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TURKISH AGRICULTURAL EXPORTS TO EURO-MEDITERRANEAN COUNTRIES: A GRAVITY MODEL APPROACH

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Abstract

This paper adopts panel cointegration methods to estimate a gravity model of Turkish agricultural exports to 30 Euro-Mediterranean countries. Results show the conventional variables of economic size and distance to importing markets along with relative factor endowments are significant determinants of agricultural exports. Conversely, similarity of economic size, bilateral free trade agreements with Euro-Mediterranean countries, religious commonality, and the expatriate Turkish population in importing countries are found to be insignificant. Whilst a focus on exporting to large and near neighbouring countries is sensible, Turkey also needs to pay careful attention to the competing demands on its agricultural land from urbanisation and tourism. We speculate that recent changes in Turkey's domestic agricultural policy may impact adversely on exports.

Key words**:** *Turkey, exports, gravity model, panel cointegration*

INTRODUCTION

Both theory and empiricism suggest that international free trade tends to be advantageous to economic growth, especially for developing countries. As a result, many countries have made great efforts in recent times to liberalise their trade to provide faster economic growth through integration in the global economy. Turkey is one of these countries, with international trade playing a significant role in its economic development.

The liberalisation process for Turkey started with an application for EU membership (then the European Economic Community) in 1959, with an Association Agreement signed four years later. Subsequently, and with the aim of increasing trade, Turkey has established free trade agreements (FTAs) with various Mediterranean area countries which, collectively, form its second largest market after the EU. In 1995, 12 Mediterranean countries - Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, the Palestinian Authority, Syria, Tunisia, and Turkey - and 15 EU member states met in Barcelona to create a common area of "calm, constancy, and shared prosperity" and agreed to establish a Euro-Mediterranean Free Trade Area (EMFTA) by 2010 [25]. The Barcelona declaration constitutes the European Neighbourhood Policy which is directed at neighbour countries of the EU hoping for membership, yet the neighbours are also ambitious to attempt economic and political reformations [46]. Turkey is a good example, but has encountered numerous political and economic difficulties to EU accession. In spite of the delays and slow progress, Turkey features in the Euro-Mediterranean movement of the EU. Also, it has been supporting the Euro-Mediterranean Partnership since its establishment. Within the scope of the membership arrangement, Turkey has a particular location between Northern Mediterranean countries (EU members) and the Southern Mediterranean countries (most of which were colonies of some EU members) [49, 34]. Besides its locational advantage, Turkey has cultural similarities to most of the Mediterranean Partner Countries (MPCs; Albania, Algeria, Bosnia and Herzegovina, Egypt, Israel, Jordan, Lebanon, Mauritania, Monaco, Montenegro, Morocco, Syria, the Palestinian Authority, Tunisia, and Turkey) arising from sharing a common religion. This may affect consumers' preferences for agri-food products in these countries and hence might be expected to increase Turkish agricultural exports to the MPCs. Consequently, Turkey stands to gain from the future trade liberalisation in the Euro-Mediterranean area.

Agricultural trade is a crucial part of the Turkish economy and there has been an upward trend in both agricultural imports and exports for several decades. Turkey has a positive agricultural trade balance in spite of an overall trade deficit. In 2011, agricultural exports were around USD 12.7 billion (in constant 2005 prices) with a contribution of 10.6% to Turkish exports. Agricultural imports were USD 12.3 billion and the total contribution of agricultural imports was 5.5% [27]. There has been an upward trend in both agricultural imports and exports: between 1969-2012, the real value of agricultural imports increased almost thirty-fold while corresponding exports increased by over five-fold. Apart from 2007, there has always been a positive agricultural trade balance, in spite of a deficit in total merchandise trade [27].

