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Determinants of Tunisia's Exports: A Gravity Model Framework

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ABSTRACT

This paper applies the gravity trade model to explain Tunisia's export patterns with non-traditional partner countries and to determine the main factors explaining Tunisia's exports with these countries. We estimate our model over the period 1986–2009 for a sample of 36 countries. A two-step estimation procedure is used in this paper to estimate time-invariant parameters and dummy coefficients. Estimation outcomes show that Tunisia tends to exchange more commodities with close countries and with countries having common maritime borders. Estimations provide strong evidence that the economic size of the partners, Tunisia's trade openness policy, and foreign direct investment, can stimulate exports to the selected countries. Furthermore, contrary to the geographic distance, the existence of a common language does not play a role in Tunisia's exports to these destinations. The results also show that Tunisia has tremendous potential to develop trade relationships with the selected partner countries.

JEL Classification: F11, F12, F17.

Keywords: International trade; Gravity model; Panel Data; Tunisia.

1. INTRODUCTION

Historically, one can intuitively state the idea that growth phases have resulted from strong international trade development. An examination of the compared evolution of foreign trade of industrialized nations and their growth provides evidence of the importance of international trade liberalization on economic growth. In the case of developing countries, the last two decades were marked by their multiple efforts for economic liberalization, aiming their integration into the global economy to ensure faster economic growth. Tunisia is a developing country whose foreign trade plays a crucial and growing role in her economy. Since her independence, Tunisia implemented a protectionist economic policy to protect domestic native industries. From 1986, the adoption year of the *Structural Adjustment Program* in Tunisia, the country started to revise her economic policy by abolishing national industry protection to ensure better competitiveness. Since then, the Tunisian government has adopted an exports incentive policy. The government's measures encouraging exporters has resulted in the creation of several mechanisms, such as the export's promotion and development fund (FOPRODEX), the exports promotion center (CEPEX), funds for access to the exports markets (FAMEX), and export financing guarantees (GFEAE).

Government policies promotion exports were complemented by signing several trade agreements. The most important trade agreement was established with European Union and enforced by the creation of a free trade zone in January 2008. Other signed agreements include such as agreement of the Arab Free Trade Zone agreement, two multilateral agreements of Agadir (with Morocco, Jordan and Egypt), the European Free Trade Association (with Switzerland, Norway, Iceland and Liechtenstein), and six other bilateral agreements with Morocco, Egypt, Jordan, Syria, Libya and Turkey.

Despite Tunisia's economic openness policy being materialized by exports encouragement through multiple trade agreements, the geographical distribution of Tunisia's exports is diverted toward Europe, which is a privilege for Tunisian exporters. The Europe share of Tunisia's exports exceeded the threshold of 80 percent in 2007 and 75 percent in 2008. Moreover**,** at the end of 2008, more than 32 percent of Tunisia's exports were exported only to France. With Tunisia's exports to Italy, Germany, Spain and England, these five European countries monopolize more than 70 percent of Tunisia's exports, whereas the shares of the other partner countries did not exceed 1 percent for certain countries (European Commission, 2008).

