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Does the Gravity Model Fit Jordan's Trade Pattern?

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ABSTRACT

This paper aims at estimating Jordan's trade pattern using an augmented gravity model. This model will seek to analyze the relative importance of variables that drive trade flows in and out Jordan. Applying OLS to cross-section data for the period 2000-2005, the results show a consistency in Jordan's trade pattern over the period years, in addition to absence of any major change in the significance of variables that affect flows of trade.

Contrary to the findings of previous studies, the distance factor was insignificant in affecting the trade volume of Jordan. This may suggest that with the worldwide developments in the shipments sector that reduced both the cost and needed time of shipping, distance becomes no longer a barrier to trade. On the other hand, the common language factor is still maintaining the highest contribution to trade volume.

Keywords: Gravity Model, Jordan, International Trade.

1. INTRODUCTION

From an economic perspective, many factors affect the volume of exports and imports of a country such as the levels of income of trading partners, and the geographic distance between them. Other factors may include the easiness of communications among the merchants of both countries, the existence of trade arrangements among trading countries such as free trade agreements or a tariff union. Accordingly, it is imperative to study such factors in a way that helps explaining the trade pattern of a country. One way to achieve that goal of this study is to utilize the gravity model approach. Gravity model is different from other models in a way it uses cross-section data, while most other models use time series data, therefore, it is expected from that model to display another perspective for those factors that might affect international trade.

Gravity models were first applied to international trade by Tinbergen (1962) and Pöyhönen (1963), who proposed that the volume of trade could be estimated as an increasing function of the national incomes of the trading partners, and a decreasing function of the distance between them. According to the gravity model, the flow of international trade between a pair of countries is proportional to their economic "mass" (real income) and inversely proportional to the distance between them, hence the gravity equation acquired its name from the force of gravity in physics.

The gravity model as an empirical tool has achieved a remarkable success in explaining trade flows among countries. The results of previous studies show that the elasticities of trade with respect to both income and distance were consistently signed correctly, and statistically significant in an equation that explains a reasonable proportion of the cross-country variation in trade (Rose, 2000).

International trade plays vital role in most countries around the world through enhancing production process, consumption, national income, and capital formation. The importance of this study arises because international trade sector is one of the most important sectors for the Jordanian economy. This sector faces many challenges especially after Jordan has increased the level of openness to trade. This step increased the level of foreign competition and resulted in increasing the size of trade deficit.

Over years, Jordan is becoming more and more open economy, especially with respect to trade. The accelerating growth of the trade sector may be attributed to several factors, of which trade reforms is at the top list. This paper aims at analyzing the major factors that influence the performance of the international trade sector in Jordan. This will be done through theoretical and

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empirical gravity models that may account for the bulk of factors affecting Jordan's international trade.

This paper proceeds as follows: the development of the external sector in Jordan is presented in section (2), while section (3) provides a brief background about the theory of the gravity model. Section (4) presents a short literature review of gravity model. Section (5) presents the data, and section (6) presents the theory behind the gravity model. The results of the empirical model are presented in section (7), while section (8) gives the conclusion.

2. THE EXTERNAL SECTOR IN JORDAN

The size of Jordan trade has been growing steadily over years (see Table 1). Jordan signed a number of bilateral agreements with many countries in order to promote trade ties and enhance trade liberalization. Tariff reforms, successful accession to the World Trade Organization (WTO), and the free trade agreements with the European Union and the United States were at the top of the trade reforms program.

Trade statistics reveal Jordan's success in achieving a larger extent of trade liberalization. The openness to trade, which is defined as the ratio of total trade to Gross Domestic Product (GDP) is widely used to measure trade openness in a country. Table (1) shows that total trade/ GDP ratio in Jordan reached 111% in 2005, compared with 72% in 2000, mainly on the back of higher imports.

Table 1. Jordan Domestic Exports, Imports and Total Trade as Percentages of GDP (2000-2005)*.

	2000	2001	2002	2003	2004	2005
Domestic exports / GDP	18%	21%	23%	23%	29%	29%
Imports / GDP	54%	54%	53%	57%	72%	83%
Total Trade / GDP	72%	76%	76%	80%	100%	111%

* Source: author's calculations.

The value of domestic exports grew at 19.4 percent during the period 2000-2005 to reach JD 3,625 million in 2005. The value of imports, on the other hand, rose by 18.8 percent for the same period to total JD 10,498 million in 2005. In effect, total trade increased by 19 percent to amount to JD 14,123 million in 2005, increasing from the level JD 6,122 million in 2000 (Table 2).

Table 2. Values of Jordan Domestic Exports, Imports and Total Trade (Million JD) and Rates of Growth (%) (2000-2005)*.

