ISLAMIC DEVELOPMENT BANK
ISLAMIC RESEARCH AND TRAINING INSTITUTE

AN INTRA-TRADE CONOMETRIC MODEL FOR OIC MEMBER COUNTRIES: A CROSS-COUNTRY ANALYSIS

Boualem Bendjilali

Research Paper
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FOREWORD

The Islamic Research and Training Institute (IRTI) of the Islamic Development Bank (IDB) has been established in 1401H (1981) "to undertake research for enabling the economic, financial and banking activities in Muslim countries to conform to *Shari'ah*". This is in implementation of the article (2) of the Articles of the Agreement establishing the bank, which has been ratified by 51 Islamic countries. In order to discharge its responsibilities, IRTI pays special attention to basic and applied research in the areas of Islamic economics, banking and finance and economic cooperation among OIC member countries.

IRTI researchers carry out research activities on various important issues of Islamic economics, Islamic banking and finance and economic cooperation and development. The Institute also encourages and promotes research activities by outside scholars. It invites eminent economists and *Shari'ah* scholars to deliver lectures on various issues of interest. It organizes research seminars, workshops and training courses. It also awards an international prize that alternates between Islamic economics and Islamic banking every year.

Trade among OIC member countries has long been considered as the basis for cooperation and economic integration. In addition, bilateral intra-trade among OIC member countries has been weak despite all the efforts engaged by the concerned countries and the Islamic Development Bank to enhance and promote it. The present research on *"Intra-Trade Econometric Model for OIC Member Countries: A Cross-Country Analysis"* was undertaken as part of IRTI's Annual Research Program.

Generally, the empirical work on OIC member countries has been of a descriptive nature. This study departs from the general practice and studies the intra-regional trade using the *Gravity Model*. It examines the relationship between exports of goods and services among OIC member countries and the main macroeconomic variables. The empirical findings of the econometric analysis shows that inter OIC member countries trade is positively affected by the size of their economies, the extent of IDB trade financing, their joint participation in regional integration schemes, and negatively affected by transportation and communication costs as proxy for the distance factor which constitutes a significant barrier to trade between the OIC member countries.

The study has drawn some important conclusions that will be useful for trade policymakers as well as those scholars who are working in this area.

It is hoped that the publication of this research monograph would encourage and lead to similar efforts so that future developments in this area of trade among OIC member countries will induce more empirical investigation and discussion.

MABID ALI AL-JARHI
Director, IRTI

I
INTRODUCTION

1.1 Statement of the Problem

The promotion of trade among OIC member countries has long been considered as the basis for cooperation and economic integration. However, it has been noticed in practice that intra-trade between OIC member countries has been around 10 percent for almost the last decade. This low intra–trade ratio between the Muslim countries indicates clearly the low level of integration and unity whereas Allah ordered Muslims to be united in ordering them in Sourate Al Imran, verse 103 saying to them:

"And Hold fast, all together, by the Rope which Allah (stretches out for you), and be not divided among yourselves; and remember with gratitude Allah's favor on you; For Ye were enemies and He joined your hearts in love, so that by His Grace, Ye became brethren; and Ye were on the brink of the Pit of Fire and He saved you from it. Thus doth Allah make His Signs clear to you; that Ye may be guided".

It is clear from this verse that if Muslim countries hold fast to the rope of Allah together, then mutual support adds to the chance of their safety and survival, making them stronger than ever. Hence, by increasing trade among themselves, they will not only benefit economically but they will be more united, responding therefore positively to the call of Allah. Furthermore, it is a religious duty for the Muslim countries to build an evolutionary process whether it is economic, political, and social or a combination of them that help converge to unity.

In its 8th Summit, the OIC member countries passed a resolution related to the *"Preparation of the Ummah for the 21st Century in the areas of economic, trade and financial cooperation among the OIC member countries"*. In pursuance of this resolution, one of the areas that IDB intends to pursue is to enhance the intra-trade among OIC member countries. How can this be enhanced, and by how much need to be investigated empirically. This research will be a step towards achieving this objective.

1.2 Objective of the Research

In its 8th Summit the resolution has fixed a target of three percent increase in the next three years passing therefore from the present level of 10 percent to a level of 13 percent by the end of year 1421H. The objective of this research is to examine the main determinants of intra-bilateral trade with reference to the characteristics of the OIC member countries that will help make this increase. The study will be able to determine the necessary amount that should be invested by IDB in enhancing trade among OIC member countries in order to reach the above fixed goal. For this, the following hypotheses will be tested.

The extent of intra- trade between any two countries will be:

1. Positively correlated with their average per capita income representing the extent of demand for differentiated products.[1]

2. Negatively correlated with the differences in their per capita income representing differences in their demand structure or in their resource endowments.[2]

3. Positively correlated with IDB trade financing representing to some extent the degree of integration between the OIC member countries.[3]

4. Positively correlated with their joint participation in a regional integration scheme.[4]

5. Positively correlated with the use of common language.

6. Positively correlated with the existence of common border.[5]

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[1] For a detailed theoretical discussion on the relationship see Chenery (1960).

[2] Several authors have discussed the theoretical relationship between the intra-trade between two countries and their differences in their per capita income. Linder (1961), p.94 argues that "Per capita income differences are a potential obstacle to trade …When per capita income differences reach a certain magnitude, trade can only take place in certain qualitatively homogeneous product."

[3] It can be argued that the more financing scheme facilities are set up by IDB to help enhance trade between its member countries the more expected increase in intra-trade will be.

[4] It is hypothesized that regional integration schemes should be positively correlated with intra-trade reflecting increased possibilities of intra-trade within regional integration. For more detail on this issue see Balassa and Bauwens (1988).

[5] Grubel and Lloyd (1975) suggested in countries sharing a common border that intra-trade may occur "in products which are function ally homogeneous but differentiated by location". Thus it may be hypothesized that the extent of intra-trade will be greater between countries that share a common border than between countries which do not have common borders.

