NAIRU IN UZBEKISTAN: A TRADE-OFF BETWEEN INFLATION AND UNEMPLOYMENT (2016-2022)

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Abstract. *Economic analysts frequently encourage the Fed to utilize unemployment rates or wages growth rates as leading measures of inflation and as indicators of whether to loosen or tighten monetary policy. The theory behind this strategy is based on current Keynesian macroeconomics, notably the Phillips curve and the nonaccelerating inflation rate of unemployment (NAIRU).*

The main purpose of this study to analyze the trade-off between inflation and unemployment of Uzbekistan and calculate NAIRU through Phillips curve approach during 6 years quarterly data from 2016-2021. In this study Hodrick-Prescott filter (HP) filter is used to calculate NAIRU and Ordinary Least Squares (OLS) model to determine the relationship between inflation and unemployment rate. VIF test is used to check collinearity or multicollinearity of determinants and result showed that there is not any collinearity between variables. OLS model indicated that there are positive and significant trade-off between inflation and unemployment, while GDP and inflation showed negative and insignificant relationship.

Keywords: *Inflation, unemployment, Phillip curve, NAIRU, and OLS.*

1. Introduction

The unemployment rate, which is the percentage of the labor force that is jobless and actively looking for work, is a key measure of macroeconomic success. Having unemployment low is significant priority of fiscal, monetary policy, and labor market since it is an essential contribution to well-being. The unemployment rate, as one indicator of labor market flexibility, has consequences for wage growth, gross domestic product (GDP) and inflation.

It is intriguing to examine Uzbekistan's economy for a variety of reasons. The fundamental reason is that Uzbekistan's economy has been plagued by a high unemployment rate since 2018 after Tajikistan, compared to other Central Asian countries, with structural unemployment playing a significant role. This indicator has the ability to offer information on the amount of unemployment at which inflation is constant, which is valuable for policymaking.
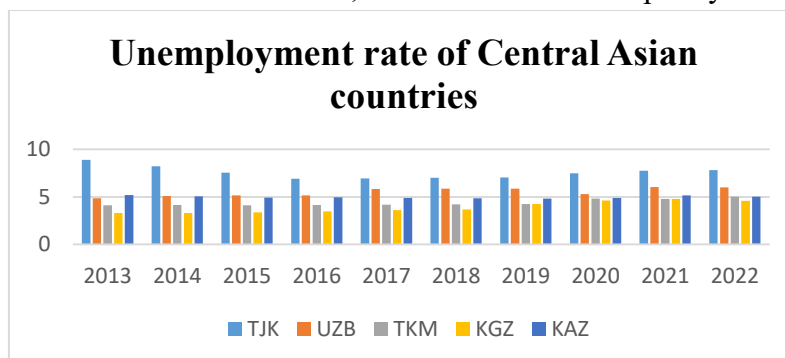
Source: World bank

Inflation is also one of the most important indicators of country's development – the lower it is, the better. For example, in developed countries, such as Switzerland, the annual inflation rate

does not exceed 1.5 percent, while in crisis-stricken countries, such as Venezuela, it exceeds 500 percent.

The dissertation's core hypothesis is that policymakers might acquire meaningful insight into Uzbekistan's basic economic shift by measuring a structural indicator such as an NAIRU.

The Non-Accelerating Inflation Rate of Unemployment (NAIRU) is a measure that policymakers are interested in because it gives an approximation of the amount of leisure in the labor market. It shows negative relationship between unemployment and inflation rates. The NAIRU, on the other hand, is not observable and must be calculated using statistical models. The Phillips curve approach, which assesses the link between price or wage increase and unemployment, is the most prevalent guideline used for this (Ruberl, 2021).

Inflation and unemployment rates are regularly studied in Uzbekistan. But their relationship studied by very few researchers. The NAIRU level is almost unexplored. For this reason, I started writing this dissertation by studying the work of foreign researchers.

Macroeconomic researchers from other developed countries have done a lot of analysis about relationship between inflation and unemployment since the last decades. Phillip (1958) found an empirical relationship between the pace of wage rise and the rate of unemployment. Phelps (1967) and Friedman (1968) later rejected Samuelson and Solow's (1960) conclusion that there is a balance between inflation and unemployment. Friedman also confirmed that inflation and unemployment show tradeoff in the short run. Main theory is that when unemployment rate falls below the natural rate of unemployment, the inflation rate rises as labor costs rise.

