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Does the Phillips curve exist in the Philippines?

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Abstract

This paper examines an intricate relationship between inflation rate and unemployment rate in the Philippines by employing several economic methods, including the dynamic ordinary least squares (DOLS) (Stock and Watson, 1993) and the Hodrick-Prescott filter (Hodrick and Prescott, 1997). The current research detected a long-run negative and a causal relationship between inflation rates and unemployment in the Philippines. In other words, the current study offered an additional empirical support for the existence of the Phillips curve in the developing countries, such as the Philippines.

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1. Introduction

Since the publication of William Phillips'seminal paper in 1958 (Phillips 1958), the nonlinear negative relationship between inflation rates and unemployment rates or so-called the "Phillips curve", has drawn large number of interest among applied economists. Despite numerous examinations, these empirical studies failed to produce any consistent results. Alogoskoufis and Smith (1991) found that there is no trade-off between United States and United Kingdom. King and Watson (1994), using the U.S. post-war macroeconomic data, found empirical support for a trade-off relationship between unemployment and inflation.

Hogan (1998) examined U.S. macroeconomic data from 1960 to 1993 and his study revealed there had been a significant and negative relationship between unemployment and inflation. However, Phillips curve appeared to be over-predicted the rate of inflation. Hansen and Pancs (2001) examined the existence of the Phillips curve in Lativa. They also found out that there is a significant correlation between the unemployment and inflation.

Niskanen (2002) completely denied the existence of inflation-unemployment trade-off by publishing a paper entitled "On the death of the Phillips curve". He argued that there is no evidence of the Phillips curve in the United States. By contrast, Niskanen argued that the unemployment rate is positively, rather than negatively, correlated with inflation rates in the country. Reichel (2003) made an important contribution to existing literature by examining the Phillips curve in 16 countries. His empirical findings supported the Niskanen's criticism on the existence of the Phillips curve in these countries. Reichel has pointed out that, in most cases, the unemployment rates and inflation rates are not cointegrated. He concluded that Niskanen's funeral oration on the Phillips curve in United States was appropriate and suggested that researchers should also entomb the Phillips curve in other countries.

Faridul Islam *et. al.* (2003) examined the hypothesis of Philips curve through US economic data from 1950 to 1999. They found out a long-run cointegrating relationship and long-run causality between unemployment and inflation. On the other hand, Hart (2003) tested the Phillips curve by employing the hourly wage earning. He concludes that during inter-war period of 1928-1938 in Britain, the Phillips curve did not exist. Furuoka (2007) examined the existence of the Phillips curve in Malaysia for the period of 1975-2004 using unit root test, Johansen cointegration test and Granger causality test. His findings clearly indicated that there exist a long-run and trade-off relationship between inflation and unemployment in Malaysia. There is also a causal relationship between these two variables. In other word, his paper has provided a definite empirical evidence to support the existence of the Phillips curve in the case of Malaysia.

Granger and Jeon (2010) examined the US Phillips curve for the period of 1861-2006. They argued that, in the linear model, there is weak causality between unemployment and inflation. However, Granger and Jeon employed a time-varying parameter model which supported the Phillips curve hypothesis. They conclude that inflation would cause unemployment in the early period, but not the latter. Ismail *et. al.* (2011) chose North Cyprus as a case study to examine the inflation-unemployment trade-off relationship. They concluded that there exists a short-run and long-run Phillips curve in North Cyprus and the relationship between these two variables are stable.

Despite numerous empirical studies on inflation-unemployment trade-off, there is yet a consensus on the existence of Phillips curve. Moreover, majority of these empirical investigations are focused on developed nations rather than Asian countries.[1] As such, this paper focuses on ASEAN countries specifically the Philippines.[2] We will examine the inflation-unemployment trade-off using annual data (1980-2010) and applying dynamic ordinary least squares (DOLS) (Saikkonen 1992; Stock and Watson 1993) and Hodrick-Prescott filter (Hodrick and Prescott 1997).

Following this Introduction, Section 2 discusses data collection and research methods. Section 3 reports and discusses research findings. Concluding remarks are offered in Section 4.

2. Data and Research Methods

This paper used several different econometric methods to examine the trade-off relationship between inflation rate (IFR_t) and unemployment rate (UNR_t). Data were obtained from the World Development Indicators (World Bank 2012). Since our numbers of observations were only 30, we anticipate our study may have a lower power.

