UNDERSTANDING EGYPT'S MAIN AGRICULTURAL EXPORT FLOWS: A GRAVITY MODEL PERSPECTIVE

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ABSTRACT

The study aims to investigate Egypt's bilateral agricultural trade flows with major trading partners. Cotton lint, onions, oranges, potatoes, rice, molasses and vegetables are the paper's main exportable concern, in which they composes about 82% of Egypt's agricultural exports throughout the last decade. Panel data for the period 2003-2012 was employed via adopting Gravity model approach in explaining Egypt's bilateral trade flows. Results revealed that Egypt's agricultural bilateral export flow is likely to be escalated in proportion to GDP, openness and dummies for border while distance showed a negative relationship towards trade volume**.** Moreover, the EU is Egypt's main trade partner. More than 30% of Egypt's exports to the world are directed to EU's 27 Member States, the main export destinations for Egyptian products in the EU are Italy, Germany, Spain, France, UK and Greece.
Keywords: Agricultural Exports, Gravity Model and Egypt
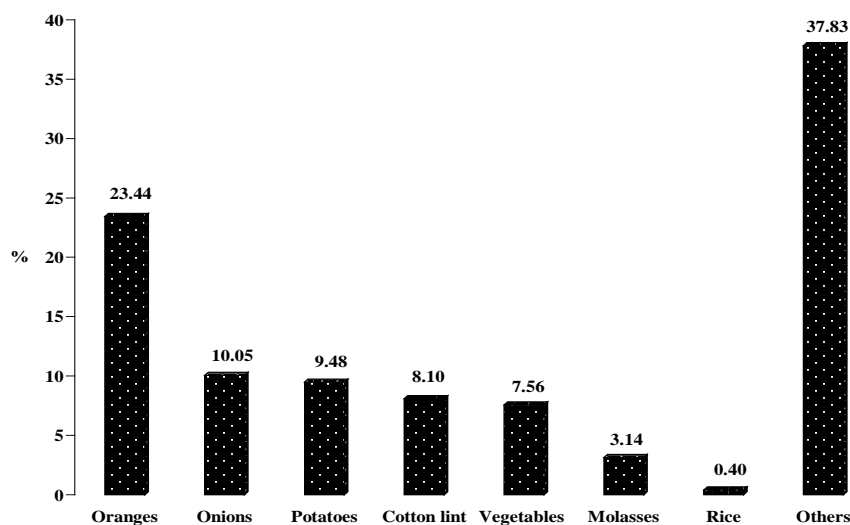
INTRODUCTION

International trade is one of the means for developing nations to achieve sustainable development and poverty reduction. Egypt as a developing country can achieve such goals by increasing its total trade volume with the rest of the world. Therefore, it is important to explore the major determinants of Egypt's bilateral trade volume to enable policy advisors to formulate policies focusing on expanding Egypt's trade volume.

In 2012, Egypt's GDP was estimated at about US$ 126 billion (constant 2005 US$) with an annual growth rate of 2.2%. Whereas, the value added of the agricultural sector accounted US$ 15.8 billion (constant 2005 US$) representing about 14.5% of GDP, employing nearly 30.8% of the labor force. Moreover, the aggregate exports and imports of goods and services reached 17.4% and 25.8% of GDP respectively. However, the agricultural exports and imports were estimated at US$1.2 billion and US$6.1 billion respectively throughout the period 2008-2012 (on average).

The study focuses on seven main agricultural export products representing about 62 % of top twenty agricultural export products during the period 2010-2012 (on average). Figure (1) represents the ranking of studied products relying on their share importance in export composition. Oranges is ranked the first, constituting 23.5% of Egypt's agricultural exports during the period 2010-2012 (on average) followed by onions (10%), potatoes (9.5%), lint cotton (10%), vegetables (7.5%), molasses (3%) and rice (0.4%).

FIGURE (1): THE RELATIVE IMPORTANCE OF MAIN AGRICULTURAL EXPORTS THROUGHOUT THE PERIOD 2010-2012
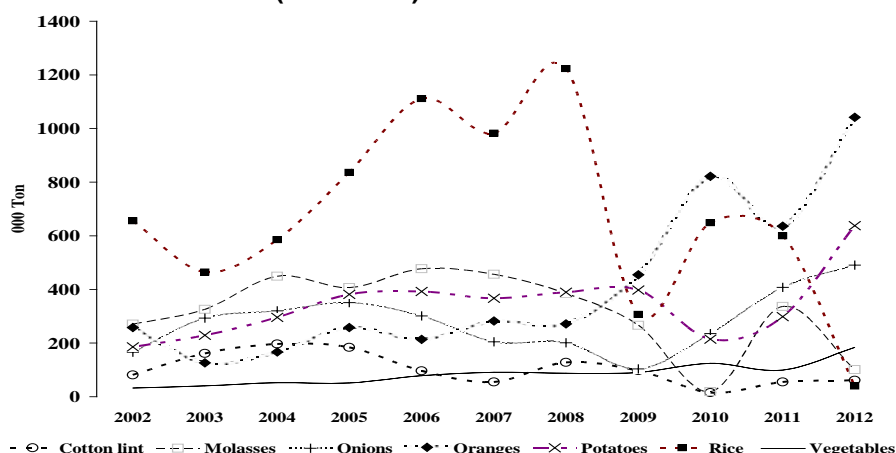

Source: FAO on line statistics

Volumes of major products exports during the period 2003-2012 are estimated as a linear function over time to identify their trend of production, as well as, to identify the annual rate of growth (increasing or decreasing) during the last decade. However, the paper assumes that agricultural export Y_t may be described by a simple *ln* linear trend model $ln(Y_t) = ln\alpha + \beta T + \mu t$ where the slope is given by β, T is a time trend and μt is a random variable of zero mean and constant variance. Consequently, we can recover the underlying growth rate trend by regressing the *ln* of agriculture export on the time trend *(T)*.

