

THE PHILLIPS CURVE IN DEVELOPING ECONOMIES: A CASE STUDY OF UZBEKISTAN

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Introduction

The Phillips curve, introduced by Alban William Phillips in 1958, highlights an inverse relationship between inflation and unemployment, suggesting that reducing inflation requires increasing unemployment, and vice versa. While this theory was initially supported by empirical data, it faced challenges in the 1970s when stagflation—high inflation and unemployment simultaneously—occurred, contradicting the model's predictions.

In response, economists like Milton Friedman and Edmund Phelps argued that the Phillips curve holds only in the short run. They introduced the concept of the natural rate of unemployment, later refined into the Non-Accelerating Inflation Rate of Unemployment (NAIRU), which suggests inflation is stable when unemployment is at its natural rate.

Today, the Phillips curve has evolved with the inclusion of inflation expectations and factors like the output gap, forming the New Keynesian Phillips Curve (NKPC). Despite its limitations, the Phillips curve remains a critical tool in monetary policy formulation.

This paper applies the Phillips curve model to Uzbekistan's economy, analyzing data from 2015 to 2023. It explores how inflation, unemployment, and inflation expectations interact, especially during the COVID-19 pandemic, and assesses the model's relevance for guiding Uzbekistan's monetary policy.

Literature review

The Phillips model, developed by Alban William Phillips in 1958 in the United Kingdom, expresses an inverse relationship between two macroeconomic indicators: unemployment and inflation. That is, to reduce inflation, it suggests increasing the unemployment rate, and conversely, to reduce the unemployment rate, it suggests increasing the inflation rate.

According to Phillips' theory, in a growing economy, increased demand for labor leads to higher wages, which in turn drives up prices, contributing to inflation. This theory was also recognized as valid by U.S. researcher R.S. Samuelson. Based on calculations for the years 1900-1960, the inverse relationship in this model was confirmed in the U.S. economy.

Nevertheless, between 1970 and 1973, observations by Robert L. S. revealed that the Phillips model did not hold during periods of stagflation, a situation characterized by high unemployment and high inflation occurring simultaneously. This contradicted the model's prediction of an inverse relationship between the two variables. Notably, stagflation had never been observed in the U.S. economy prior to 1970, highlighting a significant challenge to the Phillips curve framework. According to his view, the Phillips model is effective in the short run but is not suitable for the long run. In the context of government manipulation of unemployment and inflation, the results predicted by the Phillips theory do not always occur. As a result, the use of the Phillips model was completely discontinued.

In 1968, the term "natural rate of unemployment" was first introduced by M. Friedman. His theory was further developed in the 1970s by L. Papademos and F. Modigliani, who built upon the Phillips curve to create the concept of NAIRU (the Non-Accelerating Inflation Rate of Unemployment). The term NAIRU refers to the level of unemployment that does not lead to an increase in inflation. According to this hypothesis, inflation is not directly related to the unemployment rate but rather depends on how much the actual unemployment rate deviates from the natural rate of unemployment. Specifically, if the actual unemployment rate is lower than the natural rate, it leads to an overheated economy, causing excessive demand for labor. This, in turn, raises wages and leads to higher inflation. Conversely, if the actual unemployment rate is higher than the natural rate, inflation remains low. As a result, the experience of considering both the actual unemployment rate and expectations in the calculation of the Phillips model began to be applied. According to Stock and Watson (1999), when inflation forecasts are based on NAIRU and assessed through the Phillips curve, they tend to be more accurate compared to forecasts that rely on

other macroeconomic indicators such as interest rates, broad money supply, and commodity prices.

According to U.S. economist Dickens, it is crucial for central banks of countries to have calculations of NAIRU in their own countries when developing measures aimed at ensuring price stability, which is the main focus of their monetary policy.

The U.S. Congressional Budget Office (CBO) suggests using the Non-Accelerating Inflation Rate of Unemployment (NAIRU) in calculating potential GDP and in making decisions regarding changes in federal spending and tax policy. This highlights the significance of having accurate NAIRU estimates, as they play a key role in guiding fiscal policy and ensuring that economic decisions are based on reliable assessments of the economy's capacity and the labor market's conditions.

In this regard, according to the views of Alcaraz and Ramírez (2022), changes in the NAIRU level are primarily driven by supply-side shocks, structural changes in the labor market, and other institutional factors.