7. Inversely related to the distance between the countries.[6]

1.3 Methodology

The gravity model has been used extensively in empirical work of international economics since the early sixties to try to explain bilateral flows among countries; Tinbergen (1962), Poyhonen (1963)and Linnemann (1966). Several other authors have recently used this model in their empirical studies, among them Bergstrand (1985, 1989, and 1990), Leamer (1988), Cyrus T. (1996), Deardorff (1995), Tamirisa (1998) and Limam and Abdalla (1998). The gravity model tries to explain the volume of trade between a pair of countries in terms of their explanatory variables.[7]

An econometric model based on the gravity model will be built for a sample of OIC member countries. The model will determine the functional relationship between the trade flow variable and the explanatory variables and will try to give a qualitative and a quantitative estimate of the impact of any of these explanatory variables on the trade flow between any pair of OIC member countries. Moreover, the model will try to predict the increase in trade between the members on the basis of a given economic policy.

The gravity model has been selected for this study mainly because of data limitation related to certain economic variables related to the OIC member countries.[8]

1.4 Significance and Relevance of the Research Study

This research is useful in at least three respects:

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[6] Balassa and Bauwen (1988) p. 84 states that "It may be hypothesized that the extent of intra-industry trade will be negatively correlated with the distance between them." This relationship has been established empirically in several studies. See for instance Havrylyshyn O. and Hassan Al-Atrash (1998).

[7] The independent variables are GNP or GDP, their per capita income, the distance between their capital cities or their main ports, the sizes of their populations, the difference between their per capita incomes , and their participation in a given economic grouping that shows their economic preferential arrangement.

[8] The gravity model is used for cross sectional data and in an aggregate form whereas time series models need long time series data. Moreover, other studies using the gravity models have used cross section analysis as quoted in the text.

1. From the country point of view, each country will benefit from this study in formalizing and improving its medium term trade strategy with the other member countries.

    2. From the IDB point of view, IDB will try to develop a financing scheme to help the IDB member countries to increase their intra-trade in the light of the findings.

3. A common trade strategy for the OIC member countries might be developed in the light of the recommendations derived from this study in the context of the process of globalization.

1.5 Sources of Data

The following data sources will be used:

1. UNCTAD and the United Nations COMTRADE Database.
2 . Handbook of International Trade and Development Statistics.
3. Trade Analysis and Reporting System (TARS).
4 .IDB Trade Finance and Promotion Department Publications.
5. International Financial Statistics and IMF Direction of Trade Statistics.

1.6   Target Group

1.   Policymakers in member countries.
2.   Trade Policy Department in IDB.
3.   Business and trade associations, Islamic banks and financial institutions.

Most of the empirical work on OIC member countries has been of a descriptive nature. This paper applies the gravity model to a sample of OIC member countries with two basic objectives. First, we will examine the main determinants of intra-bilateral trade with reference to the characteristics of these countries. Secondly, we will look more closely at the IDB trade financing role among its members. To our knowledge, only few rigorous analytical investigations based on the use of the gravity model have been undertaken for OIC member countries.[9]

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[9] Among the studies that have estimated the gravity model for OIC member countries are Ashfaque H.Khan and Zafar Mahmoud (1996) .and Limam and Abdalla (1998) .The first study has estimated the gravity model for Pakistan and the second study has estimated the gravity model for Arab Countries.

The remainder of the paper is organized as follows: Section 2 presents a brief account of the theoretical foundations of the gravity model as discussed in the literature. Section 3 formulates and estimates a model for the OIC member countries' bilateral trade. In addition, it presents the possible interpretation of the empirical findings. Finally, Section 4 draws conclusions from the results obtained in this study and suggests some policy recommendations.

THEORETICAL FOUNDATIONS
OF THE TRADE MODEL

The gravity model has been used extensively in empirical studies of international trade. It has been probably the most successful empirical device over the last three decades.[10]

This model based on ad hoc but intuitive theorizing has first been developed by Tinbergen (1962) and Poyhonen (1963), independently in a series of econometric models of bilateral trade flows. The model explains the bilateral trade between two countries in terms of their gross national product (GNP) or gross domestic product (GDP), and the distance between them taken sometimes to be the distance between their respective capitals sometimes between their largest ports. The model proposed is as follows:

$$X_{ij} = \alpha_0 \alpha_i \alpha_j \frac{(Y_i)^a (Y_j)^b}{(1 + eD_{ij})^c} \qquad (1)$$

Where X_{ij} are exports from country i to country j, Y_i and Y_j their respective GDP's or GNP's and D_{ij} the distance between their capitals and the lower case letters are all constants to be estimated. This simple model is called gravity model.[11]

The model was then elaborated by Linnemann (1966) where he added the population variable to the equation reflecting the role of scale economies. He showed in his study how the gravity equation can be derived theoretically from a quasi Walrasian general equilibrium model. Applied to a wide variety of goods and factors moving over regional and national borders under different economic environments, it usually gave a good fit. Linnemann (1966) used this model and his equation fitted to the trade of 80 countries; explaining about 80 percent of the variance in the data. Aitken (1973) estimated a gravity model

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[10] See James E. Anderson (1979) and Natalia Tamirisa (1998) for more discussion on the subject.

[11] This model given by equation (1) is called gravity model because of the similarity between this equation and the law of gravity in Physics. Even though, there exists a large resemblance between the two, the explanation of the model based on Physics has little interest to economists.

that included dummy variables for common membership in a free trade area and thus was able to estimate the trade creation and trade diversion effects of the European Economic Community (EEC) and the European Free Trade Association (EFTA). Leamer (1974) extended the gravity model to include tariff variable as well as distance among the trade resistance variables. He used the framework of the gravity model to test the importance of factor endowments and other country characteristics as they affect international trade. Natalia Tamirisa (1998) estimated a gravity model by adding exchange and capital control as barrier variables to trade and found that capital controls represent a significant barrier to trade for the full sample comprising forty industrial, developing and transition countries.