Figure (2) portrays the export pattern of the earlier mentioned exportable products during the period (2003-2012) on average, while, Table (1) shows the modelling of the regression analyses. The results depicts that all of the series appear to be trending over time. Results from the t test results (at 1% level of significant), depicts an evidence of statistical significance in both slope and intercept coefficients for oranges, vegetables, potatoes and onions with an annual growth rate of 17.8%, 14.6%, 5.8% and 2.7% respectively. Whereas, cotton lint, rice and molasses show a falling trend performance (despite their insignificance). These results were also confirmed by F test results (at 1% level of significant).

FIGURE (2): THE EXPORT PATTERN OF MAIN AGRICULTURAL EXPORTS DURING THE PERIOD (2003-2012)

- ⊖ - Cotton lint   - ☐ - Molasses   + Onions   ◆ Oranges   ✕ Potatoes   - ■ - Rice   —— Vegetables

Source: FAO on line statistics

TABLE 1: TRENDS OF MAJOR AGRICULTURAL EXPORTS IN EGYPT THROUGH THE PERIOD 2002-2012

Coefficients			SE	T ratio	P value	F (Calculated)
Oranges	α	4.74***	0.21	22.57	3.1E-09	33.06***
	β	0.17***	0.03	5.74	0.0002	(0.0002)
	R^2	0.78				
Vegetables	α	3.44***	0.10	32.72	1.1E-10	89.14***
	β	0.14***	0.01	9.44	5.7E-06	5.7E-06
	R^2	0.90				
Potatoes	α	5.44***	0.19	27.21	5.9E-10	3.82*
	β	0.05*	0.02	1.95	0.0820	(0.0820)
	R^2	0.92				
Onions	α	5.38***	0.29	18.24	2.0E-08	0.38
	β	0.02**	0.04	0.61	0.05527	(0.09527)
	R^2	0.40				
Cotton lint	α	5.22***	0.39	13.08	3.6E-07	4.93**
	β	-0.13*	0.05	-2.22	0.0533	(0.0533)
	R^2	0.35				
Rice	α	7.07***	0.57	12.38	5.8E-07	2.47
	β	-0.13	0.08	-1.57	0.1500	0.1500
	R^2	0.21				
Molasses	α	6.35***	0.57	11.03	1.5E-06	2.72
	β	-0.14	0.08	-1.65	0.1333	(0.1333)
	R^2	0.23				

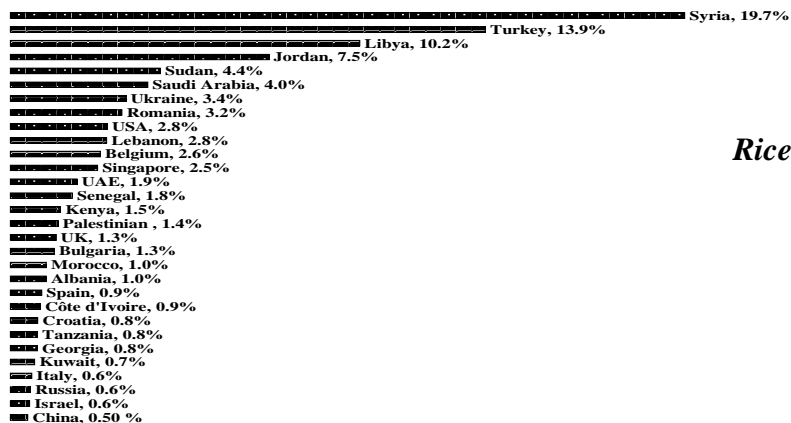*** significant at 10%, ** significant at 5%, *** significant at 1%**
Source: author calculation

Figure (3) portrays a detailed picture for exporting destinations and shares of the earlier mentioned agri-products among main importers. It reveals that, Egypt's main seven agricultural products are exported among 131 countries, the European Union (EU) and the Arab countries are Egypt's largest trading partners accounting for about 37% and 34% respectively

(2002-2012 on average). Of the EU countries, Germany, Italy, the Netherlands and France are the most important importing partners, whereas, for the Arab countries, Kingdom of Saudi Arabia, United Arab Emirates and Oman
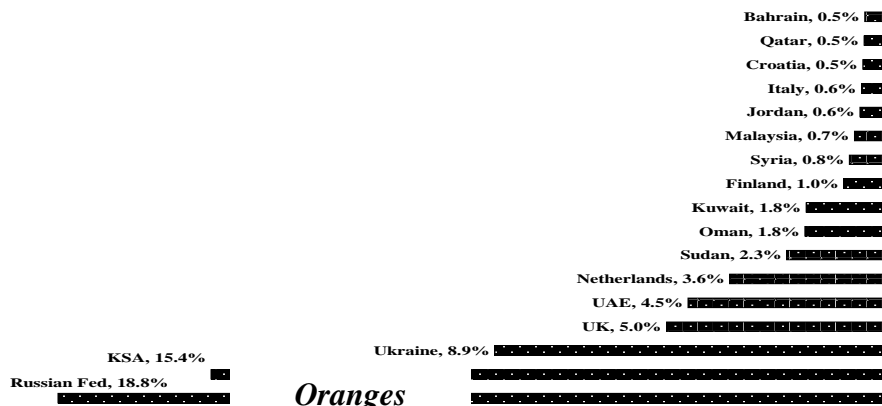
The paper is structured as follows. The next section briefly discusses the aim of the paper. Data collection is the subject of part three. The forth section is devoted to give a background on gravity model. The paper's methodology is the main topic for section five. The sixth section discusses the estimated results. The seventh and last section is devoted to conclusion.

