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Is the Phillips Curve Stable for Malaysia? New Empirical Evidence[#]

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Abstract: The objective of this study is to investigate the stability of trade-off Phillips curve in Malaysia. The sample covers annual data from 1970 to 2005. This study finds that trade-off Phillips curve exists in Malaysia for both short run and long run. Furthermore, there is a stable long-run tradeoff relationship between the inflation and unemployment rates in Malaysia.

Keywords: Cointegration, inflation, unemployment, Phillips curve
JEL Classification: C01, E24, E31

1. Introduction

The Phillips (1958) curve which trade-offs between inflation and unemployment rates had been long debated in the economics literature. Several studies have investigated this relationship, among them being Phelps (1967), Leijonhufvud (1968) and Brinner (1977). They agreed that the trade-off Phillips curve was dead in the industrialised countries and had shifted out from the actual economy. Friedman (1968) added that the trade-off Phillips curve would not exist in the long run because this relationship is temporary and accidental. On the other hand, Fuhrer (1995) found the trade-off Phillips curve to be alive and well in the United Kingdom. Indeed, it is widely applied to the macroeconometric modeling studies. Malinov and Sommers (1997) also found this trade-off Phillips curve to be alive and stable for many OECD countries.[1]

Although the trade-off Phillips curve has been researched extensively, there is no consensus evidence on the existence of the trade-off Phillips curve. Hence, the relationship between inflation and unemployment rates shown by the Phillips curve remained crucial. As to our knowledge, there is no obvious empirical study on the Phillips curve in Malaysia,

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1 Organization for Economic Co-operation and Development (OECD) members countries refer to Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

particularly on testing its stability. Earlier empirical studies on inflation and unemployment rate in Malaysia merely focused on (i) searching for its determinants; (ii) examining the existence of long run relationship by the conventional cointegration techniques; and (iii) studying inflationary and unemployment behavior modeling (see Yusuff 1988; Tan and Cheng 1995; Habibullah 1998; Cheng and Tan 2002). A paper closer to the topic is that of Wong (1995) who used the two-step Engle-Granger cointegration test to investigate the presence of a long run equilibrium relationship between inflation and unemployment rates in Malaysia. His results indicate that the variables are not cointegrated. On the other hand, he found inflation and unemployment rates to have an inverse relationship but found no evidence of parameter stability.

In this article, we attempt to investigate the relationship between inflation and unemployment rates in Malaysia from 1970 to 2005. The existence of trade-off Phillips curve is important especially for a developing country like Malaysia because the Phillips curve is a menu for the policymaker to monitor inflation and unemployment rates (see Samuelson and Solow 1960). If the trade-off Phillips curve exists, it may shed some light on the supply-side economy policy in reducing both the inflation and unemployment rates simultaneously to the success of the Ninth Malaysia Plan and towards the vision of an industrialised and developed country by the year 2020. In order to increase the reliability of the study, we employed modern time series econometrics techniques. First, we used the newly developed bounds testing approach by Pesaran *et al.* (2001) to examine the existence of a long-run relationship. Then, if the inflation rate and its determinants were cointegrated, Bardsen's (1989) method was used to derive the long-run and short-run coefficients. Lastly, the CUSUM and CUSUM of Squares tests based on recursive regression residuals were used to investigate the stability of the Phillips curve.

The rest of this paper is set as follows. Section 2 provides a brief review of the literature. Section 3 discusses the data and econometrics techniques used in this study. The empirical results are reported in Section 4 and Section 5 concludes.

2. Literature Review

Phillips curve is one of the well known terminologies in economics to explain the relationship between inflation and unemployment rates. This relationship has been studied extensively, both theoretically and empirically. The empirical literature on the stability of the Phillips curve can be classified into two groups: the unstable Phillips curve evidence and evidence on the stable Phillips curve.

