



## In Turkey, The Relationship of Agricultural Sector and Economic Variables: Panel Cointegration Analysis

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### ABSTRACT

That agricultural sector is examined closer from every point of view and is restructured in complied with the requirements of the age has to be structured comes to our face as a reality any longer accepted by every sector of the society. The various developments experienced in the world in the recent years have directly or indirectly affected agricultural sector. In the economy of Turkey, one of the countries attracting attention with its rapidly growing, there are many theoretical studies dealing with the direct or indirect contribution of agricultural sector. However, it is necessary to increase the number of the applied studies introducing the existing situation of the sector and enabling to develop the effective policies for the sector. For, it is highly important for the theories put forward in theoretical framework to be supported by empirical analyses in terms of forming effective policy suggestions. In the study, the three sub-sectors were considered such as the subsectors of cereal, legume, and fruit-vegetable and the existing situation of the sector was analyzed by moving from the macro variables. In order to identify the effects of macroeconomic variables (inflation, exchange rate, interest, monetary supply), selected in the direction of the aim of the study, panel cointegration test was utilized. Setting off from this point, when the analysis made in the study is examined for all sectors, it was identified that the variable affecting the sector the most was interest rate. When the results of panel cointegration test between interest rate and agricultural production were examined, while there was a negative directional relationship between the production of subsector "fruit vegetable" and the variable "interest" as expected, it attracts attention that there was a positive relationship between the subsector of cereal legume and interest in contrast to this.

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### Introduction

Together with globalization, the phenomenon competition gradually increases and country economies try to increase their competitive powers to be able to obtain more share from market. As a result of these developments, in many national and international arenas, the concept of competitive power can come to our face in many different forms at the level of sector and business. Competitive power is defined in the form of that a country orderly and continuously increases its production process and capability at national and international level. In other words, competitive power, increasing value added of a country in a stable way, can be defined as raising its economic welfare level. Providing increase of competitive power in countries brings together with it reaching balanced level of foreign trade in that country, increasing income and employment level, raising quality of life and increasing its share in international markets (Aktan, 2003:115-116). The main element of countries in

introducing their competitive powers is based on that they can make innovations in the structure of product produced in the sectors or production systems (Porter, 1990).

One of the strategic sectors that can cause the competitive power of Turkey to increase is agricultural sector. In fact, one of ten strategic aims in the scope of increasing competitive power, one of five axes of Economic and Social Development, determined in the document of 9<sup>th</sup> Development Plan of Turkey (2007-2013), was determined as "activating agricultural structure". 9<sup>th</sup> Development Plan was prepared, with a vision of Turkey, which is stably growing, which more fairly shares its income, which has a competitive power in global scale, which transforms into information society, which has completed EU adaptation process", was prepared in the framework of a long term strategy (2001-2023). In the determination of Vision Strategies of First Agricultural Sector, in the period of before and after 9<sup>th</sup> Development

Plan, the plans and strategies, prepared in this direction, were also taken into consideration. November 11<sup>th</sup> Plan submitted to Grand National Assembly of Turkey, covers the period 2019-2023. As in the other plans, also in this plan, it is especially emphasized that it is necessary to increase competitive power of agricultural sector. For particularly agricultural sector to be able to increase its competitive power in international arena, individually evaluating subsectors of agricultural sector has a great important in terms of making a dynamic prediction associated with the next period.

It is necessary to form comprehensive economic policies, in which the distinctness of each sector taking place in economy is considered. Regardless of level of development countries, agricultural sector rising to a strategic position in the world has become the focus of political and economic discussions due to its key role in climatic change, drought, global food crises which have been experienced in the recent years and in providing food security and security of countries. In this framework, there is a need for the studies, which focus on the problem of this sector and consider potential sensitivity of agricultural sector. In this study, the relationship between selected economic variables (interest rate, exchange rate, inflation, and monetary supply) and agricultural sector was tried to be discussed. In this context, in the study, testing economic prediction regarding; in what direction the real effect of increase in monetary supply on agricultural production according to hypothesis "neutrality of money" is; how the effect of increase at the level of general price level on agricultural prices is; in what direction the effect of rise in interest rates on agricultural production is; and how the effect of rise in exchange rate on the prices of agricultural products, the results were introduced for each sector. In this study Turkish agricultural sector was discussed as three subsectors; subsectors of cereals legumes, fruit, and vegetable. In order to identify the effect of selected economic variables on agricultural sector, panel cointegration test was used.

### **Economic Variables and Agricultural Sector Relationship**

Economic unbalances forming with globalization process rapidly spreads from an economy to the other one. In this process, lowering the negative effects of global unbalances experienced to the lowest level, maintaining stability has considerably importance. Eliminating these deviations, for providing economic balance, sometimes, there is a need for intervention of government to economy. In country economies, reaching the main economic targets required depends on economic policies as well as many factors such as geopolitics position, political and cultural structure, health and educational quality, economic, infrastructure, shaped with structural arrangements and governance quality of a country (Önder, 2005: 19). Economic policies are divided into two subgroups as fiscal policy and monetary policy. Fiscal policies are executed, being prepared by government, and monetary policies, by central bank. As economic theory foreses, in a malfunction that will emerge in run of economic theory, optimal distribution of economic resources disturbs. For being able to stably provide run of this process, it is

relatively important to apply the effective and right economic policies in a suitable time. The effect of monetary policies on agricultural sector especially emerges with the effect of particularly agricultural products on domestic and export demand. Application of expansionary monetary policy leads the value of national money to fall and export demand to increase. In case of realizing expansionary monetary policies, the curve of agricultural products, shifting to the right, leads the prices of agricultural products to increase. In application of contractionary monetary policy, process reversely operates. Contractionary monetary policy, rising the value of national money, reduces export demand. This policy also causes interest rate and exchange rate to rise. The rise of exchange rate causes the domestic demand of agricultural products to decrease and, demand curve, shifting to the left, causes the prices of agricultural products to fall.

