RELATIONSHIP BETWEEN INFLATION AND UNEMPLOYMENT: THE ARDL BOUND TESTING APPROACH FOR TURKEY[1]

ENFLASYON VE İŞSİZLİK ARASINDAKİ İLİŞKİ: TÜRKİYE İÇİN ARDL SINIR TESTİ YAKLAŞIMI

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ABSTRACT

Inflation and unemployment are among the most important economic and social problems encountered by both developed and developing countries. As countries are trying to lower inflation and maintain price stability, they also strike to increase production and hence economic growth by lowering unemployment rates. Therefore, policymakers are committed to these two variables. The relationship between inflation and unemployment is examined by the Phillips Curve approach in macroeconomics literature. This approach suggests that an inverse relationship exists between inflation and unemployment. In other words, higher inflation rate results in lower unemployment and lower inflation rate leads to higher unemployment. This study aims to test the validity of the Phillips Curve throughout the years 1987-2016 by the ARDL approach regarding the Turkish economy. In the analysis, the stability of the series is examined first, and then the cointegration test is utilized to investigate whether or not a long-term relationship exists between the series. As a result of the cointegration analysis, it is concluded that there is no long-term relationship between the variables in the model where the inflation is considered as the dependent variable. The unemployment rate is taken as the dependent variable, the existence of a long-run relationship among the variables included in the analysis would be determined.

Keywords: *Inflation, Unemployment, Phillips Curve, Cointegration Test.*
JEL Classification: *E31, E24, C22.*

ÖZ

Enflasyon ve işsizlik, gerek gelişmiş gerekse de gelişmekte olan ve az gelişmiş ülkelerin yaşadıkları en önemli ekonomik ve sosyal sorunların başında gelmektedir. Ülkeler bir yandan enflasyonu düşürüp, fiyat istikrarını sağlamaya çalışırken; diğer yandan işsizlik oranlarını düşürerek üretimi ve dolayısıyla da ekonomik büyümeyi artırmaya çabalamaktadırlar. Bu sebeple politika yapıcılar bu iki değişkene son derece büyük önem vermektedirler. Enflasyon ve işsizlik arasındaki ilişki makroekonomi literatüründe Phillips Eğrisi yaklaşımıyla incelenmektedir. Bu yaklaşım enflasyon ile işsizlik arasında ters yönlü bir ilişki olduğunu ileri sürmektedir. Diğer bir ifadeyle, yüksek enflasyon oranı düşük işsizliğe, düşük enflasyon oranı ise yüksek işsizliğe yol açmaktadır. Bu çalışmanın amacı, 1987-2016 yıllarını kapsayan dönemde Phillips Eğrisi'nin geçerliliğini ARDL yaklaşımı ile Türkiye ekonomisi açısından sınamaktır. Analizde önce serilerin durağanlığı incelenmiş, sonra eşbütünleşme testi ile seriler arasında uzun dönemli bir ilişkinin var olup olmadığı araştırılmıştır. Yapılan eşbütünleşme analizi neticesinde enflasyon değişkeninin bağımlı değişken olarak alındığı modelde değişkenler arasında uzun dönemli bir ilişki söz konusu değilken, işsizlik oranının bağımlı değişken olarak alındığı modelde değişkenler arasında uzun dönemli bir ilişki olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: *Enflasyon, İşsizlik, Phillips Eğrisi, Eşbütünleşme Testi.*
JEL Sınıflandırması: *E31, E24, C22.*

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1. INTRODUCTION

One of the focal points of ongoing debates in macroeconomic theory and policy literature since the 1970s is inflation, unemployment and the relationship between these two variables. Inflation and unemployment are two important problems regarding economic policies. Even though the countries have a variety of policy practices in order to overcome these problems, due to the inverse relationship between inflation and unemployment, it would not be possible for the countries to get rid of them concurrently. This inverse relationship between inflation and unemployment is examined by the Phillips Curve approach in macroeconomics literature.

The relationship of price changes with unemployment and production has been in dispute for many years. In 1926, Irving Fisher analyzed the relationship between price changes and unemployment statistically in his article entitled "A Statistical Relationship between Unemployment and Price Changes." Later on, Tinbergen conducted the first econometric study in 1936 and found a causality relationship from unemployment towards wage inflation. However, the relationship between inflation and unemployment has become synonymous with A.W. Phillips' (1958) study which attracted intense attention (Büyükakın, 2008: 134-136). The Phillips Curve has been changed many times since 1958, and finally, the results of the approach have been concluded as being meaningful and valid in the short-term.