Lipsey (1960) conducted a study in the United Kingdom to investigate the relationship between growth rate of nominal wages (wages inflation) and unemployment rate. He found a significant inverse relationship between the variables of interest. However, this relationship does not hold after the Great War (1914 – 1918). Lucas (1976) argued that the Phillips curve is unstable due to government policy changes over time. Thus, the inflation rate forecasted by the Phillips curve is unreliable. Okun (1980) adds that the Phillips curve has become "an unidentified flying object" in United States from the 1970s onward.

Turner (1997) argued that there might be at least one major structural break in the United Kingdom from the1970s onward and that the Phillips curve is unstable. Therefore, he states that the emphasis should be on explaining the instability observed rather than seeking out a possibly non existent stable Phillips curve. This finding is supported by

Atkeson and Ohanian (2001). Despite the Phillips curve being valid only in the short run as in Friedman's (1968) finding, it cannot be used to forecast short-term inflation rate because the estimated coefficient approaches zero and is unstable.

Recently, Niskanen (2002) found that the long-run Phillips curve is positively sloped and claimed that the usual specification of the Phillips curve is wrongly specified. Moreover, he argued that the tax code is not fully indexed. Hence, inflation will increase the effective tax rate, particularity on the income from capital and eventually reduce the output and increase the unemployment rate. Thus, a positive slope is profound in his study. With this finding, he argued that it is longer efficient for policy planners to use the trade-off Phillips curve as a guidepost. Reichel (2004) extended Niskanen's study by employing the cointegration technique to the industrialised economies and found that only Japan and United States are cointegrated, and the trade-off Phillips curve only exists in the United States.

On the other hand, Furher (1995) conducted a study in the United Kingdom to re-investigate the relationship between inflation and unemployment. He found the Phillips curve to be alive and well. Malinov and Sommers (1997) used annual data from 1973 to 1992 in nineteen OECD countries to ascertain the existence of the stable Phillips curve. They found that seventeen OECD countries had stable Phillips curve, except for Switzerland and the United States. They concluded that the much maligned Phillips curve has not failed empirically, at least not for many OECD countries over the last twenty years.

Ewing and Seyfried (1999) examined the inflation model for the United States with CUSUM of Squares test. They found the Phillips curve to be stable over the sample period. Payne *et al.* (2000) included a lagged value of inflation as a proxy of expected inflation to capture the inertia effect. They found a trade-off relationship between inflation and unemployment rates during the sample period. In a more recent paper, Eller and Gordon (2002) found the trade-off Phillips curve to be alive in the United States. In Turkey, Önder (2004) found the forecasted inflation rate by the Phillips curve to be more accurate than those forecasted by other macroeconomic variables, such as money or interest rate.

In Asia, Bhanthumnavin (2002) estimated Thailand's Phillips curve using the output gaps and import price inflation as the regressors. The writer found that the trade-off Phillips curve existed only at the time of the Asian financial crisis. He explained that in general the trade-off Philips curve exists in Thailand, but the low variation of import price inflation and output gaps hide the phenomenon. Scheibe and Vines (2005) found that the trade-off Phillips curve appeared after the reform of China. However, they concluded that the output gap derived from production function is superior to others.

3. Data and Methodology

This study uses annual data of inflation rate, unemployment rate, output gap and money supply (M1) in Malaysia for the period of 1970 to 2005. The data were extracted from the World Development Indicators (WDI) and the Malaysia Economic Report respectively. Annual data was applied to avoid biases in seasonally adjusted data. Hakkio and Rush (1991) document that cointegration is a long run concept and hence requires long span data to draw more meaningful inferences than merely using large numbers of observations from high frequency data. However, it is admitted that using interpolation techniques to increase the frequency of data will improve the results of cointegration (Zhou 2001). Alias and Tang

(2000) argued that using raw data in empirical studies has less measurement error than interpolated series.

