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Validity of Okun Law in Agricultural Sector in Turkey: ARDL Bounds Test Approach

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Türkiye'de Tarım Sektöründe Okun Kanununun Geçerliliği: ARDL Sınır Testi Yaklaşımı

Abstract

Okun's Law asserts an inverse relationship between unemployment and economic growth in the economy. The study examines the relationship between the growth rate and unemployment rate for Turkey's agricultural sector from 2014Q1 - 2021Q3. The stationarity test is carried out with the Generalized Dickey-Fuller Unit Root Test. Then, the relationship between growth and unemployment rates in the agricultural sector is analysed with the ARDL bounds test. According to the study results, the growth rate of the agricultural sector and the unemployment rate in the agricultural sector are cointegrated in the long run, and the relationship between them is statistically significant and positive. The result reached in the study; Okun's Law is valid in the agricultural sector of the Turkish economy.

Keywords : Okun Law, Agriculture Sector, ARDL Bounds Test.

JEL Classification Codes : E24, J43, O47.

Öz

Okun Kanunu, ekonomide işsizlik ile ekonomik büyüme arasında ters orantı olduğunu ileri sürmektedir. Çalışmada Türkiye'nin tarım sektörüne yönelik, büyüme oranı ile işsizlik oranı arasındaki ilişki 2014Ç1 - 2021Ç3 dönemi için incelenmiştir. Değişkenler Genelleştirilmiş Dickey-Fuller Birim Kök Testi ile durağanlık sınaması yapılmıştır. Ardından, ARDL sınır testi ile tarım sektöründeki büyüme ve işsizlik oranları arasındaki ilişki analiz edilmiştir. Çalışmanın sonucuna göre; tarım sektörünün büyüme oranı ve tarım sektöründeki işsizlik oranı uzun dönemde eşbütünleşik ve arasındaki ilişki istatistiksel olarak anlamlı ve pozitiftir. Çalışmada ulaşılan sonuç; Türkiye ekonomisi içerisinde tarım sektöründe Okun Kanunu geçerlidir.

Anahtar Sözcükler : Okun Kanunu, Tarım Sektörü, ARDL Sınır Testi.

1. Introduction

The effects of unemployment can be divided into economic and non-economic effects. The economic effects can be explained as the production volume is lower than it should be. Non-economic effects can be explained as the psychological problems experienced by the unemployed (Abel et al. 2008: 458). Examples of non-economic effects are situations that are related to unemployment. Some of them are psychological disorders, suicide, substance abuse, divorce and criminal habits.

The economic effects of unemployment are a decrease in the amount of production. Arthur Okun made one of the most important studies in the literature on this subject in 1962. A. Okun investigated the possible effects of unemployment on the gross domestic product deficit and found that unemployment causes a deficiency in the GDP. The fact that unemployment causes the gross domestic product deficit, that is, the economy to grow less than its potential, is called "Okun's Law".

The equation shows the Okun coefficient numbered 1 (Barışık et al. 2010: 91).

$$U = U^* - \beta \left(\frac{Y - Y^*}{Y^*}\right) \quad (1)$$

In this equation, β is Okun Coefficient, U* is the natural unemployment rate, U is the unemployment rate, Y* represents potential GDP, and Y is actual GDP.

The coefficient β in the equation numbered 1 is called the "Okun Coefficient". In A. Okun's study, this coefficient was calculated as 0.3. That is, for every 1% increase in unemployment rates, the gross domestic product gap increases by 0.3%. From a different perspective, the unemployment rate decreases by 0.3% for every 1% increase in the actual product.

The study aims to examine the correlation between the growth rate of the agricultural sector in the Turkish economy and the unemployment rate in the agricultural sector. In the study, first of all, a literature review will be done on the studies in the field of Okun's Law. Followingly, methodological information will be given about the tests in that the relationship between the two variables will be examined. After the method information, the relationship between the variables will be discussed with econometric analysis. In this context, agricultural sector growth data and unemployment rates in the agricultural sector will be used between the 2014Q1 and 2021Q3 periods. The relationship between the mentioned variables will be analysed with the ARDL bounds test approach after the stationarity test of the variables is done with the Augmented Dickey-Fuller Unit Root Test.

2. Literature Review

The literature review focuses on selected studies about Okun Law related to the Turkish economy since no analysis has been found regarding the validity of Okun's Law in the agriculture sector.

Evaluation of the studies according to the scanned literature is given in Table 1.

