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Empirical Validation of the Phillips Curve: An Analytical Study of Inflation and Unemployment Dynamics in India

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ABSTRACT :

This study revisits the Phillips Curve hypothesis, focusing on the relationship between inflation and unemployment in the Indian economy from 1991 to 2022. The paper analyzes the inflation-unemployment trade-off using evolving Phillips curve dynamics over time, including the classic Phillips Curve, expectations-augmented Phillips Curve, New Keynesian Phillips Curve (NKPC), and models integrating supply shocks. The investigation period, which included considerable economic liberalization, structural reforms, and the Reserve Bank of India's adoption of inflation targeting, provides a unique setting for investigating the changing dynamics of the Phillips Curve. Using annual inflation and unemployment data, this analysis first investigates the two variables' basic inverse relationship. The findings indicate that although the conventional Phillips Curve correlation has diminished in the past few decades, the dynamics of inflation and unemployment have been greatly impacted by structural modifications, supply shocks, and enhanced monetary policy frameworks. The results highlight the necessity for sophisticated policy strategies that take supply-side variables and the changing nature of inflation expectations into account. With empirical data of India, the study adds to the body of knowledge on the Phillips Curve and provides policy-relevant insights for controlling inflation and unemployment in India.

Keywords: Phillips Curve, Inflation, Unemployment, India, Econometric Models, Monetary Policy, Supply Shocks, Inflation Expectations, Structural Reform

INTRODUCTION :

The Phillips Curve has long served as a foundational concept in macroeconomics, positing an inverse relationship between inflation and unemployment. Originally articulated by A.W. Phillips in 1958, this relationship suggests that as unemployment decreases, inflation tends to rise, and vice versa. The theoretical implications of this trade-off have shaped monetary policy frameworks globally, influencing how policymakers balance objectives of price stability and full employment. The Indian economy offers a convincing case study for the Phillips Curve theory to be reviewed. India has experienced significant structural changes since the historic economic reforms of 1991 with the goals of promoting industrial growth, liberalizing markets, and assimilating into the world economy.

An era of rapid economic expansion was brought about by these reforms, along with changes in the unemployment rate and variations in inflation. Both internal policy reforms and international economic developments affected India's post-1991 dynamic shifts in inflationary pressures and unemployment rates. Inflationary spikes were first observed during the liberalization era as pricing mechanisms were changed to account for supply-side limits and market pressures. Simultaneously, structural modifications in the labor market resulted in differences in unemployment rates between industries and geographical areas. Furthermore, the implementation of inflation targeting by the Reserve Bank of India in 2016 represented a critical turning point in the country's monetary policy framework. This change demonstrated the central bank's dedication to preserving price stability in the face of changing economic circumstances. To influence wage negotiations, corporate decisions, and consumer behavior, inflation targeting was introduced to anchor inflation expectations (Patra, 2017).

Basic Phillips Curve Equation

The original Phillips Curve equation suggests a simple inverse relationship between inflation (π) and unemployment (u):

$$\pi_t = \alpha - \beta u_t + \varepsilon_t$$

where: π is the inflation rate at time t, u is the unemployment rate at time t, α and β are the parameters to be estimated, ε_t is the error term. This model implies that as unemployment decreases, inflation increases, and vice versa. In the context of India, this basic model might capture the initial post-liberalization years where structural adjustments led to changes in both inflation and unemployment rates.

Expectations-Augmented Phillips Curve

Milton Friedman (1968) and Edmund Phelps (1967) introduced the expectations-augmented Phillips Curve, incorporating the role of inflation expectations:

$$\pi_t = \pi_t^e - \beta(u_t - u^*) + \varepsilon_t$$

where: π_t^e is the expected inflation rate, $u^*$is the natural rate of unemployment (or NAIRU - Non-Accelerating Inflation Rate of Unemployment). The expectations-augmented model recognizes that inflation expectations influence actual inflation. If inflation expectations are adaptive (i.e., based on past inflation), then:

$$\pi_t^e = \pi_{t-1}$$

Substituting this into the equation, we get:

$$\pi_t = \pi_{t-1} - \beta(u_t - u^*) + \varepsilon_t$$

This model is particularly relevant for India, where inflation expectations often reflect past inflation due to persistent inflationary trends and structural rigidities.