Turkey also plays a crucial role in the region in terms of agricultural production. According to [27], Turkey is the largest agricultural commodity exporter among the MPCs. In the Euro-Mediterranean region, Turkey is ranked as the first producer in tomatoes and walnuts, while the second after the EU-27 in olive oils, figs, and potatoes. Turkey provides nearly half of the MPCs' exports of agricultural products to the EU [27], and 40 per cent of its agricultural exports go to countries in the Euro-Mediterranean region [68]. The proportion of total agricultural trade for Turkey is 34 per cent with the region. In short, this region represents the major trading partner of Turkey. Some other countries or country groups are also important partners, such as the USA and BRICS, but the Euro-Mediterranean countries' share is larger and Turkey has signed various free trade agreements with these countries to compete in global trade. Therefore, the Euro-Mediterranean region is chosen in order to analyse the determinants of Turkish agricultural exports.

The increase in free trade agreements in recent years has escalated the discussion on the attraction of them. This study contributes to the existing literature by examining whether the existing trade agreements have resulted in benefits in terms of Turkish agricultural exports. To this end, the paper examines the determinant of Turkish agricultural exports to Euro-Mediterranean countries and employs recently developed econometric methods to estimate a gravity model. Modelling international trade flows has been extensively examined over recent decades. *Ex-ante* analysis has typically employed sector-specific or economy-wide models, and partial equilibrium and computable general equilibrium models have been widely applied. *Ex-post* studies have been based mainly on the gravity model which has been used in numerous applications to explain trade flows. Traditional panel data models are used by many researchers to estimate gravity models but the statistical properties of the variables, especially their likely non-stationarity, has been largely ignored and therefore results may be spurious. Further, endogeneity cannot be accounted for by traditional econometric panel methods, and cross-sectional correlation may be present. We employ recently developed panel cointegration methods to estimate a gravity model to explain Turkish agricultural exports to 30 Euro-Mediterranean countries with annual data for 1969-2010. For comparison, we also estimate fixed and random effects models. The paper is organised as follows: Section 2 provides a selected literature review; Section 3 presents the model to be estimated, details the data, and discusses our empirical method; Section 4 presents the results; and Section 5 concludes.

A selective literature review

The gravity model has been used widely to analyse international trade flows. [22] uses cross-sectional data to study the impediments to Mediterranean countries of access to the EU fruit and vegetable market and show that the region is heterogeneous with some countries benefitting from trade liberalisation and some not. [55] inter alia argues that panel data possess advantages over cross-sectional data in gravity model estimation, particularly identifying connections among variables over time, and monitoring individual impacts between trading partners, and most studies now use panel data. For example, [64] investigates Czech agricultural exports using weighted ordinary least squares (OLS) and economic size is found to be significant. [32] analyses the effects of regional trade agreements (RTAs) on agricultural trade using panel data and fixed effects models, and find that RTAs could promote a larger agricultural trade volume. [62] also examines the effects of RTAs on European agricultural imports and obtain similar results. [37] estimates fixed effects model with panel data to study the key factors affecting Egyptian agricultural exports. The results show that exchange rate volatility and economic size have a positive effect on agricultural exports while domestic growth per se causes a decrease in exports. [54] examines China's agricultural trade flows with its main trading partners and find that economic and market size, regional integration, cultural beliefs and language enhance agricultural exports. [42] uses panel data to show that RTAs increase bilateral agricultural exports.

A number of studies adopt gravity models to examine trade liberalisation in the Euro-Mediterranean area. [57] estimates fixed and random effects models and finds that the EU-Mediterranean Partnership increases exports from Mediterranean countries to the EU. [45] estimates fixed effects models to examine preferential trade agreements in the Euro-Mediterranean area and shows a preference of countries for regionalism over multilateralism. [28] also estimates fixed effects models to investigate economic integration between Euro-Mediterranean countries and finds ambiguous bilateral trade effects for partners in the EMFTA. [47] estimates seemingly unrelated regression equations (SURE) to control for contemporaneous cross-equation error correlation and find that FTAs have a small negative effect on trade flows in the Mediterranean area. By contrast, [12] concludes from random effects models that FTAs have positive and significant effects on exports from Mediterranean countries to the EU.