Methodology

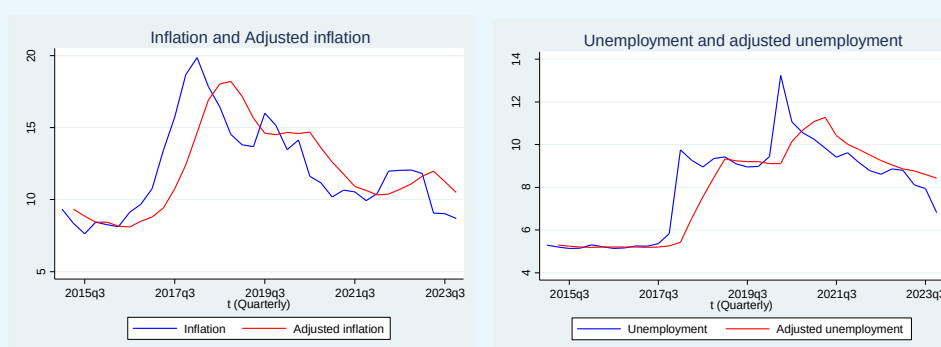
Today, the Phillips model has been refined over the years, incorporating several additional factors such as inflation expectations, global economic changes, structural characteristics of the labor market, and more. This enhanced version of the model is widely used by many developed and developing countries for inflation forecasting. When calculating the Phillips model, countries choose independent variables based on the unique characteristics of their national economies, but the dependent variable is always inflation. For example, in Brazil, when calculating the Phillips curve model for 2022, variables such as transfer payments, inflation, and the GDP gap (between potential and real GDP) were used. In the United States, however, the model relies primarily on the relationship between inflation and unemployment. In general, any voluntary macroeconomic factor can be taken into account when trying to determine its impact on inflation. However, the most widely used is the following new Keynesian Phillips model:

$$\pi_t = \beta E_t \pi_{t+1} - K(u_t - u_t^n) + v_t .$$

According to this, inflation π_t is determined by the following three factors: expected inflation $E_t \pi_{t+1}$, the difference between actual unemployment and the natural rate of

unemployment $u_t - u_t^n$, and cost-push shocks, which are factors that lead to an increase in costs.

The calculations for Uzbekistan based on the Phillips model were carried out using quarterly data from 2015 to 2023. In this analysis, indicators such as the inflation rate, inflation expectations, and unemployment rate were used. Additionally, the following variables were calculated using these indicators: the natural rate of unemployment, adjusted inflation, adjusted unemployment rate, and their values from the previous quarter (lags). To calculate seasonally adjusted inflation and adjusted unemployment rate, the Moving Average (MA) model was applied.



In Uzbekistan, the difference between the natural rate of unemployment and the actual unemployment rate (NAIRU) was negative from the fourth quarter of 2019 to the fourth quarter of 2020, coinciding with the pandemic. During this period, unemployment rates increased in many countries. In Europe, the unemployment rate rose to 8.4%, while in the United States, it reached 14.7%, a level not seen since the recession. In Uzbekistan, the unemployment rate reached 13.2% and 11% in the second and third quarters of 2020, respectively. However, the rise in unemployment did not lead to a significant increase in the gap between the natural and actual unemployment rates. The main reason for this was government interventions, unemployment benefits, social assistance, and the shift of many organizations to online operations. Additionally, during this period, the economically active population decreased sharply by 79,000 people. According to macroeconomic theory, when the difference between actual and natural unemployment is negative, the economy experiences overheating, leading to inflationary pressure and an increase in inflation. However, in many countries, including Uzbekistan, during this period, the inflation rate decreased from 15.2% in the fourth quarter of 2019 to 11.1% in the

fourth quarter of 2020 (in the U.S., it fell from 1.8% to 1.2%, in Canada from 1.8% to 0.7%, and in Russia from 4.5% to 3.4%). According to Dixon (2020), during the pandemic, consumption patterns changed dramatically, especially in the services sector (such as travel, hotels, restaurants, cinemas, logistics). Additionally, the inability to purchase certain products online, a sharp decline in demand for clothing, the suspension of production processes in many businesses for a certain period, and disruptions in supply chains all had an impact on inflation.

In the UK, prior to 2020, the prices of 700 types of goods in the consumer basket were studied to calculate inflation. However, during the pandemic, it became necessary to exclude 90 of these items (mainly services) from the basket. Additionally, during the pandemic, digital technologies advanced significantly, as many services began to be consumed online. Many organizations recognized the effectiveness of remote work, and this shift also had an impact on the consumption patterns of households.

As a result of the pandemic, transportation and logistics services came to a standstill, leading to a significant decrease in demand for fuel. This caused a sharp drop in oil prices on the global market, with the price of a barrel falling to as low as 18 USD in April 2020. Consequently, electricity prices also decreased. Therefore, despite the negative gap between actual and natural unemployment, inflation did not rise as expected.

OLS regression was used to compute the model. According to the results, a 1 percentage point increase in the unemployment gap (the difference between actual and natural unemployment) leads to a 1.19 percentage point decrease in the inflation rate.

Furthermore, the empirical results show that a 1 percentage point increase in inflation expectations leads to a 0.98 percentage point rise in the current quarter's inflation rate, indicating a positive correlation. This suggests that inflation is not driven by random fluctuations caused by various factors, but rather follows a consistent trend and pattern that persists over multiple quarters.

