

Granger Causality Relationship Between Agricultural Gross National Product and Agricultural Exports: The Turkey Case

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ABSTRACT

This study aims to determine the long-term relationship between the agricultural gross national product and agricultural export in Turkey between the years 1998-2017. In the determination of the relationship, gross domestic product and the annual agricultural export data (1998-2017) were used. Initially, the unit root test was performed to identify long-term analysis. ADF method was used for the unit root test. In the long-term cointegration determination between the variables, Johansen cointegration analysis was performed. The presence of cointegration between the variables was determined in the cointegration test. The error correction model (VECM) was estimated based on the existence of a long-term relationship. Granger causality test was performed to determine the direction of the relationship between the variables. The causality analysis results reveal a bidirectional relationship between agricultural gross national product and agricultural exports in Turkey. The change in agricultural gross national product will also affect agricultural exports in an additional direction or the opposite. The growing importance of agriculture and supporting it in the economy will have a positive impact on the increase in national income.

Keywords: Agricultural exports, Agricultural gross national product, Cointegration, Johansen cointegration, Turkey

INTRODUCTION

The agricultural sector in Turkey is very important due to many reasons such as it provides the nutrition of the country's population, it contributes to national income and employment, it provides raw materials to the industry sector based on agriculture, and it contributes to foreign trade (Picard and Zeng, 2004). The agricultural sector is the most important sector that produces various foods, provides raw materials in the production of many foods in the food industry, and provides healthy nutrition for people in a society (Rehber and Vural 2018, Turhan and Tamer 2017). Its contribution to agriculture, national income, and employment and its contribution to other sectors have maintained its importance from past to present. Considering that the nutritional needs of people will never end and the world population increases every year, agriculture will also be among the basic sectors of countries in the future (Doğan, 2009).

In Turkey, 6.3 million people live in rural areas and 4.9 million people are employed in agriculture (Rehber and Vural, 2019). Turkey is highly capable of meeting its needs in terms of agricultural production. Also, since agricultural and agro-industrial products have an important share in export, agricultural foreign trade is of great importance for Turkey. The ratio of agricultural gross national product in total GNP is 5.8% (TRY 216.6 billion). Its share in the country's total exports is 3% (TRY 24 billion). This study aims to determine the relationship between agricultural exports and agricultural gross national product in Turkey. Finding out whether agricultural export provides agricultural growth or agricultural growth provides agricultural export is of paramount importance for the creation of national growth and development strategies (Carter et al, 1996).

This study tested the validity of the hypothesis of the growth of the agricultural gross national product based on agricultural exports using the annual data between 1998-2017. The results obtained contribute to agricultural policies.

MATERIALS AND METHODS

Granger causality analysis is a type of test used to determine the direction of the causality of the relationship statistically if there is a time-dependent delayed relationship between the two variables (Lee et al 2005). There are many studies on Granger causality analysis in the literature.

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Demirhan (2005) investigated the causal relationship between exports and growth in Turkey between the first quarter of 1990 and the first quarter of 2004. The causality relationship results exhibit that there is a one-way relationship between exports and growth and this one-way relationship is from exports to growth. This conclusion suggests that policies increase exports boost growth in Turkey.

Gül and Ekinci (2006) examined the causal relationship between nominal exchange rates and inflation in Turkey. The analyses established a long-term relationship between nominal exchange rates and inflation and that the causality relationship between exchange rates and inflation is one-way from exchange rates to inflation.

Using monthly data for the period 1987-2007, Bilgin and Şahnaz (2009) examined the relationship between exports and growth in Turkey. The study tested the export-based growth hypothesis. Granger causality tests and Wald (MWALD) tests transformed by Toda and Yamamoto (1995) were applied to determine the direction of the relationships between variables. According to the Toda and Yamamoto method, a one-way Granger causality phenomenon was observed from exports to the industrial production index, supporting the export-based growth hypothesis. Also, a bilateral causality relationship was obtained between export and international terms of trade.