New Keynesian Phillips Curve (NKPC)

The New Keynesian Phillips Curve (NKPC) integrates forward-looking expectations and real marginal costs often proxied by the output gap.

$$\pi_t = \gamma\, \pi_{t+1}^e + \lambda\, m_t + \varepsilon_t$$

where: π_{t+1}^e is the expected future inflation rate, m_t is the real marginal cost, often proxied by the output gap. Gali and Gertler (1999) proposed a hybrid form of the NKPC, which includes both forward-looking and backward-looking components:

$$\pi_t = \gamma_f\, \pi_{t+1}^e + \gamma_b\, \pi_{t-1}^e + \lambda\, m_t + \varepsilon_t$$

This hybrid model can be seen in the Indian context, capturing both the forward-looking behavior of firms and the backward-looking nature of price-setting due to institutional factors since 1991.

Structural Phillips Curve with Supply Shocks

India's economy is significantly influenced by supply shocks, such as fluctuations in food and fuel prices. The structural Phillips Curve incorporates these supply shocks (z_t)

$$\pi_t = \pi_t^e - \beta(u_t - u^*) + \delta z_t + \varepsilon_t$$

where δ measures the impact of supply shocks on inflation. For example, an increase in global oil prices can lead to higher domestic inflation, irrespective of the unemployment rate.

Non-Linear Phillips Curve

A non-linear Phillips Curve captures potential asymmetries in the relationship between inflation and unemployment:

$$\pi_t = \alpha - \beta_1 u_t + \beta_2\, u_t^2 + \varepsilon_t$$

Where β_2 captures the non-linear effects of unemployment on inflation. This model can account for scenarios where the impact of unemployment on inflation might differ at different levels of unemployment.

India's Empirical Context since 1991

For the Indian economy, the economic liberalization of 1991 represented a dramatic sea change. Following its liberalization, India went through different stages of economic expansion, inflation, and joblessness, all of which were impacted by national and international economic changes.

- *Initial Post-Liberalization Period (1991-2000):* Significant structural changes were made in India during the first post-liberalization phase, which affected unemployment and inflation. Some of the early trade-offs may have been accounted for by the simple Phillips Curve model, as unemployment also experienced transitional shocks and inflation rates were relatively high as a result of deregulation and fiscal adjustments.

- *Economic Boom and Inflationary Pressures (2000-2010):* The early 2000s saw strong economic growth, which was aided in part by the surge in foreign direct investment (FDI) and the IT industry. However, supply-side limitations and shocks to global commodity prices, particularly those of food and oil, also contributed to growing inflation during this time. This is where the expectations-augmented and structural Phillips Curve models come into play, as they capture the impact of supply shocks and inflation expectations on the trade-off between inflation and unemployment.

- *Globalization and Monetary Policy Evolution (Post-2010):* After 2010, the global economy, monetary policy frameworks, and structural changes like the 2017 implementation of the Goods and Services Tax (GST) all had an increasing impact on India's inflation dynamics. A good framework for this time is offered by the New Keynesian Phillips Curve, which places a strong focus on real marginal costs and forward-looking expectations. The implementation of an inflation-targeting system by the Reserve Bank of India in 2016 emphasizes the significance of controlling inflation expectations even more.

LITERATURE REVIEW :

The Phillips Curve, initially proposed by A.W. Phillips in 1958, established a foundational concept in macroeconomics by positing an inverse relationship between inflation and unemployment. Phillips's empirical observation suggested that when unemployment rates are low, wages tend to rise, leading firms to increase prices, thereby causing inflation. This relationship implied a potential trade-off for policymakers: they could target either low unemployment or low inflation, but not both simultaneously (Phillips, 1958). The initial Phillips Curve model provided a straightforward framework for understanding macroeconomic dynamics, but its simplicity was soon challenged by theoretical refinements and empirical observations. Milton Friedman and Edmund Phelps introduced the expectations-augmented Phillips Curve in the late 1960s, arguing that inflation expectations play a critical role in determining actual inflation rates. According to this model, individuals and firms form expectations about future inflation based on past experiences and economic signals. These expectations then influence wage negotiations and price-setting behavior, affecting the actual rate of inflation. The expectations-augmented Phillips Curve thus suggested that the trade-off between inflation and unemployment observed in the short run might not persist in the long run. As expectations adapt to economic conditions, the Phillips Curve could shift, making it difficult for policymakers to exploit a stable trade-off over extended periods. (Friedman, 1968; Phelps, 1967).

