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LABOUR PRODUCTIVITY, REAL WAGES AND UNEMPLOYMENT: AN APPLICATION OF BOUNDS TEST APPROACH FOR TURKEY

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ABSTRACT

This study investigates the relationship between labour productivity, average real wages, and the unemployment rate by employing the bounds testing procedure within an autoregressive distributed lag (ARDL) modeling approach and applies Toda-Yamamoto causality test for the period 2007:01–2016:04. The results indicate that real wages and unemployment have a significant and positive long-run impact on labour productivity. While a long-run wage–productivity elasticity of 0.97 supports the efficiency wage theorem and the unemployment–productivity elasticity of 0.53 indicates that workers increase efforts to secure jobs. Therefore, a rise in real wages and unemployment may induce higher productivity by raising the costs and probability of job loss, respectively, which implies rigidity in Turkish labour market. Furthermore, the causality tests provide evidence for the effect of a high and persistent unemployment rate on the Turkish economy, where unemployment affected both labour productivity and real wages. While a bi-directional causality was found between labour productivity and unemployment, a unilateral causality was observed between unemployment and real wages. Unemployment causes real wages, but there is no evidence of reversal causation.

Keywords: *Bounds testing procedure, Causality, Labour productivity, Real wages, Structural break, Unemployment*

1. INTRODUCTION

The relationship between productivity, real wages, and unemployment has been considered as one of the important issues in the economics literature. In macroeconomic perspective, with the effect of globalization and openness of countries to international trade, the growth of productivity and wages become crucial factors, which decide the international competitiveness between countries. The increase in productivity and competitiveness

induces economic growth. This is especially true for the countries that are able to increase their welfare by the job creation concomitant with the economic growth. On the other side, there are many empirical studies that analyze the relationship between productivity-real wages and productivity-real-wage inflation rate. However, there are a few studies that examine the interrelationships among productivity, real wages, and unemployment. In this context, Alexander (1993) investigated the relationship between productivity, wages, and unemployment in the United Kingdom for the period 1955–91 by employing the cointegrating VAR methodology and the Granger causality. After finding the evidence of a structural break in 1979, the author divided the sample into two subperiods and stated that ‘before 1979 unemployment is the central variable, being caused by both wages and productivity’; while after 1979 there is ‘a strong bivariate causality between wages and productivity’. She related this shift to a change in the policy environment introduced by the then Prime Minister Margaret Thatcher. Wakeford (2004) also analyzed the relationship between productivity, real wages, and unemployment in South Africa by using cointegration and the Granger causality tests.

The quarterly data comprise from 1983:Q1 to 2002:Q4. After finding evidence of a structural break in 1990, Wakeford divided the sample into two subperiods and found a long-term equilibrium (cointegrating) relationship between the real wages and productivity for the two sub-periods. The results indicate that productivity has grown faster than real wages. Pazarlıoğlu and Çevik (2007) analyzed the relationship between productivity, real wages, and unemployment in Turkey by employing cointegration and causality tests for the period of 1945–2005. After finding evidence of a structural break in 1967, they also divided the sample into two subperiods and found the unemployment rate as the central variable being caused by both the wages and productivity rate for the period of 1945–1966. However, a unidirectional causality running from the unemployment to productivity and a bi-directional causality between the productivity and real wages were found for the period of 1969–2005, and then productivity became a central variable for the period of 1969–2005. They related this shift to a change in the competition of international trade through the impact of globalization, especially after the 1980s. Yusof (2007) examined the long-run and dynamic behaviors of real wage-employment-productivity relationship for the Malaysian manufacturing industry over the period of 1992:Q1– 2005:Q3. His findings indicate a long-run relationship between the variables. The theory that real wages inversely affect employment was not supported, while the performance-based pay scheme theory (but not the efficiency wage theory), was validated. Following the previous studies, the main objective of this one was to measure the relationship between average labor productivity, real wages, and the unemployment rate in Turkish manufacturing industry by using the autoregressive distributed lag (ARDL) approach to cointegration analysis and Toda-Yamamoto’s (1995) causality tests. The quarterly dataset covers the period of 2007:01–2016:04. This study differs from the earlier ones in two ways. Firstly, an alternative cointegration and causality approach is used to test the relationship between the variables. Secondly, on the basis of empirical testing, this study attempts to shed some light on the labour market theories that dominate the Turkish manufacturing industry at present. In this context, this paper is structured as follows. Section 2 explains the theoretical background. Section 3 describes the data and methodology. Section 4 presents the empirical results and, finally, Section 5 concludes.

