The Inflation Dynamics of the ASEAN-4: A Case Study of the Phillips Curve Relationship

Klarizze Anne M. Puzon

BS Economics student
University of the Philippines, Quezon City, Philippines
kmpuzon@gmail.com

Abstract: The conventional Phillips curve argues that there is a trade-off or negative relationship between unemployment and inflation. The aim of this study is to investigate the validity of the Phillips curve for the ASEAN-4 countries: Philippines, Thailand, Indonesia, and Malaysia from 1980 to 2005. Besides unemployment, the relationship of interest rate, exchange rate, and supply shocks to inflation, were also investigated. Using various econometric techniques like Ordinary Least Squares and Instrumental Variables, it was found out that for the ASEAN-4, there seems to be no stable one-to-one trade-off between unemployment and inflation. Variables that could help control inflation were also different for the four countries. For Thailand, the inflation lag, unemployment and oil dummy were significant. As for Indonesia, the interest rate, 1997 East Asian Financial Crisis dummy, and oil dummy were significant in affecting inflation. The OLS regression gave the best linear unbiased estimate for both countries. For the Philippines, serial correlation was detected. Thus, Prais-Winsten method was employed. It was then shown that the unemployment lag, interest rate, and exchange rate lag were significant at the 10% level of significance. [Report and Opinion. 2009;1(2):42-44]. (ISSN: 1553-9873).

Key words: Phillips curve; inflation; unemployment; ASEAN

I. Introduction

The empirical studies on the Phillips curve analyzing the relationship of unemployment rate to the inflation rate are the results of the search for a tool for forecasting inflation and implementing monetary policy. The conventional Phillips curve argues that there is a trade-off or negative relationship between unemployment and inflation (Dornbusch, *et al.* 2005). Economists soon modified the Phillips curve theory to focus on inflation in relation to unemployment. The aim of this paper is to investigate the validity of the Phillips curve for the ASEAN-4 countries: Philippines, Thailand, Indonesia, and Malaysia from 1980 to 2005. Some variables that could affect inflation are also analyzed. Thus, this paper will explore some tools that could aid in the inflation targeting strategies of the ASEAN-4 economies.

II. Empirical Model

I used annual Consumer Price Index, exchange rate (domestic currency per dollar), and money market interest rate data sets supplied by the United Nations Statistical Database (UNSD). For each country, the inflation rate was computed as the percentage change in the Consumer Price Index. That is, inflation rate= $(CPI_t - CPI_{t-1})/ CPI_{t-1} * 100$. All CPI and inflation rates data would have 2000 as the base year (CPI= 100). In addition, since the UNSD only have survey data for unemployment, we acquired more reliable unemployment rates from the National Economic Development Authority of the Philippines website. All of the annual data sets covered the period from 1977 to 2005.

For the empirical model, I modified the equations by Gordon (1997), Dua (2006), Stiglitz (1997), Staiger, Stock, and Watson (1997), and Smith (2000). In the formulation of a simple augmented Phillips curve, I also utilized Wan's (2001) linear model involving lagged inflation and cyclical unemployment as explanatory variables.

For Equation 1, I use the augmented version of Stiglitz's model to capture inflationary expectations by including the lagged inflation rate as a measure of the expected inflation rate. In addition, I include an unemployment lag to determine if such would provide a better fit. I also have additional explanatory variables: interest rate, lagged exchange rate, 1997 East Asian financial crisis binary dummy, and oil shock dummy variable for oil price fluctuations.

$$\pi_\tau = \beta_{0\tau} + \beta_1 unemp_t + \beta_2 \pi_{\tau-1} + \beta_3 unemp_{t-1} + \beta_4 intrate_t + \beta_5 xr_{t-1} + \delta_0 97 + \delta_1 oil + \upsilon_\tau \qquad (1)$$

The following are the hypotheses for the signs of the explanatory variables:

- Unemployment, unemp, and unemployment lag, $unemp_{t-1}$, as stated by the Phillips curve, is negatively related to inflation. That is, if the demand for labor increases due to an expansionary monetary expansion, the unemployment rate would fall causing wages/ prices to rise. Thus, creating a trade-off between inflation and unemployment.
- The inflation lag, $\pi_{\tau-1}$, the assumed expected inflation, is positively related to inflation. I assume this using the adaptive expectations theory.
- The interest rate, intrate or mmintrate, is positively correlated to inflation. Increasing interest rates results to higher costs for businesses, which causes prices to rise.
- Due to policy lags, the current exchange rate may be endogenous. Thus, I assume that the exchange rate lag is exogenous and use it in the model. The exchange rate I use is in the form: domestic currency per dollar. I use xr_1 to account for trade prices. I hypothesize that an increase in xr_1, a depreciation of the local currency, would increase inflation because of a higher import prices.
- Binary dummies, 97 and oil, were added to account for price shocks brought by the 1997 financial crisis and oil crises. Such control variables are expected to have a positive sign because they serve as supply shocks. To account for East Asian financial crisis, the years 1997 and 1998 have their 97 dummy equal to one. Meanwhile, the oil dummy for 1980, 1990, and 2005 is equal to unity since oil price fluctuations occurred during those years.