Table: 1
Literature Review on Okun's Law

Author	Year	Country	Data Period	Result
Okun	1962	United States	1947-1960	Every increase in the unemployment rate creates a greater GDP gap than the rate of increase.
Yılmaz	2005	Turkey	1978-2004	For the Turkish economy, there is unidirectional causality from the growth rate to the unemployment rate.
Uysal & Alptekin	2009	Turkey	1980-2007	For the Turkish economy, one-way causality from growth to unemployment has been determined. Okun's Law is invalid.
Takım	2010	Turkey	1975-2008	There is bidirectional causality between unemployment and growth in the Turkish economy.
Ceylan & Şahin	2010	Turkey	1950-2007	Okun's law is valid for the Turkish economy in the long run.
Barışık, Çevik & Çevik	2010	Turkey	1988-2008	Although growth does not create employment for the Turkish economy, Okun's Law is not valid either.
Tiryaki & Özkan	2011	Turkey	1998-2010	The Turkish economy has unidirectional causality from output gap to unemployment. Okun's Law is not valid.
Kanca	2012	Turkey	1970-2010	Although growth affects unemployment in the Turkish economy, Okun's Law is not valid.
Özdemir & Yıldırım	2013	Turkey	2005-2013	Although there is a causal relationship between growth to employment for the Turkish economy, Okun's Law is invalid in the long run.
Şentürk & Akbaş	2014	Turkey	2005-2012	Okun's Law is valid for the Turkish economy.
Eser	2014	Turkey	1970-2010	Okun's Law is valid for the Turkish economy.
Işık, Şahbaz & Şahbaz	2015	OECD Countries	1990-2014	Okun's Law is valid for OECD country economies.
Göçer	2015	Turkey	2001-2015	For the Turkish economy, economic growth is the cause of unemployment and Okun's Law is valid.
Demirbaş & Kaya	2015	Turkey	1980-2009	Okun's law is valid for the Turkish economy in the long run.
Altunöz	2015	Turkey	2000-2015	Although unemployment growth affects the Turkish economy, Okun's Law is invalid.
Akay, Aklan & Çınar	2016	Turkey	1969-2014	Okun's Law is more effective for the Turkish economy than in periods of economic growth.
Erkuş, Gemrik & Aytemiz	2016	Turkey	2000-2015	Okun's law is valid for the Turkish economy.
Uras	2016	Turkey	2000-2014	Okun's law is valid for the Turkish economy.
Köse	2016	Turkey	2003-2014	Okun's law is valid for the Turkish economy.
Arı	2016	Turkey	1980-2014	There is growth in the Turkish economy that does not create employment. Okun's Law is invalid.
Economou & Psarianos	2016	EU Countries	1993-2014	The Okun Law applies to the economies of European Union countries.
Hooper	2017	Developing Countries	2011-2015	Okun's Law is valid in 85 different countries' economies.
Grant	2017	United States	1948-2016	Okun's Law applies to the American economy.
Yüksel & Oktar	2017	Developed and Developing Countries	1993-2015	Okun's Law is valid in developed and developing countries.
Mucuk, Edirneligil & Gerçeker	2017	Turkey	2002-2014	Okun's law is valid for the Turkish economy.
Eğri	2018	Egypt	1970-2016	Okun's Law does not apply to the Egyptian economy.
Güçlü	2018	Turkey	2004-2014	Okun's law is valid for the Turkish economy.
Özçelik & Erdem	2020	Turkey	1990-2019	Okun's law is valid for the Turkish economy.
Yayar & Öztaş	2020	D-8 Countries	1998-2017	Okun's Law is not valid
Karadağ-Ak	2021	Turkey	2005-2020	Okun's law is valid for the Turkish economy.
Koçak	2021	Turkey	2005-2020	Okun's law is valid for the Turkish economy.

3. Methodology

In the study, total production data of the agricultural sector between 2014Q1-2021Q3 and unemployment rates in the agricultural sector are used. The data are taken from the data repository of the Turkish Statistical Institute (TURKSTAT). To start the evaluations, the

unit root inclusion status of the data above is analysed. The Augmented Dickey-Fuller Unit Root Test, developed by D. David and W. Fuller in 1979 and revised and finalised two years later, is employed to conduct the analysis. This test analyses the model over three equations: the plain version, the constant term version, and the trend and constant term version. In the study, the equations of the model, which are used for both constant term and trend models, are used. The equation in which the model contains a constant term is shown with the number 2, and the equation containing both the constant term and the trend with the number 3 (Taş et al., 2017: 270-271).

$$\Delta Y_t = \alpha_0 + \lambda Y_{t-1} + \mu_t \quad (2)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \lambda Y_{t-1} + \mu_t \quad (3)$$

By using these equations, it is aimed to find the estimated value of the coefficient ∂ and its standard error. The estimated ∂ value from these equations is compared with the corresponding value in the DF table created by Dickey and Fuller. Table values consist of 0 and "-" negative values. As a result of the mentioned comparison, the following hypotheses are tested, and it is concluded whether it contains a unit root or not.