2. THEORETICAL BACKGROUND

The interrelationships between productivity, real wages, and unemployment are highly complex, with many feedback effects as well as ambiguous or multiple signs. Most well-known economics theories of the labour market, such as bargaining, search contract and efficiency wage theories try to explain these relationships

Table 1: The theoretical relationship between productivity, wages, and unemployment (Wakeford, 2004, p. 113)

<i>Causal Direction</i>	<i>Expected Sign</i>	<i>Rationale</i>
<i>UR→PROD</i>	<i>+</i>	<i>Workers increase effort to secure jobs; Less productive workers are fired first</i>
<i>UR→RW</i>	<i>-</i>	<i>Surplus labour weakens union bargaining power</i>
<i>PROD→RW</i>	<i>+</i>	<i>Performance-based pay; bargaining</i>
<i>PROD→UR</i>	<i>+</i> <i>-</i>	<i>Greater efficiency implies reduced labour demand</i> <i>Positive output effect on employment</i>
<i>RW → PROD</i>	<i>+</i>	<i>Efficiency wages</i>
<i>RW → UR</i>	<i>+</i>	<i>Higher labour costs cause factor substitution</i>

Wakeford (2004) stated that the effect of an increase in average labour productivity on unemployment is ambiguous. Whereas, in the light of the commonly known labour market theories, and opposite effect of productivity on employment can be considered. If ceteris paribus, an increase in the productivity of workers could reduce the demand for labour and thus raise the unemployment rate. Contrary, an increase in the productivity of workers could also reduce unemployment rate through the effect of output growth. As the efficiency of worker increases, the output and investment of firms also increase. Thus increased investments lead to labor demand and therefore productivity increase reduces unemployment rates. Conversely, unemployment affects productivity. High unemployment may induce workers not to shrink and increase their efforts. Therefore, workers' productivity will increase in order to secure their jobs. As less productive workers are usually the first to lose their jobs, increased unemployment may be associated with higher average productivity among the remaining workers. Therefore, this will cause the efficiency of workers to increase who are not the first to lose their jobs. The theories of wage bargaining imply that the unemployment rate affects wages in two ways. High unemployment rate weakens the bargaining power of union and therefore dampens the real wages. However, during the period of the low unemployment rate, unions can be able to offer high nominal wages (Pazarlıoğlu and Çevik, 2007, p.6). Secondly, if the individual pay is performance-based, the productivity will increase, this, in turn, will cause the real wages to increase (Alexander, 1993, p.87; Wakeford, 2004, p.113). Moreover, if real wages increase more than the productivity growth, unemployment arises, because firms prefer to substitute costly labour to capital. On the other hand, this substitution stemming from an increase in real wages will also increase marginal productivity (Wakeford, 2004, p. 113; Yildirim, 2015, p.89).

3. DATA AND METHODOLOGY

Following Alexander (1993, p.88) and Wakeford (2004, p.115), the long-run empirical model of labour productivity, real wages, and the unemployment rate could be specified as follows:

$$\ln LPROD_t = \gamma_0 + \gamma_1 \ln RW_t + \gamma_2 UR_t + \varepsilon_t \quad (1)$$

where $LPROD_t$ is labour productivity, RW_t is the real wages, UR_t is the unemployment rate and ε_t is the regression error term. While γ_1 , the coefficient of RW_t , indicates the elasticity of productivity with respect to real wages, γ_2 , the coefficient of UR_t , indicates the elasticity of productivity with respect to the unemployment rate. Theoretically, both variables are expected to have positive signs.

This study uses quarterly seasonal adjusted data for productivity, real wages, and the unemployment rate for 2007:1–2016:4 period. The productivity represents average labour productivity (production index/employment index) in the Turkish manufacturing industry. The real wages are obtained by deflating the nominal wage index with the consumer price index (CPI) (2000= 100). All data are obtained from the Turkish Statistical Institute (TURKSTAT). The variables are transformed into logarithmic form except for the unemployment rate.