The effect of fiscal policy on agricultural sector, mostly depending on the share of product in domestic market and price flexibility of export demand, is directed to export demand. While expansionary fiscal policy increases budgetary deficit, it reduces the price of agricultural products. Because high interest rates result in the rise of exchange rate it also reduces export demand for agricultural products. As a result of this, demand curve shifts to the left, and prices fall. Tight fiscal policy reduces interest rate and exchange rate and increases the demand of products exported. Consequently, demand curve shifts to the right. Fluctuations in the prices of agricultural products makes difficult to form the short and long term economy policies directed to sector and negatively affect the price predictions and expectations belonging to the next years. In this sense from the aspect of policymakers, understanding the sources of movements in prices of domestic agricultural products and revealing at what extent the mentioned prices reacted to the applications of monetary and fiscal policies have a great importance in terms of measuring the effectiveness of policies applied. In this section of the study, economic infrastructure of the relationship between the selected economic variables and agricultural production and price were attempted to be discussed.

### **Materials**

That countries are in different level of development makes interaction dimension between economy and agricultural sector different. In theory, depending on the level, in economy agricultural sector level of countries increase, it is accepted that the role of agricultural sector on economy decreases; as level of development decreases, it is accepted that the role of agricultural sector on economy increases. In this framework, in Turkey that is developing, it is expected that the effects of economic policies on agricultural sector are bigger. In the study, the period of 1994-2014 is based on, the relationship between exchange rate, inflation, interest rate and monetary supply that are the selected economic variables used in this study and the variables of production and price belonging to the subsectors were examined. The explanation of the variables used in the study are given in Table 1 together with its symbols.

Table 1. The variables used in analysis

Symbol of the Variables	Explanation
LogYA	Agricultural Production
LogP	Agricultural Price
logREXR	Real Exchange Rate
logTUF	Inflation Rate
LogM	M1 Monetary Supply
I	Interest rate

The variables used in the study and the resources, from which the variables are drawn are put in order as follows.

*Agricultural Production:* Agricultural production data used in the study were compiled from Agricultural Production Statistics of Turkish Statistical Institute (TURKSAT)

*Agricultural Price:* Real Data of Agricultural Prices were compiled from (2005=100) Turkish Statistical Institute (TURKSAT)

*Exchange Rate:* Real Statistics of Exchange Rate used in the study were compiled from International Financial Statistics (IMF)

*Domestic Monetary Supply:* Domestic real monetary supply used in the study, M1 monetary supply size index (2005=100) was compiled from International Financial Statistics, published by IMF.

*Inflation Rate:* Data of Consumer Price Index (2005 = 100) used in the study were compiled from International Financial Statistics, published by IMF.

*Interest Rate:* Interest rate of Annual Time Deposit used in the study were compiled from International Financial Statistics, published by IMF.

In panel cointegration analysis, since interest rate is already a rate, it was used in logarithmic form in order to make free all variables other than interest from small fluctuations and make linear (Altunoğlu, 2009: 18; Güvenek et al. 2010: 13).

In the study, among the products taking place in cereal group, oat, wheat, barley, corn, rice, rye, chickpea, dried beans, red lentil, tobacco, sugar beet, and potatoes take place. The products taking place fruit groups are bananas, fig, grape, orange, mandarin, lemon, grapefruit, hazelnut, walnut, almond, pistachio, and apricot. The products taking place in vegetable group are: tomatoes, cucumber, pepper, okra, eggplant, melon, water melon, haricot, olive, garlic, leek, and carrot.

## Methods

In the different economies, many national and international studies are carried out, which analyzes relationship between economics polices and agricultural sector. In a part of this literature study, time series belonging to a certain country quite frequently comes to our face. It is possible to introduce current situation of a certain country with only time series. Together with globalization process, a period was entered, when a crisis occurring in one of country economies very rapidly spread to another country. This development limits empirical applications of time series and makes it difficult to test theoretical predictions. Panel data analysis helps to eliminate this constraint of empirical applications of time series. With a panel data analysis, being able to

simultaneously include many country economies in panel data analysis or many variables to be simultaneously taken place in analysis for a certain country enable the relationships between variables to be able to more accurately introduce. There are some advantages of panel data analysis. These are (Tatoğlu, 2012: 9);

- Panel data analysis includes unobservable effects in group and time dimension,
- Compared to time series and horizontal sectional analysis, it presents more information for economic deductions,
- It presents main advantages such as obtaining more effective results.

When national literature is examined, there are many studies introducing the relationship between economic policies and agricultural sector. In these studies, where the relationship of economic variables with agricultural sector is discussed, it is seen that time series empirical analysis method is more frequently used. In the literature studies which have been made in the recent years, in a country group also including Turkey, the studies, in which the relationship between a selected economic variable and agricultural sector is discussed, have been begun to be more intensively carried out. However, in the literature, there is not any study examining the relationship between economic variables affecting subsectors taking place in agricultural sector in Turkey. In this study, which economic variables affect products taking place in cereal, legumes, and vegetable fruit subsector group, among subsector groups of agricultural sector in Turkey, and in which direction this effect is, are attempted to be introduced. With this study, it is aimed to eliminate deficiency in literature. In this context, this study has the feature to be the first study introducing the state and direction of the relationship between subsector groups in the literature and selected economic variables.

