Orissa Journal of Commerce
Vol. 44, Issue 1, January-March 2023
ISSN: 0974-8482

URL: www.ojcoca.org
DOI: https://doi.org/10.54063/ojc.2023.v44i01.04

Testing the Existence and Stability of Phillips Curve in India

N. Kubendran
Assistant Professor, Department of Economics, Pondicherry University, Puducherry. E-mail: kubendran1979@gmail.com

To cite this paper
Kubendran, N. (2023). Testing the Existence and Stability of Phillips Curve in India. *Orissa Journal of Commerce.* 44(1), 44-53.

Keywords
Money supply, Unemployment, Inflation, GDP, VECM, Phillips curve

JEL Classification
E51, E24, E31, E01, E37

Abstract: The major objective of this study is to test the empirical applicability of Philips Curve in the Indian context with a focus on short-run as well as long-run relationships. For empirical analysis, the study uses five decades of data from 1968 to 2018 and applied Vector Error Correction Model (VECM) after running ADF Unit root and Johansen's cointegration. Based on the empirical analysis, the present study has observed that there is a long-run correlation between Money Supply, Inflation and Unemployment proving the relevance of the Philips curve. But, the study has observed a direct correlation between inflation and unemployment which invalidates the presence of Philips Curve in India and posed challenges to expansionary monetary policy to curb unemployment. The novelty of the study is that it provides concrete evidence for the relevance of Philips curve in the short-run as well as in the long-run using the VECM model for India since the 70s.

1. Introduction

The Phillips curve depicts an inverse association among inflation and unemployment in an economy. It is essential to study this concept because inflation and unemploymentare two of the most diligently monitored economic variables that have a substantial effects on the economy and macroeconomic policy. Moreover, it is described as an important framework often used by the central bank to maintain the targeted inflation and exchange rate stability.

This study mainly focuses the existence of the Phillips curve in Indian context. The basic theoretical framework of the Phillips curve is very simplistic to fit any economy, in reality that may not be true because it is not a simple negative relationship between the two, because various other forcesaffecteconomic performances. The study perceived that the Indian context would be appropriate because India is a highly populated country with a lot of socio-economic problems like poverty and unemployment with a high level of fiscal deficit usually causing inflation. Moreover, the finance ministry always expects expansionary monetary policy for their macroeconomic goals. For these reasons, the study uses five decades of data from 1968 to 2018 to measure the efficacy of monetary policy on the macroeconomic goals of India using the Philips curve method.

Therefore, it is necessary to understand the timing, frequency and magnitude of change in various policy rates that affect monetary policy and its efficacy. Both monetary and fisal policy (expansionary and contractionary) aid in shifts of the Phillips curve but the present study focuses solely on monetary policy and its changes in inflation rates and unemployment.

2. Review of Literature

Since 1970, extensive literature has been conducted on the applicability of the Philips curve with more variables and analyzing their dynamics, concerning monetary policy. Kim *et al.* (2013) analyzed the factors responsible for invalidating the relevance ofthe Phillips curve and observed that the surge in inflation trends led to a decline in real economic activity and increases the inflationary gap. Peterson *et al.* (1971) tried to investigate the relationship between prices and earnings using monetary rule based on the role of the Phillips curve. They observed a recurring path of unemployment and price along the Phillips curve captured by changes in prices, labour demand and money supply.

Hodes and Snyder (1981) found that the Phillips curve failed to explain the existence of inflation in absence of excess demand, which has theoretical evidence in the 1950s. Haynes and Stone (1985) tested the relevance of Philips curve and found the short-run association among inflation and unemployment but in the long-run, inflation and unemployment trade-off was lagging.Alogoskoufis (1990), tried to analyze the association between monetary policy and its implications for the Phillips curve.It reveals that with the coexistent reaction of nominal wages to unemployment, optimal monetary policy must be conditioned on both wages and prices.Leeson (1997)found that it is undesirable to set an inflation target at appoint where the wage inflation rate is greater than the amount of average productivity in the economy.

Flaschel and Krolzig (2006) analyzed Phillips curves in a simple Keynesian model of economic growth. They observed that thewage-price instability caused economic instability, which was corrected by applying monetary policy. Graham and Snower (2008) went a step ahead and tried to analyze the relevance of Phillips curve with hyperbolic preferences and found that employment cycling effects and labor smoothening effects have an inverse relationship with inflation and macro-activities while discounting effect has a positive relationship.

