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Analyzing the Phillips Curve in the Context of Population Growth in Pakistan

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ABSTRACT

This study investigates the long-term link between unemployment and inflation trade-offs in the context of population and GDP growth rates in Pakistan, utilizing yearly time series data from 1980 to 2020 to assess the Phillips curve. Unemployment is the dependent variable in this study, whereas inflation, GDP growth rate, and population growth rate are independent factors. For the data analysis of the proposed model, the Johansen co-integration technique is used to analyze the long-run co-integration study. The findings of the co-integration analysis show that inflation and GDP growth rate have a significant and negative impact on unemployment, whereas the impact of population growth rate on unemployment is positive and significant, supporting the formulated hypothesis. The findings show that the government and policymakers may devise measures to enhance GDP growth, regulate inflation, and properly manage the country's population growth rate in order to reduce unemployment. Policymakers may establish an appropriate and efficient macroeconomic policy mix.

Keywords: *Phillips Curve, Unemployment, Inflation, GDP, Population growth, Pakistan*

INTRODUCTION

Either Keynesian or monetarist models can explain the negative slope of the Phillips curve. According to Keynesians, nominal wages are set for a length of time; therefore, any rise in the money supply and hence in prices would lead real wages to fall, thereby raising labor demand. Assuming there are idle resources in the economy, rising labor demand by enterprises would result in higher employment, lowering unemployment. Wages and pricing, on the other hand, are completely variable in the traditional structure. As a result, any rise in the money supply would cause an increase in both nominal wages and prices.

Workers, on the other hand, directly perceive salary increases, whereas information about price changes is only available with a lag. Workers face the signal extraction problem in this manner, and they raise labor supply as if their relative price (real wage) has increased. Despite their differing interpretations of the Phillips curve's negative slope in the short run, both schools of thought agreed on money's long-term neutrality. Within the scope of adaptive expectations,

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both arrived at the same conclusion. Economic agents are thought to be retroactive. The policymaker accepts the predicted inflation position of private actors as provided and then decides on the monetary policy shock. As a result, policy is successful in the short term but not in the long run, resulting in a vertical Phillips curve in the long run. An essential issue to note here is that agents make systematic prediction mistakes. It is vital to emphasize that in this scenario, deflationary policy is far more expensive in terms of production loss. In Pakistan, a negative relationship between inflation and one term of delayed unemployment was explored. According to the survey, there are more job prospects and a stronger demand for workers, which has resulted in salary increases in the labor market. Rising wage rates raised the cost of manufacturing goods, resulting in a high rate of inflation. Consequently, the Phillips curve was maintained in Pakistan over the research period (Satti et al., 2007).

The Phillips curve depicts the link between the inflation rate and the unemployment rate. Despite having forerunners, A. W. H. Phillips' researched on wage inflation and unemployment in the United Kingdom from 1861 to 1957 represented a watershed moment in the evolution of macroeconomics. Wages climbed slowly while unemployment was high and swiftly when unemployment was low. Phillips observed an adverse relationship between the two. Phillips hypothesized that when the unemployment rate fell, the labor market tightened and companies had to boost pay quicker to attract scarce workers. The strain eased when unemployment rates rose. The "curve" of Phillips indicated the average link between unemployment and wage behavior across the business cycle. It depicted the rate of wage inflation that would occur if a certain level of unemployment remained for a period of time. Economists quickly computed Phillips curves for the majority of industrialized nations. Most people linked unemployment to general price inflation rather than salary inflation. (Hoover, 2008).

In developing nations, particularly Pakistan, the large population has concerning concerns. Rapid population growth causes several socioeconomic issues in the economy. It not only increases unemployment, but it also adds to the backlog of unemployed people. If people are unable to find work in their native nation, they may be enticed to migrate to another country. This may be perilous for a country's future, especially if other countries are draining its brains. As a result, if this problem remains in any economy, it might be a key factor in slowing economic development. Furthermore, continuous unemployment not only harms a country's standing in relation to other countries, but it also causes harsh domestic difficulties. Long-term unemployment invariably leads to financial difficulties, poverty, homelessness, criminality, frustration, and a variety of other issues such as family disintegration and conflict, social isolation, and a loss of confidence and self-esteem (Maqbool et al., 2013).