As Phillips (1986) clearly spelled out his concerns, a regression analysis that include non-stationary variable may produce misleading empirical findings. Thus, this paper will conduct research in following four stages to examine the relationship between IFR_t and UNR_t. Philippines has higher unemployment rate as compared to its neighbouring countries (Thailand and Malaysia). One of the main reasons are political instability and frequent incidents of natural disasters, For example, Philippines' average unemployment rate from 1980 to 2010 is 8.17 percent as compared to 4.09 percent and 2.17 percent in Malaysia and Thailand, respectively.[3] As compared to its neighbours, both Malaysia and Thailand have better political stabilities and fewer natural disasters.

In the first stage, unit root test was used to determine whether the unemployment rate and inflation rates can be described as stationary process. The time series data is *stationary* if the mean, variance and covariance remain constant over time (Thomas 1997). These are important macroeconomic variables that have significant impact on economic condition. Due to the resilience of labour and good market, unemployment rate and inflation rate can be considered as mean-reversion processes.[4] For example, the higher-than-normal unemployment rate should revert to the equilibrium level after the end of economic recession. Moreover, inflation rate could rise during prolonged period of the economic expansion. A higher-than-normal inflation rate is expected to revert to normal level after the end of economic boom. Thus, there is a need to examine whether these variables are stationary, prior to examine further relationship between them.

[1] Association of South East Asian Nation (ASEAN). These countries are Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam.
[2] Due to lack of data, this paper excluded other ASEAN countries from this analysis.
[3] Data were also obtained from the World Development Indicators (World Bank 2012).
[4] These two variables can be considered as stationary process, rather than non-stationary or unit root process.

In the second stage, cointegration tests were carried out in order to analyse whether the pairs of variables were cointegrated or moved jointly in the long-run.[5] In the third stage, three residual-based cointegration analyses are used to estimate the natural rate of unemployment. In the final stage, this paper examined whether there was a causal relationship between the two variables.[6]

First of all, an important prerequisite for the existence of a long-run equilibrium relationship between two variables, such as IFR_t and UNR_t is that the variables have the same order of integration. In order to analyse the common integrational property, unit root tests need to be run. A standard unit root test, i.e. the augmented Dickey-Fuller (ADF) unit root test, can be employed for this purpose (Dickey and Fuller, 1979, 1981).

Secondly, the Johansen cointegration test would be employed to examine the co-movement of the variables in the long-run (Johansen 1988, 1991). The Johansen cointegration test is based on maximum likelihood estimation of the *k*-dimensional Vector Autoregressive (VAR) model of order *p*,

$$Z_t = \mu + A_1 Z_{t-1} + A_2 Z_{t-2} + ...A_p Z_{t-p} + \varepsilon_t \qquad (1)$$

where Z_t is a $k \times 1$ vector of stochastic variables, μ is a $k \times 1$ vector of constants, A_i is $k \times k$ matrices of parameters, and ε_t is a $k \times 1$ vector of error terms. The model could be transformed into a Vector Error Correction Model (VECM) form:

$$\Delta Z_t = \mu + \Pi Z_{t-1} + \sum_{j=1}^{p-1} \Gamma_j y_{t-j} + \varepsilon_t \qquad (2)$$

where Δ is the difference operator, Π and $\Gamma_1,\ldots,\Gamma_j$ are $k \times k$ matrices of parameters. On the other hand, if the coefficient matrix Π has reduced rank, $r < k$, then the matrix can be decomposed into $\Pi = \alpha\beta'$. In this context, α is the adjustment parameter and β is cointegrating vector. It should be noted that Π will have a maximum of rank 2 because it contains only two variables. (α and β are considered as vectors).

The Johansen cointegration test involves testing for rank of Π matrix by examining whether the eigenvalues of Π are significantly different from zero. There could be three conditions: 1) $r = k$, which means that the Z_t is stationary at levels, 2) $r = 0$, which means that the Z_t is the first differenced Vector Autoregressive, and 3) $0<r<k$, which means there exists r linear combinations of Z_t that are stationary or cointegrated.