In this study, cointegration relationship between agricultural production and price in cereals-legumes, vegetable, and fruit subsectors and selected economic variables are discussed in three stages. The first stage of cointegration analysis consists of examining unit root features of variables. In the second stage following testing stationarity levels, whether or not the variables have cointegration relationship in long term is identified by means of panel cointegration tests and, in the last stage, panel cointegration vector is predicted. The models based on in the study are summarized as follows:

$$\text{Model 1: } \log P_{it} = \alpha_0 + \alpha_1 \log \text{REXR}_{it} + \varepsilon_{it} \quad (1)$$

$$\text{Model-2: } \log P_{it} = \alpha_0 + \alpha_1 \log \text{TUF}_{it} + \varepsilon_{it} \quad (2)$$

$$\text{Model-3: } \log Y_{it} = \alpha_0 + \alpha_1 I_{it} + \varepsilon_{it} \quad (3)$$

$$\text{Model-4: } \log Y_{it} = \alpha_0 + \alpha_1 \log M_{it} + \varepsilon_{it} \quad (4)$$

In this context, panel unit root tests, panel cointegration tests and panel cointegration method are explained step by step in a theoretical framework.

### Panel Unit Root Test Method

Before passing to test the presence of panel unit, it is necessary to test horizontal cross- section dependence in panel data. According to the case of considering horizontal cross section dependence, panel unit root tests are in two

sections as first generation panel unit root and second generation panel unit tests In panel data set, if the presence of horizontal cross –section dependence is rejected, using the first generation unit root tests enable to make more consistent, effective, and strong prediction, and if there is horizontal cross-section dependence in panel data, using the second generation panel unit root tests (Çınar, 2011:5).

In the literature, in panel cointegration studies, Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003, among first generation tests; Maddala and Wu (1999), as known Fisher type-ADF test; and tests known Fisher PP test are commonly used. However, in this study, the results of only unit root tests, developed by Levin, Lin and Chu (LLC, 2002), were given.

LLC (2002), panel unit root test model is predicted as follows:

$$\Delta y_{it} = \mu_i + \theta_t + \delta_i t + \rho y_{it-1} + \sum_{j=1}^k \Delta \alpha_j \Delta y_{it-j} + e_{it} \quad (5)$$

In the model y shows the variable, on which unit root test will be made;  $\Delta$ , first degree difference processors;  $\mu_i$ , constant effects;  $\theta_t$ , time effect; T, general trend and  $e_{it}$  is error term. In LLC(2002) unit root test, the assumption that constant effects change from country to country; that  $\rho$  is homogenous for all horizontal cross –sections in panel data test; and that there is no dependence between horizontal sections is based on This assumption is one of weak points of LLC (2002) panel unit root test. In LLC (2002) unit root test showing normal distribution, null and alternative hypotheses are defined as follows:

Null hypothesis,  $H_0 : \rho = 0$  There is unit root in panel data set.

Alternative hypothesis,  $H_1 : \rho < 0$  There is no unit root in dataset.

In null hypothesis, it is expressed that all data in data set are not stationary, while in alternative hypothesis, it is stated that all data are stationary (Şak, 2006: 43).

**Panel Cointegration Test Method**

Panel cointegration test, developed by Pedroni (1999 and 2004), in testing long term co-integration relationship, in empirical analyses is commonly used. In Pedroni (1999 and 2004) approach, firstly, regression model is predicted by means of LCC method. Model is defined in the form of;

$$y_{it} = \alpha_i + \delta_i t + \beta_i x_{it} + e_{it} \quad (6)$$

In the model, y , shows dependent variable; x , explanatory variable;  $\alpha_i$  , constant effect;

t , trend and  $e_{it}$  , error term. Since  $\beta_i$  can vary for each horizontal section, it is based on the assumption that co-integration vector is heterogeneous between horizontal cross sections forming panel. Hypotheses in Pedroni Approach are (Pedroni, 2004:599);

Null Hypothesis,  $H_0 = 0$  There is no co-integration relationship for all horizontal cross-sections.

Alternative Hypothesis,  $H_1 =$  There is cointegration relationship for all horizontal cross-sections.

Pedroni tests were developed as an approach based on error terms obtained from regression model. Therefore, long term coefficients of the tests, predicted for the level values of variables has to be equal to short term error

correction coefficients, predicted by using unit differences. In case that this condition is not fulfilled, its application causes spurious regression relationship to occur (Westerlund 2007: 710). For testing Pedroni hypotheses, seven co-integration statistics were developed, whose the first four is within-dimension panel co-integration tests and the others, between dimension ones.

Panel cointegration tests are given in Equation 8.

*Within-Dimension Panel Co-Integration Tests*

$$Z_v = T^2 N^{3/2} (\sum_{t=1}^T \sum_{i=1}^N \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2)^{-1} \quad (7)$$

Panel Statistics

$$Z_\rho = T \sqrt{N} \left( \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$$

Panel t- statistics (Non-Parametric)

$$Z_t = (\hat{\sigma}_{N,T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2)^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$$

Panel t-statistics(Parametric)

$$Z_t^* = (\hat{S}_{N,T}^{*2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2})^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^*)$$

*Between-Dimension Panel Co- Integration Tests*

Group  $\rho$ - Statistics

$$Z_t^* = (TN^{-1/2} \sum_{i=1}^N (\sum_{t=1}^T \hat{e}_{i,t-1}^2)^{-1} \sum_{i=1}^N \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$$

Group t –statistics ( Non-Parametric)

$$Z_t = N^{-1/2} \sum_{i=1}^N \hat{\sigma}_i^2 (\sum_{i=1}^N \hat{e}_{i,t-1}^2)^{-1/2} \sum_{t=1}^T (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$$

Group t statistics (Parametric)

$$\tilde{Z}_t = N^{-1/2} \sum_{i=1}^N (\sum_{t=1}^T \hat{s}_i^{*2} \hat{e}_{i,t-1}^{*2})^{-1/2} \sum_{t=1}^T (\hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^*)$$

Statistics of Pedroni tests shows a standard normal distribution and, regarding tot statistics values, whether or not there is panel cointegration relationship is tested. In the study, Pedroni panel cointegration test predictions were obtained by means of RATS Econometric Package Software.

