INFLATION AND UNEMPLOYMENT IN SOUTHEAST ASIAN COUNTRIES: A PANEL GMM APPLICATION ON PHILLIPS CURVE

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Abstract

This study aims to analyze the relationship between inflation and unemployment in 10 Southeast Asian from 1996 to 2016 using 210 data samples. The estimation results, using the GMM panel method, showed that the use of Instrument Variables (IV) is valid for the model and the results show a negative and significant relationship between inflation and unemployment. The optimal value of inflation and unemployment for the Southeast Asian Region were found to be 4 percent and 8 percent respectively. This means that a trade-off has taken place. Thus, the existence of the Phillips Curve in Southeast Asian countries during the period of 1996-2016 can be proven. In accordance with the Phillips Curve review, if the trade-off occurs, the government cannot resolve both problems simultaneously. In other words, policy makers must be able to choose the problem to be addressed first, either by implementing monetary policy, fiscal policy or both, so that economic stability and public welfare are maintained.

Keywords: Inflation, Unemployment, Phillips Curve, Panel GMM, Southeast Asia.
JEL classification: E24, E31, C23, J01

1. Introduction

Inflation and unemployment are two things that have always been problems in countries' economies. Ideally these two problems should be overcome simultaneously, so that the amount of inflation and unemployment in a country can be minimized simultaneously. But both of these macroeconomic problems are very complicated. If the government wants to reduce inflation, then at the same time it will cause the number of unemployed people to increase. Conversely, if we want to reduce unemployment, then at the same time we will increase inflation.

Even though the problems of inflation and unemployment are two important issues, the priorities of countries in solving these two problems are different. A study conducted by Inoue et al. (2012), about several Southeast Asian countries including Indonesia, Thailand and the Philippines, showed that those countries prioritized overcoming inflation problems (Inflation Targeting) even though the unemployment rates in Philippines and Indonesia were still quite high (International Labor Organization, 2014).

The relationship between inflation and unemployment was introduced by Phillips (1958), who argued that there was a trade-off between inflation and unemployment in the UK. Since then, the inverse relationship between inflation and unemployment has been known as the *Phillips Curve*. The original Phillips curve showed a negative and non-linear relationship between unemployment and inflation. This allows policymakers to choose between the combinations of unemployment or inflation that they need most. However, several recent empirical studies showed that the relationship between unemployment and inflation may not always be able to be determined by the Phillips Curve. In fact, inflation and unemployment

can occur in a negative or positive relationship in the same period in one country (Al-Zeaud & Al-Hosban, 2015).

The existence of Phillips curves in various countries has been widely shown, Panel data has been used in OECD countries (Bhattarai, 2004), (DiNardo & Moore, 1999), (Turner & Seghezza, 1999), and several other studies have used time series data (Alisa, 2015) (Dritsaki & Dritsaki, 2013), (Dammak & Boujelbène, 2009). Meanwhile, a study of Southeast Asian countries has been conducted by Furuoka & Munir (2009), but it was limited only to 5 countries. Therefore, this study included all countries in the region of Southeast Asia, namely Brunei Darussalam, the Philippines, Indonesia, Laos, Cambodia, Malaysia, Myanmar, Singapore, Thailand, and Vietnam in order to analyze the relationship between inflation and unemployment, with an overview of the existence of the Phillips Curve in Southeast Asia in the period of 1996-2016.

2. Literature Review

The term inflation refers to an increase in the level of prices of goods and services as a whole in an economy which causes a decrease in household purchasing power. Whenever prices rise, the value of money will depreciate and finally real household income will drop (Singh & Verma, 2016). According to Al-Zeaud & Al-Hosban (2015) inflation is an upward movement in the average price level, while deflation is a downward movement in the average price level. Inflation can occur due to an increase in the money supply, a decrease in demand for money, a decrease in the supply of goods and services, or a combination of those various factors.

According to Al-Zeaud & Al-Hosban (2015) unemployment has always been a major issue for many economies in various countries, especially in times of recession in which work must be sought to increase the aggregate demand (AD) and aggregate supply (AS). However, unemployment can be controlled to a certain extent, depending on the type and causes of unemployment in each country.

Many studies have been undertaken since the end of the 1960s either to support or to refute the results of Phillips's research. Two American economists, Samuelson and Solow (1960), supported Phillips's hypothesis by examining the relationship between the two macroeconomic variables and concluded that there is an inverse relationship between inflation and unemployment in the United States. Furthermore Solow (1970) and Gordon (1971) confirmed the existence of a negative trade-off relationship between inflation and unemployment, which known as "*Solow-Gordon Affirmation"* (Furuoka & Munir, 2009).