For example, if r is equal to 1, then the relationship between the inflation rates (IFR_t) and unemployment rates (UNR_t) could be written as:

[5] According to a definition, pairs of variables could be described as co-integrated if they have a long-run equilibrium relationship which means that these variables move jointly (Gujarati 2003).
[6] According to Granger (1969), a time series *X* is said to Granger-cause another time series *Y* if this *X* would provide statistically significant information about future value of *Y*.

$$\begin{bmatrix} \Delta IFR_t \\ \Delta UNR_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \sum_{i=1}^{k-1} \begin{bmatrix} \Gamma_{i,11}\Gamma_{i,12} \\ \Gamma_{i,21}\Gamma_{i,22} \end{bmatrix} \begin{bmatrix} \Delta IFR_{t-i} \\ \Delta UNR_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} [\beta_1 \beta_2] \begin{bmatrix} IFR_{t-1} \\ UNR_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix} \quad (3)$$

The vector β represent the r linear cointegrating relationship between the variables. This paper uses the Trace (Tr) eigenvalue statistics (J_{trace}) and the maximum eigenvalue statistics (J_{max}) (Johansen 1988; Johansen and Juselius 1990). The likelihood ratio statistic for the trace test is:

$$J_{trace} = -T \sum_{i=r+1}^{k} \ln(1 - \hat{\lambda}_i) \quad (4)$$

where $\hat{\lambda}_{r+1}, \ldots\ldots, \hat{\lambda}_k$ are the ordered eigenvalues of the Π matrix. The null hypothesis for the trace test is that there are at most r cointegrating vectors. On the other hand, the maximum eigenvalue test could be calculated as:

$$J_{\max} = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (5)$$

The null hypothesis for the maximum eigenvalue test is that r cointegrating vectors are tested against the alternative hypothesis of $r+1$ cointegrating vectors. If trace test and maximum eigenvalue test yield different results, the results of maximum eigenvalue test should be used because power of maximum eigenvalue test is considered greater than the one of trace test (Johansen and Juselius, 1990).

Thirdly and more importantly, this paper estimated following two type of natural rate of unemployment in the Philippines; 1) the time-invariant natural rate of unemployment (*TIV-NRU*) and 2) the time-variant natural rate of unemployment (*TV-NRU*). The dynamic ordinary least squares (DOLS) (Saikkonen 1992; Stock and Watson 1993) and the Hodrick-Prescott filter (Hodrick and Prescott 1997) are used for this purpose.

The inflation-unemployment trade-off can be expressed as (Ball and Mankiw 2002):

$$\Delta IFR_t = \beta UNR^* - \beta UNR_t + v \quad (6)$$

where UNR^* is the natural rate of unemployment, β is the parameter and v is supply shock. In the equation (6), the ratio of the constant term (βUNR^*) to the absolute value of the unemployment coefficient (β) can be considered as the estimate of the time-invariant natural rate of unemployment (Ball and Mankiw 2002). The time-invariant natural rate of unemployment (*TIV-NRU*) can be calculated as:

$$TIV - NRU = \beta UNR^* / |\beta| \quad (7)$$

The furthermore, the equation (6) can be re-written as:

$$UNR^* + v / \beta = UNR_t + \Delta IFR_t / \beta \quad (8)$$

The right side of the equation (8) can be calculated from the data. The left side of equation is the combination of the long-term trend (*UNR**) and the short-term shock (v/β). In this context, *UNR** can be interpreted as the TV natural rate of unemployment (*TV-NRU*). The Hodrick-Prescott filter (Hodrick and Prescott 1997) is employed to estimate the long-term trend. In other words, to extract *UNR** from $UNR^* + \beta / v$ by using the HP filter (Ball and Mankiw 2002; Yu 2009).[7]

Finally, the present study used the Granger causality test (Granger 1969) to analyse causality between inflation rates and unemployment rates in the Philippines. The Granger causality test could be based on the following Vector Error Correction Models (VECMs)

$$\Delta IFR_t = c_1 + \alpha_{11}\Delta IFR_{t-1} + ...\alpha_{1k}\Delta IFR_{t-k} + \beta_{11}UNR_{t-1} + ... + \beta_{1k}UNR_{t-k} + \gamma_1 EC_{t-1} + \varepsilon_1 \quad (9)$$

$$\Delta UNR_t = c_2 + \alpha_{21}\Delta UNR_{t-1} + ...\alpha_{2k}\Delta UNR_{t-k} + \beta_{21}IFR_{t-1} + ... + \beta_{2k}IFR_{t-k} + \gamma_2 EC_{t-1} + \varepsilon_2 \quad (10)$$