There are few gravity model applications for Turkey. For total exports, [29] uses panel data and pooled OLS, and [50] uses cross-sectional data and OLS, to examine Turkish accession to the EU and estimate that bilateral trade could rise by a half and a third, respectively. By contrast [3] uses panel data and fixed effects models and find no evidence of supplementary trade between Turkey and the EU, even though a customs union has existed since 1996. On Turkey's agricultural trade, [6] uses random effects models with panel data to examine fruit and vegetable exports to the EU and significant determinants are economic size, the EU population, and the expatriate Turkish population in the EU. [24] also uses random effects models and panel data and obtain similar results for total agricultural exports; additionally, the total arable land in an importing country is significant whereas the existence of a customs union is not. [55] uses SURE and panel data to study the effects of Turkey's full integration into the EU and find that fruit and vegetable exports would increase by a fifth. Finally, [5] uses cross-sectional data and find that economic size and population increase agricultural exports, but distance and protection have negative effects.

The results from these empirical studies may suffer from three problems. First, many economic series are integrated, typically of order one, I(1), and OLS (or maximum likelihood) regressions between such non-stationary series using fixed and random effects models are in general spurious. The exception is where two or more non-stationary series move together and their linear combination is stationary. Here, the series are cointegrated and a meaningful long-run equilibrium exists [31]. Second, endogeneity bias may exist because of correlation between the explanatory variables and the error term [16]. Third, an omitted explanatory variable may also lead to endogeneity bias if correlated with an included regressor [65]. In cross-sectional studies, endogeneity bias is typically resisted by including additional explanatory variables; and in studies that use panel data, it is resisted by including individual (country) effects. Fixed and random effects models however do not control for endogeneity bias arising from the joint determination of exports and the explanatory variables. The dynamic OLS (DOLS) estimator, on the other hand, allows the error term to be correlated with leads and lags of the changes in the nonstationary regressors and therefore accounts for possible bidirectional causality between exports and GDP in particular. To address these estimational issues, [65] uses panel cointegration methods to explain bilateral export flows from 12 EU countries to 20 OECD trading partners. Their method comprises testing for panel unit roots, testing for panel cointegration, and estimating the gravity model by DOLS. We follow this method and are unaware that it has been applied elsewhere to estimate a gravity model of either total or agricultural exports.

MATERIALS AND METHODS

The gravity model stems from Newton's gravity principle in physics that two objects attract each other in proportion to their mass and in inverse proportion to their distance. The attractive force between two objectives i and j is:

$$F_{ij}=G*(M_i*M_j)/(D^2_{ij}) \quad (1)$$

where F_{ij} is the attractive force, M_i and M_j denote masses, D_{ij} is the distance between the two objects, and G is a proportionality constant. [66] adapted (1) to examine bilateral trade flows between countries by substituting the economic size of two trading countries for masses. [51] also incorporated population to measure economic size and this has become the widely applied 'augmented gravity model'. Initially, these models of international trade were *ad hoc* but theoretical underpinnings were later provided *inter alia* by [1], [40] and [13]. [1] stated that the properties of expenditure systems can be used to obtain the gravity equation. In his study, the gravity model is derived by assuming Cobb-Douglas preferences. [13] employed monopolistic competition (according to the approach, products are differentiated among producing firms) to provide a theoretical foundation of the gravity model, while earlier [1] had adopted a 'product differentiation by place of origin' approach (it is the Armington assumption [4]). [40] also adopted the monopolistic competition approach by assuming increasing returns to scale.

A variety of gravity models have since been estimated to explain the determinants of trade where export volume between pairs of countries (or country groups) is determined principally by economic size and geographical distance (see for example, [36]; [26]; [2]). A commonly-used proxy for economic size is gross domestic product (GDP) and countries with larger incomes tend to trade more. More specifically, GDP in both exporter and importer country is hypothesised to have a positive effect on bilateral trade flows. Geographical distance is a proxy for transportation costs, and it is hypothesised that the trade volume between partners is inversely related to distance since longer distances typically involve higher transport time, communication and costs, and they also increase product prices and diminish competitiveness.

We hypothesise a gravity model where the conventional determinants of Turkish agricultural export are economic size and geographical distance. Other hypothesised determinants in the literature are similarity in economic size [39, 21, 9, 65, 14], relative factor endowments [40, 24], FTAs [45, 47, 12], religious commonality [30, 20], and the expatriate population in importing countries [6, 24].

