Determinants of dried fruit products sector export: A gravity model for Türkiye

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ABSTRACT

Agriculture contributes to economic development as well as meeting the basic nutritional needs of a society. The dried fruits and dried fruit products industry is one of the leading industries contributing to the national economy and forms a significant part of the agricultural industry. This study investigates the determinants of Türkiye's exports of dried fruits and dried fruit products using the gravity model. In this context, the data for the 2005-2021 period for 78 countries importing dried fruits and dried fruit products from Türkiye were analyzed using the Poisson Pseudo Maximum Likelihood estimator (PPML). The analysis revealed that the GDP of Türkiye and the importing country, nominal exchange rate, EU membership of the importing country, the availability of a free trade agreement with the importing country and the average surface temperature changes, positively impact Türkiye's exports of dried fruits and dried fruit products. Whereas the distance between countries, which is a good indicator for transportation costs, negatively affects Türkiye's exports of dried fruits and dried fruit products. The results of the analyses show that exports of dried fruits and products exhibit similar results to that of exports of agricultural products. Additionally, the gravity model for exports of dried fruits and dried fruit products is valid for Türkiye.

1. Introduction

The agricultural industry is dependent on a variety of natural factors such as weather conditions, climate change, soil quality, water resources and other environmental factors. Therefore, the agricultural industry carries a greater element of uncertainty and risk compared to other industries. However, agriculture is an indispensable industry across the globe due to its provision of raw materials and capital to other industries, feeding the growing population, contributing to national revenue and employment, etc., as well as its impact on ecological balance. Agriculture has played an integral role in the economic and social development of countries throughout history and is expected to continue to play a major role in the future (Erdinç and Erdinç 2018).

The globalization of international trade has greatly contributed to the development of agribusiness in recent years (Qiang et al. 2013). With the growth of agricultural exports, it has increased the productivity of domestic production in the national economy, improved the welfare of those employed in the agricultural industry, and provided resources for other imports (FAO 1995). In addition to providing foreign exchange, agriculture also contributes to the growth of related industries such as production, packaging and logistics. As agriculture contributes to the economic development of countries, its weight in the overall economic structure gradually decreases over time. However, even in this case, agriculture deeply concerns all segments of the society with its economic, social and environmental aspects (Doğan et al. 2015).

Türkiye, which is one of the important actors in the global agricultural economy with its rich biological diversity, different climatic and geographical characteristics and developed agricultural industry, has 0.8% of the world's total farmland and accounts for 1.35% of the world's agricultural production. Ranked among the top 10 countries in the world's agricultural production, with an annual agricultural production value of USD 50 billion, Türkiye is also one of the countries that have a major say in the world's agricultural products. As a matter of fact, Türkiye, which realizes 1.64% of the world's agricultural exports and 1.14% of its imports, is a country with a foreign trade surplus. Türkiye's fertile soils and large agricultural lands allow fruits and vegetables to be grown in high quality and good conditions thanks to its climatic diversity in different regions (AKİB 2023). Türkiye is a leading country in the trade of dried fruits and dried fruit products with its wide product range and high product quality.

Agriculture is a fundamental component of the Turkish economic system, as in other developing countries, and plays a critical role in the development of the country. Although its relative importance is gradually decreasing in the process of economic development, the agriculture sector continues to be one of the main pillars of socioeconomic life in Türkiye today as it was in the past. Table 1 shows Türkiye's export data for the 2005-2022 period. As shown in Table 1, total exports of Türkiye increased by 246% from 2005 to 2022. The growth of the agricultural industry has been in parallel with the growth in total exports. In 2005, agricultural exports amounted to over USD 9.5 billion, reaching USD 34 billion in 2022. During this period, dried fruit exports increased by 147% from USD 636 million to

USD 1.6 billion. As shown in Table 2, Türkiye ranks high in the global exports of dried fruits and dried fruit products. Türkiye ranks first in the world in the export of raisins, dried apricots and fresh or dried figs, and second in unshelled pistachios. Raisins, dried apricots and dried figs are the most exported products. It is noteworthy that exports of dried apples and dried plums are very small compared to other products. Türkiye's share in the global export of dried apricots and fresh or dried figs is high. The three products with the highest unit prices in USD are pistachios, walnuts and almonds. Table 2 shows that Türkiye exports almonds mostly to nearby countries and dried apricots to distant countries.

