Unemployment and Inflation in Malaysia: Evidence from Error Correction Model

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Abstract

The negative association between unemployment and inflation is known as the Phillips Curve because the trade-off relationship between these two variables was first pointed out by William Phillips in 1958. For several decades, the Phillips Curve has been an important tool for macroeconomic policy formulators in various countries. Considering the fact that the majority of the studies on the Phillips Curve have been done in the context of the developed economies, this study focuses on Malaysia and aims to empirically analyze the relationship between unemployment rate and inflation rate in a developing country. The main finding of the current inquiry is that there existed an equilibrium relationship between unemployment rate and inflation rate in Malaysia. In other words, the results of this study support the validity of the Phillips Curve hypothesis.

Keywords: unemployment, inflation, Malaysia
JEL classification: E52, E24, J3

1   Introduction

In 1958, William Phillips published his seminal paper entitled "The Relationship between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom 1861 – 1957". According to Phillips, there existed a strong negative association between unemployment and inflation in the country during the observation period. This trade-off relationship discovered by Phillips is now known as the "Phillips Curve".

Despite some criticisms of the basic tenets of the Phillips Curve, the hypothesis remains one of the most important foundations for macroeconomics. Since 1958 till the present time, numerous academic inquiries have been done on the relationship between unemployment and inflation in various countries. As Hart (2003, p.108) observed, "The Phillips curve still plays a prominent role in macroeconomic theory and associated empirical work".

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The basic theoretical foundations of the Phillips Curve can be understood by using the concept of labour demand and supply. If labour demand is greater than labour supply, the excessive demand for labour can put upward pressure on the wage rate, which will cause high inflation in the country. In this situation, it would be easy for workers to find employment and the unemployment rate would remain at a low level. By contrast, if labor supply exceeds labour demand, the surplus of labour supply would push the wages down, which would result in a lower inflation rate in the country. At the same time, with the excessive labour supply, it would be difficult for workers to find job, and unemployment would be at a high level.

In other words, during the years of economic boom, companies would try to increase their production volumes by employing more workers. During these economic upturns, low unemployment would co-exist with high inflation. On the other hand, during economic recessions, companies would try to decrease their production volumes by decreasing the number of workforce. In such a situation, high unemployment would be accompanied by low inflation.

Besides providing a solid theoretical foundation the Phillips Curve hypothesis has important policy implications. Price stabilization is one of the important policy targets of central bank in any country, and it can be achieved through controlling inflation rate. Central bank tends to formulate and conduct the monetary policy with the aim to keep inflation as low as it is possible. However, assuming that there exists an inverse relationship between inflation and unemployment, achieving a low inflation rate would be possible when or if the unemployment rate is high. This means that central bank will face a serious dilemma of whether to choose a combination of low inflation and high unemployment or vice versa.

The problem of high unemployment is one of the most onerous domestic economic and political issues in any country. High unemployment may prompt political leaders to oppose central bank's initiatives aimed at price stabilization if these initiatives exacerbate unemployment. In other words, central bank and political leaders may have different opinions about the proposed price stabilization policies, which could prevent the policy makers from introducing decisive economic measures.

Considering important implications of the Phillips Curve hypothesis the current study aims to examine whether there existed the trade-off relationship between unemployment and inflation in Malaysia and employs several econometric techniques for this purpose. This article consists of five sections. Following this introduction, Section 2 gives a brief review of literature on the Phillips Curve hypothesis. Section 3 offers information on the unemployment rate and the inflation rate in Malaysia over the period 1975–2004. Research method and data used in this study are explained in Section 4, and the empirical results are reported in Section 5. Section 6 concludes.

2   Literature review

For several decades, the Phillips Curve remains an important criterion and a guiding principle for macroeconomic policy formulators. As Islam et al. (2003, p.107) noted, "In the 1960s and 1970s, the Phillips Curve was used as an important macroeconomic policy tool in the developed as well as less developed countries. It acted as a reminder for the macroeconomic policy formulators and the governments how far they were able to push down inflation rate or unemployment rate without unduly risking the other because of the trade-off relationship between these two key macroeconomic variables".

