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Does Philips Curve Really Exist In Indian Economy? An Econometric Overview

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Abstract
The existence of the Phillips Curve in India has been a topic of debate among economists. The Phillips Curve is a macroeconomic concept that describes an inverse relationship between inflation and unemployment. Some studies suggest that there is a weak or nonexistent Phillips Curve relationship in India, while others suggest that there is a positive relationship between inflation and unemployment. Indian economy has also experienced significant economic growth but with persistent inflationary pressure. Factors such as structural changes in the Indian economy, supply side shocks and the impact of external factors on the Indian economy can contribute to the complexity of analyzing the Philips curve relationship in India. Additionally, the Philips curve may not apply uniformly across all regions of India due to difference in economic development and industrialization levels. Overall, the Philips curve continues to be a topic of interest and debate in the Indian economy. Its relevance and applicability in the Indian economy are still being explored and found the weaker relationship between unemployment and inflation in India at present.

Keywords: Philips Curve, Economists, Inflation, macroeconomic, industrialization

1. Introduction

The Philips Curve, named after the economist A.W. Phillips, postulates an inverse relationship between unemployment and inflation in an economy. This relationship has been studied over the years by policymakers, analysts, and economists to gain insights into the workings of economies around the world. In India, the Philips Curve has been a widely discussed concept, especially as the country has experienced fluctuations in inflation and unemployment in recent years. In 2017, India witnessed a change in government, accompanied by significant shifts in economic policies, which led to a slow-down in economic growth. This was accompanied by a rise in inflation, which hit its highest level of 6.7% in June 2017. As a result, policymakers and analysts began to examine the relationship between inflation and unemployment in the country more closely. The Philips Curve explained that as employment rates increase, inflation tends to rise as well. This relationship can be explained by the fact that as more people are employed, the demand for goods and services increases, leading to a rise in prices. Conversely, when unemployment is high, demand is low, leading to a decrease in prices.

However, this relationship is not always straightforward, and the timing and nature of the relationship between inflation and unemployment can vary significantly depending on external factors such as natural disasters, global economic conditions, and political unrest. Indian's recent experience with the Philips Curve is a case in point. In the wake of the COVID-19 pandemic, the country experienced a sharp decline in economic activity, coupled with rising inflation, laying to rest the Phillips curve theory. Despite a contraction of nearly 4% in the economy, the inflation rate has remained high and stubbornly above the target range of the Central Bank. Furthermore, the shift to digital services and online businesses introduced a modern supply chain that has kept the inflation

levels up due to logistics bottlenecks and increased costs incurred by the supply chain actors. Hence, the theories underlying Philips Curve require a new set of analytical tools to explain the changes in the economy in light of technological advancement, economic and environmental shocks.

In conclusion, Indian's experience with the Philips Curve highlights the changing nature of the relationship between inflation and unemployment in a fast-moving global economy. While the Philips Curve may provide a useful starting point for policymakers and analysts, it is important to take a more holistic approach to macroeconomic analysis, incorporating other variables that can influence the economy's behavior.

2. Literature Review

This curve was first introduced by A.W. Phillips in 1958 after analyzing the data on wage inflation and unemployment rates in the United Kingdom. The literature review of the Phillips curve is quite extensive and covers various aspects of the theory. Researchers have found mixed results regarding the relationship between inflation and unemployment.

In the case of India, there have been several studies examining the applicability of the Phillips curve to the Indian economy. One study conducted by Ghosh and Ghosh (2017) found that the Philips curve applies to the Indian economy, but with a lagged effect. They found that there is a significant negative relationship between unemployment and inflation, but the effect of unemployment on inflation is not immediate and it takes about two years to manifest. Another study by Panchal and Panchal (2018) looked at the relationship between inflation, unemployment and GDP growth in India. They found that there is a significant negative relationship between unemployment and inflation, but the relationship between GDP growth and inflation is more complex and depends on several factors. In a paper by Bhanumuthy and Varma (2019), they found evidence of a "non-linear" Philips curve in India which suggests that the relationship between unemployment and inflation is not always straightforward. They also found that the Philips curve relationship varies across different states in India.

