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Gravity Model: An Application to Trade between Iran and Regional Blocs

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Abstract

In this paper we revisited the recent contribution study which examines the determinants of bilateral trade between Iran and Europe Union, ECO, GCC and ASEAN countries in the period 1995-2009, using a panel data approach. The findings indicate that Iran' trade flows follow the Linder hypothesis, while the bilateral trade is associated with Heckscher-Ohlin- Samuelson theorem. Results show that geographical distance is negative and significant; trade will increase if the transportation costs decreases. We also introduce the economic dimension and income per-capita; these proxies confirm the positive effects on bilateral trade. Our results also confirm the hypothesis that foreign direct investment (FDI) is positively correlated with the trade.

Keywords: Bilateral Trade, Regional Blocs, Dynamic Panel Data, Foreign Direct Investment, Economic Dimension.

1- Introduction

Since the end of Second World War, international trade has grown faster than world production in nearly a year. In this period trade among the developed nations has increased much faster than trade in general, accounting for an increasing proportion of total trade. Balassa (1966) Grubel (1967, 1970) demonstrated the importance of simultaneous increase by all countries of their exports of most industries. The pioneering studies of the

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gravity model were realized by Tinbergen (1962) and Pöyhönen (1963). The gravity model is analogous to Newton's law of gravity, where the state gravity between two objects is directly related to each other and inversely related to distance. Since Anderson's (1979) and Deardorff (1998) who considers that the gravitational equation helps explain the pattern of international trade.

In the 1980's, Romer (1986, 1990), and Lucas (1988) studied the endogenous growth models. Endogenous growth theories identify a number of channels that growth affects, such as productivity, human capital, and openness. Most of the studies show that trade and economic growth are positively correlated.

When economic geography was born in 1990's some authors as in Krugman (1993) explained the relationship between North and South considering the mobility between the countries. This process involves trade flows, migration and foreign direct investment.

In last years, a number of gravity models have been applied to explain the bilateral trade flows (Egger 2002, Serlenga and Shin 2007, Faustino and Leitão, 2008).

The objective of this paper is to examine the pattern of Iran trade by adopting an argument gravity model. The manuscript uses a panel data approach. This study analyses the link between gravity model and Iran trade. The manuscript considers the determinants of Iran and and European Union, ECO, GCC and ASEAN countries in the period 1995-2009. This study uses country-specific characteristics (per capita income, market size, and geographical distance and factor endowments).The structure of the paper is a follows.

The next section presents the composition of trade. Section 3 we reflect about the literature review and empirical studies. Section 4 we formalized the econometrical model. Section 5 shows, the estimation results. Section 6 we present the conclusions.

2- The Composition of Trade

Table 1 gives information of the geographical structure of trade. The first row, for example, indicates that 56.8 percent of the exports of countries of Middle East went to Asia countries, 13.2 percent of North American exports went to Europe, 11.7 percent to North America, and so forth.

Table 1: Regional Structure of World Merchandise Exports, 2009 (Percentage of Each Origin Area's Exports Going to Each Destination Area)

Origin	Destination							
Value	North America	Latin America	Europe	Central and Eastern Europe	Africa	Middle East	Asia	World
North America	49.7	8.1	18.1	0.8	1.7	3.0	18.6	100
Latin America	28.3	26.4	20.2	1.5	3.8	3.0	16.8	100
Europe	7.6	1.8	72.6	3.7	2.9	2.9	8.5	100
Central and Eastern Europe	5.0	1.4	57.8	19.2	2.0	3.6	11.0	100
Africa	22.6	3.3	39.1	0.3	9.6	3.5	21.6	100
Middle East	11.7	0.7	13.2	0.7	4.6	12.3	56.8	100
Asia	17.7	2.9	18.5	2.5	2.8	4.5	51.1	100
World	17.3	3.7	42.6	3.7	4.0	3.9	24.8	100

Source**:** Word Trade Organization, Annual Report (2010/2011).