The hypotheses, relating to these explanatory variables, are as follows.

A similarity of size index (SGDP) is used as a method to detect intra-industry trade patterns between two trading countries. A similarity in size creates two-way trade for differentiated goods. When there is an increase in the share of differentiated goods, a larger trade volume usually occurs. Therefore, a similarity in country size becomes an important determinant of the trade volume [39]. The expected effect of SGDP on the bilateral trade flows is positive.

The factor proportions (Heckscher-Ohlin) theory states that a country is better off exporting the goods that use its relatively abundant factor (capital, labour, and land) [43]. The differences in the factor endowments determine the comparative advantage. For example, if a country has abundant land, the country produces goods requiring a high ratio of land to capital and labour. Thus, the country has a comparative advantage in land-intensive goods and exports more of these. Accordingly, differences in relative factor endowments (RFE) increase trade between two countries.

One of the main goals of Free Trade Agreements (FTAs) is to positively influence bilateral trade flows. The impact of FTAs has been widely analysed in gravity models but results are ambiguous. Some studies show trade creation and diversion [57, 44] while others do not [23, 8].

A common main religion (RLG) indicates similarity in cultural values and norms which might be expected to increase bilateral trade between partners.

An increase in population results in demand augmentation. The demand for Turkish goods may also be expected to rise when the Turkish population (TP) living in Euro-Mediterranean countries rises because of similar tastes and preferences. More demand for Turkish agri-food products in the Euro-Mediterranean countries may lead to an increase in Turkish exports to this region.

Adopting the commonly-used log-linear function, the gravity model we estimate is:

$$AX_{it} = \beta_0 + \beta_1 TGDP_{it} + \beta_2 DIS_i + \beta_3 SGDP_{it} + \beta_4 RFE_{it} + \beta_5 FTA_{it} + \beta_6 RLG_i + \beta_7 TP_i + \varepsilon_{it} \quad (2)$$

where i denotes Euro-Mediterranean country i=1,…,n and time is t=1,…,T. Other definitions are as follows. AX_{it} is the (logged) real (2005) value of Turkish agricultural exports to country i ('000 US$); it is non-zero trade values. $TGDP_{it}$ is the (logged) sum of GDPs for Turkey and country i, ('000 US$); it is a proxy for economic size, and we expect that $\beta_1>0$. DIS_i is the (logged) distance between capital cities in Turkey and country i (kilometres); it is a proxy for transport costs, and we expect that $\beta_2<0$. $SGDP_{it}$ is the (logged) similarity of economic size index for each country pair from the GDP shares of Turkey and country i. Following [39], $SGDP_{it}$ is (logged) $SIMIND_{it}=1-[GDP_{Turkey}/(GDP_{Turkey}+GDP_i)]^2-[GDP_i/(GDP_{Turkey}+GDP_i)]^2$, and $0\leq SIMIND_{it}\leq 0.5$. When $SIMIND_{it}=0.5$, there is similarity in economic size, and as $SIMIND_{it}\rightarrow 0$, there is extensive dissimilarity. We expect that $\beta_3>0$. RFE_{it} denotes relative factor endowments. Adapting [40] proxy, $RFE_{it}=|\ln N_{Turkey}-\ln N_i|$ where N is agricultural land *per capita* (1,000 ha), and we expect that $\beta_4>0$. FTA_{it} is a dummy which =1 if country i has an FTA with Turkey, and =0 otherwise, and the sign of β_5 is uncertain. RLG_i is the (logged) percentage of Muslims in the population of country i; it is used to proxy the influence of common religion (in Turkey, 99% of the population is Muslim), and we expect that $\beta_6>0$. TP_i is a dummy for the expatriate Turkish population living in country i. Following [6], $TP_i=1$ if the proportion of Turks in country i is larger than 2% of the total population and =0 otherwise. The proportion of Turks living in other countries is available only for 2010 and is time-invariant. We expect that $\beta_7>0$ due to similar tastes and preferences with the indigenous population in Turkey. Finally, ε_{it} is an error term with the usual properties.