Another study by Das and Sahoo (2019) found evidence of a "hump-shaped" Philips curve in India which suggests that low levels of unemployment are associated with higher levels of inflation, but this relationship reverses when unemployment is very high. A paper by Kaur and Singh (2018) examined the Philips curve relationship in India over a longer time period (1950-2014) and found evidence of significant negative relationship between inflation and unemployment. They also noted that the strength of this relationship has weakened in recent years. In a study, Acharya and Pattanayak (2020) found that the Philips curve relationship in India has become weaker and less predictable in recent years. They argue that this may be due to the variety of factors, such as changes in the structure of the Indian economy and shifts in monetary policy. A study by Chakraborty and Acharyya (2019) examined the relationship between unemployment, inflation and economic growth in India. They found that a negative Philips curve relationship exists in the short run, but not in the long run. They also found that this relationship is stronger during periods of high economic growth.

In a paper by Kumar and Dubey (2019), the authors found that the Philips curve relationship in India a sensitive to the choice of inflation measure used. They argue that using headline inflation as the measure of inflation may overstate the degree of inflationary pressure in the economy, and that using core inflation (which excludes volatile food and oil prices) may provide a more accurate measure of the Philips curve relationship. A study by Kapur (2018) examined the Philips curve relationship in India from a historical perspective, and found that the relationship has been weak and unstable over the long run. He argues that this is due to variety of factors including changes in the structure of the Indian economy, shifts in economic policy and global economic shocks. A paper by Mukhopadhyay

and Chakraborty (2019) examined the Philips curve relationship in India using time-varying coefficient model. They found that the Philips curve is dynamic and changes over time, depending on the state of the economy and other macroeconomic factors.

A paper by Kapur and Behera (2018) found that the Philips curve relationship in India has become weaker and less stable in recent years, particularly since the global financial crisis of 2008. They argue that this may be due to several of factors including changes in the structure of the Indian economy, shifts in economic policy and global economic shocks. Overall, these studies suggest that the Philips curve relationship in India is complex and varies across time and space depending on a variety of economic and policy factors. While the Philips curve relationship may still exist in the Indian economy, there are several factors that make the relationship more complex and less predictable than in other countries. Policymakers therefore need to take into account these complexities when formulating economic policies.

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3. Objective of the Research

The main or general objective of the study is to examine the existence of Philips curve in Indian economy

4. Model Specification for the Research

The econometric model developed in this study is designed to measure the existence of the Philips curve in the Indian economy. The main independent variable is unemployment rate (UNEMP) and dependent variable is inflation (INF). The model further includes control variables such as government expenditure (GE) as a percentage of GDP. To investigate the objective of the research the econometric regression analysis is conducted particularly OLS, VAR, FEM, RAM, GMM and Hauseman Test. Hypothesis testing is applied to test the validity of the Philips curves hypothesis by evaluating the statistical significance of the relationship between inflation and unemployment. The time series data of 49 years have been used in this research.

The econometric model is as represented below;

INF = f (UNEMP, GROWTH, GE, GDP, POP)

$$INFLA_{t} = \alpha_{i} + \beta_{1} GDP_{it} + \beta_{2} GROWTH_{it} + \beta_{3} UNEMP_{it} + \beta_{4} POP_{it} + \beta_{5} GE_{it} + \mu_{t} + \varepsilon_{it}$$

$$INFLA_{t} = \alpha_{i} + Y_{t} INFLA_{t-1} + \beta_{1} GDP_{it} + \beta_{2} GROWTH_{it} + \beta_{3} UNEMP_{it} + \beta_{4} POP_{it} + \beta_{5} GE_{it} + \mu_{t} + \varepsilon_{it}$$

Where,

UNEMP = Unemployment rate
INF= Inflation rate
GROWTH = Annual change in real GDP
GE= Government Expenditure
GDP= Gross Domestic Product
POP= Population

5. Variable and Data

5.1 Variables

The study is completely based on secondary data. It uses annual time series data covering the periods

of 1973-2021 for India. The main sources of data are World Development Indicators-2022, International Monetary Fund (IMF) year book 2022 and World Bank (WB) report 2022. Graphical and tabulation representations of the data are used. It presents the data on GDP growth, Inflation Rate (INFLA), Unemployment (UNEMP), Per Capita Income (PCI), Population Size (POP), and Government Expenditure (GOVTEXP) sequentially.

GDP Growth: World Bank (WDI, 2022) explains GDP growth as annual percentage of growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all residents plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation.

