Does the Phillips Curve really Exist in India?

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Key Points

- The hypothetical trade-off relationship between inflation and unemployment rate known as the Phillips Curve. It plays an important role in the decision-making process, to stabilise the economy and to target these variables to keep them as low as possible.
- This study analyses the empirical relationship between unemployment and the inflation rate in order to predict the trade-off between these two variables and to estimate its existence in the context of Indian economy over the period of 1991 to 2017.
- It finds both short and long run causal relationship between unemployment and inflation rate in India.

Introduction

The Indian economy is the sixth-largest economy in the world, with nominal GDP of US$2.9 trillion; and it will overtake the UK by 2020 to become the fifth-largest economy. India is the fastest-growing large economy after China, with numerous resources and favourable demographics. It remains a challenge for the Indian economy to take advantage of this. If we look at employment figures, we see that the unemployment rate fell from 6.2% in 2014 to 2.3% in 2016. On the other hand, the economy has been under high inflationary pressure in recent decades. These are two major economic problems for India, and therefore the most important macroeconomic targets.

Economists and policymakers try to keep both inflation and unemployment as low as possible.

Whether this is possible was examined by A. W. Phillips in 1958, who proposed an inverse relation between inflation and unemployment in the United Kingdom, using a graph known as the Phillips curve (Furuoka, 2007). Two explanations of the Phillips curve posit a short-term trade-off between inflation and unemployment, but no comparable long-term trade-off relationship: that is, in the long term unemployment rates may not change even when inflation rates do (McConnel, 16th edn).

Literature Review

In 1958 A. W. Phillips published a research paper entitled 'The relation between unemployment and the rate of change of money wage rates in the United Kingdom 1861–1957', which proposed the trade-off relationship between unemployment and inflation. The Phillips curve shows a strong inverse relationship between inflation and the unemployment rate in the United Kingdom during the study period. Since Phillips' phenomenal research, several studies have attempted to confirm or disprove his theory.

Two years after Phillips published, Lipsey (1960) and Samuelson and Solow (1960) provided a theoretical framework for and asserted a negative relationship between inflation and unemployment using US macroeconomic data. Solow (1970) and Gordon (1971) also confirmed the existence of the Phillips curve, via the 'Solow–Gordon affirmation'. However, Friedman (1968), Phelps (1973) and Lucas (1976) openly criticised the Phillips proposition and argued that no trade-off relationship exists. Lucas argued that the negative relationship and the Phillips curve might appear in the short run only, if workers failed to anticipate policymakers creating an artificial situation with high inflation and low unemployment: the 'Lucas critique'. Lucas has been supported by Alogoskoufis and Smith (1991) and Niskanen (2002), who also rejected the existence of a trade-off relationship between inflation and unemployment.

In contrast, King and Watson (1994) supported the Phillips curve. Furuoka (2007) examined the Phillips curve using econometric tests (the unit root test, the Johansen test and the Granger causality test) on macroeconomic data from 1973–2004 and found both a long-term negative trade-off and a short-term relationship between inflation and unemployment in Malaysia. Al-zeaud and Al-hoshan (2015) examined the case for the Phillips curve in the Jordanian economy, using data from 1976 to 2013 and employing a vector error correction model, and provide strong evidence in support of it. Ismael and Sadeq (2016) used quarterly inflation and unemployment data for Palestine from 1996 to 2015. They found that the inflation rate affected the unemployment rate positively in the short term, and that the relationship was attributable to oil prices, which they considered an exogenous variable. Schreiber and Wolters (2007) used a vector autoregression (VAR) model and found a long-term relationship between inflation and unemployment in Germany. Hogan (1998) used the same model with US macroeconomic data from 1960 to 1993, and found a significant inverse relationship between unemployment and inflation. DiNardo and Moore (1999) used data for nine member countries of the Organisation for Economic Co-operation and Development (OECD) and found a Phillips relationship. Hansen and Pancs (2001) examined the Phillips curve in Latvia and found strong association between inflation and unemployment. Islam et al. (2003) used US data from 1950 to 1999 and found a weak long-term co-integrating and short-term causal relationship between inflation and unemployment. Granger and Jeon (2011) also examined US data but for the period 1861–2006, and found causality between inflation and unemployment. Bhattarai (2016) used inflation and unemployment data for 35 OECD countries and a VAR model and found the Phillips curve significant for 28 of those countries.