The standard specification of the Phillips curve relates the inflation rate with the unemployment rate, and other scale variables such as real GDP and marginal cost of production. The alternative specification considers the output gap or the real output as proxy for unemployment rate (Khalaf and Kichian 2005).[2] In this study, we considered both bivariate and multivariate Phillips curve functions for comparison purpose. The equations are presented as follows:

Model 1: $INF_t = a_1 + a_2 UR_t + \mu_t$ (1)

Model 2: $INF_t = b_1 + b_2 UR_t + b_3 GAP_t + b_4 M1_t + \varepsilon_t$ (2)

where INF_t is the inflation rate derived from GDP deflator, UR_t represents the unemployment rate, GAP_t is the output gap[3] and $M1_t$ denotes the log of real money supply. Model (2) is implemented by controlling other variables such as output gap and monetary policy instruments that may affect inflation.[4] We used the bounds testing approach to test the existence of a long-run relationship between inflation rate and its determinants. To implement the bounds testing approach, the following *Unrestricted Error-Correction Models* (UECMs) were estimated by Ordinary Least Squares (OLS).

$$\Delta INF_t = \alpha_1 + \sum_{i=i}^{p} \delta_i \Delta INF_{t-i} + \sum_{j=0}^{q} \lambda_j \Delta UR_{t-j} + \pi_1 INF_{t-1} + \pi_2 UR_{t-1} + \xi_t \quad (3)$$

$$\Delta INF_t = \beta_1 + \sum_{i=1}^{p} \phi_i \Delta INF_{t-i} + \sum_{j=0}^{q} \varphi_j \Delta UR_{t-j} + \sum_{k=0}^{r} \gamma_k \Delta GAP_{t-k} + \sum_{l=0}^{s} \theta_l \Delta M1_{t-l}$$
$$+ \pi_1 INF_{t-1} + \pi_2 UR_{t-1} + \pi_3 GAP_{t-1} + \pi_4 M1_{t-1} + \varepsilon_t \quad (4)$$

where π_1, π_2, π_3 and π_4 are the long-run parameters; ξ_t and ε_t are the error terms respectively and assumed to be white noise. The existence of a long-run relationship is tested by restricting the lagged level variables, INF_{t-1} and UR_{t-1} in Equation (3) or INF_{t-1}, UR_{t-1}, GAP_{t-1} and $M1_{t-1}$ in Equation (4). It is a joint significance *F*-test for the null hypothesis of no cointegrating relation against the alternative hypothesis of a cointegrating relation.

Aware that the critical values provided by Pesaran *et al.* (2001) are not suitable for our small sample size, we chose to use the small sample critical values provided by Narayan (2005). If the computed *F*-statistics exceed the respective upper critical bounds value, we

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[2] Gordon (1984) proposed to use the real GNP as a proxy for unemployment rate, thus his Phillips curve is positively sloped in the short run.
[3] Output gap is the log of actual GDP subtracted from the log of potential GDP.The potential GDP is derived from Hodrick and Prescott (1997) filter.
[4] We would like to thanks an anonymous referee for the suggestion.

conclude that the variables are cointegrated. If the *F*-statistics fall below the respective lower critical bounds, we fail to reject the null hypothesis of no cointegrating relationship. If the *F*-statistics fall between its upper and lower critical bounds values, the inference is inconclusive.[5]

If the examined variables were cointegrated, computation of long-run coefficient is required and the Bardsen's (1989) method was used to derive the long-run coefficients from the UECM. Bardsen (1989) noted that this approach is computational convenient and provides efficient results.[6] The long run coefficient was derived as the coefficient of the one lagged level explanatory variable divided by the coefficient of the one lagged level dependent variable and then multiplied with a negative sign. Thus, the long-run coefficients for unemployment rate, output gap and money supply were $-(\pi_2/\pi_1)$, $-(\pi_3/\pi_1)$, and $-(\pi_4/\pi_1)$. On the other hand, the short run effect was captured by the total coefficients of the first differenced variable in Equation (3) and Equation (4).

The CUSUM and CUSUM of Squares tests were carried out to examine the stability of parameters over the sample period. These parameter stability tests were applied because it does not require any breakpoint to be specified in the equation. If the plot of cumulative sum of square residual breaks in the upper or lower bound, instability of parameters has occurred, (see Greene 2003). Besides, a number of diagnostic tests were employed to ensure the estimated residuals were white noise.

