DOES PHILLIPS CURVE REALLY EXIST? AN EMPIRICAL EVIDENCE FROM JORDAN

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Abstract

This study empirically examined the relationship between inflation rate and unemployment rate in order to predict and estimate the existence of Philips curve trade-off relationship within Jordanian economy over the period of 1976 to 2013. It employs multiple descriptive and econometrics approaches using unit root tests, co-integration tests, VECM, and linear and non-linear ordinary least square regression tests.

In the findings of this study, there was a negative and non-linear relationship between unemployment and inflation. The lowest limits of inflation and unemployment were estimated to be 3.779% and 11.077% respectively. The elasticity of inflation with respect to unemployment, and the elasticity of unemployment with respect to inflation were estimated to be -0.23% and-0.02% respectively. Therefore, this study provides a strong empirical existence of Phillips Curve on Jordanian economy over the period of 1976-2013.

However, this trade-off implies that policymakers can target low unemployment or low inflation, but not both. As a result, policy makers should pay attention to this kind of relationship between these two important economic variables in applying fiscal and monetary policies in reducing any of these two variables.

Keywords: Phillips Curve, inflation, unemployment, Jordan

Introduction

Jordanian economy is among the smallest economies in the Middle East, with insufficient supplies of water, oil, and gas. The government depends heavily on all types of foreign aids due to inadequate resources, international economic crises, regional wars and instability, and local permanent economic problems such as unemployment, inflation, budget deficit, public debt, and high rate of poverty. Thus, all of these issues have

become a great challenge to government policymakers and economists. The government of Jordan has taken a number of steps in recent years to open-up its economy, control public debt, boost Foreign Direct Investment, and increase privatization. Nevertheless, the global economic slowdown and the continuous regional crises and instability have decreased the rate of Jordanian's Gross Domestic Product (GDP), impacting export, construction and the tourism sectors.

Economic growth, inflation, and unemployment are the major concerns of every economy. The main goal of macroeconomic is to have an economic growth with full employment and stable prices. Events in the three markets, which are goods and service market, financial market, and labor market affect the rate of unemployment and inflation in any economy. However, economists and policymakers are working to increase economic growth and reduce the unemployment and inflation rate in the economy.

An economist, William Phillips' showed a negative and non-linear relationship (not a law or a theory) between unemployment and wage inflation rates in the United Kingdom in the period of 1861-1957. Therefore, this relation is known as Phillips Curve (PC). In Economics, the Phillips Curve has been acknowledged clearly, that the lower the unemployment rates in an economy, the higher the rate of inflation. Also, it has been observed that there is an established tradeoff between unemployment and inflation. Similar configurations were found in other countries in 1960, which shows a precise link between inflation and unemployment. This was such that when inflation was high, unemployment becomes low, and vice-versa. Original Phillips has appeared under a determined attack by a group of economists, where some of them agreed that the Phillips Curve relationship exists only as a short-run phenomenon, but not in the long-run. Furthermore, other economists argue that there is no such trade-off relationship at all. Thus, Phillips curve trade-off relationship between unemployment and inflation was subjected to controversial debate in the past decades on whether or not a negative relationship exists.

Original Phillips curve suggests that there is a negative and nonlinear relationship between unemployment and inflation. This enables policymakers to choose between any two combination of unemployment and inflation which they desired most. However, some recent empirical studies show that the relationship between unemployment and inflation may not be in the manner proposed by PC. Also, it could be either negative or positive or negative and positive in the same period in one country.

Jordanian economy is among the smallest economies in the Middle East, with scarce resources of water, oil, and gas. Beside the regional and international crises of wars and instability, there are local and permanent economic problems such as high rate of unemployment, high rate of

inflation, budget deficit, public debt, and high rate of poverty. These factors forced the government of Jordan to take a number of steps in recent years to open-up its economy, control public debt, boost Foreign Direct Investment, and increase privatization in order to increase the economic growth and lower the rates of unemployment and inflation.

Study Objective

The main objective of this study is to investigate, test, and to make certain whether the original Phillips curve trade-off relationship exists between unemployment and inflation in the Jordanian economy over the period of 1976-2013.

Theoretical and Literature Review

Unemployment has always been a major issue for many economists in different economies, and has become an even bigger problem in the time of recession, where work has to be carried out in increasing the AD and supply side factors. Nevertheless, unemployment can be controlled to a certain limit, depending on the types and the causes of unemployment in each country.

Inflation is an upward movement in the average level of prices, while deflation is a downward movement in the average level of prices, and the price stability is between the inflation and deflation boundaries. Also, inflation could be a result of increase in the supply of money, decrease in the demand of money, and decrease in the supply of other goods and services, or any combination of these factors.

The idea of trade-off between unemployment and inflation was originated in 1958 by A.W. Phillips, who showed a negative and non-linear relationship between unemployment and wage inflation in the U.K over the period of 1861-1957 (Abel et al., 2008). As shown in figure 1, higher wage inflation means lower unemployment, and lower wage inflation means higher unemployment. However, low inflation and low unemployment are unlikely. In other words, Phillips Curve is a curve showing an inverse relationship between the inflation rate and the unemployment rate, such that the opportunity cost of more employment is more than inflation and vice versa.
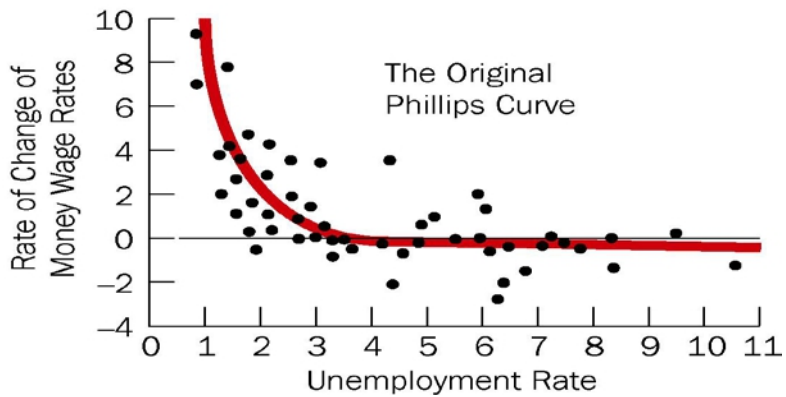
Figure 1. Original PC. U.K (1861-1957), from (Abel et al., 2008)

The theory behind original PC relationship, is that if the economy experienced a rise in Aggregate Demand (AD), it will cause an increased output as economy comes close to full employment, and this would lead to a rise in inflation (Pettinger, 2011). However, the increase in real GDP encourages firms to take more workers leading to a rise in employment, and a decline in unemployment as shown in Figure 2.