In his work conducted for the UK economy between 1861 and 1957, A.W. Phillips (1958) investigated whether or not there was a relationship between the rate of change in monetary wages and the rate of unemployment and he found a nonlinear, inverse and stable relationship between the rate of change in monetary wages and the rate of unemployment (Phillips, 1958: 283-299). The downward sloping, concave curve depicting the inverse relationship between these two variables is called the Phillips Curve with reference to A.W. Phillips.

The original Phillips Curve, which depicts this inverse relationship between the rate of change in monetary wages and the unemployment rate, has been transformed by Samuelson and Solow into a graph demonstrating the relationship between the inflation rate and the unemployment rate. Samuelson and Solow stated that the rate of price increase went up to 4.5% when the unemployment rate dropped to 3%. Thus, the higher the employment and the cost of production, the higher the price increase (Samuelson and Solow, 1960: 177-194). In other words, the modified Phillips Curve is confronted with either 'higher unemployment - lower inflation' or 'lower unemployment - higher inflation' options, while the Central Bank and policymakers aim to design the economy through monetary and fiscal policies. In this sense, the Phillips Curve would be considered as an important policy instrument.

In the 1970s, the validity of the Phillips Curve began to be questioned and subjected to various criticisms along with the stagflation (unemployment and inflation coexistence) process. Among these critics, the most recognized one is the ignoring of expectations in the Phillips Curve model. The Phillips Curve analysis has been developed with new studies that take expectations on these criticisms into account and differentiate the Phillips Curve into the short and the long-term conceptions.

2. LITERATURE REVIEW

A number of studies have been conducted using different countries, periods and methods related to the Phillips Curve, which claims an inverse relationship between the inflation rate and the unemployment rate. Many of these empirical studies confirmed an inverse relationship between the inflation rate and the unemployment rate, while others found positive or meaningless relationships. Some of these studies are summarized in Table 1.

Table 1. Selected Literature Review

Author(s) (Year)	Country Sample	Period	Variables	Method	Findings
Vredin and Warne (2000)	Sweden, England, US	1959-1998	Unemployment rate, inflation rate	VAR analysis	A short-term relationship between inflation and unemployment is found.
Ewing and Seyfried (2003)	The US	1954-1999	Inflation rate, output gap	GARCH model	The existence of the short-term Phillips Curve is proven.
Uysal and Erdoğan (2003)	Turkey	1980-2002	Unemployment rate, price level	Regression analysis	The positive relationship between two variables for the period of 1980-1990; while a negative relationship between two variables for the period of 1990-2002.
Kuştepeli (2005)	Turkey	1980-2003	Inflation rate, unemployment rate	Regression analysis	Phillips Curve hypothesis is rejected. The inflation rate is a more important indicator compared to unemployment for inflationary expectations.
Furuoka (2007)	Malaysia	1973-2004	Inflation rate, unemployment rate	VECM	Causality relationship between unemployment rate inflation is detected in the short-run.

Hepsağ (2009)	Turkey	2000-2007	Unemployment rate, inflation rate	ARDL	Past inflation rates, rather than unemployment rates, are effective on inflation in the short-run; however, a trade-off appears in the long-run.
Önder (2009)	Turkey	1987-2004	CPI, output gap	OLS	According to the results, Turkish Phillips curve is not linear. No evidence exists on the asymmetry in the inflation response to the output gap.
Herman (2010)	Romania	1990-2009	Unemployment rate, inflation rate	Correlation	No statistically significant relationship between the unemployment rate and the inflation rate for the period of 1990-2009.
Altay, Tuğcu, and Topcu (2011)	G8 Countries	2000-2009	Unemployment rate, inflation rate	Cointegration and causality test	Cointegration exists between the inflation rate and the unemployment rate. Causality occurs from inflation towards unemployment in the short-run; however, it occurs from unemployment towards inflation in the long-run.
Mangır and Erdoğan (2012)	Turkey	1990-2011	Unemployment rate, inflation rate	Regression analysis	No compensation relationship between unemployment and inflation in the short-run.
Bayrak and Kanca (2013)	Turkey	1970-2010	Unemployment rate, inflation rate	Cointegration	The Phillips Curve is not valid in Turkey in the long-run, while an inverse

					relationship is detected between unemployment and inflation in the short-run.
Öztürk and Emek (2016)	Turkey	1997-2006	Unemployment rate, inflation rate	Cointegration	An inverse relationship is detected between inflation and unemployment in Turkey from 1997 to 2006.
Yılancı and Aydın (2016)	Turkey	2005-2015	Unemployment rate, inflation rate	Cointegration	A long-term relationship is detected between the variables in Turkey when the unemployment is considered as the dependent variable for the period of 2005-2015.