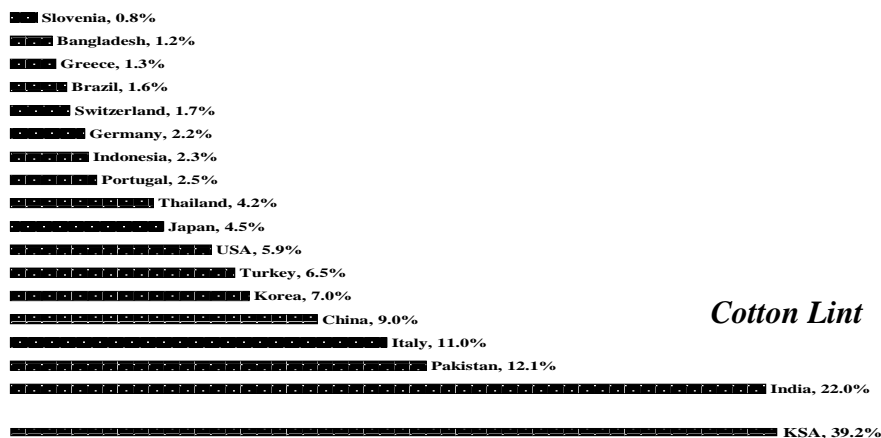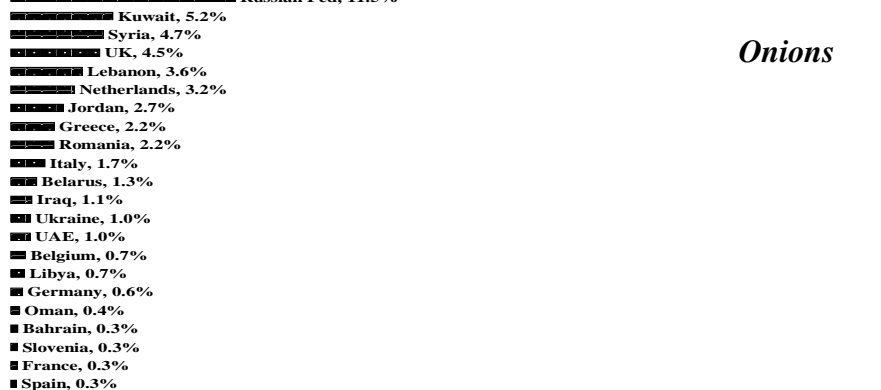**FIGURE (1): EGYPT'S MAIN AGRICULTURAL EXPORT PRODUCTS FLOWS AMONG MAIN IMPOR**

Syria, 19.7%
Turkey, 13.9%
Libya, 10.2%
Jordan, 7.5%
Sudan, 4.4%
Saudi Arabia, 4.0%
Ukraine, 3.4%
Romania, 3.2%
USA, 2.8%
Lebanon, 2.8%
Belgium, 2.6%
Singapore, 2.5%
UAE, 1.9%
Senegal, 1.8%
Kenya, 1.5%
Palestinian , 1.4%
UK, 1.3%
Bulgaria, 1.3%
Morocco, 1.0%
Albania, 1.0%
Spain, 0.9%
Côte d'Ivoire, 0.9%
Croatia, 0.8%
Tanzania, 0.8%
Georgia, 0.8%
Kuwait, 0.7%
Italy, 0.6%
Russia, 0.6%
Israel, 0.6%
China, 0.50 %

Rice

TERS DURING THE PERIOD (2003-2012) ON AVERAGE

Bahrain, 0.5%
Qatar, 0.5%
Croatia, 0.5%
Italy, 0.6%
Jordan, 0.6%
Malaysia, 0.7%
Syria, 0.8%
Finland, 1.0%
Kuwait, 1.8%
Oman, 1.8%
Sudan, 2.3%
Netherlands, 3.6%
UAE, 4.5%
UK, 5.0%
Ukraine, 8.9%
KSA, 15.4%
Russian Fed, 18.8%

Oranges

2160

Cotton Lint

- Slovenia, 0.8%
- Bangladesh, 1.2%
- Greece, 1.3%
- Brazil, 1.6%
- Switzerland, 1.7%
- Germany, 2.2%
- Indonesia, 2.3%
- Portugal, 2.5%
- Thailand, 4.2%
- Japan, 4.5%
- USA, 5.9%
- Turkey, 6.5%
- Korea, 7.0%
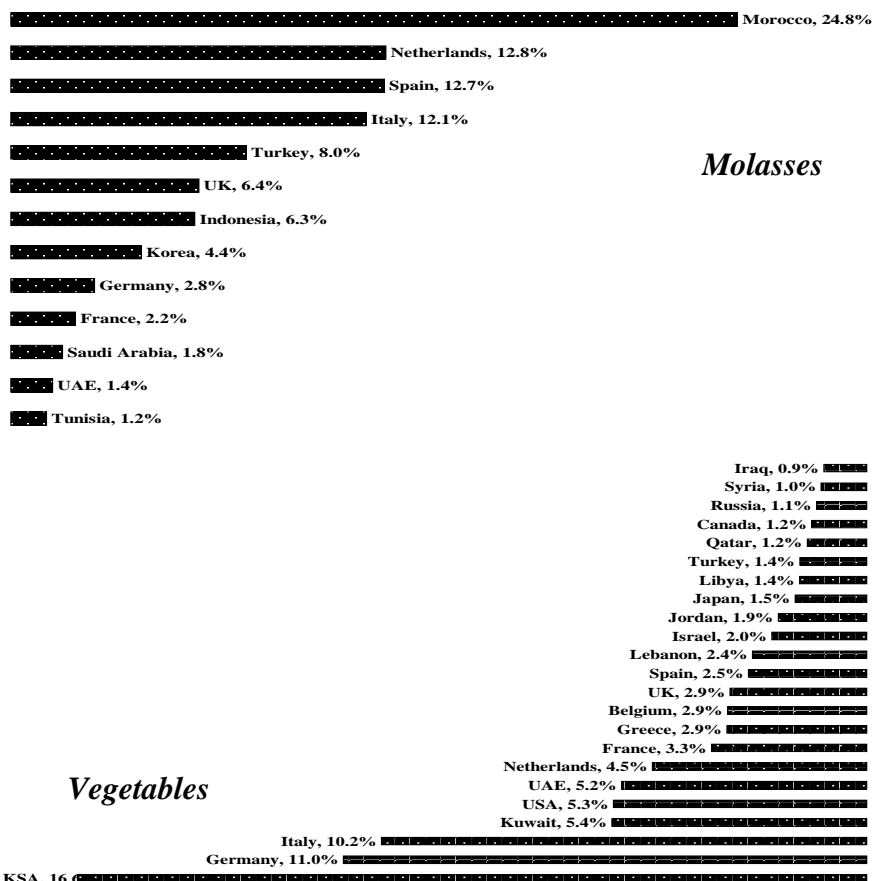- China, 9.0%
- Italy, 11.0%
- Pakistan, 12.1%
- India, 22.0%