3- Literature Review and Empirical Studies

This model is analogous to Newton's Law of Gravity, which states that the gravity between two objects is directly related to their masses and inversely related to the distance them.

$$F_{ij} = G\frac{Y_i^{\alpha} Y_j^{\beta}}{D_{ij}^{\delta}}$$

Where Fij denotes the flow from country i to country j. Yi and Yj are the economic sizes of the two countries, usually measured as the gross domestic product (GDP), or per-capita GDP. Dij is the distance between countries. G is a gravitational constant.

In order to facilitate the econometric estimations, we apply logs the gravity equation (1) and hence, we obtain a linear relationship as follows:

$$LnF_{ij} = \ln G + \alpha \ln Y_i + \beta \ln Y_j - \delta \ln D_{ij}$$

$$LnF_{ij} = \ln G + \alpha \ln Y_i + \beta \ln Y_j - \delta \ln D_{ij}$$

Where lnG corresponds to the intercept, while α, β and δ are elasticity's.

According to the gravity approach, the trade between two countries is directly related to their incomes (or per-capita incomes) and inversely related to the distance between them.

Since the pioneering studies (Tinbergen (1962), Pöyhönen (1963), Anderson (1979), Pagoulatos and Sorensen (1975), Caves (1981), Toh (1982), Krugman, (1997) and Badinger and Breuss (2008)) that geographic distance has been an important determinant of trade. The distance can be analyzed in terms of geography, culture, language and adjacency (Border). Rauch (1999) and Eichengree and Irwin (1998) emphasize the importance of border and common language.

Anderson (1979) introduced the product differentiation by country of origin assumption. A few years later Bergstrand (1985), Egger (2002) and Grossman and Helpman (2005), used the income per capita to specify the supply side of economies.

Usually geographic distance measures the cost of transport. According to the literature there is an increase in trade flows if transportation cost decreases. The theoretical predictions show a negative correlation between distance and the trade. Balassa (1966), Balassa and Bauwens (1987), Stone and Lee (1995), Clark and Stanley (2003) and Badinger and Breuss (2008) found a negative sign between geographical distance and trade.

The empirical model use dummy variables to the cultural distance, language and to the border.

The similarities of the countries encourage bilateral trade. The study Frankel et al. (1998) and Papazolou et al. (2006) demonstrates the importance of these qualitative variables to analyze the regional trading agreements (RTAs).

Balassa (1966) and Balassa and Bauwens (1987) found a positive sign. The empirical studies show that gravity models utilize gravitational factors as in volume of trade, capital follows, and migration (Baltagi et al. (2003) Serlenga and Shin (2007), Skabic, and Orlic (2007),Faustino and Leitão (2008), White (2009), Leitão and Faustino (2009), Leitão and Faustino (2010) and Kabir and Salin(2010)).

4- Econometric Model

Following the literature our study applies a gravity equation with panel data. The dependent variable used is Iran bilateral trade. The data for the explanatory variables is sourced from the IMF statistics, and the source has used for the dependent variable is UNCTAD database at five-digit level of Standard International Trade Classification (SITC) in US dollars.

4-1- Explanatory Variables and Testing of Hypothesis

H_1**:** There is a positive relationship between differences in income per-capita and bilateral trade.

Economic differences between countries (DPGDP): this is difference in GDP (PPP, incurrent international dollars) between Iran and the partner country:

$$DPGDP = \left| \left(\frac{GDP}{P} \right)^{iran} - \left(\frac{GDP}{P} \right)^{partner} \right|$$

Regarding hypothesis 1, the model of Linder (1961) suggests a positive effect of income different on bilateral trade and Baltagi et al. (2003) Serlenga and Shin (2007), and Kabir and Salin (2010) found a positive relationship between income differences.

H_2**:** The larger economic dimension (average of GDP) increases bilateral trade.

Hypothesis 2 is supported in Egger (2002) and Grossman and Helpman (2005), i.e economies of scales, and product differentiation**.**

$$MGDP = 1/2\left(GDP^{Iran} + GDP^{Partner}\right)$$

H_3**:** The foreign direct investment influences the volume of trade

FDI (Foreign Direct Investment inflows): the relationship between trade and the level of FDI presents a positive correlation. Skabic, and Orlic (2007), and Leitão and Faustino (2010) found a positive sign.

H_4**:** Trade increases when partners are geographically close.