There exists a vast body of literature on the Phillips Curve. Research studies on the topic began appearing as early as in the 1960s. Samuelson and Solow (1960) examined the relationship between unemployment and inflation in the context of the United States economy and concluded that there had existed an inverse relationship between these two macroeconomic variables. A significant contribution to the research on the Phillips Curve was made by Solow (1970) and Gordon (1971) who confirmed the existence of a negative trade-off relationship between unemployment and inflation in the United States using macroeconomic data for both the pre-1970s and the post-1970s periods. The studies by Solow and Gordon have been known as the "Solow-Gordon affirmation" of the Phillips Curve.

Despite a solid theoretical foundation and the availability of numerous empirical studies that have confirmed the validity of the Phillips Curve, there exist criticisms and doubts regarding the soundness of the hypothesis. As Islam et al. (2003, p. 107) remarked, "Since its inception, the Phillips Curve hypothesis has been open to debates". For example, such prominent economists as Friedman (1968) and Phelps (1967) refuted the existence of the trade-off relationship between unemployment and inflation. They both conceded that a negative relationship between unemployment and inflation could be in evidence but only in the short run. In the long run, unemployment rate would conform to a vertical pattern and the trade-off relationship between the two variables would cease to exist. A more recent study by Cashell (2004) supported this argumentation. The researcher maintained that in the long run, unemployment tends to move towards an equilibrium level, which is dubbed as the natural rate of unemployment or the "non-accelerating inflation rate of unemployment" (NAIRU).

Robert Lucas (1976), a prominent economist and a representative of the Chicago economic school, argued that the trade-off relationship between unemployment and inflation may exist only if the workers do not expect that the policy makers could create an artificial situation of high inflation combined with low unemployment. Otherwise, if the workers can foresee an impending high inflation they would demand a wage increase. In such a case, high unemployment and high inflation would co-exist, which

contradicts the Phillips Curve hypothesis. This line of argumentation is known as the "Lucas critique" of the Phillips Curve.

The thorough and systematic criticism of the Phillips Curve done by Lucas led to a loss of interest in the topic among the academicians. As Debelle and Vickery (1998, p. 384) put it, "The Phillips Curve fell into a period of neglect in academic circles during the 1980s, while remaining an important tool for policy makers". However, in the 1990s, there occurred a revival of interest in the Phillips Curve hypothesis, and it once again became "the subject of intensive debate (for example, the symposium in the Journal of Economic Perspectives)" (Debelle & Vickery, 1998, p. 384).

To reflect this renewed interest, King and Watson's (1994) study examined the existence of the Phillips Curve in the context of the U.S. economy using the post-war macroeconomic data. The findings of the study provided empirical support to the existence of the trade-off relationship between unemployment and inflation in the United States. As King and Watson (1994) pointed out, the presence of the inverse relationship between unemployment and inflation could be detected if the long-run and the short-run noises are eliminated from the data. A study by Hogan (1998) tested the Phillips Curve hypothesis using the U.S. macroeconomic data over the period 1960 – 1993. The findings of the study supported the existence of a significant and negative relationship between unemployment and inflation although the traditional Phillips Curve seemed to over-predict the rate of inflation.

Recent methodological innovations allow a more thorough examination of the Phillips Curve hypothesis. For example, in some research studies, panel data analysis has been used to test the existence of the "common" Phillips Curve in different countries over the same period of time. One of such studies done by DiNardo and Moore (1999) employed the panel data analysis, the method of Ordinary Least Squares (OLS) and the Generalised Least Squares (GLS) to investigate the Phillips Curve in the context of the developed economies and selected 9 OECD (Organization for Economic Co-operation and Development) member countries. The findings of the study confirmed the existence of the "common" Phillips Curve in all these countries. As DiNardo and Moore (1999, p. 19) concluded, "In sum, we believe that our results show a remarkable robust relationship between relative inflation and relative unemployment".

Another study that employed the panel data analysis to examine the Phillips Curve hypothesis was done by Turner and Seghezza (1999). It focused on 21 OECD member countries over the period from the early 1970s to 1997. To analyze the pooled data, the researchers used the method of Seemingly Unrelated Estimation (SURE) rather than the OLS. Based on the findings, Turner and Seghezza concluded that there was a "strong support" for the existence of the "common" Phillips Curve among the 21 OECD member countries.

Academic inquiries on the Phillips Curve hypothesis in the context of the Malaysian economy are still lacking. An empirical research on the relationship between inflation and unemployment in Malaysia was done by Furuoka (2007) who examined the unemployment gap, which is the difference between the natural rate of unemployment and the actual rate of unemployment. The study detected the presence of a long-run equilibrium and a causal relationship between inflation and unemployment in the country.