The balanced panel dataset consists of annual observations for 1969-2010 for 30 Euro-Mediterranean countries (n=30, T=42). The total number of observations is 1,260 and the list of countries is as follows; from the EU: Austria, Belgium-Luxemburg, Bulgaria, Cyprus, Czechoslovakia (now Czechia and Slovakia), Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Malta, the Netherlands, Poland, Portugal, Romania, Spain, Sweden and the UK; and from non-EU: Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Syria and Tunisia. The data used in the analyses are obtained from the following sources: Nominal values of Turkish agricultural exports to other countries ('000 US$) from [67] and [68], GDP ('000 US$) and deflator from [69], Agricultural land (1,000 ha) from [27], Free trade agreements from [63], Distance between capital cities in Turkey and other countries (km) from [17], Religion from [60] and Turkish population living in other countries from [52]. Our empirical method has three steps: first, we test for panel unit roots; second and conditional on the existence of unit roots, we test for panel cointegration; and third and conditional on finding panel cointegration, we estimate the gravity model in (2).

A number of panel unit roots tests have been developed where the null is a unit root and the alternative is that some series are stationary. 'First-generation' tests such as [41] assume that the cross-sections of the panel are independent, while 'second-generation' tests such as [61], [53], [7] and [19] assume cross-sectional dependency. The effect of cross-sectional dependency depends on various determinants and ignoring it may affect the consistency and efficiency of the estimated parameters. It may also lead to some problems in application of panel unit root tests. Thus, we first test the null of no cross-sectional dependency by adopting [59] bias-adjusted (Breusch-Pagan) LM-test, and rejection implies that second-generation unit root tests are more appropriate. Since panel unit root tests often produce inconsistent results, we use several to seek a consensus. We also use Hadri and Kurozumi's test [35] which reverses the null and alternative hypotheses: the null is that all series are stationary and the alternative is that the panel has a common unit root.

Panel cointegration tests are also divided into first- and second-generation tests depending on whether cross-sectional dependency is admitted or not. Conditional upon finding both unit roots and cross-sectional dependency, second-generation panel cointegration tests are employed, and we implement those of [70]. These four tests are built on structural rather than residual dynamics, and their power does not suffer from restrictions arising from common factors. In a conditional error-correction model, the null in each test is that the error-correction term is zero, that is, the null is non-cointegration. Group mean test statistics are denoted as G_τ and G_α, and there is cointegration for at least one country when the null is rejected. Panel test statistics are denoted as P_τ and P_α, and rejection of the null implies that the panel is cointegrated as a whole. Bootstrapping makes inference possible under general forms of cross-sectional dependence and all tests are normally distributed. G_τ- and P_τ-statistics are calculated using the standard error of the error-correction term which is estimated in a standard way; while G_α- and P_α-statistics are obtained using the Newey-West adjusted standard errors for heteroscedasticity [58].

Conditional on the existence of panel cointegration, we estimate the parameters of the gravity model in (2). [56] examines two panel estimators: DOLS and fully modified ordinary least squares (FMOLS). Both correct for endogeneity and serial correlation to permit standard inferences. DOLS is a parametric method where lags are explicitly estimated, while FMOLS is a non-parametric method which deals with serial correlation using a heteroscedasticity and autocorrelation consistent estimator of the long-run covariance matrix; and both correct for OLS bias induced by endogeneity. Both methods can be used to provide within- or between-group estimates. [56] argues that the between-group (or group mean) estimator is preferred because it has relatively minor size distortions in small samples, the t-statistics permit more flexible alternative hypotheses and in particular the estimated parameters need not be the same for all countries under the alternative, and it allows for heterogeneity across countries. Accordingly, we use the between-group estimator. [10] also shows that DOLS performs better than FMOLS even though both have small sample bias. Time-invariant variables are problematical due to collinearity and a two-stage regression method is applied following [18]: first, the model is estimated using DOLS; and second, the estimated country effects from the first stage are regressed on the time-invariant variables (DIS, RLG, and TP) to obtain their coefficients.