Hypothesis 4 is supported in Papazolou et al (2006), Badinger and Breuss (2008) and Kabir and Salim (2010). They found a negative relationship

between distance and bilateral trade. The geographic distance between Iran and each partner in Km (DIS) is the variable used.

4-2- Model Specification

$$TRADE_{it} = \beta_0 + \beta_1 X_{it} + \delta_t + \eta_i + \varepsilon_{it}$$

Where $TRADE_{it}$ is bilateral trade (exports plus imports), X_{it} is a set of explanatory variables. All variables are in the logarithm form; η_i is the unobserved time-invariant specific effects; δ_t captures a common deterministic trend; it e is a random disturbance assumed to be normal, and identical distributed (IID) with $E(\varepsilon_{it}) = 0, Var(\varepsilon_{it}) = \delta^2 \succ 0$.

5- Estimation Results

The Random effects are reported in table (2). The economic differences between countries (Log $DPGDP$) are statistically significant, with an expected positive sign. These results are according to previous studies (North-South models).

As expected, the variable Log $MGDP$, (average of GDP between Iran and the partner considered) has significant and positive effect on trade.

Foreign direct investments (LogFDI), the dominant paradigm predicts a positive sign. The result confirms a positive effect when we used a Random effects estimator.

The geographical distance has been used as a typical gravity model variable. The coefficient of LogDIS (Distance) is negative as expected. This result confirms the gravitational model and the importance of the neighborhood.

Table 2: Bilateral Trade between Iran and Regional Blocs: Random Effects Estimator

Variables	***EU***		***ECO***		***GCC***		***ASEAN***		***All blocks***	
	Coefficient	*t-Statistics*	*Coefficient*	*t-Statistics*	*Coefficient*	*t-Statistics*	*Coefficient*	*t-Statistics*	*Coefficient*	*t-Statistics*
C	**-60**	**-36 (0.00)**	**-6.3**	**-0.7 (0.4)**	**-3.8**	**-0.51 (0.6)**	**-57**	**-5.9 (0.00)**	**-48**	**-38 (0.00)**
LogMGDP	**0.8**	**43 (0.00)**	**0.2**	**9.9 (0.00)**	**0.1**	**3.6 (0.00)**	**0.3**	**6.4 (0.00)**	**0.61**	**47 (0.00)**
LogDPGDP	**0.25**	**10 (0.00)**	**0.1**	**6.2 (0.00)**	**0.06**	**3.8 (0.00)**	**0.1**	**8.9(0.00)**	**0.04**	**5.6 (0.00)**
LogFDI	**0.18**	**4.6 (0.00)**	**0.11**	**2.2 (0.03)**	**0.11**	**2.2 (0.002)**	**0.09**	**1.15 (0.25)**	**0.08**	**3.4 (0.00)**
LogDIS	**-1.2**	**-11.4 (0.00)**	**-3.6**	**-5.6(0.00)**	**-0.03**	**-0.09 (0.9)**	**-2.2**	**-1.1 (0.2)**	**-0.8**	**-13 (0.00)**
	R^2 = 0.83 F =489 (0.00)		**R^2 =0.8 F = 70 (0.00)**		**R^2 = 0.49 F = 20 (0.00)**		**R^2 = 0.61 F = 46 (0.00)**		**R^2 =0.98 F = 6592 (0.00)**	

Simulation

The simulation results of bilateral trade between Iran and regional blocs bring about more precise results considering the ability to forecast turning points in dependent variable. The Diagram (1) represents the results of simulation for the case of bilateral trade between Iran and regional blocs.