This early theoretical explanation for original PC is focused on the state of the labor market. It is based on the changes to AD, where firms must offer higher wages to obtain additional workers when unemployment rate is low. Therefore, the cost of production increases and the prices rises accordingly.
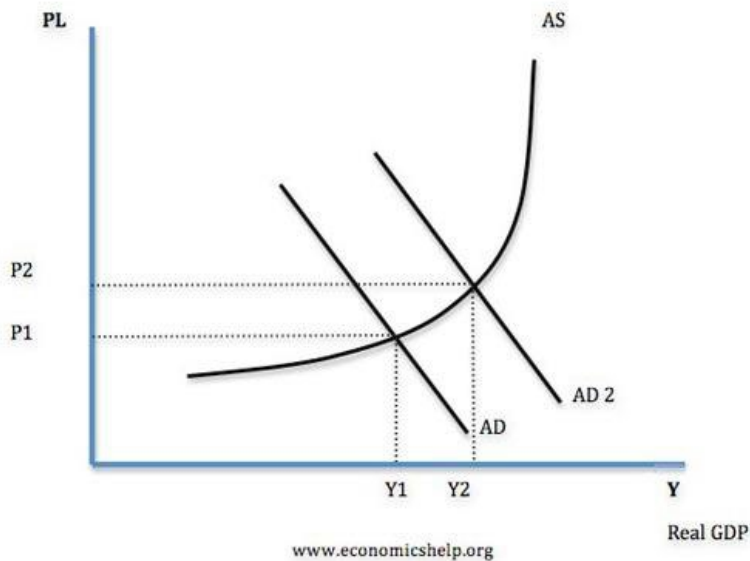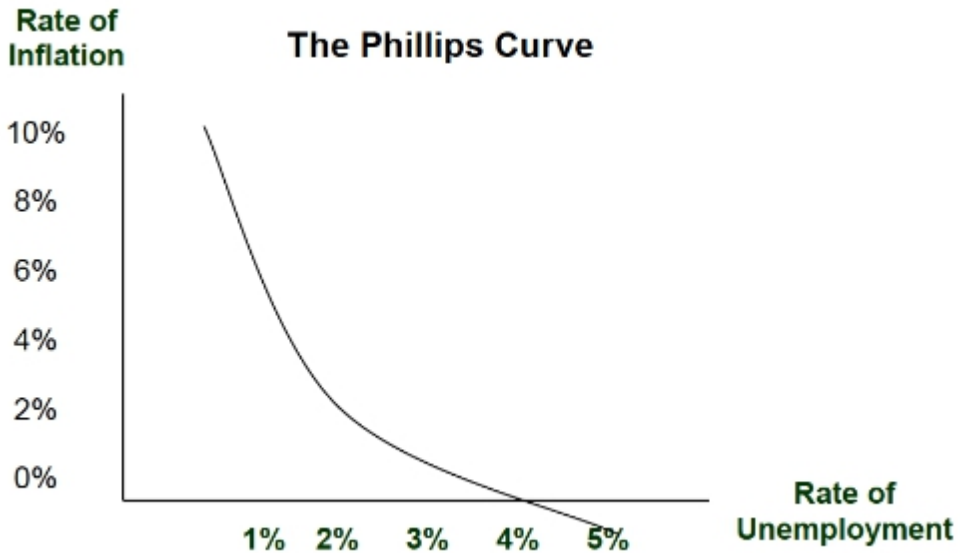

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Figure 2. Keynesian Phillips curve theory,www.economicshelp.org

Original Phillips curve suggests that policymakers could choose between the combination of unemployment and inflation. They must desire to expand AD, in such a way that they can lower unemployment rate but on the cost of higher inflation. Additionally, they could contract AD and they can lower the inflation, but on the cost of higher unemployment.

Furthermore, many nations seemed to have this negative relationship during the 1960s. Phillips curve closely fitted inflation and unemployment rates in the United States of America (USA) as shown in figure 3.

Figure 3. PC of USA in1960s, www.economicshelp.org

The standard PC shows that the growth rate of wage inflation decreases with the increase in unemployment (Startz, 2004), and can be represented by the following equation:

$$g_w = (w_{t+1} - w_t)/w_t \quad \ldots\ldots\ldots\ldots\ldots(1)$$

Where g_w is the rate of wage inflation; w_t is the wage at this period; and w_{t+1} is the wage at next period. Also, the simple PC can be defined by the following equation:

$$G_w = -\varepsilon \, (U - U^*) \quad \ldots\ldots..(2)$$

Where ε is the responsiveness measure of wages to unemployment; U is the unemployment rate; U^* is the natural rate of unemployment; and $U - U^*$ is the unemployment gap.

Suppose that the economy is in equilibrium such that stable prices and natural rate of unemployment exist, by substituting equation (1) in equation (2), we have:

$$W_{t+1} = W_t [1 - \varepsilon (U – U^*)] \quad \text{…….(3)}$$

Equation (3) shows that when $U > U^*$, the wages is falling. Thus, for wages to rise above the previous level ($W_{t+1} > W_t$), the unemployment rate must fall below the natural rate ($U < U^*$) so that PC is originally defined as trade-off between inflation and unemployment.

Phillips proposed from his empirical evidence to the policymakers to have a menu of choices they could choose from at any point along PC. This made it possible for them to target a low inflation rate or low unemployment rate, but could not have both of them low at the same time.

The simple intuition behind this is that as unemployment falls, workers are empowered to push for higher wages. Furthermore, firms try to pass this extra cost to the consumers, resulting in higher prices and inflation build-up in the economy.

The simple model of Phillips Curve framework can be represented in econometric term by the following equation:

$$INFR_i = B_o + B_1 UNER_i + \varepsilon_i \quad \text{……….(4)}$$

Where $INFR_i$ is the inflation rate of CPI in year I; B_o is the intercept coefficient (constant); B_1 is the slope coefficient (constant); $UNER_i$ is the unemployment rate in year I; and ε_i is the error term.

The relationship between unemployment and inflation has been the subjects of controversial debate between macroeconomists. Indeed, following Phillips 1958 findings, the inverse relationship between unemployment and inflation became the focal point for macroeconomic policy analysis. Most of the focus has been directed at establishing whether or not a negative relationship exists in the short run, and what this may imply for economic policies. Empirical studies in many countries have contributed to the debate on Phillips Curve trade-off relationship. Here, some studies supported the existence of Phillips Curve trade-off relationship, while other studies rejected Phillips Curve trade-off relationship as follows:

(1) Fumitaka, Furuoka (2007), **Does the Phillips Curve Really Exist? New Empirical Evidence from Malaysia.**

This paper chooses Malaysia as a case study to empirically examine the relationship between inflation rate and unemployment rate. The research methodology was conducted using three separate econometric methods to test the existence of the Phillips curve in Malaysia for the period from 1973 to 2004. They include unit root test, Johansen co-integration test, and Granger causality based on the Vector Error Correction Model (VECM) analysis. The finding of this paper is the existence of a long-run and trade-off relationship, and a causal relationship between the unemployment rate

and the inflation rate in Malaysia. In other word, this paper provides an empirical evidence to support the existence of the Phillips Curve in the case of Malaysia for the period of 1973 to 2004.