For Equation 2, I use first differencing. This model will only be used if the equation experiences unit root problems. Such unit root behavior was tested using the Phillips-Perron test.

$$\Delta\pi_\tau = \alpha_0 + \Delta\beta_1 unemp_t + \Delta\beta_2 \pi_{\tau-1} + \Delta\beta_3 unemp_{t-1} + \Delta\beta_4 intrate_t + \Delta\beta_5 xr_{t-1} + \delta_0 97 + \delta_0 oil + \upsilon_\tau \qquad (2)$$

To have more efficient estimates, I tested Equations 1 or 2 for heteroskedasticity and serial correlation. If either problem exists, corrections are employed to ensure consistent estimates. As will be discussed later, I also used Instrumental Variable method for Malaysia. More specifically, since unit root behavior occurs in the inflation variable, I used an instrument, the inflation lag of Singapore, for the inflation lag of Malaysia.

IV. Discussion of Regression Results

Using t-test, with an H_o: B_j=0, and a two-sided alternative of H_1: $B_j \neq 0$, the results for Equation 1 can be summarized as follows:

Table 1. Fully-corrected regression results for Equation 1
Dependent variable: Inflation
Significance level: 10%

Explanatory Variable	Indonesia	Malaysia	Thailand	Philippines
Infla_1	-.0488733 (.1096472)	.3483649 (.2066877)	.3773198 (.1637375)	-.0074889 (.1133733)
Unemp	0.2920096 (.7119024)	-.4904054 (.5649236)	-.9443959 (.4813811)	1.164838 (1.157631)
Unemp_1	.0188285 (.8245843)	.3516186 (.5329042)	-.389395 (.5979983)	-2.008291 (.7032352)
Mmintrate	1.200941 (.1402781)	-.060483 (.1525026)	-.3699473 (.3366451)	2.594078 (.2925591)
Xr_1	.0001955 (.0008092)	-1.265882 (1.38491)	-.1813196 (.1655893)	.8965375 (.3458095)
D97	-14.92133 (5.921631)	1.656048 (1.073852)	4.670027 (2.812547)	-3.558471 (3.915062)
Doil	4.907661 (2.690442)	1.596374 (1.078417)	5.304789 (1.658721)	4.543862 (4.269187)
Constant	.5815264 (.9750957)	.07467 (.830654)	-.9713239 (.566889)	-.2621564 (.9492679)
R^2	0.8855	0.4730	0.6918	0.8244
Adj R^2	0.8409	0.2680	0.5720	0.7561
n	26	26	26	26

For Thailand and Indonesia, the OLS regression gave the best linear unbiased estimate (BLUE). For both countries, the error terms have constant variance and have no autoregressive conditional heteroskedasticity (ARCH). There were also no random walk and serial correlation problems. For Thailand, using the adjusted R^2 value, 57.20% of the inflation variation was explained by the model. This is an improvement compared to Equation 1's adjusted R^2 value of 23.44%. Moreover, the inflation lag, current unemployment rate, and oil dummy were significant at the 10% level. The significance of the inflation lag is consistent to the findings of Dua (2006). This may signal that inflation is inertial (Smith, 2000). For Thailand, past inflation influences people's expectations on future inflation. Meanwhile, it was also estimated that a one percentage increase in unemployment, decreases inflation by .94439 percentage points. Such value is very near to one. Thus, I could say that the Phillips curve is present in Thailand using 1980-2005 data. Unemployment and inflation have a trade-off. This finding is similar to that found by Bhanthumnavin (2002). Oil price shocks also influenced Thai inflation values immensely. It was implied that, controlling for all other variables, when there is an oil price shock, predicted inflation is about 5.30 points higher than for a year without an oil price shock (i.e. inflation= doil + constant). That is, when there are oil price fluctuations, inflation increases by about 5.30 + (-.917)= 4.329 percentage points. From these, I could see that as the price of energy rises, the inflation rate will increase as production becomes more expensive. For Indonesia, the significant variables at the 10% significance level were the interest rate, oil and 1997 financial crisis dummies. The dummy for the 1997 East Asian financial crisis, surprisingly, depresses predicted inflation by about 14.92 percentage points. More specifically, ceteris paribus, during the 1997 East Asian financial crisis, inflation decreases by approximately .581- 14.92= |-14.339| percentage points. Such result, most probably, was due to lower productivity growth and aggregate demand in the economy. This finding was similar to that of Vong (2001) in his study of Macau's Phillips curve. Meanwhile, the oil dummy indicated that, in the presence of oil price shocks, ceteris paribus, predicted inflation for Indonesia, is 4.9076 percentage points higher than usual. That is, when there are oil price shocks, inflation increases by .581 + 4.9076= 5.4886 percentage points. In addition to these, it was seen that unemployment and its lag were not statistically significant. The unemployment variables also had positive signs which could indicate that there maybe no trade-off between inflation and unemployment. Being a developing country, it seems to be that Indonesia suffers from both persistent high inflation and high unemployment rates.

