

Abstract

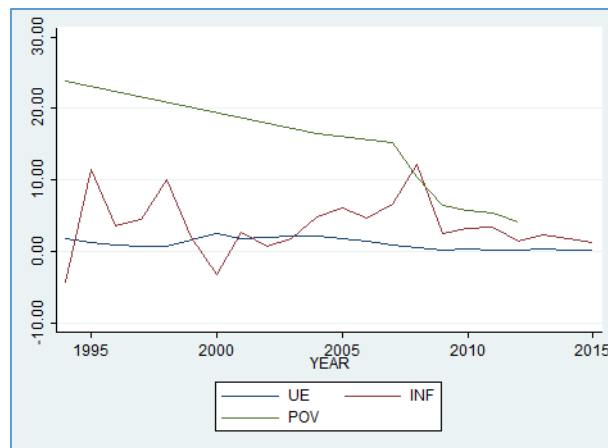
This study aims at investigating the causal relations between unemployment and inflation in Cambodia according to the Phillips curve framework. Time series analysis based on VEC model is employed to evaluate the causality among variables. The observed variables are stationary at first difference using Augmented Dickey-Fuller test, and one cointegrating equation is found from Johansen cointegration test. VECM model is therefore appropriate for testing the long run relationship. The study finds that there is two-way causality between unemployment and inflation in the short run while there is one-way relationship from inflation to unemployment in the long run. However, the study could not state whether there is a tradeoff between unemployment and inflation in both short and long run. Therefore, further study can be conducted to illustrate if tradeoff exists and to examine the effect of these factors on Cambodian economy.

I. Introduction

Cambodia has shown strong economic growth over the last two decades after its first national election in 1993. This country has recognized as one of the lower middle-income economies with significant growth by the World Bank, and the government aims to reach upper-middle income and high-income status by 2030 and 2050, respectively (Ministry of Economy and Finance, 2016).

Along with this recent achievement, the government also pays attentions on reducing the poverty, inflation as well as the unemployment rate to ensure sustainable growth. Figure 1 explains the downward sloping trends of these economic determinants from 1994 to 2015 which represents the efforts of the government to reduce these development constraints. Inflation and unemployment in Cambodia plays a significant role to reduce poverty and enhance economic growth. This study therefore will focus on the relationships among them and try to explain this phenomenon.

Figure 1: Trends of unemployment, inflation and Poverty¹ in Cambodia



Source: The World Bank, World Development Indicator (2016)

From an Asian Development Bank (ADB) report (2017), inflation rate in Cambodia will rise from 3.4 percent in 2017 to 3.5 percent in 2018. This scenario happens due to the higher international price of oil and other goods. However, this level of inflation remains favorably low. Inflation has been fluctuating over this period. Also, Cambodia confronted high inflation rate at around 12 percent due to the existence of global financial crisis in 2008.

¹ Poverty is measured by the poverty gap index at \$3.10 a day (2011 PPP). Some data on poverty gap are not available (from 1995 to 2003, 2005, 2006, 2013, 2014 and 2015).

Moreover, unemployment rate in the country is relatively low at 1.4 percent average between 1994 and 2015. Cambodia has a high rate of labor participation in the economic activities. However, it is informed in ADB report (2015) that young Cambodian workers are poorly educated which leads to a mismatch between worker's skills and employers' demand. Over 4 out of 10 Cambodian workers do not have appropriate knowledge to perform their jobs well. Thus, quality of education plays an important role to solve this issue. Yet, accessibility to education for the poor and enhancement of teachers' quality need to be in place.

As seen in figure 1, the inflation in Cambodia keeps fluctuating over time while the unemployment does not move that much. Hence, this study would investigate whether there is any short-run or long-run relationship connecting inflation and unemployment comparing to the Phillips curve framework where the tradeoff between them in the short-run is present.

II. Literature Reviews

There are some previous studies on the relationship between the two economics factors, namely unemployment and inflation. Those studies are summaries as follow.

Author Mankiw (2001) studied the short-run inflation-unemployment tradeoff based on the standard dynamic models of price adjustment. In this study, he raised that monetary policy has short-run influence on unemployment and determines inflation in the long run; he added that it can be explained why there is a short-run tradeoff through price stickiness. Nevertheless, it is still unexplainable the dynamic relationships between these two factors.

According to Staiger, D. *et al.* (1997), the author aims to observe the relationship among non-accelerating inflation rate of unemployment (NAIRU), unemployment and monetary policy. The study explained that the unemployment is not well estimated, so change in NAIRU should be considered to explain the effectiveness of monetary policy. Furthermore, the authors described the unemployment history could only explain inflation in the next year, not the next two years. In this sense, there is no long-run effect from unemployment to inflation.