Data and Methodology

The present study is based on annual time series data over the period from 1991 to 2017 and has been collected from the Reserve Bank of India (RBI) statistical bulletin and the Indian Ministry of Labour and Employment. Econometric methods (see below) were used to analyse the causal relationship between Indian unemployment and inflation.

Econometric methodology

We sought to test and estimate any Phillips-curve trade-off relationship between inflation and unemployment in the Indian economy over the period 1991–2018. Our model was:

$$INF = \alpha + \beta UNE + \varepsilon \qquad (1)$$

where *INF* is the inflation rate in India, measured using the consumer price index (CPI), and *UNE* is the unemployment rate in India, while α and β are coefficients to be estimated and ε is an error term.

To ensure the linearity of variables, we used a converted form of equation (1) which is given below, where *ln* stands for the natural logarithm.

$$InINF = \alpha + \beta lnUNE + \varepsilon \qquad (2)$$

For validity and to verify the model, equation 2 had to pass through four steps:

Step 1

To check whether the time series data are stationary, we used the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests of unit root. The null hypothesis in the ADF test is that the time series data are not stationary, or there exists a unit root, while the alterative hypothesis is that the series are stationary.

Two cases were used to test for the existence of unit root:

1. with intercept

$$\Delta X_t = \alpha + \delta X_{t-1} + u_t \qquad (3)$$

2. with intercept and trend

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + u_t \mathrm{t} \qquad (4)$$

Step 2

The next step was to test whether the inflation and unemployment series are co-integrated or not. For this purpose the Johansen-Juselius technique was employed to test the existence of a co-integration relationship. The procedure depends on the Trace test and maximum Eigenvalues test to determine the number of co-integration equations between these variables. Accordingly the null hypothesis is (R=0)—no co-integration equations—and the alternative hypothesis (R≤1)—existence of at least one co-integration equation.

Step 3
The ADF, PP and Johansen-Juselius tests are sensitive to the number of lags used in the model. The optimal lag length for the model was selected on the basis of Schwarz Information Criteria (SIC).

Step 4
After following the above steps, finally we employed vector error correction to determine the causal relationship between inflation and unemployment.

Empirical Results

The analysis starts with descriptive statistics which give a general idea of the series. The mean, minimum and maximum values, standard deviation, skewness and kurtosis of inflation and unemployment in the Indian economy are shown in Table 1.

Table 1: Descriptive statistics

	INF	UNE
Mean	6.224815% pa	4.238889% pa
Median	5.790000% pa	3.900000% pa
Maximum	12.11000% pa	13.07000% pa
Minimum	2.490000% pa	3.410000% pa
Standard deviation	2.459295%	1.796651%
Skewness	0.855085	4.628285
Kurtosis	2.927701	23.32478
Observations	27	27

Table 1 shows that the mean of the annual inflation rate (INF) over the period observed was 6.23%, with a minimum value of 2.49% and maximum value of 12.11% (so the mean is closer to the minimum than the maximum value), and positive skewness with standard deviation of 2.45% from mean. Likewise the mean of the annual unemployment rate (UNE) was 4.24%, with a minimum value of 3.41% and maximum value of 13.07%. The unemployment rate also showed positive skewness with standard deviation from mean of 1.79%.

Our objective was to assess the existence of a Phillips curve in India. For this the first step was to examine the data set as the classical regression model requires both dependent and independent variables to be stationary (Al-Zeaud, 2014). The ADF and PP tests, both with intercept and with intercept and trend, were applied to check whether the series are stationary or contain unit root. Table 2 displays the result of the ADF and PP test for unit root (the levels as well as the difference).