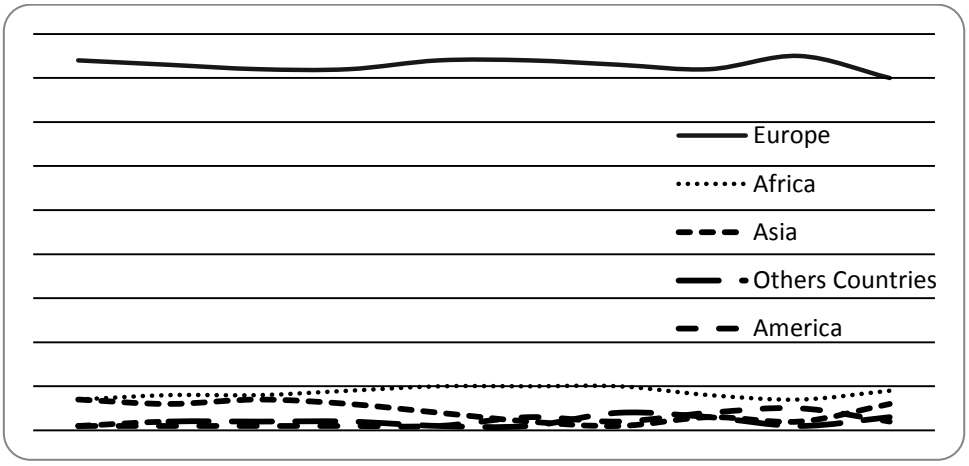

Figure 1.
Tunisia Exports by Continent

According to the European Commission (2008), this strong geographical concentration of Tunisian exports represents a risk, particularly taking into account their weight compared to the GDP. This weak international trade diversification exposes the Tunisian economy to many risks. The diversification of Tunisia's exports to other destinations is thus a foundational question.

The objective of this paper is to analyze and assess the trade pattern and explanatory factors of Tunisia's export flows with 36 trading partner countries in the recent past using a gravity model. The standard gravity model is augmented with a number of variables to test whether they are relevant in explaining Tunisia's exports. The main novelty in our approach is that, to our knowledge, it is the first attempt to investigate the importance of the factors driving Tunisian exports with non-traditional markets in a panel data framework.

This paper is organized as follows. First, the relevant literature reviews on trade gravity models are discussed in the following section. After the detailed methodology section, at the end of the paper, the findings of the study are discussed. Finally, the paper concludes with policy recommendations.

2. GRAVITY MODELS: A BRIEF LITERATURE OVERVIEW

In traditional trade theories (absolute advantages theory of Adam Smith, comparative advantages theory of Ricardo and factors endowment theory of Hecksher-Ohlin-Samuelson), international trade is basically explained by production costs. Trade occurs because of absolute costs or factor differences among countries. Moreover, the prescriptions of traditional theories often reduced the reality by neglecting concepts of perfect competition, product heterogeneity and technological innovations. The new theories seek to address problems with these assumptions and try to rebuild the theory of the international trade by including perfect competition and introducing the role of technology, economies of scale and product differentiation. Trade theories, however, only explain why trade in different products occurs, but fail to explain why some countries' trade links are stronger than others and why the levels of trade between countries tend to increase or decrease over time; these are the main limitations. While trade theories cannot explain the extent of trade, the gravity model is successful in this regard. The gravity models allow more factors to be taken into account to explain the extent of trade as an aspect of international trade flows (Paas, 2000).

The gravity model originated in physics and acquired its name for a family of quantitative models developed in 1940 by making recourse to Newton's gravity principles. Newton's law states that two bodies attract each other proportionally with the product of their weight divided by the square of their distance. Gravity theory has been primarily used in those fields in which distance plays a significant role. They were then extended to economics by Tinbergen (1962) and Poyhönen (1963), who provided some initial foundations for the gravitation of trade flows by replacing bodies' weights with the economic weights of the countries engaged. It has also proven to be useful in describing social phenomena in space, such as population migration, flows of goods, money,

information, traffic movements and tourist travel (Paas, 2005). The prediction power of the gravity model also made it useful for policy issues such as currency unions, political blocks, trade agreements and historical linkages (Paas, 2005).

The gravity equation sets the relation between the attractive forces corresponding to the incomes of two countries and the forces of repulsion, which correspond to the distance between the countries' capitals. Linnemann's (1966) model—called the *augmented gravity model*—included the population variable as a measure of the size of economies and is largely recognized and used for its empirical success. In gravity models, the size of an economy can be expressed by its population, and her per capita income expresses her level of economic development, which represents the attractive forces. Trade flows are then explained by these attractive forces, and the repulsion force is the distance between trading countries.

