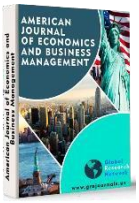

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Article

Comparative Econometric Analysis of Investment Factors Affecting the Development of Industrial Enterprises in the Region

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Abstract: The development of industrial enterprises largely depends on the effectiveness of investment processes and the structure of investment factors influencing regional economic dynamics. This study aims to conduct a comparative econometric analysis of key investment determinants affecting the growth of industrial enterprises in a regional context. The research evaluates the role of capital inflows, foreign direct investment, infrastructure development, financial accessibility, and institutional conditions in shaping industrial performance. Using econometric modeling techniques, including correlation and regression analysis, the study identifies the strength and direction of relationships between investment indicators and industrial output growth. The findings reveal that investment in infrastructure and technological modernization significantly contributes to enterprise productivity, while institutional stability enhances investment efficiency. The results provide policy-relevant insights for improving regional investment strategies and fostering sustainable industrial development.

Keywords: Investment Factors, Industrial Enterprises, Econometric Analysis, Regional Development, Capital Investment, Foreign Direct Investment, Infrastructure, Industrial Growth, Regression Modeling

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1. Introduction

Industrial enterprises play a crucial role in ensuring regional economic stability, employment generation, and technological advancement. The sustainability of industrial growth in developing and transition economies is closely connected with investment activity and the efficient distribution of finance. These investment factors drive enterprise productivity and competitiveness: domestic capital formation, foreign direct investment, infrastructure quality, access to credit, and government policy frameworks [1]. Although investment led industrialisation is increasingly recognised as an important aspect of growth prospects, there has yet to be a quatitative assessment of the comparative powers of influence of these variables between regions. Causal analysis with econometrics is a high-trust means of establishing causal relations and measuring the force of influence between variables. This study deals with the comparative evaluation of investment determinants relevant to the development of industrial enterprises and provides insights into their impact and effectiveness on regional investment policy strategies as well as evidence on evidence-based policy decisions.

In economic and econometric literature, there have been many papers investigating the nexus between investment activity and industrial development. More recently: Capital accumulation, eastward, common in classical and neoclassical growth theories, as a key industrial driver and productivity enhancer [2]. Solow´s growth framework posits that investment in physical capital expands output potential, while by contrast, endogenous growth models emphasize the relevance of technological investment and innovation in maintaining long-term industrial competitiveness. Numerous empirical studies have provided convincing evidence of the vital role of both domestic and international investment in industrial enterprise performance. Blonigen and Piger (2014): In general, FDI is critical to industrial modernization because it promotes transfer of technology, managerial skills, and market access. In a similar vein, the World Bank (2023) found that investment inflows foster job creation, specialisation and export potential for recipient developing economies. It is also known that infrastructure development is one of the major determinant of investment for the efficiency of productive investment in the manufacturing sector. Studies suggest that investment in transport, energy, and communication systems brings down production costs enabling greater and efficient production. According to the OECD, sophisticated infrastructure contributes to higher industrial asset flows and better enterprise outcome indicators. In addition, UNIDO states that upgrading of an industrial character is limit with its strategic infrastructure and technological support systems [3]. For instance, much of the quantitative give-and-take concerning investment variables.

Detailed frameworks for regression modeling and correlation analysis are provided by Gujarati and Porter and Wooldridge, which are commonly employed to assess cause-effect links between capital investment and industrial output. Different methods such as panel data models, time-series analysis or regression techniques for cross-sectional comparative analysis have been employed to study regional investment dynamics and structural differences. However, several comparative regional analyses integrating multiple investment determinants impacting industrial firms still have gaps of knowledge in the literature. Most studies either examine one of the factors or at the macro level, and thus integrating these factors using an econometric approach at a regional level is still a gap this research aims to fill [4]. Therefore, this study contributes to the literature by offering a comparative econometric evaluation of investment factors influencing industrial enterprise development, providing deeper insights into regional investment efficiency and policy implications.

