

## Inflation – Unemployment Tradeoff: Evidence from India using OLS & Granger Causality Test

Dhruva Teja Nandipati

Sarla Anil Modi School of Economics, NMIMS, Bengaluru, India.  
E-mail: ndhrvateja@gmail.com

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**Abstract:** The purpose of this study is to investigate the relationship between inflation and unemployment in India. The study is based on secondary data for the period of 1991 to 2019. This paper used OLS and Granger Causality Test to find the causality link between inflation and unemployment. The result reveals that, there is no causality running between inflation and unemployment in the short run. However, there is one direction of causality running from unemployment to inflation in the long run in India. These findings support the existence of the Phillips curve in the long run in India.

### 1. Introduction

In 1958, A. W. Phillips drew a diagram plotting the rate of inflation against the rate of unemployment in the United Kingdom for each year from 1861 to 1957. He found clear evidence of a negative relation between inflation and unemployment: When unemployment was low, inflation was high, and when unemployment was high, inflation was low, often even negative. Two years later, Paul Samuelson and Robert Solow replicated Phillips's exercise for the United States, using data from 1900 to 1960. Apart from the period of very high unemployment during the 1930s, there also appeared to be a negative relation between inflation and unemployment in the United States. This relation, which Samuelson and Solow labelled the Phillips curve, rapidly became central to macroeconomic thinking and policy. It appeared to imply that countries could choose between different combinations of unemployment and inflation. A country could achieve low unemployment if it were willing to tolerate higher inflation, or it could achieve price level stability—zero inflation—if it were willing to tolerate higher unemployment. Much of the discussion about macroeconomic policy became a discussion about which point to choose on the Phillips curve.

In the 1970s, however, this relation broke down. In the United States and most OECD countries, there was both high inflation and high unemployment,

clearly contradicting the original Phillips curve. A relation reappeared, but it reappeared as a relation between the unemployment rate and the change in the inflation rate. Today in the United States, high unemployment typically leads not to low inflation, but to a decrease in inflation over time. Conversely, low unemployment doesn't lead to high inflation, but to an increase in inflation over time.

## 2. Theoretical Framework

### *Inflation*

Inflation is the rate of increase in prices over a given period of time. Inflation is typically a broad measure, such as the overall increase in prices or the increase in the cost of living in a country. But it can also be more narrowly calculated—for certain goods, such as food, or for services, such as a haircut, for example. Whatever the context, inflation represents how much more expensive the relevant set of goods and/or services has become over a certain period, most commonly a year.

Inflation is a general and ongoing rise in the level of prices in an entire economy. Inflation does not refer to a change in relative prices. A relative price change occurs when you see that the price of tuition has risen, but the price of laptops has fallen. Inflation, on the other hand, means that there is pressure for prices to rise in most markets in the economy. In addition, price increases in the supply-and-demand model were one-time events, representing a shift from a previous equilibrium to a new one. Inflation implies an ongoing rise in prices. If inflation happened for one year and then stopped—well, then it would not be inflation any more.

Consumers' cost of living depends on the prices of many goods and services and the share of each in the household budget. To measure the average consumer's cost of living, government agencies conduct household surveys to identify a basket of commonly purchased items and track over time the cost of purchasing this basket. (Housing expenses, including rent and mortgages, constitute the largest component of the consumer basket in the United States.) The cost of this basket at a given time expressed relative to a base year is the consumer price index (CPI), and the percentage change in the CPI over a certain period is consumer price inflation, the most widely used measure of inflation. (For example, if the base year CPI is 100 and the current CPI is 110, inflation is 10 percent over the period.) Core consumer inflation focuses on the underlying and persistent trends in inflation by excluding prices set by the government and

the more volatile prices of products, such as food and energy, most affected by seasonal factors or temporary supply conditions. Core inflation is also watched closely by policymakers. Calculation of an overall inflation rate—for a country, say, and not just for consumers—requires an index with broader coverage, such as the gross domestic product (GDP) deflator.