2. Methodology

The data used in this research are collected from sources (International Monetary Fund (IMF), Ministry of employment and labor relations of the Republic of Uzbekistan). Research uses a quarterly time series data starting from 2016 till 2021. The main dependent variable is inflation rate measured in consumer price index (CPI), while unemployment rate of Uzbekistan is independent variable in this research.

The Phillips curve refers to the observed inverse link between unemployment and inflation, which was initially established by William Phillips in his essay "The Relationship between unemployment and the rate of change of money wage rates in the United Kingdom, 1861 to 1957". Since then, macroeconomic researchers have focused on unemployment and inflation as economic terms. These two notions are regarded crucial in every country's economic growth terms.
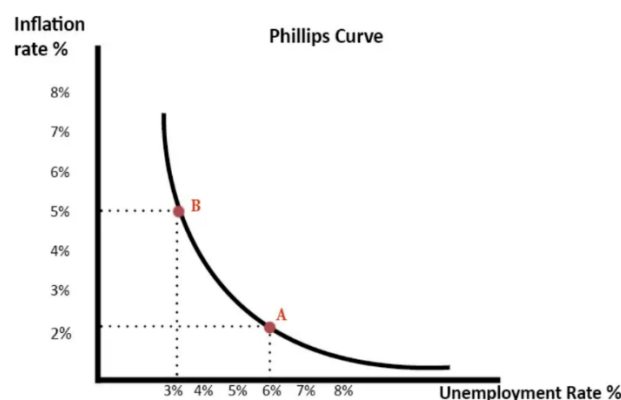

Figure 1. Relationship between inflation and unemployment
Source: Economics.

According to Phillips, the lower the unemployment rate, the stronger the labor market and, as a result, faster companies must boost pay to attract scarce employees. The strain eased when

unemployment rates rose. The average association between unemployment and income behavior across the business cycle was illustrated by Phillips' "curve". It depicted the level of wage inflation that would occur if a certain level of unemployment was maintained for an extended period of time (Figure 3).

Nevertheless, the inability of Phillips curve to explain economic occurrences during the 1970s crisis raised major concerns the Phillips curve hypothesis. The Monetarist school, including Milton Friedman, publicly challenges the Phillips curve hypothesis. According to Phillips theory, there is only a short-run relationship between inflation and unemployment. For this reason, he created the nation of the NAIRU for the long-run. The NAIRU rate of unemployment is measured as the rate of unemployment when inflation is steady. As a result, the Phillips curve is vertical in the long run, and there is no trade-off among unemployment and inflation (Stamatiou and Dritsaki, 2019).

The fact that there is a positive unemployment gap suggests that the economy is not operating at full capacity. It contains abundant labor resources that, if not used for lengthy periods of time, may lose their expertise. The negative unemployment gap, on the other hand, reveals the economy's inefficiency, since individuals without the necessary skills are employed (owing to a labor shortage) and employees are overpaid (pay growth is not dependent on productivity growth) (Boone et al., 2002).

Constant NAIRU: The most fundamental idea is a constant NAIRU, which was though to be true in the 1960s by economists who believed that unemployment converges to its natural rate of unemployment over time and is a constant figure.

To reach an objective, Staiger et al. used a benchmark model of the augmented expectations Phillips Curve. According to the report, inflation is "implicitly driven by the jobless gap and supply shock" (Staiger et al. 1996)

The expectations-augmented Phillips relation is generally used in the NAIRU model, which is the classic model for inflation:

$$(\pi_t - \pi_t^e) = \beta(U_t - U_t^*) + \delta X_t + v_t \qquad (1)$$

π_t — is an estimate of the actual inflation rate, π_t^e — is the expected inflation rate, U_t — is unemployment rate, X_t — supply shock, v_t — error term, U_t^* — is the NAIRU.

For inflationary expectations, "random walk" model will be used (Gordon 1990, Stock and Watson 1997).

$$\pi_t^e = \pi_{t-1}, \text{ so that } \pi_t - \pi_t^e = \Delta\pi_t \text{ Hence,}$$

$$\Delta\pi_t = \beta(U_t - U_t^*) + \beta_2(U_{t-1} - U_{t-1}^*) + \beta_3(U_{t-2} - U_{t-2}^*) + \delta X_t + \varepsilon_t \qquad (2)$$

If the NAIRU, U_t^* does not vary with t, equation (2) will be rewritten in a form which can be conveniently estimated by ordinary least squares (OLS):

$$\Delta\pi_t = \mu + \beta(L)U_t + \delta(L)\Delta\pi_{t-1} + \gamma(L)X_t + \varepsilon_t \qquad (3)$$

To deal with the serial correlation in the error term, the lagged (L-*lag operation*) impacts of inflation, unemployment, and supply shock are introduced to address the inaccuracy of the NAIRU estimate.