where EC_{t-1} is a one-period lagged value of the error correction term, γ is coefficient for the error correction term; *c* is constant; α and β are slope coefficients. There are two joint null hypotheses for the Granger causality tests. The Granger causality could be examined by using the Wald test for the first joint null hypothesis that the unemployment rate would not "Granger" cause the inflation rates:

$$1H_0 : \beta_{11} = \beta_{12} .....\beta_{1k} = 0 \quad (11)$$

The second joint null hypothesis that the inflation rate would not "Granger" cause the unemployment rates:

$$2H_0 : \beta_{21} = \beta_{22} .....\beta_{2k} = 0 \quad (12)$$

There is a considerable advantage to using a Granger causality test based on the VECM rather than a standard test because the former can identify both the short-run and the long-run causalities. In a Granger causality based on the VECM, the Wald test of the independent variables could be interpreted as the short-run causal effect while the significant correction term (EC_{t-1}) could be interpreted as the long-run causal effects.

Four types of causal relationship between inflation rates and unemployment rates are possible: (a) There is no causality between inflation rates and unemployment rates, which could be interpreted as an independent relationship between the variables. (b)There is a unidirectional causality from inflation rates to unemployment rate, *but not vice versa*, which could be interpreted that the changes in the inflation rate would be caused by the change in unemployment rate. (c) There is a unidirectional causality from unemployment rate to inflation rate, *but notvice versa*, which could be interpreted as any changes in unemployment rate will be caused from changes in inflation rate. (d) There is a unidirectional causality from inflation rate to

[7]The smoothing parameter (*lambda*) is set as 100.

unemployment rates, *and vice versa*, which could be interpreted as a mutually reinforcing bilateral causality between inflation rates and unemployment rates.

3. Empirical Results

First of all, the augmented Dickey-Fuller (ADF) test was employed to examine stationarity properties of inflation rates and unemployment rates. The results obtained from these tests are shown in Table 1. As the results indicate, these variables are integrated of order one, *I(1)*. Thus, these two variables have the same order of integration.

Secondly, the Johansen cointegration analysis is employed to examine co-movement of two variables. As Table 2(a) and 2(b) showed, the findings from the Johansen integration test indicate that there exists long-run relationship between *IFR* and *UNR*, which means that these variables are cointegrated. In other words, although the variables are not stationary at levels, in the long run, they closely move with each other. Long-run cointegration when the variables are normalised by cointegrating coefficients could be expressed as:

$$IFR = -2.247UNR$$

This cointegrating vector equation indicates that there exists a negative long-run relationship between *IFR* and *UNR*. This means that there would decrease in inflation rates as unemployment rates would increase in the Philippines.

More importantly, this paper used the dynamic ordinary least square (DOLS) to estimate time-invariant natural rate of unemployment (*TIV-NRU*). The TIV-NRU can be calculated as:

$$TIV - NRU = \beta UNR^* / |\beta|$$

$$2.957 / |-0.344| = 7.549$$

The constant term (βUNR^*) is 2.957 and unemployment coefficient (β) is -0.344. Thus, the time-invariant natural rate of unemployment (*TIV-NRU*) in the Philippines is 7.549. Due to a high natural rate of unemployment, Philippines became a “labour-exporting” country. There could be a positive correlation between unemployment rates and outflow migration of workers. For example, in the 1990’s the unemployment rate was 8 percent while outflow of migrant workers were 600,000. By contrast, in 2000’s, the unemployment rate was 11 percent with an outflow of 800 thousands migration workers.[8]

The Hodrick-Prescott filter (Hodrick and Prescott 1997) is used to estimate the time-variant natural rate of unemployment (*TIV-NRU*). In Figure 1, the combination of long-term trend and short-term supply shock ($UNR^* + v/\beta$) is shown as the blue-coloured line. The long-term trend of the TIV natural rate of unemployment (UNR^*) is shown in the red-coloured line. The green coloured line indicated the short-term supply shock (v/β).

[8] The source of data is the Philippines Overseas Employment Administration (POEA) (2013).