In order to test the stationarity of variables and the integration and the possible cointegration among the variables, the augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1981) and an alternative Phillips–Perron (PP) unit-root test (Phillips and Perron, 1988) are employed. Following the stationarity tests, the bounds test for co-integration within ARDL modeling approach of Pesaran, Shin, and Smith (2001) was adopted to determine whether a long-run relationship exists between average labour productivity, real wages, and unemployment in Turkey. Since the bounds testing approach can be applied irrespective of the order of integration of the variables, the regressors can be $I(1)$, $I(0)$ or mutually cointegrated. First of all, for implementing the bounds test procedure the following ECM (error correction model) was estimated:

$$\begin{aligned} \Delta \ln LPROD_t = & \alpha_0 + \sum_{i=1}^{p-1} \alpha_1 \Delta \ln LPROD_{t-i} + \sum_{i=1}^{p-1} \alpha_2 \ln RW_{t-i} + \sum_{i=1}^{p-1} \alpha_3 UR_{t-i} + \\ & + \alpha_4 \ln LPROD_{t-1} + \alpha_5 \ln RW_{t-1} + \alpha_6 UR_{t-1} + \alpha_7 D + \mu_t \end{aligned} \quad (2)$$

Equation (2) can be further transformed to accommodate the one period lagged error correction term (ECT_{t-1}) as in equation (3).

$$\Delta \ln LPROD_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_1 \Delta \ln LPROD_{t-i} + \sum_{i=1}^{p-1} \alpha_2 \ln RW_{t-i} + \sum_{i=1}^{p-1} \alpha_3 UR_{t-i} + \alpha_4 D + \lambda ECT_{t-1} + \mu_t \quad (3)$$

where Δ is first difference operator, \ln is the log of the variables, and μ_t is the serially independent random error with zero mean and finite covariance matrix, and the

deterministic term, constant, is denoted by α_0 . In Equation (3), the parameter λ represents the long-run relationship and α_1 and α_2 represent short-run dynamics of the model. D is the dummy variable that represents the structural break period. In order to examine the long-run relationship between the dependent variable Y_t and its determinants, an F-test procedure is followed to estimate the combined significance of the coefficients of the lagged levels of the variables. While the null hypothesis is $H_0: \alpha_4 = \alpha_5 = \alpha_6 = 0$ (no cointegration) and the alternative hypothesis is $H_1: \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq 0$ (cointegration). If the null hypothesis is rejected, it indicates the existence of a long-run relationship or cointegration. Pesaran et al. (2001) provided a set of asymptotic critical values where the critical bounds can be applied irrespective of the order of integration of the regressors. The critical values are composed of two sets: lower bounds $I(0)$ and upper bounds $I(1)$. The first set gives the lower bound, applicable when all regressors are $I(0)$. The second one gives the upper bound, applicable when all regressors are $I(1)$ (Akkoyunlu and Siliverstovs, 2014:3240). If the calculated F-statistic exceeds the upper bound, the null hypothesis of no relationship between dependent variable Y_t and independent variables X_t can be rejected. Conversely, if the F-statistic falls below the lower bound, the null hypothesis of no long-run relationship cannot be rejected. However, if the F-statistic falls within the critical bounds, the result of cointegration will be inconclusive. According to Narayan (2005), the existing critical values reported by Pesaran et al. (2001) cannot be used for small sample sizes because they are based on large sample sizes for 500 and 1000 observations. Therefore, Narayan (2005) provided two sets of critical values for a given significance level with and without a time trend for small samples between 30 to 80 observations. Given the relatively small sample size in this study (40 observations), the hypothesis testing relies on the critical values simulated by Narayan (2005). As the last step, the Granger causality test is applied to examine the causal linkages between labor productivity, real wages, and unemployment. The notion of the Granger causality (Granger, 1969; Engle and Granger, 1987) is one of the most commonly and extensively used methods for evaluating the existence and direction of linkages among time series variables within vector autoregressive (VAR) models in economics literature (Pitarakis and Tridimas, 2003:362). According to Sims et al. (1990), the asymptotic distribution theory cannot be applied for testing causality of integrated variables in the level from using the VAR model even if the variables are cointegrated (see Clark and Mirza, 2006; Wolfe-Rufael, 2007:201). In this context, Toda and Yamamoto (1995) proposed an alternative approach that can be applied in the level VARs irrespective of whether the variables are integrated, cointegrated, or not. Toda and Yamamoto (1995), on the basis of augmented VAR(k) modeling, introduced a modified Wald test statistic that asymptotically has a chi-square (χ^2) distribution irrespective of the order of integration or cointegration properties of the variables in the model (Wolde-Rufael, 2007:201). The test has two steps: Firstly, in order to apply Toda and Yamamoto's approach (1995), it is essential to determine the true lag length (k) and the maximum order of integration (d_{max}) of the series under consideration. The modified Wald test statistic is valid regardless of whether a series is $I(0)$, $I(1)$ or $I(2)$ non-cointegrated or cointegrated of an arbitrary order. The lag length, k , is obtained in the process of the VAR in levels among the variables in the system by using different lag length criterion such as AIC (Akaike Information Criterion), SC (Schwarz Information Criterion), HQ (Hannan-Quinn Information Criterion), FPE (Final Prediction Error) and LR (Sequential Modified LR Test Statistic). Then the unit root testing procedure can be used to identify the order of integration (d_{max}). As the second step, the modified