Chletsos et al. (2016) conducted a study about the ability of the Phillips Curve to predict inflation during the great recession in the United States and Canada, with the results showing that the Phillips Curve could help improve predictive accuracy for the US, but not for Canada. Then, DiNardo & Moore (1999) conducted research in 9 OECD countries, and proved the existence of the Phillips Curve in these countries. Furthermore, Turner & Seghezza (1999) also used panel data to examine 21 OECD countries from 1970 to 1997 using the SURE (Seemingly Unrelated Estimation) method and obtained strong support for the existence of the Phillips Curve in 21 OECD countries.

In line with the studies above Bhattarai (2004) has also conducted research on the trade-off between inflation and unemployment using quarterly panel data from 1970:4 to 2002:1 that shows a trade-off between inflation and the unemployment rate in accordance with the provisions of the Phillips Curve in a number of countries including Great Britain, Italy, Norway, the Netherlands, New Zealand and the US. Furthermore Bjornstad & Nymoen (2008), examined the Phillips Curve with panel data using the New Keynesian Phillips Curve (NKPC) model approach including an Econometric for Assessing Economic Models.

Furuoka & Munir (2009) studied the existence of the Phillips Curve in Southeast Asia by examining the relationship between the rate of inflation and the unemployment rate for the period of 1982-2004 using a Pooled Least Square (PLS) analysis method. This research was only limited to 5 countries in ASEAN (Malaysia, Singapore, Indonesia, Thailand and the Philippines). The results of the study found that there was no trade-off relationship between inflation and unemployment in these ASEAN countries.

Studies using time series data in several Southeast Asian countries have also been conducted. Among them, Furuoka (2007) chose Malaysia as the focus of research on the

empirical relationship between the rate of inflation and the unemployment rate for the period 1973-2004 using the OLS and GLS methods. Furuoka & Munir (2010) also examined the validity of the Phillips Curve in Brunei Darussalam, with results showing that it was valid. Then, Furuoka et al. (2013) also examined the existence of the Phillips Curve in the Philippines in the period of 1980-2010 and found evidence of the existence of the Phillips Curve in the Philippines. Furthermore, Solikin (2004) used Indonesian quarterly data in (1974:4-2002:1) and tested the classical regression model variation with the State-Space-Time Varying Parameter model using the OLS, GMM, and MLE methods and the KF Algorithm. The results of this research showed that the Phillips Curve phenomenon exists in the Indonesian economy. In line with this research, Maichal (2012) also examined the existence of the Phillips Curve in the Indonesian Economy in the period of 2000.Q1-2010.Q3 using the GMM method for Hybrid models and the NKPC, indicating that the Phillips Curve phenomenon exists in the Indonesian economy.

Another study was also carried out by Stimel (2009) which tested non-linear models based on U.S. data from 1960:1 to 2006:1, using an STR nonlinearity testing strategy. This study found evidence that the U.S. Phillips curve is nonlinear, with the result indicating that the nonlinearity is tied to the business cycle. Dammak & Boujelbène (2009) found that there was a long-term trade-off relationship between inflation and unemployment in Tunisia, thus proving the existence of the Phillips Curve in the period of 1962-2004. Then, to explore the existence and stability of the Phillips Curve in North Cyprus, Shahbaz, et al. (2012) conducted research and found that the Phillips Curve was stable both in the short and long term. Furthermore, the relationship between inflation and unemployment in Greece was examined by Dritsaki & Dritsaki (2013), with results showing a long-term and causal relationship between inflation and unemployment in the period of 1980-2010.

Furthermore, the existence of the Phillips Curve in Jordan for the period of 1976-2013 was scrutinized by Al-Zeaud & Al-Hosban (2015), who showed a negative and non-linear correlation between inflation and unemployment which proves the existence of the Phillips Curve in the Jordanian economy and also showed the amount of inflation and optimal unemployment during this period. Finally, Alisa (2015) examined the relationship between inflation and unemployment in Russia by analyzing the opinions of economists during the period of 1994-2015, ultimately obtaining significant results.

Based on the consideration that the previous research was limited to only a few countries, this study of the existence of the Phillips Curve is significant because it covers all countries in the region of Southeast Asia.

3. Research methods

This study used secondary data with inflation variables and unemployment rates obtained from the World Bank, the Asian Development Bank (ADB), The International Labor Organization (ILO), and other institutions. The data collected is time series 1996-2016 panel data with cross-sections of 10 countries in the region of Southeast Asia that have different socio-economic characteristics, namely: Brunei Darussalam, the Philippines, Indonesia, Cambodia, Laos, Malaysia, Myanmar, Singapore, Thailand, and Vietnam. There was a total of 210 data samples used.