(2)   Aaron, Chicheke (2009), **Monetary Policy, Inflation, Unemployment, and the Phillips Curve in South Africa.**

The study employed the Vector Error Correction Method (VECM) to examine the linkage and causal relation between these two variables. The test was carried out for both the short run and the long run. The results showed that there is no long-run trade-off between unemployment and inflation. This confirms the demonstration of Nobel Prize winners Milton Friedman and Edmund Phelps. In other words, the Reserve Bank is not able to lower unemployment permanently by running up inflation. The causal relation runs only in one direction which is from inflation to unemployment only in the long run. Thus, in the short run, there is no causation. Therefore, the empirical findings of the present study show that there is a positive long-run relationship between inflation and unemployment. The results showed that the Phillips Curve does not exist in South Africa over the period of 1980-2008. The results suggests that there is a long run relationship between inflation and unemployment, and the monetary policy reacts more to variations in inflation compared to variations in unemployment.

(3)   Soudi, Nedjoua and Lerafeh, Taiza (2012), **Phillips curve in Algeria, Econometric Study from 2003-2011**.

This study focuses on Phillip curve and its application in the Algerian economy in order to estimate the relationship between unemployment and inflation using the standard equation of the Phillips Curve. However, this represents the relationship between the rate of inflation and the unemployment rate over the period of 2003-2011. The study methodology is based on using a graphical analysis such as trend, scatter, and regression plot of the two variables by the aids of SPSS tools to predict Phillips Curve trade-off relationship between unemployment and inflation. This is done by estimating the non-linear regression equation in the form of Box-Cox Transformations. The study shows an inverse and non-linear relationship between unemployment and inflation rate. Also, it determines the minimum rate unemployment of 0.09 that does not decline no matter how high the inflation rate.

(4) Fumitaka Furuoka, Qaiser, Munir and Hanafiah, Harvey (2013), **Does the Phillips Curve Exist in Philippines?**

The aim of this study was to examine the trade-off relationship between inflation rate and unemployment in the Philippines over the period of 1980-2010. The empirical findings of this study detect a long-run negative and a causal relationship between inflation and unemployment rate in the Philippines over the period 1980-2010. The study shows that there is an

empirical evidence for the existence of the Phillips curve in a developing economy such as the Philippines.

Research Methodology

Having done the theoretical descriptive method to investigate Phillips curve and its critique by referring to related references to explore unemployment and inflation and the relationship between these two variables, this study utilizes the following multiple approaches:

(1) A descriptive statistical method was used to analyze Jordanian unemployment and inflation, and investigate the mutual relationship between these variables in graphical approaches over the period of 1976-2013.

(2) An econometric analysis method was used to examine the economic models of the variables under study and the mutual relationship between these variables using linear regression and

non-linear regression approaches. This analysis was done in order to test and estimate Phillips Curve trade-off relationship between unemployment and inflation, and to estimate Phillips Curve on the Jordanian economy over the period of 1976-2013.

Data

The annual time series data over a thirty-eight year period from 1976 to 2013 of the selected variables of Jordanian economy were collected from the Department of Statistics (DOS) in Jordan, Central Bank of Jordan (CBJ), and international financial statistics and Global Bank data base. Jordanian inflation rate (INFR), which is the average consumer price change %, and unemployment rate (UNER) over the period 1976-2013 was also collected.

Descriptive and Graphical Analysis Approach

The mean, standard deviation, minimum values and maximum values of the inflation and unemployment of the Jordanian economy over the period 1976-2013 are shown in Table 1 below:

Table 1. Descriptive statistics

	INF	UNE
N Valid	38	38
Missing	0	0
Mean	5.8508	11.1047
Std. Deviation	5.30925	5.07215
Minimum	-.67	1.60
Maximum	25.67	19.60

Source: Descriptive statistics tests with the aids of SPSS.

Table 1 show that the mean of the inflation rate (INFR) is 5.85 percent. This means an average inflation rate of 5.85 percent annually. Inflation rate exhibiting a minimum value of -0.67 percent in 1980 and maximum value of 25.67 percent in 1989, means that the mean is closer to the minimum value. As such, most of the values for INFR are skewed to the minimum value (positive skewness). Hence, the standard deviation (Std Dev) for inflation rate is 5.31 percent which shows about 5.31 deviation of the values from the mean of 5.85.

Also, Table 1 shows that the mean of unemployment rate (UNER) is 11.11 percent. This means on the average, the mean of unemployment rate (UNER) is 11.11 percent annually. UNER exhibiting a minimum value of 1.6 percent in 1976 and a maximum value of 19.6 percent in 1993, means that the mean is almost between the minimum value and the maximum value. However, most of the values for UNI rate are not skewed to the minimum value or to the maximum value (zero skewness). The standard deviation (Std Dev) for UNIR is 5.07 which shows that about 5.07 deviation of the values from the mean is 11.11 percent.

The Phillips curve trade-off relationship between the unemployment and the inflation was examined directly using a graphical approach over the period of 1976-2013. Figure 4 shows the trend of Jordanian inflation rate and unemployment rate over the period 1976-2013. Thus, we can easily notice that there are some periods of negative relationship between unemployment and inflation. In other words, when unemployment is increasing, the inflation is decreasing in a steady and continuous manner, but when unemployment is decreasing, the inflation begins to increase.
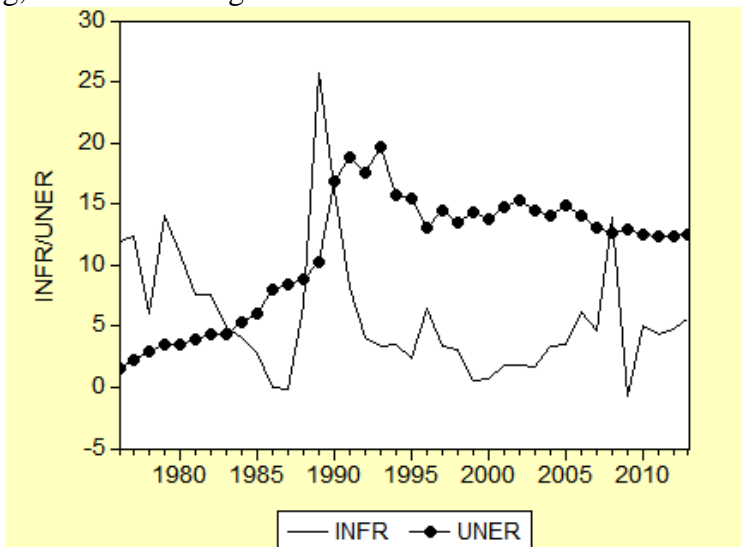

Figure 4. Inflation Rate-Unemployment Rate Trend (1976-2013), using graphical tool, SPSS.

