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The Effect Of Interest Rate Spread On Unemployment Rates*

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Abstract: *This study examines the long run relation between interest rate spread and unemployment rates of OECD countries over the period of 2005 and 2016. When explaining unemployment rate, we used prominent financial variables such as long-term interest rates, money supply (M1), and stock exchange index beside spread. First, a cointegration method is used to discover the long run movement. Second, ARDL estimation method is used to see relation between the variables in the long term. It is found out that all explanatory variables are cointegrated with unemployment rates; the effect of spread on unemployment rate seems to be significant and moves in same direction in the long run. Further, meaningful relationship between unemployment rate, money supply, long term interest rates and stock exchange index is pointed out.*

Keywords: *Interest rate spread, Panel data, Unemployment, ARDL, Finance*

Kredi ve Mevduat Faiz Oranı Farkının İstihdam Üzerindeki Etkisi

Öz: *Bu çalışma 2005 ve 2016 döneminde OECD ülkelerinde kredi ve mevduat faiz oranları farkının(faiz oranı dağılımının) işsizlik oranları üzerindeki uzun dönemli ilişkisini incelemektedir. İşsizlik oranının açıklanmasında uzun dönem faiz oranları, para arzı (M1) ve borsa indeksi gibi finansal değişkenler kullanılmıştır. İlk olarak, eştümleşim yöntemiyle uzun dönemli hareketler incelenmiş, ikinci olarak ARDL (Gecikmesi Dağıtılmış Ardışık Bağlanım) tahmin metodu ile değişkenler arasındaki uzun dönemli ilişkiler ele alınmıştır. Tüm açıklayıcı değişkenlerin işsizlik oranı ile eştümleşik olduğu görülmüştür. Faiz oranı dağılımının işsizlik oranı ile uzun dönemli önemli bir ilişki içinde olduğu saptanmıştır. Yine, işsizlik oranı, para arzı, uzun dönem faiz oranları ve borsa indeksi arasında anlamlı bir ilişkinin varlığına işaret edilmektedir.*

Anahtar Kelimeler: *Faiz oranı, Panel veri, ARDL, İşsizlik, Finans*
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I. Introduction

The terminology of interest rate spread (also known as yield curve) not only refers to the difference between long term government bonds and short term treasury bills- which is a general definition of the spread- but also involve several other long term corporate

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Bu makale araştırma ve yayın etiğine uygun hazırlanmıştır iThenticate intihal incelemesinden geçirilmiştir.

bond interest rates with respect to short term treasury bills. In doing so, the analysts consider the risk premium in their investigation.

While the linkage between interest rate and economic growth and related economic activities have been througly investigated in academia, there are only few studies that which examined the relation between yield curve and unemployment rate. These studies have been particularly on individual countries such as the US, South Korea and Brazil.

The economic intuition of term structure of interest rate is generally tended to seek the relation between spread and economic growth to obtain future information about the economic activities (Bernanke, 1990). The evidence that the yield curve predicts the future economic activities were found by the most prominent economists such as Stock and Watson (1989), Bernanke (1990), Estrella and Hardouvelis (1991),Estrella and Mishkin (1997). While Bernanke (1990), Wheelock and Wohar (2009) and more recently Chinn and Kucko (2015) claim that the capability of term spread to forecast future output growth were weakening in recent years up until 2008,the information contained by the yield curve still takes a great attention even after the global financial crisis of 2008. Since then, for instance Hännikäinen (2015),Shareef and Shijin (2017) and Chinn and Kucko (2015) examined the predictive power of interest spread at the time of extremely low short term interest rates and found term spread and credit spread as useful indicators of economic activity in the post crisis period.

The empirical researches suggest that when the interest rate spread of 10-year bond and 3-month Treasury bill squeezed or narrowed, it means that future economic activities should also fall accordingly or an upward sloping yield curve will mean that economies will grow in the future. The intuition behind this theory is that the expected future growth in an economy can generate higher prices of goods and services. So, the investors wish to compensate their returns for the risk of inflation and require higher return on bonds they invested. So the longer term interest rates will surpass the short term interest rates. Correspondingly, the spread will be positive.

