International Journal of Educational Research and Development
www.journalofeducation.in
Online ISSN: 2664-7095; Print ISSN: 2664-7087
Received: 09-08-2019; Accepted: 11-09-2019; Published: 18-09-2019
Volume 1; Issue 4; 2019; Page No. 56-61

The impact of inflation on unemployment in Indian economy

Ashis Kumar Mukherjee
Department of Economics, Nistarini College, Purulia, West Bengal, India

Abstract
The main aim of this study is to find out the relationship between inflation rate and unemployment rate in India from the year 1991-2017. It also aims to test for the existent of the Phillips curve in the short run as well as in the long run. The study used a model in which inflation rate and unemployment rate were the independent variable and dependent variable respectively. In order to estimate the impact of the inflation rate on unemployment rate we have planned to estimate a log linear model. To examine the long run relationship between the unemployment rate and inflation rate, we use Engle and Granger test known as co-integration. Apart from, coefficient of determination (R^2), t-test, F-test, Durbin-Watson test statistic was also used. The observation from this study showed that there is an inverse relationship between inflation rate and unemployment rate in the short run but this relation breaks down in the long run. In the long run inflation rate does not control unemployment rate.

Keywords: inflation, unemployment, Phillips curve, India

Introduction

The Phillips curve shows an inverse relationship between inflation rate and unemployment rate. This means that a lower rate of unemployment can be achieved only by accepting a higher rate of inflation and vice versa. If the objective of the government is to attain price stability then the country must accept an unemployment rate. The trade-off between unemployment rate and wage inflation was first discussed by A.W. Phillips in the context of British economy so the Phillips curve is derived from his name. The actual Phillips curve drawn from the data of sixties (1961-69) for the United States also shows the inverse relation between unemployment rate and inflation rate. On the basis of this, many economists came to believe that there existed a stable Phillips curve which depicted an inverse relation between inflation rate and unemployment rate. According to Phillips, as aggregate demand rises price level will rise. As a result, aggregate national output will increase. Increase in aggregate national product means increase in employment of labour and therefore reduction in unemployment rate. Thus, the rise in the price (i.e., occurrence of inflation) results in lowering of unemployment rate showing inverse relation between the inflation rate and unemployment rate.

We can derive the equation of a short run Phillips curve from the short run aggregate supply curve. The equation of a short run aggregate supply curve can be written as

$$P_t = P^e + 1/\alpha\ (Y - y) + v \qquad \text{(i)}$$

Where, Pt = Price level in period t.
P^e = Expected price level.
(Y-y) = GNP from full employment output.
'V' = supply shock to the economy.
Taking one period lag and subtracting from equation (i) we get,

$$(P_t - P_{t-1}) = (P^e - P_{t-1}) + 1/\alpha\ (Y - y) + v \qquad \text{(ii)}$$

Here $(P_t - P_{t-1})$ = Change in price level i.e. inflation (denoted by π) And $(P^e - P_{t-1})$ = Expected inflation rate (denoted by π^e)
Therefore, from (ii) we have

$$\Pi = \Pi^e + 1/\alpha\ (Y - y) + v \qquad \text{(iii)}$$

We know that there is an inverse relationship between unemployment rate and gross national product of the country (Okun's law). As unemployment rate increases GNP of the country decreases. In other words, the deviation of GNP from potential GNP is inversely related to the deviation of unemployment from the natural rate of unemployment. Symbolically we can write,
$1/\alpha\ (Y - y) = -\beta\ (U - u)$
Hence, from (iii) we can write,
$\Pi = \Pi^e - \beta\ (U - u) + v$
Where, Π = inflation rate.
Π^e = expected inflation rate.
U = Total Unemployment.
u = Natural Unemployment.
ν = Supply shocks to the economy.

This is the equation of short run equation of a Phillips curve.
The inverse relationship between inflation rate and unemployment rate can be explained in an alternative way as follows:
We know that under perfect competition the firm employ labour up to the point where the value of the marginal productivity of labour must be equal to the wage rate. Symbolically we can write,

$$W = P.\ \Phi_N$$

Where, W = nominal wage rate. P=price level. Φ_N= marginal productivity of labour.