Inflation is typically assumed to be harmful for an economy; however, research undertaken by Alban William Housego Phillips, better known as A.W. Phillip, demonstrated this to be incorrect. Dr. A.W. Phillips was a New Zealander who taught economics at the London School of Economics. He was recognized for his study that demonstrated that the rate of inflation had an influence on the unemployment rate of any country, which became known as the "Phillips Curve." This study provided a hypothesis suggesting an indirect relationship between the two variables and concludes that anytime inflation rises, job possibilities increase and the country's

economic growth increases, and vice versa. Because the variables have an indirect connection, the graph of inflation and unemployment is always downward-sloping. (Khan & Pohwani, 2020).

Ahmad (2020) has investigated Pakistan's inflation-unemployment relationship. In order to verify whether the Phillips curve exists in Pakistan, he employed time series data from 1991 to 2015 in his research and the Eviews9 software. He notices a drop in the unemployment rate and increased inflation. Thus, his research provided evidence in favor of Pakistan's Phillips Curve.

In most nations, unemployment is a serious issue that has an impact on economies. In the D8 countries—Turkey, Iran, Pakistan, Bangladesh, Indonesia, Malaysia, Egypt, and Nigeria—the correlation between inflation and unemployment was examined. Data spanning from 1996 to 2020 was used for this purpose. Regression analysis with dynamic panel data was applied. The dependent and independent variables' lagged values revealed statistically significant and negative findings. Thus, statistically significant results in D8 nations and the negative correlation between unemployment and inflation support the Phillips curve (Yayar and Tekgun, 2022).

Objectives of the Study

i. To investigate the applicability of the Phillips curve in Pakistan.

ii. To identify the effect of economic growth and population growth rates on unemployment

iii. To provide policy options based on the findings of this study.

Significance of the Study

It is crucial to remember that the Phillips curve has been criticized and modified throughout the years. Various economic changes have called into question the initial assumption of a steady, predictable trade-off between inflation and unemployment. In actuality, numerous factors other than this basic trade-off influence both inflation and unemployment, such as population growth and global economic conditions. The link between population growth, inflation, and unemployment is complicated and can be impacted by a variety of different economic, social, and policy issues. In addition to the energy crisis, which is causing industry closures and gas and electricity load shedding, Pakistan is facing a dire economic situation. The cost of production is rising due to the extraordinarily high prices of goods, and producers are passing those costs along to consumers. These factors are causing production to decline and workers to be forced out of the industry and paid low wages (Gul et al., 2012).

The Phillips Curve has limits and may not always precisely reflect the dynamics of an economy. In conclusion, while population increase has consequences for both inflation and unemployment in Pakistan, it is only one of several factors influencing both economic indicators. When making choices on inflation and unemployment in Pakistan, policymakers must examine a wide range of economic and demographic issues. As a result, while the Phillips Curve is still an important tool for economic research, it is frequently utilized in conjunction with other economic indicators and data to influence policy choices in Pakistan and abroad.

LITERATURE REVIEW

Price regulation is rendered difficult if a lowering or recessionary monetary shock causes a sustained decrease in inflation and raises unemployment, which is most likely only temporary in the short term. Under these circumstances, the short-run trade-off between unemployment and inflation presents a significant challenge to the theory of business cycles, and the outcomes of monetary policy combined with price control remain enigmatic to business cycle theorists (Mankiw, 2003).

Furuoka and Munir (2009) checked whether or not the Phillips Curve exists in several ASEAN countries throughout the world. Malaysia, Singapore, Indonesia, Thailand, and the Philippines were chosen as nations. Data for the tradeoff between inflation and unemployment were collected from 1982 to 2004. The findings revealed that there is no balanced relationship between the unemployment rate and the inflation rate in these ASEAN nations.

In Pakistan, Gul et al., (2012), investigated the validity of the Philips curve to determine if inflation and unemployment had a positive or negative connection between the years 1992 and 2010. Their paper's findings indicated a negative association between unemployment and inflation. Accordingly, it is said that the Philips Curve is still applicable to the Pakistani economy because unemployment has declined as inflation has increased.