This literature developed to constitute a basic theory for explaining international trade. Later, several authors reconciled the traditional theories of international trade with the gravity approach. Eaton and Kortum (1997) extended the gravity model in a Ricardian framework, while Deardoff (1998) developed it in a Hecksher-Ohlin approach. The multiple forms of gravity models are applied in a variety of fields despite the fact that they lack strong theoretical bases (Paas, 2005). Theoretical support of gravity models originated in the second half of the 1970s with several theoretical developments, mainly with the seminal papers of Anderson (1979), Bergstrand (1985, 1989), Helpman and Krugman (1985). During the last two decades, it has become a standard and powerful tool for analyzing the determinants of trade (Evenett and Keller, 2002; Anderson and Wincoop, 2003; Harrigan, 2001; Hanson and Xiang, 2002). Evenett and Keller (2002) and Deardoff (1998) stressed the explanatory power of the gravity model and compared it to other theoretical trade models, stating that it remains an irreplaceable tool for computing potentials trade flows.

From an econometric point of view, numerous empirical papers in the literature have contributed to improving the performance of the gravity equation. While Matyas (1998), Chen and Wall (1999), and Egger (2000), among others, improved the econometric specification of the gravity equation, Helpman (1987), Wei, (1996), Limao and Venables (1999) contributed to the refinement of the explanatory variables considered in the analysis and to the addition of new variables.

In empirical gravity model literature, the explanatory factors of bilateral trade are assessed by two types of dependent variables: basic and dummy variables. Basic variables, or gravitational forces influencing bilateral trade flows, are mainly: countries' incomes, foreign direct investment, trade openness and foreign exchange rate. Other forces, namely, time-independent variables such as language, existence of a maritime border, and the existence of trade agreements can also affect the intensity of trade. In the gravity model, all theses time-independent variables are introduced by dummy variables according to the specific issue addressed in the literature.

3. METHODOLOGY

In this section, we discuss data, tools and the technique used to assess the determinants of Tunisia's exports. A specific model is used.

Data Collection and Sampling Procedure

Classical gravity models generally use a cross-section framework to estimate trade relationships for a particular time period. Such a framework wipes out many features that may occur over time in a country's trade pattern. In this study, we estimate our model for the period of 1986–2009 for a sample of 36 countries. All observations are annual. The beginning year of the period (1986) is the year of establishment of the *Structural Adjustment Program* in Tunisia. The sample covers countries of sub-Saharan Africa, namely, the Ivory Coast, Senegal and Cameroon. From Europe, Greece, Turkey, Romania, Hungary, Cyprus and Bulgaria (Eastern Europe), Norway, Sweden, Finland and Denmark (Northern Europe), Ireland, Austria and Portugal (Western Europe) were selected. The sample also includes China, India, Japan, South Korea, Thailand, Malaysia (East Asia) and Iran, Bahrain, Oman, Syria, Egypt and Mauritania (Arab countries), the United States and Canada (North America) and, finally, Brazil, Argentina, Mexico, Bolivia, Uruguay and Colombia (the Latin America).

Variables were drawn from the United Nations Commodity Trade Statistics Database. Countries are selected on the basis of their share in of Tunisia exports and the availability of required data. These countries never exceeded

1 percent in exports from Tunisia for the period of the study. We exclude those countries for which there is no data in the most years of our sample period. Exchange rate data were extracted from IFS—the International Financial Statistics database. Data of Gross Domestic Products, per capita gross domestic products and trade openness rate were extracted from the *World Development Indicators* (WDI) of World Bank. Distance and language data were extracted from CEPII—the GeoDist database. The maritime border variable was derived from the Earth Globe Chart. Finally, foreign direct investment data are from the FIPA (*Foreign Investment Promotion Agency, Tunisia*) database.

An important issue, relevant to the estimation, is the potential co-linearity between our regressors. For that purpose, both models' correlation matrixes (the basic export model and distance and dummies' export model) have been checked. Therefore, in our estimations, we are especially careful when including all variables at the same time. We have also checked some statistical properties of the data, focusing primarily on the characteristics of our variables for the entire sample, by presenting the respective means and medians, minimum and maximum values and standard deviation for each country in our sample.[1]

Model Specification and Estimation Methodology

In the traditional design of the generalized gravity equation of trade as developed by Tinbergen (1962), the volume of exports between pairs of countries, Xij, is explained by the sizes of economies and is represented by multiplying the Gross Domestic Products (GDP) of two countries i and j and dividing by their distance (D):

$$X_{ij} = \alpha_0 \frac{GDP^{\alpha 1}{}_i \; GDP^{\alpha 2}{}_j}{D^{\alpha 3}{}_{ij}}$$

where, α_0, α_1, α_2 and α_3 are the parameters to be estimated.

