A COMPARATIVE ANALYSIS OF THE VALUE-ADDED AGRICULTURE INDICATORS FOR POLOND AND TURKEY

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Abstract
The agricultural sector creates added value for the country's economy by supplying raw materials to the industry, as well as the supply of foodstuffs necessary for nutrition. Value added refers to the difference between the monetary value of goods and services produced and the inputs used in production. In this study, the determinants of agricultural value added in Poland and Turkey for the period 1995-2018 were analyzed. In the study, while value added agriculture constituted the dependent variable, individual GDP, gross capital formation, ratio of agricultural land constituted the independent variables. An 1% change in agricultural land and GDP per capita changed value added agriculture in the same direction by 0.0643% and 2.8223% for Poland, respectively. On the other hand, an 1% change in gross capital formation changed value added agriculture by 0.0498% in the opposite direction. When the findings obtained for Turkey were evaluated, the agricultural land and gross capital formation coefficients were negative and statistically significant. GDP per capita coefficient was positive but statistically it was not significant. Accordingly, an 1% change in agricultural land and gross capital formation was expected to change value added agriculture per employee by 0.0365% and 0.0367% in the opposite direction for Turkey, respectively.
Keywords: Value Added Agriculture, Turkey, Poland, Cointegration

TARIMSAL KATMA DEĞER GÖSTERGELERİNİN POLONYA VE TÜRKİYE İÇİN KARŞILAŞTIRMALI ANALİZİ

Özet
Tarım sektörü, beslenme için gerekli olan gıda maddelerinin temininin yanı sıra sanayiye hammadde temin ederek ülke ekonomisine katma değer yaratmaktadır. Katma değer, üretilen mal ve hizmetlerin parasal değeri ile üretimde kullanılan girdiler arasındaki farkı ifade eder. Bu çalışmada, 1995-2018 döneminde Polonya ve Türkiye’nin tarımsal katma değerlerinin belirleyicileri analiz edilmiştir. Çalışmada tarımsal katma değer bağımlı değişkeni oluştururken, bireysel GSYİH, brüt sermaye oluşumu, tarım arazisi oranı bağımsız değişkenleri oluşturmuştur. Tarım arazisi ve kişi başına düşen GSYİH tarımsal katma değer üzerinde olumlu bir etkiye sahipken, brüt sermaye oluşumunun tarımsal katma değer üzerinde olumsuz etkiye sahip olduğu belirlenmiştir. Elde edilen uzun dönem katsayılarının Polonya için istatistiksel olarak anlamlı olduğu tespit edilmiştir. Tarım arazisindeki %1'lik değişim ve kişi başına düşen GSYİH, tarımsal katma değeri Polonya için sırasıyla %0,0643 ve %2,8223 oranında aynı yönde değiştirmiştir. Brüt sermaye oluşumundaki %1'lik değişim ise tarımsal katma değeri %0,0498 oranında ters yönde değiştirmiştir. Türkiye için elde edilen bulgular değerlendirildiğinde, tarım arazisi ve brüt sermaye oluşum katsayıları negatif ve istatistiksel olarak anlamlı bulunmuştur. Kişi başına düşen GSYİH katsayısı pozitif ancak istatistiksel olarak anlamlı bulunmamıştır. Türkiye için tarım arazisi ve brüt sermaye oluşumundaki %1'lik değişim tarımsal katma değeri sırasıyla %0,0365 ve %0,0367 ters yönde değiştirmiştir.
Anahtar Kelimeler: Katma Değerli Tarım, Türkiye, Polonya, Kointegrasyon

1. INTRODUCTION

The agricultural sector provides added value to the country's economy by supplying the necessary raw materials for industrial production, as well as providing animal and plant foodstuffs for nutrition. Added value represents the difference between the monetary value of produced goods and services and the inputs

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used in production. From a macro point of view, the concept of value added agriculture expressed as the net production amount obtained by the difference between the sum of the outputs and the inputs in the agricultural sector. According to the United States Department of Agriculture (USDA), value added agriculture means improving the material value of the agricultural product as well as its physical condition (Lu & Dudensing, 2015). Countries battle to increase added value to increase their national income. The increase in the added value of the goods produced is important in the development of the country.

In the economic structural transformation of countries, while the share of the agricultural sector in national income decreases, the share of the industry and service sector increase. When the structural transformation processes of developed countries were examined, it was observed that the share of the agricultural sector had decreased in total production and revenue. Despite this decrease, agricultural productivity continues to increase in developed countries.