Maqbool et al., (2013) investigated the empirical relationships between unemployment, population, foreign direct investment, gross domestic product, inflation, and external debt in Pakistan from 1976 to 2012 in order to determine the variables that caused unemployment in Pakistan. These variables are thought to have a significant influence on the unemployment rate in Pakistan. Because of unemployment, the components were tested using the Autoregressive-Distributed-Lag (ARDL) approach. According to an empirical study, the key long- and short-term predictors of unemployment in Pakistan were population, inflation, foreign direct investment, and GDP. According to their findings, Pakistan possessed both a short-term and long-term Phillips curve.

Jayawardana and Jayasinghe, (2016) explained that a variety of factors lead to inflation. On the demand-pull front, the expansion of the money supply is a key predictor of inflation. According to the QTM, the rate of inflation and the increase in the money supply are proportionate. Increased government spending may produce inflation in two ways: directly by boosting aggregate demand or indirectly by causing a budget deficit, which the government may have to fill by borrowing from inflationary sources. As the Philips curve connection demonstrates, an increase in real GDP can lead to inflation. When the nominal pay rate rises faster than productivity growth, wage increases become inflationary. Salary increases raise production costs, which leads to a reduction in aggregate supply, resulting in higher prices. Wages can also be inflationary in the sense that they increase aggregate demand.

Khan and Khan (2018) explored the relationship between inflation rates and economic development in five Asian countries, such as Bangladesh, Iran, Indonesia, Malaysia, and Pakistan. The stationarity feature was assessed using relevant methods and time series data from 1973 to

2016. The data was verified to be free of unit root issues. The study used least squares and traditional panel estimating methods for analysis. The findings demonstrated that inflation had a negative and statistically significant influence on economic growth in the nations studied. Panel data methodologies indicated a similar significant negative relationship between inflation and economic growth. This study discovered that regulating inflation and sustaining economic growth and development in the studied nations need a strong and effective combination of macroeconomic policies.

Zayed et al., (2018) used the Philips curve in the Philippines to analyze the inflation rate in terms of unemployment, GDP, and yearly pay rate from 1950 to 2017. The major purpose of this article was to determine the existence of the Phillips curve in the Philippine economy. An OLS (Ordinary Least Square) model was built alongside the ADF (Augmented Dicky-Fuller) unit root test to examine the association between the listed variables. The study concluded that the Philippine government should apply policy instruments addressing GDP and the yearly wage rate in such a way that they favorably affect the country's inflation and unemployment rates.

Mangnejo et al., (2020) conducted a pragmatic analysis on unemployment and inflation in Pakistan from 1991 to 2015 to determine the trend and link between the variables. They used EViews software to evaluate the data to see if the Philips curve existed in Pakistan. The Philips curve was discovered in Pakistan, according to the findings of this investigation.

Ali et al., (2021) investigated the impact of Pakistan's monetary policy on unemployment from 1977 to 2019. The ARDL approach was used to estimate time series data for the inquiry. According to the findings of the study, there is a weak relationship between unemployment and the budget deficit. Unemployment exhibited negative associations with population growth, positive relationships with GDP growth, and inverse relationships with the consumer price index over the research period.

The relationships between unemployment (UNE), GDP, population growth (POP), renewable energy use (REN), non-renewable energy consumption (ENE), and ecological footprints (EF) for South Asian nations were examined by Tariq et al. (2022). The PMG and ARDL methods, respectively, were used to analyze the panel annual data for the years 1991–2019. The environmental Phillips curve for South Asian nations was verified by the study.

Research Gap

The Phillips curve represents the negative link between the inflation rate and the unemployment rate. Pakistan is experiencing both high inflation, significant unemployment rate and high population growth rate. Hence, the purpose of this study is to investigate the reality of the existence of Phillips curve in the context of population growth in Pakistan. This leaves a research gap to investigate the phenomenon. It is vital to discuss, investigate, and assess the issue as it has evolved through time. According to Mahmood (2013), the long-term impact of Pakistan's tradeoff between inflation, interest rate, and unemployment rate may be studied. One approach to identifying research gaps in the area of "Analyzing the Phillips Curve in the Context of Population Growth in Pakistan" is to look for studies that examine how population growth in Pakistan directly

affects the Phillips curve. These studies may not be as numerous. An important gap can be closed by examining how quickly population growth influences the relationship between unemployment and inflation, given Pakistan's rapid pace of population growth. Considering the challenges of managing both inflation and unemployment in a rapidly growing population, research may focus on the most effective ways to apply monetary and fiscal policies. Examining these demographic characteristics in the context of Pakistan may help us better understand how they affect the dynamics of inflation and unemployment. By bridging this study gap, we can better comprehend Pakistan's Phillips curve, which accounts for the nation's economic dynamics and population increase.