Estrella et al., (2003) believe that a tightening monetary policy will also lead to negative yield curve in an economy. The authors view that if the central bank raises short-term interest rates and market participants expect this policy to be effective in curbing inflation in the long run, the long-term rates (the averages of future expected short rates, according to the expectations hypothesis) should rise in smaller proportions. Thus, a restrictive monetary policy tends to flatten the yield curve, and at the same time slows down the economy (Estrella, 2005; Bernanke, 1990).

When looking at the relation between interest rate spread and unemployment, the work of Ofer et. al. (2014) can identify the these two variables. The authors build up several argument about this positive relationship. The first is that in the case of interest rate rise, the profit of companies will fall and the cost of capital per employees will rise and hence unemployment increases. Second, incerases in interest rates also extends the cost of working capital which directly increases the cost of vacancies and leading to

higher unemployment rate. The third is that in the event of bankruptcy, the firms will be unwilling to take new post.

The above first explanation contains information about long term interest rates. When long term interest rates are high, obviously the interest spread also will be high in respect to short term rates. As explained above by Estrella and Mishkin (1997), the upward sloping yield curve occurs when economies grow. During this time, while economies grow, the demand side of consumption will increase and this will lead to inflationary expectation. Subsequently, as inflation climbs, interest rates likely to rise to compensate purchasing power (Angelo, 2017). In his report, Blanchard (2004) argued that unemployment rate could be higher due to increasing real interest rate and as a result of this, capital accumulation will decrease, which will further lead to a higher unemployment rate.

As Ofer et. al. (2014) suggested, the increasing interest rates create an economic environment in which the cost of capital will escalate upwards and finally this situation leads to economic downturn. Here, the relation between interest rate spread and unemployment rate come to fore. Once the producers see an economic downturn or uncertainty in the future, they will curb their work force or may not be willing to hire new employees.The Figure 1 in appendix section shows a linear relationship between interest rate spread and unemployment rate for OECD countries.

The main motivation of this paper is to analyze the long run relation between interest rate spreads (The spread between 10-year government bond and 3-month Treasury bill) and unemployment rates for OECD countries over the period of between 2005 and 2016. While previous studies focused on specific and individual countries, this study will discover this relation among a group of countries (OECD) by using the latest panel data models that take structural breaks and cross-sectional dependency into account. We believe that this paper will also contribute to the literature of the relation between interest rate spread and unemployment rate by bringing additional dimensions to this issue. For instance, it will allow us to see how several financial economic variables, such as money supply of M1, stock prices and long term interest rates, affect unemployment rate in OECD countries.

II. Literature Review

In general, the literature on the effect of interest rate spread is more likely related with the economic activities such as economic growth rate and industrial production of countries. However, there is not much works that specifically bring forth the linkage between term structure of interest rate and the issue of unemployment. A few studies that carried out on this issue belong to Bernanke (1990) and more recently Papadamou and Siriopoulos (2009), Glocker and Towbin (2012), and Ofer et. al. (2014).

In general, the literature mainly have focused on the relationship between interest rate spread and economic activities. One of the main work that dealt with this issue is the study of Bernanke (1990). The author uses spread of several bonds interest rate to find which spread is better at predicting macroeconomic variables including unemployment

rates. The author suggests that the spread between commercial paper rate and T-Bill seems to be better at forecasting economic activities. This spread further gives information about default risk and finds a positive and significant relation between spread and unemployment rates.The author claims that this spread is also a measure of monetary policy.

Similarly, Estrella and Mishkin (1997) used 10-year government bonds and T-bill spread to explain inflation and recession by using VAR (Vector Autoregression) and OLS (Ordinary Least Squares). The authors conclude that monetary policy plays an important role in determining interest rate spread. This paper applied the power of spread to predict future output and inflation not only for the U.S. but also for major European countries such as Germany, the UK, France and Italy.The previous results are similar to those of these countries. Spread can predict real activity and inflation at least one year in advance for the U.S.and two years for European countries. Not only spread that has the predicted power but also other monetary policy instruments that have effect on future output and inflation.