Onions

- KSA, 39.2%
- Russian Fed, 11.5%
- Kuwait, 5.2%
- Syria, 4.7%
- UK, 4.5%
- Lebanon, 3.6%
- Netherlands, 3.2%
- Jordan, 2.7%
- Greece, 2.2%
- Romania, 2.2%
- Italy, 1.7%
- Belarus, 1.3%
- Iraq, 1.1%
- Ukraine, 1.0%
- UAE, 1.0%
- Belgium, 0.7%
- Libya, 0.7%
- Germany, 0.6%
- Oman, 0.4%
- Bahrain, 0.3%
- Slovenia, 0.3%
- France, 0.3%
- Spain, 0.3%

Potatoes

- Syria, 0.3%
- Libya, 0.4%
- Saudi Arabia, 0.4%
- Oman, 0.4%
- Albania, 0.4%
- Croatia, 0.5%
- UAE, 0.6%
- Kuwait, 0.8%
- Iraq, 0.8%
- Belarus, 0.8%
- Romania, 0.9%
- Tunisia, 2.1%
- Netherlands, 2.2%
- Ukraine, 3.4%
- UK, 6.0%
- Lebanon, 8.7%
- Germany, 12.5%
- Italy, 16.8%
- Greece, 16.8%
- Russian Fed, 23.4%

Molasses

- Morocco, 24.8%
- Netherlands, 12.8%
- Spain, 12.7%
- Italy, 12.1%
- Turkey, 8.0%
- UK, 6.4%
- Indonesia, 6.3%
- Korea, 4.4%
- Germany, 2.8%
- France, 2.2%
- Saudi Arabia, 1.8%
- UAE, 1.4%
- Tunisia, 1.2%

Vegetables

- Iraq, 0.9%
- Syria, 1.0%
- Russia, 1.1%
- Canada, 1.2%
- Qatar, 1.2%
- Turkey, 1.4%
- Libya, 1.4%
- Japan, 1.5%
- Jordan, 1.9%
- Israel, 2.0%
- Lebanon, 2.4%
- Spain, 2.5%
- UK, 2.9%
- Belgium, 2.9%
- Greece, 2.9%
- France, 3.3%
- Netherlands, 4.5%
- UAE, 5.2%
- USA, 5.3%
- Kuwait, 5.4%
- Italy, 10.2%
- Germany, 11.0%
- KSA, 16.0

Source: compiled from FAO statistics, the total may not equates 100%, as the author neglected shares less than 0.3% for onions and potatoes, 0.5% for rice and oranges, 0.8 for cotton lint, 0.9 for vegetables and 1.2% for molasses.

Aim of the Paper

The objective of this paper is to explore the factors affecting Egypt's main agricultural trade with its trading partners via employing a gravity model approach. Main products covered by the paper are cotton lint, onions, oranges, rice, potatoes, vegetables and molasses.

Data

Data for the study period (2003-2012) was mainly collected from FAO statistics, Ministry of Agricultural and Land Reclamation (MALR), World Development Indicators (WDI) database, International Financial Statistics (IFS), CD-ROM database, International Monetary Fund (IMF), Direction of trade statistics and World Atlas website (for distance - in kilometer - between capital cities of countries)

The Gravity Model

Owing to Irwan et al (2013), the gravity trade model originates from the law of gravity in Physics called the Newton's law of universal gravitation. This law is discovered by the English physicist, Sir Isaac Newton in his famous work, "*Philosophiae Naturalis Principia Mathematica in 1687*". This law states that the attractive force between two bodies is directly related to their size and inversely related to the distance between them. However, the origins of the application of the gravity model analysis to the field and sub-field of social sciences can be dated as far back as in the 1930's from various fields such as Astronomy, Sociology, and Regional Economics (e.g: Reilly,1931; Stewart, 1948; Zipf, 1946)

Since the seminal work of Jan Tinbergen (1962), it has been known that the size of bilateral trade flows between any two countries can be approximated by the Newtonian theory of gravitation. Initially the gravity equation was thought of merely as a representation of an empirically stable relationship between the size of economies, their distance and the amount of their trade. Prominent models of international trade at that time included the Ricardian model, which relies on differences in technology across countries to explain trade patterns, and the Heckscher-Ohlin (HO) model that relies on differences in factor endowments among countries as the basis for trade. It was assumed then that standard Ricardian and HO models were incapable of providing a foundation for the gravity model. In the HO model, for example, country size has little to do with the structure of trade flows (UN-WTO, 2012).

Owing to Said and Shelaby (2014), the volume of bilateral trade is based on; the level of economic activity, income, and the barriers to trade. The latter include in particular transportation costs, trade policies, uncertainty, cultural differences, geographical characteristics, limited overlap in consumer preference schemes, regulatory bottlenecks, and common borders (Anderson & van Wincoop, 2003). While trade potential is the result of matched export capacities and import demands at the microeconomic level, on a more aggregated level of analysis, proximity in demand, in per capita income, in space, and in culture, are key macroeconomic determinants of export potentials. Thus various combinations of macroeconomic variables, such as GDP and population with geographic distance, are powerful predictors of trade potentials. Hence, gravity equations use these variables and have been used extensively in the empirical literature on international trade (Bayoumi & Eichengreen, 2007; Evenett & Hutchinson, 2002). The model is widely used in the empirical literature to evaluate the determinants of bilateral trade. It explains a trade-related dependent variable, by the combination of macroeconomic variables, such as country size, income, population, etc., for both countries. Moreover, indicators of transportation costs between the two countries and more general market access variables are commonly added.

The determinants of flow of goods from a single country to its trading partners in a particular year are generally estimated using the gravity equation. Popularized by Tinbergen (1962), Anderson (1979), Bergstrand (1985), Frankel (1993), and Deardorff (1995), Sharma and Chua (2000), Greenaway and Milner (2002) Rahman (2003, 2009), Ghani (2007), Raimi and Mobolaji (2008), Abu Hatab *et al.,* (2010), Shaista *et al.,* (2013) and Said

and Shelaby (2014) among others. However, the gravity model employed in this study adopts an (N x 1) setting for examining bilateral trade flows of Egypt. Most of other studies have used (N x N) setting for enquiring trade situations among pair of countries. Analysis conducted using (N x 1) setting leads towards policy inferences for a particular country while (N x N) setting gives policy implications equally suitable for N economies. Therefore N x 1 setting is having advantage over N x N setting in a way that the former leads to policy implications for a specific country while the later leads to trade policies equally appropriate for N countries.