The estimate of the constant NAIRU is then:

$$\widehat{U^*} = \frac{\widehat{-\mu}}{\widehat{\beta(1)}} = \frac{\mu}{\sum \beta_i} \qquad (4)$$

Where $\beta(1) = \sum_{i=1}^{p} \beta_1$ with p being the order of the lag polynomial $\beta(L)$. NAIRU is a nonlinear function of the coefficients μ and $\beta(1)$.

The estimation approach outlined in Equations (3) and (4) can be case where the NAIRU varies with time.

3. Empirical Results

In the Table 2, Inflation gap is 0.0039238, which is the lowest mean value with a standard deviation of 1.46974. The maximum mean indicator is 2.68473. The high volatilities belong to GDP gap, adjusted GDP, and potential GDP with 8927.99, 5620.1 and 5466.8, respectively. Unemployment rate as well as expected inflation illustrate the volatility equal to 2.0961 and 1.85582, correspondingly. The average mean value of unemployment rate is 8.2333, while this indicator for independent variable, adjusted GDP is 0.0000005. The minimum average indicators of adjusted GDP and potential GDP are equal to -8397.6 and -8793.6.

Table 1.

Descriptive statistics

Variable	definition	Mean	std. dev.	min.	max
cpi_gap	inflation gap	0.0039238	1.46974	-2.2195	2.68473
Unemp	unemloyment rate	8.233333	2.0961	5.2	11.1
gdp_gap	GDP gap	70216.84	8927.99	53586.1	78546
cpi_exp	expected inflation	3.28981	1.85582	0.5996	7.56153
Adjustedgdp	adjusted GDP	0.00000509	5620.1	-8397.6	9583.97
pot_gdp	Potential GDP	-0.0000305	5466.8	-8793.6	8972.89

The Constant NAIRU for the sample period is 8.05. The constant NAIRU, inflation and unemployment rate are depicted in Figure 8. It is calculated by this model:

$$\widehat{U^*} = \frac{\widehat{-\mu}}{\widehat{\beta(1)}}$$

$-\mu$- is a constant and equal to 4.644184
$\widehat{\beta(1)}$- is a sum of unemployment rate lags and equal to 0.577123
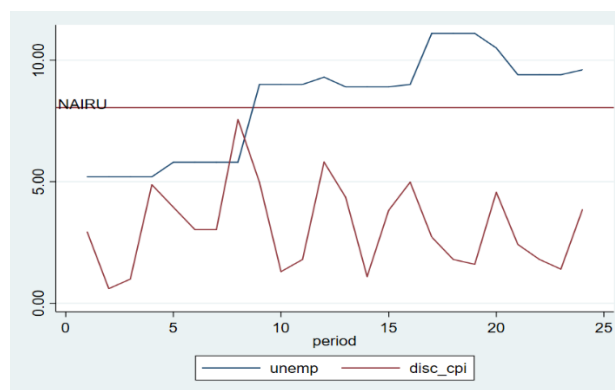After doing simple calculation, we found that U^*- (NAIRU) is equal to almost 8.047

Figure 3. The Constant NAIRU, inflation, and unemployment rate (2016-2021)

Table 3.

OLS results.

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Linear regression                          Number of obs    =         18
                                           F(6, 11)         =      16.58
                                           Prob > F         =     0.0001
                                           R-squared        =     0.8215
                                           Root MSE         =    .73682
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cpi_gap	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
unemp						
--.	.0133642	.196441	0.07	0.947	-.4189996	.445728
L1.	-.5904872	.1519048	-3.89	0.003	-.9248275	-.2561469
gdp_gap						
--.	.0000134	.000019	0.71	0.494	-.0000284	.0000552
L1.	-6.81e-06	.0000212	-0.32	0.754	-.0000535	.0000399
cpi_gap						
D1.	.908478	.1890085	4.81	0.001	.4924731	1.324483
D2.	-.2810077	.1147851	-2.45	0.032	-.533648	-.0283674
_cons	4.644184	2.551625	1.82	0.096	-.9719045	10.26027

At the beginning of the regression, there were 24 observations. After using HP filter, generation new variables, there left 18 observations when we run regression in OLS model.