Many authors have tried to give a theoretical interpretation to the gravity equation. Leamer and Stern[12] offered three different explanations to the gravity equation. The first interpretation came from Physics because of its resemblance to the gravity equation, but this had little interest to economists. The second interpretation identifies the equation as a reduced form with exogenous demand side variables and supply side variables.[13] The importer and exporter characteristics identify the size of the foreign sector in each country, with any flow a function of size at either end. The third theoretical explanation is based on a probabilistic approach where they consider the country's total imports as an unidentified reduced form function of income, population, and possibly some other unobservable variables. Taking the ratio of the ith country's import over the world trade $(M_i /\Sigma M_j)$ a random variable with a given probability distribution, they showed that the probability of the occurrence of flow between country i and country j was equal to the product of the ratios of the ith country's total import over the world trade by the ratio of the jth country's total import over the world total $(M_i /M \times M_j /M = M_iM_j/ M^2)$. The expected size of the flow given the world trade M is shown to be equal to M_iM_j/M. The resistance variable to trade is proxied by the distance variable. By taking the log form for all functions the authors were able to establish the gravity equation for the trade model. This interpretation had the advantage of explaining the multiplicative functional form. A more comprehensive version of the gravity equation was extended later by Lamer which includes among the explanatory variables the countries' tariffs.[14]

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[12] Leamer Edward E. and Robert M.Stern: Quantitative International Economics, Boston 1970.

[13] Among the demand side variables we have the importer income and population. On the other hand, the supply side variables are exporter income and its population among others.

[14] For more discussion see Leamer (1974).

Anderson (1979) has provided an alternative theoretical explanation for the gravity equation applied to commodities. The gravity equation advanced by the author used the properties of expenditure system with a maintained hypothesis of identical homothetic preferences across-regions. The gravity model constrains the pure expenditure system by specifying that the share of national expenditure accounted for by spending on openness to trade is a stable unidentified reduced form function of income and population. Whereas, the share of total tradable goods expenditure accounted for by each tradable good category across- regions is an identified (through preferences) function of transit cost variables.

More specifically, he considered many commodity classes of goods traded between country i and j with a full set of national tariffs in each country, and with transport costs proxied by distance. Preferences for traded goods are taken to be identical across-countries and are homothetic, with the traded goods share being a function of income and population.

The landed value at country j of commodity class k goods produced in country i is equal to the expression $M_{ijk}c_{ijk}$ where M_{ijk} is the foreign port value and c_{ijk} is the transit cost factor (including all border adjustments and transport costs). With identical homothetic preferences for traded goods; the traded goods expenditure shares are identical functions of the form $\theta_{ik}(c_j)$ where c_j is the vector of the transit cost factor c_{ijk}'s for country j. Letting ϕ_j be the share of expenditure on all traded goods in total expenditure of country j, with $\phi_j = F($

Y_j , N_j) the demand for import (with foreign port prices of unity) becomes .

$$M_{ijk} = \frac{1}{c_{ijk}} \theta_{ik}(c_j) \phi_j Y_j \qquad (2)$$

The aggregate traded flows between i and j is thus:

$$M_{ij} = \sum_k M_{ijk} = \phi_j Y_j \sum_k \frac{1}{c_{ijk}} \theta_{ik}(c_j) \qquad (3)$$

The trade balance relation is:

$$m_i \phi_i Y_i = \sum_j M_{ij} = \sum_j \phi_j Y_j \sum_k \frac{1}{c_{ijk}} \theta_{ik}(c_j) \qquad (4)$$

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Setting all the c_{ijk} equal to unity and dividing both sides of equation (4) above by $\sum_j \phi_j Y_j$ we obtain the aggregate share parameter for country i goods on the right $\sum_k \theta_{ik}$. Substituting the left-hand side into equation (3) he obtained the following gravity equation.

$$M_{ij} = \frac{m_i \phi_i Y_i \phi_j Y_j}{\sum_j \phi_j Y_j} \qquad (5)$$

Where m_i represents the capital account scale factor, the other variables have already been defined in the text. In case the $c_{ijk\ are}$ different from unity, the gravity equation takes the form.[15]

The theoretical explanation for the gravity equation given by Anderson had several advantages. It gave an explanation of the multiplicative form. It permits an interpretation of distance in the equation, identifying the estimated coefficient. It also gave a straightforward interpretation to the underlying assumptions of identical structure across-regions or countries as identical expenditure functions. The gravity model can then be used for the countries

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[15]Using Cobb Douglas preferences, and starting with the following demand equation and trade balance equations.

$$M_{ij} = (\sum_k \theta_{ik}) \phi_j Y_j \frac{1}{f(d_{ij})} U_{ij} \qquad (6)$$

$$m_i \phi_i Y_i = (\sum_k \theta_{ik}) \sum_j \phi_j Y_j \frac{1}{f(d_{ij})} \qquad (7)$$

Equation (6) states that the foreign port value of country j's demand for all of i's goods equals country j's total expenditure on traded goods (in home price) $\phi_j Y_j$ times the common aggregate traded goods expenditure share for i's goods $\sum_k \theta_{ik}$ deflated by the transit cost factor

Equation (7) states that country i's expenditure on all traded goods at i's prices $\phi_i Y_i$ times the capital account scale factor m_i must equal the value of country i of i's exports to all countries. From the above two equations Anderson derived the following gravity equation

$$M_{ij} = \frac{m_i \phi_i Y_i \phi_j . Y_j}{\sum_j \phi_j Y_j} \frac{1}{f(d_{ij})} \left[\sum_j \frac{\phi_j Y_j}{\sum_j \phi_j Y_j} \frac{1}{f(d_{ij})} \right]^{-1} U_{ij} \qquad (8)$$

Where M_{ij} represents the aggregate trade flows between country i and country j; ϕ_i represents the share of expenditure on all traded goods in total expenditure of country j , Y_i represents the gross national product of country i ; d_{ij} the distance between the two countries and m_i indicates the capital account scale factor. The function $f(d_{ij})$ represents the transit costs of all sorts which are taken to be an increasing function of distance and the same across commodities.