Considering the important political and economic implications and the fact that the majority of the previous academic inquiries on the Phillips Curve have been done in the context of the developed economies, the present paper chooses Malaysia as a case study to analyse the relationship between unemployment and inflation.

3   Unemployment Rate and Inflation Rate in Malaysia

Unemployment rate in Malaysia was above 5 per cent in the 1970s (see Figure 1). In the beginning of the following decade, i.e., in 1981 and 1982, it fell below the 5 per cent level. From 1983, the unemployment rate kept increasing until it reached its peak of 8.7 per cent in 1987. Starting from 1988, the reverse trend was in evidence. Due to the economic boom in the country the unemployment rate was shrinking and, in 1997, it amounted to 2.6 per cent. From 1998 to 2004, the unemployment rate in Malaysia remained at a moderate level of approximately 3.5 per cent.
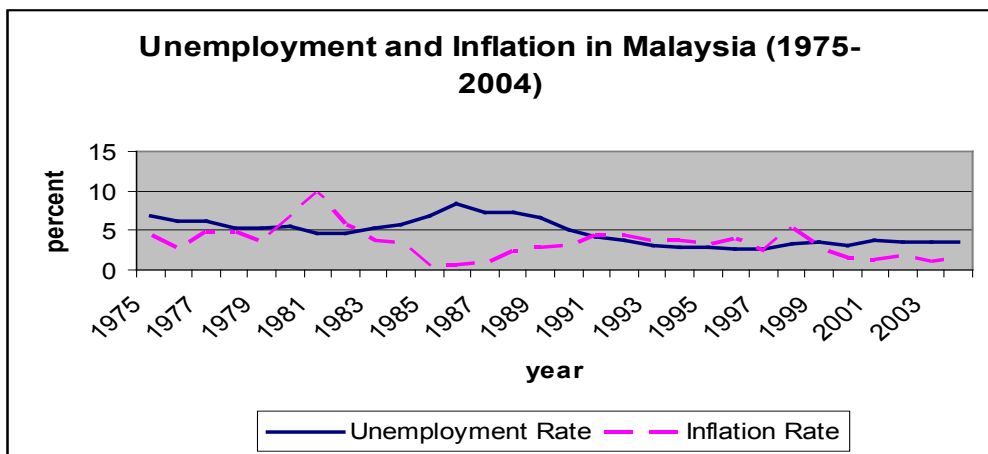
Source: NEDA (2009), DOS (2006) and ADB (2007)

Figure 1 Unemployment and inflation in Malaysia (1975 – 2004)

As to the inflation rate, there have been greater fluctuations between 1975 and 2004 compared to the unemployment rate in the country over the same period (see Figure 1). In the second half of the 1970s, the inflation rate was approximately

4 per cent. In 1980, it reached 6.6 per cent, and further increased to 9.7 per cent in 1981. Beginning from 1982, the inflation rate kept decreasing until it amounted to less than 1 per cent in 1986. In the first half of the 1990s, the inflation in the country remained stable at approximately 4 per cent. The Asian economic crisis that started in 1997 triggered the inflation rate in Malaysia which reached 5.2 per cent in 1998. Between 2000 and 2004, there was some stabilization in the inflation rate fluctuations and the inflation rate remained at approximately 1.5 per cent. It should be noted that between 1975 and 2004, both the inflation rate and the unemployment rate in Malaysia were relatively low. Thus, the average annual inflation rate was 3.37 per cent, while the average unemployment was 4.76 per cent.

4   Data and Methods

This study uses the Error Correction Model (ECM) analysis to test the Phillips Curve hypothesis and to examine the relationship between unemployment rates and inflation rates in Malaysia for the period of 1975 – 2004. The annual data for unemployment rate and inflation rates for these countries are obtained from National Economic and Development Authority (NEDA), Philippines (2009), the Department of Statistics (DOS), Malaysia (2006) and the Asian Development Bank (ADB) (2007).