The interdependence of the agriculture and industry sectors has been gradually increased and fed each other in developed countries. In other words, as the agricultural sector develops, the industrial sector develops as well. The development in the industrial sector supports the agricultural sector. Achieving a balanced development in the economy depends on the positive interactions of these two sectors.

In addition to sectoral interactions, economic growth has an important place in ensuring agricultural development. An economic growth will increase fixed capital investment and production capacity of the country. Therefore, value added agriculture could be increased by more infrastructure investments as a result of economic growth and by proliferation of technology in agriculture.

Contribution of agriculture to economic growth is related to fast and continuous development of the agricultural sector in a country. Fixed capital investments, which results from investment increases, have a great importance in ensuring the desired development in the agricultural sector. It constitutes the main source of increased production capacity in a country. Fixed capital investments have positive economic effects on country’s economy by improving technology transfer, capital accumulation, production, employment, income, stability in the balance of payments, economic development and increasing welfare (Bayraktutan & Arslan, 2008).

Fixed capital investments are one of the most important factors affecting agricultural development. It contributes to the realization of agricultural development through rapid technological changes. The purpose of fixed capital investments in the agricultural sector is to ensure the sustainability of agricultural production supply and to improve production conditions (Bahşi, 2005).

Countries with high per capita income and production can generally allocate more resources to improve education, health, service and environmental problems through technological developments and contribute to an increase in welfare (Bucak, 2021).

Agricultural land size is another factor to increase value added agriculture since soil is one of the most important natural resources of a country. Countries with large agricultural areas are advantageous in terms of agricultural production.

In our study, the effects of economic growth, fixed capital investments and quantity agricultural areas on value added agriculture will be examined Turkey and Poland comparatively.

2. AGRICULTURAL SECTOR IN POLAND AND TURKEY

Poland is a medium-sized European country with a significant land, population and economic potential. Its importance and share in the world economy is increasing due to the increase in GDP in recent years. As a result of the privatization practices, it is a country revieving of the most direct foreign capital investments among the Central and Eastern European countries. A significant improvement was observed in the Poland's economy since the 2000s as a result of the economic policies implemented towards the transition to the free market economy after 1989. Its export-based performance, increased private consumption and increased fixed capital investments were the main dynamics of growth in the country's economy.

About 2.5% of the GDP in Poland consists of the agricultural sector **(O'Neill, 2022)**. According to the data obtained from the World Bank development indicators, 8.924% of the employed population in Poland is employed in the agricultural sector as of 2020. In Poland, total agricultural land constitutes 59% of the country's surface area and arable land constitutes 76% of the total agricultural land.

Poland is an important producer for some agricultural products in Europe and the world. It ranks first in apple production in Europe and ranks second in Europe and in the world for grape, rye and raspberry production. It has an important share in potato, strawberry, onion, sugar beet, wheat, milk, pork production in Europe and in the world. The average agribusiness land size is 8.2 hectares.

As of 2021, the share of the agricultural sector in GDP is approximately 6.7% in Turkey. The agricultural sector is very important for the Turkish economy. Although the share of the agricultural sector in GDP has decreased over the years, the share of agriculture in total employment is still high with 17% (**TURKSTAT, 2021**. The average agribusiness land size approximately 6 decares.

Turkey has a high agricultural potential. It ranks first in the production and export of hazelnuts, cherries, figs and apricots in the world. While grain has the largest share in cultivated areas, industrial plants, vegetables and legume productions are also important.

Turkey and Poland, which are considered among emerging economies, show similarities in terms of agricultural structure (Figure 1). It is also possible to see many common features such as the splitted and small size of agricultural lands, the migration of the young workforce, and the elderly population employed in agriculture. Both countries had an increasing trend based on the variables evaluated in this study. Although both countries have a high potential in plant and animal production, the agricultural sector stays behind other sectors.