The CPI basket is mostly kept constant over time for consistency, but is tweaked occasionally to reflect changing consumption patterns—for example, to include new hi-tech goods and to replace items no longer widely purchased. Because it shows how, on average, prices change over time for everything produced in an economy, the contents of the GDP deflator vary each year and are more current than the mostly fixed CPI basket. On the other hand, the deflator includes non-consumer items (such as military spending) and is therefore not a good measure of the cost of living.

## **Unemployment**

Unemployment can be a terrible and wrenching life experience—like a serious automobile accident or a messy divorce—whose consequences can be fully understood only by someone who has gone through it. For unemployed individuals and their families, there is the day-to-day financial stress of not knowing where the next pay check is coming from. There are painful adjustments, like watching your savings account dwindle, selling a car and buying a cheaper one, or moving to a less expensive place to live. Even when the unemployed person finds a new job, it may pay less than the previous one. For many people, their job is an important part of their self-worth. When unemployment separates people from the workforce, it can affect family relationships as well as mental and physical health.

The human costs of unemployment alone would justify making a low level of unemployment an important public policy priority. But unemployment also includes economic costs to the broader society. When millions of unemployed but willing workers cannot find jobs, an economic resource is going unused. An economy with high unemployment is like a company operating with a functional but unused factory. The opportunity cost of unemployment is the output that could have been produced by the unemployed workers.

### ***Types of Unemployment***

- Classical: occurs when real wages for jobs are set above the market-clearing level. It causes the number of job seekers to be higher than the number of vacancies.

- Cyclical: occurs when there is not enough aggregate demand in the economy to provide jobs for everyone who wants to work. Demand for goods and services decreases, less production is needed, and fewer workers are needed.
- Structural: occurs when the labour market is not able to provide jobs for everyone who wants to work. There is a mismatch between the skills of the unemployed workers and the skills needed for available jobs. It differs from frictional unemployment because it lasts longer.
- Frictional: the time period in between jobs when a worker is searching for work or transitioning from one job to another.
- Hidden: the unemployment of potential workers that is not taken into account in official unemployment statistics because of how the data is collected. For example, workers are only considered unemployed if they are looking for work so those without jobs who have stopped looking are no longer considered unemployed.
- Long-term: usually defined as unemployment lasting longer than one year.

### *Phillips Curve*

The Phillips curve represents the relationship between the rate of inflation and the unemployment rate. Although he had precursors, A. W. H. Phillips's study of wage inflation and unemployment in the United Kingdom from 1861 to 1957 is a milestone in the development of macroeconomics. Phillips found a consistent inverse relationship: when unemployment was high, wages increased slowly; when unemployment was low, wages rose rapidly.

Phillips conjectured that the lower the unemployment rate, the tighter the labour market and, therefore, the faster firms must raise wages to attract scarce labour. At higher rates of unemployment, the pressure abated. Phillips's "curve" represented the average relationship between unemployment and wage behaviour over the business cycle. It showed the rate of wage inflation that would result if a particular level of unemployment persisted for some time.

Economists soon estimated Phillips curves for most developed economies. Most related general price inflation, rather than wage inflation, to unemployment. Of course, the prices a company charges are closely connected to the wages it pays. Figure 1 shows a typical Phillips curve fitted to data for the United States from 1961 to 1969. The close fit between the estimated curve and the data encouraged many economists, following the lead of Paul Samuelson and Robert Solow, to treat the Phillips curve as a sort of menu of policy options. For