**Panel Cointegration Predictors Method**

Following identifying that there is cointegration relationship, the stage of identifying long-term coefficients was proceeded. The various methods were developed, which provides to be predicted co-integration vector. Among these methods, DOLS (Dynamic Ordinary Least

Square) and FMOLS (Full Modified Ordinary Least Square) predictors, developed by Pedroni (2000, 2001), are of commonly used methods in empirical analyses. In the study, after cointegration tests are applied, in order to predict consistency of predictors that has non-final deviations coefficients, DOLS and FMOLS methods, developed by Pedroni (2000, 2001), were used. While FMOLS method corrects deviations in standard effective predictors (resulted from the problems such as autocorrelation, varying variance), DOLS method, including dynamic elements in the model, is a method having feature to be able to eliminate the deviations in static regression (resulted from the problems with internality) (Kök et al., 2010). FMOLS method, which Pedroni largely permits heterogeneity between individual cross-sections, takes into account the presence of possible correlation between the differences of constant term and error terms and independent variables. Pedroni (2000) also studied the power of FMOLS method in small samples and calculated that performance of t-statistics in small samples is well with Monte Carlo simulations (Kök and Şimşek, 2006).

Group average FMOLS method, developed by Pedroni (2000) is given in panel regression model, based on the assumption that there is no dependence between cross-sections forming the panel in Equation 9 given below. In the Model,

$$y_{it} = \alpha_i + \beta x_{it} + \mu_{it} \quad (8)$$

$$x_{it} = x_{it-1} + e_{it}$$

In this equation; dependent variable,  $x_{it}$  independent variables,  $\beta$  long term coIntegration vector that is necessary to be predicted,  $\alpha_i$  constant effects,  $\mu_{it}$  dummy variable and  $e_{it}$  error term. In Equation 8, error terms, due to the fact that it is a stationary process, if  $y_{it}$  is first degree integrated, there is a long term co-integration relationship between  $y_{it}$  and  $x_{it}$ . In the study, while co-integration vector is obtained in panel FMOLS predictor for panel, firstly, in the model in Equation 8, FMOLS predictor is predicted for each horizontal cross section. Secondly, in each horizontal cross-section, taking the average of co-integration coefficients, obtained from FMOLS predictor, co-integration vector for panel is calculated. Panel cointegration vector for FMOLS predictor is calculated as in Equation 10.

$$\hat{\beta}_{GFM}^* = N^{-1} \sum_{i=1}^N \beta_{FM,i}^* \quad (9)$$

$\hat{\beta}_{FM,i}^*$  denotes co-integration coefficient obtained from FMOLS prediction for each horizontal cross-section. T statistics belonging to FMOLS predictors is obtained from t statistics belonging to cointegration coefficient obtained from FMOLS prediction for each horizontal section. In Equation 10, t statistics associated with panel co-integration coefficient is calculated.

$$t_{\beta_{FM,1}^*} = N^{-1/2} \sum_{i=1}^N t_{\beta_{FM,i}^*} \quad (10)$$

In the model,

$$t_{\beta_{FM,i}^*}$$

denotes cointegration coefficient obtained from FMOLS prediction made for horizontal cross-section.

Group average model DOLS predictor suggested by Pedroni(2001) [in] the following regression model as in Equation 11.

$$y_{it} = \alpha_i + \beta x_{it} + \sum_{k=-K_i}^{K_i} \gamma_{ik} \Delta x_{it} + \mu_{it} \quad (11)$$

In regression model in Equation 11,  $-K_i$  shows premise numbers,  $K_i$ , shows lagging numbers. In this model, it is assumed that in general data set, there is no dependence between horizontal cross sections. In DOLS predictor, as in FMOLS predictor, prediction is made for each horizontal cross section like Equation 12. Differently from FMOLS predictor, taking arithmetical average of co-integration coefficients obtained in FMOLS predictor, panel cointegration coefficients are calculated. In calculation of DOLS panel cointegration coefficients,

$$\hat{\beta}_{GD}^* = N^{-1} \sum_{i=1}^N \beta_{D,i}^* \quad (12)$$

$$\hat{\beta}_{GD}^*$$

denotes co-integration coefficients obtained from DOLS prediction. t-statistics belonging to group average panel DOLS predictors is given Equation 13.

$$t_{\beta_{D,i}^*}$$

denotes t-statistics associated with co-integration coefficient obtained from DOLS prediction.

$$t_{\beta_D^*} = N^{-1/2} \sum_{i=1}^N t_{\beta_{D,i}^*} \quad (13)$$

In the study, the test results of DOLS and FMOLS panel cointegration predictions were obtained by means of RATS-7.0 econometric package software.

## Results and Discussion

In the developed countries while the importance of agricultural product trade relatively decreases, in the countries sensitively developing countries to agricultural product trade, this sector continues to protect its importance. In the recent years, due to contractions experienced in international agricultural product markets and rapid increase in agricultural prices, the requirements formed in the direction of that the sectors reaches to a structure that can compete in domestic and foreign markets. In this section of the study, cointegrated relationship was aimed to be introduced between the subsectors of vegetable fruit, cereals, and legumes coming forefront in agricultural foreign trade of Turkey and the selected economic variables. Before testing the presence of long term cointegrated relationship between the variables, it is necessary to provide the condition of being stationary at I(1) level, one of the main assumptions of panel cointegration test. Therefore, firstly, the results of unit root test results were given place. Besides that the variables become stationary, the results of unit root test forming the first conditions of introducing the first condition of

cointegrated relationship additionally give important information in terms of applications of agricultural policy. After testing that the variables are stationary at I(1) level, for identifying whether or not the variables have cointegration relationship in long term, panel cointegration test and panel cointegration prediction were made.