Wald test procedure is used to test the VAR(k) models for causality. The VAR(k) models are estimated by Ordinary Least Squares (OLS) estimation technique. Unlike the Granger causality test, Toda and Yamamoto's approach (1995) fits a standard vector auto-regression on the levels of the variables, not on the first difference of the variables (Wolde-Rufael, 2007:202). Therefore, to undertake Toda and Yamamoto's version (1995) of the Granger non-causality test, the following VAR system is presented:

$$\ln Y_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} \ln Y_{t-i} + \sum_{j=1}^{d \max} \nu_{1j} \ln Y_{t-j} + \sum_{i=1}^k \phi_i \ln X_{t-i} + \sum_{j=1}^{d \max} \psi_{1j} \ln X_{t-j} + \lambda_{1t} \quad (4)$$

$$\ln X_t = \beta_0 + \sum_{i=1}^k \delta_{1i} \ln Y_{t-i} + \sum_{j=1}^{d \max} \theta_{1j} \ln Y_{t-j} + \sum_{i=1}^k \varrho_i \ln X_{t-i} + \sum_{j=1}^{d \max} \pi_{1j} \ln X_{t-j} + \lambda_{2t} \quad (5)$$

The null hypothesis that independent variable X_t does not cause dependent variable Y_t is constructed as follows: $H_0: \phi_1 = \phi_2 = \dots = \phi_i = 0$. Similarly, in Equation (5), the null hypothesis that Y_t does not cause X_t is formulated as follows: $H_0: \delta_1 = \delta_2 = \dots = 0$.

4. EMPIRICAL RESULTS

Table 2 gives the ADF and PP unit root testing results of labour productivity, real wages, and unemployment. All of the series are non-stationary (contain a unit root) in their levels but are stationary in their first differences. Thus, they are integrated of order one, I(1).

Table 2: ADF and PP Tests for Unit Root

ADF				
	Level		First Difference	
	τ_μ	τ_η	τ_μ	τ_η
LPROD	-	-	-5.253[0]***	-5.185[0]***
	0.361[0]	2.481[0]		
RW	-	-	-5.341[0]***	-5.279[0]***
	0.634[0]	1.848[0]		
UR	-	-	-4.205[1]***	-4.141[1]**
	2.220[3]	2.185[3]		
PP				
	Level		First Difference	
	τ_μ	τ_η	τ_μ	τ_η
LPROD	0.059[8]	-	-	-
		2.570[3]	5.023[10]***	4.967[11]***
RW	-	-	-5.312[3]***	-5.198[4]***
	0.659[1]	1.837[3]		
UR	-	-	-3.387[6]**	-3.342[6]*
	1.647[2]	1.619[2]		

Note: All series are at their natural logarithms except the unemployment rate. τ_μ represents the model with a drift and without trend; τ_η is the most general model with a drift and

trend. The optimal lag lengths used in the ADF test are indicated within brackets and determined by the AIC. When using PP test, the values in brackets represent Newey-West Bandwidth (as determined by Bartlett Kernel). (*), (**) and (***) indicate that the corresponding coefficient is significant at 10%, 5%, and 1% levels, respectively.