Unemployment-(UNEMP):
Unemployment is one of the biggest economic issues faced by many countries aroundthe world. It is a situation where individuals who are able and willing to work are unable to find jobs despite activel y seeking employment. Unemployment can have a significant impact on individuals, families, and th e economy as a whole. One of the most obvious consequences is a loss of income for those who are unemployed, which can lead to financial hardship and difficulty paying bills. Unemployment can also lead to a loss of skills and work experience, making it even harder for individuals to find employment in the future. When individuals are unemployed, they are unable to contribute to the production of goods and services in the economy, leading to a decline in output. This can have a ripple effect on other sectors of the economy and lead to a decline in consumer spending. This can ultimately exacerbate the economic downturn in a country.

Per Capita Income (PCI): Per capita income (PCI) measures the average income earned per person in a country within a specified year. It is calculated by dividing the country's total income by its total population. Per capita income is national income divided by population size. Per capita income is often used to measure a sector's average income and compare the wealth of different populations. Per capita income is often used to measure a country's standard of living. It is usually expressed in terms of a commonly used international currency such as the euro or United States dollar. This helps to ascertain a country's development status. It is one of the three measures for calculating the Human development Index of a country.

Population Size (POP): Population size is the total number of human beings within a geographical boundary or a country. Total number of population of selected five south Asian countries namely Bangladesh, India, Sri Lanka and Nepal are used in this study**. Inflation Rate (INFLA**): Inflation is the increase in the prices of goods and services over time. It's an economic term that means you have to spend more to meet your basic expenses. Inflation increases your cost of living. Inflation reduces the purchasing power of each unit of currency. As prices rise, money buys less. That's how it reduces one's standard of living over time. The inflation rate is the percent increase in prices during a specified period. The percentage tells us how quickly prices rose during the period.

Government Expenditure (GOVTEXP): Government expenditure refers to the amount of money the government spends on various activities and programs, such as infrastructural development, healthcare, education, defence, social welfare and public services. This includes both capital spending operational spending. The government may fund these expenditure through taxes, borrowing or printing money.