Due to Türkiye's position in this industry, it is important to investigate the factors affecting the export of dried fruits and dried fruit products. Given the country's position in global trade, the contribution of dried fruit and vegetable exports to the national economy can be increased by continuing to pursue a policy of growth in exports. This study differs from the literature in several points. First, exports of agricultural products or exports of fruits and vegetables have been studied in the literature, but the number of studies investigating exports of dried fruits and dried fruit products in Türkiye is not sufficient. There are also studies investigating the export of dried figs, raisins and dried apricots, but there is no study analyzing the entire industry using panel data. Another difference is the variables used in the present study. The use of agricultural loans provided by FAOSTAT and changes in average surface temperature tracked by NASA in the panel gravity model is yet another difference.

This study analyzes the determinants of Türkiye's exports of dried fruits and dried fruit products using the gravity model. The second section of the study includes a literature review on exports of dried fruits and dried fruit products and agricultural exports, both with time series and panel data. The third section introduces the data used in the study and provides information about the panel gravity model. The fourth section presents the methodology used in the study and the results of the analysis. The final section of the study, namely the conclusion, provides a general assessment and recommendations.

2. Material and Methods

The gravity model is an economic model that is frequently used to explain trade between countries. This model is similar to Isaac Newton's "Law of Universal Gravitation" in physics. When this law is applied to international trade, countries seem to trade in proportion to their size and the distance between them (Yotov et al. 2016). The first adaptation of the gravity model to international trade was introduced by Jan Tinbergen in 1962. Model 1 shows the traditional gravity model (Tinbergen 1962):

$$F_{ij} = aY_i^{\beta_1}Y_j^{\beta_2}D_{ij}^{\beta_3} \tag{1}$$

F_{ij}: exports of country i to country j
Y_i: economic size of country i
Y_j: economic size of country j
D_{ij}: geographical distance between country i and country j
a: represents the constant coefficient of the model and $\beta_1, \beta_2, \beta_3$ represent the coefficients of the variables in the model.

According to Model 1, where Tinbergen explains trade flows, although there are many variables that explain foreign trade between countries, the three most important factors are the economic size of the exporting and partner countries and the geographical distance between the countries. These three factors indicate that exports are positively affected by the economic size of the exporting and partner countries, while distance is negatively affected by transportation costs. Variables other than these three factors seem to have a limited effect on exports (Tinbergen 1962). Model 2 is a linearly rearranged representation of Model 1 by taking its logarithm (Tinbergen 1962):

$$LogF_{ij} = \vartheta + \vartheta_1 logY_i + \vartheta_2 logY_j - \vartheta_3 logD_{ij} + \varepsilon_{ij} \tag{2}$$

In Model 2, $\vartheta_1, \vartheta_2, \vartheta_3$ are the coefficients of the independent variables to be estimated and ε_{ij} is the error term in the model. Economic size and geographical distance are the main variables of the gravity model, but Model 2 can be extended with appropriate variables in econometric studies. In the extended gravity model, a number of different factors such as the population of the countries, social ties, trade agreements and spatial conditions can be added to the model (Dayıoğlu and Kaplan 2016).

After the 1970s, there have been several studies trying to establish the theoretical foundations of the gravity model. In one such study, Anderson (1979) reduced the constant elasticity of substitution of the expenditure system from the Cobb-Douglas

Table 1. Export Values ($) and rates of change (%) by industry in Türkiye

Sectors	2005	2022	Rate of Increase (%)
A. Total exports	73426151	254209535	246.2%
I. Manufacturing	62243740	185880772	198.6%
II. Mining	1513969	6469002	327.3%
III. Agriculture	9668441	34246492	254.2%
I. Dried fruit exports	636747	1573464	147.1%

Source: TİM (2023) Türkiye Exporters Assembly. https://tim.org.tr/tr/ihracat-rakamlari Accessed 26 February 2023.