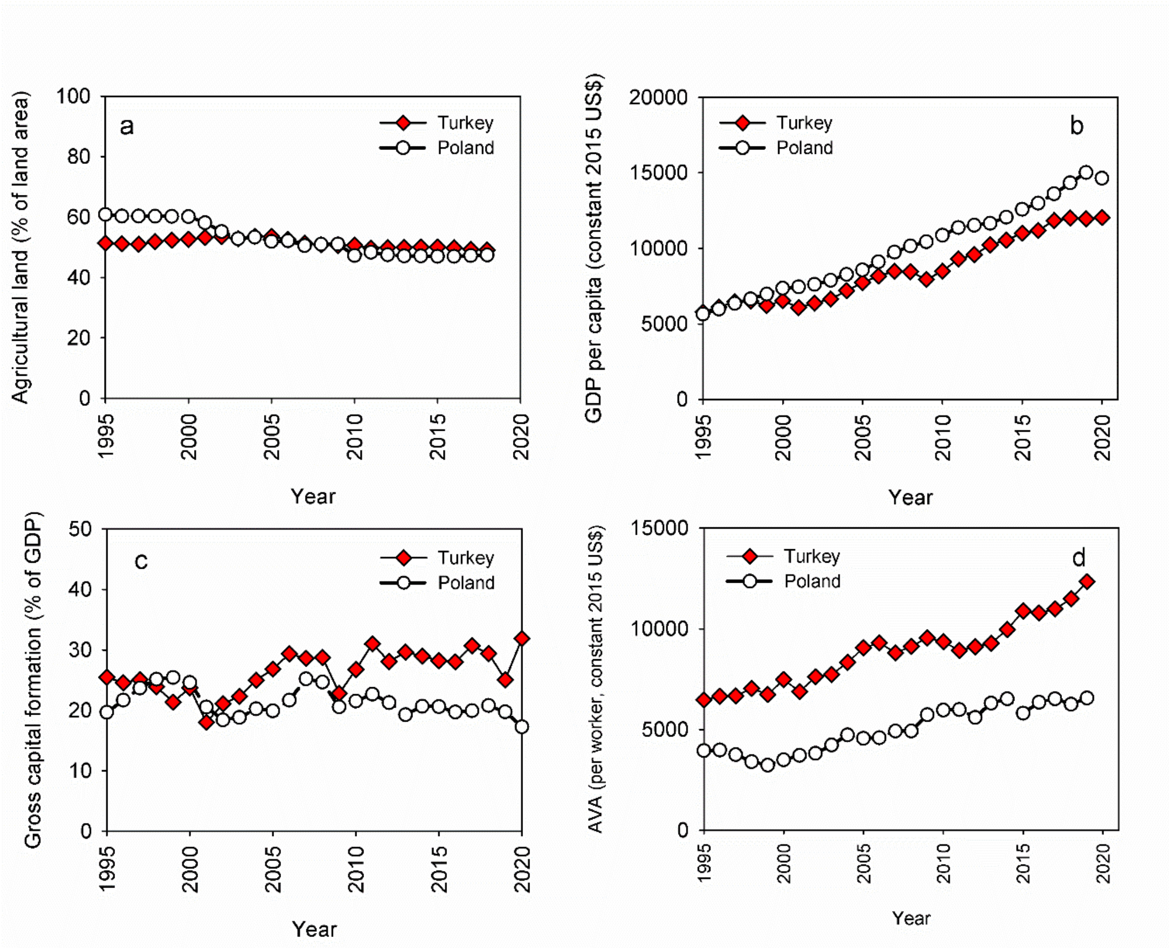

Figure 1. Agricultural Land (a), GDP Per Capita (b), Gross Capital Formation (c) and Value Added Agriculture Per Worker (d) for Turkey and Poland

3. LITERATURE REVIEW

Agriculture is very important for a country's economy. Therefore, many studies have been carried out on value added agriculture in the literature. Gardner (2005) used Granger causality analysis for 85 country groups for the years of 1961-1980 and 1981-2001 and found a strong causal relationship between value added agriculture and per capita national income. Lio and Liu (2008) applied the panel data analysis for 127 countries covering the periods of 1996-1998 and 2000-2002 they concluded that while the rule of law index increased agricultural productivity, the political stability index decreased agricultural productivity.

Erçakar and Taşçı (2011) used panel data analysis for the period of 1972-2008 for Turkey and reported that while agricultural productivity increased the nominal prices obtained by the farmer, it decreased the real prices. Ceylan and Ozkan (2013) applied panel data analysis for the European Union Member States for the periods of 1995-2007 and 2002-2007 and found that the increase in value added agriculture contributed to the increase in per capita income. Rizov, Pokrivcak, and Ciaian (2013) applied GMM regression analysis on 15 European Union member countries for the period of 1990-2008 and reported that while the incentives before the production-independent direct support aids reform affected value added agriculture negatively, the ones after the reform affected it positively.