Empirical studies on the Phillips Curve have yielded mixed results, especially in the context of developed economies where structural changes, such as globalization and technological advancements, have altered inflation dynamics. Early empirical validations supported the existence of a short-term inverse relationship between inflation and unemployment (Gordon, 1970). However, subsequent studies revealed variations in the Phillips Curve over different economic periods and countries, challenging its universal applicability. In the Indian context, empirical investigations into the Phillips Curve hypothesis gained prominence following the economic reforms of 1991. These reforms aimed to liberalize markets, boost industrial growth, and integrate India into the global economy. Initially, the liberalization era saw inflationary pressures as pricing mechanisms adjusted to market forces and supply-side constraints (Joshi & Little, 1994). The transition from a controlled economy to a market-oriented one necessitated adjustments in monetary policy frameworks to stabilize inflation and unemployment rates.

Post-1991, India witnessed significant fluctuations in inflation and unemployment rates, influenced by both domestic policy reforms and global economic trends. The Reserve Bank of India (RBI) played a pivotal role in managing these dynamics, transitioning from a focus on credit control to inflation targeting in 2016 (Patra, 2017). This strategic shift aimed to anchor inflation expectations and enhance the credibility of monetary policy, reflecting India's commitment to achieving price stability amidst evolving economic conditions. Studies by Reddy and Reddy (1994) and Kumar and Okimoto (2007) examined inflation-unemployment dynamics in India post-liberalization. They highlighted the initial challenges of inflation management and the subsequent stabilization efforts as the economy adapted to market-oriented reforms. The Phillips Curve framework provided a lens through which policymakers could assess the impact of monetary interventions on macroeconomic variables, albeit with adaptations to suit India's unique economic structure and challenges.

Contemporary debates surrounding the Phillips Curve theory focus on its relevance in explaining inflation dynamics in today's globalized and technologically advanced economies. Critics argue that structural changes, such as the increased flexibility of labor markets and the globalization of supply chains, have diminished the predictability of inflation based on unemployment rates alone (Blanchard, 2016). Moreover, the persistence of low inflation rates in advanced economies despite low unemployment levels challenges the traditional Phillips Curve framework (Stock & Watson, 2019). In India, debates continue regarding the applicability of the Phillips Curve amidst structural reforms and demographic shifts. The demographic dividend, characterized by a youthful population entering the workforce, poses unique challenges and opportunities for inflation management and economic growth (Khan & Sen, 2015). Policymakers must navigate these complexities while considering the implications of global economic interdependencies and technological advancements on domestic inflation dynamics.

OBJECTIVE & METHODOLOGY :

The purpose of this study is to reexamine the Phillips Curve theory in light of the Indian economy between 1991 and 2024. The study uses a rigorous empirical methodology to examine the relationship between unemployment and inflation. In particular, the goals consist of:

- Empirical Analysis: Applying historical data on India's unemployment and inflation to estimate and assess the classic Phillips Curve relationship.
- Impact of Structural Factors: Using a structural Phillips Curve framework, this study examines how supply shocks and structural reforms affect the inflation-unemployment trade-off.

Descriptive statistics, such as mean, median, maximum and minimum values, variance, standard deviation, skewness, kurtosis, percentiles, correlation, etc. testing to look at the relationship between the variables, have been used to analyze the current study. While the unemployment data was gathered from the World Bank's data repository utilizing the metadata on the World Development Index, the inflation data utilized in the analysis came from the World Bank's "Cross country database of inflation". A portion of the data was extracted using Excel, and the remainder was collected directly from the website.
Also, data have been examined, visualized, and analyzed using R, STATA, and Microsoft Excel.