	2000	2001	2002	2003	2004	2005
Domestic exports	1,524	1,907	2,196	2,363	3,253	3,625
- growth rate		25%	15%	8%	38%	11%
Imports	4,597	4,871	5,076	5,743	8,179	10,498
- growth rate		6%	4%	13%	42%	28%
Total Trade	6,122	6,779	7,272	8,106	11,433	14,123
- growth rate		11%	7%	11%	41%	24%

* Source: Central Bank of Jordan.

The huge jumps in domestic exports are attributed mainly to exports of clothing, food, animal and vegetable oils and fats, and potash. Exports of clothing witnessed remarkable growth rates by 169%, 75%, 34%, 48%, and 5% for the years 2001 - 2005; respectively. These positive rates of growth helped this item to reach the level of JD 745 million in 2005 almost 29% of domestic exports (Central Bank of Jordan, 2006). It worths to mention that the qualified industrial zones (QIZ) make it easier for that sector to reach that high level. QIZ opens the door for domestic exports to reach foreign markets since domestic exports are helped to meet the required international standards.

Exports of food and live animals increased in 2005 as compared to 2004; rising by 37% to reach JD 275 million. Potash has increased by 13% and 20% in years 2004 and 2005; respectively. Other items have witnessed large increases in their values, examples of these items are: phosphates, chemicals, and machinery and transport equipment. On the imports' side, three items were the

main reasons for the huge jumps in imports magnitudes; crude oil, machinery and transport equipment, and manufactured goods. It is noted that crude oil, and machinery and transport equipment increased from JD 373 and JD 931 million in 2000 to reach the levels JD 1,213 and JD 1,869 million in 2005; respectively. Manufactured goods like textile, iron, and steel increased in 2005 as compared to 2000; rising from JD 494 million in 2000 to total JD 1,162 million in 2005 (Central Bank of Jordan, 2006).

The geographical distribution of domestic exports indicates that Jordan trades almost with all countries (Figure 1). Arab countries are the major destination of Jordan exports. The share of Arab countries in Jordan exports has grown from 40% in 2000 to 43% in 2005, mainly because of vegetables, medical and pharmacy products, and fertilizers(1).

North America has become the second major market for Jordanian products since 2003, with its share jumping from 4% in 2000 to 31% in 2005. The free trade area signed in 2000 between Jordan and USA, in addition to the establishment of the QIZ which enjoy free access to the US market were behind the surge in exports to the US. Meanwhile, exports to the other two major groups (Asian non-Arab countries and European countries) were more stable over years (Figure 1).

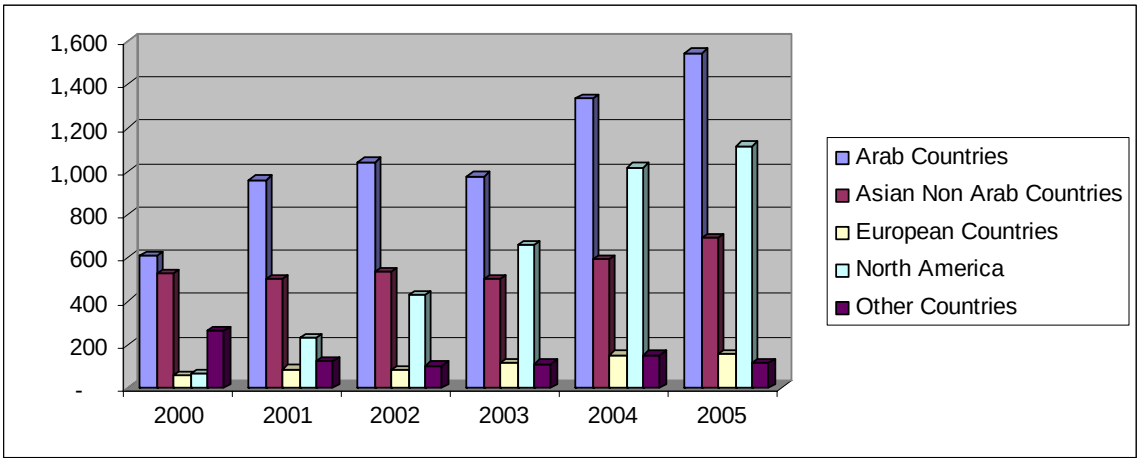

Figure 1. Geographic Distribution of Jordanian Domestic Exports (2000-2005).

With respect to the sources of imports, Arab countries have become the major source of Jordan imports since 2004 in light of the surge in oil prices. The Central Bank of Jordan data shows that the value of crude oil imports has increased by an average 27% per annum over the period 2000-2005, pushing the relative importance of imports from Arab countries from 24% in 2000 to 34% in 2005. European countries came second with a share of 30% by end 2005.