In the study conducted by Ben Jebli and Ben Youssef (2015), panel cointegration analysis was applied for the period 1980-2011 for Algeria, Egypt, Morocco, Sudan and Tunisia reported that value added agriculture reduced carbon emissions in the long term. Asom and Ijirshar (2016) used Augment Dickey-Fuller Test, ADF Johansen cointegration test and error correction model for Nigeria for the period of 1981-2015 and concluded that value added agriculture had a positive effect on economic growth for the short and long term, however, this effect was not statistically significant. Akyol (2018) conducted a study for South Africa, Turkey, China, Brazil and Mexico for the period of 2000-2006 using panel data analysis and concluded that agricultural incentives have a positive effect on value added agriculture. Yavuzaslan and Soyyiğit (2019) applied panel data analysis method for Turkey, Brazil, Russia, India, China, Mexico and Indonesia (E-7 countries) in the period of 1996-2017 and they found bidirectional causality between the government efficiency index and value added agriculture. Çuhadar (2020) conducted a study using the System GMM model for 20 countries in the period of 200-2014. It has been stated that value added agriculture, participatory democracy and energy use had a statistically significant effect on carbon emissions. Erdinç and Aydınbaş (2021) used panel data analysis on selected 20 countries for the period of 2000-2018 and they reported a significant and positive relationship between value added agriculture and GDP per capita, gross capital formation, agricultural labor force ratio, and urbanization. However, a significant and negative relationship was found between value added agriculture and the rule of law index.

4. DATA AND METHOD

The effects of agricultural land, GDP per capita and gross capital formation on agricultural value added have been investigated comparatively within the framework of Turkey and Poland. Explanatory information of data used in the study were given in Table 1.

Table 1. Explanatory Information of Data.

	Notation	Period	Source
Agriculture, forestry, and fishing, value added per worker (constant 2015 US$)*	AVA	1995-2018	World Bank Database
Agricultural land (% of land area)	AL		
GDP per capita (constant 2015 US$)*	GDP		
Gross capital formation (% of GDP)	GCF		
*: The natural logarithms of the agricultural value added and per capita GDP series were taken.			

The long-run relationships between value added agriculture and agricultural land, GDP per capita, gross capital formation were examined by Johansen co-integration test techniques (Johansen, 1988, 1995). In order to perform the cointegration test, first, the stationarity properties of the individual time series were investigated. For this purpose, the traditional unit root tests ADF (Dickey & Fuller, 1981), PP (Phillips & Perron, 1988) and Lee and Strazicich (2003) test, which allows structural breaks in the model, were applied for each series.

The instantaneous change in the mean, trend or both of the series may cause a stationary series found as non-stationary by traditional unit root tests. Structural break can appear in three different ways: at intercept

(Model A), trend (Model B) and both intercept and trend (Model C). Breaks in the time series were analysed with the help of dummy variables (Mert & Çağlar, 2019). Lee and Strazicich (2003) unit root test with two breaks, based on the Lagrange Multiplier (LM) type test strategy, the break time was determined endogenously. Data generation process could be expressed as follows:

$$y_t = \delta Z_t + e_t \text{ and } e_t = \beta e_{t-1} + \varepsilon_t \quad (1)$$

where Z_t, is the exogenous vector. When the exogenous variable vector Z_t was constructed taking into account two-break:

Model A: Allows two breaks at level and was defined by $\mathrm{Z_t} = [1, \mathrm{t}, \mathrm{D_{1t}}, \mathrm{D_{2t}}]'$ where $\mathrm{D_{jt}} = 1$ for $\mathrm{t} \geq \mathrm{T_{Bj}} + 1$, $\mathrm{j} = 1, 2$, and 0 otherwise. $\mathrm{T_{Bj}}$ shows the time period in which the break occurred.

Model C: Includes change in level and trend and is defined by $\mathrm{Z_t} = [1, \mathrm{t}, \mathrm{D_{1t}}, \mathrm{D_{2t}}, \mathrm{DT_{1t}}, \mathrm{DT_{2t}}]'$ where $\mathrm{DT_{jt}} = \mathrm{t} - \mathrm{T_{Bj}}$ for $\mathrm{t} \geq \mathrm{T_{Bj}} + 1$, $\mathrm{j} = 1, 2$, and 0 otherwise.