Two approaches were taken in this study, a linear and a nonlinear approach. The linear approach used dynamic panel data models, which were estimated using the Generalized Method of Moments or GMM method (Arellano & Bond, 1991). The GMM panel method is the best estimation method for dynamic panel data models involving lagged variables. Therefore, in this study, in order to determine the trade-off relationship between inflation and unemployment, the model created by Furuoka & Munir (2009) included the lagged value of inflation as expressed in the following equation:

$$INF_{it} = \alpha + \beta_1 UN_{it} + \beta_2 INF_{it-1} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where INF_{it} is the inflation rate in country i in the year t; The UN_{it} is the unemployment rate in the country i in the year t; INF_{it-1} is the value of the lag inflation for year t in country i; α is the intercept; β_1 and β_2 are slope parameters, and ε is the error term.

The non-linear approach was used to calculate the optimal rate of inflation and unemployment. The non-linear model created by Al-Zeaud & Al-Hosban (2015) was developed in this study into a quadratic equation in order to find the optimal value of inflation and unemployment. This quadratic function was also used to determine the shape of an inverted U or U curve with the following equation:

$$Y_{it} = B_0 + B_1 X_{it} + B_2 X_{it}^{\ 2} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where Y_{it} is the independent variable; B_0 is the scale of the constant; B_1 and B_2 are the elasticity of X to Y; X_{it} is the dependent variable; and ε_{it} is the error term.

Equation (2) was estimated using the Panel Least Square (PLS) method, then the optimal inflation and unemployment rate were calculated using the following optimization formula:

$$\frac{d\,Y_{it}}{d\,X_{it}} = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

4. Empirical Findings

A summary of descriptive statistics for inflation and unemployment variables in Southeast Asian countries can be seen in Table 1, where the variable of inflation has an average value (mean) of 6.93 and a standard deviation of 13.31. The mean value is smaller than the standard deviation, indicating that the linearity is not ideal due to its large deviation. Conversely, the average value (mean) obtained for the unemployment rate was 4.30, with a standard deviation of 3.60, which shows that the unemployment rate variable data is normally distributed because the mean value is greater than the standard deviation. The range of values of the two variables (inflation and unemployment rate) are completely different from each other, which can be seen from the minimum values of -2.31 and 0.58, respectively, while the maximum values are 125.27 and 14.97, respectively.

Table 1. Summary Description of Statistics

Criteria	Inf	Un
Mean	6.937735	4.306242
Median	3.820324	2.885000
Maximum	125.2721	14.97627
Minimum	-2.314972	0.580000
Std. Dev.	13.31040	3.605312
Skewness	5.462280	1.144098
Kurtosis	40.71468	3.220436
No. of Observations	210	210

Sources: Estimated Results, 2019.

Before the estimation was carried out, the stationary test was first conducted, because the data exhibited time periods (T) > number of regions (N). The stationary test was carried out with the LLC (Levin, Lin, & Chu), IPS, (Im, Pesar, & Shin), ADF, and PP approaches.

The results of stationary testing can be seen in Table 2, in which shows that because inflation (INF) does not have a unit root at level it is stationary. As with the LLC, IPS, ADF, and PP approaches, each value had a significance value smaller than 1 percent. The same results with individual intercept and trend conditions show results obtained for inflation. These results do not have a unit root and are stationary with a significance level of 1 percent. Whereas for the variable of unemployment (UN), testing showed stationary results, with a 1 percent significance levels for LLC, while IPS, ADF, and PP had 5 percent significance levels. Therefore, the INF and UN variables are integrated in I (0).

Table 2. Panel Unit Root

Variable	At-level		First-difference	
	Individual Intercept	Individual Intercept and trend	Individual Intercept	Individual Intercept and trend
Inflation (INF)				
LLC	-5.611**	-6.977**	-	-
IPS	-3.921**	-4.338**	-	-
ADF	49.975**	56.294**	-	-
PP	69.861**	68.859**	-	-
Unemployment (UN)				
LLC	-3.396**	0.789	-3.767**	-3.489**
IPS	-1.768*	-0.215	-4.974**	-3.842**
ADF	31.764*	38.41**	85.416**	60.502**
PP	33.997*	29.57	144.094**	110.608**

Sources: Estmated Results, 2019. Represents *5%, **1%.

The estimation results of the Phillips Curve with a linear approach can be seen in Table 3. To determine the best estimation method to use, three analytical methods namely OLS / PLS, GMM 2SLS and GMM First-Difference (GMM FD), were compared.