4. Empirical Results

We begin the analysis by examining the properties of each time series. From the visual inspection as depicted in Figure 1, the series were either *I*(0) or *I*(1). In addition, the results of KPSS (Kwiatkowski *et al.* 1992) stationarity test in Table 1 also suggest that all the variables are integrated either *I*(0) or *I*(1).

Thus, we could proceed to bounds testing for cointegration. The estimated UECM for Model (1) and Model (2) are reported in Table 2.

The estimated results in Table 2 show that UECM (0, 0) and UECM (1, 0, 2, 0) are the appropriate lag orders[7] for Model (1) and Model (2) respectively. We found the computed *F*-statistics for cointegration test to be significant at 1 per cent level. Thus, the null hypothesis of no cointegrating relation was rejected for both models. These findings indicate that the inflation rate and its determinants are cointegrated. The finding is consistent with the existing literature (see Niskanen 2002; Lundborg and Sacklén 2001; Reichel 2004). However, our finding is contrary to that of Wong (1995) who found no long-run relationship between inflation and unemployment rates in Malaysia. This may be attributed to the use of the Engle-Granger test which is inappropriate for small samples (see Mah 2000).

Since the inflation rate and its determinants were cointegrated, we proceeded to estimate the long-run equilibrium and the short-run relationship using Bardsen's (1989) method. The estimated results are reported in Table 3.

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[5] Pesaran *et al.* (2001) suggested that the order of integration for the series must be known before any conclusion can be drawn.

[6] Some empirical applications with Bardsen's (1989) method can be found in Tang (2001) and Tang (2003).

[7] We used Schwarz Bayesian Criterion (SBC) to determine the optimal lag order.

Table 1: KPSS stationarity test

Variable	Test statistic	
	η_{μ}	η_{τ}
INF_t	0.174	0.077
UR_t	0.466**	0.089
GAP_t	0.059	0.053
$M1_t$	0.714**	0.067
ΔUR_t	0.105	0.101
$\Delta M1_t$	0.100	0.064

Note: The asterisks *, ** and *** denote significance at 1 per cent, 5 per cent and 10 per cent levels respectively. The ç statistics refer to the KPSS test of the stationarity null hypothesis against the alternative hypothesis of a unit root. The subscripts ì and ô indicate the models that allow for drift terms and both a drift and deterministic trend respectively. The following asymptotic critical values are obtained from Kwiatkowski *et al.* (1992: 166).

Significance Level	Level	Trend
1 per cent	0.739	0.216
5 per cent	0.463	0.146
10 per cent	0.437	0.119