Yapraklı (2010) determined the relationship between inflation and economic growth in the context of Turkey. Relationships between inflation rates and economic growth rate were analyzed econometrically using multivariate co-integration analysis and error correction-enhanced Granger causality tests and the study concluded that there is a one-way causality relationship from inflation to economic growth.

This study determines the long-term relationship between agricultural gross national product and agricultural exports in Turkey between the years 1998-2017. Gross national product and agricultural export annual data were used to determine the relationship. To determine the long-term analysis, the unit root test was performed initially. ADF method was used for the unit root test (Yuan and Bentler, 1998). In the determination of long-term cointegration between variables, Johansen cointegration analysis was performed. The cointegration test ascertained the presence of cointegration between the variables. Error correction model (VECM) was estimated based on the presence of a long-term relationship (McCracken, 2007).

To express the explanation of error correction equations, let us assume that there are two variables defined as ΔLY (TG) and ΔLT (TI). Accordingly, if the two variables are stationary and cointegrated, causality tests can be created according to the vector error correction model (VECM). The error correction-enhanced Granger causality model to be created for the two variables is as follows (Yapraklı 2010);

$$\Delta LY_t = \alpha_1 + \sum_{i=1}^m \beta_{1i} \Delta LT_{t-i} + \sum_{i=1}^n \gamma_{1i} \Delta LY_{t-i} + \sum_{i=1}^r \delta_{1i} ECM_{t,t-1} + u_t \quad (1)$$

$$\Delta LT_t = \alpha_2 + \sum_{i=1}^m \beta_{2i} \Delta LY_{t-i} + \sum_{i=1}^n \gamma_{2i} \Delta LT_{t-i} + \sum_{i=1}^r \delta_{2i} ECM_{t,t-1} + u_t \quad (2)$$

EViews 5.1 econometric analysis package program was used in the analyses.

The Relationship between Agricultural Exports and Agricultural Gross National Product in Turkey

Another positive effect of the agricultural sector on the economic development of the countries is that the sector provides foreign exchange through foreign trade (Tiffin and Irz, 2006). Foreign exchange inflows to countries are provided through the agricultural sector in three ways. The first of these is that the agricultural sector provides foreign exchange inflows by exporting agricultural products produced by countries. The second way is to ensure that foreign exchange, which is likely to go out of the country, remains in the country by providing import substitution as a result of agricultural production. The third way is to provide foreign currency inflow with the export of consumer goods as well as raw materials, as a result of the development of agriculture-based industrialization (Deran, 2005). Thus, agricultural foreign trade contributes to growth. To put it simply, export expansion increases factor efficiency and enables the adaptation of technological innovations and more efficient

use of resources (Ruttan, 2002). Also, an increase in economic growth is observed due to factors such as the advantages of foreign competition and the return of the scale effect of opening up to international markets (Hausmann et al., 2007). For these reasons, the promotion of exports is seen as a factor that increases the momentum of economic growth. Besides, new theoretical results reveal that trade can increase not only efficiency but also growth rate through technology effect (Şahnaz and Bilgin, 2009).

In economic terms, income is expressed as the total monetary amount of the physical value of the goods or products created at the end of production activity (Anonim, 2014). Gross Domestic Product (GDP), on the other hand, is defined as the currency value of all final goods and services produced within a country's borders and a certain period (Rehber, 2016). In terms of the agricultural sector, income can be expressed as the total monetary amount of the physical value of the products produced as a result of agricultural activities. The Agricultural GDP, which is calculated by the Turkish Statistical Institute (TUIK) with the production method, determines the impacts of the agricultural sector on the economic development, in other words, its contribution to the economy and the share of Agricultural GDP in the overall economy reveals the size of this contribution (Ege, 2011).

Table 1 exhibits the agricultural gross domestic product values with current prices and the shares of agriculture in the total gross domestic product in Turkey by years. On the other hand, reveals the agricultural export values and the annual shares of agriculture in the total exports of Turkey.