In this section, the results of unit root test, one of assumptions of panel cointegration test, introducing the condition that variables are stationary at I(1) level take place. Therefore, in the study, Levin, Lin and Chu (LLC) (2002), test that are among first generation tests, in which horizontal cross-section dependence is not taken into consideration, was used. Firstly, it was aimed to identify

whether or not the selected economic variables, used in all sectors at level and first difference, and the results of unit root test was given in Table 2.

When Table 2 is examined, it is identified that all variables are stationary at 1<sup>st</sup> difference and meet the condition to be stationary. For all subsectors, the results of unit root test belonging to price series are given in Table 3. When the results of unit root test in Table 3 are examined, it is seen that all questions are stationary in first difference and meet the assumption of cointegration relationship. The results of unit root test additionally present important information in terms of applications of agricultural policy.

Table 2. The results of panel unit test belonging to economic variables

	Level			First Difference	
	Variables	LLC		Variables	LLC
Constant	logTUFEE	-0,85898 [0.4315]	Constant	ΔlogTUFEE	-11,7947*** [0.0000]
	log REXR	-1,26033 [0.1038]		ΔlogREXR	-6,59747*** [0.0000]
	I	1,72044 [0.9573]		Δi	-13,0626*** [0.0000]
	log M	-1,5526 [0.8648]		ΔlogM	-7,27898*** [0.0000]
Constant- Trend	logTUFEE	1.77366 [0,9619]	Constant- Trend	ΔlogTUFEE	-9.55067*** [0.0000]
	logREXR	-0,15910 [0.4368]		ΔlogREXR	-5,31739*** [0.0000]
	I	-1,29441* [0.0978]		Δi	-12,1413*** [0.0000]
	logM	-1.87342 [0,9856]		ΔlogM	-14,9215*** [0.0000]

In LLC test, appropriate lagging number was determined according to Schwarz information criterion. In LIC test, Barlett method was used as spectral prediction method and band width was identified according to Newey-West method. Values in parentheses are probability values and \*, \*\*, \*\*\* expressions shows that they are significant at, 10%, 5%, and 1% levels, respectively.

Table 3. The results of Unit Root Test [Belonging to] agricultural production and price variables

	Test	Variables	LLC	
		Level		
Cereals-Legumes Subsector	Constant	logYA	-0.47541 [0.3172]	
		logp	-1.21404 [0.1124]	
	Constant – Trend	logYA	-1,72343* [0.0424]	
		logp	-1.42290* [0.0774]	
	In 1 <sup>st</sup> Difference			
	Constant	Δ logYA	-11.0856*** [0.0000]	
		Δ logp	-10,5435*** [0.0000]	
	Constant- Trend	Δ logYA	-9.11359*** [0.0000]	
Δ logp		-9,11730*** [0.0000]		
Fruit Subsector	Level			
	Constant	logYA	-0.82769 [0.2039]	
		logp	-0.53050 [0.2979]	
	Constant – Trend	logYA	-1,64592 [0.3864]	
		logp	-1.42290 [0.4392]	
	In 1 <sup>st</sup> Difference			
	Constant	Δ logYA	-15,2282*** [0.0000]	
		Δ logp	-13,0754*** [0.0000]	
Constant- Trend	Δ logYA	-12,6525*** [0.0000]		
	Δ logp	-11,4456*** [0.0000]		
Vegetable Subsector	Level			
	Constant	Δlogp	-1.10700 [0.1284]	
		Δlogpro	-1,07227 [0.1418]	
	Constant – Trend	Δlogp	-2,78610 [0.1242]	
		Δlogpro	-2,28785 [0.1111]	
	In 1 <sup>st</sup> Difference			
	Constant	Δ logYA	-10,5788*** [0.0000]	
		Δ logp	-13,7226*** [0.0000]	
Constant- Trend	Δ logYA	-8,37621*** [0.0000]		
	Δ logp	-12,0691*** [0.0000]		

Agricultural product prices show important variations with the effect of factors effecting the supply and demand of these products in both short and long term. In agricultural sector, since amount of production is not arranged according to the variations in demand occurring in short term or supply control in agricultural production is not as easy as in industry, fluctuations in the prices of agricultural products are more intensive. These fluctuations are seasonal, short term periodic from year to year, and long term gradual fluctuations (Aksöz 1973).

In the previous section, it was identified that variables are stationary at I(1) level and condition to be able to introduce cointegrated relationship formed. In this section, in order to introduce long term cointegrated relationship between variables Pedroni (1999) and panel cointegration test vector prediction were made. The results of panel cointegration test and vector prediction were individually given and interpreted under subheadings for each sector

In the developing countries not completing industrialization and economic development, providing economic stability has a great importance. In the developing countries that are open capital movements, while the leading main factor affecting economic stability is exchange rate, in terms of that it affects both international economic relationships and national markets, it takes place among frequently discussed subjects in economic literature. In this section of the study, whether or not there is long term relationship between the price of agricultural product and exchange rate, in case that there is a long term relationship, identifying how the sector is affected from exchange rate fluctuations were aimed.

In the study, regression models introducing panel cointegration relationship between the price of agricultural product and exchange rate in the long term were defined in the form of Model 1. In this section, for each subsector, the relationship between the price and exchange rate were discussed under distinct headings. At this point, considering the case of “constant and trend”, long term cointegration parameter was predicted. When panel cointegration test results between the prices of agricultural products belonging to the subsector of vegetable fruit and exchange rate are examined, it was identified that there was a long term relationship between the variables in the cases of both “constant” and “constant and trend”. When the results of panel DOLS and FMOLS tests are evaluated on the panel basis, it is seen that the sign of cereals and legumes prices is positive as expected and that it is significant at 1% level. Namely, increase in exchange rate in long term causes increase in cereals legumes prices.