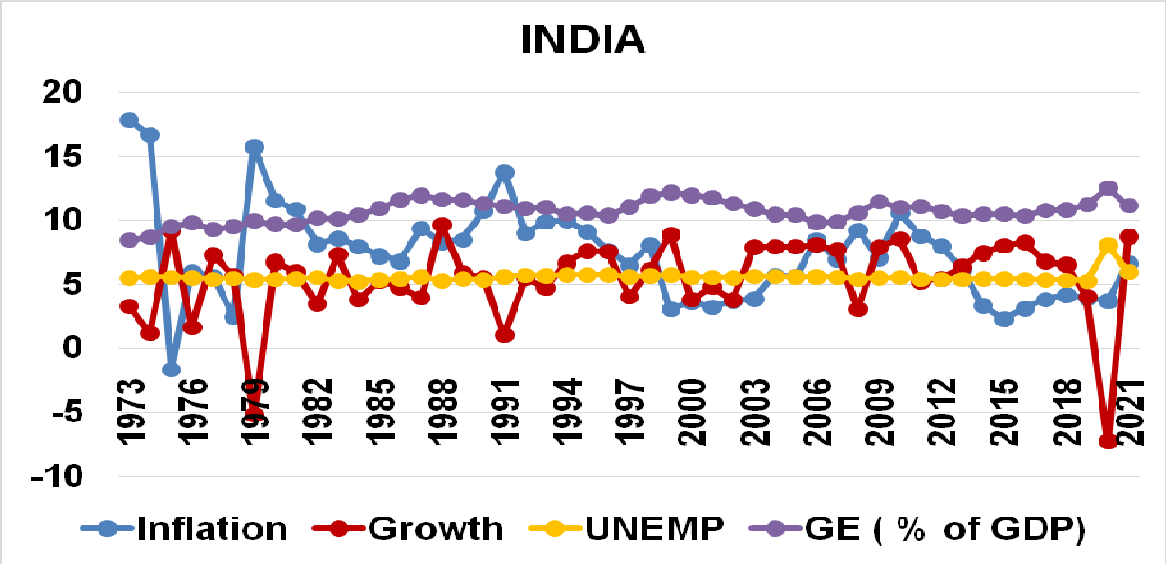
5.2 Data

Year	Inflation	Growth	UNEMP	GE (% of GDP)	GDP(Billion)	Pop in Million
1973	17.83	3.296	5.54	8.407	85.52	596.11
1974	16.668	1.185	5.61	8.641	99.53	609.72
1975	-1.649	9.150	5.57	9.488	98.47	623.52
1976	5.982	1.663	5.53	9.780	102.72	637.45
1977	5.637	7.255	5.41	9.210	121.49	651.69
1978	2.46	5.713	5.49	9.440	137.30	666.27
1979	15.728	-5.238	5.38	9.895	152.99	681.25
1980	11.508	6.736	5.41	9.652	186.33	696.83
1981	10.828	6.006	5.43	9.626	193.49	712.87
1982	8.096	3.476	5.55	10.173	200.72	729.17
1983	8.553	7.289	5.32	10.091	218.26	745.83
1984	7.923	3.821	5.21	10.356	212.16	762.90
1985	7.194	5.254	5.39	10.930	232.51	780.24
1986	6.789	4.777	5.44	11.550	248.99	797.88
1987	9.328	3.965	5.60	11.929	279.03	815.72
1988	8.233	9.628	5.31	11.604	296.59	833.73
1989	8.437	5.947	5.45	11.564	296.04	852.01
1990	10.668	5.533	5.38	11.285	320.98	870.45
1991	13.752	1.057	5.60	11.079	270.11	888.94
1992	8.965	5.482	5.73	10.915	288.21	907.57
1993	9.862	4.751	5.69	11.003	279.30	926.35
1994	9.98	6.659	5.74	10.436	327.28	945.26
1995	9.063	7.574	5.76	10.540	360.28	964.28
1996	7.575	7.550	5.74	10.331	392.90	983.28
1997	6.476	4.050	5.61	11.029	415.87	1002.34
1998	8.01	6.184	5.67	11.910	421.35	1021.43
1999	3.068	8.846	5.74	12.175	458.82	1040.50
2000	3.645	3.841	5.56	11.948	468.39	1059.63
2001	3.216	4.824	5.58	11.761	485.44	1078.97
2002	3.716	3.804	5.53	11.314	514.94	1098.31
2003	3.868	7.860	5.64	10.876	607.70	1117.42
2004	5.725	7.923	5.63	10.405	709.15	1136.26
2005	5.622	7.923	5.61	10.366	820.38	1154.64
2006	8.401	8.061	5.60	9.802	940.26	1172.37
2007	6.944	7.661	5.57	9.862	1216.74	1189.69
2008	9.194	3.087	5.41	10.538	1198.90	1206.73
2009	7.04	7.862	5.54	11.460	1341.89	1223.64
2010	10.526	8.498	5.55	11.008	1675.62	1240.61
2011	8.734	5.241	5.43	11.084	1823.05	1257.62
2012	7.934	5.456	5.41	10.684	1827.64	1274.49
2013	6.187	6.386	5.42	10.295	1856.72	1291.13
2014	3.332	7.410	5.44	10.441	2039.13	1307.25
2015	2.28	7.996	5.43	10.428	2103.59	1322.87
2016	3.124	8.256	5.42	10.309	2290.43	1338.64
2017	3.836	6.795	5.36	10.767	2652.55	1354.20

2018	4.185	6.533	5.33	10.789	2726.32	1369.00
2019	3.945	4.042	5.27	11.228	2973.53	1383.11
2020	3.723	-7.252	8.00	12.496	3269.24	1396.39
2021	6.623	8.7	5.98	11.13	3647.32	1407.56

Source: WDI-2022

Table- 1: Data of India



Source: Author's self construct

Figure-1: Trend of the variables (India)

6. Empirical Result

Series: INFLA UNEMP GDP GOVTEXP GROWTH POP				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability**
None *	0.928179	222.1452	111.7805	0.0000
At most 1 *	0.594100	108.9015	83.93712	0.0003
At most 2 *	0.544137	70.13060	60.06141	0.0056
At most 3	0.300335	36.35137	40.17493	0.1152
At most 4	0.264495	20.99374	24.27596	0.1227
At most 5	0.137520	7.784204	12.32090	0.2539
At most 6	0.032543	1.422647	4.129906	0.2728
Maximum Eigenvalue				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability**
None *	0.928179	113.2437	42.77219	0.0000
At most 1 *	0.594100	38.77090	36.63019	0.0277
At most 2 *	0.544137	33.77924	30.43961	0.0185
At most 3	0.300335	15.35763	24.15921	0.4769
At most 4	0.264495	13.20954	17.79730	0.2146
At most 5	0.137520	6.361558	11.22480	0.3104
At most 6	0.032543	1.422647	4.129906	0.2728