METHODOLOGY

Data and Variables Overview

This study used annual secondary time series data from 1980 to 2020 to investigate the long-run and short-run trade-off of inflation and unemployment in Pakistan. There are 41 observations in the data sample. Larger sample sizes yield stronger and more trustworthy results since they have narrower error margins and lower standard deviations. The standard deviation (SD) quantifies how much the data values deviate from the mean. The margin of error decreases as the study sample size increases. Using larger sample sizes, researchers can lower the chance of reporting false-negative or false-positive results. The accuracy of the results will improve as the number of samples grows. According to the applicable Schwarz Bayesian Criteria (SBC), the data of the chosen model are stationary, normally distributed, and have no multicollinearity. Based on the aforementioned data set, we determined that our model is the best linear regression model and can be used to accurately forecast inflation and unemployment trade-offs in Pakistan. The variables' data were gathered from the data sources of the State Bank of Pakistan, World Development Indicators (WDI), 2021, and 2022 of the World Bank.

The average global rate in 2021, based on 181 countries, is 8.46 percent. Trading Economics global macro models and analyst estimates anticipate that Pakistan's unemployment rate will reach 6.20 percent by the end of 2022 (tradingeconomics.com). In this study, the unemployment rate is reported as a percentage of the total labor force.

The expected inflation rate is known as the "threshold rate," and it may be used to calculate how much it would help or hinder the speed of economic growth, according to Khan and Senhadji (2001). According to the report, the expected threshold rate for developed countries is between 1 and 3 percent, whereas it is between 11 and 12 percent for underdeveloped countries. For a positive association, the inflation rate should be lower than the threshold rate (Azam & Saleem, 2018). In this study, it is expressed as an annual percentage.

The gross domestic product (GDP) of a country is the market value of all completed goods and services produced in that country in a given year. The real GDP per capita (adjusted for inflation) is frequently used as the primary indicator to assess a country's economic position over time or in comparison to other countries. The vast majority of economists tend to accept the role of GDP as a welfare or progress gauge in empirical economics and politics as a given, despite the

fact that a rising number of them realize the GDP indicator's faults (Bergh, 2009). GDP is employed as a constant LCU data variable in this investigation.

The world population might reach 8 or 10 billion people in the following decades (United Nations, 2022). Overpopulation is the root cause of the majority of the world's issues. Pakistan has a population of 231,379,047 people as of today. It has a 2.0 percent yearly growth rate (World Meter and United Nations, 2022). The population is expected to reach 260.3 million in 2030 and 330.8 million by 2050, which is quite worrying. In this study, the population growth rate is given as an annual percentage.

The Empirical Model

The following model estimated the Philips Curve in Pakistan.

Unemployment = f (Inflation, GDP growth rate, Population growth rate) ..... (1)

This function says that whenever Price and GDP and population growth are changed then they will surely effect on the unemployment.

Functional form of equation (1):

$$UNEMPLOYMENT = \beta_0 + \beta_1 INFLATION + \beta_2 GDP\_GROWTH + \beta_3 POP + e_i \ldots\ldots (2)$$

Where,

GDP_GROWTH = gross domestic product growth rate
POP = population growth rate
ei = standard error term

Here, UNEMPLOYMENT is dependent variable while, INFLATION, GDP_GROWTH and POP are independent/explanatory variables.

β_0 is intercept (constant) may be either positive or negative, showing exogenous variable's effect on the model (the impact of all other variables on the model that is not taken into consideration in the model). Here, β_1, β_2 and β_3 are the slope coefficients of Inflation, GDP growth rate and population growth respectively. Where, $\beta_1 < 0$, $\beta_2 < 0$, & $\beta_3 > 0$ are the expected signs of the coefficients, showing the dependent variable's percentage change when explanatory variable is changed by 1 unit. The standard error is ε_i of regression model.