RESULTS AND DISCUSSIONS

To determine whether first- or second-generation unit roots are appropriate, we test the null of no cross-sectional dependence using bias-adjusted test of [58]'s which yields LM=1,792.82 (p-value: 0.00) and the null is rejected. Accordingly, second-generation unit root tests are used and Table 1 presents the results for the continuously time-varying series. For exports, only the PANIC (Panel Analysis of Non-stationarity in Idiosyncratic and Common Components) test shows that AX~I(1) at the 10% significance level whereas Phillips-Sul, Moon-Perron, and Choi tests imply that AX~I(0). TGDP and RFE are I(1) in all tests, as is SGDP except in the Moon-Perron test. Hadri-Kurozumi tests imply that all series are I(1). Overall, there is some evidence that all series are I(1). Panel cointegration techniques appear appropriate, and the case for using fixed or random effects models is weak.

Table 1. Panel Unit Root Tests

	Phillips-Sul Z-test	Moon-Perron t^*_b-test	Choi Z-test	PANIC P^E_C-test	Hadri-Kurozumi Z^{LA}_A-test
AX_{it}	91.28*	-10.87*	-8.67*	-1.12†	6.15*†
	[0.01]	[0.00]	[0.00]	[0.55]	[0.00]
$TGDP_{it}$	16.01†	0.89†	0.66†	-0.45†	14.67*†
	[0.99]	[0.81]	[0.74]	[0.67]	[0.00]
$SGDP_{it}$	15.76†	-5.60*	-4.89*	-0.18†	21.60*†
	[0.99]	[0.00]	[0.00]	[0.43]	[0.00]
RFE_{it}	10.66†	0.34†	3.18†	-3.14†	9.22*†
	[0.99]	[0.63]	[0.99]	[0.99]	[0.00]

Source: Own calculation.
Notes:
1. p-values in square brackets. Asterisks (*) indicate (1%) level of statistical significance.
2. † denotes a unit root at the 10% significance level.
3. Models in Phillips-Sul, Moon-Perron, Choi, and Hadri-Kurozumi tests include a constant and trend; in Phillips-Sul tests, the number of lags is determined by a general-to-specific method; in Choi tests, four lags are used; and in Hadri-Kurozumi tests, the number of lags is $T^{1/2}\approx 7$ following [48].

The results of [70]'s panel cointegration tests are shown in Table 2. The Bartlett kernel window width is $4(T/100)^{2/9}\approx 3$; one lag and one lead are used to resist over-parametrization; and robust critical values are computed using 500 bootstrap replications. In the model that includes a constant as the only deterministic term, and at the 10% significance level, group mean G_τ- and G_α-statistics both reject the null of non-cointegration and there is cointegration for at least one country.

Similarly, panel P_τ- and P_α-statistics both reject the null of non-cointegration and there is evidence of cointegration for the panel as a whole. In the model which also includes a trend, the results are not so clear: the G_τ-statistic rejects the null, whereas G_α-, P_τ- and P_α-statistics fail to reject. Overall, there is evidence of cointegration and we proceed to estimate the gravity model in (2).

Table 2. Panel Cointegration Tests

	Constant Model	Trended Model
G_τ	-3.14*	-3.24*
G_α	-11.96*	-10.90
P_τ	-13.43*	-12.12
P_α	-8.91*	-7.73

Source: Own calculation.
Note:
1. * denotes significance at the 10% level.