H0 = $\lambda = 0$ There is a unit root in the series; it is not stationary,

H1 = $\lambda < 0$ There is no unit root in the series, it is concluded that the series is stationary.

The ARDL bounds test developed by M.H. Pesaran, Y. Shin, and R.J. Smith in 2001 has also been used. ARDL bounds test enables the analysis of the cointegration relationship between the series used in the model, regardless of their stationarity of the same order. In addition, determining the short- and long-term relationships with the help of the error correction model by keeping long-term information available in the model is one of the advantageous aspects of the ARDL bounds test.

Equation 4 is the one used in ARDL bounds test (Peseran et al., 2001).

$$\Delta Y = \alpha_0 + \sum_{i=1}^{k} \alpha 1i\, \Delta Y_{t-1} + \sum_{i=1}^{m} \alpha 2i\, \Delta X_{t-1} + \alpha_1 Y_{t-1} + \alpha_2 X_{-1} + \varepsilon_t \quad (4)$$

Within the ARDL bounds test scope, "0" and "1" bounds are determined for the model in question. 1%, 2.5%, 5% and 10% error probability are determined separately with the bound's calculated F statistical value. If the calculated F statistic has a value above the "1" springs, the result is that the model is cointegrated. If the F statistic under the "0" boundary is calculated, it is determined that the model is not cointegrated. Finally, suppose the F statistical value is between the bounds of "0" and "1". In that case, it is concluded that the model is undecided whether it is cointegrated and does not reach a conclusion.

Also, in this study, agricultural growth rate (AGR) and agricultural unemployment rate (AUR) variables were supplied from the Turkish Statistical Institute data bank.

The model used in the analysis is presented in equation number 5.

$$AUR = \beta 0 + \beta 1 AGR + \varepsilon \quad (5)$$

The ARDL Bounds Test values applied within the framework of this model and the Augmented Dickey-Fuller Unit Root Test, in which the stability of the variables is analysed, are reported in the valuable empirical findings section.

4. Empirical Findings

The results of the Augmented Dickey-Fuller (ADF) Unit Root Test are reported in Table 2.

Tablo: 2
ADF Test Results

Variable	Intercept %1 Value %5 Value %10 Value (Test Statistics) [Probability Value]	Trend and Intercept %1 Value %5 Value %10 Value (Test Statistics) [Probability Value]
AGR	-3,67170 -2,963972 -2,621007 (-3,107947) [0,0367]	-4,296729 -3,568379 -3,218382 (-2,990424) [0,1512]
D AGR	-3,679322 -2,967767 -2,622989 (-5,909805) [0,0000]	-4,309824 -3,574244 -3,221728 (-5,994783) [0,0002]
AUR	-3,711457 -2,981038 -2,629906 (-1,847560) [0,3504]	-4,356068 -3,595026 -3,233456 (-2,585570) [0,2890]
D AUR	-3,699871 -2,976263 -2,627420 (-8,741133) [0,0000]	-4,146345 -3,622033 -3,248592 (-4,191345) [0,0160]

First, the statistical test and the confidence value are compared to interpret the Augmented Dickey-Fuller Unit Root Test table. This study has been shaped on a 95% confidence value, that is, a 5% margin of error. Therefore, comparing the test statistic value with the 5% error value is necessary. As a result of this comparison, if the test statistic value is greater than the error value, it is concluded that the series contains a unit root. Otherwise, if the test statistic value is less than the error value, it is concluded that the series is stationary.

According to the results in the model with constant term and model with both constant term and trend, it has been determined that the variables of the growth of the agricultural sector and the unemployment rate in the agricultural sector contain unit root in their level values, that is, they are not stationary. Surprisingly, the agricultural sector growth rate is found to be stable in the level value in the fixed term model; even stability in the level value in both the fixed term and trend model is not the case. Yet, after taking the difference, the growth rate is detected to be stationary in both cases.