In LLC test, appropriate lagging number was determined according to Schwarz information criterion. In LIC test, Barlett method was used as spectral prediction method and band width was identified according to Newey-West method. Values in parentheses are probability values and \*, \*\*, \*\*\* expressions shows that they are significant at, 10%, 5%, and 1% levels, respectively.

For the subsectors taking place in Table 4, according to the results of group panel DOLS test, coefficient of exchange rate is 0.147, and this coefficient was calculated as 0.149 according to the results of FMOLS test. For a total of 12 products taking place in the group of cereals legumes, it was identified that one unit increase caused a price increase of 0.147 according to DOLS results and a price increase of

0.149 according to FMOLS results. When the results of both DOLS and FMOLS predictions taking place in Table 4 are examined, it is seen that the sign of the effect of exchange rate on fruit prices are positive and statistically significant. Namely, it was identified that the increase of one unit in exchange rate in the long term fruit prices increased fruit prices. For a total of 12 products taking place fruit subsector, it was identified that increase of one unit in exchange rate caused price increase of 0.126 according to DOLS results, and 0.121, according to FMOLS results. When the results of both DOLS and FMOLS predictions taking place in Table 4 are examined, the sign of the effect of exchange rate on vegetable prices also turned out positive and statistically significant in vegetable sector as in the other two subsectors. According to the results of panel cointegration predictor, it was identified that increase of one unit in exchange rate increased vegetable prices. For vegetable subsector, it was identified that in all group panel, exchange rate coefficient was 0.137 according to the result of DOLS test and 0.141, according to FMOLS test results. For a total of 12 products taking place vegetable subsector, it was concluded that while increase of one unit in exchange rate increased vegetable prices increased by 0.137 according to DOLS test results, it increased by 0.141 according to FMOLS test results.

The model introducing the relationship between inflation and price of agricultural product in the theoretical framework was defined as Model 2. Model 2 was identified that according to the statistical results of the panel cointegration test, for all subsectors, there was a long term relationship between agricultural prices and inflation in the cases of both “constant” and “constant and trend”. For Model 2, the results of panel cointegration relationship prediction are given in Table 4. According to prediction results taking place in Table 4, it is seen that the effect of inflation on the prices of cereals legumes is statistically significant and positive in both DOLS and FMOLS predictors. When the results of Panel DOLS and FMOLS tests are evaluated in panel basis, it is seen that the sign of the cereals legumes prices are positive and statistically significant at 1% level as expected. Namely, in long term, according to the results of both tests, it is seen that increase in inflation positively affect the cereals- legume prices in all panel. According to the results of panel DOLS test in all panel, inflation coefficient was found 0.62, while according to the results of FMOLS test, this coefficient was 0.59. In other words, for a total of 12 products taking place in cereals legumes, it was identified that one unit increase in inflation caused a price increases of 0.62 according to the results of DOLS test and price increase of 0.59 according to the results of FMOLS test. According to the results of both predictor, since  $0 < \alpha_1 < 1$  is in the model, it was concluded that the increase in agricultural prices was less than the increase in inflation rate.

According to the results of prediction taking place in Table 4, it is seen that the effect of inflation on fruit prices is statistically significant and positive at 1% level in both DOLS and FMOLS predictors. When the results of Panel DOLS and FMOLS tests are evaluated on the basis of panel, in the long term, it is seen that the increase in inflation positively affects fruit prices in all panel. According to the results of Panel DOLS test, inflation coefficient was found 0.008 in all panel and 0.148, according to the results of FMOLS test. In other words, for

a total of 12 products taking place in fruit group, one unit increase in inflation caused a price increase of 0.08 on inflation according to the results of DOLS test and price increase of 0.148, according to the results of FMOLS test. According to the results of both predictor, in this model, since  $0 < \alpha_1 < 1$  is, it was concluded that increase in agricultural prices was smaller than increase in inflation rate. According to the results of FMOLS predictor, it is seen that the effect of inflation on vegetable prices is statistically significant and positive. When the results of Panel FMOLS tests are evaluated on the basis of panel, in the long term, it is seen that the increase in inflation increases vegetable prices in all panel. According to the results of Panel FMOLS test, inflation coefficient was found 0.098 in all panel in other words, for a total of 12 products taking place in vegetable group, one unit increase in inflation caused a price increase of 0.098 on inflation according to the result of FMOLS test. According to the results of FMOLS predictor, in this model, since  $0 < \alpha_1 < 1$  is, it was concluded that increase in vegetable prices was smaller than increase in inflation rate.

For all subsectors, the prediction results of the panel cointegration relationship between agricultural production and interest rates are given in Table 4.

According to the statistical results of panel cointegration test belonging to Model 3 taking place, it was identified that there was a long term relationship between the variables in cases of both constant and constant and trend. Following identifying the presence of long term relationship, the results of panel cointegration relationship prediction belonging to Model 3 were calculated and the results were given in Table 4. According to the prediction results taking place in Table 4, while it is seen that the sign of the effect of interest rates on the prices of cereals and legumes is positive and statistically significant at 1% level according to DOLS results, the results of FMOLS predictor is seen not to turn out statistically significant. Therefore, cereal legume subsector, DOLS results were interpreted. According to DOLS test result in long term, it was identified that rise in interest rate increased cereal legumes production by 2.48. When DOLS results were examined on product basis, in case of increase of interest rates, while the production of rye, corn, and rice decreases, it is seen that the increase of interest rate in the other products positively affects production.