Karanassou, M. *et al.* (2005) conducted a study on the effect of monetary policy on inflation-unemployment tradeoff in the long run following frictional growth. The authors

found three empirical results. First, they argued that the long-run Phillips curve could be flat. They stressed that, based on the result from OECD, inflation does not fall unconditionally when unemployment is above its natural rate. It is obvious that unemployment does not affect inflation rate in this case. Their second finding is that money growth shock has a slow effect on inflation. Third, the effect of monetary shock on unemployment is quicker. However, they added that the effect of monetary policy takes time for us to see its real consequence.

There is another study conducted by the above authors, Karanassou, M. *et al.* (2008), related to the impact of money supply on the long-run changes of inflation and unemployment in the case of Spanish economy. They estimated the model for long-run Phillips curve before and after the change of institution and policy separately. They then found that effect of the decrease in money growth contributed larger to the rise of unemployment before rather than after the policy change. The 10% decrease in money growth forced the unemployment to rise by 5.3 percent before and 3.7 percent after the change. However, they argued that this institutional change was not the reason behind this differential effect. The restrictive monetary policy after policy change in post 1973 era could be the real cause. They further found that the money growth during 1990s led to significant decrease of unemployment at the end of the decade. Their conclusion is monetary policy helps directly promote macroeconomic activities and unemployment in long run. Yet, the challenge occurs where it is no longer conspicuous that policymakers should focus just on reducing inflation. Nevertheless, the main purpose for monetary policy is to achieve both lower inflation and unemployment rates in the country. This seems to demonstrate the effort of the government to reduce unemployment and inflation should be balanced.

III. Theoretical Frameworks

According to Mankiw (2013), the Phillips curve determines the tradeoff between wage inflation and unemployment in short run. The policymakers are always focusing on reducing both inflation and unemployment, but the results become mostly contradictory which reflects the Phillips curve framework. However, the author emphasizes that today Phillips curves has been redefined where wage inflation is replaced by price inflation, expected inflation and supply shock are taken into account. He further explains the forces

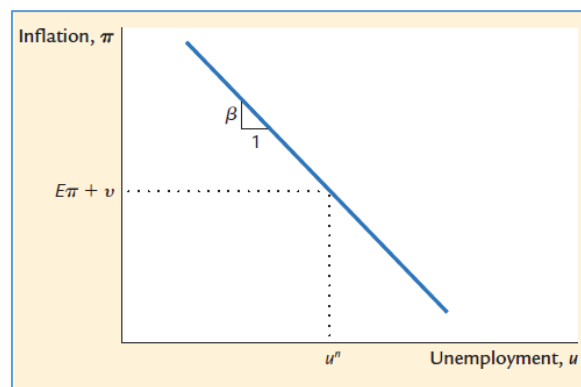
on inflation rate which are expected inflation, cyclical unemployment and the supply shocks as expressing in below short-run Phillips curve equation:

$$\pi = E\pi - \beta(u - u^n) + v$$

$$\text{inflation} = \text{expected inflation} - \beta \times \text{cyclical unemployment} + \text{supply shock}$$

The minus sign before cyclical unemployment represents negative relationship between unemployment and inflation. Unemployment (u) and inflation (π) are endogenous variables which is influenced by supply shock (v) (Karanassou, M, *et al.*, 2005). The coefficient β is the slope of tradeoff between the two endogenous variables.

Figure 2: The Short-run Phillips Curve



Source: Mankiw, *Macroeconomic*, 8th edition (p.412)

According to Mankiw 2013, he stated that “In the long run, the classical dichotomy holds, unemployment returns to its natural rate, and there is no tradeoff between inflation and unemployment” (p. 412). It implies that the cyclical unemployment become zero in the long run, and it will not have an impact on inflation.

In addition to the long run scenario, even if the unemployment is at its natural rate, the government policy to reduce inflation will affect the future unemployment. This can be interpreted through sacrifice ratio which refers to the percentage of GDP sacrificed to lower the inflation. Then, sacrificed ratio is linked with Orkun’s law to illustrate how long it takes the unemployment to increase in order to reduce the certain rate of inflation (Mankiw 2013).

IV. Data and Methodology

1. Data and Limitation

Due to the availability of data, this study will analyze the relationship between unemployment and inflation in Cambodia using time series data from 1994 to 2015.

Annual data on unemployment and inflation are compiled from the World Bank data (2016). Specifically, inflation is regarded as the gross domestic product (GDP) deflator at annual rate while unemployment is measured as the total unemployment as percentage of total labor force. STATA is used as a tool to analyze this case study.