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where the structure of traded goods preference is very similar and where trade tax structures and transport cost structures are similar.

Several other authors have recently tried to give a theoretical derivation of the gravity equation based on the theory of trade under imperfect competition. These include the work of Bergstrand (1985,1989 and 1990), Sanso et Al (1993), Cyrus (1996), Deardorff (1995), Helpman and Krugman (1985), and Helpman (1987). These studies have shown that the gravity equation can be derived based on the theory of monopolistic competition and the theory of product differentiation, among others.

THE EMPIRICAL MODEL FOR
OIC MEMBER COUNTRIES

Based on the above theoretical discussion, the basic empirical gravity equation involves three types of explanatory variables. The first type describes the potential supply of the exporting country, the second describes the potential demand of the importing country and the third type describes the trade resistance variables.

A variant of the basic gravity equation commonly used in empirical works using these three types of variables will be used in this study.

The gravity equation takes the following general multiplicative form. [16]

$$X_{ij} = a_0 (y_i * y_j)^{a_1} (GDP_i * GDP_j)^{a_2} N_i^{a_3} N_j^{a_4} D_{ij}^{a_5} e^{a_6 Bor_{ij}} e^{a_7 IDBF^i_{94}} e^{\Sigma_k a_k Bl_k} e_{ij}$$

(6)

Where the estimated intercept will give an indication of the unmeasured trade distortions on exports.

X_{ij} denote the dollar value of country i's exports to country j, measured according to country j's import data. X_{ij} represents the dependent variable of the trade model .

GDP_i and GDP_j represent the gross domestic products of countries i and j expressed as a dollar value. They measure the scale economy effect. The larger the values of GDP_i and GDP_j the larger the value of exports X_{ij}.

N_i and N_j are the populations in country i and country j respectively. N determines market size and, assuming economies of scale, larger the N the larger the domestic market to foreign market ratio and the smaller the potential export supply of the country. GDP_i and N_I, together, determine the potential export supply of country i.[17] Consequently, N_i and N_j are hypothesized to have a negative effect on the dependent variable X_{ij}, y_i and y_j represent GDP per capita in dollars. The per capita income measures the effect of the stage of

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[16] Several authors have used a closer specification. Among them are Frankel et Al (1995), Cyrus (1996) and Limam &Abdalla (1998).

[17] For a more detailed discussion see Linneman pp. 11-14.

economic development of the country. The anticipated sign of the coefficient of this explanatory variable is anticipated to be positive reflecting the enhanced demand for differentiated products.[18]

D_{ij} measures the distance between the main commercial ports of the countries or between the most important commercial centers or the distance between the capital cities of the countries.[19] The proxy variable D_{ij} which is a composite of transport cost, transport time etc. is hypothesized to have a negative effect on the dependent export variable X_{ij}.

$IDBF^i_{94}$ represents the value in dollars of the year 94 import trade financing operations of the Islamic Development Bank (IDB) to country i. The coefficient of this variable is expected to be positive.

Bor_{ij} The Bor explanatory variable is a dummy variable for adjacent or neighboring countries. It takes the value of zero if country j is not a neighboring country or adjacent to country i and the value of one otherwise. Neighboring countries are expected to be stimulated to trade because of similarity in tastes and awareness of common interests.[20] The sign of the coefficient is therefore expected to be positive. However, the coefficient might be negative in case the neighboring countries are facing political difficulties.

BL_k represents a dummy variable for trade between partners of the same economic block. The variable BL_k takes the value of one if country i belongs to the economic block member k and zero otherwise. The following economic blocks will be considered in this study: the Arab Maghreb Union (AMU), the GCC countries, the Arab Free Trade Area (AFTA), and the Asian block. The coefficients of these dummy variables could be either positive or negative, ε_{ij} is a log normally distributed error term.

Taking the logarithm of both sides of equation (6) we get the following equation that will be estimated using data on OIC member countries:

$$\ln X_{ij} = \ln a_0 + a_1 \ln(y_i * y_j) + a_2 \ln(GDP_i * GDP_j) + a_3 \ln N_i + a_4 \ln N_j + a_5 \ln D_{ij} +$$

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[18] Several authors in their empirical investigations see Balassa and Bauwen (1988), Stone and Lee (1995), and Havrylyshyn and Peter Kunzel (1997) have used this explanatory variable.

[19] See Fitzpatrick and Modlin 1986.

[20] For more discussion see Balassa (1963).

$$a_6 Bor_{ij} + a_7 IDBF\,^i{}_{94} + \sum_8^{11} a_k BL_k + \varepsilon_{ij} \tag{7}$$

Where ε_{ij} represents the log of the error term in equation. (6)

DATA

The estimation of the model requires cross-sectional data on bilateral exports of goods and services, gross national income or gross domestic product, gross national income per capita, population, the distance between capital cities, the IDB import trade financing operations. The model is estimated for a sample of OIC member countries selected from the fifty-two OIC member countries using a selection criteria based on the percentage of exports defined as the ratio of the export of a given country to the other member countries over the total intra-export of all OIC member countries. The data used in this study refers to 1994 unless specified otherwise.

Our dependent variable is exports of goods and services among the nineteen OIC member countries of the selected sample. Data for this variable is computed from the IMF Direction of Trade Statistics Yearbook 1996.