Table 2. Data of Türkiye's dried fruits and dried fruit products industry (2021)

Products	Exports	Price (USD)	Share in global exports	Global ranking	Average distance
Raisin	478849	1862	27.6%	1	3582
Dried apricot	338351	3856	72.3%	1	5042
Fresh or dried fig	330514	3623	42.8%	1	3965
Pistachio (unshelled)	174713	12893	22.9%	2	2314
Almond (unshelled)	110879	6757	2.0%	7	1515
Walnut (unshelled)	45379	6938	1.8%	8	2321
Dried apple	10408	1751	7.4%	4	2392
Dried plum	331	3194	0.5%	15	3901

Source: TradeMap (2023) Statistical database.

production function and in this model, consumers are able to distinguish that goods differ depending on their country of origin (Demir and Bilik 2018). The main disadvantage of Anderson's (1979) model is that it does not consider price differences. In this respect, Bergstrand (1985), who later emphasized price differences in the model, proposed a supply-side gravity model that includes price differences. Bergstrand (1985) included the income levels of exporting and importing countries and the distance parameter representing the transportation cost for importers (Zaimovic 2022). Based on the general gravity model, models that include extended cases of Model 2 are given below:

$$LogEXP_{ijt} = \beta_0 + \beta_1 logTRGDP_{it} + \beta_2 logPGDP_{jt} - \beta_3 logDistance_{ij} + \beta_4 ER_{ij} + \varepsilon_{ijt} \quad (3)$$

$$LogEXP_{ijt} = \alpha_0 + \alpha_1 logTRGDP_{it} + \alpha_2 logPGDP_{jt} - \alpha_3 logDistance_{ij} + \alpha_4 logLOAN_{ij} + \varepsilon_{ijt} \quad (4)$$

$$LogEXP_{ijt} = \gamma_0 + \gamma_1 logTRGDP_{it} + \gamma_2 logPGDP_{jt} - \gamma_3 logDistance_{ij} + \gamma_4 logTMP_{ij} + \varepsilon_{ijt} \quad (5)$$

$$LogEXP_{ijt} = \delta_0 + \delta_1 logTRGDP_{it} + \delta_2 logPGDP_{jt} - \delta_3 logDistance_{ij} + \delta_4 EU_{ij} + \varepsilon_{ijt} \quad (6)$$

$$LogEXP_{ijt} = \theta_0 + \theta_1 logTRGDP_{it} + \theta_2 logPGDP_{jt} - \theta_3 logDistance_{ij} + \theta_4 FTA_{ij} + \varepsilon_{ijt} \quad (7)$$

In these models, i represents Türkiye, j represents partner countries (1,2,3,…,78), t represents time (2005-2021) and ε_{ijt} represents the error term. Table 3 shows definitions and sources of the variables used in the study. EXP is Türkiye's exports of

dried fruits and dried fruit products, PGDP is the GDP of the partner country, TRGDP is the GDP of Türkiye and distance is the distance between the capitals of the countries in kilometers. In addition, ER is the nominal exchange rate, LOAN is the loans provided to the agricultural industry in foreign currency, TMP is the change in the average annual surface temperature, EU is the EU membership of the partner country, and FTA is a dummy variable indicating the existence of a free trade agreement with the partner country.

3. Results and Discussion

In econometric studies, the panel gravity model is estimated with the Least Squares (LS) method by taking the logarithm of the series. Due to the use of the LS method, the error term is assumed to have constant variance (Kaplan 2016). However, Westerlund and Wilhelmsson (2011) showed in their study that this assumption is not always true and highlighted that the traditional fixed effects estimator is biased in this case. Therefore, Westerlund and Wilhelmsson (2011) argue that it would be correct to use the fixed effects Poisson Pseudo Maximum Likelihood estimator with bootstrap standard errors to analyze the gravity model (Keskin 2019).