Figure 5 below, shows the relationship between unemployment rate and Inflation rate. The fitting line is decreasing (downwards), and so, there is a negative relationship between unemployment rate and inflation rate on Jordanian economy in this period. Also, there is a trade-off relationship between unemployment and inflation during this period. Nevertheless, it can be seen clearly from figure 4, that there is a positive relationship between unemployment and inflation in many short periods, such as 1986-1889, 1994-1995, 2002-2003, and 2010-2011. This was not suggested by Phillips Curve due to supply shocks namely; oil crises, regional wars, and the liberalization policy. Hence, these could be the main reasons behind the absence of Phillips Curve in the short-run in Jordan. So it can be seen from Figure 5 that there is no single curve that fits the data in the short-run, but there were many periods showing a positive relationship between unemployment and inflation. However, this was not as suggested by the data in the long run. In fact, all modern studies distinguish between short-run and long-run relationship, and between unemployment and inflation.
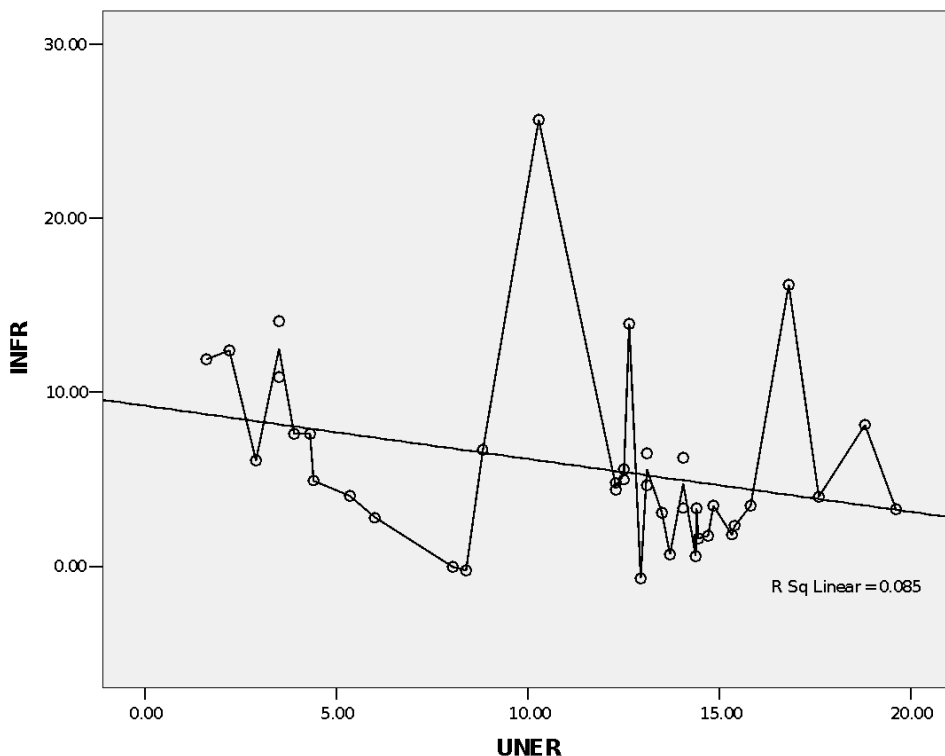

Figure 5. Inflation-Unemployment Scattered Diagram (1976-2013), using graphical tool, SPSS.

The negative relationship between unemployment and inflation are consistent with the theories between these economic variables and the theory

behind Phillips Curve. Therefore, it can be concluded that there is a Phillips Curve trade-off relationship between unemployment and inflation. Also, there is an evidence of Phillips Curve existence in Jordanian economy in the long run over the period of 1976-2013.

Econometric Analysis and Multiple Approaches
Logarithmic Non-linear Approach

Phillips Curve (PC) suggests a negative and a non-linear relationship. Therefore, to be consistent with this approach, a non-linear model should be used. By observing the pattern that represent the two variables and the residuals from the non-linear regression, we could predict whether a non-linear relationship between exists between the two variables under study.

The following original non-linear equation is used:

$$Y_i = B_0 X_i^{B1} \varepsilon_i \quad \ldots\ldots\ldots\ldots.(5)$$

Where Y_i is the independent variables; X_i is the dependent variables; B_0 is the scale (constant); B_1 is the elasticity of Y with respect to X; and ε_i is the error. If the parameters is in the form such as B or ε, the function of this non-linear relationship is f = f(x, B). And if df/dB = constant or df/dB depends only on the independent variable, then the function is linear. Otherwise, it is a non-linear function. Furthermore, if the B_1 coefficient is negative, then the relationship is negative, and if it is positive, then the relationship is positive. Also if the absolute value of B_1 coefficient is less than one, then the relationship is diminishing return; and if the absolute value of B_1 coefficient is greater than one, then the relationship is increasing return.

Non-linear regression can estimate models with arbitrary relationship between dependent and independent variables using iterative estimation algorithms. In other words, to make equation (5) a linear equation, a natural log is taken to both sides. Therefore, this gives us a linear form of the non-linear equation(6) as:

$$lnY_i = ln B_0 + B_1 lnX_i + Ln \varepsilon_i \quad \ldots\ldots..(6)$$

Where Y_i is the independent variable; B_0 is the scale (constant); B_1 is the elasticity of Y with respect to X; X_i is the dependent variable; and ε_i is the error.

Therefore, equation (6) can be rewritten in the following form:

$$y = a + bx + v \quad \ldots\ldots\ldots(7)$$

Where y= lnY_i; a = ln B_0; x = lnX_i ; b=B_1 and v is assumed to behave like an error and is equal to Ln ε_i.

Therefore, equation (7) can be rewritten as:

$$INFR = a + b UNER + v \quad \ldots\ldots\ldots(8)$$

Where INFR is the inflation rates; UNER is the unemployment rates; "a" is the scale (constant); and "b" is the elasticity of INFR with respect to UNER.

To examine the model in equation (8), least square regression tool with the aids of EVIEWS software was used in order to estimate the parameters (a & b) for solving the change in inflation based on how unemployment changes with time as expressed in the *simple linear m*odel in equation (8).

Where the null and the alternative hypotheses are:

$H_o : b = 0$

$H_1 : b \neq 0$

By estimating equation (8) in the period 1976-2013, the results are shown in Table 2 below:

Table 2. Inflation-Unemployment Logarithmic Regression

period	R-squared	Coefficient a	T-statistic of a	P-value of a	Coefficient b	T-statistic of b	P-value of b
1976-2013	0.19	2.745	6.21	0.00	-0.531	-2.81	0.008

Source: Ordinary Least Square regression, EVIEWS, researcher own tabulating.