Hypothesis of the Study

The following Hypotheses were formulated with respect to the objectives of this study.

H_1: Increase in inflation and GDP growth rate shall result in decreasing unemployment
H_2: Increase in population growth rate will lead to raise unemployment

Because this study used annual time series data, time series techniques such as descriptive statistics, correlation analysis, determining whether the data are stationary, co-integration test, and error correction mechanism have been used.

Estimation Methodology

In order to achieve the aforementioned objectives, this study investigated the factors that drive inflation in Pakistan. The study employed the following methodologies:

I. Descriptive statistics are used to explain the nature and normality of data by employing mean, median, mode, skewness, kurtosis, and Jarque bera values.
II. The correlation matrix was constructed in the study to test for the presence of multicollinearity among the variables.
III. The Augmented Dickey Fuller (ADF) unit root test was used in this work to determine the presence of a unit root in a time series.
IV. Johansen's Cointegration test was employed in the study to examine whether there was a long-term relationship between the variables. If it is discovered that a long-run relationship between variables exists, i.e., variables are cointegrated with each other.
V. Short-term changes, historical disequilibrium levels, and adjustment speed have all been approximated using the Error Correction Model (ECM).

The study's findings were computed using the computer program EViews 10. These are discussed in detail below.

RESULTS AND DISCUSSION

Descriptive Analysis

The descriptive statistics and Jarque-Bera statistics for each variable in the model have been generated in this part to verify the data's normality. Table 4.1 in appendix displays the mean values of the variables as well as their standard deviations. The analysis demonstrated the normal distribution of these variables by showing that the mean values of the unemployment, inflation, GDP growth rate, and population growth rate are greater than the values of their standard deviations. As a result, every variable in the aforementioned model has a normal distribution

Jarque-Bera Statistics

Additionally, data normality is examined using Jarque-Bera statistics. Table 4.2 indicates that the probability values of unemployment, inflation, and population are greater than 0.05, showing a normal distribution. But for GDP, the probability values of Jarque-Bera statistics are smaller than 0.05, showing a non-normal distribution. According to Gujrati (2011), if the probability value greater than 0.05 in Jarque-Bera statistics signifies that the data is normal.

Correlation Analysis

The correlation coefficients between the unemployment, inflation, GDP growth rate, and population growth rate are listed in Table 4.3. As a result, none of the values for the repressors' correlation coefficients are greater than 0.9, indicating that the model variables are not multicollinear. The multicollinearity problem, according to Asteriou and Hall (2007), appears when the correlation between any two explanatory variables is greater than 0.9.

Unit Root Test

An Augmented Dickey- Fuller (1984) test is run for each variable to determine stationarity of each variable before assessing the co-integration connection. The results of this study at level and at first difference are given in Tables 4.4 and 4.5 in Appendix.

ADF Result at Level

The ADF test is used to check the stationary nature of the variables in the selected model. The ADF-statistics values are displayed along with their critical values at the 5% significance level in Table 4.4. Results from every ADF test are given at each level. This classification is expanded to include the following three categories: with intercept, with intercept and trend, and with none (neither with intercept nor with trend). All of the results show that all of the variables are not stationary at level.

ADF Results at First Difference

Following the unit root testing at the level, it is tested once more for the first difference. The unit root test at first difference results are shown in Table 4.5 with intercept, with intercept and trend, and without intercept or trend. The results show that all variables are stationary at the first difference. All variables are integrated into order 1, or I (1), in conclusion.

Lag Length Selection Criteria

Before confirming Cointegration between variables, the lag structure of the VAR (Vector Autoregressive Model) should be examined using the Schwarz Criterion. Statistics for various lag length criteria are shown in Table 4.6. The Cointegration outcomes favor SC (Schwarz Criterion) of VAR lag order 1, as indicated by the asterisk (*).

Unrestricted Cointegration Rank Test (Trace Statistic)

Johansen the Cointegration test was used to count the amount of integrating vectors among variables of the model by using Trace statistics. Unrestricted Cointegration Rank Test (Trace) results are obtained for the aforesaid model given in Table 4.7, which indicates 1 integrating equations at the 0.05 level.