Model predicted according to LM strategy:

$$\Delta y_t = \hat{\delta} \Delta Z_t + \phi \hat{S}_{t-1} + \varepsilon_t \quad (2)$$

$\hat{S}_t = y_t - \tilde{\psi}_x - Z_t \tilde{\delta}$, $t = 2, \ldots, T$; and while $\tilde{\psi}_x$ was denoted by $y_1 - Z_1 \tilde{\delta}$, y_1 and Z_1 represent the initial values of the matrices, and $\hat{\delta}$ represented the coefficients matrix. The unit root null hypothesis was described by $\phi = 0$ and the LM test statistics were given by

$$\tilde{\rho} = T \tilde{\phi} \quad (3)$$

$\tilde{\tau} = t -$statistic testing the null hypothesis $\phi = 0$.

While determining the breaking time, τ value, which gives the lowest t statistic, is taken into account (Lee & Strazicich, 2003, p. 1083).

The Johansen technique consists of VAR (Vector Auto Regression) estimation, which includes the differences and levels of non-stationary series. The series in the system of equations in which the Johansen cointegration analysis will be performed must be integrated of the same order I (eq. 2). The parameter matrix related to the levels of the variables includes information about the long-term properties of the model. Consider four series AVA, AL, GDP, and GCF which are stationary in their first difference. Let the vector formed by these four variables be called W (W=(AVA, AL, GDP, GCF)). Let assume that the vector autoregressive model (VAR) consisting of four variables as in equation (4).

$$W_t = \Pi_1 W_{t-1} + \Pi_2 W_{t-2} + \Pi_3 W_{t-3} + \cdots + \Pi_p W_{t-p} + u_t \quad (4)$$

In equation (4), Π_i, (i = 1, 2, ..., p) is the parameter matrix of the variables within the scope of W_{t-i}. Assuming that the variables within the scope of W_t were first-order difference stationary, the VAR model (eq. 4) could be writen as the VAR model (eq. 5), including both the first differences and the levels of the series.

$$\Delta W_t = \Gamma_1 \Delta W_{t-1} + \Gamma_2 \Delta W_{t-2} + \cdots + \Gamma_{p-1} \Delta W_{t-p+1} + \Pi W_{t-p} + u_t \quad (5)$$

In equation (5); Γ_i *(i = 1, 2, ..., p-1)* is the parameter matrix of the time series in ΔW_{t-i}; Π represents the parameter matrix of the series within the scope of W_{t-p}. The Π matrix had information about the long-run properties of the time series or model. If the rank of the Π matrix is zero, the VAR model (eq. 5) turns into a VAR model consisting of only the first differences of the series. In such a case, it was revealed that there was no long-run relationship between the series. On the other hand, if the rank of the Π matrix was one or more, it turns out that the series within the scope of W_t had linear and independent combinations, which means that there was a single or more long-run relationship between the series. The co-integration relationships between the series forming W_t were evaluated with the help of the "Trace Test" and "Maximum Eigenvalue Test" statistics. While the Trace Test the null hypothesis, which states that the rank of the Π matrix was equal to or less than r (number of cointegrating vectors), the maximum eigenvalue test statistic tests the null hypothesis, which states that the cointegrated vector is r, against its alternative, which states that it is r+1.

5. RESULTS

The first step of the empirical test to determine the long-run equilibrium relationship between value added agriculture (AVA) and agricultural land (AL), GDP per capita (GDP) and gross capital formation (GCF) was examininig the stationarity properties of the variables to be included in the cointegration equation. The findings obtained from the ADF and PP tests of the series used in the study were reported in Table 2.

According to the unit root results presented in Table 1, all variables of value added agriculture, agricultural land, GDP per capita, and gross capital formation for Poland and Turkey were stationary at their first difference.