The significance of coefficients "a" and "b" are 0.00 and 0.008 respectively, and are both less than 0.05 significant level. Also, the t-values of these coefficients are -6.17 and 15.0 respectively, and are both significant too. Thus, this means the null hypothesis of this test can be rejected. So, the alternative hypothesis of the existence of significant non-linear relationship between inflation rate and unemployment rate is accepted. This therefore indicates a good non-linear relationship between these two variables.

The predications and estimated coefficient have to be transformed to anti-log to get back to the parameters in the original non-linear equation $(Y=B_0 X^{B1} U)$.

The coefficient "b" from the least square analysis is -0.531 as shown in Table 2 which represents B_1, i.e $b=B_1$. In addition, it is negative which indicates a negative relationship between unemployment (Y) and inflation(X). Also, the absolute value of "b" is less than one, which indicates a diminishing return relationship. Thus the estimation of equation (8) is:

INFR = 11.967 – 0.531 UNER

And the original non-linear equation (11) would be:

INFR = c UNER$^{-0.531}$ = c/ UNER$^{0.531}$ = 11.967/ UNER$^{0.531}$

Where "c" is a positive constant that represents $a=\ln B_0$; and $B_{0=}11.967$ and the error term $\ln \varepsilon_i$.

Therefore, the negative non-linear relationship between unemployment rate and inflation rate in the Jordanian economy over the

period of 1976-2013 is consistent with Phillips Curve non-linear trade-off relationship between unemployment and inflation. Also, this finding is consistent with the findings of Fumitaka (2007).

Finally, this logarithm non-linear relationship between inflation and unemployment is presented graphically in Figure 6 below:
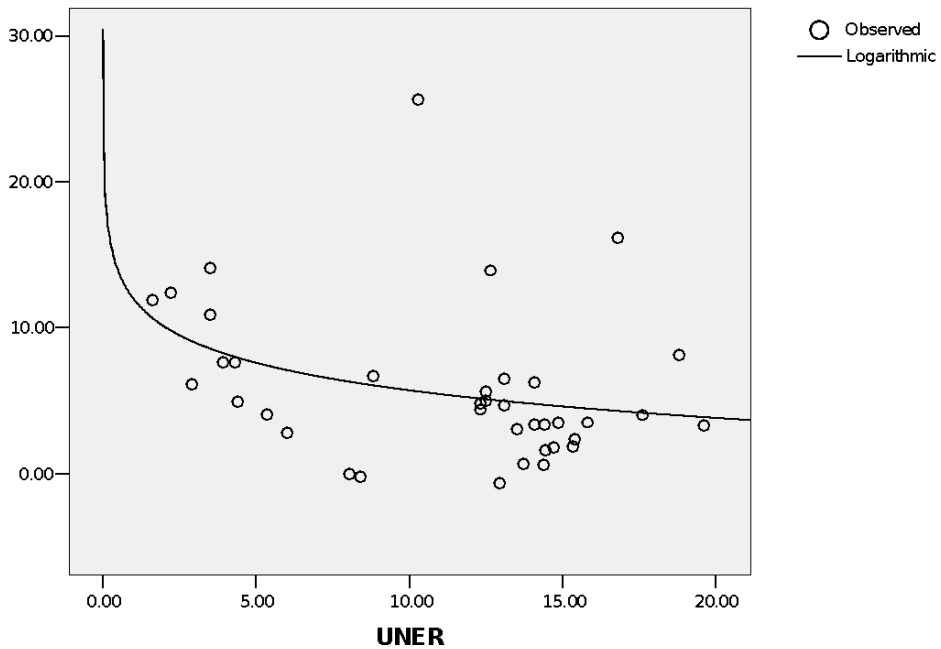

Figure 6. Inflation-Unemployment Logarithmic Relationship (1976-2013), using graphical tool, SPSS.

Inverse Non-linear Approach

A simple form of non-linear regression equation of Box-Cox Transformations is:

$$Y^{ʌ1} = a_0 + BX^{ʌ2} + u \quad \ldots\ldots\ldots\ldots(9)$$

Where Y is the independent variable; X is the dependent variable; a_0 is the scale (constant); B is
the elasticity of Y with respect to X; and u is the error. Thus:

$$X^{ʌ2} = \begin{cases} X^{ʌ2}-1/ʌ2 & \text{for } ʌ2 \neq 0 \\ Ln\ X & \text{for } ʌ2 = 0 \end{cases}$$

If $ʌ1 = ʌ2 = 1$, then the equation is linear in the form:

$$Y = a + bX + u \quad \ldots\ldots..(10)$$

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If $\kappa1 = 1$ and $\kappa2 = -1$, then the equation is non-linear in the form:

$Y = a + b(1/X) + u$ ……..(11)

Therefore, equation (11) can be rewritten as:

$INFR = a + b(1/UNER) + v$ …………(12)

Where INFR is the inflation rates; UNER is the unemployment rates; "a" is the scale (constant); and "b" is the elasticity of INFR with respect to UNER.

By using least square regression to estimate equation (12) in the period of 1976-2013, the null and the alternative hypotheses are:

$H_o : b = 0$

$H_1 : b \neq 0$

The results are shown in Table 3 below:

Table 3. Inflation-Unemployment Inverse Regression (1976-2013)

Period	Coefficient "a"	T-statistics of "a"	Coefficient "b"	T-statistics of "b"	P-value of "a"	P-value of "b"
1976-2013	3.779	3.09	15.166	2.28	0.00	0.028

Source: Ordinary Least Square regression, EVIEWS, researcher own tabulating.

The coefficients "a" and "b" from the least square analysis in Table 3 are 3.779 and 15.166. They are both positive, and indicates a diminishing return relationship which is a negative relationship between unemployment (X) and inflation(Y). Thus, the estimation of equation (12) is:

$INFR = 3.779 + 15.166(1/ UNER)$

Hence, this represents an estimated non-linear Phillps Curve, where the lowest estimated limit of inflation rate is 3.779% no matter how high the unemployment rate was. The slope of equation (12) is given as:

$dy/dx = -b/ \mu_u^2 = -15.166/11.1097^2 = -0.13$

Where μ_u is the mean of unemployment rate, and - 0.13 means that one point increase in the unemployment rate will cause 0.13 point decrease in the inflation rate. Also, the elasticity of inflation with respect to unemployment (E_{iu}) is given as:

$E_{iu} = -b/ \mu_i \mu_u = -15.166/11.1097 \times 5.85095 = \times 5.85095 = -0.23$

where μ_i is the mean of the inflation rate, and -0.23 means that 10% increase in the unemployment rate will cause 2.3% decrease in the inflation rate on an average.

Therefore, it can be concluded from the inverse non-linear approach that there is a negative and a non-linear relationship between unemployment and inflation in the suggested period.