Estrella and Hardouvelis (1991) use the difference between the 10-year government bond rate and the 90-day T-bill rate to forecast U.S. output growth and its components up to 5 years into the future. They find that the term structure is an excellent predictor of output growth and its private components. Further, 100 basis point increase in the spread translates into just over a 1 percentage point increase in growth a year later. When they add extra variables to their model, such as the growth rate of an index of leading indicators, a short term interest rate, the inflation rate and a lagged growth rate, the term structure remains significant at predicting output growth up to three years.

In addition to the previous mentioned studies, Bauer and Mertens (2018) claim that a term spread predicts a recession within two years and properly indicated nine recessions since 1955 with interest rate spread being negative all the time. A negative or flat yield curve means for banks that borrowing short term rates and then lending long term rates will cause their profit to fall and lead banks to be unwilling to supply loans (Bauer and Mertens, 2018).

When analyzing the effects of monetary policies on unemployment rate in South Korean economy, Papadamou and Siriopoulos (2009) found a positive relation between corporate bond spread and unemployment rate which was predicted several months ago by the spread used. However, the authors also believe that the response of unemployment rate to change in monetary policies was smaller.

Ofer et. al. (2014) used Moody's Baa- and Aaa-rated corporate bond spread together with the U.S. unemployment rate. The authors found a strong and positive relation between corporate bond spread and unemployment rate. The authors further argue that this correlation higher for the spread of corporate bonds than treasury bills.

In contrast to Papadamou and Siriopoulos (2009) and Ofer et. al. (2014), Glocker and Towbin (2012) tried to see the effect of reserve requirement on macroeconomic variables by examining Brazil. When applying structural VAR model, the authors find that a

tightening of credit conditions, i.e. increasing short term rate, which in effect will cause negative or flat interest rate spread, will increase unemployment rates.

III. Data and Variables

In this paper, all data were gathered from the OECD data base. However, some missing data for some countries are found through their Central Bank statistics. Long term interest rates for Turkey, i.e. 10-year government bonds, were taken via Bloomberg Terminal.

Monthly periods are used for the period of 2005:1 and 2016:12 in the model. When identifying and selecting the appropriate variables, the previous studies in the literature are considered. So that the variables can be identified and be consistent with previous researches.

Generally, the logarithm of M1 money supply and stock prices are used in the literature. In this analysis, the variables spread, long-term rates, unemployment rates are taken in their level. However, the logarithm of spread and long-term interest rate cannot be taken due to some of their negative values. The value of M1 and stock index were converted to natural logarithm. The reason for taking logarithm of values of variables that will be used in econometric analysis is that by having logarithm, the scale of data transformed in order to make variables seem to be normally distributed. The variables that are used in the analyses based on the data from 29 OECD countries are shown with their descriptive statistics in the Table 1.

Table 1: The Variables on Interest Rate Spread and Financial Indicators from OECD Economies. Summary Statistics

Countries	N.of Obs.	Variables	Mean	Median	Max.	Min.	S. D.
29 OECD countries	4175	Unemployment rates	7.564	6.9	27.9	2.3	4.163
		Spread (Treasury 10-years and T-Bills)	1.521	1.13	28.19	-2.87	2.168
		Long term interest rates (10-years)	4.032	3.7	29.24	-0.54	2.934
		Stock exchange indexes	4.659	4.653	5.806	3.334	0.306
		M1 money supply	4.626	4.620	5.772	3.575	0.308

Interest rate spread is used because as it is found in the literature, a positive long run relation between spread and unemployment rate, which are regarded as the main indicator of economic activities. This result is consistent with the literature, which states that an increase in spread is followed by increase in unemployment rate.