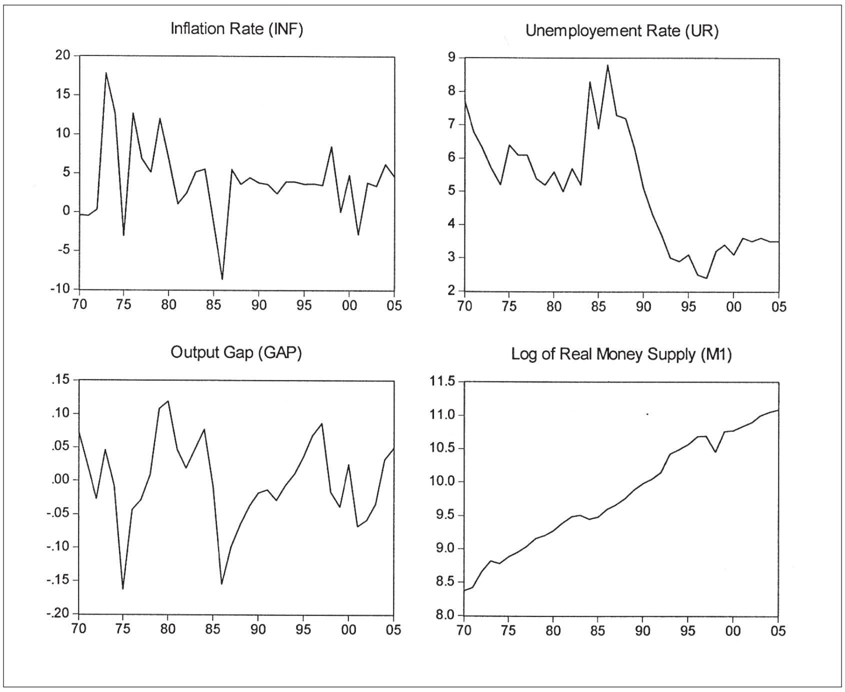

Figure 1: The plot of variables

Table 2: Estimation of unrestricted error-correction model (UECM)

Dependent Variable: ΔINF_t		
Method: Ordinary Least Squares (OLS)		
Variable	Model (1)	Model (2)
Constant	4.729	44.625*
ΔINF_{t-1}		0.263**
ΔUR_t	–1.401	–1.271*
ΔGAP_t	–	53.599*
ΔGAP_{t-1}	–	–22.385**
ΔGAP_{t-2}	–	13.688
$\Delta M1_t$	–	–29.748*
INF_{t-1}	–0.904*	–0.891*
UR_{t-1}	–0.219	–1.180*
GAP_{t-1}	–	–7.707
$M1_{t-1}$	–	–3.360*
R^2	0.505	0.951
Adjusted R^2	0.457	0.928
F-Statistics	10.533*	41.083*
Breusch-Godfrey LM test	2.464	5.101***
Jarque-Bera (J-B)	0.130	0.373
Ramsey RESET	2.900	0.222
ARCH	0.817	0.000
Bounds test:		
F-Statistics	13.243*	7.273*

Note: Breusch-Godfrey LM test is the test of serial correlation and Jarque-Bera (J-B) is the test of the normality of the residuals. The Ramsey RESET is the test of specification error and ARCH is the heteroskedasticity test in time series. The asterisks *, ** and *** denote significance at the 1 per cent 5 per cent and 10 per cent levels respectively.

Table 3: Long-run and short-run coefficients

Variable	Model (1)	Model (2)
Long Run:		
UR_t	–0.242	–1.325*
GAP_t	–	–8.653
$M1_t$	–	–3.772*
Short Run:		
$\Sigma\Delta UR_t$	–1.401	–1.271*
$\Sigma\Delta GAP_t$	–	44.902*
$\Sigma\Delta M1_t$	–	–29.748*

Note: The asterisks *, ** and *** denote significance at the 1 per cent, 5 per cent and 10 per cent levels respectively. The χ^2-statistics is used for the above statistical inference.

A remarkable finding of this study is that the short- and long -run unemployment rate coefficients are consistently negative for both bivariate and multivariate models. Specifically, the long-run coefficient for unemployment rate is statistically significant at 1 per cent level in Model 2 (see Table 3). This is consistent with the strong form of trade-off Phillips curve. Thus, we surmise that there is a stable long run trade-off relationship between inflation and unemployment rates in Malaysia. Moreover, the result also shows that the short-run coefficient for unemployment rate has a negative sign and statistically significant at 1 per cent level for Model 2. This infers that the trade-off Phillips curve does appear in the short run as well. Comparing Model 1 and Model 2, we find that the short-and long-run coefficients for unemployment rate in Model 1 are not significant, but the coefficients are statistically significant at 1 per cent level in Model 2. This significant improvement may be from the controlling of output gap and monetary policy instrument in the model.

Table 3 shows that the short run coefficient for output gap is positively related to inflation rate and statistically significant at 1 per cent level. This is consistent with Khalaf and Kichian (2005). Contrary to theory, we found the effect of real money supply on inflation rate to be negative; however, this result is consistent with that of Wong (1995) and Tang (2001) for the case of Malaysia. Furthermore, Cheng and Tan (2002) found that money supply in narrow definition (M1) has an indirect effect on inflation. The negative sign on M1 infers that the growth of money supply leads the price level to increase at a decreasing rate or in other words, inflation rate decreases when money supply increases. Ibrahim (1995) noted that money supply and price level are inelastic and thus it is no surprise to have a negative relationship between the inflation rate and money supply.