Methodology

As mentioned earlier and cited by (UN-WTO, 2012), the gravity model describes trade flow between two countries as a function of the economic size of both the origin and the destination one, as well as of the geographical distance between each of them. In most of the applications based on the original gravity model formulation by Tinbergen it is possible to split between two groups of variables, relatively to their effect, that could be push (positive contribution to the flow) or pull (negative contribution). The push factor is represented by the economic size and the gross domestic product (GDP) of the origin as well as the destination country is the main proxy. We can use other variables, such as population and GDP per- capita. The pull factor is represented by the transport costs of the traded goods, and it is possible to use the geographical distance between the two countries as an appropriate proxy. Other variables could be inserted in the model to specify the push effect, such as dummy variables representing if the two countries have common border, or if they share the same official language, or if they use the same currency; Rose (2000) was the first to introduce these variables in the gravity model.

The basic idea of the gravity model emerges from Newton's gravity equation that argues that the attractive force between two objects *i* and *j* could be expressed as follows:

$$F_{ij} = GM_iM_j / D_{ij}^2 \qquad \text{Where,}$$

F_{ij} = attractive force

G = gravitational constant

M_i, M_j = masses of the two objects

D_{ij} = distance between the two objects *i* and *j*

Then, in 1962, Jan Tinbergen suggested a similar functional relation to explain international trade flows between two countries is determined positively by each country's GDP, and negatively by the distance between them. This formulation could be rewritten as:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \qquad \text{Where,}$$

β_0 = Constant of proportionality

X_{ij} = the flows of exports from country *i* to country *j* or imports from *j* to *i*

Y_i , Y_j = GDPs for countries *i* and *j*

D_{ij} = the geographical distance between the two capitals

So, when considering the logarithmic form of the above model, it could be rewritten as:

$$Ln(X_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(D_{ij}) + e_{ij}$$

The above-mentioned model is the basic gravity model. However, many researchers modified that model to include more variables such as common border, common language, per capita GDP,..etc..

Baltagi et al., (2003), argued that Oguledo and MacPhee (1994) survey the literature on gravity models and find that 49 explanatory variables have been used in earlier work. Out of these variables, 18 vary in the exporter-by-time or the importer by time dimensions. Important examples are most favored nation tariff rates, wholesale price indices and political and institutional conditions. Other variables cited by Anderson and Marcouiller (2002, p. 349) include insecurity variables like the transparency of government economic policy, the enforceability of commercial contracts, and a composite security index. Gould (1994) motivates immigrant links to their home countries as an additional determinant of bilateral trade. Hence, in attempting to estimate a gravity model one could try to include all these variables. In addition, one can think of other unobserved factor endowments or cultural aspects that cannot be controlled for in a cross-section study. With panel data one can specify a generalized gravity model, which controls for all possible dimensions of the panel, namely main and interaction effects:

However, the study employs two models, each of them consider a number of variables that could be expressed as follows:

Model One: The Gravity Model

$$Ln(X_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(Op_i) + \beta_4 \ln(Op_j) +$$

$$\beta_5 \ln(Ypc_i) + \beta_6 \ln(Ypc_j) + \beta_7 \ln(D_{ij}) + \beta_8 \ln(CommonB_{ij}) +$$

$$\beta_9 \ln(CommonL_{ij}) + e_{ij} \ldots\ldots\ldots\ldots(1)$$

where,

i = Egypt, j = Importing countries

X_{ij} = The flows of exports from country Egypt to importing countries

$(Y_i), (Y_j)$ = GDPs of countries *i* and *j*

$(Op_i), (Op_j)$ = Openness of countries *i* and *j*

$(Ypc_i), (Ypc_j)$ = GDP per capita of countries *i* and *j*

(D_{ij}) = the geographical distance between the two capitals in Kilometers

$(CommonB_{ij})$ = Dummy variable, indicating having common border or not

$(CommonL_{ij})$ = Dummy variable, indicating having common language or not

(e_{ij}) = the normal random error term

In line with Abu Hatab et al., (2010) and Irwan et al., (2013), for panel analysis, unbalanced data are to be used for the model, where, a pooled regression model is to be estimated then, the Hausman test is to be employed to determine whether Fixed effect (FE) model or Random Effect model (RE) model is more appropriate to be employed.

In pooled model, the observations are pooled together neglecting the cross section and time series nature of data. The problem within this model is that it does not distinguish between various exportable products. In other words, it denies the heterogeneity and individuality that exist among exportable products. Meanwhile, in fixed model, it allows for heterogeneity and individuality among exportable products by allowing having its own intercept value. The term fixed is because of allowing the intercept may differ across products but the intercept does not vary over time that is time invariant. Whereas, for random effect model, it allows having a common mean value for the intercept.

It is important to note the problems of estimating the FE model for Egypt's exports. As cited by Irwan et al., (2013), *according to Rahman (2003), "we cannot directly estimate variables that do not change over time because inherent transformation wipes out such variables" (p. 17),* and as such the dummy and distance variables need to be dropped. This problem can be solved by running a second stage regression with taking into account the individual effects as the dependent variable whereas the dummy and distance as independent variables. The equation to be estimated for the second stage regression thus as follows:

$$E_{ij} = \varphi_0 + \varphi_1 D_{ij} + \varphi_2 (CommonBorder) + \varphi_3 (CommonLanguage) + eu_{ij}$$
……………… (2)

Where E_{ij} is the individual effects, D_{ij} denotes to distance and other variables are as defined earlier. Equation 1 is to be estimated and Table 1 shows the results for Pooled Model, Random Effects Model and Fixed Effects Model.