M1 measure of money supply is one of the most important financial indicator of the economy. M1 money supply used as a proxy for monetary policy beside spread and short term rates in analyzing the effect of spread on economic activities. Berument et. al (2014) state money supply (M1) as total size of monetary aggregates and a measure of liquidity. Here is the rationale is that increasing money supply will lower interest rates as the

supply of monetary base increases according to central banks' policy decisions. The conventional wisdom is that short term interest rates will soon react to the money supply and these rates will increase before long term interest rates in capital markets. Hence, increase in short term rates will lower interest rate spread in the short term.

Stock exhange index is used as one the explanatory variable to see its long run relation between unemployment rate as it is believed that the stock exchanges foresee the future of economic standing and it will rise or fall depending on the direction economies go. Increase in stock exchanges will give signal to economic agents about future economic direction. An increase in stock exchanges will follow the economic expansion. So that when economies expand the number of workforce rises which in turns reduces unemployment rate.

The reason why long term interest rates are chosen instead of short term rate is that short term interest rates are affected by business fluctuations and monetary policies in the short run, however, long term interest rates considers longer term economic prospect (Humpe and Macmillan, 2007). Furthermore, any movement of long term interest rates will have effect on the level interest rate spread which is altered by both short and long interest rate change. For instance, an increase in long term bonds interest rates, if greater than relative to short term rates, will expand spread. In opposite case, i.e. if short term interest rates increase more than long term rates than the spread will narrow. Consequently, unemployment rate will be influenced by the change in long term interest rates.

A.Empirical Model

As an econometric methodology, panel cointegration analysis will be used in order to capture long run relation between interest rate spread and unemployment. Cointegration method first introduced by Engle and Granger (1987) to see long run correlation relation between non stationary variables. Because they believe in the long run, if two variable are cointegrated there will be an equilibrium between the variables. Later on this technique developed to be applied on model with more than two variables by Johansen (1988). While cointegration methods have been performed for non-stationary variables, Pesaran et. al. (1999) applied this method for variables with different degree of integration of order (I(0) or I(1)) to find long run relationship. Further, Westerlund (2006) uses LM based test to test cointegration for panel data series. The advantage of this test is that it takes serial correlation, cross-sectional dependency and breaks into account in series. To find long run relation between the variables, the below equation constructed for panel data analysis:

$$UNEMP_{it} = \alpha_i + \beta_{1i} SPREAD + \beta_{2i}\, lnSTOCK + \beta_{3i}\, lnM1 + \beta_{4i} LONG + \varepsilon_{it} \quad (1)$$

In above equation (1), *UNEMP* stands for unemployment rate, *SPREAD* shows interest rate spread, *lnSTOCK* expresses logarithm of stock exchange indexes, *lnM1* indicates logarithm of money supply of M1, *LONG* shows long term interest rates and ε illustrates the error term of the model.

Before proceeding further to see the statistical assessment of the variable by using panel cointegration analysis, it is necessary to check whether the variables are stationary or not. For instance, for the case of time series, Sarı et. al., (2007) suggest that the characters of time series can be determined by applying appropriate unit root estimators that will suit the model. Similar to time series, variables in panel data analysis, which comprises both time series and cross sections, must be stationary in order to avoid spurious regression. In other words, the traditional values of t-test, F-test and determination coefficient tend to be biased, the regression output may give misleading results (Brooks, 2004). By having stationary variables, the likelihood of spurious regression will be removed and the significance of regression will be higher as well (MacKinnon, 1991).

1. Unit Root Tests

In econometric modeling, it is necessary to use variables with constant variance and error terms to have a zero mean to get more robust results and use the most proper econometric modeling accordingly. To investigate whether our variables have constant variance with zero mean for error terms, we need to use several unit root applications.

The unit root methods that will be tested are Levin, Lin and Chu (LLC) Test, Im, Pesaran and Shin (IPS) test, ADF and Hadri LM unit root tests. These tests are also called as first generation panel unit root tests. However, it should also be noted that the first generation unit root test results may not be proper in the case of cross-sectional dependency, in which case the results will assume over rejection of null hypothesis (O'Connell, 1998). One of the unit root test that take cross-sectional dependency into account is Pesaran's (2007) Cross-Sectionally Augmented Dickey-Fuller (CADF or CIPS) unit root test takes cross-sectional dependency into account when examining unit root in heterogeneous panel data series.Pesaran also assumes a common factor that affects cross-section units.