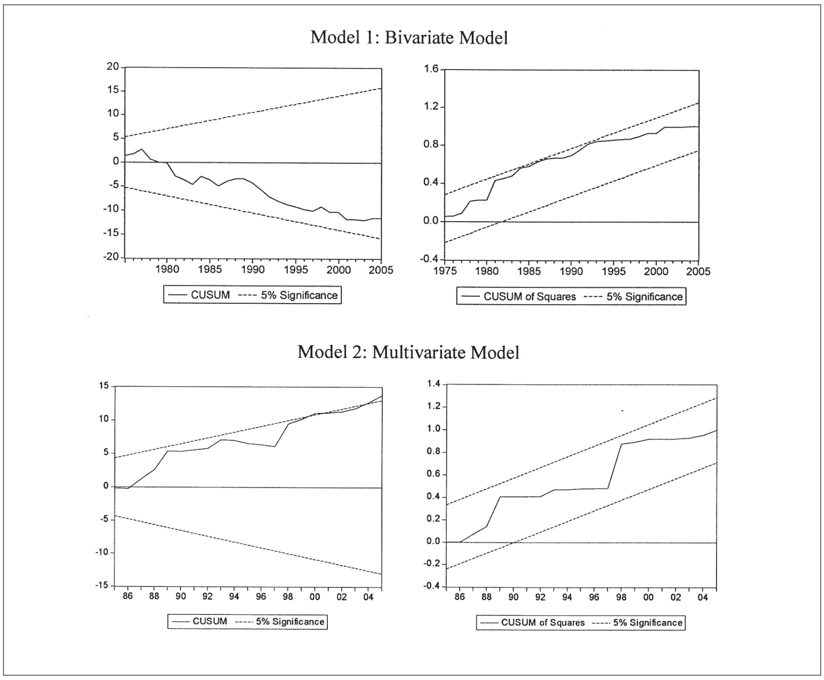

Figure 2: *The plot of CUSUM and CUSUM of squares statistics*

Even though the inflation rate and its determinants co-move and converge in the long run, there is no guarantee of parameter stability. As demonstrated by Bahmani-Oskooee and Bohl (2000), cointegration may not imply a stable relationship among the set of variables. Thus, following Bahmani-Oskooee and Bohl (2000) and Bahmani-Oskooee (2001), we carried out the CUSUM and CUSUM of Squares stability tests to the recursive residuals of the estimated UECMs (Model 1 and Model 2). The CUSUM and CUSUM of Squares in Figure 2 reveal that the test statistics always stay within the 5 per cent significant level bounds. Hence, the null hypothesis of parameters stability cannot be rejected at the 5 per cent level of significance. The cointegration, CUSUM and CUSUM of Squares tests infer that the Phillips curve is alive and well in Malaysia over the sample period of 1970 to 2005.

5. Conclusion

This study examined the stability of Phillips curve in Malaysia. We examined the relationship between inflation rate and its determinants using the recently developed bounds testing approach for cointegration. New empirical evidence was found. First, the inflation rate and its determinants, in particular the unemployment rate are cointegrated in Malaysia. Second, the trade-off Phillips curve exists in Malaysia for both short-run and long-run relationships. Third, the parameters are stable over the sample period of 1970 to 2005. Therefore, we conclude that the trade-off Phillips curve is alive and well in Malaysia.

It is interesting to note that the existence of the trade-off Phillips curve shows that the Malaysian economic structure has remained at the demand-side despite extensive encouragement of industrialisation since the 1980s. The existence of the trade-off Phillips curve with a stable relationship may assist policy makers in controlling the inflation rate and unemployment rate simultaneously. It is suggested that the Malaysian authorities liberalise policies with a dogmatic philosophical adherence to supply-side economy. This policy implication is in line with the Ninth Malaysia Plan which emphasises human capital development, and enhances productivity and efficiency in all sectors.

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