Table 6.1: Johansen Co-integration Rank Test-India

Note: Max-eigenvalue test indicates 3 co-integrating eqn (s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Table 6.1 represents the co-integration relationship among the variables - inflation, unemployment, GDP, growth, govt. expenditure, and population size of India. Results of the trace and maximum eigenvalue tests indicate the co-integrating relationship among the variables. Thus, the null hypothesis of no co-integration is rejected at less than 5 percent and estimated values of Trace and maximum eigenvalue tests are greater than their respective critical values. Thereby, the alternative hypothesis is accepted. Result shown in table 1.6.1 confirms that there is a co-integration among the variables in case of India.

The short-run pair-wise directional causal relationship between the variables is depicted in the table 6.2 in case of India. The Granger Causality Test result shows that inflation has unidirectional relation with GDP. Similarly, inflation does Granger Cause to population size of India. As the probability value is less than 5 percent, therefore the null hypothesis is rejected. The result is the mixed order causal relation between the variables of India.

Null Hypothesis:	F-Statistic	Probability
Inflation does not Granger Cause GDP	6.77244	0.0030
GDP does not Granger Cause Inflation	0.45917	0.6352
Govt. expenditure does not Granger Cause Inflation	0.35058	0.7065
Inflation does not Granger Cause Govt. expenditure	5.07512	0.0110
Growth does not Granger Cause Inflation	1.15153	0.3267
Inflation does not Granger Cause Growth	0.93572	0.4009
Unemployment does not Granger Cause Inflation	0.38262	0.6846
Inflation does not Granger Cause Unemployment	1.19473	0.3136
POP does not Granger Cause Inflation	4.45196	0.0181
Inflation does not Granger Cause POP	8.20429	0.0011

Table 6.2: Pairwise Granger Causality Tests for India

Table 6.3 represents the Vector Auto-regression test for India. The result indicates that GDP affects the inflation positively in India. There are positive coefficient of the variables population, and economic growth for India. Among them, result of population is expected and significant. On the other hand, result of unemployment and growth are expected but insignificant. The coefficient of govt. expenditure is negative which is unexpected and insignificant. In lag 1 coefficient is positive which confirms that inflation is positively explained by its lag 1 and negatively influenced by its lag 2.

INFLA	Coef.	z	P>z
L1.	0.793	5.110	0.000
L2.	-0.398	-2.690	0.007
GDP	0.002	-0.080	0.934
UNEMP	-1.3123	-1.520	0.129
Population	22.090	3.330	0.001
GROWTH	14542.950	0.940	0.348
Govt. expenditure	-0.002	-0.170	0.863
cons	-1.087	-3.160	0.002

Table 6.3: VAR Test for India

Inflation	Coefficient	t-value	p-value	Sig
GDP	0.013	5.87	0.000	***
UNEMP	-0.424	0.40	0.000	***
Population	32.762	24.65	0.673	
GROWTH	0.016	0.05	0.840	**
Govt. expenditure	-0.020	-2.90	0.011	**
Constant	-2950.173	-12.19	0.000	***
R^2	0.985	Number of obs		245.00
F-test	2513.102	Prob > F		0.000

Table 6.4: Results of Fixed Effects Model (FEM)

Note: ***, ** and * denote significance at 1, 5 and 10 per cent levels respectively.

Table 6.4 represents the regression results of FEM. Here, the value of R^2 is 0.985 which means that dependent variable – inflation is explained by 98.5 percent by the independent variables – unemployment, GDP, government expenditure, population. This confirms the effectiveness of the model. This means the model is very good and fit best to explain the panel data. The coefficient of the independent variable, unemployment, is highly significant at 1% level and it is negative which indicates that 1 percent increase of unemployment decreases the inflation by 0.4 percent. Here the coefficients of GDP and government expenditure are also highly significant. Coefficient of population is positive but insignificant. From this result, we conclude that there is a long-term relationship between the inflation and unemployment in India.