According to the results of prediction taking place in Table 4, it is seen that the sign of effect of interest rate on fruit prices is negative as expected and statistically significant at 1% level in both DOLS and FMOLS predictors. Namely, in the long term, according to the results of both tests, the rise in interest rate reduces fruit production. According to the results of Panel DOLS test, interest coefficient was found -4.04 in all panel and 4.40, according to the results of FMOLS test. In other words, for a total of 12 products taking place in fruit group, it was identified that one unit increase in interest rate reduced by 4.05 agricultural production according to the results of DOLS test and 4.40, according to the results of FMOLS test.

According to the prediction results taking place in Table 4, it is seen that the sign of the effect of interest rate on vegetable prices is negative as expected and statistically significant at 5%. According to the results of DOLS and

FMOLS prediction results. In other words, in the long term, it was concluded that the rise in interest rate reduced vegetable production in all panel. According to the results of Panel DOLS test, it was found that interest coefficient was -1.69 in all panel according to FMOLS test results. Namely, one unit increase in interest rate reduces vegetable production by 1.69 according to the results of DOLS test and, 3.29 according to FMOLS results. In all subsectors, for Model 4, the results of panel cointegration relationship test are given in Table 4. According to the statistical results of panel cointegration relationship for subsectors, it was identified that there was a long term relationship between the variables.

The relationships of cointegration relationship between cereals legumes and monetary supply prediction are given in Table 4. According to the results of prediction taking place in Table 4, it is seen that the sign of the effect of monetary supply expansion on cereals-legumes production is positive and statistically at 1% level according to the results of DOLS predictor and that the results are not statistically significant according to FMOLS predictor. Namely, in the long term, according to the result of DOLS predictor, it was identified that rise in interest rate increased the production of cereals-legumes. According to the results of Panel DOLS, in all panel, it was identified that monetary supply coefficient increased by 0.06 units. According to the results of DOLS test. In other words, in every part of 12 product taking place in cereals legumes group, it was identified that one unit increase in the rate of monetary supply increased agricultural production by 0.06 units according to the results of DOLS test. On the other hand, it is seen that the sign of the effect of monetary supply on fruit production is positive and that it is statistically significant at 1% level according to the results of both DOLS and FMOLS test results. Namely, in the long term, according to the results of both tests, it was identified that increase in monetary supply increased fruit production. According to Panel DOLS test results, in the long term, in every part of panel, it was found that monetary supply coefficient was 0.106, while according to the results of FMOLS test, this coefficient was 0.112. In other words, in every part of 12 products taking place in fruit group, it was identified that one unit increased by 0.106 units according to the results of DOLS test and 0.121 units according to the results of FMOLS test. In addition, it is seen that the sign of the effect of monetary supply on vegetable production is positive and that it is significant at 1% level according to the results of both DOLS and FMOLS predictors. Namely, the conclusion that one unit expansion in monetary supply increased vegetable production by 0.033 unit according to DOLS results and 0.129 unit, according to FMOLS results takes place among the findings obtained. According to Model 4, while expansionary monetary policy had a positive effect on agricultural production, it is seen that this does not form an inflationist effect. Beginning from the years 1970 and 1980, it is seen that a study area directed to what the effects of economic policies on agricultural sector are. In this study cointegration relationship between agricultural sector and the selected economic variables (interest rate, inflation, exchange rate and monetary supply) was discussed and the results were summarized in Table 4.



Table 4. Co-integration Relationship between the Selected Economic Variables and Agricultural Sector

Group Characteristics Belonging to the Variables and Sector	DOLS		FMOLS	
	Coefficient	t-statistics	Coefficient	t-statistics
Model-1: $\log P_{it} = \alpha_0 + \alpha_1 \log \text{REXR}_{it} + \varepsilon_{it}$				
The Subsectors of Cereals Legumes	0.146997***	12.09456	0.149450***	6.960620
The Subsector of Fruit	0,126312***	10,50961	0,120790***	5,032037
The Subsector of Vegetables	0.136659***	9.055258	0.140957***	5.777170
Model-2: $\log P_{it} = \alpha_0 + \alpha_1 \log \text{TUFE}_{it} + \varepsilon_{it}$				
The Subsectors of Cereals Legumes	0.615878***	40.53640	0.585334***	19.16533
The Subsector of Fruit	0,075002***	4,179493	0,148121***	14,61836
The Subsector of Vegetables	0.296930	0.303513	0,097560***	4,346282
Model-3: $\log YA_{it} = \alpha_0 + \alpha_1 i_{it} + \varepsilon_{it}$				
The Subsectors of Cereals Legumes	2,481695**	2,700129	-0,86541	1,15546
The Subsector of Fruit	-4,04785***	-18,8646	-4,39270***	-16,0720
The Subsector of Vegetables	-1,69041**	-2,50844	-3,28690*	-2,15444
Model-4: $\log YA_{it} = \alpha_0 + \alpha_1 \log M_{it} + \varepsilon_{it}$				
The Subsectors of Cereals Legumes	0,059154***	5,641350	0,001576	0,841029
The Subsector of Fruit	0,105425***	9,983533	0,120817***	23,86196
The Subsector of Vegetables	0.033430***	5.669539	0.029504***	10.24619

## Conclusion and Discussion

That agricultural sector, scrutinizing from every aspects, is necessary to be restructured in accordance with the requirements of the age comes to our face as a reality, any longer accepted by every sector of the society. The various developments, experienced in the world, in the recent years, have directly or indirectly affected agricultural sector. Food crises emerging together with fluctuations in climatic movements, often begun to be experienced, and the increasing food prices seriously affected not only Turkey but also world economies.