In its basic form, this model can be transformed to the following natural log-linear form:

$$\text{Log } (X_{ijt}) = \alpha_0 + \alpha_1 \log (GDP_{it}) + \alpha_2 \log (GDP_{jt}) + \alpha_3 \log (D_{ij}) \quad (1)$$

However, the gravity equation is rarely estimated in this too simple form. As discussed above, a set of dummies (such as the existence of trade agreement, common language, the existence of land or maritime borders and so on) can be specified and tested for a probable existing correlation either facilitating or restricting trade between pairs of countries. We introduce such variables in our model. These variables are selected on the basis of past literature and aspects of the Tunisian economic background that may affect import trade. Then, the extended form of this model makes it possible to determine the other characteristics of two trading countries. Our model is therefore "augmented" in the sense that several conditioning variables that may affect trade have been included, as follows:

$$\text{Log } X_{ijt} = \alpha_{ij} + \beta_1 \log PGDP_{ijt} + \beta_2 \log PGDPT_{ijt} \; \beta_3 \log FDI_{j(t-1)} + \beta_4 \log CHAN_{ijt} + \beta_5 OPEN_{jt} + \beta_6 OPENT_{ti} + \beta_7 MF + \beta_8 \; LANG + \beta_9 \log DIST_{ij} + \varepsilon_{ijt} \quad (2)$$

Because the dependent variable in the gravity model is exports between Tunisia and a partner county, the product of their GDP and their per capita GDPs were used as independent variables (Sharma and Chua, 2000; Hassan, 2001). The variables are defined as:

X_{ijt}:	Total exports of Tunisia (country i) to partner country j during the year t.
$PGDP_{ijt}$:	The product of GDP of Tunisia (country i) by GDP of the partner country j at year t.
$PGDPT_{ijt}$:	Product of the per capita GDP of Tunisia (country i) by that of partner country j at year t.
$FDI_{j(t-1)}$:	First lagged volume of foreign direct investment of the partner country j in Tunisia at the year (t-1).
$OPEN_{jt}$:	Trade openness ratio of the partner country j at time t.
$OPENT_{it}$:	Tunisia's trade openness ratio (country i) at time t.

[1] These results are not reported here for space considerations, but may be provided upon requests.

MF_{ij}: Maritime border dummy variable. It takes the value of one if the country has a maritime frontage and zero otherwise.
$DIST_{ij}$: A variable for geographical distance as a proxy for transports costs. Geographical distance between countries is defined as the distance between their capital cities.
$LANG_{ij}$: Common language dummy variable, which take value of one of the partner country has Arabic and/or French languages and zero otherwise.[2]
$CHAN_{ijt}$: Nominal exchange rate at time t, indicating price competitiveness.
ε_{ijt} Error term.

The basic hypotheses of our gravity model are as follows:

H_1: Tunisia has developed more active foreign trade relationships with those countries having higher GDP.
H_2: Distance negatively influences trade flows.
H_3: Absence of common language negatively influences Tunisia exports to the partner country.
H_5: Exchange rate is supposed to exert a positive effect on Tunisian exports, indicating that any currency depreciation of the exporter enhances its export flows.
H_5: Absence of maritime border between Tunisia and partner countries negatively influences Tunisian exports to the partner country.

According to Hsiao (1986), pooled OLS yields biased and inconsistent coefficient. Therefore, we statistically test which empirical model is most suitable for estimating exports. The Lagrangian Multiplier test (LM test) (Breusch and Pagan, 1980) is used to test the random effect model versus the pooling regression.