2. Methodology

Before reaching the causality estimation of unemployment and inflation followed VAR framework, this study will start with a simple linear model with unemployment and inflation as dependent and independent variables, respectively.

$$UE_t = \beta_0 + \beta_1 INF_t + \mu_t, \quad \mu_t \sim WN(0, \sigma^2)$$

where UE_t is the unemployment as percentage of total labor force at time t , INF_t is the inflation rate at time t , and u_t is assumed to be a white noise process to avoid obtaining biased estimators.

Since this study is conducted using time series analysis, the stationarity of observed variables first needs to be checked to avoid spurious regression. An estimation with non-stationary data leads to inefficient estimators and produce invalid standard test results (Granger and Newbold, 1974). Augmented Dickey-Fuller test is therefore employed to perform the unit root check with null hypothesis stated that the series have unit roots. The rejection decision is made depending on Mackinnon critical values at 1%, 5% and 10% significance level.

Next step is to define the optimal lags for the estimation. This lag length selection process plays an important role to avoid error estimation from choosing too many or few lags. There are different criteria to help choose optimal lags such as Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC) and Schwartz Bayesian Information Criterion (SBIC).

The Johansen cointegration test is then employed to test whether or not there is a stationary relationship among observed variables in long run. It consists of two tests namely the maximum eigenvalue and trace test. Most importantly, this test will identify the correct model (VAR model or VECM) for examining the causality between unemployment and inflation.

V. Empirical Results

1. Unit Root Test

This test follows the simple autoregressive, AR(1), model as $Y_t = \phi Y_{t-1} + \varepsilon_t$, where $\varepsilon_t \sim WN(0, \sigma^2)$. The two hypotheses are given as:

The null hypothesis $H_0: \phi = 1$ and alternative hypothesis $H_1: \phi < 1$

In performing the unit root test, the study has first tested the observed variables at level and found that inflation is stationary while unemployment contains a unit root after failing to reject the null hypothesis. It is necessary to perform another test at first difference. The result then shows that both variables are stationary at first difference considered as I(1) random walk process. Therefore, first difference variables will be used in the estimated model. Table 1 shows the results from Augmented Dickey-Fuller unit root test.

Table 1: Augmented Dickey-Fuller Test

Variables	Level		First Difference	
	Constant No Trend	Constant & Trend	Constant No Trend	Constant & Trend
UE	-1.099	-1.451	-3.275**	-3.232*
INF	-4.993***	-5.016***	-8.458***	-8.091***

Note: ***, **, * represent significance level at 1%, 5% and 10%, respectively.

2. Lag length Selection

The study has performed a test for selecting optimal lags for the analysis. From table 2, the optimal lag at 4 is selected by LR, FPE, AIC and HQIC while lag 1 is chosen by SBIC. This study will follow AIC result by choosing 3 optimal lags for each variable.

Table 2: Lag length selection criteria

Lag	LR	FPE	AIC	HQIC	SBIC
0	-	9.23727	7.89877	7.91241	7.9977
1	32.752	2.34944	6.52365	6.56458	6.82044*
2	4.6177	2.90311	6.71156	6.77976	7.20621
3	13.946*	2.20757*	6.38124*	6.47673*	7.07375
4	5.8359	2.78135	6.50147	6.62424	7.39184

Note: * denotes the optimal lag selected by each criterion.

3. Cointegration test

The cointegration test is performed to check the cointegrating equations among stationary variables. According to the results from Johansen cointegration test in table 3, trace statistic is

smaller than the 5% critical value which tells that the null hypothesis is failed to reject. Therefore, there is at least a cointegration equation representing long-run relationship between observed variables. When variables are cointegrated, vector error correlation model should be applied.

Table 3: Johansen cointegration test

Maximum Rank	Parms	LL	Eigenvalue	Trace Statistic	Max Statistic	5% Critical Value
0	10	-53.548272	-	15.5774	14.6043	15.41
1	13	-46.2461	0.53636	0.9730*	0.9730	3.76
2	14	-45.759596	0.04992			

Note: * denotes the cointegration at each rank.

4. Granger Causality

This paper will adopt Vector Error Correction Model (VECM) with 3 optimal lags since due to the results from lag length selection criterion and co-integration test. The VEC model can be written as follows:

$$\Delta UE_t = \alpha_1 + \sum_{i=1}^p \alpha_{11} \Delta UE_{t-i} + \sum_{i=1}^p \alpha_{12} \Delta INF_{t-i} + \delta_1 ECT_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta INF_t = \alpha_2 + \sum_{i=1}^p \alpha_{21} \Delta UE_{t-i} + \sum_{i=1}^p \alpha_{22} \Delta INF_{t-i} + \delta_2 ECT_{t-1} + \varepsilon_{2t} \quad (2)$$

The result of VECE estimation is shown in Appendix 4.