Unrestricted Cointegration Rank Test (Max Eigen Value)

Using the Maximum Eigen statistic, the Johansen Cointegration test was run to count the number of Cointegration vectors between the variables. The Johansen test was applied to the aforementioned model, and the results are shown in Table 4.8. At the 0.05 level, Table 4.8 shows 1 integrating equations.

Long-Run Relationship

The Johansen Cointegration test was used to find the slope coefficients of the independent variables in this study or to ascertain the long-term relationship between the dependent and independent variables. Table 4.9 in Appendix displays the long-term coefficient estimates for the regression model, where the unemployment is the dependent variable and the inflation, GDP growth rate, and population growth rate are the independent variables.

The long-term findings indicate that there is a significant and long-term negative correlation between inflation and unemployment. The results show that inflation has a significant and negative association with unemployment; and the coefficient of inflation indicates that a one-unit increase in inflation will decrease unemployment by 82 percent. Long-term GDP growth rate are negatively and significantly correlated with unemployment rate, as shown by the coefficient of GDP growth rate, which predicts that a one-unit increase in GDP growth will result in a 177 percent fall in unemployment. While population is important and has a long-term significant and positive association with unemployment, its coefficient shows that a one-unit rise in population growth will result in a 469 percent increase in unemployment.

Short Run Estimates

The short-term relationship between the dependent and independent variables as well as the short-run equilibrium for the model in this study are both determined using the Vector Errors Correction Model (VECM). The initial difference state that each variable plus the lagged value of the residual from the co-integrating regression (et-1). The model has been used with a vector error correction technique.

In Table 4.10, the results show that short-term unemployment is inversely correlated with inflation, GDP growth rate and population growth rate. The T-ratios-ratios table indicates that GDP is significant at 5% level, although inflation and population are not in short run. The vector error correction term's (CointEq1) value is -0.327464, with a t-value of -3.64 indicating the presence of short-run disequilibrium and a coefficient that is within the range of 0 and -1, suggesting a proper rate of adjustment or conversion into long run equilibrium. Essentially, Cointegration involves determining and simulating long-term equilibrium connections between non-stationary time series variables. Even though other techniques can be used to model short-run dynamics, they are nonetheless important.

CONCLUSION

In order to assess the existence of the Phillips curve in Pakistan, this study seeks to explore how inflation, GDP growth rate, and population growth rate affect unemployment in the long run.

This study investigates the model using yearly time series data sets from 1980 to 2020 derived from various national and international data sets, and it applies the Johansen tests of co-integration. The study is carried out using the computer program EViews 10.

To ensure that the data is normal, a descriptive analysis was performed. The correlation matrix is used to test the model's regressors for multicollinearity. Before doing the co-integration analysis, the ADF test is used to check that all of the variables in the models were stationary. The VAR (vector autoregressive) lag order is used to determine the appropriate lag time for the model engaged in the present research investigation. The model chooses optimal lag length 1 based on the Schwarz criteria (SC). The co-integrating equations connecting the variables are determined using trace and maximum Eigen value statistics in order to evaluate the model's long-run coefficients. The Johansen system of co-integration is utilized to construct predicted long-run coefficients for the inflation targeting model.

The model findings show that inflation and the GDP growth rate have significant and negative associations with unemployment, but the population growth rate has positive and significant long-term impacts on the unemployment rate. According to the inflation coefficient, a one-unit increase in inflation causes an 82 percent decrease in unemployment, proving the applicability of Phillips Curve in Pakistan. According to Mahmood, Bokhari, and Aslam (2013), inflation acts as the function in the Cointegration equation for interest rates and the unemployment rate, and inflation has an inverse connection with both interest rates and the unemployment rate. The GDP coefficient suggests that a one-unit increase in GDP growth decreases unemployment by 177%. While the population coefficient implies that a one-unit increase in population increases unemployment by 469 percent. According to Maqbool, Mahmood, Sattar, and Bhalli (2013), population, GDP, inflation, and foreign direct investment all have a significant long-term influence on unemployment.