The long-run relationship between labour productivity, real wages, and unemployment rate can be affected by the structural breaks/changes. In order to take this issue into account, the Chow breakpoint test (1960) was employed to identify the existence of an exogenously determined structural break time. The Chow test is applied for a linear model with one known single break in the mean. In this context, a limitation of the Chow test is that the breakdate must be known a priori. If the researcher picks an arbitrary or a known candidate break date, there may be two cases. Firstly, the Chow test may be uninformative, as the true breakdate can be missed. Secondly, the Chow test can be misleading, as the candidate breakdate is endogenous (it is correlated with the data) and the test is likely to indicate a break falsely when none in fact exists (Hansen, 2001, p.118). Therefore, the Quandt-Andrew test where the breakdate is unknown a priori was introduced (Andrews, 1993; Quandt, 1960). This test examines one or more structural breakpoints in a sample. The null hypothesis is “no breakpoints”, and the test statistics are based on the Maximum (Max) statistic, the Exponential (Exp) Statistic, and the Average (Ave) statistic. In this study, to improve the accuracy of the estimation, the Quandt-Andrews breakpoint test (Quandt, 1960; Andrews, 1993) was adopted in combination with the Chow test (Chow, 1960).

Table 3: Stability Test Results

A. Quandt–Andrews unknown breakpoint test.		
Statistics	Value	p-Value
Max. LR F-stat. (2010:Q4)	67.6636	0.0000
Max. Wald F-stat. (2010:Q4)	202.9910	0.0000
Exp LR F-stat.	30.6467	1.0000
Exp Wald F-stat.	98.1296	1.0000
Ave LR F-stat.	31.3868	0.0000
Ave Wald F-stat.	94.1605	0.0000
B. The Chow breakpoint test result		
Null Hypothesis: No breaks 2010:Q4	67.663	F(3,34)=0.00

Table 3 reports the stability (break–point) test results. The Quandt–Andrews unknown breakpoint test compares 29 breakpoints and the null hypothesis of no break within the trimmed sample period is rejected by two of the three test statistics. The test is performed by using a trimming region of 15%. Hence, both tests suggest a structural break in 2010:Q4, which represents a significant economic growth after the 2008 financial crisis in Turkey. Since 2004, the Turkish economy showed a rapid economic growth of 9.4% in 2010. In this case, the influence of break can be captured as a dummy variable in the cointegration test. Following the results of unit root and stability tests, the long-run relationship between the variables can be investigated by using the bounds test to cointegration within the ARDL modeling approach developed by Pesaran et al. (2001). In this context, the lag length of the

estimation is determined. The lag length that provides the smallest critical value is determined as the lag length of the model by using several lag selection criteria such as AIC, SC, HQ, FPE, and LR. According to the results of the selection criteria and considering the evidence of no residual autocorrelation, a value of 1 is preferred for the relationship between LPROD, RW, and UR. The calculated F-statistics for Equation (1) is found as 4.833, which is above the critical value. In this context, the null of no cointegration can be rejected at 10% level, implying that there exists a long-run relationship or cointegration between labour productivity, real wages, and unemployment rate.

Table 4: Results of Bounds Test for Cointegration

Model				F-statistic	
<i>LPROD=f(RW, UR)</i>					
Calculated F Statistic				4.833	
Narayan (2005)				k=2, T=40	
90%level		95%level		99%level	
I(0)	I(1)	I(0)	I(0)	I(1)	I(0)
3.373	4.377	4.113	5.260	5.893	7.337

Notes: (*), (**), and (***) indicate that the corresponding coefficient is significant at 10%, 5%, and 1% levels, respectively. Critical values are cited from Narayan (2005:1988) (Table Case III: Unrestricted intercept no trend)

After establishing the cointegration relationship for Equation (1), the next step is to estimate the long-run coefficients of the equation by using the ARDL specification. Owing to the ARDL specification, it is assumed that the errors are serially uncorrelated and the, maximum lag is selected as 1 according to the lag length criteria, where no autocorrelation is found in Equation (1). The estimated long-run coefficients of ARDL(1,1,1) model are given in Table 5.

Table 5: Estimated Long-Run Coefficients Using ARDL Approach

Regressors	ARDL(1,1,1)
<i>Constant</i>	0.076 [0.122]
<i>RW</i>	0.970 [2.429]**
<i>UR</i>	0.535 [1.853]*
<i>DUMMY_2010</i>	1.582 [2.710]**

Note: t-values are given in parentheses. (*), (**) and (***) indicate that the corresponding coefficient is significant at 10%, 5%, and 1% levels, respectively.