Furthermore, to estimate the lowest limit of unemployment rate and the elasticity of inflation with respect to unemployment, the least square regression is used to estimate equation (12) again during the period of 1976-

2013. But in this case, Y is the independent variable (unemployment rate) and X is the dependent variable (inflation rate) as shown in equation (12) below:

$$UNER = a + b(1/INFR) + u \quad \ldots\ldots(12)$$

The results of estimating equation (12) are shown in Table 4 below:

Table 4. Unemployment-Inflation Inverse Regression (1976-2013)

Period	Coefficient- "a"	T- statistics of "a"	Coefficient- "b"	T- statistics of "b"	P-value of "a"	P-value of "b"
1976-2013	11.077	13.067	0.924	1.019	0.00	0.031

Source: Ordinary Least Square regression, SPSS, researcher own tabulating.

The coefficients "a" and "b" from the least square analysis in Table 4 are 11.077 and 0.924. They are both positive, which indicates a diminishing return relationship. Thus, there was a negative relationship between unemployment (X) and inflation (Y). The estimation of equation (12) is given as:

$$UNIR = 11.077 + 0.924(1/INFR)$$

Which represents an estimated non-linear Phillps Curve, where the lowest estimated limit of unemployment rate is 11.077% no matter how high the inflation rate is. The slope of equation (12) is given as:

$$dy/dx = -b/\mu_i^2 = -0.924/11.1097^2 = -0.01$$

where μ_i is the mean of inflation rate, and - 0.01 means that one point increase in the inflation rate will cause 0.01 point decrease in the unemployment rate. Also, the elasticity of unemployment with respect to inflation (E_{ui}) is given as:

$$E_{ui} = -b/\mu_i \, \mu_u = -0.924/11.1097 \times 5.85095 = \times 5.85095 = -0.02$$

where μ_u is the mean of unemployment rate, and -0.02 means 10% increase in the inflation rate will cause 0.2% decrease in the unemployment rate on an average.

Vector Error Correction Model Approach

It is used to explore and investigate the relationships between the economic variables under study in order to model the relationship between these variables using unit root tests, co-integration tests, Vector Error Correction Tests, and Model efficiency tests in the Jordanian economy over the period of 1967-2013.

Testing for Stationary

The assumptions of the Classical regression model necessitate that both the dependent and independent variables must be stationary and the

errors have a zero mean and finite variance. Non-stationary variables results in spurious regression. In other regression, the data through the regression equation (8) Augmented Dickey-Fuller unit root test and Phillips-Perron unit root test being run to test for unit root for the two variables with intercept and trend, and without intercept and trend (none) are at significant 5% level. However, the result is shown in Table 5 below.

Table 5. Inflation-Unemployment unit root test

	Augmented Dickey-Fuller unit root test				Phillips- Peron unit root test			
SERIES	t-statistic with intercept	t-statistic with trend & intercept	t-statistic without trend & intercept	No. of differential	t-statistic with intercept	t-statistic with trend & intercept	t-statistic without trend & intercept	No. of differential
INFR (INF RATE)	--3.40 (-2.94)	-3.50 (-3.53)	-2.17 (-1.95)	Level	-3.66 (-2.94)	-7.77 (-3.53)	-2.32 (-1.95)	Level
	-5.05 (-2.94)	-4.97 (-3.54)	-5.13 (-1.95)	1st difference				
UNER (UNE RATE)	-1.91 (-2.94)	-1.23 (-3.53)	0.13 (-1.95)	Level	-1.91 (-2.94)	-1.28 (-3.53)	0.09 (-1.95)	Level
	-3.12 (-2.94)	-3.55 (-3.53)	-3.07 (-1.95)	1st difference	-5.35 (-2.95)	-5.57 (-3.53)	-5.27 (-1.95)	1st difference

Note: The number in the parenthesis ( ) is the 5% critical value.
Source: unit root tests, EVIEWS, researcher own tabulating.

Table 5 shows that the inflation rate series is not stationary at its level, but it is stationary at first difference for Augmented Dickey-Fuller test. Consequently, it is stationary at its level for Phillips-Peron test. The unemployment rate series is stationary at first difference for Augmented Dickey-Fuller test and is stationary at the first difference for Phillips-Peron test. Figure 7 and figure 8 clearly show the differences in trends with non-stationary and with stationary inflation rate and unemployment rate series.
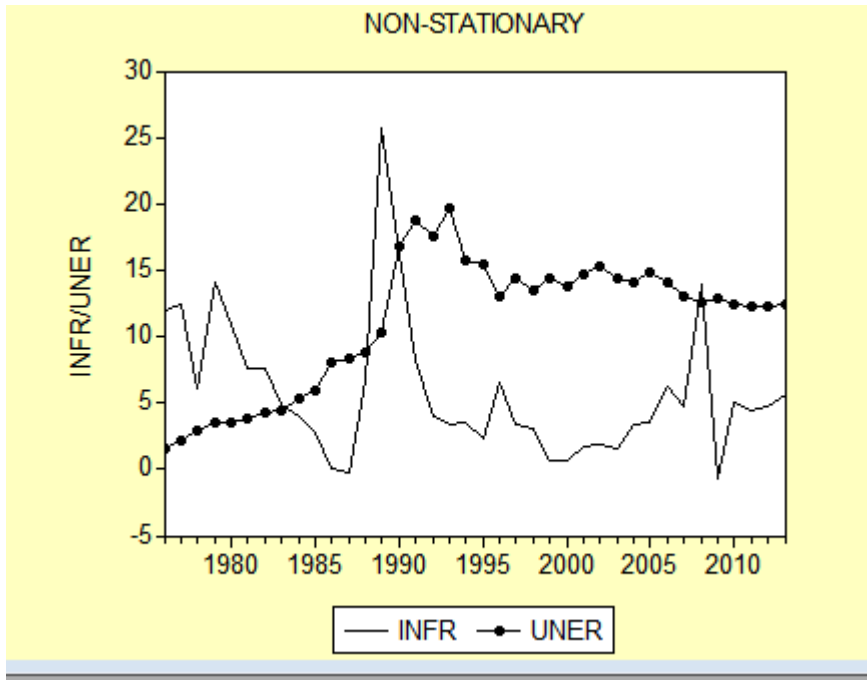
Figure 7. Inflation-Unemployment non-stationary Tend at level, using graphical tool, SPSS.
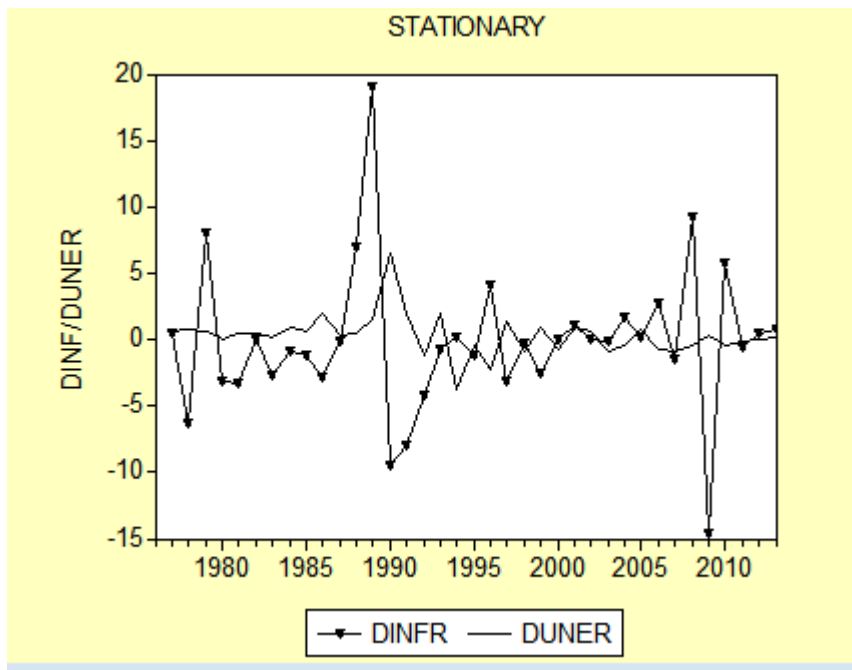