An Instrument Variable (IV) method was used to estimate the GMM Panel in accordance with estimation variables, namely inflation (INF) and unemployment (UN), by assuming that the past effects of these two variables have an effect on predictions of the future. While the use of variable exchange rates (ER) was treated as an exogenous IV, because ER can create imported inflation.

The results of the estimation of the three methods above showed a negative relationship between inflation and unemployment, but the use of the PLS method showed insignificant results. The estimation with the GMM 2SLS Panel method that used an endogenous IV: C, UN (-1), INF (-1), UN (+1), and an exogenous ER, ER (-1), produced 6 instrument ranks with a J-stat probability value of 0.000, meaning that this data is invalid, and the model is not appropriate. Then, proceeding using the GMM First-Difference Panel (GMM FD) method using an endogenous IV: @DYN (INF, -2), UN (+1), UN (-1) and exogenous: ER, ER (-1), resulted in 10 rank instruments with a J-Stat probability value of 0.419> 0.05, which means that the use of IV in this model is valid.

In the measurement of the GMM model, R-square was not used as a standard statistic to determine whether or not a model is appropriate. Instead the value of the J-Stat used in the model (Solikin, 2004) was used to assess the validity of the Variable Instrument (IV). The estimation results with a GMM FD panel showed a negative and significant relationship between inflation and unemployment. An increase of 10 percent in unemployment will cause inflation to decline by 0.3 percent. This shows that the trade-off between inflation and unemployment does occur, and thus the Phillips Curve is proven to exist in the economies of Southeast Asian countries.

The findings of this study contradict the previous study conducted by Furuoka & Munir (2009), who found no trade-off between inflation and unemployment in five Southeast Asian countries, which indicated the absence of the Phillips Curve in the economies of these countries. This may be due to the number of countries studied and the use of different methods. Then, several results of similar studies with time series data found a trade-off between inflation and unemployment, in effect confirming the existence of the Phillips Curve in several Southeast Asian countries (Furuoka, 2007), (Furuoka & Munir, 2010) (Solikin, 2004), (Furuoka et al., 2013), (Maichal, 2012).

Table 3. Linear Estimation of Phillips Curves

Variable	OLS/PLS	GMM	
		2SLS	First-Difference
Constant	3.396	3.553	-
	(2.555)**	(2.515)*	
UN	-0.16	-0.17	-0.356
	(-0.733)	(-1.852)	(-7.551)**
INF(-1)	0.594	0.59	0.488
	(10.29)**	(2.663)**	(2163.6)**
R-Square	0.358	0.354	-
R-Square Adjusted	0.351	0.348	-
F-Stat	54.471	-	-
	[0.000]**		
DW	1.81	1.81	-
AR(1)			-1.898
			[0.057]
AR(2)			-1.484
			[0.137]
Instrument Rank	-	6	10
J-Stat	-	43.76	8.139
		[0.000]**	[0.419]

Sources: Estimated Results, 2019. () t-stat, [] prob., *5%, **1%. GMM exogen instrument: ER, ER(-1).

Table 4 shows the estimation of the quadratic non-linear model regression applied to the unemployment variable (UN). The estimation results explain that the effect of unemployment on inflation is negative, but not significant, where an increase in unemployment of 1 percent will reduce inflation by 1.8 percent.

Table 4. Non-Linear Estimation of Phillips Curves

Variable	Coefficient	T-Stat	Prob.
Constant	11.236	4.962	0.0000**
UN	-1.801	-1.833	0.0682
UN^2	0.112	1.511	0.1322

Sources: Estimated Results, 2019. Represents *5%, **1%.

To calculate optimal inflation and unemployment in the region of Southeast Asia, an optimization formula d (INF) / d (UN) = 0 was used:

$$INF = 11.236 - 1.801UN + 0.112UN^2 \quad \text{.....(4)}$$

$$\frac{d(INF)}{d(UN)} = -1.801 + 0.224UN \quad \text{.....(5)}$$

$$UN = \frac{1.801}{0.224} = 8.04 \quad \text{.....(6)}$$

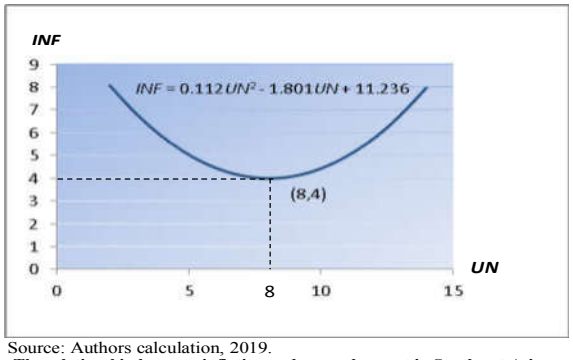
$UN \approx 8$ Percent

The UN result of 8.04 percent was substituted into Equation (4); in order to obtain the optimal INF number:

$$INF = 11.236 - 1.801\,(8.04) + 0.112\,(8.04)^2$$
$$= 11.236 - 14.48 + 7.239$$
$$= 3.995$$

$INF \approx 4$ Percent

Based on these findings, the relationship between inflation and unemployment in the countries of Southeast Asia can be described as follows:

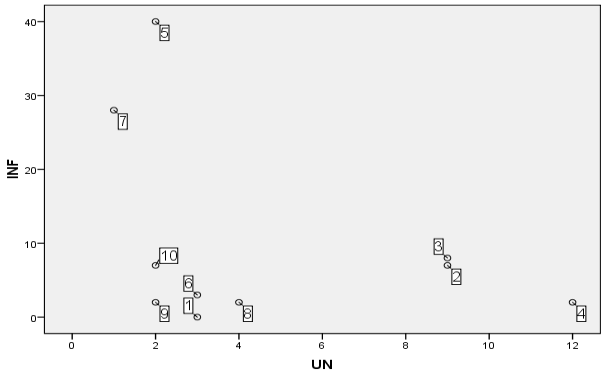


Source: Authors calculation, 2019.

Figure 1. The relationship between inflation and unemployment in Southeast Asia

The optimal inflation limit in the region of Southeast Asia obtained in this study was 4 percent, approaching the inflation limit obtained by Al-Zeaud & Al-Hosban (2015), which

was 3.779 percent. While the optimal unemployment rate obtained, 8.04 percent was as much as 8 percent lower than the result obtained for Jordan, was 11.077 percent. This is possible because both Jordan and countries in Southeast Asia have small and open economies, and this can also occur because of the use of different methods and data.



Note : 1. Brunei Darussalam (3,0); 2. Filiphina (9,7); 3. Indonesia (9,8); 4. Kamboja (12,2); 5. Laos (2,40); 6. Malaysia (3,3); 7. Myanmar (1,28); 8. Singapura (4,2); 9. Thailand (2,2);10. Vietnam (2,7)

Source: Authors calculation based on estimated results, 2019.

Figure 2. The relationship between inflation and unemployment in 10 Southeast Asia Countries

The relationship between inflation and unemployment in Southeast Asian countries can be seen in Figure 2. Out of ten countries in Southeast Asia, 5 have trade-off values that meet the criteria of optimal unemployment and inflation in the region namely, countries where the unemployment value (X) is higher than the inflation value (Y). These five countries are Brunei Darussalam (3,0), Philippines (9,7), Indonesia (9,8), Cambodia (12,2), and Singapore (4,2). While Laos (2,40), Myanmar (1,28) and Vietnam (2,7) have different trade-off values, where the unemployment values are much lower than the optimal inflation values. Then as Malaysia and Thailand have the same values of unemployment and inflation, namely (3,3) and (2,2), they exhibit no trade-off.

This occurred because during the period of around 1997-1998 there was a global crisis that affected the economies of countries in Southeast Asia, and each country had a different level of resilience to the crisis.

5. Conclusion

From analysis of the results of the relationship between inflation and unemployment in Southeast Asian countries, it can be concluded that through a linear approach, the estimation results of dynamic panel data models with the GMM / DPD panel method show that inflation and unemployment have a negative and significant relationship. Thus, the trade-off between inflation and unemployment occurs, and the Phillips Curve is proven to exist in Southeast Asian countries. With a non-linear approach, estimates were made using the Panel Least Squared (PLS) method with a quadratic equation model, from which an inflation value of 3.996 percent ≈ 4 percent and unemployment of 8.04 percent ≈ 8 percent were obtained. These values are thus the optimal inflation and unemployment values for Southeast Asian countries.

Based on the Phillips Curve review, the trade-off between inflation and unemployment in Southeast Asian countries indicates that these two problems cannot be addressed simultaneously. Governments and policy makers must choose to address the issues that are most urgent, either by applying monetary policy, fiscal policy, or both. Then, every country in Southeast Asia can determine the optimal level of inflation and unemployment and also try to reduce inflation and unemployment as much as possible in order to maintain economic stability and public welfare.

In this study, only the original Phillips Curve Model was used, because the variables studied were limited, as it only focused on the problems of inflation and unemployment. Further research could be done using the Hybrid Phillips Curve model and the New Keynesian Phillips Curve (NKPC) model, so that more accurate results can be obtained with a broader scope of research.

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