Table: 3
ARDL Test Values

The ARDL Model = > AGR = *f* (AUR)		
F Statistics	10,31989	
Model	(4, 0)	
Significance Levels	Critical Values	
	0 Boundary	I Boundary
%1	6,84	7,84
%2,5	5,77	6,68
%5	4,49	5,73
%10	4,04	4,78
Diagnostic Tests	Statistics	
R^2	0,501292	
Durbin-Watson Statistic	2,241748	
F Statistic	4,221769	
Breusch-Godfrey LM	0,1417	
Jargue-Bera Normality Test	0,748687	
Ramsey Test	0,9407	

According to Table 3, the cointegration status of the stationary variables is analysed by the ARDL bounds test; the F statistic has been calculated as 10.31. As a result of comparing this test with the "0" and "1" bounds, it can be concluded that the model established is cointegrated even at the 99% confidence interval. However, since the study is continued at the 95% confidence interval - as stated in the paragraph below Table 2-we keep comparing the F statistical value calculated with the 5% significance level. In the 95% confidence interval, the "0" bounds are calculated as 4.94 and the "1" bounds as 5.73. Since the F statistical value is greater than the "1" bounds, it is concluded that the model is cointegrated at the 95% confidence interval.

Considering the diagnostic values calculated by the ARDL bounds test, there is no autocorrelation problem when the Breusch-Godfrey LM test is considered. Moreover, based on the Jargue-Bera Normality Test, it is figured that the error term has a normal distribution. According to the Ramsey Test, it is understood that there is no model building error. In light of this information, the long-term relationship between the variables is analysed in Table 4.

Table: 4
ARDL Bounds Test Cointegration Values

Cointegration Form				
Variable	Coefficient	Standard Error	Test Statistic	Probability Value
D(TB(-1))	-10,412752	0,229698	-45,332301	0,0000
D(TB(-2))	-5,964518	0,20795	-28,687246	0,0000
D(TB(-3))	-2,433677	0,186299	-13,063300	0,0000
D(TIO)	1,938127	1,390673	1,393661	0,1780
CointEq(-1)	-0,422510	0,289080	-1,839320	0,0000
Cointegration Equation = AGR = - 0.0365 - 0.5663 x AUR				
Long Rotation Coefficients				
Variable	Coefficient	Standard Error	Test Statistic	Probability Value
AUR	-0,017518	0,007806	-2,244253	0,0307
C	0,036548	0,004528	8,070811	0,0000

It can be seen that the F statistical value calculated in the established model is greater than the 1 bound, and it is understood that there is a cointegrated relationship between the variables. When the model's coefficients, which are found to have a cointegration

relationship, are examined, it was concluded that the agricultural sector's unemployment rate negatively affected the agricultural sector's growth, which is statistically significant. Therefore, it has been concluded that the Okun Law is valid in the agricultural sector.

5. Conclusion

In this study, the validity of Okun's Law in the Turkish agricultural market has been analysed. Between 2014Q1 and 2021Q3, the unemployment rate in the agricultural market and the value of real production in the agricultural market are used. For the analysis of the relationship between the mentioned variables, firstly, the stability of the variables is tested with the Augmented Dickey-Fuller unit root test. Then the relationship is evaluated with the ARDL bounds test.

It can be stated that the statistical value of F, calculated according to the result of the ARDL bounds test, is greater than the upper value of the bounds and the established model contains a cointegration relationship when the long-term relationship of the model in which the cointegration relationship is determined, a negative relationship is detected between the variables and it is concluded that there was no statistical error in the established model and there was a statistically significant relationship. Therefore, it has been completed as Okun's Law is valid for the agricultural sector in the Turkish economy.

As a result, the result reached in the study is similar to the literature. In the literature review, no study analysed Okun's Law's validity for the agricultural sector. In this respect, the study is thought to contribute to the literature. With this situation, as a result of the study, it can be concluded that Okun's Law is valid in the agriculture sector by finding similar results to the results of the studies carried out to analyse the validity of Okun's Law in the Turkish economy.

The main conclusion drawn from the study is that the policies applied to reduce unemployment in the agricultural sector will increase agricultural production and, thus, economic growth. However, the effect of agricultural unemployment on economic growth is limited. This situation is thought to be caused by the structural situation of the agricultural sector. Due to the study's limitations, only the data belonging to the agricultural sector are examined.

The economy mainly consists of agriculture, industry and services sectors. Among these sectors, the sector that contributes the least to economic growth is the agricultural sector. Analysing the validity of Okun's Law for sectors other than agriculture is important for the development of the study. After calculating the coefficients of the Sectoral Okun coefficient, making employment policy recommendations for the sector in which unemployment reduction will affect economic growth more will make the study more meaningful.

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