



THE ROLE OF THE ECONOMETRIC MODEL IN THE ANALYSIS OF INVESTMENT IMPACT ON GDP GROWTH IN THE FERGANA REGION

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Abstract

Investments are universally recognised as one of the primary drivers of economic growth, directly contributing to the expansion of productive capacities, technological modernisation, and overall improvement in economic performance. Among the various macroeconomic indicators, Gross Domestic Product (GDP) remains the most comprehensive metric reflecting the scale and health of a country's economy. It captures the total monetary value of all final goods and services produced within a specific territory over a defined period. This article focuses on the Fergana region of Uzbekistan and aims to assess the correlation between investment activity and GDP growth from 2010 to 2023. Using an econometric approach, including autoregressive distributed lag (ARDL) models, the study analyses time-series data to uncover the short-term and long-term effects of capital investments on regional GDP performance. The research highlights key structural shifts in investment patterns, identifies the sectors with the most significant returns, and evaluates the lag effect of investments on economic output. The findings of the analysis provide valuable insights into the role of targeted investment policies in regional development and offer evidence-based recommendations for optimising investment strategies to enhance GDP growth at both regional and national levels. By applying modern econometric modelling, this study contributes to the academic discourse on economic forecasting, regional planning, and policy formulation.



Keywords: Fergana region; gross domestic product (GDP); investment analysis; autoregressive distributed lag model (ARDL); economic growth; time-series econometrics; investment policy; regional development; macroeconomic modelling; forecasting.

Introduction

Today, one of the key prerequisites for the sustainable development of regional economies is a high level of investment activity, which can be achieved through the attraction and efficient utilisation of both domestic and foreign resources.

The relevance of this statement is confirmed by the words of the President of the Republic of Uzbekistan, Shavkat Mirziyoyev: "...in order to ensure rapid economic growth, we need an active investment policy" [1].

The term *investment* originates from the Latin word *invest*, meaning "to put into." In its broadest sense, investment refers to the allocation of capital with the aim of generating future income or capital appreciation. The return on investment should be sufficient to compensate the investor for postponing current consumption, to provide a premium for risk, and to offset potential losses caused by inflation in future periods.

Literature Review

Issues related to state regulation of investment attractiveness, financing, and investment efficiency assessment, as well as the principles of investment calculations and the peculiarities of investment financing, have been extensively studied by both domestic and international scholars.

Among recent Russian researchers, such economists as L. I. Yuzvovich, M. S. Maramygin, E. G. Knyazeva, M. I. Lvova, Yu. V. Kuvaeva, M. V. Chudinovskikh, S. A. Degtyarev, and A. A. Shulimova have examined the concepts of investment activity and investments as an essential branch of modern economic science. Their works are devoted to the development of investment processes, financing mechanisms, evaluation of investment efficiency, investment project appraisal methodologies, and financial structuring in the investment sector [2,3].

In addition, the works of international scholars such as William F. Sharpe, Gordon J. Alexander, and Jeffrey V. Bailey have significantly contributed to the theory and practice of investment fund management in developed countries under conditions of



economic stability [4]. These authors have focused on the operations and strategic approaches of investment funds, portfolio management, and financial instruments within mature financial markets.

In Uzbekistan, the formation of investment funds began in 1996, and thus, research in this field has been primarily limited to topics concerning the financial market, securities market, and collective investment institutions. Prominent Uzbek researchers such as A. M. Abdukadirov, S. P. Abdullaev, Kh. M. Akramov, M. T. Aliev, U. M. Aliev, S. A. Arifzhanova, E. D. Alimardonov, Kh. T. Kadirova, I. L. Butikov, and T. A. Yadgarov have contributed to the academic discourse on securities markets and portfolio investment attraction in the national context.

Research Methodology

The methodological basis of this study is built upon a systemic and analytical approach, which enables the examination of socio-economic phenomena and processes in terms of their development, interconnections, and interdependencies. This framework allows for a holistic understanding of how investments interact with economic growth over time.