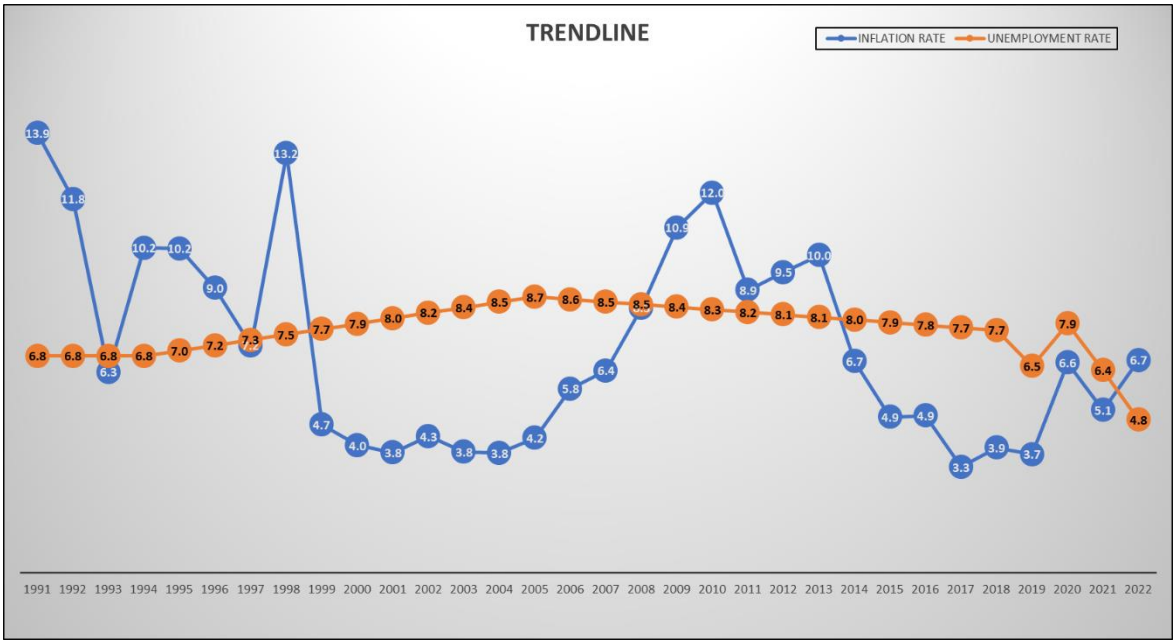
EMPIRICAL ANALYSIS :

The trendline (Fig-1), which covers the years 1991 to 2022, provides a thorough picture of India's economic dynamics, especially with regard to unemployment and inflation rates. India saw substantial economic changes in the early 1990s. Significant economic liberalization, including structural changes meant to expand the economy, took place in the nation in 1991. At this time, unemployment was very moderate at 6.8%, but inflation was exceptionally high, peaking at 13.9% in 1991. The main causes of the high inflation were the post-liberalization adjustments and economic uncertainty. The unemployment rate did not significantly fall despite the strong inflation, suggesting a weak initial alignment with the conventional Phillips Curve model. India's inflation rates started to decline in the late 1990s; they peaked in 1998 at 13.2% and then decreased to 4.7% in 1999. On the other hand, during this time, unemployment rose, hitting 7.9% in 2000. The Phillips Curve theory, which linked greater unemployment rates to lower inflation rates, is somewhat supported by this trend. The increase in unemployment can be ascribed to the economy's structural adjustments, which entailed changes toward increased productivity and efficiency and frequently resulted in job losses at first before stabilizing.

There was a period of high unemployment and somewhat stable inflation rates in the mid-2000s. For example, in 2005, the unemployment rate peaked at 8.7%, while the inflation rate was 4.2%. The classic Phillips Curve relationship was put to the test because of the persistently high unemployment rate despite the modest inflation. The labor market's structural changes and the shift to more capital-intensive industries were perhaps some of the factors that contributed to the high unemployment rate that persisted during this time. This stage suggests that, when structural changes occur, the Phillips Curve might not adequately represent the complexity of India's economic environment. An important turning point in Indian economic policy occurred in the 2010s, primarily with the Reserve Bank of India's (RBI) adoption of an inflation-targeting framework. This policy change sought to keep inflation within a particular range, which resulted in a sharp decline in inflation rates. Inflation by 2017 was 3.3%, among the lowest throughout the time under review. Concurrently, but with some variations, unemployment rates started to drop. For instance, because of the COVID-19 pandemic, unemployment decreased to 6.5% in 2019 but increased to 7.9% in 2020. The inflation-targeting policy probably altered the classic Phillips Curve dynamics, which prioritized controlled inflation over direct employment considerations.