Our independent variables comprise GDP, population, distance between capitals of the different countries, the IDB trade financing among the OIC member countries, the per capita GDP, dummies of membership taking the value of unity if country i and country j adhere to the same economic group and zero otherwise and dummy variable taking the value of unity if country i and country j share a common border or are adjacent to each other and zero otherwise.

Data on exports of goods and services are from the IMF's *Direction of Trade Statistics Yearbook.* Population data are for 1996 or the latest available year as published in the *IMF's International Financial Statistics*. The geographic distance is measured as the direct line distance between the capital cities of countries.[21]

The study analyses a cross-section of a sample drawn from the set of the fifty-two OIC member countries that represent various geographical regions and levels of economic development. The sample includes: Bahrain, Cameroon, Egypt, Indonesia, Iran, Jordan, Kuwait, Lebanon, Libya, Malaysia, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, and the

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[21] Fitzpatrick, G., and M. Modlin, (1986), Direct Line distances: International Edition (Methuchen, New Jersey and London: The Scarecrow Press).

United Arab Emirates. The countries of the sample have been selected on the basis of importance of their volumes of export to the OIC member countries. The 1994 total exports of these nineteen member countries of OIC represent 91.46 percent of the total mentioned exports of all the fifty-two OIC member countries. In other words, the thirty-three other OIC member countries' trade contributes less than 9 percent and is therefore omitted from the analysis. Table 1 below gives the ranking of the selected OIC member countries in terms of their volume of trade in millions of dollars and their percentage of trade. The total number of observations based on the sample corresponds to the number of trade flows between the OIC member countries of the sample. The 1994 total volume of the inter OIC member countries export is equal to 31689 million US Dollars.[22]

Table No. 1
Ranking of OIC Member Countries per Volume and Percentage of Exports to OIC Member Countries (Year 1994)

No	Name of The Country	In Million $	Percentage
1.	Saudi Arabia	6211	19.6
2.	Malaysia	3454	10.9
3.	UAE	3292	10.38
4.	Turkey	3188	10.0
5.	Indonesia	2680	8.5
6.	Iran	2093	6.6
7.	Kuwait	1454	4.6
8.	Pakistan	1133	3.6
9.	Egypt	826	2.6
10.	Syria	800	2.52
11.	Libya	676	2.13
12.	Bahrain	618	1.95
13.	Morocco	494.5	1.56
14.	Tunisia	460	1.45
15.	Lebanon	447	1.4
16.	Oman	444.9	1.4
17.	Jordan	425	1.34
18.	Cameroon	402	1.27
19.	Qatar	338	1.06
Total			91.46

Source: Computed from the Rapport Annuel 1996-1997: Organization de la Conference Islamique .

Centre Islamique Pour Le Developpement du Commerce, Le Commerce Inter Islamique.

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[22] Computed from the same source as in Table No 1.

APPLICATION OF THE MODEL
TO OIC MEMBER COUNTRIES:
EMPIRICAL RESULTS

5.1 Regression Results

In this section we will present the statistical results that have been obtained. There are four tables. Table 2 gives the summary statistics about the means, standard deviations, and the count for all explanatory variables that are statistically significant in addition to the dependent variable. Table 3 presents the correlation matrix between the independent variables. The entries of the correlation matrix represent the correlation coefficients between the explanatory variables. Table 4 presents the ANOVA table. In Table 4 the F-statistic which gives an indication on the overall statistical significance of the regression as a whole, the adjusted R-square which indicates the overall explanatory power, the degree of freedom, the regression sum squares (SSE), the residual sum of squares, and the total sum of squares are presented. Tables 2, 3 and 4 are given in Appendix B. Table 5 below presents the estimations result of the revised and final model. In this table the estimated coefficients of the independent variables, their standard errors, the t-statistics and the level of significance are given.

Box1 presents the regression results for the two models. Model 1 starts with seven explanatory variables which are the distance D_{ij} between capitals of country i and country j, the year 94 IDB financing trade variable $IDBF^i_{94}$, the product of the GDP's of country i and country j (GDP_i*GDP_j); the product of their per capita GDP's (Y_i*Y_j) and the dummy variables, GCC, Asian and AMU (Arab Maghreb Union). These dummy variables should be positively correlated with intra-trade reflecting increased possibilities of intra-trade within these economic blocks.

Model 2 is a reduced model of Model 1 from which the dummy variable AMU has been dropped. Several other forms have been tested before arriving to the first model[23] from which some explanatory variables have been deleted from the analysis.[24]

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[23] The log linear form has been tested and it has been found that some of the explanatory variables were statistically insignificant. Moreover, the form with the log of the product of

Table 5
Estimation Results

Independent Variable	Coefficient	t-Values	Significance
Constant	-5.211	-2.769	0.006
LnD_{ij}	-0.802	-7.924	0.000
$IDBF^i_{94}$	5.713E-03	1.711	0.088
Asian	0.747	3.361	0.001
$Ln(Y_i * Y_j)$	0.119	1.82	0.07
GCC	0.415	1.738	0.083
$Ln (GDP_i * GDP_j)$	0.595	8.762	0.000
Adjusted R-Square	0.38		
#of observations	260		

1. The White procedure was used to correct the problem of heteroskedasticity.[25]

2. The problem of autocorrelation does not arise in the study of cross-section analysis.

5.2 Interpretation of the Results

Looking at the estimation results of the revised model as summarized in table 4 and table 5 the value of the adjusted R-square is 0.394 which means that almost 40 percent of the total variation in the exports variable can be

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the explanatory variables has given better results than the sum of the log of these explanatory variables.

[24] Before model one other variants of this model have been examined in which other explanatory variables have been used. Among the variables that were tested are, Bor_{ij} ,N_j which represent respectively the per capita GDP inequality between the two countries i and j ,the dummy variable used for adjacency or neighborhood and the population variable. These explanatory variables have been dropped from the model because they were statistically insignificant (with very low t-statistics and at the same time large standard deviations).