There two independent variables including, unemployment and GDP gap, which we look their relationship with inflation rate (CPI). The results from OLS model show that unemployment rate was not significant first, after taking its first lag, it become significant at 0.003 percent. First lag of unemployment rate has negative and significant impact on inflation rate. It means that 1 percent change in unemployment rate will decrease inflation 0.59 percent. It is similar with research done by German researchers, Schreiber and Wolters. They also found short-run negative relationship between inflation and unemployment. By theory (Phillip curve) it is also supported that if unemployment increases, inflation rate will decrease. But gdp_gap did not show any cointegration with inflation rate. By theory it is confirmed that inflation rate and GDP has short- and long-run relationship. But in this research P value of gdp_gap was 0.494 percent, after taking first lag it became 0.754 percent. Both values show that there is not any relationship between gdp_gap and inflation rate. In this research relationship between cpi_gap and differences of cpi_gap also checked. The result showed that first and second differences of cpi_gap have both positive and negative significant impact on cpi_gap, at 0,001 and 0,032 percent, respectively.

To test determinants whether there is collinearity or multicollinearity, we used the Variance inflation factor (VIF).

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. vif
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Variable	VIF	1/VIF
unemp		
--.	4.46	0.224168
L1.	4.21	0.237267
cpi_gap		
D1.	3.83	0.261366
D2.	3.51	0.285201
gdp_gap		
--.	1.23	0.811244
L1.	1.07	0.934409
Mean VIF	3.05	

VIF test showed that there are not any collinearity or multicollinearity between determinants. VIF ratio of unemployment rate is 4.46 and 4.21 when we take first lag. cpi_gap's

VIF ratio were 3.83 and 3.51, respectively, after taking first and second differences. VIF ratio of gdp_gap also did not showed collinearity with 1.23 VIF ratio and lag of gdp_gap was 1.07.

4. Conclutions

The main goal of this research was to find trade-off unemployment and inflation rate over the last few decades and calculate the NAIRU. We can offer statistics on the unemployment rate, but because the NAIRU is a non-observable macroeconomic indicator, there is no estimate available. First constant NAIRU is calculated by the help of HP filter. NAIRU of Uzbekistan for period of 2016-2021 was 8,047 and it is not far from unemployment rate of Uzbekistan for that period, and any further reduction in unemployment through expansionary policy will increase the danger of overheating and further inflation pressure. As a result, if the state tries to reduce unemployment below the NAIRU, the effect will only be higher inflation.

The results of this research, based on VIF test and OLS method, confirm trade-off inflation and unemployment hypothesis exist in Uzbekistan. More precisely, short-run calculation suggests that a 1 percent increase in unemployment rate will result in a rise of 0.59 percent in inflation. Furthermore, VIF test showed that there are not any collinearity or multicollinearity between inflation and its determinants. Finally, gdp_gap does not have any relationship with inflation rate of Uzbekistan.

Inflation rate of Uzbekistan has been showing significant decreases for last few years because of Uzbekistan has moved to an inflation targeting system. In this system, The Central Bank sets an inflation target and does everything possible to achieve it. The target for 2021 was 10 percent, but by 2023 it is planned to increase this figure to 5 percent. To reach this target, there are several policy implications, such as rising interest rates, in particular, decreases demand and helps to keep inflation under control. There are other strategies, which may be used to minimize inflation, for example, wage control, tight fiscal policy such as increase taxes, supply-side policies, exchange rate appreciation, money supply management are some of the other strategies that may be used to minimize inflation.

Other neighbor countries' unemployment rates are not quite high as Uzbekistan's. The unemployment rate of Uzbekistan is two times higher compared to ten years before. This emphasizes the need of taking swift action to decrease it. Because the majority of Uzbekistan's unemployment is due to structural factors, monetary policy, in my opinion, will not be able to lower rate of unemployment without allowing high inflation. But according to the findings of the study, the constant NAIRU estimate is much higher than inflation rate during the sample period. Monetary policy aimed to decrease inflation rate by 5 percent until 2023, for this reason it is impossible to increase inflation rate in order to decrease unemployment rate.

Although the figures seem outstanding, they are based on labor supply that is being squeezed by immigration, a low participation rate, and government initiatives like raising the retirement age.

- To decrease unemployment rate without increasing inflation, there are some policy implications:
  - Education and training can be useful to decrease structural unemployment;
  - For encourage businesses in rural areas should give subsidies;
  - To minimize real wage unemployment, the minimum wage should be reduced;
  - Open more flexible markets to make it simpler to employ and fire people.

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