Now taking logarithm we have,

$$\text{Log } W = \log P + \log \Phi_N$$

Differentiating both sides we get,

$$(1/w)(Dw/dt) = (1/p)(dp/dt) + (1/\Phi_N)(d\Phi_N/dt) \quad \text{(iv)}$$

Here, $(1/w)(dw/dt)$ = rate of change of wage rate,
$(1/p)(Dp/dt)$ = rate of change of price or inflation rate and
$(1/\Phi_N)(D\Phi N/dt)$ = rate of change of marginal productivity of labour.

From (IV) we can write,

$$(1/p)(Dp/dt) = (1/w)(dw/dt) - (1/\Phi_N)(d\Phi_N/dt)$$

This shows that rate of change of price is the difference between rate of change of nominal wage and rate of change of marginal productivity of labour.

Now if productivity remains constant then from the above relation we can say that rate of change of price depends only on the rate of change of nominal wage. If the rate of change of wage depends on the magnitudes of the excess demand for labour, then

$$(1/w)(Dw/dt) = f(L^D - L^s)$$

Where $L^{D=}$demand for labour, L^s=supply of labour

The function is such that as $(L^D - L^s)$ increases $(1/w)(dw/dt)$ will also increase. In other words, if there is a positive relationship between excess demand in the labour market and rate of change of wage.

From the above equation we can write

$$(1/w)(Dw/dt) = f[-(L^s - L^D)]$$

The function is such that as $(L^s - L^D)$ increases, $(1/w)(dw/dt)$ decreases and vice versa. In other words, there is an inverse relationship between excess supply in the labour market and rate of change of wage. Rate of change of wage is lower (or rate of price increase or inflation is lower) if there is a higher level excess supply of labour or unemployment.

According to Friedman the negative relationship between the inflation rate and unemployment rate can exist in the short run, but the relationship breaks down in the long run. In the long run there exist no trade-off between the rate of change of price and unemployment rate. We can explain the shape of long run Phillips curve with the help of adaptive expectation and rational expectation model.

According to adaptive expectation model, as price level increases the workers realise that their real wages or their income decreases. In this situation if trade unions are act efficiently, they demand higher nominal wages to restore their real income. If nominal wage rises, profit of the business firm will fall. But in this situation the firm will not expand their output rather they will reduce employment till the unemployment rate rises to the natural level. Unemployment is natural when some people do not want to work at the prevailing wage rate or their services are no longer required. Further the government may think that the current level of inflation is not too high and adopt an expansionary policy (either monetary or fiscal) to increase the aggregate demand thereby to expand the level of employment. As aggregate demand rises, price level will rise further and workers demand higher nominal wages. When the higher nominal wages are granted the business firm further reduce employment. This process may be repeated again and again. Thus, we see that in the short run the unemployment rate falls below the natural rate and in the long run it returns to its natural rate. But throughout the process inflation rate rises continuously. So in the long run there is no trade-off between inflation rate and unemployment rate. If we measure rate of unemployment on the horizontal axis and rate of inflation on the vertical axis then in the long run Phillips curve is parallel to the vertical axis. In the short run people make incorrect expectation of the price change so the trade-off relationship emerge but in the long run actual and expected price change become equal and trade-off between the above said variables break down.

But, according to rational expectation theory, it is unrealistic that price expectations are formed mainly on the basis of the experience of past inflation. At that time, individual will use all available information to forecast future inflation more accurately. Firms have better information about prices in their own industry. They mistakenly think that the increase in prices is due to the increase in the demand for their products and they employ more workers in order to increase output. So when government take any expansionary measure either monetary or fiscal to increase aggregate demand, there is no reduction in unemployment rate. They believe that the workers and producers are quite rational and they have a current understanding of the economy and therefore correctly anticipate the effects of the government's economic policies. They assume that all product and factors markets are competitive, so wages and prices are flexible both upward and downward direction. As prices of the product increases workers would press for higher wages and get it granted, businessmen would raise the prices of their products, lenders would hike their rate of interest and all these changes take place immediately. Now, With the help of the equation of exchange (PT = MV, P=Price level, T= total output produced, M= money supply, V= velocity circulation of money) we can say that due to expansionary monetary policy as money supply increases aggregate expenditure (MV) will increase. But, people's expectations of inflation cause increases in P in equal proportion to the expansion of MV. This means that despite the increase in MV, real output and the level of employment will remain unchanged. In other words there is no trade-off between inflation rate and unemployment rate.

