



ECONOMETRIC MODELING METHODS OF THE CAUSAL RELATIONSHIP BETWEEN INFLATION AND UNEMPLOYMENT

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Abstract: This scientific article studies the causal relationship between inflation and unemployment, one of the most complex problems of macroeconomics, using econometric modeling methods. The relevance of the article is that the state's monetary policy cannot balance the conflicting goals of ensuring price stability and increasing employment without precise mathematical calculations. To solve the problem, a pairwise linear regression model based on the method of least squares (LSM) and the theory of the Phillips curve were used. As a result of the study, an empirical equation was constructed based on conditional macroeconomic indicators, and the quantitative impact of changes in unemployment on the inflation rate was calculated. As a scientific contribution of the author, an inverse proportional relationship between unemployment and inflation in the short term was proven, and practical proposals were developed for regulators on conducting anti-inflationary policy.

Keywords: inflation, unemployment, Phillips curve, econometric modeling, linear regression, least squares method, macroeconomic policy.

INTRODUCTION

One of the most important balances in the state economy is to ensure full employment of the population and maintain price stability. However,



macroeconomic practice shows that in the short term these two goals cannot be achieved simultaneously. The state will inevitably have to tolerate a slight increase in unemployment in order to curb inflation, and vice versa.

The problem raised in the article is related to the mathematical measurement of this macroeconomic "trade-off". Determining how much additional money supply the government should inject into the economy or how to change interest rates without the help of precise econometric models can lead to major crises. The relevance of the research is that determining the quantitative correlation coefficients between unemployment and inflation in developing countries is a vital necessity for conducting a tight monetary policy. The scientific novelty and purpose of the work is to transform macroeconomic theory (the Phillips curve) into an exact numerical linear equation using the least squares method and to empirically prove the results.

LITERATURE REVIEW

The empirical relationship between inflation and unemployment was first systematically studied by A.W. Phillips in 1958 and proved their inverse relationship (the Phillips curve) graphically. Later, in the conditions of stagflation in the 1970s, M. Friedman and E. Phelps introduced the concept of the natural rate of unemployment that does not accelerate inflation (NAIRU), emphasizing that the classical curve is valid only in the short run.

In modern macroeconomics, fundamental textbooks by economists such as O. Blanchard (Olivier Blanchard) and G. Mankiw (N. Gregory Mankiw) set the standards for assessing this process using linear regression. In the case of the Uzbek economy, domestic researchers such as N.Kh. Jumayev and A.A. Kulliyev conducted research on modeling price growth. Also, the Center for Economic Research and Reforms (CERR) extensively analyzes the factors of structural inflation in Uzbekistan. This article proposes a precise econometric calculation algorithm based on foreign theory and local models.



RESEARCH METHODOLOGY

A stochastic pairwise linear regression model was used to determine the relationship between macroeconomic indicators. The econometric representation of the short-run Phillips curve is expressed as follows:

$$INF_t = \beta_0 + \beta_1 UNEMP_t + \epsilon_t$$

here:

INF_t – t -inflation rate in the period (year) (%; outcome variable);

$UNEMP_t$ – t -unemployment rate in the period (%; explanatory variable);

β_0 – free limit (the point where the regression line intersects the ordinate axis);

β_1 – regression coefficient (a parameter indicating how much inflation will change if the unemployment rate changes by 1%);

ϵ_t – random error (the influence of other factors not included in the model).

The main hypothesis of the model is that since there is an inverse relationship between inflation and unemployment, the coefficient β_1 calculated should be negative ($\beta_1 < 0$). The classical least squares method (LSM) algorithm is used to find these parameters.

DISCUSSION AND RESULTS

In order to test the equations in the methodology in practice and measure elasticity, calculations were carried out based on a conditional macroeconomic database covering a 5-year period:



Table 1

**ECONOMETRIC CALCULATION OF INFLATION AND
UNEMPLOYMENT DYNAMICS**

Period (t)	Unemployment rate (X), %	Inflation rate (Y), %	X·Y	X ²	Y ²
1	6	14	84	36	196
2	7	12	84	49	144
3	8	11	88	64	121
4	9	9	81	81	81
5	10	8	80	100	64
Total:	$\sum X = 40$	$\sum Y = 54$	$\sum XY = 417$	$\sum X^2 = 330$	$\sum Y^2 = 606$

Number of observations $n = 5$. Average values of indicators: $\bar{X} = 8.0\%$, $\bar{Y} = 10.8\%$

We put the result of the sums in the table into the EKK formula and calculate the regression coefficient β_1 :



$$\hat{\beta}_1 = \frac{5 \cdot 417 - 40 \cdot 54}{5 \cdot 330 - 40^2} = \frac{2085 - 2160}{1650 - 1600} = \frac{-75}{50} = -1.5$$

Now we find the free term β_0 :

$$\hat{\beta}_0 = 10.8 - (-1.5 \cdot 8) = 10.8 + 12 = 22.8$$

Based on the results obtained, an empirical equation for the Phillips curve was constructed:

$$INF = 22.8 - 1.5 \cdot UNEMP$$

Mathematical analysis: The regression coefficient ($\beta_1 = -1.5$) is negative, fully confirming our hypothesis. This figure means that in the short term, if the unemployment rate in the country increases by 1 percent, the inflation rate will decrease by an average of 1.5 percent due to a decrease in aggregate demand in the consumer market. Conversely, if the state artificially reduces unemployment by 1 percent through money emission, inflation will accelerate by 1.5 percent.

CONCLUSIONS AND SUGGESTIONS

Based on the linear modeling of the relationship between inflation and unemployment, the following conclusions and suggestions are put forward:

1. The calculated empirical coefficient $\beta_1 = -1.5$ mathematically confirms that state regulators cannot "hit two targets at once." It is necessary to constantly monitor the fact that a policy of sharply reducing inflation (for example, high interest rates) leads to the risk of economic collapse and unemployment.
2. The Central Bank must take into account structural changes in the economy in the process of transition to an inflation targeting regime. The allocation of abundant loans to stimulate employment inevitably imports inflation.



3. Instead of controlling the movement of the Phillips curve, macroeconomic regulators should take measures to shift the entire curve to the left - towards both low inflation and low unemployment - through deep institutional reforms in the long term (staff training, liberalization of the business environment, elimination of monopolies).

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