Asian non-Arab countries almost tripled their exports to Jordan in the period (2000-2005). Even though, Europe is still a main source for Jordanian imports. The level of imports from Europe almost doubled between the years 2000 and 2005 despite the significant appreciation of the euro and sterling pound against the Jordanian dinar. This reflects the weak substitutability of commodities imported from Europe which comprise mainly manufactured products, tools, and machinery and transport equipments. Meanwhile, imports from North America continue to grow steadily over the last five years (Figure 2).

Accordingly, total trade figures (domestic exports and imports) show that Arab countries are Jordan's major trading partners over the period 2000-2005, followed by Asian non-Arab countries, European countries, and North America (Figure 3).

3. THEORY OF THE GRAVITY MODEL

The theoretical foundation of the gravity model is related to Newton's law of gravitation which states that the attraction force between two bodies is proportional to their masses but inversely proportional to the squared distance between them (Sohan, 2005). In economics, the basic gravity model examines the interaction between two places in relation to size (usually presented by national income) and distance. This relationship is positively related to national income, and inversely to distance. This

model is mostly used in regional economics and transport studies.

Tinbergen (1962) proposed that the same functional form of Newton's law could be applied to international trade flows. However, since that time, this model has been applied to many fields including migration, tourism, and foreign direct investment. Following its first application, the theoretical foundations of the gravity model were subsequently developed by, among others, Anderson (1979) and Bergstrand (1989), who derived gravity models from models of monopolistic competition, and Deardorff (1998), who demonstrated that the gravity model can be derived within the Ricardian and Heckscher-Ohlin (H-O) frameworks.

The general gravity law may be expressed in the following equation:

$$F_{ij} = G \frac{M_i^{\alpha} M_j^{\beta}}{D_{ij}^{\theta}} \qquad (1)$$

where F_{ij} is the "flow" from origin i to destination j, or it could represent the sum of flows in both directions, M_i and M_j are the economic sizes of the two countries, D_{ij} is the distance between the two countries, and G is a proportional parameter.

For example, if F represents export values or total trade volumes, then M represents usually the gross domestic product (*GDP*). Meanwhile, if F represents flows of people, then M is the population.

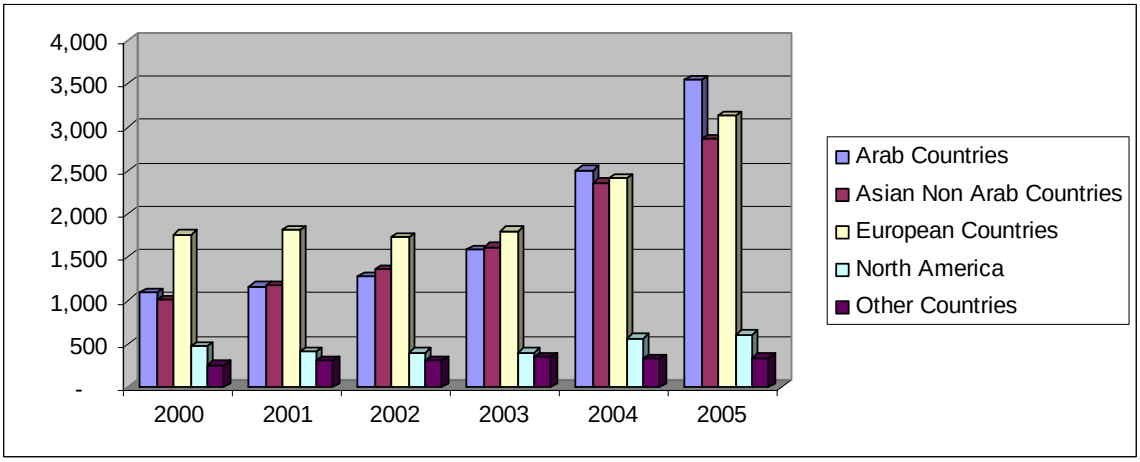

Figure 2. Geographic Distribution of Jordanian Imports (2000-2005).