Unit root test results suggest that all the variables are not stationary at their level(i.e. they behave in random walk process) with the exception of interest rate spread variable which is found to be stationary in level according to both first generation unit root tests and unit root test which consider cross-sectional dependency.

2. Homogeneity Test

To test whether all the parameters of all betas are the same, i.e. equal to zero, we run homogeneity panel test of Pesaran and Yamagata (2008). This model is favorable for high-dimensional panel data series. The basic model is;

$$UNEMP_{it} = \alpha_i + \beta_{1i}SPREAD + \beta_{2i}STOCK + \beta_{3i}M1 + \beta_{4i}LONG + \varepsilon_{it} \qquad (2)$$

The below results suggest a strong rejection of homogeneity of betas. So, it can be concluded that the panel cross-sections slope coefficients are heterogeneous.

Table 2: Panel Unit Root Test at Level

Variables	Test	Constant			Constant and Trend		
		Statistics		*p-value*	*Statistics*		*p-value*
Unemp	LLC	-2.669		0.0007	-0.408		0.3417
	IPS	-0.338		0.3676	2.007		0.9776
	ADF	64.415		0.2623	50.268		0.7549
	HADRI	30.119		0.0000	22.630		0.0000
	CIPS	2.923		0.9980	5.098		1.0000
Spread	LLC	-1.982		0.0238	-1.004		0.1576
	IPS	-3.940		0.0000	-1.144		0.1262
	ADF	96.905		0.0010	68.117		0.1709
	HADRI	13.657		0.0000	17.465		0.0000
	CIPS	-1.907		0.0280	0.057		0.5230
Stock	LLC	-1.177		0.1196	0.759		0.7936
	IPS	-2.236		0.0127	-0.746		0.2280
	ADF	71.816		0.1049	61.611		0.3482
	HADRI	24.728		0.0000	15.943		0.0000
	CIPS	3.825		1.0000	1.322		0.9070
M1	LLC	1.539		0.9381	-0.332		0.3699
	IPS	9.479		1.0000	0.531		0.7023
	ADF	6.385		1.0000	53.460		0.6446
	HADRI	43.208		0.0000	14.411		0.0000
	CIPS	-2.601		0.0050	-0.863		0.1940
Long	LLC	1.946		0.9741	-2.564		0.0052
	IPS	3.784		1.0000	-2.534		0.0056
	ADF	22.666		1.0000	83.988		0.0145
	HADRI	20.918		0.0000	14.578		0.0000
	CIPS	0.390		0.6520	-1.424		0.0770

For lag selection, SIC is used.

Table 3: Panel Unit Root Test First-Differenced

Variables	Test	Constant			Constant and Trend		
		Statistics		*p-value*	*Statistics*		*p-value*
Unemp	LLC	-26.971		0.0000	-33.071		0.0000
	IPS	-32.549		0.0000	-34.238		0.0000
	ADF	1034.310		0.0000	1007.360		0.0000
	HADRI	5.587		0.0000	10.202		0.0000
Spread	LLC	-45.153		0.0000	-50.806		0.0000
	IPS	-42.453		0.0000	-42.468		0.0000
	ADF	1450.530		0.0000	1305.780		0.0000
	HADRI	-2.048		0.9797	2.031		0.0212
Stock	LLC	-46.173		0.0000	-52.038		0.0000
	IPS	-45.551		0.0000	-45.981		0.0000
	ADF	1595.570		0.0000	1451.450		0.0000
	HADRI	-2.320		0.9898	0.850		0.1975
M1	LLC	-16.295		0.0000	-21.047		0.0000
	IPS	-18.470		0.0000	-17.748		0.0000
	ADF	502.435		0.0000	452.825		0.0000
	HADRI	1.557		0.0598	8.355		0.0000
Long	LLC	-52.253		0.0000	-59.303		0.0000
	IPS	-48.710		0.0000	-49.727		0.0000
	ADF	1713.330		0.0000	1579.850		0.0000
	HADRI	-1.484		0.9310	0.016		0.4935

For lag selection, SIC is used.