Policy Suggestions

The study highlights essential policy suggestions in order to design appropriate strategies for decreasing inflation, unemployment, and the population growth rate in Pakistan. The study's findings can be utilized to generate policy inferences and recommendations for the government and policymakers. The findings suggest that factors like inflation, population growth, and GDP have a long-term influence on unemployment. In both the short and long run, unemployment and inflation are inversely related. This circumstance demonstrates that the Phillips curve exists in Pakistan and is active, both in the short and long term. The Phillips Curve has substantial policy implications for the government and the central bank (the State Bank of Pakistan). Policymakers in Pakistan, like those in other nations, have frequently battled with the trade-off between controlling inflation and lowering unemployment. Understanding the Phillips curve can aid in the formulation of suitable monetary and fiscal policies to strike a balance between these two aims.

A rapidly expanding population can impose a strain on the supply of products and services. The need for essential necessities such as food, shelter, and healthcare grows in tandem with the population. Population increases may have an impact on government policy concerning job development, education, healthcare, and family planning. If the supply of these products and

services does not keep up with population expansion, this increasing demand may contribute to inflationary pressures. Government measures to combat unemployment and inflation may be impacted by demographic patterns related to population growth. Policymakers may examine how to accommodate a growing population in a sustainable manner, such as by providing infrastructure, education, and healthcare facilities.

Firms and labor organizations in Pakistan may utilize the Phillips Curve as a reference point when negotiating pay and pricing agreements. Understanding the trade-off between inflation and unemployment can affect these talks and alter the country's wage and price dynamics.

The quality of the labor force, including education and skills, can have an influence on both inflation and unemployment. An increasing population can provide a greater pool of labor, but if that workforce lacks the requisite skills and education, it may not contribute effectively to economic progress. This can have an impact on both unemployment (if there is a skills mismatch) and inflation (if productivity remains low). Policymakers' decisions can have an impact on both inflation and unemployment in this context.

High population growth rates can have a negative impact on a country's long-term economic strategy. The Phillips Curve may also aid long-term economic planning in Pakistan. Understanding the historical link between inflation and unemployment allows policymakers to make better-informed judgments about economic growth strategies and structural reforms.

A successful macroeconomic policy mix is therefore recommended in order to target inflation and manage unemployment, promote economic growth, and regulate population growth rate in order to boost social well-being in a meaningful way. Khan and Khan (2018) make the same point.

APPENDICES

Table 4.1: Normality Test

	UNEMPLOYMENT	*INFLATION*		*GDP*	*POP*
Mean	4.0793	8.1632	+11	1.23E	2.6164
Median	4.0800	7.8443	+10	7.95E	2.6474
Maximum	7.8300	20.286	+11	3.56E	3.3640
Minimum	0.4000	2.5293	+10	2.37E	1.9783
Std. Dev.	2.1040	3.7631	+11	1.02E	0.4585
Skewness	-0.1721	0.6755	8	0.943	0.2239
Kurtosis	2.2724	3.7700	4	2.540	1.6287
Jarque-Bera	1.1067	4.1309	8	6.447	3.5551

				0.039	
Probability	0.5750	0.1268	8		0.1690
				5.05E	
Sum	167.25	334.69	+12		107.27
				4.20E	
Sum Sq. Dev.	177.07	566.43	+23		8.4107
Observations	41	41		41	41

Sources: Authors own calculations.

Table 4.2: Normality Test with Jarque-Bera Statistics

	UNEMPLOYMENT	*INFLATION*	*GDP*	*POP*
				3.555
Jarque-Bera	1.1067	4.1309	6.4478 1	
				0.169
Probability	0.5750	0.1268	0.0398 0	
Observations	41	41	41	41

Sources: Authors own calculations.

Table 4.3: Multicollinearity Test

	UNEMPLOYMENT	*INFLATION*	*GDP*	*POP*
UNEMPLOYMENT	1			
LNFLATION	-0.4273	1		
GDP	-0.1645	-0.0456	1	
			-	
POP	0.0719	-0.0414	0.8679	1

Sources: Authors own calculations.