As Figure 1 indicated, there were very high fluctuations in the short-term supply shock (v/β) in the 1980s. However, the fluctuation became smaller in the 1990s. Similarly, the fluctuation in the combination of long-term trend and short-term shock ($UNR^* + v/\beta$) become smaller in the 1990s, comparison with its fluctuation in the 1980s.

Figure 2 focused on the time-variant natural rate of unemployment (*TIV-NRU*) in the Philippines. The natural rate of unemployment was around 4 percent in the first half of 1980s. The natural rate gradually increased to 5 percent in the second half of 1980s and natural rate reached to 6.2 percent in 1990. The *TIV-NRU* continued increasing to 7 percent in the first half of 1990s and reached to 8.1 percent in 1997.

As Figure 2 clearly indicated, the time-variant natural rate of unemployment reached its peak in the beginning of the 2000s. The natural rate become 9.1 percent in 2000 and continued increasing to 9.6 percent in 2003. However, the natural rate started decreasing from 2004 and decreased to 9.0 percent in 2005. The *TIV-NRU* decreased to 7.2 percent in 2008 and further to 5.6 percent in 2010.

Finally, the Granger causality test based on VECM was employed to examine the causality relationship between inflation rates and unemployment rates in the Philippines. The results obtained from the chi-square statistics, its degree of freedom, the coefficient of the error correction term (ECT_{t-1}) and the *t*-statistics are reported in Table 4.

According to the empirical results, the null hypothesis that *UNR* did not Granger-cause *IFR* could be rejected at the 1 percent level of significance. Therefore, the results indicated that the change in the unemployment rates"Granger" caused the some changes in the inflation rates in the Philippines. This is because the coefficients of error terms were statistically significantly different from zero. By contrast, the null hypothesis that *IFR* did not Granger-cause *UNR* could not be rejected.

In short, the present study detected a long-run negative cointegrating relationship between inflation rates (*IFR)* and unemployment rates (*UNR)* in the Philippines. More importantly, this paper estimated that the time-invariant natural rate of unemployment is 7.549 percent. By contrast, the time-variant natural rate of unemployment was around 4 percent in the 1980s and gradually increased to 9.6 percent in 2003 when it reached its peak. Since 2004, it started decreasing to 7.2 percent in 2008 and further to 5.6 percent in 2010. The present research also detected the unidirectional causality from the unemployment rates to inflation rates in the Philippines. These findings clearly lead a conclusion that there is inflation-unemployment trade-off in the Philippines. In other words, empirical findings provided an additional proof that Phillips curve could exist in a developing country such as the Philippines.

4. Concluding Remarks

The negative relationship between unemployment and inflation rate as proposed by William Phillips has been an important foundation in macroeconomic policy. An intense debate engendered from Phillips' original hypothesis. However, majority of these explorations have engrossed mainly in developed economies. As such, our empirical analysis is to extend this debate and evaluate a developing economy, the Philippines.

Our empirical findings detect a long-run negative and a causal relationship between inflation and unemployment rate in the Philippines. This shows that there is an empirical evidence for the existence of the Phillips curve in a developing economy such as the Philippines. Philippines's unemployment rate is a "cause", rather than an "effect" in the unemployment-inflation relationship. In other words, a higher-than-normal unemployment rate would return to the equilibrium level in an economic boom. However, a decline in unemployment rate could cause an increase in inflation rate. By contrast, inflation rate would increase during a prolonged period of economic expansion. As such, unemployment rate would not decline or there would be a persistence of high unemployment due to the inflexibility of labour market condition. Philippine's policymaker should take appropriate actions to deal with its problem specifically structural unemployment. These findings encourage future research to evaluate the existence of Phillips curve in other Asian economies such as Thailand, Singapore, and Indonesia. Assessing the existence of the Phillips curve in other Asian economies will be insightful. The reason is that variation in socio-economic background among Asian economies may influence the relationship between unemployment and inflation rate.