To control for individual heterogeneity, we employ a random effect as well as a fixed effect model. To compare the fixed effect and the random effect models, we conduct the Hausman specification test (Hausman, 1978). The Haussman statistic tests the correlation between individual effects and explanatory variables. Rejection of the null hypothesis thus leads to the adoption of a fixed effects model against the random effects model and vice versa (Baltagi, 2008). As stated by Martinez-Zarzoso and Nowak-Lehman, 2003, from an a priori point of view, the random effect model (REM) would be more appropriate when estimating typical trade flows between a randomly drawn sample of trading partners from a larger population. On the other hand, the fixed effect model would be better choice than REM when one is interested in estimating typical trade flows between an ex ante predetermined selection of nations (Egger, 2000). Because our sample includes exports flows between Tunisia and some selected partners countries, our intuition leads us to think that this view is consistent with a fixed effects specification.

The statistics of Hausman test are reported in Table 1, and the null hypothesis—that the individual effect is uncorrelated with the independent variable—is rejected at the 5% significance level. This result provides evidence in favor of the fixed effect.

Certain variables of our model are time-dependent, whereas others (maritime border, language and distance) are not. The FEM does not allow for estimating variables that do not change over time because this framework wipes out such variables. In line with the methodology used, these variables can be estimated in a second step, running another regression with the individual country effects as the dependent variable and distance and dummies as explanatory variables (Martinez-Zarzoso and Nowak-Lehman, 2003, Filippinic and Molini, 2003, Egger and Pfaffermayr).

$$IE_{ij} = \alpha_0 + \alpha_1 DIST_{ij} + \alpha_2 LANG + \alpha_3 MF + U_{ijt} \quad (3)$$

where, IE indicates individual effects. These effects are constants and are independent of time and relative to each country. The equations will be estimated separately. For that, we have to determine the optimal model. The *Backward Elimination* method was used. This method initially considers the model by incorporating all candidate variables and testing them one by one for statistical significance, deleting any that are not significant

[2] Arabic and French are the two official languages in Tunisia.

(Hocking, 1976; Draper and Smith, 1981).[3] After the estimation of the two equations, we use the coefficients thus obtained to predict bilateral exports of Tunisia with the considered trading partners. The predicted exports values are then compared with the actual exports values to forecast Tunisia's exports potential.

4. RESULTS AND DISCUSSION

Estimation outcomes show that the coefficients of the model are all significant and have expected signs. As regards time-dependent variables of the gravity equation, our results, presented in Table 1, show that PGDP, foreign direct investment, and Tunisia's trade openness (OPENT) variables affect the level of exports positively. The estimated coefficient for the PGDP variable is equal to 0.26. The sign of this coefficient indicates that economic growth influences Tunisia's exports positively. The coefficient shows that an increase of 1 percent in GDP of one of the two countries (Tunisia or partner country) generates an increase in Tunisia exports to the corresponding country of approximately 0.263 percent.

This positive sign is interpreted economically by the fact that the increase in GDP of the partner country offers a more important market size for Tunisian exporters. In the same way, the growth of Tunisia's GDP is a sign of increase for Tunisia's production in terms of the quantity and/or diversity of the products, which can increase the partner countries' demand for Tunisian exports.

The estimations also show that the PGDPT variable is not significant and indicates that Tunisia's exports target large-size markets or countries rather than countries with high per capita incomes. This result can be explained by a weak competitiveness assumption of Tunisian products (in terms of quality) in those markets where citizens have high purchasing power.

The coefficient for the foreign direct investment variable is equal to 0.06. This means that, if in a given year, the foreign direct investment of one of the partner countries increases (decreases) by 1 percent, Tunisia's exports to this country will increase (decrease) by 0.061 percent.
The coefficient of Tunisia's trade openness variable indicates that an increase of 1 percent in Tunisia's trade openness variable stimulates Tunisian exports to the partner countries by 1 percent. The Tunisian economic openness gives these countries the possibility of exporting their products to Tunisia, and consequently, they would tend to behave in the same manner for Tunisian products that may have a positive effect on Tunisia exports.

As regards distance time-independent variables of the gravity equation, estimation outcomes of the second equation show that the different variables' coefficients are significant with the threshold of 5 percent except for the language, which does not possess the expected sign. This shows that the "language" variable is not a determinant factor in Tunisia's exports to the partner countries.