Table 2. ADF and Philips-Perron Unit Root Test (Level and First Difference)

			AVA	AL	GDP	GCF
Poland			Level			
	ADF	Constant	-0.5193 (0.8702)	-1.2148 (0.6498)	-1.3435 (0.5913)	-4.2197 (0.0045)
		Constant & Trend	-2.5508 (0.3033)	-1.1811 (0.8907)	-3.0889 (0.1353)	-4.6660 (0.0077)
	PP	Constant	-0.5015 (0.8739)	-1.2148 (0.6498)	-1.3435 (0.5913)	-2.5243 (0.1230)
		Constant & Trend	-2.5267 (0.3135)	-1.1812 (0.8907)	-2.3716 (0.3831)	-2.8189 (0.2050)
			First Difference			
	ADF	Constant	-3.8135 (0.0095)	-4.8638 (0.0009)	-4.6893 (0.0018)	-5.1652 (0.0007)
		Constant & Trend	-3.6284 (0.0516)	-4.9785 (0.0033)	-4.7736 (0.0069)	-4.9477 (0.0050)
	PP	Constant	-4.3001 (0.0031)	-4.8636 (0.0009)	-2.8882 (0.0629)	-5.0145 (0.0006)

		Constant & Trend	-4.1824 (0.0170)	-4.9785 (0.0033)	-2.5728 (0.2943)	-4.4966 (0.0089)
Turkey			Level			
	ADF	Constant	-0.5775 (0.8575)	-0.2496 (0.9184)	0.0780 (0.9567)	-1.8575 (0.3451)
		Constant & Trend	-2.7806 (0.2174)	-1.6865 (0.7243)	-3.5259 (0.0623)	-3.1749 (0.1139)
	PP	Constant	-0.4092 (0.8920)	-0.4474 (0.8847)	0.0692 (0.9559)	-1.7571 (0.3910)
		Constant & Trend	-2.8464 (0.1964)	-1.6865 (0.7243)	-2.1077 (0.5148)	-3.1749 (0.1139)
			First Difference			
	ADF	Constant	-6.5377 (0.0000)	-3.4490 (0.0200)	-4.3840 (0.0025)	-6.1568 (0.0000)
		Constant & Trend	-6.3757 (0.0002)	-3.7424 (0.0405)	-3.6459 (0.0541)	-6.0295 (0.0004)
	PP	Constant	-6.5377 (0.0000)	-3.4490 (0.0200)	-4.3817 (0.0026)	-6.2578 (0.0000)
		Constant & Trend	-6.3757 (0.0002)	-3.7388 0.0408	-4.4027 (0.0108)	-6.1302 (0.0003)

Notes: Probability values are given in parentheses. The optimal lag length was determined using the Akaike Information Criteria.

In Table 3, the unit root test results of the Lee-Strazicich Test allowing for two breaks were reported. As a result of the tests applied to the level and first differences of the series, it was determined that all series were stationary at the first differences according to the Lee and Strazicich test for both Poland and Turkey.

Table 3. Lee and Strazicich Two-Break Test

			AVA	AL	GDP	GCF
Poland			Level			
	Model A	$\tilde{\tau}$ statistic	-2.3225	-2.3805	-3.0888	-3.87**
		Break point	2008 2014	2000 2002	1999 2009	2004 2009
	Model C	$\tilde{\tau}$ statistic	-5.0093	-5.2962	-3.8989	-5.1535
		Break points	2001 2013	2001 2014	2000 2007	2000 2007
			First Difference			
	Model A	$\tilde{\tau}$ statistic	-5.86***	-7.6480***	-4.1595***	-5.4125***
		Break points	1998 2005	1999 2007	2002 2013	1999 2001

	Model C	$\tilde{\tau}$ statistic	-6.0615*	-6.6828**	-5.0821	-7.2636***
		Break points	1999 2005	1999 2003	2003 2011	1998 2006
Turkey			Level			
	Model A	$\tilde{\tau}$ statistic	-4.0107*	-2.8258	-3.8539**	-3.89**
		Break point	2005 2010	2003 2010	2000 2011	1998 2003
	Model C	$\tilde{\tau}$ statistic	-5.9454	-5.0322	-3.7356	-5.1030
		Break points	2003 2011	2002 2008	1999 2013	2000 2007
			First Difference			
	Model A	$\tilde{\tau}$ statistic	-4.1069***	-5.1781***	-4.1006***	-5.2064***
		Break points	1998 2010	2000 2003	2000 2009	2005 2012
	Model C	$\tilde{\tau}$ statistic	-5.2255	-6.1565*	-4.6769	-5.7771
		Break points	1998 2008	2005 2010	1999 2005	1998 2009

Notes: (*) Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%.