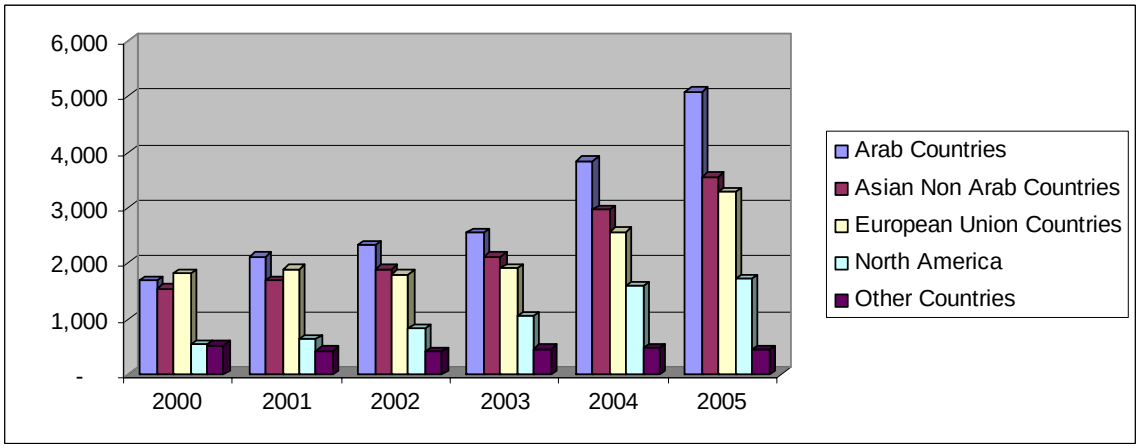

Figure 3. Geographic Distribution of Jordanian Trade (2000-2005).

4. LITERATURE REVIEW

The purpose of many studies using the gravity model as a framework lies in predicting trade potentials. Such studies focused on either regions or countries per se. In this section, the review will cover two sets of studies. The

first covers papers that analyzed Jordan and Arab countries. The other set includes papers that studied the Middle East and North Africa (MENA) countries.

First: Papers covering Jordan and Arab countries

Limam and Abdalla (1998) used a framework that utilized the gravity model to analyze trade among Arab countries. The results of that model are used to examine the prospects for increased inter-Arab trade following trade liberalization under the newly established Arab Free Trade Area (AFTA). The paper tried to establish a tentative list of commodities that represent opportunities for expanded trade as well as a list of partner countries that have higher chances of benefiting from trade liberalization under AFTA. Although the possibilities for expanded inter-Arab trade are real, the realization of these possibilities depends, among other things, on the improvement of transport links and the isolation of political effects on economic ties.

Al-Atrash and Yousef (2000) estimated a gravity model to address the issue of whether intra-Arab trade is too little. Their results suggest that intra-Arab trade and Arab trade with the rest of the world are lower than what would be predicted by the gravity equation, suggesting considerable scope for regional - as well as multilateral - integration. The results also suggest that intra Gulf Cooperation Council (GCC) is low compared with other intra-groups.

Bany Ahmad (2000) aimed to measure the most important factors that affect foreign trade of Jordan for the period (1985-1995) by using gravity model using data drawn from 40 countries that have trading relations with Jordan. The results showed that the relationship between Jordan exports and the GDPs for Jordan's trading partners is negative, that is if income increases in these countries, the Jordanian exports will be unable to meet the needs because of the small export ground in Jordan and its small size relative to rest of world countries. Also the study didn't find any impact for exchange rate on exports and imports because the monetary authorities in Jordan adopt a policy of fixed exchange rate for the Jordanian Dinar.

It's worth to mention here that our study will exclude a variable that represents Jordan's exchange rate. This step is consistent with previous findings especially the finding of Bany Ahmad (2000).

Al-Ziyood *et al.* (2004) analyzed the bilateral trade between Jordan and Arab countries during the period 1995-2003 for a sample consists of 18 Arab countries. The analysis used data based on 5-digit SITC system. Their study used the Grubel-Lloyd Index to show the pattern of trade between Jordan and Arab countries. The results showed that there was a positive relationship between Jordan's intra-trade with Arab countries and the level of per capita for those countries. In addition, a positive relationship was found regarding the size of the country (represented by the *GDP* level).

Second: Papers covering MENA countries

Kalbasi (2001) analyzed the volume and direction of Iran's trade using the gravity model. The study tried to explore whether Iran is over or under-traded with its 76 trade partners relative to the predicted trade flows of the model. In the model, population has a negative effect on intra-developing countries' trade flows, as well as the distance between developing and industrial countries. Overall, the results suggest that Iran over-traded with most industrial countries. The value of trade with countries sharing a common geographical border with Iran is relatively limited.

Some studies have analyzed the trade enhancing impact of preferential trading arrangements. These studies predict additional bilateral trade that would be a consequence of the economic integration between a set of economies. Both the cross section and panel data approaches have been used by these studies which are mainly static and refer to long run relationships. Christie (2002) estimates trade potential for Southeast Europe using ordinary least square estimation on cross section data from 1996-99. Rahman (2003) has estimated trade potential for Bangladesh using panel data approach employing a set of economic factors like openness, exchange rates instead of the natural factors.