Table 4: Homogeneity Test Results

Homogeneity test (for *Unemp*)	Statistic	p-value
$\tilde{\Delta}$	136.596	0.000
$\tilde{\Delta}_{adj}$	139.519	0.000

3. Pesaran's Cross-Section Dependency Test (CD)

To see whether the variables in this analysis have cross-section dependency, a test of cross-sectional dependency will be applied to the analysis[1]. In panel data, cross-sectional dependency is important, because as Bai and Kao (2006) pointed out that leaving the assumption of dependence would give biased and inconsistent results and size distortions. For this purpose we used Pesaran's (2007) cross-sectionally augmented ADF unit root test (CADF or CIPS), which considers cross-sectional dependency.The reason why all the above tests are going to be performed is to see whether all test results will give the same answer (Mahadeva and Robinson, 2004). Kar et.al (2011) believe that the case of cross-sectional dependency can occur, because in today's global world, a shock in one country may also have effect on other countries and for this reason cross-section independence may not be valid.

Pesaran (2004) suggests a basic test for finding out cross-section dependency for panel data. His test method is built on OLS test, from which the average of residuals taken from each individual regression of panel data. The null hypothesis of this test is strongly rejected, meaning that there is cross-sectional dependency within the variables in this panel data (See Table 4).

Table 5: Pesaran (2004) CD test results

	UNEMP	
CD Test	Stats	p-value
CD LM (Breusch-Pagan, 1980)	10567	0.000
CD LM (Pesaran CD, 2004)	356.58	0.000
CD (Pesaran, 2004)	77.75	0.000
Bias-adjusted CD	610.95	0.000

4. Westerlund and Edgerton (2007) LM Cointegration test

Westerlund and Edgerton (2007) panel cointegration test is in contrast to Pedroni (2004), hypothesis cointegration in panel series. Westerlund and Edgerton (2007) use a LM statistics to estimate statistics. This model uses Fully Modified Ordinary Least Square (FMOLS) regression to estimate residuals. The residuals are taken from the following equation:

[1] Pesaran's (2004) Cross-section dependency (CD) Test is used for checking cross-section dependency. As a result, cross-sectional dependencies are found within the variables.

The null and alternative hypothesis of this test is as follow:

H_0 :σ_i^2 = 0, there is cointegration for all *i*'s

H_1 :σ_i^2 > 0, no cointegration for some *i*'s

Table 6: Westerlund and Edgerton (2007) Cointegration Testing Results

y	**Constant only**		**Constant and Trend**			
Unemployment	Statistics	p-value[a]	p-value[b]	Statistics	p-value[a]	p-value[b]
LM stat	26.189	0.000	0.130	27.355	0.000	0.000

The bootstrap p-value was generated with 10.000 replications. This model was arranged as a constant and trend mod. Superscripts a and b refer to asymptotic and bootstrap values respectively.

The above figures from Westerlund and Edgerton (2007) indicate that there is cointegration for all dependent variables, i.e. economic activities between the independent variables of financial indicators at the level. The crucial value to determine cointegration is bootstrap value of LM test. However, when trend and constant are considered together, the cointegration does not appear between the variables.

Figure 1 indicates how interest spread and unemployment rate are closely move together.

