0.0452
D(TO(-1))	0.50		4.66	0.0012
D(PCIDIFF)	-3.26		-2.32	0.0454
D(PCIDIFF(-1))	12.44		7.73	0.0000
D(FDIC)	0.00		0.32	0.7560
CointEq(-1)*	-0.98		-9.52	0.0000
F-Bounds Test		Null Hypothesis: No levels Relationship		
Test Stat.	Value	Signif.	I(0)	I(1)
F-statistic	9.720041	10%	2.26	3.35
k	5	5%	2.62	3.79
		1%	3.41	4.68

**Error correction: ECM (-1)*

CONCLUSION

The intra industry trade between the United Kingdom and the United States is analysed in this study. The United States has been the best trading partner of the UK and have been ever closer since the exit decision of the UK from the European Union. Since the intra industry trade involves trade in differentiated products between the countries with similar demand structure, this study examined the degree of the intra industry trade and the affecting factors. The constraint of the study lies in the selection of one sector. Further researches may examine the other sectors with different trade partners.

The results in this study generally compatible with the hypotheses and with some studies in the literature review. In the long-run, the expected results are obtained as formulated in the hypotheses. Per capita income difference, foreign direct investment and openness are found as significant in the long-run model. The per capita income difference is smaller between the United Kingdom and the United States. Smaller per capita income difference is a sign of similar demand patterns. This shows that, the consumers in both countries demand similar product or product groups which is a stimulus of intra industry trade between the countries. This result is also in line with the study of Baysal Kurt and Çoban (2021) who found an impact of per capita GDP difference on intra industry trade. Foreign direct investment is found as complementary to intra industry trade, FDI does not affect

the trade between the countries negatively. This result is compatible with the result of Tatar (2020) revealing the impact of FDI on the intra industry trade. Also, Küçükahmetoğlu and Aydın (2015) found a complementary relationship between the intra industry trade and the FDI in their study. Trade openness was expected to find as a positive impact, but in this study, openness does not have a positive impact. This may be the reason of the smaller share of the manufacturing sector in the GDP of the United Kingdom. In the short run, GDP difference, per capita income difference, and trade orientation are affective on the intra industry trade. Trade orientation is significant and has a positive sign with 1 lag. This indicates a low trade barrier between the countries. Clark and Stanley (1999) also revealed the significance and positive impact of trade orientation on intra industry trade.

Intra industry trade is a crucial trade theory which explains the trade between the countries with similar economic development. This study shows that the intra industry trade index is very high between the United Kingdom and the United States. Both countries have similar demand structure and similar economic development than any other partner countries. As both countries are close trade partners, intra industry trade may even rise more between the countries in the following years.

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