2. Methods

The methodology of the study is based on the quantitative econometric method, which will be used to measure the effect that investment, institutional and innovational factors have on the development of industrial enterprises in the Kashkadarya region for the years of 2014 to 2024. Secondary statistical data were obtained from the managing of the official regional and national statistical sources. In order to have comparable figures and to remove the effect of inflation, all nominal indicators were transformed into constant prices according to the consumer price index [5]. The real volume of industrial production was chosen as the principal dependent variable, while explanatory variables included investments in fixed capital, labor resources, export volume, transport and logistics indicators, innovation activity, and the viability coefficient of enterprises. The functional form was specified in log form to enable interpretation of estimated coefficients as elasticities and to reduce potential heteroscedasticity. Log OLS regression and ARDL dynamic modeling techniques were both employed to detect short run and long run effects and to take into consideration any lag structures that may be present in the time series data. To ensure model adequacy and reliability, diagnostics including the Durbin Watson test for autocorrelation and the Variance Inflation Factor for the presence of multicollinearity were conducted. We performed further correlation analysis to assess the

directional strength of relationships between key variables. The relative evaluation of alternative models' specification also facilitated the identification of the most suitable econometric framework with adequate power of explanation to back up evidence driven conclusions [6].

3. Results and Discussion

The level of innovative development of the region is largely determined by the state of economic, social and infrastructural factors that form the investment potential. These results create the need for a deeper analysis of the impact of investment potential factors on innovative development, that is, based on econometric methods. One of the key issues in the science-based development of a regional economic policy is the identification of causal links between investment and innovation. Special investment resources, labour market development, infrastructure provision, foreign trade activity, educational and scientific potential are the main factors of shaping and developing innovative activity [7]. A quantitative estimation of the effects of the factors on innovative development, therefore, would be of scientific and practical significance. The author estimates the functional relationship between the main indicators that characterize the investment potential of the region and the indicators of innovative development of the region using econometric models. Based on the data of the SSU (State Statistics Service of Ukraine), the study uses the system of indicators, and taking into account the regression analysis, determines the level of influence of investment factors on innovative activity. As a result, we can identify the most. The results of econometric analysis serve to develop sound scientific conclusions on the case of the Kashkadarya region on the orientation of investment policy towards innovative development, improving economic incentive mechanisms, and increasing regional innovative potential. The role of the industrial sector in the regional economy in the Kashkadarya region is closely related to investment and innovative development processes, and its structural and dynamic changes over the past decade require a separate scientific analysis. In particular, as of 2024, the share of industry in the gross regional product in the region remains relatively low, which indicates that the existing opportunities for the development of industrial sectors are not fully utilized. This situation justifies the relevance of quantitative assessment of the impact of investment potential factors on industrial development using econometric methods [8]. In this study, statistical data for the last ten years, covering 2014-2024, were used to identify trends in industrial development in the Kashkadarya region. During the analysis, the structural structure of the industry and its changes were assessed, and economically important sectors were identified. When selecting the main directions, their share in the total volume of industrial products was taken as a criterion. In this case, sectors with a share of at least 10 percent in the structure of industrial products in the initial or final year of the analysis period were identified as priority directions. Based on this criterion, four main directions were distinguished from the industrial structure in the Kashkadarya region. The first direction is the production of food products, and over the past ten years, a downward trend in the share of this sector in the industrial structure has been observed. The second direction is the textile industry, which has shown stable growth rates during the analysis period and has become one of the leading directions of the regional industry. The third direction is some types of processing industry, which had a relatively stable share in the early years, but in recent years its share in the industrial structure has been decreasing [9]. The fourth direction is the production of other non-metallic mineral products, which has shown high growth rates, especially as a result of the expansion of construction activities. In order to ensure the accuracy of the econometric analysis and the reliability of the results, all statistical data were initially converted from nominal values to constant (real) prices. The consumer price index was used to determine real values. This approach eliminates the effect of inflation and allows assessing the real development trends of industrial sectors. An econometric model was developed based on real indicators to determine the impact of

investments, labor resources and infrastructure factors on the development of industrial sectors. For the econometric assessment of the industrial development of the Kashkadarya region (2014–2024), we will select one of the specific model equations in the study (since it is a time series, ARDL or log-log OLS are very suitable). Basic model (log-log regression) — recommended

Dependent variable (Y): industrial production volume (real), or industry's share in GRP. Model 1: By real industrial production volume

$$ln(IND_t) = \beta_0 + \beta_1 ln(INV_t) + \beta_2 ln(LAB_t) + \beta_3 ln(EXP_t) + \beta_4 ln(TRANS_t) + \beta_5 ln(INNO_t) + u_t$$

IND_t is the real industrial production volume in year t

INV_t is real investment in fixed capital

LAB_t is labor resources or economically active population

EXP_t is export volume

$TRANS_t$ is a transport and logistics indicator

$INNO_t$ is an innovation activity indicator

u_t is the error term

Interpretation: β is elasticity — for example, if INV increases by 1%, IND will increase by β1 % on average increases.