In their study, Santos Silva and Tenreyro (2006) identified through Monte Carlo simulation experiments that the constant variance is neglected by estimating logarithmized series (Santos Silva and Tenreyro 2006). In addition, if there are zero observations in the dependent variables, there is a problem in the estimation of the gravity model since the logarithm cannot be taken. Removing zero observations from the series or assigning very small values does not solve this problem (Keskin 2019). The use of the PPML estimator in cases of changing variance and zero observations in dependent variables in gravity model analysis yields more robust and consistent results than other estimation methods (Solmaz and Bayraktutan 2020). Therefore, this study utilizes the PPML estimator. Table 4 shows the results of PPML estimation.

Table 3. Definitions and sources of the variables used in the study

Variables	Definitions of Variables	Source
EXP	Türkiye's exports of dried fruits and dried fruit products	Türkiye Exporters'Assembly
TRGDP	GDP of Türkiye	World Bank
PGDP	GDP of the partner country	World Bank
Distance	Distance between the capital of Türkiye and the capital of the partner country in km	https://tr.distance.to/
ER	Nominal Exchange Rate (Buying)	The Central Bank of the Republic of Türkiye
LOAN	Türkiye's foreign currency denominated loans provided to the agricultural industry	FAOSTAT
TMP	Changes in annual average surface temperature	NASA
EU	Dummy variable indicating the EU membership of Türkiye's trade partner	Ministry of Foreign Affairs
FTA	Dummy variable indicating the existence of a free trade agreement between Türkiye and the partner country	Ministry of Trade

Table 4. PPML Estimation results

Variables	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	-0.533278	-0.33058	0.0468325	0.341628	-0.5532508	-0.493948
TRGDP	0.0829188*	0.075297*	0.063752*	0.048635*	0.083422 *	0.076878*
PGDP	0.0522198*	0.051949*	0.0519728*	0.051996*	0.0502569*	0.080995*
Distance	-0.0474839*	-0.04728*	-0.047302*	-0.04732*	-0.041556*	-0.046957 *
Exchange rate		0.003689*				
Agricultural loan			-0.008402*			
Temperature				0.087101*		
EU membership					0.0283924*	
FTA						0.0107523**

*represents 1% level of significance, while ** represents 5% level of significance.

According to the PPML estimation results in Table 4, it is concluded that the gravity model is valid for Türkiye's exports of dried fruits and processed products. It has been determined that the GDP of Türkiye and partner countries positively affects exports, while the distance has a negative effect. In his seminal work, Tinbergen (1962) states that expected signs for economic variables in explaining international trade are positive, indicating a positive relationship, while distance has a negative sign. The empirical literature on agricultural products also confirms these findings. (Erdem and Nazlioglu 2008; Atif et al. 2017; Kaplan 2016; Işın 2017; Sapa ve Droždz 2019; Arı ve Sayar 2020). However, the studies conducted have also reached findings indicating that distance does not have an impact on agricultural product exports (Atici and Guloglu 2006; Potelwa et al. 2016), or that an increase in per capita income of the partner country reduces exports (Abdullahi et al. 2022). The influence of exchange rates on agricultural product trade in a country is an important indicator for understanding the problems in economic development and trade in agricultural products (Schuh 1974). Indeed, it has been determined that the addition of the exchange rate variable to the model reveals that an increase in the exchange rate positively affects exports. The same result has been reached in studies conducted by Gündüz (2010), Nazlioglu and Erdem (2011), Verter and Bečvářová (2014), Atif et al. (2017), Orman and Dellal (2021), and Awoderu et al. (2022). Unlike these studies, Fidan (2006) has expressed that the real exchange rate does not have a significant impact on agricultural exports. Abdullahi et al. (2022), on the other hand, stated that currency depreciation negatively affected agricultural exports. In the study, it was found that the decrease in agricultural loans taken in foreign currency had a negative effect on exports. Bakari et al. (2020) and Ogunjobi et al. (2022) emphasized that agricultural loans have a positive effect on exports.