Mehanna (2003) estimated the effects of politics and culture on Middle East trade by applying the gravity model. The econometric specification of the model accounts for oil-exporting countries, regional trade blocs and other pertinent exogenous factors. Furthermore, the model endogenously accounts for potential selection-bias between Arab and Islamic countries.

In an attempt to estimate India's global trade potential, Batra (2004) used an augmented gravity model to first analyze the world trade flows, then the estimated coefficients were used to predict trade potential for India. The estimation results show that the gravity equation fits the data and delivers precise and plausible income and distance elasticities, and estimates for other geographical, cultural and historical

characteristics. Using alternative measures of GNP have not altered either the sign or the significance of explanatory variables. The magnitude of India's trade potential is the highest with the Asia-Pacific region followed by Western Europe and North America.

Söderling (2005) analyzed export performance in MENA using a gravity model applied to panel data. He addressed two questions: (i) Are there significant unexploited export markets for the MENA region?; and (ii) Have integration efforts with the European Union (EU) since the mid-1990s yielded positive results? The results suggest that several MENA countries are substantially under exploiting the United States as a vital export market. Moreover, the overall impact of integration efforts with the EU has been moderate, yet significant in a number of individual countries.

5. DATA

Jordan trade data were obtained from the monthly bulletin of the Central Bank of Jordan, the bulletin of the Department of Statistics of Jordan, the Directions of Trade and the International Financial Statistics (IFS) published by the International Monetary Fund (IMF).

The paper covers trade figures of the major 34 trade partners of Jordan over the period 2000-2005. Jordan exports to and imports from these countries, their levels of GDP, and their sizes of population are the main variables. For consistent comparison among countries in the sample, the first three variables were converted into US dollars. Another variable that is included in the analysis is the distance between Jordan and its main trade partners. The data for that variable are obtained and available on the web site for the Macalester College (www.macalester.edu).

However, there was one limitation in the data; Iraq is Jordan main trading partner. Since the 1990s, Iraq lacks accurate data about the size of its population, income, and trade. In addition, Iraqi data does not appear in major international statistics. Therefore, the analysis in this paper will exclude Iraq.

6. THE EMPIRICAL GRAVITY MODEL

Trade theories based upon imperfect competition give adequate justification for the inclusion of the core variables - income and distance in a gravity model. However, the majority of studies that try to explain international trade behavior include additional variables to control for differences in geographic factors, historical ties and in certain cases economic factors like overall trade policy and exchange rate risk. In its basic form, the empirical gravity can be stated as:

$$T_{ij} = \alpha_1 \frac{(GDP_i GDP_j)^{\alpha 2}}{(D_{ij})^{\alpha 3}} \qquad (2)$$

where T_{ij} is the value of the bilateral trade between country i and j, GDP_i and GDP_j are the national incomes of country i and j's; respectively, D_{ij} is a measure of the bilateral distance between the two countries, and α_i (i = 1, 2, 3) are coefficients to be estimated. Rewriting equation (2) in the log form gives the linear form of the model:

$$\log (T_{ij}) = \log \alpha_1 + \alpha_2 \log (GDP_i\, GDP_j) - \alpha_3 \log (D_{ij}) + u_{ij} \qquad (3)$$

where log α_1 is constant; α_2 and α_3 are elasticities to be estimated; u_{ij} is the error term captures any other shocks that may affect bilateral trade between the two countries.

There are several reasons for the inclusion of income and distance in the empirical model. Higher income countries are tended to trade more in general. That may be due in part to the fact that high income countries have superior transportation infrastructure (roads, container ports, airports…). Furthermore, high income countries are more probably have lower tariffs which results in turn in higher trade to GDP ratio.

Figure (4) gives an idea about the ratio of trade to GDP for the richest countries in the world (the G-7 group, Switzerland and South Korea) over the period 1996-2005. The Figure shows that all countries, except US and Japan, have trade to GDP ratio exceeding 50%. The low ratio for the US and Japan, which is below 25%, can be explained by the large size of GDP in those two countries (the biggest two economies in the world) with a substantial weight for the non tradable sector. It is also worthy to mention here that despite the low trade ratio for those two countries, the US and Japan are still the world leaders in terms of the size of their participation in international trade.