3. DATA, METHODOLOGY AND EMPIRICAL RESULTS

The annual data used in this study which aims to determine the relationship between inflation (INF) and unemployment (UE) for the period 1987-2016 in Turkey are obtained from the World Bank database. The models to be used for the analysis are as follows:

$$INF_t = \beta_0 + \beta_1 UE_t + \varepsilon_T \quad (1)$$

$$UE_t = \beta_2 + \beta_3 INF_t + \varepsilon_T \quad (2)$$

According to Öztürk and Acaravcı (2013), if one of the variables' unit root degree is higher than I(1), the critical values obtained by Pesaran et al. (2001) and Narayan (2005) cannot be used in the Autoregressive Distributed Lag (ARDL) approach. These critical values are based on I(0) and I(1). Therefore, it is necessary to determine whether or not the variables abide by the assumptions of the ARDL bound testing approach by performing the unit root test at the first stage of the analysis. In the first phase of the econometric analysis in this framework, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are to be performed to determine the degrees of integration of the series. The ADF and PP unit root test results are shown in Table 2.

Table 2. The ADF and PP Unit Root Test Results

At Level	ADF		PP	
	Intercept	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
INF	-5.8353	-4.2634	-6.8534	-5.8185
UE	-2.0517	-3.2220	-1.9505	-2.3003
1st Differences	ADF		PP	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
UE	-4.7308	-4.6409	-4.8713	-4.7423

As noted in Table 2, INF variable is stationary in level [I(0)], while UE variable is stationary in the 1st difference [I(1)].

After the degrees of integration of the series are determined, the ARDL method developed by Pesaran et al. (2001) is used. The ARDL bound testing approach has several advantages. The first advantage involves the applicability of the ARDL method, irrespective of whether the series are either I(0) or I(1). Two asymptotic critical bounds are utilized in the ARDL method. If the obtained F-statistic value exceeds the critical upper bound, the null hypothesis which claims a long-run relationship between the variables would be rejected. If the F-statistic value is below the critical lower bound, the null hypothesis cannot be rejected, and the result is that there is no long-run relationship between the variables. If the F-statistic value is between two critical bounds, no comments can be made. Table 3 indicates the ARDL test results for Equations 1 and 2.

Table 3. The ARDL Bound Test Results

Estimated Equation	INF=f(UE)	UE=f(INF)
F-statistics	1.11	5.82
Optimal Lag Length	[1, 0]	[2, 0]
Asymptotic Critical Values	Lower Bound, I(0)	Upper Bound I(1)
1%	6.027	6.760
5%	4.090	4.663
10%	3.303	3.797
Diagnostic Tests		
R^2	0.801	0.791
Adjusted R^2	0.725	0.704
F-statistics	386.542 (0.000)	376.213 (0.000)
Breusch-Godfrey Test	2.020 (0.3215)	2.720 (0.3456)
ARCH LM Test	0.204 (0.508)	0.154 (0.472)
Jarque-Bera Normality Test	1.753 (0.241)	1.031 (0.214)
Ramsey Reset Test	1.547 (0.178)	1.104 (0.168)

Note: The lag length is determined in accordance with the AIC. The critical values for bounds testing are abstracted from Narayan (2005, p. 1987, Case II). The numbers in parenthesis show the probability values.

Since the F test value of Equation 1 is below the lower bound at 10% significance level, no long-run relationship between the variables involved in the analysis is found. Since the F-test value of Equation 2 is above the upper bound at 10% significance level, a long-run relationship is found between the variables.

Based on the results of the ARDL bound testing, the short-term coefficients are estimated by applying the Ordinary Least Squares (OLS) method for Equation 1 and the long-term coefficients are found by using Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) methods for Equation 2. The obtained results are given in Tables 4 and 5, respectively.

Table 4. The OLS Estimation Results

Variables	Coefficient	Probability
UE	-0.3207	0.0060
C	-2.3302	0.2834

Table 5. The Error Correction Model (Equation 2)

Variables	Coefficient	P Value
ΔUE(-1)	0.4523	0.0169
ECM(-1)	-0.8276	0.0002

The results of the Error Correction Model are shown in Table 5. In order to comprehend the short-term adaptation process, the sign and the magnitude of the error correction coefficient [ECM (-1)] should be considered. Since the ECM (-1) coefficient is between 0 and -1, the adaptation process may be monotonic towards the long-term equilibrium value.

Table 6. The FMOLS and DOLS Estimation Results

Variables	FMOLS	DOLS
INF	-0.032 (0.0000)	-0.033 (0.0009)

Note: The numbers in parenthesis indicate the probability values.