INFLA	Coefficient	t-value	p-value	Sig
GDP	0.031	4.21	0.000	***
Population	12.403	17.36	0.000	***
UNEMP	-0.215	5.72	0.000	***
GROWTH	0.213	2.21	0.193	
Govt. expenditure	-0.017	-2.12	0.412	
Constant	-451.502	-2.75	0.069	*
Overall R^2	0.994	Number of obs	245.00	
χ^2	12794.311	Prob > chi2	0.000	
R^2 within	0.967	R^2 between	0.994	

Table 6.5: Results of Random Effect Model (REM)

Note: ***, ** and * denote significance at 1, 5 and 10 per cent levels respectively.

The regression results of Random Effects Model (REM) for panel data analysis are portrayed in table 6.5. Here the value of overall R^2 is 0.994 which means that dependent variable – inflation is explained by the independent variables by 99.4 percent. That is, the model is very good and fit to explain the panel data analysis. The independent variable, unemployment, is highly significant and coefficient is negative which indicates that 1 percent increase of unemployment decreases the inflation by 0.21 percent. Here the independent variables, GDP and population are also highly significant. The coefficient of growth is positive which is expected but it is insignificant. Coefficient

of government expenditure is negative but insignificant. Finally, we may deduct that inflation and unemployment rate are interrelated in the long run for India

	Coeffcient
χ^2 value	197.72
P-value	0.000

Table 6.6: Hausman Specification Test

With a view to identify the appropriate model out of Fixed Effects Model (FEM) and Random Effects Model (REM), Hausman specification test is estimated. Here the null hypothesis is: Fixed Effects Model (FEM) is not appropriate. As the probability value is less than 5 percent, so the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore we may decide that, Random Effects Model (FEM) is more appropriate for this study. The result of REM confirms the causal relation between inflation and unemployment of India for long run, while keeping GDP, population size, economic growth, and government expenditure as control variables.

INFLA	Coef.	t-value	p-value	Sig
Lag Inflation	0.872	29.38	0.000	***
GDP	0.013	2.12	0.294	
Population	3.021	4.31	0.000	***
UNEMP	-0.396	3.14	0.013	***
GROWTH	0.128	0.51	0.701	
Govt. expenditure	-0.015	-0.31	0.793	
Constant	-121.124	-0.87	0.314	
Number of obs	245		χ^2	79436.312

Table 6.7: Results of Generalized Methods of Moments (GMM)

Note: ***, ** and * denote significance at 1, 5 and 10 per cent levels respectively.

Table 6.7 provides the GMM regression results which show the long run relationship between dependent and independent variables considering the endogeneity of the variables. The advantage of GMM model over FEM and REM is that it removes the heterogeneity in variables within the model. Results show that lag inflation; population and unemployment are highly significant at 1% level indicating that these three variables play significant role in determining the inflation rate. Further, results reports that the coefficients of GDP and economic growth are positive implying that these also contribute positively to the inflation but these are insignificant. Government expenditure has negative coefficients but insignificant.

7. Conclusion

The existence of Philips curve relationship in the Indian economy is subject of debate among economists. While there is some evidence to suggest that the Philips curve applies to the Indian economy, there are also several factors that make the relationship more complex and less predictable than in other countries. For instance, Indian economy is highly diverse and fragmented with significant regional differences in inflation and unemployment rates. Additionally, the Indian economy is subject to a range of structural and policy related factors that can affect the strength and

nature of the Philips curve.

The results of co-integration indicate that there are co-integrations among inflation, unemployment, and economic growth proxies by GDP of India. Granger causality test shows that the short-run pair-wise causal relationship between various pairs the variables, like GDP and inflation, unemployment and inflation, inflation and population size and so on. Vector Auto-regression test result confirms the relationship among inflation, unemployment and economic growth in India. The results of panel analysis based on Fixed Effects Model (FEM), Random Effects Model (REM) and Generalized Methods of Moments (GMM) confirm the relationship among inflation, unemployment, economic growth, population size, and govt. expenditure in India at various levels.

The research found that the Philips curve relationship has weakened or broken down in Indian economy. This is due to the changes in the structure of the Indian economy, such as the rise of the service sector and the increasing importance of global supply chains. Additionally, the monetary policy frameworks such as the adoption of inflation targeting have reduced the strength of the Philips curve relationship in India. India is a developing country with large informal sector which makes it difficult to accurately measure unemployment rates. Additionally, the countries complex economic and social structure makes it challenging to draw clear conclusions about the relationship between inflation and unemployment. Overall, while the Philips curve may have some relevance in India, it is not straight forward concept and requires further analysis to fully understand its impact on the country's economy.

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