Climate change gives rise to unsuitable conditions for the cultivation of agricultural products, affecting the supply side of agriculture through its impact on productivity, arable land, and drought (Huang et al. 2011). Studies in the literature have shown that agricultural products are the most widely affected by climate change, as revealed by Nordhaus (1991), Pearce et al. (1996), and Cline (2007). However, in this study, it has been concluded that incorporating annual average increases in surface temperature into the model leads to an increase in the demand for dried fruit exports. Furthermore, a free trade agreement with importing countries or the importing country being a member of the EU has had a positive impact on dried fruit exports by reducing or completely eliminating trade barriers, thus facilitating trade in dried fruits. In their study analyzing Pakistan's agricultural exports, Atif et al. (2017) arrived at a similar conclusion.

4. Conclusion

With the rapid increase in the world's population, the need for food has increased dramatically, and is still on the rise. In today's world, where clean water resources are gradually diminishing, agricultural lands are shrinking and global warming poses a significant threat, access to sufficient and safe food, which is one of the most fundamental human rights and needs, is among the most important priorities of all nations of the world. In this context, the importance of the agricultural sector, which produces the food needed for societies to exist, is increasing. From this point of view, the agricultural industry is indispensable for all countries regardless of their level of development. Türkiye has a significant agricultural production potential due to its ecological structure and climate characteristics. Its high agricultural potential makes Türkiye a strategic country in agriculture in general and in the production and trade of dried fruits and dried fruit products in particular.

The purpose of this study is to identify the determinants of Türkiye's exports of dried fruits and dried fruit products. To this end, annual data for 78 countries covering the years 2005-2021 were used in the study. As a result of the literature review, the panel gravity model was preferred and analyzed using the PPML estimator. Türkiye's GDP and the importing country's GDP affect exports of dried fruits and dried fruit products positively, while the distance variable affects exports negatively. In addition, devaluation of the national currency, increases in the average surface temperature, the EU membership of the importing country and the existence of a free trade agreement with the importing country increase Türkiye's exports of dried fruits and dried fruit products.

An evaluation of the results of this study as a whole shows that since the depreciation of the national currency increases the exports of dried fruits and dried fruit products, consideration should be given to adjusting the exchange rate policy to the benefit of all components of the industry. In other words, it makes it important to adopt a competitive price policy in order to be persistent in the existing markets and to maintain its effectiveness. Moreover, as the national currency depreciates against foreign currencies, the amount of agricultural loans taken also decreases. Failure to meet the financing requirements needed in the production and trade of products leads to a decrease in both production and exports. In order to eliminate or mitigate this negative effect, decision makers should establish exchange rate policies by taking into account both the competitive price and the loans provided to the industry. A country's production capacity and the advantages of its geographical location, as well as its willingness and efforts to maintain mutual relations with other countries, are effective in its success in foreign trade. Türkiye should develop policies to make free trade agreements with its trade partners. Türkiye should make the best use of its potential and increase its share in the global agricultural products market by ensuring food security for its population as well as ensuring a competitive advantage in foreign markets through the commercial partnerships it develops. This will contribute more to the development of the country.

Considering the importance of the EU in Türkiye's dried fruit exports, it is necessary to closely follow the EU's policies on health, hygiene, quality standards, border regulations, and imports of agricultural products. In addition to the EU, neighboring countries also have a positive impact on Türkiye's dried fruit exports. In this respect, Türkiye's orientation towards bilateral trade relations with the EU and neighboring countries is the right policy, and this is confirmed by the results of the econometric analysis. In addition, exports of dried fruits to distant countries are adversely affected due to transportation costs. Considering the impact of both sharing a border and distance on exports, it is recommended that Türkiye further develop its trade relations with countries in its immediate neighborhood. It is also important for Türkiye to sign free trade agreements with more countries. The depreciation of the national currency has paved the way for Türkiye to be more competitive in international markets and export more, but the depreciation of the national currency has also negatively affected exports as it has increased the cost of foreign currency-denominated agricultural loans. In this respect, a more balanced policy on exchange rates is needed.

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