After 2010, domestic and international policy initiatives and prevailing economic conditions in India contributed to the complexity of the relationship between unemployment and inflation. The 2008 financial crisis and the ensuing volatility in the world economy had a major effect on India's economy. For example, in 2009, inflation peaked at 10.9% before leveling out. In contrast, the unemployment rate has been steadily declining since 2010, with some significant declines in recent years, including a drop to 4.8% in 2022. This time frame highlights how supply-side variables, including oil prices and agricultural productivity, and external shocks can have a greater impact on inflation than the demand-side variables that are usually highlighted in the Phillips Curve paradigm.

Fig. 1 – Trendline of Inflation and Unemployment Rate of India 1991-2022



From Table 1, with a mean inflation rate of 7.13%, India appears to have had modest inflation during the last thirty years, which is consistent with a growing nation undergoing some structural and economic reforms. The global financial crises and shifting commodity prices are examples of external shocks and times of economic instability that are indicated by the 3.12% standard deviation of inflation rates. Higher inflation rates were more common than lower ones, as indicated by the median inflation rate of 6.50%, which was somewhat lower than the mean and had a positive skewness of 0.62. This is in line with India's economic history, which has seen high inflation during times of both supply-side limitations and rapid expansion. The dramatic changes in inflation are highlighted by the range of 10.54%, which includes a minimum of 3.33% and a maximum of 13.87%. These fluctuations represent times of both major economic overheating and strict monetary constraints. A distribution with lighter tails than a normal distribution is suggested by the negative kurtosis score of -0.79, which implies fewer extreme episodes of inflation or deflation than would be predicted in a more volatile economy. The core tendency of inflation rates is captured by the 95% confidence interval, which ranges from 6.00% to 8.26%. This range offers policymakers a trustworthy estimate that they may use to assess long-term inflation patterns and make well-informed decisions about monetary policy and economic planning.

DESCRIPTIVE STATISTICS	INFLATION	UNEMPLOYMENT
MEAN	7.130484016	7.65790625
STANDARD ERROR	0.552249741	0.147320314
MEDIAN	6.498159066	7.855
MODE	NA	6.838
STANDARD DEVIATION	3.123996292	0.833369544
SAMPLE VARIANCE	9.759352831	0.694504797
KURTOSIS	-0.789912279	2.839753476
SKEWNESS	0.618615667	-1.400181943
RANGE	10.5420728	3.878
CONFIDENCE LEVEL (95%)	1.126320772	0.300461761

Table. 1 – Descriptive Statistics of Inflation and unemployment rate 1991-2022 (India)

The average unemployment rate, which is roughly 7.66%, reflects difficulties in creating jobs despite economic expansion and reflects a continually high level of unemployment. Given that the 7.86% median rate is near the mean, the distribution around this central number appears to be reasonably symmetrical. When compared to inflation rates, the standard deviation of 0.83% indicates very low variability in unemployment rates, pointing to more stable labor market circumstances. The range of 3.88%, with a low of 4.82% and a maximum of 8.70%, nevertheless, indicates some variation, maybe brought on by shifts in the economy's fundamental makeup and economic cycles. The negative skewness of -1.40 indicates that the unemployment rate distribution is skewed to the left, with a longer tail for lower unemployment rates. This suggests that lower unemployment rates were less common, while the economy frequently suffered higher levels of unemployment. The kurtosis value of 2.84 indicates a leptokurtic distribution, which has more occurrences of extreme values than a normal distribution.The 95% confidence interval for the mean unemployment rate ranges from 7.36% to 7.96%, providing a precise assessment of the central tendency.

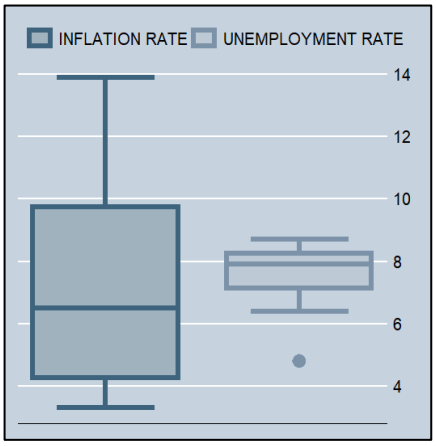


Fig. 2 – Boxplot of Inflation and Unemployment Rate of India 1991-2022

POLICY RECOMMENDATIONS & CONCLUSION :

Based on our understanding of the Phillips Curve and its implications for the Indian economy, numerous policy proposals can be developed to manage inflation and unemployment while promoting long-term economic growth successfully. Balanced Monetary and Fiscal Policies:

- Monetary Policy: The Reserve Bank of India (RBI) should pursue a balanced monetary policy. While managing inflation is critical, tightening monetary policy too vigorously may impede economic development and raise unemployment. It would be prudent to gradually modify interest rates while keeping inflation and economic targets in mind (Blanchard, 2017).
- Fiscal Policy: The government should strive for fiscal discipline while making enough public investments in infrastructure, education, and healthcare. Reducing budget deficits can assist control inflation without impacting employment (Samuelson & Solow, 1960).
- Inflation Targeting : The RBI should keep inflation targeting as a core policy, with a target inflation rate of 2-4%, which is widely considered best for economic stability. This objective should be flexible enough to account for short-term economic volatility while maintaining long-term price stability (Friedman, 1968).
- Labor Market Reforms: Increased labor market flexibility can help to minimize structural unemployment. Policies that promote skill development, vocational training, and labor mobility across regions and industries might be helpful (Phillips, 1958).
- Ease of Doing Business: Simplifying regulatory procedures and lowering bureaucratic barriers can encourage both domestic and foreign investment. This can boost economic activity, create jobs, and possibly lower unemployment .
- Supply-side Policies: Policies targeted at enhancing productivity and supply-side capacity can help to keep inflation under control while minimizing job losses. Investments in technology, infrastructure, and innovation can boost productivity and drive long-term economic growth (Stock & Watson, 2019). Encouraging agricultural production and improving supply chain efficiencies will help stabilize food costs, which are a substantial component of India's inflation.
- Inclusive Growth: Ensure that economic growth is inclusive and benefits all segments of society. This can help lessen income inequality and social discontent. Policies focused on rural development, poverty reduction, and social security can help to achieve more equal economic outcomes (Blanchard, 2017). Promoting small and medium-sized enterprises (SMEs) can generate job opportunities and boost economic activity at the grassroots level.
- NAIRU and employment policies: The Non-Accelerating Inflation Rate of Unemployment (NAIRU) should be factored into policy design. Efforts should be undertaken to discover and maintain the NAIRU level, which keeps inflation steady while reducing unemployment (Friedman, 1968). Active labor market policies, such as job search aid, retraining programs, and unemployment compensation, can help control unemployment during economic changes (Phillips, 1958).

The exploration of the Phillips Curve in the context of the Indian economy from 1991 to 2022 has yielded significant insights, highlighting the intricate interplay between inflation and unemployment. The findings underscore the short-run trade-off between these two crucial economic indicators while emphasizing the complexities that arise in the long run due to various structural, cyclical, and policy-related factors. The unemployment rate at which inflation stays constant is represented by the NAIRU. In order to control inflation without jeopardizing economic growth, unemployment must be kept at or close to this level (Friedman, 1968; Ball & Mankiw, 2002). In order for India to achieve this balance, monetary and fiscal policy must be integrated in a coordinated manner. Empirical evidence from India indicates that while the unemployment rate has fluctuated relatively less, the inflation rate has been extremely erratic. This finding is consistent with the more general economic theory that states that supply-side restrictions and overall global economic conditions can have a greater impact on inflation (Rangarajan, 2018). The ramifications of these findings for policy are significant.

Deflationary strategies can be used to control inflation in the US, since the unemployment rate is comparatively low. But in India, where unemployment and inflation are high, a more sophisticated strategy is required. While enacting steps to limit inflation, policymakers must concentrate on enhancing the ease of doing business, drawing investments, and promoting economic growth. This two-pronged strategy can assist in moving the aggregate supply (AS) and demand (AD) curves to the right, promoting price stability and economic growth. Strict deflationary measures are essential to bring inflation under control in volatile economies such as Venezuela, where high levels of inflation coexist with manageable unemployment rates. This demonstrates how the Phillips Curve's applicability varies depending on the economic environment.

To sum up, the Phillips Curve continues to be an important conceptual tool for comprehending the relationship between unemployment and inflation. Its usefulness, however, changes dramatically over time and in various economic settings. To effectively manage inflation and unemployment, policymakers must take a flexible and context-specific approach that takes into account both short- and long-term trends. The study's conclusions highlight the significance of a well-balanced policy mix that supports both price stability and sustainable economic growth. India can create a stable macroeconomic climate that promotes growth and improves the well-being of its citizens by carefully balancing its monetary and fiscal policies.

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