Table 2: Results of ADF and PP tests

Series	Intercept		Intercept with trend	
	ADF	PP	ADF	PP
LINF	–13.18998 (–2.981038)*	–8.36213 (–2.981038)*	–13.32735 (–3.595026)*	–8.480241 (–3.595026)*
DINF	–32.39729 (–2.986225)*	–30.46438 (–2.986225)*	–31.11444 (–3.603202)*	–30.8983 (–3.603202)*
LUNEM	–0.686006 (–2.981038)	–1.062357 (–2.981038)	–0.347597 (–3.603202)	–0.809416 (–3.595026)
DUNEM	–2.84484 (–2.986225)	–2.821824 (–2.986225)	–2.841772 (–3.603202)	–2.825747 (–3.603202)
DDUNEM	–6.695867 (–2.991878)*	–7.598757 (–2.991878)*	–6.730127 (–3.612199)*	–9.173787 (–3.612199)*

Note: * denotes significant at 5% level.
Source: Unit root test, EVIEWS, researchers' own tabulating.

The ADF and PP tests imply that inflation (LINF) is stationary at levels I(0) and first difference I(1) with intercept and intercept with trend. Thus the null hypothesis that (LINF) series contain unit root is strongly rejected at both the zero order level and the first difference of (LINF). On the other hand, both the ADF and PP tests show that the null hypothesis was not rejected at level zero or first difference, but strongly rejected the null hypothesis when the unemployment series (UNEM) was differenced at second order I(2). Consequently, the results in Table 1 indicates that the two series (inflation & unemployment) are integrated at different orders: I(0) for inflation and I(2) for unemployment.

So both variables are stationary at different orders after using the ADF and PP tests, as shown in Table 2. To test co-integration of the variables, the Johansen-Juselius technique was applied and the results are shown in Table 3.

Table 3: Inflation–unemployment: Johansen-Juselius co-integration test

HO	Trace statistic	Max. Eigenvalue statistic
None (R=0)	18.67571 (15.49471)*	15.11091 (14.26460)*
At Most 1	3.564800 –3.841466	3.564800 –3.841466

Note: * indicates 5% level critical value.
Source: Johansen-Juselius co-integration test for INF and UNE, EVIEWS, researchers' own tabulating.

The results show that both the Trace test and the maximum Eigenvalue statistic are higher than the 5% level critical value. Thus the null hypothesis (R=0) of no co-integration between inflation and unemployment rates can be rejected at 5%, and we can conclude that co-integration between inflation and unemployment is present. The second hypothesis (R≤1) cannot be rejected as the Trace statistic and the maximum Eigenvalue are lower than the 5% critical values, so we can conclude that at least one co-integration equation is present in our model.

Table 4: Granger causality test based on vector error correction model

Dependent variable: UNM

$$\Delta(UNM)t = b_1 + \sum_{i=1}^{n} b_{2i}\,\Delta(UNMt-i) + \sum_{i=1}^{n} b_{3i}\,\Delta(INFt-i) + b_4 ECT_{t-1} + \varepsilon$$

	Coefficient	Standard error	t-statistic	Probability
ECT_{t-1}	–0.055144	0.017031	–3.237777	0.0041

Thus, a long-term relationship was detected between inflation and unemployment, as the error coefficient (ECT_(t–1)) is both negative and significant at the 5% level. This confirms that there is long-term Granger causality between unemployment and the inflation rate in India. In other words there exists a long-term equilibrium between unemployment and inflation, just as suggested by the Johansen-Juselius co-integration test.

Table 5: Wald test statistics

Test statistic	Value	df	Probability
F-statistic	22.08692	2	0.0000
Chi-square	44.17384	2	0.0000

The Wald test indicates that there is a Granger causality between inflation and the unemployment rate in the short term. In other words, in India there is an an inverse relationship between inflation and the unemployment rate in the short term, which is consistent with macroeconomic theory. These results are supported by Sing (2018), Thiruneelakandan and Ullamudaiyar (2018) and Singh and Verma (2016). Therefore this study finds both a short-term and a long-term relationship between inflation and unemployment in India, which supports the existence of a Phillips curve in India.

Conclusion

The conventional Phillips curve suggests a stable trade-off between inflation and unemployment, and is an important foundation for macroeconomic policymakers. However, this argument has been attacked over the years. This study was conducted in the context of India in order to test the existence of a Phillips curve when Indian data are used. We carried out stationary tests on both series and found inflation stationary at level, while unemployment rates are stationary at first difference. Then we used a Granger test to check the direction of causality and found that inflation causes unemployment to fluctuate both in the short and the long term. The overall results show that there is an inverse trade-off between inflation and unemployment and this supports the existence of the Phillips curve in India.

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