Similarly, when the analysis was conducted for Brazil by Mazali and Divino (2010), a positive correlation between past and current inflation was observed. Specifically,

a 1 percentage point change in inflation from the previous period led to a 0.59 percentage point increase in the current period's inflation rate.

1. Regression

Source	SS	df	MS	Number of obs	=	34
Model	5303.53952	2	2651.76976	F(2, 32)	=	19152.21
Residual	4.43064424	32	.138457632	Prob > F	=	0.0000
				R-squared	=	0.9992
				Adj R-squared	=	0.9991
Total	5307.97016	34	156.11677	Root MSE	=	.3721

adj_inf	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lag1_inf	.9865194	.0052236	188.86	0.000	.9758793	.9971594
ugap	-1.194071	.0928704	-12.86	0.000	-1.383241	-1.0049

The R-squared value is relatively high, indicating that the independent variables in the model (lagged inflation, unemployment gap, and expected inflation) explain 99% of the variation in the dependent variable (adjusted inflation). The p-value of less than 0.05 also indicates the statistical significance of the model. There was no evidence of multicollinearity among the independent variables. Furthermore, the Root Mean Squared Error (RMSE) value of 0.36 suggests the reliability of the model's results. As time series analysis typically exhibits cyclical tendencies, stationarity was not required for this model, so no stationarity tests were performed. Heteroscedasticity was detected through the White test, and the issue was addressed by applying robust standard errors to correct for it.

As previously mentioned, the Phillips curve model also has a New Keynesian Phillips Curve (NKPC) approach, which takes the following form. According to this model, when demand is high, businesses start selling more products by increasing production and hiring additional workers, which leads to a decrease in unemployment. As a result, there is an increase in the demand for intermediate consumer goods, thereby creating inflationary pressure. Furthermore, this model allows for the analysis of the effect of future inflation expectations on current inflation. In this framework, firms set prices and make decisions based on inflation expectations. Consequently, central

banks in many countries use this model for inflation targeting and for monitoring and controlling inflation expectations.

$$\pi_t = \beta E_t[\pi_{t+1}] + \gamma y_{gapt} + \varepsilon_t$$

π_t - current inflation in period t

$\beta E_t[\pi_{t+1}]$ - expected inflation for the next period

y_{gapt} - GDP gap

As mentioned above, there is a direct relationship between the output gap and inflation, meaning that as the output gap increases, inflation also increases, and vice versa. To calculate the output gap, quarterly GDP data from the statistical agency was used and filtered through the Hodrick-Prescott filter, resulting in the cyclical component. Then, this was subtracted from the potential GDP. To analyze this relationship, quarterly data from 2015 to 2023 were used, including inflation, output gap, inflation expectations, and lag inflation. Using OLS regression, the following results were obtained.

Table 2: Regression Results

Source	SS	df	MS	Number of obs	=	32
Model	5155.99047	3	1718.66349	F(3, 29)	=	20234.83
Residual	2.46314106	29	.084935898	Prob > F	=	0.0000
				R-squared	=	0.9995
				Adj R-squared	=	0.9995
Total	5158.45361	32	161.201675	Root MSE	=	.29144

adj_inf	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
output_gap	.0198118	.0204187	0.97	0.340	-.0219492	.0615728
lag_adjinf	.5125143	.0292088	17.55	0.000	.4527755	.572253
exp_inf	.49089	.0290471	16.90	0.000	.4314819	.550298

According to the results, during the analyzed period, a 1-unit increase in inflation expectations led to a 0.49 percentage point increase in current inflation. Similarly, a 1-unit increase in lag inflation resulted in a 0.5 percentage point rise in current inflation, indicating a direct relationship between them in the above model as well.

A 1-unit increase in the output gap resulted in a 0.019 percentage point increase in current inflation, aligning with the concept of the NKPC model. However, the p-value

for the output gap being greater than 0.05 indicates that the output gap was not a driving factor in inflation growth during the analyzed period.

Since the data in our analysis is not panel data, the GMM approach was not employed. Many countries prefer using the GMM approach over OLS regression for such models because GMM is one of the best methods for addressing endogeneity issues. For instance, the ADB applied the NKPC approach for Sri Lanka to analyze the impact of the output gap, fuel prices, the nominal exchange rate, and inflation expectations on inflation. Their findings showed that a 1-unit increase in the output gap led to a 0.51 percentage point increase in inflation, while a 1 percentage point rise in inflation expectations caused a 0.067 percentage point increase in current inflation. Similarly, in the U.S., A. Lubik (2010) calculated that a 1-unit increase in inflation expectations resulted in a 0.75 percentage point rise in current inflation according to the NKPC model.

The fundamental idea of the Phillips curve model, which suggests an inverse relationship between the unemployment gap (the difference between actual and natural unemployment) and inflation, was confirmed in this study based on the example of Uzbekistan.

In conclusion, Uzbekistan can utilize this model to monitor inflation expectations and the unemployment gap, and to develop appropriate monetary policy responses, thereby managing inflationary pressures in the economy.

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