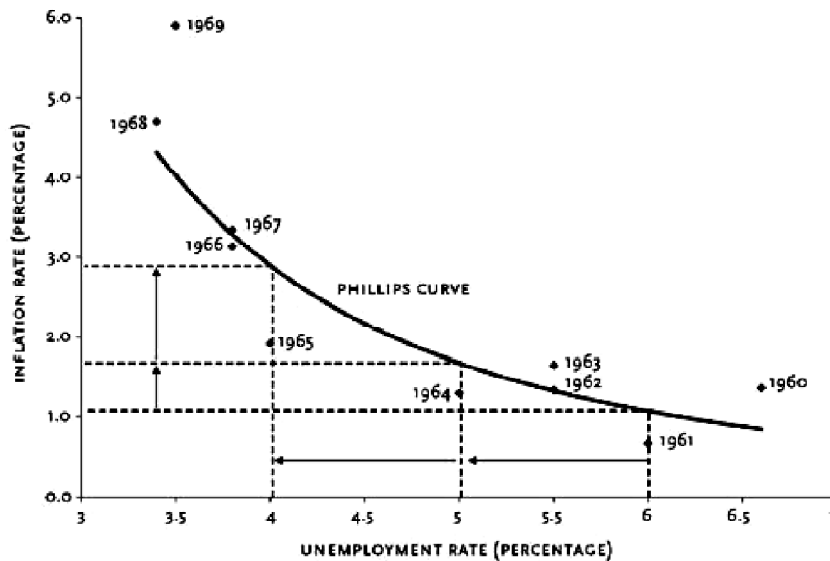
example, with an unemployment rate of 6 percent, the government might stimulate the economy to lower unemployment to 5 percent. Figure 1 indicates that the cost, in terms of higher inflation, would be a little more than half a percentage point. But if the government initially faced lower rates of unemployment, the costs would be considerably higher: a reduction in unemployment from 5 to 4 percent would imply more than twice as big an increase in the rate of inflation—about one and a quarter percentage points.

At the height of the Phillips curve’s popularity as a guide to policy, Edmund Phelps and Milton Friedman independently challenged its theoretical underpinnings. They argued that well-informed, rational employers and workers would pay attention only to real wages—the inflation-adjusted purchasing power of money wages. In their view, real wages would adjust to make the supply of labour equal to the demand for labour, and the unemployment rate would then stand at a level uniquely associated with that real wage—the “natural rate” of unemployment.

### 3. Review of Literature

Sinha (2017) investigated the causal link between inflation rate and the unemployment rate in India using Granger causality test. Firstly, unit root using

Figure 1: The Philips Curve, 1961-1960



Source: Bureau of Labor Statistics.

Note: Inflation based on the Consumer Price Index.

Phillips-Perron test was tested. The result shows that, both the variables are stationary after first difference. So, Johansen tests for co-integration to find the co-integration among the variables were performed. Based on Trace statistic and Max-eigen value, the test suggests that inflation rate and unemployment rate are co-integrated in the long run. As, both variables are co-integrated, it used the Granger causality with VECM setting to find the causality. The result reveals that, there is no causality running from inflation and unemployment in the short run in India. However, it finds one direction of causality running from unemployment and inflation and the nature of the relationship is negative. This implies that, if the unemployment rate increases, the balance of bargaining power between a firm and a worker tilts in favour of the former; firms gain the ability to hire workers at lower wages. As a result, the firm is able to produce at low cost and which in turn decreases the price level and vice versa. Thus, the govt. should take suitable policy to control the inflation and unemployment to accelerate the economic growth in India.

Turner and Seghezza (1999) employed the panel data method to examine the Phillips curve in 21 OECD countries over the period from the early 1970s to 1997. To analyse the pooled data, Turner and Seghezza used the method of Seemingly Unrelated Estimation (SURE) rather than the OLS. The researchers concluded that the overall result provided a “strong support” for the existence of the “common” Phillips curve among the 21 chosen member countries of OECD. Arratibel et al. (2002) analysed New Keynesian Phillips curve with forward-looking expectations by using panel data. They found that the unemployment rates have significant relationship with non-tradable inflation rates. By contrast, Masso and Staehr (2005) used the dynamic panel data method and failed to identify a significant relationship between the unemployment rate and inflation rates.