Three separate econometric tests will be conducted, i.e., (1) unit root test, (2) Johansen cointegration test, and (3) Error Correction Model. In order to test the simple Phillips Curve, the following equation can be used:

$$IFR_t = a_0 + \gamma_1 UER_{t-1} + \varepsilon_t \tag{1}$$

where α_0 is a constant, γ_1 is the slope coefficient, IFR_t is inflation rate in Malaysia in the year t, UER_t is unemployment rate in Malaysia in the year t, and ε_t is the error term. Support for the Phillips Curve hypothesis would require a negative and significant coefficient for the unemployment rate, i.e. $\gamma_1 < 0$.

The current paper estimates the "augmented Phillips Curve" rather than the simple Phillips Curve. Therefore, the equation could be expressed as:

$$\Delta IFR_t = a_0 + \sum_{i=1}^{n} \beta_i \Delta IFR_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta UER_{t-i} + \varepsilon_t \tag{2}$$

There are three stages in which the Phillips Curve is tested in this paper. In the first stage, a unit root test is used to examine the stationarity of the data sets. According to Gujarati (2003), the time series data is stationary if its mean and variance are constant over time. The current study uses the augmented Dickey-Fuller (ADF) unit root test

to examine the stationarity (Dickey & Fuller, 1979, 1981). The ADF test is based on the following regression:

$$\Delta y_t = \mu + \beta_{t-i}\, t + \sum_{i=1}^{n} \gamma_i \Delta \gamma_{t-i} + \varepsilon_t \tag{3}$$

where t is the linear time trend, μ is a constant, Δ is the difference operator, and ε_t is the error term. The ADF test tends to be sensitive to the choice of lag length n which is determined by minimizing the Schwarz information criterion (SIC) (Schwarz, 1978).

In the second stage, this study examines the implications of equation (1). For this purpose, the OLS regression model could be used provided that the variables are integrated of order zero, $I\,(0)$. On the other hand, if the variables are integrated order one, $I\,(1)$, Johansen cointegration test (Johansen, 1988, 1991) could be used to check the cointegrating relationship between the variables. The variables are considered cointegrated if there is a long-run equilibrium relationship between them (Gujarati, 2003). The Johansen co-integration test is based on a maximum likelihood estimation of the K-dimensional Vector Autoregressive (VAR) model of order p,

$$Z_t = \mu + A_1 \Delta Z_{t-1} + A_2 \Delta Z_{t-1} + \ldots\ldots + A_{k+1} \Delta Z_{t-p+1} + \varepsilon_t \tag{4}$$

where Z_t is a vector of stochastic variables, μ is a vector of constants, A_t is matrices of parameters, and ε_t is a vector of the error terms. The model could be transformed into an error correction form:

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots\ldots \Gamma_{k+1} \Delta Z_{t-p+1} + \pi Z_{t-1} + \varepsilon_t \tag{5}$$

where π and $\Gamma_1 \ldots \Gamma_{k+1}$ are the matrices of the parameters. On the other hand, if the coefficient matrix π has reduced rank $r < k$, then the matrix can be decomposed into $\pi = \alpha\beta'$. The Johansen cointegration test involves testing for rank of the π matrix by examining whether the eigenvalue of π is significantly different from zero. There could be three conditions: (1) $r = k$, which means that Z_t is stationary at levels, (2) $r=0$, which means that Z_t is the first differenced Vector Autoregressive, (3) $0<r<k$, which means that there exist r linear combinations of Z_t that are stationary or cointegrated.

The current study uses the Trace (T_r) eigenvalue statistic (Johansen, 1988; Johansen & Juselius, 1990). The likelihood ratio statistic for the trace test is:

$$Tr = -T \sum_{i=r+1}^{p-2} \ln(1 - \lambda_i) \tag{6}$$

where $\lambda_{r+1},\ldots\ldots , \lambda_p$ are the smallest eigenvalues of the estimated $p - r$. The null hypothesis for the Johansen test is that there are at most r cointegrating vectors. Johansen cointegration test is also sensitive to the choice of lag length n which is determined by minimizing the Akaike information criterion (AIC) (Akaike, 1974).

In the third stage, this study runs the following Error Correction Model (ECM):

$$\Delta IFR_t = \beta_1 + \sum_{i=0}^{n} \beta_2 \Delta UER_{t-1} + \sum_{i=1}^{n} \beta_{3t} \Delta IFR_{t-1} + \beta_4 ECT_{t-1} + \varepsilon_t \tag{7}$$

where ECT_{t-1} is the lagged value of the error correction term. There are two advantages to using this model. Firstly, the Wald test for the joint significance of the lagged independent variables can be used to examine the short-run impact of a change in the independent variables on the dependent variable. Secondly, the *t*-test for the significance of the error correction term can be used to examine the long-run impact.