[25] Potential problems that may arise in cross sectional models are inefficient results attributable to the problem of heteroskedasticity. When checking for this problem more than one test have been used. Among them the White test that suggests the squares of the residuals (e^2_i) should be regressed on all the explanatory variables, together with their squares and cross products. Significance of any of the regressors would then suggest heteroskedastic disturbances.

attributed to a linear relationship between the explanatory variables such as the GDP's, the distance between the capitals of the different countries, the per-capita GDP, the IDB year 94 trade financing variable and the dummy variables Asian and GCC. In addition, the F-statistic which gives an indication on the statistical significance of the regression as a whole is significant at the 99 percent level indicating that the regression equation as a whole is very highly significant.

From Box1 and starting with model 1, the estimated equation comprises seven explanatory variables. Whenever significant, the estimated coefficients have the expected signs: the IDB trade financing, per capita GDP, gross domestic product, Asian and GCC affect positively and distance negatively. The coefficient estimate of the AMU explanatory variable is found to be negative implying that the adherence to the Maghreb union block has a negative impact on the export variable. This may be attributed to the fact that neighboring countries in the Maghreb region have the same factor endowments and hence the same structure of trade. The R^2 of 40.9 percent which represents the overall explanatory power may appear a little low but is in fact quite respectable for cross- sectional data.[26]

The F-statistic for overall fit is well above the one percent confidence level. The t-statistics as shown between parentheses in the first equation indicate that most of the explanatory variables are significant at less than ten percent level except the dummy variable GCC which is significant at the 13 percent level and the AMU dummy variable that shows a very low t-statistic implying may be that this variable is unimportant in the determination of the export variable.

The revised model which excludes the dummy variable AMU is even more robust. The AMU explanatory variable has been dropped because of its insignificance (very low t-statistics) and the possibility of collinearity problem arising from the large values indicated by the collinearity diagnostics.[27] The insignificance of this dummy

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[26]The adjusted R square value of 0.394 is acceptable especially for cross-sectional data. In comparison with previous studies Balassa and Bauwens (1987) and Lee and Lee (1993) find R-square values of 0.57 and 0.43 respectively. Another study by Imed Liman and Adil Abdalla (1998) finds adjusted R-square 0.42 for total commodity inter Arab trade model and 0.37 for non-oil inter Arab trade model.

[27]The problem of multicollinearity deserves a special reference. We should be aware that small t-ratios does not imply automatically the drop of an apparently insignificant variable from the estimating equation when in fact this variable is important in the determination of the dependent variable. Its true importance may be obscured by the presence of multicollinearity. In fact a high degree of

variable AMU indicates no systematic membership effect. The overall explanatory power has increased but insignificantly (from 39.2 percent to 39.4 percent) indicating that almost 40 percent of the variation in exports is explained by the regression as a whole .The estimated coefficients still have the expected signs: per capita GDP, gross domestic product, IDB trade financing, GCC and Asian dummy variables are all positively related to the export variable whereas the distance variable affects the dependent variable negatively. The t-statistics as shown in Table 5 and as given between parentheses in equation two Box1 have improved considerably. The explanatory variables are all significant at less than ten percent level. The F-statistic for overall fit has also improved (from 24.96 to 29.17) and is well above the 1 percent confidence level. The positive coefficient on gross domestic product indicates perhaps that scale effects dominate proximity effects resulting in positive coefficient. Moreover, the high significance level of this explanatory variable implies strong effects of GDP's on the level of exports. It also indicates that rich Muslim countries trade more than poor countries and that large countries trade also more than small countries. The estimated intercept is negative, implying that unmeasured trade distortions tend to reduce exports. The coefficient of the distance variable is negative and highly significant. This implies that exports and distance are inversely related because of the trade costs in particular the transportation and communication costs. The effect of the stage of development as measured by per capita income has significant positive effect on bilateral exports reflecting the enhanced demand for differentiated products. The coefficients of both dummy variables GCC and Asian are positive and statistically significant indicating that countries participating in the same preferential arrangement trade more with each other. The coefficient of IDBF[i] $_{94}$ is positive and statistically significant at less than 10 percent level as indicated in Table 5 last column indicating therefore that the Islamic Development Bank has contributed positively to the financing of bilateral exports of the OIC member countries even though the coefficient of this variable is very small.

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multicollinearity may have an adverse effect on regression results. However, this is **inevitable** .The implication is that, if regression equations have low estimated standard errors and high t-ratios, we should **not worry** about any multicollinearity that might be present. On the other hand, if R –square is high and standard errors are large then multicollinearity must be present. In general the high value of R-square indicates that the explanatory variables influence the dependent variable. The fact that neither variables are significant means that their true importance is being obscured by multicollinearity. However, we observed from the collinearity diagnostic related to our first estimated regression equation three large condition indexes (19.2 , 34.4 and 59.9) implying that we may have as many as near dependencies among the variables. The very low t-ratio of the coefficient of the AMU variable with the collinearity diagnostic encouraged us to drop this latter variable.