The long-run coefficients show that all regressors in the productivity equation exhibit the positive sign and are statistically significant at the 5% or higher level. The results imply the importance of real wages in labour productivity in the long-run. The long-run coefficient of real wages is positive and strongly statistically significant at 5% level. A 1% increase in the real wages increases the labour productivity by 0.97%. The findings support the efficient wage theory in Turkish manufacturing industry in the long-run. Moreover, the unemployment rate also affects labour productivity in the long-run. A 1% increase in unemployment rate increases the labour productivity by 0.53%. The results indicate that

high unemployment leads to increase workers' performance because less productive workers are fired first. To sum up, the results found that both real wages and unemployment positively affect labour productivity in the long-run.

The error correction model was also estimated within the ARDL framework. The results of the short-run dynamic coefficients related to the long-run relationships estimated by Equation (1) are reported in Table 6.

Table 6: Error Correction Model

Regressors	ARDL(1,1,1)
Dependent variable: $\Delta LPROD_t$	
Constant	0.009[0.127]
ΔUR	-0.451[-6.604]***
ΔRW	-0.588[-5.463]***
DUMMY_2010	0.195 [1.867]*
ECT_{t-1}	-0.171[-2.550]**
Adjusted R ² : 0.79 DW:2.31 F=25.188(0.000)	
$\chi^2_{LM}(1) = 0.242$	$\chi^2_{ARCH}(1) = 0.604$
$F_{(1,31)}^{RESET} = 0.247[0.622]$	$\chi^2_{NORM}(2) = 0.649[0.722]$

Note: t-values are given in parentheses. (*), (**), and (***) indicate that the corresponding coefficient is significant at 10%, 5%, and 1% levels, respectively. The statistics are distributed as chi-squared variates with the degrees of freedom in parentheses.

The results for 2007:Q1–2016:Q4 period show that the error correction term, ECT_{t-1} , is negative and statistically significant, indicating that the feedback mechanism is effective in Turkey. In other words, the convergence to long-run equilibrium after a shock is relatively small for the Turkish manufacturing industry. The estimated coefficient of error correction term (-0.17) indicates that around 5% of the deviation from equilibrium is eliminated within a quarter. However, the sign of the short-run coefficients is negative except dummy variable and statistically significant in productivity equation.

The model passes the specification tests, such as the tests of no residual autocorrelation, no residual ARCH effects, residual normality, and no residual heteroscedasticity and the RESET test for functional form misspecification. The cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMQ) tests were employed to determine whether the parameters in the models are stable. The results of CUSUM and CUSUM-Q tests are shown in Figure 1. The lines show the boundaries of 5% significance levels. It can be seen in the figures that the parameters are stable; the sum of the squared residuals lies inside the critical bounds of 5% significance.