Table 4. Gregory-Hansen Cointegration Test (Model 3: Level Shift with Trend)

	Poland		Turkey	
	Test Statistic	Break	Test Statistic	Break
$Z_a(\tau)$	-29.0829	1997	-26.8048	1997
$Z_t(\tau)$	-6.1990	1997	-5.0391	1997
$ADF(\tau)$	-5.5867	1998	-5.1994	2001

While the critical value for $ADF(\tau)$ and $Z_t(\tau)$ is -6.32, the critical value for $Z_a(\tau)$ is -78.87.

The existence of a long-term relationship between the variables was firstly investigated with the Gregory and Hansen (1996) test, which takes into account the single possible regime change. According to the results reported in Table 4, the null hypothesis cannot be rejected since the test statistics $Z_a(\tau)$,$Z_t(\tau)$, and $ADF(\tau)$) for both countries were calculated larger than critical values indicating there was no cointegration relationship between the variables under structural change.

Table 5. Stability Tests for VAR Models

	Poland VAR (1)	Turkey VAR (1)
LM(1)	14.3509 (0.5726)	15.6715 (0.4761)
LM(2)	16.4328 (0.4232)	17.1229 (0.3777)

White Heteroskedasticity Test	163.2972 (0.4128)	140.7270 (0.8613)
Jarque-Bera Test	12.3642 (0.1357)	6.1471 (0.6308)
Notes: Probability values are given in parentheses. The optimal lag length was determined using the Akaike Information Criteria.		

After finding there was no structural break cointegration relationship, the long-term relationship between the variables was investigated with the (Johansen, 1988, 1995) test, one of the traditional cointegration tests. In order to perform the Johansen cointegration test, it was necessary to determine the optimal lag length of the VAR system to be created. According to the AIC information criterion, the optimal lag length was determined as 1 for Poland and Turkey. The tests showing whether the VAR (1) models meet the stability conditions were given in Table 5. It has been determined that both models do not have autocorrelation and heteroskedasticity and show normal distribution.

In Table 6, the estimation results of equation (3), including VAR(1) for Poland and Turkey, were reported. Trace and Max-Eigen tests indicated the existence of 1 and 2 cointegration equations at the 0.05 level for Poland and Turkey, respectively. The coefficients for the cointegration vector, in which value added agriculture was the dependent variable, were given in Table 6. The results of the Johansen cointegration analysis for Poland and Turkey showed that there was a long-run relationship between value added agriculture and agricultural land, GDP per capita and gross capital formation for both countries.

Table 6. Johansen Cointegration Tests (Linear Deterministic Trend in The Data)

	Poland			Turkey		
	Trace Test					
H_0	Trace Statistic	0.05 Critical Value	Prob.	Trace Statistic	0.05 Critical Value	Prob.
$r = 0$	89.7598	63.8761	0.0001	85.0199	63.8761	0.0003
$r \leq 1$	37.9072	42.9152	0.1449	46.1158	42.9152	0.0231
$r \leq 2$	16.2556	25.8721	0.4722	21.3415	25.8721	0.1654
$r \leq 3$	4.3835	12.5179	0.6862	8.6301	12.5179	0.2044
	Maximum Eigenvalue Test					
	Max-Eigen Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
$r = 0$	51.8525	32.1183	0.0001	38.9041	32.1183	0.0064
$r \leq 1$	21.6516	25.8232	0.1618	24.7743	25.8232	0.0683
$r \leq 2$	11.8720	19.3870	0.4272	12.7113	19.3870	0.3519
$r \leq 3$	4.3835	12.5179	0.6862	8.6301	12.5179	0.2044

Notes: *, According to the Pantula principle, it was decided that the most suitable model was the model 4. Two dummy variables were used for the years 1997 and 2008.

Table 7. Normalized Cointegrating Coefficients

		AL	GDP	GCF	Trend
Cointegrated Vectors	Poland	0.0643**	2.8223**	-0.0498**	-0.1027**
		[8.31093]	[3.9941]	[-5.4870]	[-4.3171]
	Turkey	-0.0365**	0.1021	-0.0367**	-0.0231**
		[-4.1587]	[0.4397]	[-6.0312]	[-3.9405]
Notes: Values in [ ] indicate t-statistics and ** denotes significance at 0.05(2-t rules).					

It was determined that while agricultural land and GDP per capita had a positive effect on value added agriculture, gross capital formation had a negative effect and all long-term coefficients obtained were statistically significant for Poland. When the coefficients were examined, for Poland, it was found that an 1% change in agricultural land and GDP per capita changed value added agriculture in the same direction by 0.0643% and 2.8223%, respectively. However, an 1% change in gross capital formation changed value added agriculture by 0.0498%, in the opposite direction (Table 7).