Box No. 1: Regressions

Model 1.

$$Ln\ X_{ij} = -5.319 - 0.792LnD_{ij} + 0.0055\ IDBF^i_{94} + 0.123Ln(Y_i*Y_j)$$

$\quad\quad\quad$ (-2.801) $\quad\quad$ (-7.63) $\quad\quad\quad$ (1.64) $\quad\quad\quad\quad$ (1.862)

$$+\ 0.595\ Ln\ (GDP_i*GDP_j) + 0.704Asean\ -0.123MAU + 0.38GCC$$

$\quad\quad$ (8.753) $\quad\quad\quad\quad\quad$ (2.918) $\quad\quad\quad$ (-0.464) $\quad\quad$ (1.514)

R-Square = 0.409 Adjusted R-Square = 0.392   F(7,253) = 24.963 [0.000]

$\quad$ RSS = 319.161   for 7 variables and 260 observations

Model 2 (Revised Model)

$$Ln\ X_{ij} = -5.211 - 0.802LnD_{ij} + 0.0057\ IDBF^i_{94} + 0.119Ln\ (Y_i*Y_j) +$$
$$0.595\ Ln\ (GDP_i*GDP_j)$$

$\quad\quad$ (-2.769) $\quad\quad$ (-7.924) $\quad\quad$ (1.711) $\quad\quad\quad$ (1.82) $\quad\quad\quad$ (8.762)

$\quad\quad\quad\quad\quad\quad$ +0.415 GCC + 0.747 Asian

$\quad\quad\quad\quad\quad$ (1.738) $\quad\quad$ (3.361)

R-Square = 0.408 Adjusted R-Square = 0.394   F(6,254) = 29.178 [0.000]

$\quad$ RSS = 318.769   for 6 variables and 260 observations

The values given between parentheses and below the coefficients represent the t-statistics

CONCLUSION AND POLICY RECOMMENDATIONS

The empirical findings indicate that the volume of intra-trade is low and that the size of economic cooperation among Muslim countries is limited at the present time. The study reveals that inter OIC member countries trade is positively affected by the size of their economies, the extent of IDB trade financing, their joint participation in regional integration schemes, particularly the Asian and the GCC blocks and negatively affected by transportation and communication costs as proxy by the distance factor which constitutes a significant barrier to trade between the OIC member countries.

Our regression results also show that, the IDB trade financing explanatory variable has the positive anticipated sign and is significant at less than one percent. These findings on the significance and positive effect of the extent of IDB trade financing on the inter OIC member countries trade offer the opportunity to initiate and develop some optimal trade financing strategy that encourages and enhances their potentials for trade at regional and sub regional levels. The policymakers of IDB may then be able to develop different scenarios that help draw concrete trade strategies that increase trade between the OIC member countries.[28] The long standing goals of promoting such an intra-trade may be concretized if appropriate accompanying measures are followed.

Equation (20) (as given in footnote 29) may be used by trade policymakers to formulate trade strategies to increase trade between OIC member countries through an increase in the explanatory variables that are positively correlated to the exports variable and by decreasing those that are negatively correlated. For instance, the distance proxy variable may be decreased through an improvement of the communication network of the country, which leads to a decrease in the

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[28] The coefficients in front of the independent variables which are in the form of the natural logarithm represent elasticities. For instance, a one percent increase in GDP leads to 0.595 percent increase in exports holding the explanatory variables constant. Furthermore, a one percent increase in per capita GDP of either countries will increase the exports between the two trading partners by 0.119 percent. In addition, a one percent decrease in the distance will increase exports between the trading partners by 0.802 percent. This last increase can be perceived as follows, assume that the distance between the two trading partners i and j is D_{ij} ,in order for country i to decrease the distance ; it suffices to look for a substitute partner from the set of the OIC member countries that is closer and has the same goods and services to be traded .

communication cost and transportation cost. It may also be decreased through the substitution effect. Countries that are trading with far countries may look for OIC member countries that are close to them and having the same goods or a substitute one to be traded.[29]

In addition, the study has shown that, the economic block membership; Asian and GCC are positively correlated with the export variable, implying that the entrance of a new closest country to one of the economic groupings may lead to a positive impact on the intra-trade as a whole.

The OIC member countries should fully participate in the Muslim countries trading regime and maximize the intra-OIC linkages through free movement of goods, capital, labor and transfer of technology. They should double efforts to diversify their exports, enhance their potentials for trade and increase financial cooperation among themselves through the central and important role that the Islamic Development Bank may play in trade finance. This kind of policy goes along with the trade globalization process imposed by the World Trade Organization (WTO).

Trade finance is not the only way to promote trade. There exist other means such as the formation of regional groupings, and liberalization of exchange systems, which may under certain economic conditions be used to enhance trade. The formation of new economic blocks encourage their members to sign trade agreements that reduce or eliminate trade barriers over a certain period of time. This eases the flow of goods and services, which will enhance intra-trade. The reduction in trade barriers will speed up the flow of capital between the members of the group as a consequence, investment increases given a boost to economic growth.

The liberalization of the exchange system under certain economic preconditions may also be another way to enhance trade.[30] Since the Bretton Woods

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[29] By totally differentiating the estimated equation of the revised model we get:

$$\Delta(\ln X_{ij}) = -0.802\Delta(LnD_{ij}) + 0.119\Delta(\text{Ln}(Y_i \bullet Y_j)) + 0.595\Delta\text{Ln}(GDP_i \bullet GDP_j)$$

$$+ 0.415 \ \Delta(GCC) \ + \ 0.747 \ \Delta(\text{Asian}) \ + 0.0057 \ \Delta(IDBF^{\,i}{}_{94}) \qquad (20)$$

From the totally differentiated estimated equation of the revised model, as shown above , a change in the dependent variable exports might result either from a simultaneous change of all explanatory variables or in some of them or in only one of them as shown by the right hand side of equation (20). The direction of change and magnitude of the export variable will depend at the same time on the signs and magnitudes of the coefficients in front of the explanatory variables .

[30] Trade finance can work only if the concerned country or countries have something to export to the rest of the world. In other words, this will happen only if there is enough production of products that are competitive in the regional or international

conference in 1944, it has been recognized the existence of the link between exchange and capital controls and international trade. One of the main purposes of the creation of the International Monetary Fund (IMF) was in fact to assist "the elimination of foreign restrictions which hamper the growth of world trade".[31] Exchange controls play the same role as a tax on the foreign currency for purchasing foreign goods and services and, by raising the domestic price of imports, they tend then, to reduce trade. Moreover, exchange and capital control may have an indirect impact on trade through transaction costs, exchange rate, hedging foreign exchange risk and trade financing. Most of the studies on the liberalization of controls on capital flows have been undertaken for industrial countries.[32]

These issues are important issues for the OIC member countries and need to be investigated from the empirical point of view. However, they are out of the scope of this study. We hope, some special attention will be given to them in future research studies.