Although the importance of agricultural sector seems to relatively decrease, the role of agriculture in production basic necessities and forming employment area is still in the dimension that cannot be ignored. Global warming, climatic change and unexpected price increase, whose tangible results are experienced especially in the last period, much more increased the importance of agricultural sector. Natural sources are gradually being polluted, and the possibilities to be able to use them decreases. Agricultural areas become a desert and, due to global sea level rise many countries and regions hold the risk to remain under water. Since all of these threaten food supply and security, they loaded a strategic role onto sector. The continuously changing global agenda and economic cycle much more makes it difficult competitive conditions in international platform. This change process closely affects all sector, especially agricultural sector. In Turkey, besides agricultural sector can rapidly adapt to this change process, it is necessary for agricultural sector both to protect its existing markets, resisting competitive conditions, and it to increase market share, opening to the new markets. Due to its mentioned importance, in this study, Turkish agricultural sector is structurally discussed, and the analysis of competitive power was made in respect of sectors and subsectors. In addition, the effect of economic variables on agricultural sector were tried to be introduced by utilizing panel cointegration analyses.

In the developed countries, while the importance of agricultural product trade is relatively decreasing, in the developing countries that are sensitive to trade of agricultural product, this sector is continuing to keep its importance. In the recent years, due to contractions experienced in the markets of international agricultural product and rapid increase, in country economies, the

necessities formed in the direction of reaching the sector to the structure to be able to compete in domestic and foreign markets. In this framework, the effect if economic variables (exchange rate, inflation, monetary supply and interest rate) on subsectors of vegetable fruit and cereals legumes, which come forefront in foreign trade of agricultural products in Turkey, was dealt with panel cointegration analysis.

Setting out from this point, when the analysis made in the study are evaluated for all sectors, it was identified that the most affecting the sector was interest rates. When panel cointegration results between interest rate and agricultural production are examined, while there was a negative directional relationship between the production of vegetable-fruit subsector and the variable interest rate as expected, that there was an opposite directional relationship between the subsector of cereals legumes and interest rate attracts attention. In Turkey, business costs in the production of vegetable fruit subsector are much higher than those of cereals-legumes. Therefore, in case that interest rate rise, while production in the subsector of vegetable fruit is negatively affected from this process, it is seen that it was reached the conclusion that this case positively affects the production of legume. This interaction is also seen in analysis results and makes the results of interest flexibility coefficient significant.

As in all over the world, also in Turkey, the current course of the prices of agricultural products forms an important risk on inflation. Fluctuations in the prices makes it difficult inflation expectation prediction of central bank in short and middle term. In this context, understanding the main causes of price fluctuations and identifying the direction of reaction they gave to the applications of monetary and fiscal policy have considerably importance in terms of introducing the effectiveness of the policies applied for the sector. Therefore, in the study, it was tried to identify the direction and dimension of long term relationship between the prices of agricultural products and inflation. In the study, following the variable interest rate, it was identified that economic variable, from which subsector is affected, is inflation. The subsector, whose sensitivity to inflation is the highest, is the subsector of cereals legumes, and the

subsector of vegetable fruit follows this rank. In other words, in case that an increase is experienced in inflation rate, identifying that there are serious price rises in the group of cereal legumes, which is the most important consumption items of consumers, is one of the most important findings obtained. For all subsectors, it was identified that inflation flexibility coefficients were smaller than the increase in agricultural prices. The results obtained in the study has a similar quality to the conclusion of the study conducted by Stearleaf et al. (1985), Reziti (2005) and Ukaho (2007) and a positive directional relationship was found between inflation rates and the prices of agricultural products. For being able to lower high inflation, among the main problems of Turkey, to desired levels, it is necessary to lower food inflation leading inflation rate to follow a high course in Turkey. In this context, especially reducing domestic costs, it was emphasized by President of Central Bank that it is necessary to lower inflation and, reducing tax directed to the sector to support the sector.

In Turkey, it is known that real exchange rate has an important effect on agricultural prices and agricultural trade equilibrium. Therefore, in the study, the relationship of exchange rate and agricultural sector was also discussed in the study. In case that the rate of the flexibility of the price of agricultural product to exchange rate is smaller than 1, it is accepted that percent variation in the price of agricultural product is smaller than percent variation in the price. According to the results of analysis taking place in the study, in case that national money devalues, in other words, that exchange rate rises, it was concluded that the prices of agricultural products caused increases in the rates of close rates in almost every sector. Due to the fact that a large majority of products included in analysis consist of export products, in case that there is a rise in exchange rate, it was identified that the increases in product prices were experienced. In this context, the results have a quality supporting the general argument. It was concluded that the relationship of agricultural production and monetary supply relationship taking place in the study formed a positive effect on agricultural production but did not cause inflationist pressure. In case of presence of expansionary monetary policy, fruit subsector leads to the increases in production, in the production of cereals, legumes, and vegetable, production increase in the rate of rather low we reached. The similar findings obtained in the study overlap with the results of the study carried out by Chamber (1984) and Tegene (1990).

Setting off from the result of two analyses carried out in the study, while evaluating the sector, [it is seen that] evaluating only the current situation of the sector is not enough, and it is necessary to consider the relationship of the sector with the other sector as well as production structure specific to the sector. In the recent year, beside experiencing climatic change, unexpected increases of food prices exhibited the strategic importance of the sector once more. In this direction, it is necessary to withdraw the policies formed for the sector form being government policy and to transform them into state policy. In addition, in the developed countries, while it is seen that sector is seriously supported by the state, in Turkey, support remains rather incapable. In this context, in international platforms, for Turkey to be able to provide competitive advantage and make it sustainable, it is thought of that it is necessary to increase the required supports and tax

subventions and form mechanism, in which supporting is effectively supervised.

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