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Appendix I: Tables

Table 1: Unit Root Tests

Table 1(a): ADF Unit Root Test				
	Level		First Difference	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
IFR	-1.079(0)	-1.174(1)	-4.160(0)**	-4.243(0)**
UNR	0.396(5)	-2.460(1)	-3.842(1)**	-3.805(1)*

Figures in parentheses in the ADF test results indicate number of lag structures
** indicates significance at 1 percent level
* indicates significance at 5 percent level

Table 2(a): The Johansen Cointegration Test (Trace Eigenvalue Statistic)

Eigenvalue	Trace statistic	5 percent critical value	Number of co-integrating equations
0.485	22.992	15.494	None*
0.121	3.741	3.841	At most 1

The results are based on a VAR with one lag, an intercept in the cointegration equation and an intercept in the VAR
* indicates significance at 5 percent level

Table 2(b): The Johansen Cointegration Test (Maximum Eigenvalue Statistic)

Eigenvalue	Max statistic	5 percent critical value	Number of co-integrating equations
0.485	19.251	14.264	None*
0.121	3.741	3.841	At most 1

The results are based on a VAR with one lags, an intercept in the cointegration equation and an intercept in the VAR
* indicates significance at 5 percent level

Table 3: DOLS regression results and a constant natural rate of unemployment

Dependent variable (*IFR*) Equation (6)		
Estimation method	*Constant (βUNR*)*	*Unemployment coefficient (β)*
Dynamic Ordinary Least Squares	2.597	-0.344
The ratio of the constant term (*βUNR**) to the absolute value of the unemployment coefficient (*β*) is the estimate of natural rate of unemployment (*UNR**): $\beta UNR^*/\lvert\beta\rvert = TIV - NRU$ $2.957/\lvert -0.344\rvert = 7.549$		

Table 4: Granger Causality Test Based on VECM

(a) UNR →IFR *Equation (9)*		
Variable	Chi-square test statistics	Degree of freedom
ΔIFR	0.062	1
	Coefficient	t-statistics
ECT_{t-1}	-1.130	-4.848**
(b) IFR→UNR *Equation (10)*		
Variable	Chi-square test statistics	Degree of freedom
ΔIFR	0.410	1
	Coefficient	t-statistics
ECT_{t-1}	-0.024	-0.715

Notes: ** indicates significance at 1 percent level

Appendix II: Figures

Figure 1: Natural Rates of Unemployment and Supply Shock in the Philippines

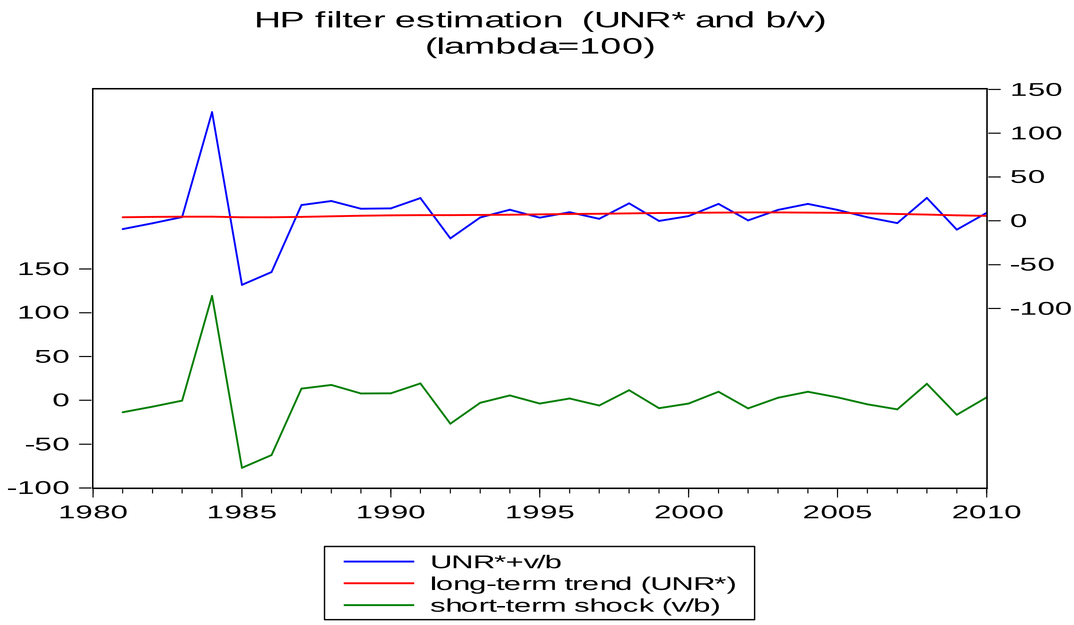

Figure 2: Time-Varying Natural Rates of Unemployment in the Philippines