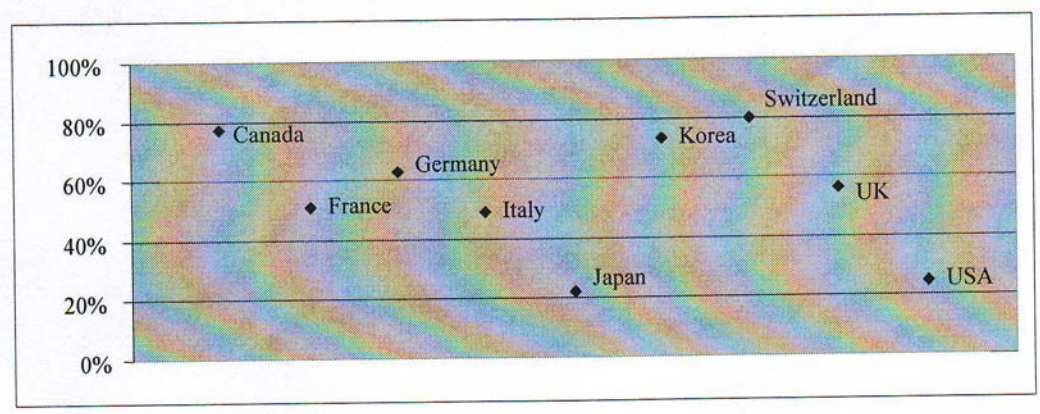

Figure 4. Trade to GDP Ratio for Selected Developed Countries (1996-2005).

With respect to distance, the literature of the gravity theory quotes the following justifications for the inclusion of distance as a key determinant for the flows of international trade among countries:

(1) Transport cost: distance is an indicator for transport cost. With longer distance, the cost of moving goods will increase. This positive relation will hold regardless of the mean of moving goods; vehicles, trains, airplanes, or ships.

(2) Synchronization costs: it is believed that large industries need large volumes and varieties of inputs. If the time of receiving these inputs will vary to the level that the production process will be affected, and leading to a synchronization cost to appear, then such cost will be positively related to distance (Batra, 2004).

(3) Marketing cost: searching for new markets to distribute and sell new products is one of the major priorities for the private sector. Marketing cost is expected to increase with searching for new markets as finding new customers becomes harder with distance. Therefore, including the distance as a variable in the international trade equation will capture this effect. Also, marketing cost comprises other costs like communication and transaction costs.

(4) Damage and loss costs: this kind of cost is more relevant to perishable goods than durable goods. Therefore, one might expect low trade volume in perishable goods flowing to long-distance locations (Vanova, *et. al*. 2005). However, Limam and Abdalla (1998) found that the distance coefficients are overwhelmingly and significantly negative, except for commodities that are not readily perishable.

(5) Distance is also used to approximate the effect of the (psychic distance) or the degree of knowledge about the partner country's market (Limam and Abdalla, 1998).

The gravity model of international trade has been historically successful in explaining international trade flows. The elasticities of trade with respect to both income and distance are signed correctly and statistically significant. These two variables explain a reasonable proportion of the cross-country variation in trade. Yet, it is to be noted that in analyzing trade between any two countries, the gravity model does not take into account certain factors that might affect the flow of trade among countries.

Augmenting the Gravity Model

The majority of recent research using gravity model to analyze trade potential regionally, globally, or among a set of countries has augmented the basic model with different set of relevant variables. Although national income and distance play the leading role in determining the trade level, some other political, cultural, and economical factors were added to the basic model in order to give a clear picture about the determinants of international trade flows among countries. Which variable to use in augmenting the gravity model is a matter of subjective, and depends on the exact purpose of the researcher. The followings are some of the variables that were used by some researchers, and the ones that are expected to be the most relevant for analyzing the Jordanian trade behavior:

Adjacency

Historically, countries that are neighbors and share common land boarders trade more with each other relative to their trade with other countries. In many studies, positive and significant relationships were

found between adjacency and trade volume, which makes the adjacency factor crucial in explaining bilateral trade between countries. A dummy variable will represent adjacency by assigning the value of 1 for countries that have common borders with Jordan and zero otherwise.

Language

Language (official or commercial) is expected to reduce transaction costs as speaking the same language helps facilitate trade negotiations. Accordingly, the coefficient of this variable is expected to be positive and significant. However, it should not be a surprise if this coefficient came statistically insignificant as there exists a common international language that can be used in trade negotiations between any two different countries. The last idea is supported by Oliva (2000) who found that language is insignificant for trade among some Arab countries. Again a dummy variable with a value of 1 will be used for countries that share a common language with Jordan, and zero otherwise.