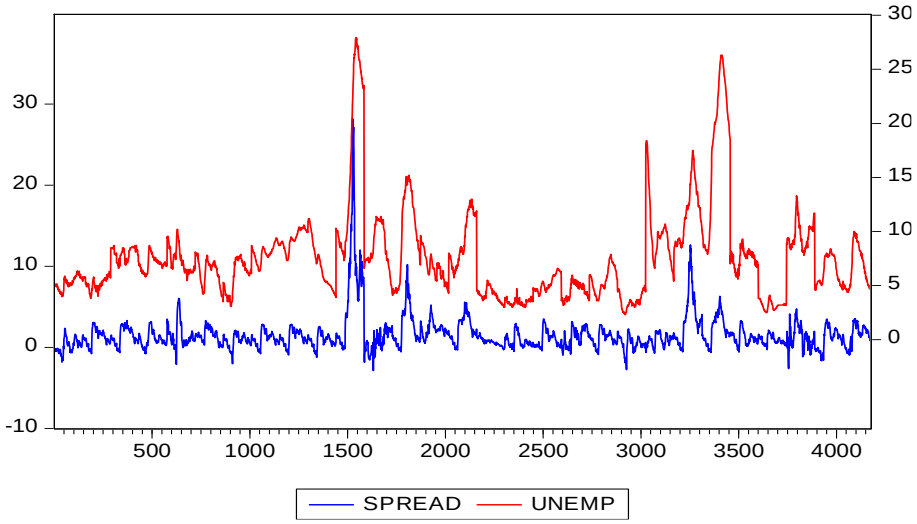

Figure 1: Movement of Spread and Unemployment Rate

5.Westerlund Multi-Structural Break Cointegration Test (2006)

Westerlund (2006) uses LM based test to test cointegration for panel data series. The advantage of this test is that it takes serial correlation, cross-sectional dependency and breaks into account in series.

When structural breaks are included in the cointegration model, Westerlund (2006) test suggests (See Table 6) that there is cointegration among all variables.(Note that the null hypothesis of this test suggests the existence of cointegration) Here again, the significance of bootstrap values are critical. Bootstrap p-values suggest that industrial production, inflation, and unemployment rates are cointegrated with financial variables of spread, stock market index, money supply of M1 and long-term rates.

Table 7: Westerlund (2006) Cointegration testing multibreak LM statistics results

Dependent Variable				
Unemployment	*Test*	*Statistics*	*p-value*[a]	*p-value*[b]
.	Constant (No break)	33.958	0.000	0.166
	Constant and trend (No break)	34.675	0.000	0.000
	Break in constant	3.835	0.000	0.580
	Break in constant and trend	9.563	0.000	0.250

The bootstrap p-value was generated with 10.000 replications. Superscripts a and b refer to asymptotic and bootstrap values respectively.

6. Panel ARDL Model

When taking cross-sectional dependency into account, we found cointegration among the variables investigated. Since the variable spread is stationary at level, i.e. I(0) and other variables are I(1), then the panel ARDL estimation method can be employed in analyses. For this purpose, Pesaran et. al. (1999) Panel Autoregressive Distributed Lags (ARDL) approach will be used. This model estimation can be applied to the variables of different integration of order. ARDL's PMG (Pooled Mean Group) estimator would be better estimator as this method considers short run heterogeneity with respect to long run homogeneity of the series.

$$\begin{aligned}\Delta UNEMP_{it} = {} & \alpha_i + \omega_i UNEMP_{it-1} + \delta_i SPREAD_{it} + \vartheta_i lnSTOCK_{it} + \gamma_i lnM1_{it} \\ & + \theta_i LONG_{it} + \sum_{j=1}^{p-1} \beta_{ij} \Delta UNEMP_{it-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta SPREAD_{it-j} \\ & + \sum_{j=0}^{k-1} \vartheta_{ij} \Delta lnSTOCK_{it-j} \sum_{j=0}^{l-1} \gamma_{ij} \Delta lnM1_{it-j} \sum_{j=0}^{m-1} \theta_{ij} \Delta LONG_{it-j} + \varepsilon_{it}\end{aligned} \quad (3)$$

In above error correction models of ARDL equation (3), *UNEMP* stands for unemployment rate, *SPREAD* shows interest rate spread, *lnSTOCK* expresses logarithm of stock exchange indexes, *lnM1* indicates logarithm of money supply of M1, *LONG* shows long term interest rates and Δ indicate first difference operator, $\omega_i = -(1 - \sum_{j=1}^{p} \beta_{ij})$ and $\omega'_i = -(1 - \sum_{j=1}^{p} \beta'_{ij})$ shows error correction coefficients. Pesaranet. al. (1999) suggests this test of PMG estimation can be used for heterogeneous panel series.