Karanassou and Sala (2010) argued there is a trade-off between inflation and unemployment in long run because of money and productivity growth which leads to decrease in International Finance and Banking unemployment, while supply shock like oil prices which leads to increase in unemployment. He also argued that the increase in productivity growth causes decrease in inflation and also fall in unemployment. Al- Zeaud (2014) argued that there is no trade-off between inflation and unemployment in the Jordan economy between 1984 and 2011 because foreign labours were not involved in the unemployment rate calculation. He used Granger-Causality test to check the relationship between variables and the direction of causation and techniques depends on testing stationary, integration, co-integration as per-requisites.

Furuoka, (2007) examined the trade-off the relationship between inflation rate and unemployment rate in Malaysia. This paper used vector error correction (VECM) to test the relationship. The results revealed the existence of the long run relationship among the variables. In other words, this paper has provided an empirical evidence to support the existence of the Phillips curve in the case of Malaysia. Afzal and Awais, (2012) also investigated the Inflation-Unemployment Trade Off in Pakistan. The empirical results show that the Phillips curve holds in Pakistan. Similarly, Singh and Verma, (2016) estimated the short-run trade-off between inflation and unemployment for the Indian economy over the period 2009-2015 using bi-variate regression. The result showed the existence of the inverse relationship of inflation with the unemployment in the short run.

#### 4. Data and Methodology

Ordinary Least Square (OLS): The procedure for estimation adopted for this study is the Classical Linear Regression Model and using Ordinary Least Square (OLS) as an estimator. The method of the ordinary least square method is attributed to Carl Friedrich Gauss, a German mathematician. The method is most preferred because it is easy to understand, simple in its computational procedure and parameter estimation. It also possesses the properties of Best Linear Unbiased Estimator (BLUE), which are consistent and sufficient.

Granger Causality Test: This is used to check for causality between two variables. In this case our aim is to test for a causal relationship between inflation and unemployment in India. The rule states that if the probability value is between 0 and 0.05 there is a causal relationship.

The data employed in this research are secondary data obtained from the world bank estimates. The data used in this study are covered the period from 1991-2019, a period of 29 years.

**Table 1**  
**Unemployment Rate & Inflation Rate for India from 1991 to 2018**

<i>Year</i>	<i>Unemployment Rate</i>	<i>Inflation Rate</i>
1991	5.45	13.870
1992	5.504	11.788
1993	5.612	6.327
1994	5.631	10.248
1995	5.636	10.225

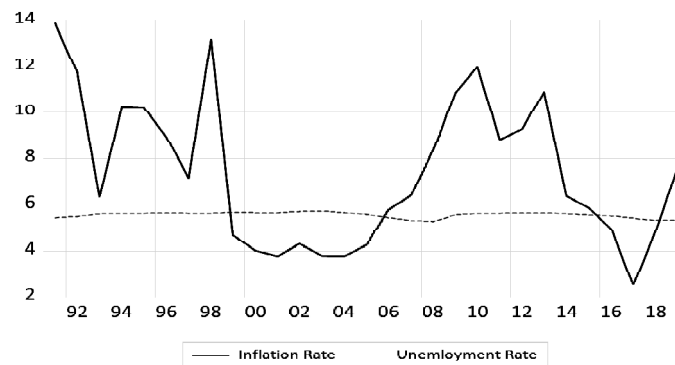
*contd. table 1*

<i>Year</i>	<i>Unemployment Rate</i>	<i>Inflation Rate</i>
1996	5.652	8.977
1997	5.637	7.164
1998	5.631	13.231
1999	5.685	4.670
2000	5.663	4.009
2001	5.659	3.779
2002	5.719	4.297
2003	5.725	3.806
2004	5.669	3.767
2005	5.598	4.246
2006	5.45	5.797
2007	5.323	6.373
2008	5.281	8.349
2009	5.566	10.882
2010	5.636	11.989
2011	5.638	8.858
2012	5.652	9.312
2013	5.671	10.908
2014	5.608	6.353
2015	5.565	5.872
2016	5.511	4.941
2017	5.419	2.491
2018	5.33	4.861
2019	5.355	7.660

*Source:* data.worldbank.org

Figure 2 graphs the inflation rate and unemployment rate for India from 1991 to 2019.