In sum, the estimated empirical model will include total trade (*T*) as a dependent variable, *GDP*, distance (*DIST*), adjacency (*ADJ*), and language (*LANG*), as independent variables. Hence, the empirical equation to be estimated can be written as:

$$\text{Log}\,(T_{ij}) = \beta_0 + \beta_1 \log\,(GDP_i\, GDP_j) - \beta_2 \log\,(DIST_{ij}) + \beta_3 \log\,(ADJ_{ij}) + \beta_4 \log\,(LANG_{ij}) + u_{ij} \quad (4)$$

7. EMPIRICAL RESULTS

To analyze whether Jordan trade pattern has changed over time, equation 4 was estimated for the period 2000-2005, and Table (3) reports the results. It is clear that the findings are generally consistent with the posted economic theory. However, some of the estimated coefficients need careful interpretations.

The income (*GDP*) has a positive sign and significant at 1% level in all years, indicating that higher income is associated with higher volumes of trade. Meanwhile, the distance variable (*DIST*) coefficient got the correct sign (negative) in all years under investigation, even though all coefficients were insignificant. This may indicate that distance is no longer a barrier to trade. One possible explanation here is that competition forces countries far distance from Jordan to absorb part of the transportation costs by lowering their profit margins and prices to be able to compete with less distant countries that enjoy lower transportation costs. Furthermore, evidence suggests reductions in transport costs are achieved worldwide with the advancement of shipping technologies.

The variable (*ADJ*) also got the expected sign (positive) indicating that Jordan trades more with countries that share common borders with it. Yet, coefficients were insignificant for the years 2000, 2001, and 2002, whereas they were significant at 5% level for the following three years. These mixed results may be attributed to the effects of the enhanced degree of openness to trade that Jordan achieved in recent years. Jordan signed a number of major bilateral free trade agreements with many countries, including the US, EU, and Arab countries. Such agreements allowed Jordan to increase its trade in some years with countries that do not share common borders with Jordan. Again, with new shipment technologies, trade becomes less costly.

Finally, the coefficient of the variable (*LANG*) has a positive sign that was significant in all years. This indicates that language is still an important factor that facilitates Jordanian trade, and that language may play a role in reducing transaction costs.

Table 3. Gravity Model Results: Independent Variables: GDP, Distance, Adjacency and Language (2000-2005).

Variable	2000	2001	2002	2003	2004	2005
C	-24.2366	-23.8729	-23.0402	-24.5582	-28.3383	-32.4632
	(-5.5274)	(-5.9940)	(-4.8297)	(-5.3400)	(-5.1364)	(-6.0603)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$GDP_i\, GDP_j$	0.5982	0.5960	0.5740	0.5871	0.6841	0.7774
	(6.6612)	(7.3137)	(5.9675)	(6.3501)	(6.1991)	(7.2527)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$DIST_{ij}$	-0.1174	-0.1407	-0.1147	-0.0111	-0.1326	-0.2025
	(-0.8230)	(-1.0918)	(-0.7534)	(-0.0777)	(-0.7891)	(-1.2598)
	[0.4174]	[0.2842]	[0.4575]	[0.9386]	[0.4367]	[0.2181]

ADJ_{ij}	0.4344	0.4502	0.6372	1.1794	1.5412	1.4769
	(0.8354)	(0.9566)	(1.1400)	(2.2525)	(2.4973)	(2.5072)
	[0.4106]	[0.3469]	[0.2639]	[0.0323]	[0.0187]	[0.0182]
$LANG_{ij}$	0.9420	0.9937	1.0421	1.3676	1.2965	1.4565
	(2.2074)	(2.5693)	(2.2447)	(3.0906)	(2.4786)	(2.9440)
	[0.0357]	[0.0158]	[0.0329]	[0.0045]	[0.0195]	[0.0064]
R-squared	0.6364	0.6777	0.5893	0.6517	0.6484	0.7094
Adjusted R-squared	0.5844	0.6316	0.5306	0.6020	0.5982	0.6678
Akaike info criterion	1.9707	1.7685	2.1170	1.9835	2.3148	2.2199
Schwarz criterion	2.1974	1.9953	2.3438	2.2103	2.5416	2.4467
F-statistic	12.2512	14.7159	10.0433	13.1000	12.9081	17.0841
Durbin-Watson stat	1.5766	1.5724	1.7368	1.7609	2.0465	1.9334

* Numbers inside the parenthesis () are t-statistic.

* Numbers inside the parenthesis [] are probability of rejection the null hypothesis.

To check the robustness of the results, equation 4 was estimated after omitting the insignificant variable (*DIST*). The results of this regression appear in Table 4, and again they are consistent with the economic theory. The coefficient of *GDP* is positive and *GDP* has a significant effect on trade at 1% level in all years. The coefficient of the variable (*ADJ*) gave the expected sing indicating that Jordan trades more with countries that share common borders with it. Yet, coefficients were insignificant for the years 2000, 2001, and 2002, whereas they were significant at 5% level for the following three years. The coefficient of *LANG* has a positive sign and it was significant in all years at 1% significant or less.