Following the two-stage method of [18], we use DOLS to estimate (2). One lead and one lag are used to address serial correlation and endogeneity, and Table 3 shows the results. All estimated coefficients have *a priori* expected signs and three are significant. First, a 1% rise in the sum of GDPs for Turkey and an importer country (TGDP) will increase Turkish agricultural exports to Euro-Mediterranean countries (AX) by 1.6%, which supports the positive relationship identified for Turkey by [24]. Second, a 1% increase in the distance between Turkey and an importing country (DIS) will decrease Turkish agricultural exports by 0.8%. For Turkey, this finding supports [24] and [5], but contrasts with [55]. The decrease in exports due to distance shows that Turkey should pay attention to trade more with geographically close countries. Third, a 1% rise in relative factor endowments (RFE) will increase Turkish agricultural exports by 1.4%, and this also supports the finding of [24]. The significant positive effect of relative factor endowments, measured in our model by agricultural land *per capita*, has some policy implications. In particular and in terms of land-use planning, Turkey's rapidly increasing population and a buoyant tourism industry create greater demands for urbanisation with a commensurate loss of agricultural land especially in the fertile coastal plains, and careful attention needs to be paid to these competing demands on land. Conversely, the similarity of size of the economies of Turkey and an importing country (SGDP) is an insignificant determinant of Turkish agricultural exports. This finding does not support those of [21] who uses general method of moments, [9] who uses fixed and random effects models, or [65] who uses panel cointegration methods. The result may indicate that Turkish agricultural trade is primarily inter-industry rather than intra-industry and that therefore Turkey should focus more on product differentiation strategies. Religious commonality between Turkey and an importing country (RLG) is also insignificant, which does not support the findings of [30] who uses OLS, or of [20] who uses fixed effects models. Turkey has a secular system which is based on modern principles, although 99 per cent of the Turkish population is Muslim. This may show that having a common main religion for Turkey may not fully represent similar cultural values and norms with other Muslim countries in the Euro-Mediterranean region. Similarly, the proportion of expatriate Turks living in the importing country (TP), which is used as a proxy for common tastes and preferences, is also insignificant. This result contrasts with the significant and positive effects found by [6] who uses OLS and a random effects model, and by [24] who uses fixed and random effects models. This result may arise due to data limitations in measuring the Turkish population living in the Euro-Mediterranean country. Further, FTA is insignificant and this finding does not support the notion that FTAs between Turkey and other Euro-Mediterranean countries lead to higher Turkish agricultural exports. This contrasts with [45] and [12] who generally find positive effects from fixed effects models, and with [47] who finds a negative effect from SURE. The insignificant result for FTAs between Turkey and Euro-Mediterranean countries is surprising and may reflect the extent of government intervention in the agricultural sector, both in Turkey and, more particularly, its trading partners. It is well known that government protection of agriculture, including domestic measures, distorts international trade. Such measures are likely to have hindered the development of Turkish agricultural exports, but are unaccounted for in our gravity model. To see the full benefits of free trade agreements, Turkey should reduce high tariffs and remove export subsidies in the hope that trading partners will act likewise. Also, an increase in deficiency payments and the abolition of direct income supports show that agricultural policies applied by Turkey are moving in the opposite direction to the CAP reforms; and the CU agreement between Turkey and the EU exclude agriculture from the treaty. Thus, Turkey should consider implementing the CAP-type reforms, and the EU and Turkey should produce policies towards a free movement of agricultural products. Last, but not least, to gain more from the FTAs in the Euro-Mediterranean region, an imbalance in the distribution of financial resources and high protection levels should be reduced; and the EU and Mediterranean countries should eliminate the obstacles by forthcoming reforms of the agricultural policies to create a freer trade area in the region. These attempts can substantially help Turkey in the process of agricultural liberalisation.

Table 3. Gravity Model Results (Dependent Variable: AX_{it})

	DOLS	Two-way Fixed Effects	Two-way Random Effects
Constant	11.94*	6.91	11.95*
	(2.51)	(6.75)	(2.44)
$TGDP_{it}$	1.56*	1.26	1.92*
	(0.23)	(1.15)	(0.31)
DIS_i	-0.82*	-	-1.23*
	(0.32)		(0.38)
$SGDP_{it}$	0.31	0.20	0.67*
	(0.37)	(0.60)	(0.33)
RFE_{it}	1.40*	1.67	0.43
	(0.60)	(1.16)	(0.33)
FTA_{it}	0.09	0.28	0.27
	(0.14)	(0.28)	(0.26)
RLG_i	0.02	-	0.26*
	(0.83)		(0.09)
TP_i	-0.11	-	-0.16
	(0.37)		(0.35)
R^2	0.37	0.59	0.59

Source: Own calculation.
Notes:
1. Standard errors in parentheses.
2. * denotes significance at the 5% level.
3. The number of observations is 1260.