5   Findings

The current study on the Phillips curve in Malaysia uses data for the period from 1973 to 2004. For the purpose of the analysis, all the data are transformed into a logarithm form.

Table 1 ADF Unit Root Test

	Levels		First Difference	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
IFR$_t$	−2.555(0)	−2.710(0)	−5.847 (0)**	−5.784(0)**
UER$_t$	−1.152(4)	−3.221(3)	−4.578 (0)**	−4.502(0)**

Note: Figures in parentheses indicate number of lag structures
** indicates significance at the 1% level
* indicates significance at the 5% level

As the first step, the ADF root test was used to examine the stationarity of the variables. The results from the ADF test are shown in Table 1. Despite some minor differences in the findings, the obtained results indicate that the two variables – *IFR* and *UER* -- are integrated of order one, *I(1)*.

In the second stage, Johansen co-integration test was used to examine the long-run movement of the variables. As Engle and Granger (1987) pointed out, only variables with the same order of integration can be tested for co-integration. In the present study, the both variables – *IFR* and *UER* – could be examined for co-integration. The results of the co-integration test are reported in Table 2.

Table 2 Johansen co-integration test

Eigenvalue	Trace statistic	5 per cent critical value	Probability	Number of co-integrating equations
0.338	13.718	12.32	0.029	None*
0.043	1.333	4.12	0.290	At most 1

Notes: the result corresponds to VAR's with one lag
** indicates significance at the 5% level

It should be noted that Johansen cointegration test can be biased when the number of observations is small. The maximum lag length for the test was set at two due to a limited number of observations (32). According to the Akaike information criterion (AIC), optimal lag length could be one (1). Therefore, the empirical results of the Johansen test and the ECM are based on the lag length of one.

The findings of the present study indicate that there existed a long-run relationship between the inflation rate and the unemployment rate (i.e., *IFR* and *UER*), which means that these variables are co-integrated. In other words, although the variables are not stationary at levels, in the long run, they closely move with each other.

Finally, the Error Correction Model (ECM) was employed to examine the short-run impact of the independent variables on the dependent variable as well as the long-run impact. The empirical results of the Wald statistic and *t*-statistic are reported in Table 3.

Table 3 Error Correction Model (Dependent variable: Δ*IFR*)

Variable	Degree of freedom	Wald statistic
Δ*UER*	2	6.007*
	Coefficient	**t-statistic**
***ECT*$_{t-1}$**	−0.427	−3.225**

Notes: the result corresponds to VAR's with one lag
** indicates significance at the 1% level
* indicates significance at the 5% level

As seen in Table 3, the error correction term (ECT_{t-1}) was statistically significant and the adjustment coefficient was –0.427. This means that the inflation rate was adjusting towards an equilibrium level at the rate of 43 per cent. On the other hand, the results of the Wald test indicate the short-run impact of the independent variable (*UER*) on the dependent variable (*IFR*). This means that the unemployment rate did seem to have a significant impact on the inflation rate in the short run.

In a nutshell, the empirical findings of the present study imply that there existed an equilibrium relationship between the inflation rate and the unemployment rate in Malaysia. Thus, this study provides evidence to support the existence of the Phillips curve in the context of the Malaysian economy.

6 Conclusion

The negative association between unemployment and inflation pointed out by Phillips (1958) has been an important foundation for macroeconomic management and the guiding principle for formulation of economic policies in various countries. The current study conducted an empirical analysis of the relationship between unemployment and inflation in Malaysia over the period 1973 – 2004, and it used three different methods for this purpose.

As the results of the unit root tests done in this study show, both the inflation rate and the unemployment rate in Malaysia could be considered as integrated of order one. Therefore, Johansen cointegration test was used to examine the long-run relationship between the variables. The findings of the Error Correction Model indicated the presence of the short-run impact of the unemployment rate on the inflation rate as well as the existence of the long-run impact.

The current inquiry lends support to the existence of the Phillips Curve in the context of a developing economy, such as Malaysia. This outcome encourages a closer look at various socio-economic factors that may influence the unemployment rate and the inflation rate in the country. For example, future studies may want to incorporate other variables, such as output gaps, to examine the workings of the Phillips Curve in Malaysia.

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