Acknowledgements

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market. On the other hand, the process of production cannot be sustained or enhanced without enough investments. However, these investments cannot take place if the rate of saving is low.

[31] See Article I of the articles of Agreement of the International Monetary Fund (IMF).

[32] See Adam and Greenwood (1985), Greenwood and Kimbrough (1987) and Stokman and Hernadez (1988).

APPENDICES

APPENDIX A

The model as described by equation (7) can be put in the form

1 . For i =1

$$
\begin{bmatrix}
\ln X_{12} \\
\ln X_{13} \\
\ln X_{14} \\
\cdot \\
\cdot \\
\cdot \\
\cdot \\
\ln X_{1N}
\end{bmatrix}
=
\begin{bmatrix}
1 & \ln(y_1 \bullet y_2) & \ln(GDP_1 \bullet GDP_2) & \ln N_1 & \ln N_2 & \ln D_{12} & Bor_{12} & IDBF_1 & BL_1 & BL_2 & BL_3 & BL_4 \\
1 & \ln(y_1 \bullet y_3) & \ln(GDP_1 \bullet GDP_3) & \ln N_1 & \ln N_3 & \ln D_{13} & Bor_{13} & IDBF_1 & BL_1 & BL_2 & BL_3 & BL_4 \\
1 & \ln(y_1 \bullet y_4) & \ln(GDP_1 \bullet GDP_4) & \ln N_1 & \ln N_4 & \ln D_{14} & Bor_{14} & IDBF_1 & BL_1 & BL_2 & BL_3 & BL_4 \\
\cdot \\
\cdot \\
\cdot \\
\cdot \\
1 & \ln(y_1 \bullet y_N) & \ln(GDP_1 \bullet GDP_N) & \ln N_1 & \ln N_N & \ln D_{1N} & Bor_{1N} & IDBF_1 & BL_1 & BL_2 & BL_3 & BL_4
\end{bmatrix}
\begin{bmatrix}
a_0 \\
a_1 \\
a_2 \\
\cdot \\
\cdot \\
\cdot \\
a_{12}
\end{bmatrix}
$$

Where N is the number of countries. In matrix form this can be written as follows:

$$X_1 = B_1 a + \varepsilon_1$$

$$X_2 = B_2 a + \varepsilon_2$$

$$X_N = B_N a + \varepsilon_N$$

Where X_i a, and B_i, represent respectively an [(N-1)x 1]   vector of exports an (16x1) vector of coefficients to be estimated and an [(N-1) x 16) matrix of inputs. The model can be rewritten to take the form.

$$
\begin{bmatrix} X_1 \\ X_2 \\ . \\ . \\ . \\ . \\ X_N \end{bmatrix}
=
\begin{bmatrix}
B_1 & 0 & 0 & . & . & 0 \\
0 & B_2 & 0 & . & . & 0 \\
0 & 0 & B_3 & & . & 0 \\
0 & 0 & 0 & & & 0 \\
. & & & & & \\
0 & 0 & 0 & . & . & 0 \\
0 & 0 & 0 & . & . & B_N
\end{bmatrix}
\begin{bmatrix} a \\ a \\ a \\ . \\ . \\ . \\ a \end{bmatrix}
+
\begin{bmatrix} \varepsilon_{12} \\ \varepsilon_{13} \\ \varepsilon_{14} \\ . \\ . \\ \varepsilon_{14} \end{bmatrix}
+
\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ . \\ . \\ \varepsilon_N \end{bmatrix}
$$

(52x51)x1   (52x51) x (16x 52)   (16x52) x1   (52x51)x1

The whole model can be summarized in matrix form to show as:

$$X = B a + \varepsilon$$

Based on the above model, the theoretical ordinary least square estimator can be obtained by

$$a = (B'B)^{-1} B' X$$

Appendix B

Table 2
Summary Statistics

	LnX$_{ij}$	LnD$_{ij}$	IDBF^i $_{94}$	Asian	GCC	Ln(Y$_{i*}$Y$_j$)	Ln(GDP$_i$*GDP$_j$)
Mean	3.1785	7.741	12.07	0.249	0.2644	15.7277	20.7948
Standard Deviation	1.7334	0.9635	28.84	0.4333	0.4418	1.5775	1.4922
Count	261	261	261	261	261	261	261

Table 3
Correlation

	Ln(GDPi*GDP$_j$)	IDBF^i $_{94}$	Asian	GCC	LNDij	LN(Yi*Yj)
LN(GDP$_i$*GDP$_j$)	1.000	-0.385	-0.273	0.09	-0.272	0.055
IDBF^i $_{94}$	-0.385	1.000	0.14	-0.311	0.087	0.036
Asian	-0.273	0.14	1.000	0.186	- 0.15	0.27
GCC	0.09	-0.311	0.186	1.000	-0.026	-0.427
LND$_{ij}$	-0.272	0.087	-0.15	-0.026	1.000	0.272
LN(Y$_{i*}$Y$_j$)	0.055	0.036	0.027	-0.427	0.272	1.000

Table 4
Anova

	Sum Of Squares	df	Mean Square	F	Sig
Regression	318.769	6	53.128	29.178	.000
Residual	462.485	254	1.821		
Total	781.253	260			

Where the dependent variable is LnX_{ij} and the predictors are $Ln(GDP_{i*}GDP_j)$, Asian, LnD_{ij}, $Ln(Yi*Yj)$, $IDBF^i{}_{94}$ and GCC .

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