Gordon (2009) observed that there is an interaction of demand and supply shocks that can create both positive and negative impacts on inflation and unemployment. Turnovsky (2009) examined output-inflation trade-offs in the context of a Philips curve and observed that the Philips curvehas been improvised time and has never failed to fulfill the expectation of the short-run macroeconomicrelationship between inflation and output. Kotia (2013) tries to analyze the inflation-output dynamic for the Indian economy and estimates Phillips Curve, using the unobserved random walk method. Even though there is literature that shows the irrelevance of Phillips curve for India, this study establishes inflation and unemployment trade-off without taking into account supply shocks.Simionescu (2014), analyzed the presence of the Phillips curve in Romania using inflation, unemployment, real GDP and the money supply. This study found that all the variables are cointegrated and exhibit a long-run association. Especially, the study observed the existence of an inflation and unemployment relation in the short run, but no such association was found in the long-run.

Svensson (2015) analyzes Phillips curve in the long runfor Sweden and observed the downward-sloping curve rather than the vertical one that is theoretically proven in the long run. Zayed *et al.* (2018) tested the relevance of Phillips curve in the Philippines and the results show that the GDP is positively correlated to inflation and unemployment, which proves that the Phillips curve is irrelevant for Philippines.

2.1. Research Gap

The government of India's dependence on monetary policy for its macroeconomic goals is increasing day by day. By considering the outcome of monetary policy on growth and unemployment reduction in the short term using Philips curve approach, this study occupies a higher level of significance in social science research. Even though there are abundant studies that are available in the context of the relevance of Philips curve, their results are not concrete. Especially, studies relating to Indian case is very rare and the period of study used in the literature survey is very short-term. Finally, the focus of the study is to test the relevance of Philips curve in India from 1968, especially the advent of the labour market and stringent regulations imposed by the private and public players, the present study occupies a higher level of significance.

3. Objectives of the Study

Against the statement of the problem and issues, the main objective of this study is

- To analyze the existence of the Philips curve in India bychecking the correlation between money supply, inflation and unemployment from 1968 to 2018.
- To inspect how rational and adaptive expectations affect future inflation in the economy.

4. Research Methodology

The present study uses only secondary data and the sources of data are collected from the RBI database, the economic survey report of the government of India and World Bank data. The present study tries to explore the relevance of Philips curve in India to measure the effectiveness of the monetary policy on macroeconomic goals using Inflation, GDP, Unemployment and Money Supply. For empirical analysis, the study considers both graphical analysis and empirical inquiry. First, this study uses Augmented Dickey-Fuller unit root to check whether the collected data sets are stationary or not. After that the study uses Johensen's cointegration to test the relationship between the explanatory variables. Finally, the study will employ the Vector Error Correction model to check the relevance of Philips curve. Appropriate trend line investigation will also be used to compare the empirical outcomes.

4.1. ADF Unit Root Test

The study first appliedthe Augmented Dickey-Fuller test for respective variables using the succeedingsequenes.

$$\Delta X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta X_{t-1} + \lambda t + u_t \quad (1)$$

If the beta value is equal to zero, denoting that the designated variable Xt comprises unit root, hence the data is said to be non-stationary. Therefore, it is very essential to take account of trend (deterministic) in the equation part. If the trend is stationary and significant, then the study can execute econometric investigation.

4.2. Co-integration Test

After checking the stationarity conditions, the study will employ Johansen (1995) co-integration test to assess the association between the selected independent variables in the study and it can be given in the following form of an equation:

$$H_1(r): P_{yt-1} + Bxt = \alpha(\beta_{yt-1} + P_0) + \alpha_1\gamma_0 \tag{2}$$

Using the above equational form, the null hypothesis is used to verify the presence of a cointegration vector. Both trace and maximum Eigenvalue will be used for the test criteria.