From Table 4, there are both short-run and long-run relationships between unemployment (DUE) and inflation (DINF) in the case of Cambodia. For short-run relationship, there is a bidirectional causality between the observed variables. Inflation has chi2 of 7.32 with p-value of 0.0257. The chi2 is statistically significant which illustrates the short-run connection from inflation to unemployment. Similarly, unemployment obtains the chi2 at 5.07 with p-value of 0.0793 which is marginally significant and exhibits another causality relation from unemployment to inflation.

As long-run causality, there is only a unidirectional connection from inflation to unemployment. The z-value of error correction term (ECT) from equation (1) is -2.44 which is negative and statistically significant at 5% level. This explains the long-run connection from inflation to unemployment. However, the z-value of ECT from equation (2) is 4.44 which is positive and statistically significant at 5% level. This positive z-value does not represent the long-run causality.

Table 4: Granger causality test

Dependent Variables	Type of Granger Causality		
	Short-run		Long-run
	DUE	DINF	ECT
	Chi2 [P-Value]		z-value [P-Value]
DUE		7.32** [0.0257]	-2.44 ** [0.015]
DINF	5.07* [0.0793]		4.437637** [0.022]

Note: ***, **, * represent significance level at 1%, 5% and 10%, respectively.

This implies that the framework of Phillips curve is applicable for Cambodia's case where there are causal impacts between inflation rate and unemployment in the economy. To lower the unemployment rate, the government would use fiscal policy to increase the aggregate demand through increasing government expenditure. The unemployment rate will then fall by the increase in demand for labor. Labor wages will also rise while firms start to raise the price of their products. The real wage will decrease and the workers will negotiate for higher wage. Firms will then lose their profits which force them to reduce their productivities and labor demands. This will lower price of goods, but raise the unemployment rate.

However, unemployment does not affect the inflation in long-run perspective because inflation is most likely influenced by the international price level of merchandises rather than unemployment issue in Cambodia and unemployment is assumed to be at its natural rate regarding the long-run theory.

It would be an advantage to emphasize that unemployment in Cambodia mainly happens due to limited education attainment of Cambodian people, especially those who live in rural areas. This is the reason that the government has recently tried to strengthen the education sector as a major priority to promote high skilled labor and meet the requirements of foreign investment firms. Furthermore, the effort to build good cooperation regionally and globally plays an important role to expand its market and be a conspicuous incentive for investors. Therefore, in the long run unemployment rate will reach its natural level and only determine the progress on economy, not the inflation rate.

In additional, it is important to make sure that the residuals in estimation do not contain serial autocorrelation. Lagrange-multiplier Test is used. From the probability of

chi2, the null hypothesis (H0: no autocorrelation at lag order) is failed to reject. Thus, there is no serial correlation among variables.

Table 5: Lagrange-multiplier Test

Lag	chi2	df	Prob > chi2
1	5.3347	4	0.25465
2	2.8480	4	0.58358

After employing VECM, the test for normally distributed disturbances after VEC is needed to check whether all residuals are normally distributed to avoid having biased estimators. Again, based on Jarque-Bera test, the null hypothesis (H0: Residual is normally distributed) is failed to reject which implies that all residuals are normally distributed.

Table 6: Result of Normally distributed disturbances based on Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_DUE	1.064	2	0.58755
D_DINF	0.371	2	0.83087
ALL	1.434	4	0.83824

VI. Conclusions

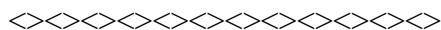
In conclusion, this paper aims to study the causality between unemployment and inflation in Cambodia based on Phillips curve theory. Time series analysis on unemployment rate and inflation is conducted, and VAR model is proposed to evaluate the causality among variable. Before reaching the causality test, it is important to conduct unit root test and cointegration tests to ensure the stationarity as well as to find whether all variables are cointegrated. Both variables are reported as stationary at first difference, and there is a cointegrating equation among them. This tells us that there is a long run relationship among our estimated variables. Therefore, the study employs vector error correlation model (VECM) instead of VAR model in order to check the long run causality.

From the regression results, the study finds that there is two-way causality between unemployment and inflation in the short run. This implies that empirical result for short-run connection corresponds to the short-run Phillips curve theory, where there exists the relationship among the two factors, but it could not tell whether there is a tradeoff between

them. Aligned with previous research on the long run tradeoff, this study finds that there is also one-way relationship from inflation to unemployment.

In efforts to reduce inflation through monetary policy in Cambodia, the government should consider the long-term effect on its GDP and unemployment rate. Moreover, this study also suggests that the government should pay more attention on promoting major economic sectors including education sector which is the key to attract more foreign investment and to stay competitive in international markets.

Further study on this framework can be conducted to illustrate the tradeoff between unemployment and inflation, and to examine the effect of these factors on Cambodia's economy.



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