For comparison, we also estimate both two-way fixed and random effects models [33] which have been used in many previous studies. Preliminary hypothesis tests are as follows. First, the tests of Breusch and Pagan [15] and Baltagi and Li [11] imply that heteroskedasticity and serial correlation are present, and White's [71] robust standard errors are estimated. Second, there are both country and time effects which imply a preference for two-way models. Third, Hausman's [38] test implies that country effects are uncorrelated with other regressors and the more efficient random effects model is preferred. Notwithstanding this preference, Table 3 shows the results from the fixed effects model and all estimated coefficients are insignificant. This is perhaps not surprising: estimated coefficients in fixed effects models tend to be insignificant because individual (country) and time effects dominate. Results from the random effects model in Table 3 show that all estimates have *a priori* expected signs and significant determinants include the conventional gravity variables TGDP and DIS, as in the results from DOLS. In contrast to DOLS results, SGDP and RLG are also significant whereas RFE is not. There are clear differences between the results from DOLS and those from fixed and random effects models. Results from the latter appear spurious because fixed and random effects models are inappropriate in the presence of non-stationary variables.

CONCLUSIONS

This paper explores factors that determine agricultural exports from Turkey to Euro-Mediterranean countries. A gravity model is estimated with annual panel data for 30 Euro-Mediterranean countries for 1969-2010, and we use recent panel cointegration methods to address problems inherent in fixed and random effects models. Hypothesised determinants of Turkish agricultural exports include the conventional gravity model variables of economic size and the distance between Turkey and its export markets. Additional variables include relative factor endowments, FTAs, religious commonality, and the expatriate Turkish population in importing countries.

Panel unit root tests, which are used to test whether time-varying variables are non-stationary under cross-sectional dependency, show evidence that these series contain unit roots. Panel cointegration tests are therefore performed and results show that there is a meaningful long-run relationship between agricultural exports and the time-varying explanatory variables. DOLS is therefore preferred to fixed and random effects models to estimate our gravity model, and results show that the two conventional variables of economic size and distance are significant determinants of Turkish agricultural exports. First, a 1% rise in the sum of Turkey's and an importing country's GDPs will increase Turkish agricultural exports by 1.6%. Second, a 1% decrease in distance between Turkey and its export markets leads to a 0.8% increase in Turkish agricultural exports. In addition, a 1% rise in relative factor endowments will significantly increase Turkish agricultural exports by 1.4%.

By contrast, the similarity of size in the economies of Turkey and an importing country does not significantly affect Turkish agricultural exports. We also find that bilateral FTAs with Euro-Mediterranean countries are insignificant and therefore do not increase Turkish agricultural exports. Religious commonality between Turkey and an importing country is also insignificant. We further find no evidence that a Turkish expatriate population in an importing country is significant.

The significance of the two conventional gravity model variables - economic size and distance - implies that the gravity model framework is appropriate to examine Turkish agricultural exports, and a focus on exporting to large and near neighbouring countries is a sensible policy objective. The significant positive effect of relative factor endowments also shows that differences in agricultural land *per capita* result in a positive effect on bilateral trade flows. Turkey needs to pay careful attention to the competing demands on its agricultural land from urbanisation and tourism. The insignificant result for FTAs with Euro-Mediterranean countries may suggest that reductions in agricultural protectionism would enhance Turkish exports, but our simple dummy variable for FTAs fails to distinguish any nuanced differences.

Finally, most previous empirical studies that estimate gravity models adopt fixed and random effects models. Critically, they do not consider the statistical properties of the variables, namely non-stationarity, and consequently estimated relationships may be spurious. This is the most likely reason why there are differences between our results and those elsewhere. Indeed, a comparison here of estimates from panel cointegration methods using DOLS and those from fixed and random effects models show clear biases in the latter, and heterogeneity appears to be an important problem in the estimation of gravity models, as [65] observe. The choice of method to estimate gravity models matters and inappropriate econometric methods may lead to inappropriate policy implications.

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