4.3. Vector Error Correction Model

The VECM model is applied to test the long-term and short-term relationship, which runs from independent to dependent variables to determine the relevance of Phillips curve in India. It takes into account level1 of stationarity of data and the cointegrating relationship among the variables. Here, inflation is considered as dependent and the othervariables are considered as independent. The model will also include lagged values of inflation observed from the literature review. In addition, if the model is correctly specified, the VECM estimates will be more effective. The VECM model can be specified as;

$$\begin{aligned}\Delta LNI_t = \beta_0 + \sum_{j=1}^{m}\theta_k \Delta LNI_{t-j} + \sum_{j=1}^{m}\gamma_k \Delta LNGDP_{t-j} + \sum_{j=1}^{m}\psi_k \Delta LNMS_{t-j} + \sum_{j=1}^{m}\varphi_k \Delta LNUNEMP_{t-j} \\ +\lambda[LNI_{t-1} - \alpha_0 - \alpha_1 LNGDP_{t-1} - \alpha_2 LNMS_{t-1} - \alpha_1 LNUNEMP_{t-1}]\mu_t\end{aligned} \tag{3}$$

Where I_t, GDP_t, MS_t, $UNEMP_t$ represents Inflation, GDP, Unemployment and Money Supply during the period t. Where λ represents the speed of adjustments from the Short run to Long Run. Δ represents the first difference and μ represents the error term.

5. Empirical Findings

The empirical analysis starts with the Unit root test to check the stationarity of the data. The study will proceed with optimal lag selection, which has been tailed by the Johansen Co-integration test. To check the behaviour of residuals, a normality test has been used. Finally, the study will employ VECM method.

ADF test has been used to evaluate the stationarity of data, with the null hypothesis that the respective variable containsa unit root. The lag is automatically selected, distinct for different variables. The results are tabulated below;

Table 1: ADF: Unit Root test

Variables	*At level*		*At first differences*	
	Test Statistic	*Prob. value*	*Test Statistic*	*Prob. value*
Inflation	0.2320	0.0004	-4.0771	0.0000
Unemployment	0.3782	0.2999	-14.8524	0.0000
Money Supply	-0.9774	0.9975	-7.5096	0.0000
GDP	0.2159	0.9530	-3.9199	0.0001

Source: Author's Own Compilation

It is observed from the probability value that the designated variables are nearly non-stationary at the level and stationary at first difference excluding Inflation. It is observed that the ADF results exposed that all the variables are stationary at first difference. Hence, it is practical from the ADF result that it is appropriate for the study to employ the VECM model for analysis.

Next, it is important to measure for *cointegration*, using Johansen cointegration test which is a precondition for running VECM. The reasons for using the Johansen test are that it provides the most accurate results and is very much compatible to run VECM and also avoids the problem of selecting a dependent variable. Most importantly,the Johansen test takes into account time series and more than two variables, unlike the Engle granger test which requires a single equation two-variable model. Correspondingly, the Johansen test applies to large samples which have asymptotic properties.

Now, the Johansen test can be performed. Trace and maximum eigenvalue indicated 2 cointegrating eauations at 0.05 level; the existence of at most 2 long-run associations in the model is a good indicator of a good fit.

Table 2: Johansen Cointegration Test

Trend assumption: Quadratic deterministic trend
Series: INF UNEMP MS GDP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration (Trace)

Hyp No. of CE(s)	*Eigenvalue*	*Trace Stat*	*0.05 Critic Value*	*Prob***
None*	0.520375	79.57931	55.24578	0.0001
At most 1*	0.446952	43.57649	35.01090	0.0049
At most 2	0.163328	14.55324	18.39771	0.1590
At most 3*	0.111910	5.815413	3.841465	0.0159

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

Unrestricted Cointegration (Max Eigenvalue)

Hyp No. of CE(s)	*Eigenvalue*	*Max-Eigen Stat*	*0.05 Critic Value*	*Prob***
None *	0.520375	36.00281	30.81507	0.0106
At most 1 *	0.446952	29.02325	24.25202	0.0108
At most 2	0.163328	8.737830	17.14769	0.5231
At most 3 *	0.111910	5.815413	3.841465	0.0159

Source: Author's Own Compilation

Now, since the two conditions are non-stationarity at a level and cointegrated series are satisfied, so the study can employthe VECM model for analysis. A rank for the test is two cointegrating equations testing both intercept and trend.