For the Philippines, using OLS, it was found out that the unemployment lag, interest rate, and exchange rate lag were significant at the 10% level. For a one percentage point increase in the unemployment lag, inflation decreases by 2.0367 percentage points. Such supports the trade-off between unemployment and inflation as indicated by the Phillips curve. That is, if the demand for labor increased due to an expansionary monetary policy, the unemployment rate would fall. Then, wages and consumer prices will tend to rise. Moreover, the significance of the unemployment lag could indicate that fiscal policies relating to inflation might not have an immediate effect. There could be policy lags. Meanwhile, a percentage point increase in interest rates increases inflation by 2.613 percentage points. In addition, when the exchange rate lag increases by one percentage point, inflation increases by 0.8893 percentage points. This supports our hypothesis that depreciation in the domestic currency makes local goods more competitive. Such increases aggregate supply and results to an increase in the price level. However, even though the Philippines' OLS model gave significant results, it is not BLUE. Using Durbin's alternative test for autocorrelation, with a p-value of 0.0167, at the 10% significance level, there was evidence that the Philippines' Equation 1 regression suffers from serial correlation. Generally, when corrected for serial correlation, I have seen that the standard errors decreased. Although they are characterized by lower coefficients, unemployment lag, interest rate, and exchange rate remain significant. For a one percentage point increase in the unemployment lag, inflation decreases by 2.0082 percentage points. On the other hand, a percentage point increase in interest rates increases inflation by 2.594 percentage points. In addition, a one point percentage increase in the exchange rate lag increases inflation by 0.8965 percentage points.

For Malaysia, the OLS model explains 43.15% of the variation in inflation. Only unemployment was significant at the 10% level. A one percentage point increase in unemployment decreases inflation by 1.543 percentage point. Such finding is still consistent with the OLS estimates of Tang and Lean (2007): that there exists a trade-off between unemployment and inflation in Malaysia. However, while this might support the Phillips curve hypothesis, we should be careful with the interpretation of results. This is because, when tested for unit root behavior using the Phillips-Perron test, with a p-value of 0.1298, it was found out that the past values of inflation were correlated. In addition, the inflation lag might be endogenous. It might be correlated with the error term. To solve for this problem, I use the inflation lag of Singapore as an instrumental variable for Malaysia's inflation lag. I use Singapore data since I thought that its price levels might be highly correlated with that of Malaysia. Such may be a result of their geographical proximity and trading relations. The simple correlation of Malaysia's inflation lag with Singapore's inflation lag was 0.7162. In addition, when Malaysian inflation lag was regressed with all other exogenous variables and the Singaporean inflation lag, it was found out that Singapore's inflation lag, with a p-value of 0.079, was significant. This supports one of the assumptions for an instrument. The covariance of our instrument, Singapore's inflation lag, and our x_j, Malaysia's inflation lag, is not zero. Meanwhile, I assume that Cov(Singapore_inflation_1, u)= 0. When I used Singapore_inflation_1 as an instrument for infla_1 in our Malaysian OLS model, the inflation lag and unemployment were significant at the 10% level. The inflation lag fulfilled our expected sign. However, again, we could not be sure as to the reliability of these results. Using the Phillip-Perron test, there was an evidence of a highly persistent time series. The past values of inflation are still correlated. Thus, I use Equation 2, the first-differenced model, for our analysis. The regression with Equation 2 showed that there seems to be no significant variables which could affect inflation. Such results might be consistent but not efficient. This is because of the presence of large standard errors caused by either heteroskedasticity or serial correlation. When tested for both stationary and autoregressive conditional heteroskedasticity, the first-differenced model was characterized by homoskedasticity. However, when tested for serial correlation of order 1, AR(1), and higher order correlation using the Breusch-Godfrey LM test for autocorrelation, it was evident that the Equation 2 for Malaysia suffers from serial correlation. With these, we have seen that although differencing could eliminate most of the serial correlation, it has not done so for our model. Most probably, our model suffers from higher order serial correlation. To correct for serial correlation, I use Prais-Winsten estimation. When corrected for serial correlation, the first-differenced equation, Equation 2, had lower standard errors. This shows that the existence of serial correlation produced large standard errors. For the fully-corrected model, it was only the inflation lag, with a p-value of 0.109, which is nearly significant at the 10% level. From the regression results, it can be seen that as the instrumented inflation lag increases by one percentage point, inflation increases by .3483 percentage points. The nearly significant value might have been the result higher order autocorrelation. The model might not have been fully-corrected because I also used Prais- Winsten method—a method which only employs feasible GLS estimation of AR(1). In addition, we should also take note that the FGLS is not unbiased and therefore, is not BLUE. Moreover, although it may be asymptotically more efficient than the OLS estimator in the presence of serial correlation, we cannot fully assume weak dependence because of a small sample size of 26. Another possible reason for our findings is that Singapore_inflation_1 might not be a completely exogenous instrument for Malaysia's inflation lag. Our IV, Singapore's inflation lag might be correlated with the error term. This could happen because Malaysia and Singapore are closely-linked economies. For example, there is a possibility that the exchange rate between the currencies of the two countries is correlated to our IV. Thus, Singapore's inflation lag might not be the best IV for Malaysia's inflation lag. With this, it is recommended, that in future studies, the exchange rate lag, the interest rate lag, and others be tested as possible instrumental variables.