Model Two: An Econometric Model to Estimate the Impact of Overall Bilateral Size, Similarity in Bilateral Size and Difference in Relative Factor Endowment on Egyptian Agricultural Exports

In line with Baltagi et al., (2003) and Antonucci and Manzocchi (2006), this model is concerned by estimating the size of economies real GDPs as a measure of bilateral overall country size (SUMGDP$_{ij}$), however, larger countries, in terms of GDP, possess both higher production capacity as well as large domestic markets for the imports. Therefore, an increase in the product of the two countries' GDP is expected to increase bilateral trade volume. Thus, it is expected that the estimated coefficient of β_1 is positive. (SIMSIZE$_{ij}$) represents a measure of size similarity. It is a similarity index of two trading partners' GDPs as a measure of relative country size, it may have either a positive or a negative effect. Countries similar in size should trade more if their exchanges are of intra-industry nature (Helpman and Krugman,

1985), if their exchanges are of inter-industry nature, the coefficient should be negative. ($RELENDOW_{ij}$) measures relative factor endowments. The proxy employed is the difference in per-capita GDP. It aims to capture a possible *Linder effect* (see, for instance, Arnon et al., 1996). As pointed out by Helpman (1987), this is an accurate proxy when there are only two factors of production, capital and labor, and all goods are freely traded. The impact of factor endowments might go in either direction: a negative coefficient would point towards an intra-industry trade structure; a positive coefficient would suggest that an inter-industry trade structure prevails. The model could be identified as follows

$$Ln(X_{ij}) = \alpha + \beta_1(SUMGDP_{ij}) + \beta_2(SIMSIZE_{ij})_{ij}$$
$$+ \beta_3(RELENDOW_{ij}) + e_{ij} \ldots\ldots\ldots(3)$$

where,

X_{ij} = The flows of exports from country Egypt to importing countries

$$SUMGDP_{ij} = \ln(GDP_i + GDP_j)$$

$$SIMSIZE_{ij} = \ln\left[1 - \left(\frac{GDP_i}{GDP_i + GDP_j} \right)^2 - \left(\frac{GDP_j}{GDP_i + GDP_j} \right)^2 \right]$$

$$RELENDOW_{ij} = \left| \ln\left(\frac{GDP_i}{Pop_i} \right) - \ln\left(\frac{GDP_j}{Pop_j} \right) \right|$$ Noting that, this is a non-linear

transformation of Helpman's (1987) measure to account for the fact that the GDP per capita difference may be very small or even zero.

　　　Both models (one and two), are generally estimated using the OLS method, employing panel data analysis throughout the period of 2002-2012. Baltagi et al., (2003) argued that, one of the econometric advantages in using panel data is that it allows individual heterogeneity which is not an available characteristic if time series or cross sectional data is used (Baltagi, 2005). Using panel data would also provide more informative data, more variability, less collinearity among the variables, more degrees of freedom, and more efficiency. Furthermore, it allows the assumptions stated in the cross-sectional analysis to be relaxed and tested (Maddala, 2001).

　　　Before the estimation of the above models, the paper analyzed the univariate characteristics of the variables, which examines panel unit root tests. This is the first step in determining a potentially cointegrated relationship between the variables. If all variables are stationary, then the traditional estimation can be used to estimate the relationship between variables. If they contain a unit root or are non-stationary, a cointegration test should be performed. The study employs two-panel unit root tests using the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. The results presented in Table (2) depict that both tests reject the null of unit root for all variables. That means all variables are stationary and this implies that

co-integration test is not required and both models are ready be estimated using the ordinary least square method.

RESULTS

For Model One

As mentioned earlier, that a pooled regression model is to be estimated then, the Hausman test is to be employed. The Hausman's null hypothesis suggest that, the regressors and individual effects are not correlated in order to decide whether the fixed effect (FE) model or random effect model (RE) model is more appropriate. Accepting the null hypothesis implies that the random effect model is to be preferred. The Hausman result presented in Table 3 suggest that, the null hypothesis is to be rejected indicating that fixed effect model results is to be relied on.

TABLE 2: PANEL UNIT ROOT TEST RESULTS

Variable		Augmented Dickey-Fuller Test (ADF)	Phillips-Perron Test (PP)
Egypt Agricultural Export's (Y_i)		-7.345496***	-14.17164***
	F-statistic	58.95555	98.88037
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	1.991388	2.349367
Egypt's GDP		-3.408210**	-3.440411**
	F-statistic	1.938063	5.606093
	Prob (F-statistic)	0.071752	0.003775
	Durbin-Watson stat	2.000204	1.980769
Importer's GDP		-10.91207***	-35.45990***
	F-statistic	229.8086	599.1221
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	1.989881	1.994113
Egypt's GDP per Capita		-3.314561*	-3.346555*
	F-statistic	1.834442	5.317729
	Prob (F-statistic)	0.089192	0.005023
	Durbin-Watson stat	2.000184	1.981602
Importer's GDP per Capita		-7.177196***	-26.67928***
	F-statistic	162.1995	286.2769
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	1.983438	2.141598
Egypt's Openness		-3.14486*	-1.790180*
	F-statistic	0.553136	1.656468
	Prob (F-statistic)	0.097772	0.091258
	Durbin-Watson stat	2.000009	1.995226
Importer's Openness		-8.022895***	-24.99695***
	F-statistic	129.8934	259.2257
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	2.016090	2.125283
Egypt's Population		-11.60946***	-31.27229***
	F-statistic	163.4082	460.7605
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	2.008453	2.024955
Importer's Population		-11.26435***	-31.38295***
	F-statistic	180.5791	448.4410
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	2.005415	2.071735
Distance		-10.45071***	-35.53041***
	F-statistic	229.6103	610.8789
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	2.011687	1.996526
Language		-13.35866***	-36.31303***
	F-statistic	239.6284	656.0780
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	2.020442	1.979988
Boarder		-16.62058***	-38.81836***
	F-statistic	243.8486	723.3588
	Prob (F-statistic)	0.000000	0.000000
	Durbin-Watson stat	1.993856	2.018277

TABLE 3A: GRAVITY MODEL ESTIMATION RESULTS (MODEL ONE)