As the first step, it is neessary to determine the appropriate lag-length for an autoregressive model meaning such models almost always assume that the current value of variables is also dependent on a previous period; it is essential to how far back this dependency go. The most important criterion in making this decision is Akaike Information Criterion (AIC) followed by sequentially revised LR test statistic at a 5% (LR) and FPE. The present study employed the above-mentioned three criteria for analysis. Also for each model, the lower value is among all the lag lengths and it can be stated that the better the length, the better the model. Our lag test reveals that for all 3 criteria specified above, the lag order selected is 2 meaning that the values of variables are dependent on their previous two time periods; for example, if inflation in 2020 says at 4%, then this value of 4% is dependent on inflation in 2018 and 2019. The output generated from the VECM model is given in table 3.

C(1) and C(2) are the coefficients of the two cointegration equations. Both these coefficients are significant (p-value< 0.05) and negative implying Long-run causality from unemployment, GDP and money supply to inflation.

To check short-run causality, the Wald test needs to be run. This test checks short-run causality from each independent variable to the explanatory variable. The null hypothesis of this test is all coefficients of the first independent variable is equal to zero, implying that there is no short-run causality from the particular independent variable to the dependent variable. Results indicate that there is no short-run causality from either of the three independent variables- unemployment, GDP, or money supply to inflation (dependent variable).

Summarizing,

Short-run relationship	Does not exists
Long-run relationship	Exists

Implications-

There is no evidence suggesting a short-run Phillips curve in India for a period of 50 years from 1968- 2018. However, there is evidence pointing towards the existence of a long-run Phillips curve in

Table 3: VECM Estimation

Dependent Variable: D(INF)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Included observations: 48 after adjustments

	Coefficient	*Std. Error*	*t-Statistic*	*Prob.*
C(1)	-1.121229	0.257112	-4.360856	0.0001
C(2)	-2.647542	0.915524	-2.891833	0.0065
C(3)	0.380122	0.184390	2.061516	0.0465
C(4)	0.038947	0.160241	0.243052	0.8093
C(5)	-3.752216	6.652182	-0.564058	0.5762
C(6)	-1.273104	6.967032	-0.182733	0.8560
C(7)	-0.076773	0.052778	-1.454644	0.1544
C(8)	0.007170	0.059932	0.119638	0.9054
C(9)	1.36E-05	2.38E-05	0.571756	0.5710
C(10)	1.02E-05	2.63E-05	0.388406	0.7000
C(11)	-0.661982	3.481484	-0.190144	0.8503
C(12)	0.105977	0.284265	0.372812	0.7115
R-square value	0.524650	Mean dependent var		-0.004824
Adj R-square	0.379404	S.D. dependent var		5.881572
S.E. of reg	4.633380	Akaike info criterion		6.116768
Sum squareresid	772.8554	Schwarz criterion		6.584568
Log-likelihood	-134.8024	Hannan-Quinn criteria.		6.293550
F-stat	3.612151	Durbin-Watson stat		2.018123
Prob(F-stat)	0.001689			

Source: Author's Own Compilation

India for the same period. The model is significant and a good fit as indicated by the following parameters like R-squared value (0.524650), the p-value of f-statistic (0.0017 <0.05) and Durban Watson statistic (2.018123).

Using thedescriptive analysis from Figure 1, the study can forecastinflation anticipations and the rationality of society concerning the likelihoods.

The inflation forecast is given by IMF, it mirrors inflation expectations of the society and hence can be taken as a proxy for inflation expectations (adaptive expectations). It is observed from the graph, both inflation expectation and actual inflation move in tandem with each other. Hence, we can infer that inflation expectations affect positively on current inflation.