Table 1. The Share of Agricultural GDP and Agriculture with Current Prices (2009 = 100) .

Years	Agricultural GDP (thousand TRY)	Development Rate of Agriculture (%)	Share of Agriculture (%)
2009	81,234,274	9.1	8.1
2010	104,703,635	28.9	9.0
2011	114,838,169	9.7	8.2
2012	121,709,079	6.0	7.8
2013	121,709,079	0.0	6.7
2014	134,724,745	10.7	6.6
2015	161,447,917	19.8	6.9
2016	161,304,618	-0.1	6.2
2017	189,193,521	17.3	6.1
2018	216,666,387	14.5	5.8

Source: tuik.gov.tr

Turkey's agricultural GDP has increased steadily over the years (Table 1). This value reached the level of TRY 216 billion in 2018. Considering the development rate of agriculture in the last two years, significant increases have occurred. Thus, we see that the contribution of agriculture to the country's economy has increased despite important production and utilization problems. If there are more supports for the agricultural sector, it is possible to expect that the contribution will be higher.

Table 2. Turkey's Value of Agricultural Export by Years and Its Share in the Country's Exports.

Years	Agricultural Export (TRY)	The Share of Agricultural Export (%)
2009	5,830,134,621	3.7
2010	6,211,826,339	3.6
2011	7,133,894,941	3.1
2012	7,541,564,970	2.7
2013	9,058,995,690	3.1
2014	10,766,417,697	3.1
2015	11,840,978,786	3.0
2016	13,897,973,566	3.2
2017	16,652,450,932	2.9
2018	24,083,418,804	3.0

Source: tuik.gov.tr

The share of agriculture in GNP decreases over the years, as other sectors show much development proportionally. However, the share of agriculture in total agricultural exports generally maintains the same level (Table 2).

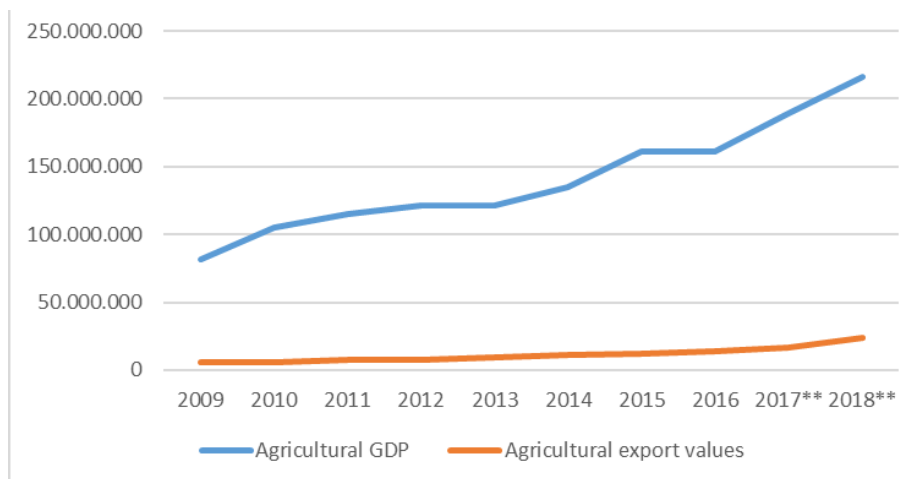


Figure 2. The comparison graph of agricultural GDP and agricultural export values, (2009-2018).
Note: Agricultural GDP* (thousand TRY), Agricultural Exports thousand.

As seen in the graphic above, there is a positive relationship between Agricultural GDP and Agricultural exports. Both values tend to increase over the years. The agricultural export increase trend is observed to be lower than the general development rate.

FINDINGS

This study aims to determine the existence of mutual causality relationship between agricultural GDP values and agricultural export values in Turkey. In the research, the analysis of GDP and export values data was done by econometric methods. As a method of analysis, Johansen cointegration analysis and Granger causality test were used. Augmented Dickey-Fuller (ADF) Unit Root Test was performed to determine the stationarity of the series (Akinboade and Braimoh, 2009; Curran et al, 1996).