Objectives of the Study

The main objectives of our study are:

1. To determine the relationship between inflation rate and unemployment rate in the short run.
2. To determine the relationship between inflation rate and unemployment rate in the long run.

Sources of Data and Methodology

To analyse the relationship between inflation and unemployment we use secondary data obtained from a number of articles published in various National and International journal. The two variables that are the inflation rate and unemployment rate of India have been taken for this study. To show the relation among the above said variables we use time series data of inflation rate and unemployment rate covering the period from 1991 to 2017. The study used a model in which logarithmic value of unemployment rate and logarithmic value of inflation rate were the dependent variable and independent variable respectively. In order to estimate the impact of the inflation rate on unemployment rate we have planned to estimate a log linear model. This model tells us the percentage change in unemployment rate when inflation rate changes by one percent. Here, we used ordinary least square technique to determine the relationship between inflation rate and unemployment rate. For the present study the following model has been used.

LUR = f (LINFR)

Or, LUR = α + βLINFR + U

Where LUR = Logarithmic value of unemployment rate

LINFR = logarithmic value of inflation rate

U = random error term

α and β parameters to be estimated

To test the stationarity of the data we use Augmented Dickey Fuller test. By using Engle and Granger test we examine the long run relationship between the unemployment rate and inflation rate, Apart from, the coefficient of determination (R^2) t-test, F-test, Durbin-Watson test statistic was also used. All the tests are performed by using E-views.

Result and Discussion

To explain the relation between inflation rate and unemployment rate we use ordinary least square technique. Data on inflation and unemployment rate was used for the estimation of the parameters of the model. Taking unemployment rate as dependent variable and inflation rate as independent variable the model is explained as,

LUR = f (LINFR)

Or, LUR = α + βLINFR + U

Where LUR = Logarithmic value of unemployment rate, LINFR = logarithmic value of inflation rate, U = random error term, α and β parameters to be estimated

We know that most of the time series data are non-stationary in nature. So at first we want to test whether the inflation rate and unemployment rate data are stationary or not. There are different tools to check the stationary of a series. Unit root test is one of them. To examine the presence of unit root in LUR series we apply ADF (Augumented Dickey Fuller) test. Here we set two hypotheses.

The Null Hypothesis is, H_0: (LUR has a unit root or the series is non-stationary) Against the Alternative Hypothesis, H_1: (LUR has not a unit root or the series is stationary). The result of ADF tests shown as follows:

Table 1: Results of the Unit Root test (Level) of Unemployment Rate

Null Hypothesis: LUR has a unit root				
Exogenous: Constant				
Lag Length: 4 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.863094	0.0660
Test critical values:	1% level		-3.769597	
	5% level		-3.004861	
	10% level		-2.642242	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LUR)				
Method: Least Squares				
Date: 06/24/19 Time: 07:35				
Sample (adjusted): 1996 2017				
Included observations: 22 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LUR(-1)	-0.294250	0.102774	-2.863094	0.0113
D(LUR(-1))	0.175054	0.193952	0.902564	0.3801
D(LUR(-2))	0.165032	0.198940	0.829559	0.4190
D(LUR(-3))	0.443505	0.203826	2.175898	0.0449
D(LUR(-4))	0.567907	0.219761	2.584202	0.0200
C	0.404724	0.141628	2.857644	0.0114
R-squared	0.447932	Mean dependent var		-0.002512
Adjusted R-squared	0.275411	S.D. dependent var		0.037138
S.E. of regression	0.031613	Akaike info criterion		-3.843505
Sum squared resid	0.015990	Schwarz criterion		-3.545948
Log likelihood	48.27856	Hannan-Quinn criter.		-3.773410
F-statistic	2.596389	Durbin-Watson stat		2.156760
Prob(F-statistic)	0.066587			

From the table we see that the value of ADF statistics is -2.863 and corresponding p-value is 0.066. Since the p-value is greater than 0.05 (5%), we can accept the null hypothesis and conclude that the LUR series has a unit root and the series is non-stationary. To make it stationary we have to repeat the above process and we select first difference. The results are as follows:

Table 2: Results of the Unit Root test (First Difference) of Unemployment Rate

Null Hypothesis: D(LUR) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.182557	0.0034
Test critical values:	1% level		-3.724070	
	5% level		-2.986225	
	10% level		-2.632604	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LUR,2)				
Method: Least Squares				
Date: 06/24/19 Time: 07:39				
Sample (adjusted): 1993 2017				
Included observations: 25 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LUR(-1))	-0.853129	0.203973	-4.182557	0.0004
C	-0.001698	0.007174	-0.236675	0.8150
R-squared	0.432012	Mean dependent var		0.001279
Adjusted R-squared	0.407316	S.D. dependent var		0.046364
S.E. of regression	0.035694	Akaike info criterion		-3.751070
Sum squared resid	0.029303	Schwarz criterion		-3.653560
Log likelihood	48.88838	Hannan-Quinn criter.		-3.724025
F-statistic	17.49378	Durbin-Watson stat		1.988632
Prob(F-statistic)	0.000357			

From the above result we observe that the value of ADF statistics is -4.182 and corresponding p-value is 0.0034. Since the p-value is less than 0.05 (5%), we can reject the null hypothesis and conclude that the LUR series is stationary in first difference. Since log of UR (LUR) is non-stationary in level but stationary in first difference that is LUR is a I (1) type model.

Now consider the logarithmic value of inflation rate (denoted by LINFR). To examine the presence of unit root in LINFR series we apply ADF test. Here we set two hypotheses

H_0: (LINFR has a unit root or the series is non-stationary)

H_1: (LINFR has not a unit root or the series is stationary)

The result of ADF test shown as follows:

Table 3: Results of the Unit Root test (Level) of Inflation Rate

Null Hypothesis: LINFR has a unit root				
Exogenous: Constant				
Lag Length: 4 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.809973	0.0731
Test critical values:	1% level		-3.769597	
	5% level		-3.004861	
	10% level		-2.642242	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LINFR)				
Method: Least Squares				
Date: 06/24/19 Time: 08:00				
Sample (adjusted): 1996 2017				
Included observations: 22 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINFR(-1)	-0.568701	0.202387	-2.809973	0.0126
D(LINFR(-1))	0.150818	0.235128	0.641430	0.5303
D(LINFR(-2))	0.448374	0.235517	1.903782	0.0751
D(LINFR(-3))	0.541989	0.212488	2.550676	0.0214
D(LINFR(-4))	0.519086	0.206200	2.517388	0.0229
C	1.038116	0.395006	2.628103	0.0183
R-squared	0.444248	Mean dependent var		-0.064185
Adjusted R-squared	0.270576	S.D. dependent var		0.351953
S.E. of regression	0.300590	Akaike info criterion		0.660863
Sum squared resid	1.445671	Schwarz criterion		0.958420
Log likelihood	-1.269492	Hannan-Quinn criter.		0.730958

F-statistic	2.557964	Durbin-Watson stat		1.808721
Prob(F-statistic)	0.069558			

From the table we see that the value of ADF statistics is -2.81 and corresponding p-value is 0.0731. Since the p-value is greater than 0.05 (5%), we can accept the null hypothesis and conclude that the LINFR series has a unit root and the series is non-stationary. To make it stationary we have to repeat the above process and we select first difference. The results are as follows:

Table 2: Results of the Unit Root test (First Difference) of Inflation Rate

Null Hypothesis: D(LINFR) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.475063	0.0002
Test critical values:	1% level		-3.724070	
	5% level		-2.986225	
	10% level		-2.632604	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LINFR,2)				
Method: Least Squares				
Date: 06/24/19 Time: 08:05				
Sample (adjusted): 1993 2017				
Included observations: 25 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINFR(-1))	-1.198083	0.218825	-5.475063	0.0000
C	-0.070640	0.074184	-0.952229	0.3509
R-squared	0.565844	Mean dependent var		-0.021422
Adjusted R-squared	0.546967	S.D. dependent var		0.547022
S.E. of regression	0.368188	Akaike info criterion		0.916171
Sum squared resid	3.117932	Schwarz criterion		1.013681
Log likelihood	-9.452140	Hannan-Quinn criter.		0.943216
F-statistic	29.97632	Durbin-Watson stat		1.799569
Prob(F-statistic)	0.000014			

From the above result we observe that the value of ADF statistics is -5.475 and corresponding p-value is 0.0002. Since the p-value is less than 0.05 (5%), we can reject the null hypothesis and conclude that the LINFR series is stationary in first difference. Since log of INFR (LINFR) is non-stationary in level but stationary in first difference that is LINFR is a I (1) type model.