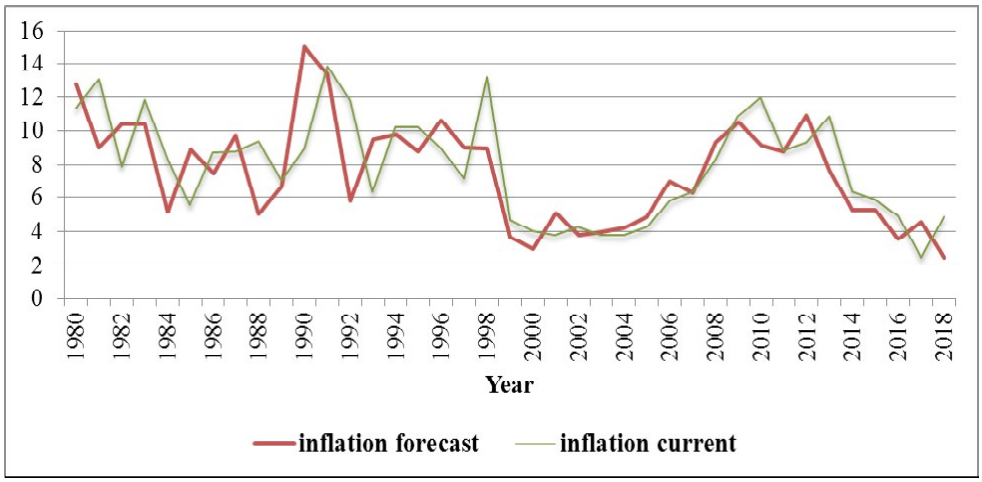

Figure 1: Trends in Forecasted and Current Inflation

Source: Author's Own Compilation

6. Results and Discussion

This paper has focused on the relevance and existence of the Phillips curve in India from 1968 to 2018. In the first step of the empirical analysis, the study ADF test to check the unit root.The unit root test result from Table 1 indicated that the p-value for all the variables are foundnon-stationary at the level and stationary at the first difference. The p- value for all the study avariables are more than 5 per cent at level excluding Inflation. But the t value for for inflation is lower than the critical value leads to the rejection of the null hypothesis and infers there is no unit root at first difference. After confirming the nonexistence of unit root from table 1, the study usesJohansen's cointegration test for association between theexplanatory variables. Test results from Johansen's test rejected the null of cointegration at 1 percent and 5 percent levels using both trace and maximum eigenvalue.

To trace the dynamic association between the selected variables, the Vector Error Correction model has been applied. The paper mainly addresses inflation and trade-off and how it reacts when we add the effect of money supply and GDP. Running VECM states that the variables are stationary at level 1 and having 2 cointegration exhibits no short-run relation exists between Unemployment, money supply, or GDP to inflation. But theoretically and past studies proved, especially from G7 countries, the variability in inflation causes a significant effect on the unemployment rate (Seyfried *et al.*, 2001; Sing et al., 2022). The study has observed increasing inflation uncertainty in prediction due to discretionary monetary policy in India. Given the above-stated arguments, the has observed that these are the reasons why money supply did not affect inflation in India. Changes in discretionary monetary policy cause uncertainty in inflation leading to variability in the inflation-unemployment tradeoff. Since this variability is affecting unemployment in the short run it becomes difficult to analyze the effect of real inflation, this can be one of the major reasons for no short-run association between inflation and

unemployment and also inflation and monetary policy. In the short run, inflation variability does not influence unemployment is an interesting finding of the study.

Although, it is measured that reliable monetary policy has enhanced the capability of central banks to anchor inflation expectations, thus reducing the effect of real economic activity on inflation and invalidating the Phillips curve. But in the case of India,the credibility of monetary policy can be questioned because of its rapid changes from 1975 to 2005, especially, the regime changes three times from an ultimate focus on an annual target for credit expansion to broad money growth to a multiple indicator approach. It was also important to discuss the effects of monetary policy because theoretically the policy effects are not seen in the Indian case.

Besides, a long-run relationship existsand flows from unemployment, money supply, and GDP to inflation. However, the association between inflation and unemployment is positive. Several economists also came up with this positive association from 70s and argued that this relationship can be acceptedwithin the targeted levels.

Post 2005,the monetary policy stance has stabilized at 'multiple approaches' by focusing on movements in several variables to bring about a more holistic and informed view. As a result, the variability in inflation has also reduced to a large extent which can be seen from figure 1 which shows the trends in forecasted inflation arein tandem with actual inflation.From the results, the study found that the monetary policy is more credible in the last ten years than it has been in the earlier period, especially when the central bank started using a multiple-indicator approach. But still, over-dependence on monetary policy for macroeconomic goals may not yield desired results in India. Instead of too much dependence on money supply and monetary policy, the government has to spend more on social sector and capital formation. Also the government has to contain inflation and bolster production for unemployment reduction and macroeconomic efficiency (Behera and Pradhan, 2019).So there is a need to use a mix of both demand and supply-side policies, to boost aggregate demand by reducing unemployment and supply-side bottlenecks.