When the findings obtained for Turkey were evaluated, the agricultural land and gross capital formation coefficients were negative and statistically significant, while the GDP per capita coefficient was found positive but not statistically significant. Accordingly, an 1% change in agricultural land and gross capital formation was expected to change value added agriculture per employee in the opposite direction by 0.0365% and 0.0367%, respectively.

Table 8. VAR Granger Causality Tests

	Poland		Turkey	
H_0	F-test	Prob.	F-test	Prob.
AL is not the Granger cause of AVA	2.8949*	0.0889	2.0356	0.1536
GDP is not the Granger cause of AVA	0.5009	0.4791	6.7011***	0.0096
GCF is not the Granger cause of AVA	0.4427	0.5058	1.8315	0.1759
Notes: (*) Significant at the 10% and (***) Significant at the 1%.				

In Table 8, Granger causality analysis results obtained over the VAR models selected for both countries showed a short-term relationship between the series. According to the results, the null hypothesis of "Agricultural land was not Granger cause of value added agriculture" for Poland was rejected at 0.10 level (F=2.8949, P=0.0889<0.10). Therefore, agricultural land was the short-term cause of value added agriculture. Similarly, the null hypothesis that "GDP per capita is not Granger cause of value added agriculture " was rejected at 0.01 level (F=6.7011, P=<0.0096) for Turkey. In other words, GDP per capita was the short-term cause of value added agriculture.

6. CONCLUSION

The effect of agricultural sector in a country's overall economy is measured by the amount of value added agriculture. The activities in the agricultural sector produce the supply food of the country and create employment for a significant part of the population.

In the structural transformation processes accompanying the development of countries, it is necessary to switch from labour-intensive low technology agricultural production with low added value to an advanced technology with high added value. Value added agriculture ratios are high in developed countries in parallel with advanced industrial and technological developments. Along with economic development, high technology and fixed capital investments affect value added agriculture positively.

In this study, a long-term relationship was found between value added agriculture and agricultural land size, GDP per capita and gross capital investments according to Johansen cointegration analysis for Poland and Turkey. There was a positive relationship between value added agriculture and agricultural land size for Poland, but there was a negative relationship for Turkey.

It has been observed that the size of the agricultural land provides an advantage in the variety of agricultural products and the applicability of new technologies. A negative relationship was found for Turkey at increased value added agriculture even though arable land had been decreased in recent years. This was probably due to not using arable land at full capacity in Turkey as a results of structural problems and high input costs of agricultural sector in Turkey When the coefficients are examined, it was found that an 1% change in agricultural land changed value added agriculture by 0.0643% in the same direction for Poland. Accordingly, an 1% change in agricultural land was expected to change value added agriculture per employee by 0.0365% for Turkey.

A positive relationship was found between GDP per capita and value added agriculture for Poland and Turkey. Gardner (2005), Ceylan and Özkan (2013), Erdinç and Aydınbaş (2021) reported similar results supporting the relationship between GDP per capita and value added agriculture. When the coefficients are examined, for Poland, it is seen that 1% change the GDP per capita changes the agricultural value added in the same direction 2.8223%. For Turkey, GDP per capita coefficient was found to be positive but not statistically significant.

A negative relationship was determined between gross capital investments and value added agriculture for both countries. It has been determined that 1% change in gross capital formation changes the agricultural value added by 0.0498%, in the opposite direction for Poland. Accordingly, 1% change in gross capital formation is expected to change the agricultural value added per employee by 0.0367%, respectively, in the opposite direction for Turkey. The approach that Poland and Turkey could develop only by industrial investments had led to the agricultural sector to be taken a backseat. Therefore, capital investments occur in non-agricultural sectors.

According to the Granger causality test results, a causal relationship was found between agricultural areas and value added agriculture in short term for Poland. On the other hand, a causal relationship was found between GDP per capita and value added agriculture in short term for Turkey.

There was a close similarity between the agricultural sector of Poland and Turkey, such as agricultural sector structure, average farm sizes and strength in the European Union market. Therefore, joint projects could be developed to increase value added agriculture.

To increase share of agriculture in GDP per capita and make this sustainable in the long run for Poland and Turkey, it is necessary to support investments in technology and digitalization to increase value added agriculture.

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