**Figure 2: Inflation rate and Unemployment rate for India from 1991 to 2019**



*Source:* data.worldbank.org



### *Model Specification*

To study the impact of inflation on unemployment, we use the following regression equation:

$$\text{Unemployment} = \beta_1 + (\beta_2 * \text{Inflation}) + \mu$$

## **5. Results and Analysis**

### *Regression Analysis*

The empirical results are presented in the table 2 below which shows the estimated parameters, their t-statistics and other diagnostic tests of equations. From the presented result it is evident that there is a trade-off relationship between unemployment and inflation. This is attributed to the negative coefficient of inflation which is -0.000766. This shows that a percentage increase in inflation will lead to a 0.000766 reduction in unemployment. The probability value of inflation (0.9202) shows that inflation has no significant impact on unemployment in India.

**Table 2**  
**Regression Analysis**

UNEMPLOYMENT_RATE=C(1)+C(2)*INFLATION_RATE				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	5.573817	0.060994	91.38323	0.0000
C(2)	-0.000766	0.007569	-0.101173	0.9202
R-squared	0.000379	Mean dependent var		5.568138
Adjusted R-squared	-0.036644	S.D. dependent var		0.126274
S.E. of regression	0.128567	Akaike info criterion		-1.198265
Sum squared resid	0.446294	Schwarz criterion		-1.103968
Log likelihood	19.37484	Hannan-Quinn criter.		-1.168732
F-statistic	0.010236	Durbin-Watson stat		0.409455
Prob(F-statistic)	0.920161			

*Source:* Author's Calculation

The coefficient of determination ( $R^2$ ) of the model under consideration which measures the goodness of fit of the model has a value of 0.000379. This indicates that the explanatory variables (inflation) explains about 0.04 % of the variations in the unexplained variable (unemployment rate).

Also, the F-test for the model has a probability value of 0.010236 which shows that the model is overall significant at 5% level of significance. It further

proves that the model has been correctly specified and can be used for forecasting purposes.

The t-statistic is -0.1012. The rule of thumb says reject the null hypothesis if the t-statistic is more than two. Here, the null hypothesis is that there is no relation between inflation and unemployment. Thus, the null hypothesis will be rejected as t statistic is less than two. However, the null hypothesis for t-statistic for intercept term will not be rejected as it is greater than two.

### **Granger Causality Test**

Causal relationship was investigated among the variables using the Granger Causality Test. The result obtained from the test is summarized below.

**Table 3**  
**Granger Causality Test**

<i>Null Hypothesis</i>	<i>Obs</i>	<i>F-Statistic</i>	<i>Prob.</i>
Unemployment_Rate does not Granger Cause Inflation_Rate	27	2.20429	0.1341
Inflation_Rate does not Granger Cause Unemployment_Rate		0.96247	0.3975

*Source:* Author's Calculation

The rule of thumb states that the probability of F-statistic must be less than 0.05 to show causal relationship. From table above, it is evident that there exists no causal relationship between inflation and unemployment. Therefore, it can be concluded that no causal relationship exists between inflation and unemployment in the Indian economy.

## **6. Conclusion**

In this paper, we have investigated the causal link between inflation rate and the unemployment rate in India using Granger causality test. The result reveals that, there is no causality running from inflation and unemployment in the short run in India. However, we find one direction of causality running from unemployment and inflation and the nature of the relationship is negative. This implies that, if the unemployment rate increases, the balance of bargaining power between a firm and a worker tilts in favour of the former; firms gain the ability to hire workers at lower wages. As a result, the firm is able to produce at low cost and which in turn decreases the price level and vice versa. Thus, the govt. should take suitable policy to control the inflation and unemployment to accelerate the economic growth in India.

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