Variables	Pooled Regression	Random Effect Model	Fixed Effect Model
Constant	-254.40** (120.57)	-296.43*** (58.14)	-621.23*** (97.37)
Egypt's GDP	1.36** (0.70)	1.69*** (0.34)	3.74*** (0.59)
Importer's GDP	0.46 (0.12)	0.09 (0.12)	0.19 (0.11)
Egypt's GDP per Capita	-1.36* (0.79)	-1.72*** (0.38)	-4.02*** (0.67)
Importer's GDP per Capita	-0.37** (0.074)	-0.04 (0.04)	-0.02 (0.04)
Egypt's Openness	0.48** (0.05)	0.38** (0.10)	1.37** (0.44)
Importer's Openness	-0.01 (0.05)	0.03 (0.06)	0.08 (0.06)
Distance	-0.86** (0.25)	-0.13 (0.30)	-
Common Language	2.35** (0.43)	0.34 (1.04)	-
Common Border	1.34** (0.49)	1.05 (1.14)	-
R^2	51	0.55	0.88
F- test	39.70***	25.33***	63.34***
Hausman test	-	40.64***	-

TABLE 3B: SECOND STAGE REGRESSION FOR EGYPT'S EXPORT MODEL

Explanatory Variable	Coefficient
Distance	-1.29* (0.67)
Common Boarder	1.25*** (0.19)
Common Language	0.75 (1.78)
R^2	0.41

*** Significant at 1%, ** significant at 5%, and * significant at 10% level, *SE* are in parenthesis.

Fixed effect model results shown in Table 3A suggest that, Egypt's GDP, GDP per capita and openness are statistically significant at 1% level of significance. Indicating that, a 1% increase in Egypt's GDP (other variables held constant) would result in an increase in Egypt's main agricultural exports flows by 3.74%. The result that mirrors the main idea behind gravity model approach in suggesting that trade volumes behave in directly proportion with economic size. In other words, as economic size increases (proxy by GDP) trade flow increases. Regardless that importer's GDP is insignificant, it achieved a positive trend following the earlier explanation.

Egypt and importer's GDP per capita show a different trend with a negative, they are estimated at -4.02 (significant at 1% level of significance) and -0.02 (insignificant) respectively. The negative sign of the importer's per capita GDP (despite its insignificance) implies that the effect of economies of scale is more dominant than the absorption effect of country *j* as a result of increment in importer's GDP per capita. In other words, due to the increase in importer's GDP per capita, more goods are produced and the tendency to

import goods from Egypt is narrowed. However, the negative coefficient for Egypt's GDP per capita, implies that (being other variables constant), as Egypt's per capita GDP increases by 1%, the main agricultural exports flows decreases by 4.02%. in line with Abu Hatab et al., (2010), this could be presumably explained by the combined effect of the accelerated economic growth rate that reached about 7% during the last decade, in addition to the escalated population rate, had probably absorbed greater portion of production, and consequently the surplus available to exports reduced.

Egypt's openness (known as trade to GDP ratio or openness index) estimated at 1.37 (significant at 1% level of significance). Suggesting that, a 1% increase in Egypt's openness would lead to an increase in Egypt's trade flows by 1.37%. This indicates that Egypt's exports to country *j* can be encouraged by promoting pro-liberal and freer trade policies for Egyptian economy with the attempt to promote free trade, such as abolishing quotas, rationalizing subsidies, reducing trade taxes among others.

The results of second stage of regressing the fixed effects on distance and dummies for border and language are presented in Table 3B. The estimated coefficient of distance (estimated at -1.29) has the expected negative sign, statistically significant (at 10% level of significance). The distance between two countries serves as a trade barrier variable such as transport cost, time and other such variables. It is argued that as distance increases, the volume of trade flow between two countries decreases. This indicates that holding other things constant, Egypt agricultural exports will increase by 1.29% for every 1% decrease in the distance with the importer countries and vice versa. Moreover, countries that Arabic is the main language is likely to encourage Egypt's agricultural trade flow; however, its coefficient (0.75) is insignificant. In addition, the sign of the dummy variable of common border is concurred with expectation, where it possessed a positive sign (1.25) and is significant at 1% level. Indicating that the Egyptian trade flows are likely to be increased with countries that Egypt shares a common border by 1.25%, this result may be due to the reduced transportation costs and bilateral agreements.

1.1 For Model Two

Results presented in Table 4 reveal that, as far as GDP size and similarity are concerned, the coefficients are statistically significant both for main agricultural exports. In particular, $SUMGDP_{ij}$ is found to have a positive coefficient, implying that Egypt tends to trade more with large economies. Trade flows are positively affected by $SIMSIZE_{ij}$, suggesting an intra-industry structure for Egypt's exchanges. This result is also supported by the positive relationship between export volumes and the difference in relative endowments: the coefficient of $RELENDOW_{ij}$ suggests that similarity in factor composition fosters Egypt's exports.

TABLE 4: GRAVITY MODEL ESTIMATION RESULTS (MODEL TWO)

	Coefficients	Standard Error	t Stat	P-value
Intercept	-13.82	3.77	-3.65	0.00002
SUMGDP $_{ij}$	0.91	0.15	5.90	4.88E-09
RELENDOW $_{ij}$	-0.56	0.08	-7.13	1.75E-12
SIMSIZE $_{ij}$	1.34	0.23	5.80	8.72E-09
F – Test	34.47***			
R^2	0.59			

*** **Significant at 1%**

CONCLUSION

The gravity model is the workhorse of the applied international trade literature. It has been used in literally thousands of research papers and published articles covering all areas of trade. It is of particular interest to policy researchers because it makes it possible to estimate the trade impacts of various trade-related policies. With data increasingly available for developing, as well as developed countries, the gravity model has come to be the starting point for a wide variety of research questions with a policy component.

This paper aimed to explore Egypt's main agricultural exports flows with their importable countries. To achieve this goal, two models were employed, that the major determinants for the first model (gravity model) are the size of the economies (GDPs and GDPs per capita), level of openness of the economy, geographical distance, common language and border, whereas for model two (the econometric model), bilateral overall country size, country size similarity and relative factor endowments.