Table 4.4: Augmented Dickey Fuller Test Results at Level (α=0.05)

Variables	*Test Equation*	*ADF Statistics*	*Critical Value at 5%*	*Result*
Unemployment	*With Intercept*	*-2.6808*	*-2.9369*	Non Stationary
	With Intercept & Trend	-2.6504	-3.5266	
	Non	-1.1084	-1.9493	
Inflation	*With Intercept*	-3.0255	-2.9369	Non Stationary
	With Intercept & Trend	-2.9779	-3.5266	
	Non	-1.2769	-1.9493	
GDP	*With Intercept*	-0.3406	-2.9389	Non Stationary
	With Intercept & Trend	-2.1966	-3.5297	
	Non	0.6865	-1.9496	
Population	*With Intercept*	-1.134	-2.9571	Non Stationary
	With Intercept & Trend	0.4517	-3.5529	
	Non	-2.367	-2.3785	

Sources: Authors own calculations.

Table 4.5: Augmented Dickey Fuller Test Results at First Difference (α=0.05)

Variables	Test Equation	ADF Statistics	Critical Value at 5%	Result
Unemployment	*With Intercept*	*-6.9763*	*-2.9389*	Stationary
	With Intercept & Trend	-6.8814	-3.5297	
	Non	-7.0694	-1.9496	
Inflation	*With Intercept*	-7.3501	-2.9389	Stationary
	With Intercept & Trend	-7.3055	-3.5297	
	Non	-7.4466	-1.9496	
GDP	*With Intercept*	-3.2630	-2.9389	Stationary
	With Intercept & Trend	-3.7362	-3.5403	
	Non	-2.9243	-1.9496	
Population	*With Intercept*	-2.2255	-2.9571	Stationary
	With Intercept & Trend	-6.1655	-3.5529	
	Non	-0.6124	-1.9524	

Sources: Authors own calculations.

Table 4.6: VAR Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-278.9593	NA	34.50 61	14.89 26	15.0649	14.9540
1	-157.3807	211.1 628	0.134 05	9.33 58	* 9.1977	9.6424
2	-120.1874	56.76 88	0.045 30	8.22 03	9.7717	8.7723
3	-81.4680	50.9 452*	0.01 48*	7.02 46*	9.2655	7.8219*

Sources: Authors own calculations.

* indicates lag order 1, 2 and 3 selected by the criterion. In the above table 4.6, SC (Schwarz Criterion) of VAR lag order 1 is preferred indicated by *

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.6794	62.0049	47.8561	0.0014
At most 1	0.2254	17.6364	29.7971	0.5930
At most 2	0.1164	7.6742	15.4947	0.5009
At most 3	0.0705	2.8499	3.8415	0.0914

Sources: Authors own calculations.

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level in the above table 4.7 for the model.

* denotes rejection of the hypothesis at the 0.05 level

** denote MacKinnon-Haug-Michelis (1999) p-values

Table 4.8: Unrestricted Cointegration Rank Test (Maximum Eigen Value)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.6794	44.3684	27.5843	0.0002
At most 1	0.2254	9.9622	21.1316	0.7482
At most 2	0.1164	4.8243	14.2646	0.7639
At most 3	0.0705	2.8499	3.8415	0.0914

Sources: Authors own calculations.

In the above table 4.8, Rank Test (Max-eigenvalue test) indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** denote MacKinnon-Haug-Michelis (1999) p-values

Table 4.9: Johansen Normalized Long Run Cointegration coefficients (Dependent Variable: UNEMPLOYMENT)

S.NO	*VARIABLE*	*COEFFICIENT*	*S.E*	*t-STATISTIC*
1	C	6.7701		
2	INFLATION	-0.8281	0.11948	-6.9308
3	GDP_GROWTH	-1.7728	0.26624	-6.6587
4	POP	4.6918	0.88614	5.2946

Sources: Authors own calculations.

Table 4.10: VECM Results (Dependent Variable: Unemployment)

S.NO	*VARIABLE*	*COEFFICIENT*	*S.E*	*T STATISTIC*
1	*C*	-0.311162	0.32	-0.9479
2	*D(INFLATION(-1))*	-0.170233	0.09	-1.8234
3	*D(GDP_GROWTH(1))*	-0.347487	0.15	-2.1885
4	*D(POP(-1))*	-6.475314	6.33	-1.0227
5	*CointEq1*	-0.327599	0.08	-3.6445

Sources: Authors own calculation

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