To examine the long run relationship between the LUR and LINFR, Engle and Granger provided a simple test known as co-integration. The test is applicable when both the series are of same order. In our data both LUR and LINFR are stationary in first difference form. That is both the series is I (1) process, so we can apply co-integration test. Taking LUR as dependent variable and LINFR as independent variable we run OLS regression of LUR on LINFR. The result is described as follows:

Table 5: Results of Regression between LUR on LINFR

Dependent Variable: LUR				
Method: Least Squares				
Date: 06/24/19 Time: 08:14				
Sample: 1991 2017				
Included observations: 27				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.508208	0.065914	22.88155	0.0000
LINFR	-0.079868	0.033435	-2.388735	0.0248
R-squared	0.185828	Mean dependent var		1.355076
Adjusted R-squared	0.153261	S.D. dependent var		0.086568
S.E. of regression	0.079658	Akaike info criterion		-2.150952
Sum squared resid	0.158636	Schwarz criterion		-2.054964
Log likelihood	31.03785	Hannan-Quinn criter.		-2.122410
F-statistic	5.706054	Durbin-Watson stat		0.252044
Prob(F-statistic)	0.024774			

On the basis of the above result the estimated regression equation can be written as
(LUR) = 1.50821 - 0.0799 (LINFR)
T-value: (22.88) (-2.389)
P-Value: (0.000) (0.0248)
R^2 = 0.1858 D.W = 0.2520

Now to test the validity of the cointegration we use unit roots test of the residuals of the above regression equation. The result of the unit root test shown in the following table

Table 6: Results of Unit Root Test of the Residuals

Null Hypothesis: RESID01 has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0.271839	0.9165
Test critical values:	1% level		-3.711457	
	5% level		-2.981038	
	10% level		-2.629906	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID01)				
Method: Least Squares				
Date: 06/24/19 Time: 08:19				
Sample (adjusted): 1992 2017				
Included observations: 26 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-0.030446	0.112001	-0.271839	0.7881
C	-0.008317	0.007838	-1.061062	0.2992
R-squared	0.003070	Mean dependent var		-0.008524
Adjusted R-squared	-0.038469	S.D. dependent var		0.039035
S.E. of regression	0.039779	Akaike info criterion		-3.537144
Sum squared resid	0.037977	Schwarz criterion		-3.440368
Log likelihood	47.98287	Hannan-Quinn criter.		-3.509276
F-statistic	0.073897	Durbin-Watson stat		2.135549
Prob(F-statistic)	0.788070			

From the above result we see that residual series is non-stationary in level. We observe that the value of ADF statistics is -0.2718 and corresponding p-value is 0.9165. Since the p-value is greater than 0.05 (5%), we can accept the null hypothesis and conclude that the residual series is non-stationary and cointegration between LUR and LINFR are invalid. In other words there is no relation between inflation rate and unemployment rate.

Conclusion

The study emphasises on evaluating the impacts of inflation on unemployment rate in India. The observation from this study showed that there is an inverse relationship between inflation rate and unemployment rate in the short run but this relation breaks down in the long run. In the long run inflation rate does not control unemployment rate. Inflation rate going on increasing but unemployment rate remains same, for that the long run Phillips curve is parallel to the vertical axis. From the study we see that in the short run if inflation rate increases by one percent then unemployment rate decreases by 0.08 percent.

References

1. Gujarati DN. Basic Econometrics. (2nd Ed.), New York: McGraw-Hill Book Company, 1988.
2. Antonio R. Short-run and long-run interaction between inflation and unemployment in the USA, 2006.
3. Koutsoyiannis A. Theory of Econometrics, ELBS with Macmillan.
4. Madnani GMK. Introduction to Econometrics, Oxford & IBH Publishing co. Pvt. Ltd.
5. Phillips A. The Econometric Analysis of Time Series. Second edition London, 1990.
6. Prasanna VS, Gopakumar K. An Empirical Analysis of Inflation, Unemployment and Economic Growth in India from, 2007, 1973-2008.
7. William h Branson. Macro Economic theory and Policy, Third edition, 2007.
8. Sampat Mukherjee. Analytical *Macroeconomics*, Third edition, 2007.