Figure 8. Inflation-Unemployment Stationary Tend at first difference, using graphical tool, SPSS.

Co-integration Test

Since both inflation rate and unemployment rate series are not stationary at level, but are stationary at first difference for Augmented Dickey-Fuller test and for Phillips- Perron test, co-integration test is required to examine the co-movement of the variables in the long-run. The results of Johansen co-integration test for inflation rate and unemployment rate is shown in Table 5 below:

Table 5. Inflation-Unemployment Johansen co-integration test

H_0	Trace statistic	Max. Eigenvalue Statistic
None(R=0)	22.83044 (15.41)	19.32874 (14.o7)
At most1(R≤1)	3.501700 (3.76)	3.501700 (3.76)

Terms in ( ) indicates 5% level critical value
Source: Johansen co-integration test for INFR and UNER, EVIEWS, researcher own tabulating.

The result in Table5 shows that the Trace statistic and the Max. Eigen value statistic are both bigger than the 5% level critical value. In addition, the null hypothesis of no co-integration (r=0) on both trace test and maximum Eigen value test between inflation rate and unemployment rate can be rejected at 5%. Also, the null hypothesis of no co-integration (r≤1) could not be rejected at 5% level, meaning that the Trace test and the Max. Eigen value test both indicates one co-integration equation at 5% level.

Vector Error Correction Tests

Having established the existence of co-integration between variables series, and that variables are sharing a common (same stochastic) trend so that they are linked by some long-run equilibrium relationship. Therefore, Vector Error Correction (VEC) Tests can be carried out in order to estimate the model in equation (8) below:

$INFR_i = B_o + B_1 UNER_i + \varepsilon_i$ ………(8)

The estimation of equation (4) by VAR test in the period of 1967-2013 is given as:

$INFR_i = 0.04 - 0.672 UNER_i$ ……….(13)

Therefore, there is a negative relationship between inflation and unemployment which is consistent with the macroeconomic theory. This is also supported by the findings from the graphical approach, Logarithm approach, and inverse approach which are discussed earlier in this study. In addition, this study is consistent with the findings of the empirical studies (Soudi and Lerafeh, 2012), and it shows that the non-linear

relationship of Phillips Curve exists in Jordanian economy over the period of 1976-2013.

Model Efficiency Tests

More diagnostic tests can be carried out to verify and confirm the model efficiency and the model specifications of the model in equation (8) which is used in the VECM test. This is done such that the model should have a normality, no Hetroscedasticity, and no autocorrelation (serial correlation) in order to end up with a good conclusion and interpretation as follows:

- Normality Test. The residual has to be normally distributed with zero mean and a constant variance, to detect the misspecification problems through observing the residuals using the significant statistic test in Table 6.

Table 6. Normality Statistic Test
VEC Residual Normality Tests

Component	Jarque-Bera	Df	Prob.
1	51.18685	2	0.0000
2	0.806637	2	0.6681
Joint	51.99349	4	0.0000

Source: Normality Statistic Test, EVIEWS, researcher own tabulating.

From Table 6, one of the *p-value* is 0.00 which is statistically not significant. However, we do not accept the null hypothesis of normality assumption. Therefore, we have some doubt about the normality of the residual distribution, but we still accept the model.

- Hetroscedasticity Test. Hetroscedasticity or unequal variances, arises if different error terms do not have identical variances. Thus, the consequence of Hetroscedasticity is that the variance of parameter is not a minimum, and it leads to model inefficiency. Table 7 shows the results of VEC Residual Hetroscedasticity Test, where the p-value is 0.9104 which is statistically significant and greater than 5% (0.05) significant level. As a result, we cannot reject the null hypothesis of no Hetroscedasticity assumption. Therefore the model is accepted.

Table 7. Residual Hetroscedasticity Test
VEC Residual Hetroscedasticity Test

Chi-square	Df	Prob.
23.00451	18	0.1904

Source: Residual Hetroscedasticity Test, EVIEWS, researcher own tabulating.

-- Autocorrelation Test. The time series data of economics is usually threatened by an autocorrelation or serial correlation, where two or more consecutive error terms are related. This occurs as a result of either excluded variables or the use of incorrect functional form. The consequence of autocorrelation is that variance of the parameter is no

longer the smallest, and the OLS remains unbiased. However, it becomes an inefficient model. Table 8 shows the results of VEC Residual Serial Correlation LM Test, where the p value is 0.6237 which is statistically significant and greater than 5% (0.05) significant level. Therefore, we cannot reject the null hypothesis of no autocorrelation assumption. Therefore the model is accepted.

Table 8. Residual Serial Correlation LM Test

VEC Residual Serial Correlation LM Test

Lags	LM-Stat.	Df	Prob.
1	2.617656	4	0.6237

Source: Residual Serial Correlation LM Test, EVIEWS, researcher own tabulating.

Conclusion and Recommendation

Unemployment and inflation have always been major issues for many economists and policies in different economies. The implemented economic reforms by Jordanian government, such as open trade, privatizing and eliminating subsides have attracted foreign investment. Nevertheless, regional and global economic crises have affected and depressed Jordanian economic growth badly.

Phillips Curve describes the negative and non-linear relationship between unemployment and inflation. This was such that policymakers can choose a point on Phillips Curve with lower inflation and higher unemployment rate or vice versa, In other words, the trade-off suggested by Phillips Curve in 1958 implies that policymakers can target low unemployment or low inflation, but not both. Here, Keynesians emphasized on targeting low unemployment (jobs creation), while monetarist emphasized on targeting low inflation (price stability). The theory behind Phillips Curve based on a negative relationship between unemployment and economic growth, and a positive relationship between inflation and economic growth, i.e. increased inflation, results in increased job opportunities which ultimately lead to economic growth in the country. However, many empirical studies have shown that either a positive or negative mutual relationship exists between unemployment and Inflation.