Figure following on the next page

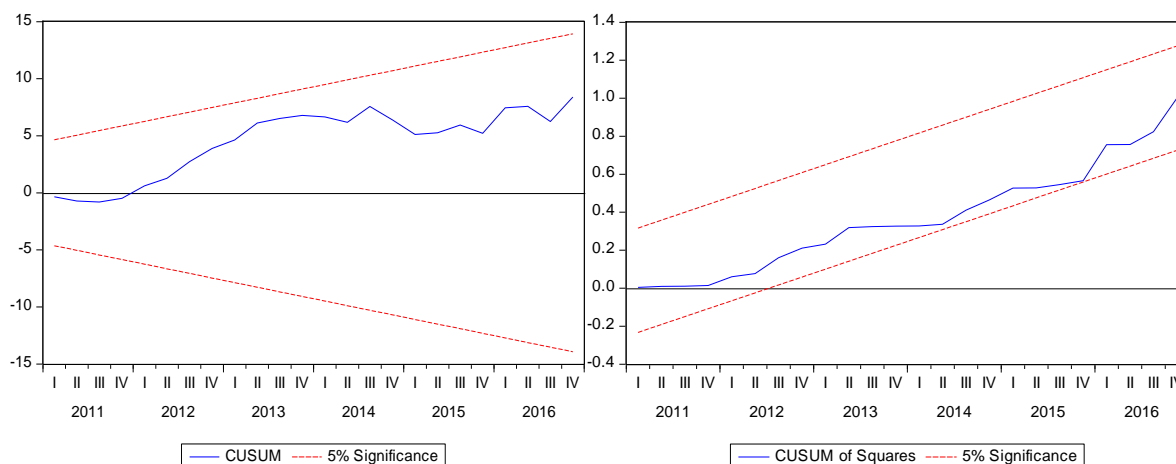


Figure 1: CUSUM and CUSUM Q Test Results for Coefficient Stability

Toda and Yamamoto’s procedure (1995), which employs a modified Wald test does not require pre-testing for the cointegrating properties of the system and is valid regardless of whether a series is $I(0)$, $I(1)$ or $I(2)$, non-cointegrated or cointegrated in an arbitrary order ‘as long as the order of integration of the process does not exceed the true lag length of the model’ (Toda and Yamamoto, 1995:225; Wolde-Rufael, 2007:202). Therefore, the results of Toda–Yamamoto’s version (1995) of the Granger causality test are presented in Table 7.

Table 7: The Results of Toda-Yamamoto’s Causality Test

Null Hypothesis	χ_p^2 - statistic	Probability value	Decision
UR does not cause LPROD	14.958	0.001	Bidirectional Causality UR ↔ LPROD
LPROD does not cause UR	12.508	0.005	
RW does not cause LPROD	5.930	0.115	No Causality
LPROD does not cause RW	2.684	0.442	
RW does not cause UR	3.355	0.340	Unidirectional Causality UR → RW
UR does not cause RW	9.394	0.024	

Notes: (*), (**), and (***) indicate that the corresponding coefficient is significant at 10%, 5%, and 1% levels, respectively. VAR is estimated by $[k + dmax] = 4$ for the model, optimal lag length $k=3$ is selected by lag length criteria, $dmax=1$.

According to Toda-Yamamoto’s causality test results shown in Table 7, it can be concluded that the causal relationship between productivity and unemployment is bi-directional. However, there exists a unidirectional causality running from the unemployment to real wages. In other words, a bi-directional causality is found from unemployment to labour productivity. A causality running from unemployment to labour productivity is found at the 5% level of significance but there is no evidence of reversal causation running from labour productivity to unemployment. The results imply a significant effect of the unemployment rate on the Turkish economy. Unemployment has been the central variable, being caused by both real wages and productivity for the period of 2007:01–2016:04.

5. CONCLUSION

This study has empirically investigated the relationship between labour productivity, average real wages, and the unemployment rate in Turkey using quarterly data from 2007 to 2016. The empirical results evidence a structural break at the end of 2010. The break-date, which indicates the rapid economic growth of Turkish economy, appears to have positively affected the relationship between the variables. The cointegration results indicate a long-run equilibrium relationship between the real wages, unemployment, and productivity. While a long-run wage-productivity elasticity of 0.97 implies the efficiency of wage theorem in Turkish manufacturing industry; a long-run unemployment-productivity elasticity of 0.53 implies the increasing efforts and thus the productivity of workers to secure their jobs. The positive effects of real wages and unemployment together on the labour productivity also indicate the rigidity of Turkish labour market. Furthermore, the causality tests indicate the importance of unemployment rate in Turkey, where unemployment affected both real wages and labour productivity. A bi-directional causality was found between labour productivity and the unemployment rate. There exists a feedback effect between the variables. High unemployment increases the productivity of workers who do not want to lose their jobs. Contrary, the productivity causes unemployment. If the productivity that leads to increase the output does not induce the investments, then sufficient employment opportunities are not created in the economy and, thus the unemployment rate continues to increase. The same effect was found in the Turkish economy, especially soon after the 2008 economic crisis. However, a unilateral causality was found between the real wages and unemployment. Unemployment causes real wages, but the absence of the reversal causation implies a broken link. Increasing labour supply affects the formation of wages. According to the theoretical expectations, if the unemployment rate is to rise, one may expect to weaken union bargaining power and the wages. However, one may mention the decreasing unionization of workers and thus decreasing bargaining power of the unions in Turkish industry. As a result, the findings indicate that the unemployment still remains an important macro-economic issue in Turkey. A high and persistent unemployment rate has been one the structural macroeconomic problems of Turkey. During the aforementioned period, the average unemployment rate reached to 10.1%. Although the Turkish economy performed a rapid economic growth right after the 2008 economic crisis, the strong economic growth performance could not be sustained in the following years and thus sufficient employment opportunities could not be created (Karaalp-Orhan and Gülel, 2016, p.152). Therefore, unemployment appears to have a clear effect on labour productivity and real wages in Turkey.

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