The agricultural export time series data was not stationary as a result of the Augmented Dickey-Fuller (ADF) Unit Root Test. The first difference was tested to stabilize the series (Hoffmann et al, 2005). Augmented Dickey-Fuller (ADF) Unit Root Test was performed to determine the stationarity of the series. The agricultural gross national product time series did not come out as stationary after the stationarity test, as in the export time series. By calculating the first differences of the time series, the series was stabilized. Table 3 exhibits the results of the Augmented Dickey-Fuller (ADF) Unit Root Test for each variable.

Table 3. ADF test results (with constant term and trend).

	With Constant Term	With Trend	Test statistics
Agricultural GNP	2.0534	-2.2699	-5.0671
Agricultural Exports	4.1317	-0.09824	-5.1778

H_0 hypothesis is not rejected as the absolute value of the agricultural gross national product series test statistic (-5.0671) at the 5% significance level is greater than the table value (-4.2465). The series is stationary in constant and in trend at the first level. At the 5% significance level, the agricultural export time series was tested and the test statistic value (-5.1778) was greater than the absolute value (-4.2465) of the table value. The time-series sequence is stationary. This series is stationary in the constant and trend at the first level as in the other data set.

Table 4. Johansen Cointegration Test Results.

Number of cointegration vectors	Path test		λ -maximum test	
	Statistics	Critical value	Statistics	Critical value
r=0	56.77	15.49	39.37	14.26
r≤1	17.39	3.84	17.39	3.84

The findings from the Johansen cointegration test obtained are shown in Table 4. Since $0.00 < 0.05$ is found according to the test statistics for $r = 0$, H_0 is rejected at 5% significance level. In other words, there is cointegration between variables. The probability value for the Johansen test for $r = 1$ was 0.00. H_1 is accepted and there is at most 1 cointegrating vector.

To perform the causality test, it is necessary to determine the most suitable delay length for the model. AIC, SC, and HQ test results were used to determine the delay length of the VAR model (Table 5). As a result of the test, the smallest value is provided in two delays. The most appropriate delay length for the VAR model is 2.

Table 5. Table granger causality test delay length.

	AIC	SC	HQ
0	-6.635784	-6.615924	-6.769734
1	-8.391505	-8.331924	-8.793356
2	-13.15386*	-13.05455*	-13.82361*

*Delay length criterion at 5% significance level

Table 6. VEC granger causality test (with error-correction term).

H_0 hypothesis	Chi-sq	Probability	df
AGNP Granger AE does not cause	1.0522	0.305	1
AE Granger AGNP does not cause	2.3480	0.125	1

According to the test statistics results, H_0 is rejected. There is a two-way relationship between agricultural gross national product and agricultural exports in the long run. The agricultural gross national product affects agricultural exports and agricultural exports affect the gross national product (Table 6).

RESULTS

There is a large contribution of the agricultural sector to the economy in Turkey. Agriculture has contributions to Turkey's economy in the fields of employment, production, national income, industry, nutrition, and export. Considering the contributions of the country's agricultural sector in realizing the production and export of food, textile, furniture, and forest products, it has very important direct and indirect contributions to the country's exports.

This study investigated the effects of gross national product and agricultural exports of Turkey on each other by causality econometric methods. As a result of the analysis of the data, the causality relationship was found between agricultural gross domestic product and agricultural exports. While the increase in the agricultural gross domestic product of the country affects agricultural exports positively, the increase in agricultural exports also increases the agricultural gross domestic product. It is possible to indicate that negative results occur in case of a decrease in both.

Factors such as investment that cause growth in the agricultural gross domestic product also increase the support given to exports. As a result of the increase in the agricultural gross domestic product in exports, revenues from exports also contribute positively to agricultural gross domestic product. While agricultural exports can increase when agricultural economic growth is provided, attaching more importance and support to agriculture will increase the level of welfare in the country's economy and increase food security.

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