7. Conclusion

The study uses five decades of data from 1968 to 2018 and applied VECM with a unit root test (ADF) and cointegration test (Johansen). Based on the empirical findings,the study has observed a direct correlation among inflation and unemployment in the short-run which invalidates the presence of Philips Curve in India and posed challenges to expansionary monetary policy to curb unemployment. Interestingly, the study has observed a long-run correlation between Money Supply, Inflation and Unemployment proving the relevance of the Philips curve. The present study stands certain useful implications for Policymakers, Research Scholars and other academicians.

8. Implication, Limitations and Scope for Future Research

The novelty of the study is that it provides concrete short-run and long-run evidence using VECM on the relevance of the Philips Curve in India since the 70s. Also, it helps the policymakers to identify the appropriate macroeconomic policies for their macroeconomic goals instead of bypassing the responsibility of the finance ministry to the Reserve Bank of India. The main implication is that

influencing real sector using monetary policy may not solve the problem of Unemployment nor GDP growth. The present study tested the relevance of Philips curve by limiting it to the Indian economy only and it can be extended to emerging economies or intra-regional trading groups like BRICS, ASEAN, European Union and others. The study uses only monetary policy to assess the association among inflation-unemployment tradeoff but there is a scope for using fiscal policy to test the relationship between inflation and unemployment and then it can be compared to the effects of monetary policy.

References

Alogoskoufis, G. S. (1990). Monetary Policy & the Informational Implications of the Phillips Curve. *Economica*, 57(225), 107-116.

Behera, B. & Pradhan, P. K. (2019). Widening Fiscal Deficit in India: Role of Subsidy Management. *Orissa Journal of Commerce*, 3, PP. 49 -58.

Flaschel, P. & H.-M.Krolzig. (2006). Wage-price Phillips curves & macroeconomic stability: Basicstructural form, estimation & analysis. In: C. Chiarella, P. Flaschel, R. Franke & W. Semmler(eds.): Quantitative & Empirical Analysis of Nonlinear Dynamic Macromodels. Contributionsto Economic Analysis, Elsevier, Amsterdam.

Gordon, R. J. (2011). The History of the Phillips Curve: Consensus & Bifurcation. *Economica*, 78 (309), 10–50.

Graham, L., & Snower, D. J. (2008). Hyperbolic Discounting & the Phillips Curve. *Journal of Money, Credit & Banking*, 40(2-3), 427–448.

Haynes, S. E., & Stone, J. A. (1985). A Neglected Method of Separating Dem & Supply in Time Series Regression. *Journal of Business & Economic Statistics*, 3(3), 238.

Kim, C., Manopimoke, P., & Nelson, C.(2013). Trend Inflation & the Nature of Structural Breaks in the New Keynesian Phillips Curve.*Journal of Money, Credit & Banking*, 46 (2-3), 253–266.

Kotia, A. (2016). An Unobserved Components Phillips Curve in an Emerging Market Economy: The Case of India. SSRN Electronic Journal.Doi: 10.2139/ssrn.2765176.

Leeson, R. (1997). The Trade-off Interpretation of Phillips Dynamic Stabilization Exercise. *Economica*, 64(253), 155–171.

Peterson, D. W., Lerner, E. M., & Lusk, E. J. (1971). The Response of Prices & Income to Monetary Policy: An Analysis Based upon a Differential Phillips Curve. *Journal of Political Economy*, 79(4), 857–866.

Seyfried, W. L., & Ewing, B. T. (2001). Inflation uncertainty & unemployment: Some international evidence. *The American Economist*, *45*(2), 33-39.

Simionescu, M. (2014).Testing the Existence & Stability of Phillips Curve in Romania. *Montenegrin Journal of Economics*, 10(1), 67.

Singh, A. K., Shrivastav, R. K., & Mohapatra, A. K. (2022). Dynamic linkages and integration among five emerging BRICS markets: Pre-and post-BRICS period analysis. *Annals of Financial Economics*, *17*(03), 2250018.

Svensson, L. E. (2015). The possible unemployment cost of average inflation below a credible target. *American Economic Journal: Macroeconomics*, 7(1), 258-96.

Turnovsky, S. J. (2009). Stabilization Theory & Policy: 50 Years after the Phillips Curve. *Economica,* 78(309), 67–88.

Zayed, N. M., Islam, M. R., & Hasan, K. R. (2018). Testing Phillips Curve to Examine the Inflation Rate regarding Unemployment Rate, Annual Wage Rate & GDP of Philippines:1950-2017. *Academy of Accounting & Financial Studies Journal*, 22(5) 1-9.