Table 7: Panel ARDL Model Unemployment Test Results

Panel A: Long Run Estimation				
Variables	*Coefficient*	*t-stat*		*p-value*
Spread	0.0805	13.456		0.0000
Stock	-0.3312	-7.7583		0.0000
M1	0.0069	0.1960		0.8445
Long	-0.0491	-6.7808		0.0000
Panel B: Short Run Estimation				
Variables	*Coefficient*	*t-stat*		*p-value*
EC (Error Correction Term)	-0.0452	-3.2641		0.0011
D(Uenmp(-1))	0.1268	2.4722		0.0135
D(Unemp(-2))	0.1215	3.4061		0.0007
D(Unemp(-3))	-0.0067	-0.2356		0.8137
D(Spread)	0.0243	3.0021		0.0027
D(lnstock)	-0.0180	-1.9217		0.0547
D(lnM1)	-0.1650	-1.8966		0.0580
D(Long)	-0.0246	-3.0689		0.0022
C	0.1498	3.3895		0.0007

The PMG estimator of ARDL approach reports that there is a positive long run relation between spread and unemployment rate, which are regarded as the main indicator of economic activities. This result is consistent with the literature, which states that an increase in spread is followed by increase in unemployment rate. Further, the p-value of the spread variable is also significant in explaining unemployment rate. These results are also in line with the literature where Bernanke (1990); Papadamou and Siriopoulos (2009) and Glocker and Towbin (2012) found significant and positive relation between the spread and unemployment rate as macroeconomic variables. We also mentioned in introduction section how spread and unemployment rate are closely related in Figure 1.

The stock exchanges have negative relation with unemployment rate. This outcome is in line with the theory that the stock exchanges foresee the future of economic standing and it will rise or fall depending on the direction economies go. On the other hand, money supply of M1, according to the results, does not give what the literature suggests. This result is also in line with view of Stiglitz (2016), as the author points out that when running a simple regression there is low correlation between large money supply and GDP. In addition, the authors suggest that, this weak relation between money base and interest with output not only exists in the post financial crisis but also over the last quarter. Further, the author also asks where this extra liquidity has gone? These questions may be found out in future experiments. However, it could be said that when looking at

stock market indexes, the value of stocks has increased since financial crisis of 2008 and reached their record level as of end of 2016 for the U.S indices and for other developed countries. This could have been one of the simple answers for the question Stiglitz asked.

IV.Conclusion

In this research, we looked at the long run relationship between interest rate spread and unemployment rates for OECD countries. OECD countries were preferred for the study due to their similar economic structure and economic interdependence. The recently developed panel data methods are applied in an effort to find the long run relationship between spread and unemployment rate. We also put priority to the issue of cross-sectional dependency and hence applied suggested panel methods accordingly. The research focused not only on term structure of interest rates other than spread but also several other financial indicators to see their relationship with unemployment for OECD countries.

The analyses indicate that a strong and positive relationship between interest rate spread and unemployment rate for the OECD countries exist. This relationship also confirms the outcomes of previous studies in literature. Despite the financial crisis of 2008, this relation seems to be continuing. On the other hand, while it appears no linkage between unemployment and M1 money supply, stock exchange index and long term interest rates look significant and there exist relation with unemployment rate over the investigated period. However, due to macro-economic development around the world, some variables such as money supply are losing its significance in explaining economic activities. This happens at the time of the economies that are in a new state, which some economists call as "New Normal". Because, interest rates in many countries are in near-zero level and have been staying there for a long time since the financial crisis of 2008. Despite these lower rates of interest, economic activities mostly failed to reach the desired level up until 2016.

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