In summary, omitting the variable (*DIST*) doesn't alter the sign or significance levels of the rest of variables in most years.

Table 4. Gravity Model Results: Independent Variables: GDP, Adjacency and Language (2000-2005).

Variable	2000	2001	2002	2003	2004	2005
C	-24.5151	-24.2051	-23.4743	-24.5973	-28.7985	-33.0410
	(-5.6390)	(-6.0751)	(-4.9943)	(-5.4754)	(-5.2837)	(-6.1292)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
GDP_i GDP_j	0.5837	0.5787	0.5632	0.5860	0.6710	0.7549
	(6.6650)	(7.2157)	(5.9659)	(6.5253)	(6.1909)	(7.0715)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ADJ_{ij}	0.5154	0.5480	0.7137	1.1868	1.6300	1.6144
	(1.0149)	(1.1821)	(1.3085)	(2.3464)	(2.7039)	(2.7610)
	[0.3185]	[0.2468]	[0.2010]	[0.0260]	[0.0113]	[0.0099]
$LANG_{ij}$	1.1004	1.1833	1.2059	1.3831	1.4827	1.7360
	(2.9051)	(3.4125)	(2.9619)	(3.5662)	(3.1974)	(3.8869)
	[0.0070]	[0.0019]	[0.0060]	[0.0013]	[0.0033]	[0.0005]
R-squared	0.6276	0.6640	0.5810	0.6517	0.6406	0.6929
Adjusted R-squared	0.5890	0.6292	0.5376	0.6156	0.6034	0.6611
Akaike info criterion	1.9340	1.7496	2.0765	1.9232	2.2762	2.2145
Schwarz criterion	2.1154	1.9310	2.2579	2.1045	2.4576	2.3959
F-statistic	16.2904	19.0974	13.40178	18.0840	17.2273	21.8083
Durbin-Watson stat.	1.5873	1.5282	1.7553	1.7578	1.9735	1.8656

Numbers inside the parenthesis () are t-statistic.

Numbers inside the parenthesis [] are probability of rejection the null hypothesis.

8. CONCLUSION

This paper attempts to explain the behavior of international trade flows between Jordan and its main trading partners. Using the gravity model approach, the findings of the theoretical analysis point that income, distance, adjacency, and language are the main determinants of Jordan trade behavior with the rest of countries.

The empirical results show that all variables were consistent with the economic theory. However, the variable that represents the effect of distance between Jordan and its partners on the volume of Jordan trade was insignificant. Running the same regression after excluding the distance variable, the results of the rest of variables were stable, indicating that distance is not a key determinant. This result was unique for the case of Jordan as it contradicts previous similar work in this field. Accordingly, future research on different countries is warrant to get more insight about the degree of uniqueness of our results.

Furthermore, and in both regression analyses (with or without distant variable), and contrary to what this paper expects, language is still making the biggest effect to trade on Jordan, followed by the level of income in the home country and the foreign country.

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هل يلائم نموذج الجاذبية نمط التجارة في الأردن؟

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ملخـص

تهدف هذه الورقة إلى تحليل نمط التجارة الخارجية في الأردن باستخدام نموذج الجاذبية (gravity model). ويسعى هذا النموذج إلى تحليل الأهمية النسبية للمتغيرات التي تؤثر في تحريك التدفقات التجارية من داخل الأردن وإلى خارج الأردن. تم تطبيق منهجية المربعات الصغرى على بيانات مقطعية للفترة 2000-2005، وقد بينت النتائج الاتساق في نمط تجارة الأردن خلال فترة الدراسة. كما أظهرت النتائج عدم وجود أي تغير رئيسي في أهمية المتغيرات التي تؤثر في تدفقات التجارة الخارجية في الأردن من سنة لأخرى.

خلافاً لنتائج الدراسات السابقة، كان متغير (المسافة) غير معنوي التأثير في حجم تجارة الأردن. وفي هذه النتيجة إشارة إلى أنه في ظل التطورات العالمية في قطاع الشحن، التي تعمل على تخفيض التكلفة والوقت اللازم للشحن، فإن متغير المسافة لم يعد عائقاً أمام حركة التجارة الخارجية. من جانب آخر، أظهرت الدراسة أن متغير (اللغة المشتركة) مازال ذا تأثير فعال في مساهمته في حجم التجارة الخارجية.

الكلمـات الدالـة: نموذج الجاذبية، الأردن، التجارة الخارجية.

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