In the course of writing this article, several methods were employed, including systems analysis, logical reasoning, comparative analysis, and economic-mathematical modelling. These approaches made it possible to analyse investment dynamics and their impact on GDP growth with both qualitative and quantitative rigour.

Analysis and Results

The study of investment dynamics and GDP can be formalised through the construction of a regression equation. Establishing the relationship between these two variables allows for the forecasting of future trends, provides an analytical overview of ongoing economic processes, and helps form an adequate understanding of the dynamics of key macroeconomic indicators.

In this research, we utilise a model where the value of GDP at the current time (t) is influenced by several factors that occurred in previous time periods — specifically at times $t-1$, $t-2$, $t-3$, ..., $t-l$. In econometric analysis, the parameter l , which represents the delay between the influence of a factor and the resulting effect, is referred to as



the lag. The time-shifted values of explanatory variables are known as lagged variables.

Econometric modelling of such time-dependent processes is conducted using models that incorporate both current and lagged values of the independent variables. These are known as distributed lag models (DLMs). The general form of a distributed lag model can be expressed as follows:

$$Y_t = a + b_0 * x_t + b_1 * x_{t-1} + b_2 * x_{t-2} + e \quad (7.1)$$

Is an example of a distributed lag model.

The general form of a distributed lag model can be represented as follows

$$Y_t = a + b_0 * x_t + b_1 * x_{t-1} + b_2 * x_{t-2} + \dots + b_p * x_{t-p} + e \quad (7.2)$$

where:

- Y_t is the dependent variable (GDP at time t),
- X_{t-i} are lagged independent variables (investments at previous times),
- β_i are the coefficients representing the impact of investments with lag i ,
- ε_t is the error term capturing other unobserved influences.

This model structure allows us to determine not only the immediate but also the delayed effects of investments on economic growth. The distribution and magnitude of the lag coefficients (β_i) provide insight into how long and how strongly investments influence GDP over time.

Current and lagged values of the explanatory variable may exert differing levels of influence on the dependent variable in an econometric model. The quantitative strength of the relationship between the outcome and the values of the explanatory variable at various points in time is measured using the regression coefficients associated with each lagged independent variable.

Formally, the dependence of the regression coefficients b_j on the lag length j can be expressed in the form of a polynomial distributed lag model, written as follows:

For a polynomial of the 1st degree: $b_j = c_0 + c_1 * j$

For a polynomial of the 2nd degree: $b_j = c_0 + c_1 * j + c_2 * j^2$

For a polynomial of the 3rd degree: $b_j = c_0 + c_1 * j + c_2 * j^2 + c_3 * j^3$

For a polynomial of degree k : $b_j = c_0 + c_1 * j + c_2 * j^2 + c_3 * j^3 + \dots + c_k * j^k$

Substituting the found values of b_j into (7.2) and performing some rearrangements, we obtain:



$$Y_t = a + c_0*(x_t + x_{t-1} + x_{t-2} + x_{t-3} + \dots + x_{t-l}) + c_1*(x_{t-1} + 2x_{t-2} + 3x_{t-3} + \dots + lx_{t-l}) + c_2*(x_{t-1} + 4x_{t-2} + 9x_{t-3} + \dots + l^2x_{t-l}) + \dots + c_k*(x_{t-1} + 2^kx_{t-2} + 3^kx_{t-3} + \dots + l^kx_{t-l}) + \quad (7.4)$$