Several policy implications can be drawn from the results of the gravity model. First, Egypt's agricultural bilateral export flow is likely to be escalated in proportion to the trading partner's GDP and falls in proportion to the distance involved. Thus, it is vital for Egyptian policy advisorss to play an important role to exploit the vast market of the importing countries, such as focusing on accelerating the effort to adopting macro policies that encourage increasing the GDP and attracting more foreign investments. In other words, Egypt is preferably had to encourage exports to countries in close proximity and having large economies. Second, to pay more attention, to invest in establishing roads between Egypt and the neighbor countries, such as Saudi Arabia, Sudan and Libya. Third, having a package of incentives for investments in the agricultural sector would result a significant impact on Egypt bilateral trade. Fourth, liberalizing the economy further, and enhancing. Fifth, variable of distance indicates the importance of logistics in the export process. One way to enhance that by investing in infrastructure, such as establishing highway roads, cargo fleet and improved maritime transportation between Egypt and its trading partners. Sixth, as there is tendency for increment Egyptian agricultural exports with countries sharing the same language, therefore there is a great priority to promote and encourage the intra Arab trade.

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العوامل المفسرة لتدفق الصادرات الزراعية المصرية الرئيسية من خلال تموذج الجاذبية

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يعتبر نمو التجارة الخارجية أحد أساليب الدول النامية لتحقيق التنمية المستدامة ومعالجة مشكلة الفقر ، ومصر كدولة نامية يمكنها تحقيق هذه الأهداف عن طريق تعظيم اجمالى حجم تجارتها الخارجية مع بقية دول العالم . ووفقا لأرقام عام 2012 بلغ اجمالى الناتج المحلى المصرى 126 بليون دولار يساهم القطاع الزراعى في هذا الناتج بحوالى 15,8 بليون دولار أو حوالى 14,5 % في حين تساهم القوة العاملة الزراعية بحوالى 30,8 % من اجمالى القوة العاملة الزراعية المصرية ، وزيادة على ذلك يبلغ المتوسط السنوى لاجمالى الصادرات والواردات المصرية من السلع والخدمات خلال الفترة 2008-2012 حوالى 17,4 % ، 25,8 % من اجمالى الناتج المحلى بينما بلغت الصادرات والواردات الزراعية حوالى 1,2 ، 6,1 بليون دولار على التوالى .

ويستهدف البحث تناول أهم العوامل التى قد تؤثر على تدفق الصادرات المصرية لأهم المحاصيل الزراعية التصديرية وهى القطن ،البصل ،البرتقال ،البطاطس ،الأرز ،المولاس والخضروات حيث يمثل قيمة صادراتهم حوالى 82% من اجمالى الصادرات الزراعية . وباستخدام موديل الجاذبية المستمد من القانون الأصلى للجاذبية في الفيزياء والمسمى بقانون نيوتن، كما يعزى أسس استخدام قانون نيوتن للجاذبية في التجارة الخارجية الى الدراسة التى قام بها جان تمبرجن عام 1962 والتى أوضحت أن حجم التدفق التجارى بين أى دولتين يمكن قياسه بواسطة دالة الجاذبية والتى تتمثل في العلاقة بين الحجم الاقتصادى للدولتين والمسافة بينهما ووفقا للموديلات الشهيرة السابقة للتجارة الخارجية كموديل ريكاردو الذى يعزى التجارة الخارجية إلى الاختلافات بين الدول في كل من التكنولوجيا والمزايا النسبية لكل دولة بالإضافة إلى موديل هكشر- أولين الذى يتناول تفسير قيام التجارة الخارجية بين الدول إلى اختلاف الهبات الطبيعية للدول حيث يعتبر هذان الموديلان معا هما اللذان قدما الأساس الرياضى لبناء نموذج الجاذبية في التجارة الخارجية وقد استخدمت الدراسة نموذجين بحيث يتناول كل نموذج منهم مجموعة من المتغيرات التى تعبر عن مدى تأثيرها على التجارة الخارجية ، فالموديل الأول يستخدم الانحدار حيث يوضح عدد من المتغيرات التى تؤثر على تدفق الصادرات والتى من أهمها الدخل المحلى ومتوسط الدخل الفردى الحقيقى ودرجة انفتاح المقتصد لكل من الدولة المستوردة والدولة المصدرة علاوة على المسافة بين الدولتين يضاف إلى ذلك متغيرين صوريين أولهما إذا كانت الدولتين ذات حدود مشتركة أم لا وثانيهما إذا كانت اللغة مشتركة ام لا.بينما الموديل الثانى المستخدم يبين أن المتغيرات التى تؤثر على تدفق الصادرات خاصة بالسعة الاقتصادية للدولتين ، فالدول الكبيرة تتسم بطاقة إنتاجية كبيرة وفى نفس الوقت تكون ذات أسواق محلية كبيرة للواردات ويكون من التوقع أن يظهر معامل نمو الصادرات بين هذه الدول موجب ، والمتغير الثانى يمثل مقياس تماثل السعة الاقتصادية معبرا عنها بالنسبة بين الدخل القومى المحلى للدولتين ويكون من التوقع ظهور معامل نمو الصادرات بين هذه الدول إما موجب أو سالب بينما المتغير الثالث يمثل مقياس نسبة الهبات الطبيعية للدولتين معبرا عنها بالفرق بين الدخل الفردى للدولتين .

وقد أسفرت النتائج على ان التجارة الثنائية بين مصر و الدول المستوردة لتلك المحاصيل تتأثر بعلاقة موجبة ذو دلالة إحصائية بكل من الدخل القومى الاجمالى، درجة انفتاح المقتصد و المتغير الصورى للحدود المكانية. بينما وجد ان هناك علاقة سالبة ذو دلالة احصائية لمتغير المسافة. كما بينت النتائج أن دول الاتحاد الأوروبى هى الشريك التجارى الرئيسى لمصر حيث نستوعب نحو ما يقرب من 30% و ان أهم الدول المستوردة لمنتجات المحاصيل الزراعية المصرية هى إيطاليا، المانيا، اسبانيا، فرنسا، المملكة المتحدة و اليونان.

الكلمات الدالة: نموذج الجاذبية، التجارة الزراعية و مصر