I will now focus our discussion on the theorized Phillips curve relationship: trade-off between unemployment and inflation. I will analyze the signs of the unemployment rate for the four countries without emphasizing their significance at the 10% level. Using the fully-corrected models, it was found out that for Thailand and Malaysia, there exist a trade-off between unemployment and inflation. The negative coefficients for unemployment are the evidences for this. The trade-off is approximately one-to-one for the two countries. Such relationship supports the Keynesian view on the Phillips curve. That is, at least for the short-run, unemployment and inflation have a negative relationship. In contrast, the unemployment coefficients for Indonesia and the Philippines were positive. The findings for the Philippines are consistent with Dua's findings (2007). The positive relationship between unemployment and inflation is supported by Rational Expectations Theory. There may be no trade-off between unemployment and inflation because markets respond quickly to changes in prices and wages.

IV. Conclusions and Recommendations

For the ASEAN-4, significant or not, there seems to be no stable one-to-one trade-off between unemployment and inflation. I also found out that the variables which could help control inflation were different for the four countries. Meanwhile, to have more conclusive results and achieve normality, I suggest obtaining a bigger sample size, e.g. usage of quarterly data. In conducting tests, such would give us higher degrees of freedom. In addition, for serial correlation problems, error terms such CPI minus unit labor cost can be used (Smith, 2000). I also suggest a lag for interest rates. There maybe a possibility that the previous year's monetary policy regarding interest rates might have a significant effect on the inflation rate. In addition, to better explain inflation dynamics, stock prices, energy/ petroleum prices, and other functional forms (e.g. quadratic or logarithmic form) can be utilized in future studies. Furthermore, panel data analysis could be utilized. Lastly, cointegration tests may be employed to explore the feedback dynamics of employment- inflation relationship.

References

[1] Bhanthumnavin, K. (2002). The Phillips curve in Thailand. St. Antony's College, *University of Oxford Working Paper*.
[2] Dornbusch, R., Fisher, S. & Startz, R. (2005). *Macroeconomics, Ninth Edition.* U.S.A.: McGraw-Hill Education.
[3] Dua, P. (2006). Inflation- Unemployment Trade-off in Asia. United Nation's *Project LINK Meeting.* University of Delhi.
[4]Gordon, R. (1997). The Time-Varying NAIRU and Its Implications for Economic Policy. *Journal of Economic Perspectives, American Economic Association*, vol. 11(1), pages 11-32, Winter.
[5] National Economic and Development Authority, Republic of the Philippines. (2007). http://www.neda.gov.ph/.
[6] Smith, H. (2000). The Phillips Curve in the 1990s. *University Avenue Undergraduate Journal of Economics,* Year 2000 Issue.
[7] Staiger, Douglas, James Stock, and Mark Watson. (1997). The NAIRU, Unemployment and Monetary Policy. *Journal of Economic Perspectives* (Winter) pp. 33-49.
[8]Stiglitz, J. (1997). Reflections on the Natural Rate Hypothesis. *Journal of Economic Perspectives,*Winter, Vol. 11(1), 3-10.
[9]United Nations. United Nations Statistics Division. (2007). http://unstats.un.org/unsd/default.htm.
[10] Vong, T. (2001). The Phillips Curve in Macau and Its Implications for Macroeconomic Policy. *Monetary Authority of Macau Publication.*
[11] Wan, Y. (2001). A Case of the Phillips Curve in the Formation of a Monetary Union: A Glimpse at High Inflation Countries of the Monetary Union. *University Avenue Undergraduate Journal of Economics,* Year 2001 Issue.

Correspondence to:
Klarizze Puzon
BS Economics (Senior year)
Email: kmpuzon@gmail.com

12/20/2008

Note: This article was primarily published in [Journal of American Science 2009: 5(1), 55-57](ISSN: 1545-1003).