4. CONCLUSION

The most discussed topics in the macroeconomic literature are inflation, unemployment and the relationship between inflation and unemployment. Decreasing unemployment and lowering inflation are among the primary targets of policymakers. The inflation-unemployment relationship, which was introduced by A.W. Phillips (1958) and has gained a different aspect along with the contributions of various economic schools, focuses mainly on whether or not any compensation relationship between these two variables exists for about 50 years.

In this study, the validity of the Phillips Curve in Turkey is investigated by using annual data from 1987 to 2016, and it is examined whether or not a relationship exists between inflation and unemployment for the designed models. The unit root results of the series show that both series are stationary in the 1st difference [I(1)]. The ARDL

bound testing approach is used to analyze the long-run relationship between these variables which are found to be stationary in the 1st difference.

According to the estimation results of the ARDL model in which the inflation variable is considered as the dependent variable, there is no long-run relationship between the variables. The model in which inflation is considered as a dependent variable, and there is no long-term relationship between variables, suggests a 1% increase in the unemployment rate reduces the inflation rate by 0.32%. This result indicates that the Phillips Curve is valid for Turkey at that time.

When the unemployment rate is considered as a dependent variable, the existence of a long-run relationship among the variables included in the analysis would be determined.

As a result of estimating the coefficients of the long-run relationship between the variables with the FMOLS and DOLS methods, a 1% increase in the inflation rate appears to reduce the unemployment rate by 0.03%. Based on this result, economic policies can be created in the long run by using the relationship between inflation and unemployment rate for fulfilling price stability as the ultimate goal of monetary policy.

REFERENCES

Altay, B., Tuğcu, C. T., & Topcu, A. G. M. (2015). İşsizlik ve enflasyon oranları arasındaki nedensellik ilişkisi: G8 ülkeleri örneği.

Bayrak, M., & Kanca, O. C. (2013). Türkiye'de Phillips Eğrisi üzerine bir uygulama. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *8*(3).

Büyükakın, T. (2008). Phillips Eğrisi: Yarım yüzyıldır bitmeyen tartışma. *İstanbul Üniversitesi Siyasal Bilgiler Fakültesi Dergisi*, (39), 133-159.

Ewing, B. T., & Seyfried, W. (2003). Modeling The Philips Curve: A Time-Varying Volatility Approach. *Applied Econometrics and International Development*. 3-2, 7-24.

Furuoka, F. (2007). Does the "Phillips curve" really exist? New empirical evidence from Malaysia. *Economics Bulletin*, *5*(16), 1-14.

Hepsağ, A. G. A. (2009). Türkiye'de enflasyon ile işsizlik arasındaki ilişkinin analizi: Sınır testi yaklaşımı. *İktisat Fakültesi Mecmuası*, *59*(1), 169.

Herman, E. (2010). Inflation and unemployment in the Romanian economy. *Annals of the University of Petrosani Economics*, *10*(2).

Kuştepeli, Y. (2005). A comprehensive short-run analysis of a (possible) Turkish Phillips curve. *Applied Economics*, *37*(5), 581-591.

Mangır, F., & Erdoğan, S. (2012). Türkiye'de Enflasyon ile İşsizlik Arasındaki İlişki (1990-2011). *Finans Politik & Ekonomik Yorumlar Dergisi*, *49*(570), 77-98.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied economics*, *37*(17), 1979-1990.

Önder, A. Ö. (2009). The stability of the Turkish Phillips curve and alternative regime shifting models. *Applied Economics*, *41*(20), 2597-2604.

Öztürk, I., & Acaravci, A. (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics*, *36*, 262-267.

Öztürk, S., & Emek, M. L. (2016). 1997–2006 yılları nisan ve ekim ayları verileriyle Türkiye için Phillips eğrisi analizi. *Balkan Journal of Social Sciences Balkan Sosyal Bilimler Dergisi*, *5*(10).

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Phillips, A. W. (1958). The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–1957. *Economica*, *25*(100), 283-299.

Samuelson, P. A., & Solow, R. M. (1960). Analytical aspects of anti-inflation policy. *The American Economic Review*, *50*(2), 177-194.

Uysal, D., & Erdoğan, S. (2004). Enflasyon ile işsizlik oranı arasındaki ilişki ve Türkiye örneği (1980-2002). *Sosyal Ekonomik Araştırmalar Dergisi*, *1*(6), 35-47.

Vredin, A. & Warne, A. (2000). Unemployment and inflation regimes. *Econometric Society World Congress Contributed Papers*.

Yılancı, V. & Aydın, M. (2016). Enflasyon ile işsizlik arasındaki ilişkinin varlığının sınanması. *International Congress on European Unions Relations, Economics, Finance and Econometrics (EUREFE'16) Bildiri Kitabı*, 1454-1464.