The distance variable presents a negative sign—that is, the geographical distance between Tunisia and the partner countries discourages Tunisian exports to these countries.

The maritime border variable presents a positive and statistically significant coefficient (6.68). The existence of a maritime frontage between Tunisia and partner countries can develop Tunisia exports. This result comes from the fact that the major part of international trade is done via seas.

After obtaining the estimated results of the gravity models for Tunisia's exports flows, we proceed to estimate the exports potential for Tunisia. For that purpose, we use the estimated coefficients obtained in the previous regressions to predict such potential with the countries of our sample. We compute the ratio of predicted exports obtained by our estimation model to actual exports to these countries to assess Tunisia's exports potentiality to the countries sampled. A ratio greater than one indicates a real potential to expand exports with the corresponding country, while a negative ratio indicates that Tunisia has already exceeded its exports potentialities with the particular trading partner. Table 2 reports such country exports potential.

[3] We report the final results of these iterations here.

Table 1: Determinants of Tunisia's Exports

	Model 1	*Model 2*
Intercept	-1.103	-4.442
	(0.790)	(0.103)
PGDP	0.263	
	(0.000)	
PGDPT	1.131	
	(0.573)	
OPEN	0.0002	
	(0.001)	
OPENT	0.0002	
	(0.001)	
CHAN	0.074	
	(0.112)	
FDI	0.061	
	(0.001)	
MF		6.689
		(0.012)
DIST		-0.0003
		(0.028)
LANG		-1.093
		(0.439)
F-stat	27.130	16.35
P-value	0.000	0.000
R^2	0.612	0.278
Hausman Test	26.906 (0.000)	

Table 2 : Country Specific Effects

Country	**Coefficient**	**Country**	**Coefficient**	**Country**	**Coefficient**
India	5,888	Ivory Coast	1,441	Denmark	-1,166
Turkey	5,326	Senegal	1,363	Hungary	-1,390
Greece	4,363	Portugal	1,147	Romania	-1,902
China	4,122	Cameroon	1,145	Bulgaria	-2,031
Brazil	3,901	Bahrain	0,979	Mauritania	-2,070
United States	3,725	Ireland	0,899	Malaysia	-2,753
Sweden	3,505	South Korea	0,198	Uruguay	-2,981
Japan	2,892	Iran	0,065	Oman	-3,445
Austria	2,799	Syria	-0,679	Thailand	-3,453
Finland	2,391	Egypt	-0,752	Mexico	-6,855
Norway	2,356	Argentina	-0,841	Colombia	-11,349
Canada	1,771	Cyprus	-1,145	Bolivia	-11,982

Table 2 show that Tunisia's exports propensity for Colombia, Mexico, Thailand and Oman is at the lowest level, and it is at the highest level for India, Turkey, Greece, China and Brazil.

5. CONCLUSION AND POLICY RECOMANDATIONS

This paper tried to determine factors driving Tunisian exports to non-traditional destinations by using the gravity model with two-step regressions. The results of the first regression show that Tunisia's or her partner's income stimulates Tunisian exports. The foreign direct investment of the partner country in Tunisia acts in favor of Tunisian exports to that country. Furthermore, Tunisia's trade openness has a positive effect on the development of her exports. The results also showed that Tunisian exporters target large-size markets rather than higher per capita income economies.

The second regression explained the differences of the partner countries' behavior while referring to certain time-independent variables. The results show that contrary to the distance and presence of maritime border, common language was not a significant factor in stimulating exports.

The results imply that all types of barriers to trade must be liberalized to a greater extent to enhance Tunisia's trade. Second, as many partner countries do not possess maritime borders, improvement in the infrastructure network may be a prerequisite for successful trade with Tunisia. Third, Tunisia and all partner countries have to enhance foreign direct investment with each other in order to ensure higher export growth. Finally, Tunisia needs to enhance her external competitiveness to target markets with higher purchasing power through producing high-quality and diversified products.

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