A descriptive and econometric analysis were carried out in this study using graphical method, VECM, and non-linear regression tests with the aids of the SPSS and EVIEWS techniques to examine and predict the mutual relationship between unemployment and inflation. This helps to show whether an existence of Phillips Curve occurs in Jordanian economy over the period of 1976-2013. The findings of this study show a negative relationship between unemployment and inflation; and the lowest limits of inflation and unemployment were estimated to be 3.779% and 11.077% respectively. Also, the elasticity of inflation with respect to unemployment

and the elasticity of unemployment with respect to inflation were estimated to be -0.23% and -0.02% respectively. Therefore, this study provides a strong empirical existence of Phillips Curve on Jordanian economy over the period of 1976-2013. This trade-off implies that policymakers can target low unemployment or low inflation but not both. Here, Keynesians emphasized on targeting low unemployment (jobs creation), while monetarist emphasized on targeting low inflation (price stability).

The trade-off relationship between unemployment and inflation rate as proposed by William Phillips in 1958 has been an important foundation in macroeconomic policy. Nevertheless, many recent empirical studies show that this relationship could be positive. Majority of these explorations were founded mainly in developed economies. This empirical analysis is to extend this debate and evaluate this relationship in a developing economy. The findings of this thesis clearly results in a conclusion that there is an inflation-unemployment trade-off in Jordan. In other words, empirical findings provided an additional proof that Phillips Curve could exist in a developing country such as Jordan.

It is recommended that governmental economists and policy makers should use fiscal and monetary policies in order to obtain better control and stabilize inflation rate. This in turn may help stabilize unemployment rate to some extent, ceteris paribus. Also, it is recommended that the Government and its institutions should put more effort to simplify and ease the task of data collection by researches in order to encourage them, and save their time and effort. However, this helps and benefits policy makers and the nation as a whole.

References:
Aaron, Chicheke (2009), Monetary Policy, Inflation, Unemployment and the Phillips Curve in South Africa. University of Fort Harc,www.contentpro.seals.ac.za.
Abel , A. ben, B. and Dean .c (2008), Macroeconomics, 6[th]ed, Pearson Addison-Wesley, chapter 12,USA,www.amazon.com.
Al-zeaud, Hussien (2013), The Trade-Off between Unemployment and Inflation Evidence from Causality Test for Jordan, International Journal of Humanities and Social Science, Vol.4 NO.4, February 2014.
Awad,Talib (2001), The Problem of Unemployment in Jordan, master thesis, University of Jordan, Amman, Jordan, www.google.Jo.
Bollerslev, T (1986), Generalized Autoregressive Conditional Heteroscedasticity, Journal of Econometrics, 31, Pages 307-327.
Burger, P. and Marinkov, M. (2006), The South African Phillips Curve: How Applicable is the Gordon model? South African Journal of Economics 74(2), 2006, pp. 172-189.

Central Bank of Jordan, annual reports, press the central bank, 2000-2013.
Central Bank of Jordan, Jordan, Monthly Statistical Bulletin, Central Bank of Jordan Press, Amman.
Central Bank of Jordan. The Annual Report 2003 and The Monthly Statistical Bulletin, several issues.
Central Bank of Jordan database: (www.cbj.gov.jo(.
Eldiri, Moh'd (2004), The Trade-off Between Inflation and Unemployment in Jordan, Econometric Approach Study (1967-2001), master thesis, University of Jordan, Amman, Jordan.
Engle Robert F and C.W.J. Granger (1987), Co-Integration and Error Correction: Representation, Estimation and Testing, Econometrical, 1987, pp 251-276.
77
Fumitaka, Furuoka.Qaiser, Munir. and Hanafiah, Harvey (2013), Does the "Phillips Curve" Exist in Philippines? Econometric Bulletin, Vol 33. No.3, PP2001-20162013.
Fumitaka, F (2007), Does the Phillips Curve Really Exist? New Empirical Evidence from Malaysia. Economics Bulletin, Vol. 5, No. 16, 2007, pp. 1-14.
Girijasankar, Mallik and Anis, Chowdhury (2001), Inflation and Economic Growth: Evidence from South Asian Countries, University of Western Sydney, www.uws.edu.au.
Greene.W (1993), 2nd ed, Asimon & Schuster company, New Jersey, USA.
Granger, C. and New bold, P. (1974), Spurious regressions in econometrics, Journal of Econometrics 2, 111-120.
-Hettinger, T (2011).Trade- off between unemployment and inflation, economic help organization, UK. www.economichelp.org ,21 Nov 2011.
Hussain, S (2011), Inflation and economic growth: Evidence from Pakistan, Bahauddin Zakariya University, Pakistan.
Khalid, Zaman. Muhammad, Mushtaq, Khan.Mehboob , Ahmad and Waseem, Ikram (2011), Inflation, Unemployment and the NAIRU in Pakistan (1975-2009), International Journal of economics and finance,Vol.3,No.1,2011.
Kreishan, F (2011), Economic growth and unemployment, An imperial analysis, Department of economics, Al-Hussin Bin Talal University, Jordan.
Makinnon James J (1991), Critical Values for Co-integration Test in Long-Run Relationships: Reading in Co-integration, Oxford University Press, 1991, pp 267-276.
Olanipekun, D and Akeju, K (2014), Unemployment and economic growth, Ekiti State University, Nigeria.
Phillips, P. C. B. & Perron, P. (1988), Testing for a unit root in times series regression. Biometrical, 75, 335-446.

Sarel, Michael (1995) ,Nonlinear Effects of Inflation on Economic Growth, Workin Paper WP/95/56, May, IMF Washington.

Starz, D (2004), Macroeconomics, The McGraw-Hill companies, USA.

Soudi, Nedjoua and Lerafeh, Taiza (2012), Phillips curve in Algeria, Econometric Study 2003-2011, University of Muhamad abu-deyaf, Almaseelah, Algeria, www.docstoc.com.

Sweidan, Osama (2004), Does inflation harms economic growth? An econometric analysis for period 1970-2000, International Journal of Applied Econometric and Quantitative Studies, vol.1., No.6, 2004.

Sweidan, O.D. (2004). Does Inflation Harm Economic Growth in Jordan, an econometric analysis for the period 1970-2000, International Journal of Applied Econometric and Quantitative Studies, vol.1-29 (2004).

Umair, M and Ullah , R (2013), Impact of GDP and inflation on unemployment rate: A study of Pakistan economy in 2000-2010, University of Peshawar, Pakistan. IRAMA Journal, Vol.2 Issue.2, June 2013.