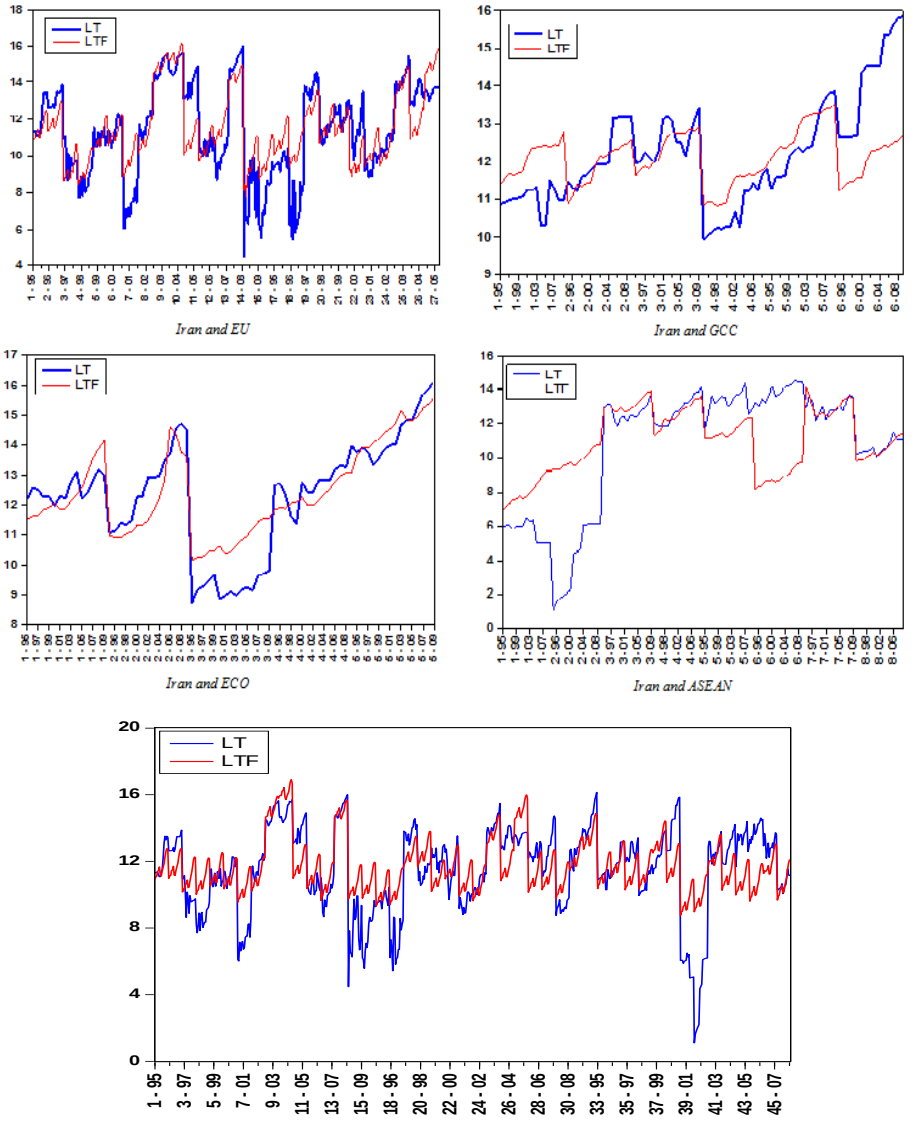

Diagram 1: Simulation of Bilateral Trade between Iran and Regional Blocs

The simulation of bilateral trade between Iran and EU, ECO and all blocks shows a detailed analysis of the ability of model to forecast turning points.

6- Conclusions

The objective of this study was to analyze the country-specific determinants of Iran trade, using a gravity model. The hypothesis put forward in regard to common country characteristics are generally confirmed by the empirical results. Our results is robust with panel data.

The variable (Log $DPGDP$) used to evaluate the economic differences between countries presents a positive impact on trade, when we used random effects estimator. These results are according to the literature (Baltagi et al. (2003), Serlenga and Shin (2007) and Kabir and Salim (2010)).

Following previous studies (Egger (2002) and Grossman and Helpman (2005)), the study also includes one proxy to evaluate the economic dimension (Log $MGDP$). The average of GDP larger economic in logs (Log $MGDP$) has an expected positive sign for Random effects estimator.

The variable foreign direct investment (FDI) is according to the literature, i.e, there is a positive relationship between FDI and trade. Skabic and Orlic (2007), and Leitão and Faustino (2010) found a positive sign. The results show that FDI and trade are complementary.

According to the gravity model we expected a negative sign to geographical distance. The findings support the hypothesis: trade increases when partners are geographically close. Papazolou et al. (2006), Badinger and Breuss (2008) and Kabir and Salim (2010) found a negative relationship between distance and bilateral trade

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