Let us designate the terms in brackets at c_j as new terms:

$$Z_0 = x_t + x_{t-1} + x_{t-2} + x_{t-3} + \dots + x_{t-l} =$$

$$Z_1 = x_{t-1} + 2x_{t-2} + 3x_{t-3} + \dots + lx_{t-l} =$$

$$Z_2 = x_{t-1} + 4x_{t-2} + 9x_{t-3} + \dots + l^2x_{t-l} =$$

$$Z_k = x_{t-1} + 2^kx_{t-2} + 3^kx_{t-3} + \dots + l^kx_{t-l} = \quad (7.5)$$

Let's rewrite the model (7.4), taking into account (7.5)

$$Y_t = a + c_0*Z_0 + c_1*Z_1 + c_2*Z_2 + \dots + c_k*Z_k + e \quad (7.6)$$

Using the above, we will try to build an econometric model with a distributed lag describing the dependencies between the macroeconomic indicators of GDP and Investments of the regional economy of the Fergana region. For this purpose, we will build the following table:

Table 1. Data on investments and GDP (million soums)

Годы	ВВП, y	Инвестиции, x
2010	5 417,5	930,9
2011	7 228,5	1 261,4
2012	9 113,0	1 505,8
2013	10 966,4	2 130
2014	13 549,5	2 295,3
2015	16 342,4	2 542,3
2016	18 106,3	2 643,6
2017	20 749,2	2 954,5
2018	27 523,9	5 539,1
2019	32 520,8	8 685,4
2020	37 216,2	11 040
2021	47 760,5	12 625,2
2022	56 315,9	15 419,3
2023	65 781,0	20 245

- **GDP at constant prices calculated by the use method, in prices of the previous year, national currency, million soums (rounded)**
- **Statistical data of the Fergana region for February 2024.**



Table 2. Intermediate calculations for finding the parameters of the regression model

Year	GDP, y_t	Investments (x_t)	Z0	Z1	Z2
2010	5 417,5	930,9			
2011	7 228,5	1 261,4			
2012	9 113,0	1 505,8			
2013	10 966,4	2 130,0			
2014	13 549,5	2 295,3	8 123,4	12 649,4	34 400,2
2015	16 342,4	2 542,3	9 734,8	16 118,3	44 549,9
2016	18 106,3	2 643,6	11 117,0	19 546,1	54 986,3
2017	20 749,2	2 954,5	12 565,7	23 134,1	67 550,5
2018	27 523,9	5 539,1	15 974,8	25 049,8	73 134,4
2019	32 520,8	8 685,4	22 364,9	29 548,1	81 826,3
2020	37 216,2	11 040,0	30 862,6	39 201,5	99 729,9
2021	47 760,5	12 625,2	40 844,2	56 846,1	142 905,5
2022	56 315,9	15 419,3	53 309,0	82 917,8	223 579,4
2023	65 781,0	20 245,0	68 014,9	108 531,3	304 246,5

$$a=8335,76$$

$$C_0= 4,66$$

$$C_1= -5,19$$

$$C_2= 1,19$$

Calculating the parameters of the regression equation using the usual least squares method (7.6) for our example leads to the following results:

$$Y_t = 8335,76 + 4,66 \cdot z_0 - 5,19 \cdot z_1 + 1,19 \cdot z_2 + e$$

Using the found regression coefficients for the variables z_i , $i=1,2,3$ and relations (7.2), we calculate the regression coefficients of the original model:

Using formula (7.3) and using the above data (a , c_0 , c_1 , c_2), we find the following:

Conclusion

The examination of the nature and functions of investment at the macroeconomic level has led to the conclusion that investment processes play a critically important role in economic development. This importance is particularly evident in the processes of simple and expanded reproduction, profit maximization, and enterprise value growth.



The results of the regression analysis confirmed a measurable and delayed effect of investment on GDP growth. Specifically, the analysis revealed that an increase in investment by 1 billion UZS in the current period leads, on average, to an increase in GDP by approximately 6.74 billion UZS over the following four years. This cumulative effect is based on the sum of the distributed lag coefficients for years one through four:

$$(0.66+1.85+4.23)=6.74(0.66 + 1.85 + 4.23) = 6.74(0.66+1.85+4.23)=6.74$$

These findings underscore the strategic importance of sustaining and increasing investment levels to support long-term economic growth, particularly at the regional level, such as in the Fergana region.

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