2) Model by the share of industry in GRP (percentage) If we want to analyze the share:

$$INDSH_t = \alpha_0 + \alpha_1 \ln(INV_t) + \alpha_2 \ln(LAB_t) + \alpha_3 \ln(EXP_t) + \alpha_4 \ln(INFRA_t) + \alpha_5 \ln(RD_t) + \varepsilon_t$$

Where:

$INDSH_t$ — share of industry in GRP, %

$INFRA_t$ — infrastructure indicator (road, communication, electricity proxy, or transport indicator)

RD_t — research and innovation indicator (R&D expenditure or innovation activity indicator)

Interpretation: in this model, many X variables are in logarithmic form, while Y is expressed in percentage points [10]. Therefore, α coefficients represent semi elasticities, indicating how many percentage points the dependent variable changes when the corresponding independent variable increases by 1%.

3) Dynamic model (ARDL) — is very suitable for a 10 year series, since it is common for time series to have a lag effect, meaning that investment made today may affect output in later periods. Therefore:

$$\ln(IND_t) = \gamma_0 + \gamma_1 \ln(IND_{t-1}) + \gamma_2 \ln(INV_t) + \gamma_3 \ln(INV_{t-1}) + \gamma_4 \ln(EXP_t) + \gamma_5 \ln(INNO_t) + e_t$$

Advantage: distinguishes short term and long term effects.

In the process of research, under "Model specification", a logarithmic regression model was developed to assess the impact of investment and innovation factors on industrial development in the Kashkadarya region. The real value of industrial production volume (IND_t) was chosen as the dependent variable. The independent variables included investments in fixed capital (INV_t), labor resources (LAB_t), export volume (EXP_t), transport and logistics indicators ($TRANS_t$), and innovation activity indicators ($INNO_t$). The model parameters were estimated using the OLS or ARDL method, and the coefficients were interpreted as elasticities [11]. The resulting econometric model serves as a scientific basis for identifying the main determinants of industrial development in the Kashkadarya region, optimizing investment policy across sectors, and developing an innovation oriented industrial policy.

The analysis based on statistical data shows that the level of development of entrepreneurial activity in the Kashkadarya region is currently insufficient. In particular, during the period under study, the viability coefficient of entrepreneurial entities in the region was characterized by sharp fluctuations, increasing to +90.6 percent in some years and decreasing to −91.9 percent in some periods. This indicates the instability of the business environment in the region and the limited long-term viability of newly established enterprises.

A comparative analysis shows that these indicators are relatively stable at the republican level, amounting to +84.9 and +8.5 percent, respectively. Thus, the effectiveness of measures aimed at developing entrepreneurship and establishing new enterprises in the Kashkadarya region is assessed as low compared to the republican average. In particular, the decrease in the viability coefficient to −91.9 percent indicates that an equal number of newly established enterprises, as well as an additional 91.9 percent of them, have ceased their activities [12]. This indicates the existence of serious problems in ensuring the continuity of production processes in the region.

In these conditions, the issue of industrial development and increasing production capacity remains relevant, since the sustainable development of industrial sectors is directly related to the activities of business entities and their viability. Therefore, the impact of the identified viability coefficients of enterprises and organizations on industrial development in the Kashkadarya region was assessed using quantitative, i.e. econometric methods. The results of the preliminary analysis carried out during the research based on various criteria and indicators, as well as the comparative evaluation of several econometric models, showed that it is appropriate to include the viability coefficient as one of the main independent variables in the interpretation of industrial development. As a result, an optimal econometric model was selected, which allows to determine the relationship between the stability of business entities and industrial development in the region. The results of the conducted econometric analysis of industrial development in the Kashkadarya region [13]. The model results showed that the labor resource indicator also has a positive impact on industrial development, but its impact is lower than that on investment and entrepreneurship sustainability. This indicates that capital and institutional factors are more important than the quantitative labor factor in industrial development. In addition, the coefficients of export volume and innovation activity indicators have a positive sign, and their statistical significance indicates that foreign markets and technological innovation are important drivers of industrial development. In particular, it is observed that production growth is faster in export-oriented industries. The overall quality indicators of the model (coefficient of determination R^2 and F-statistics) confirm that the regression equation has sufficient explanatory power. This indicates that the selected factors reflect the main determinants of industrial development in the Kashkadarya region. It scientifically substantiates the need to expand investment flows, increase the viability of business entities, and support innovative and export-oriented production to accelerate industrial development in the Kashkadarya region. These conclusions serve as an important methodological basis for developing practical recommendations for improving regional investment and industrial policy. In order to ensure the reliability of the results of the econometric model, a series of diagnostic tests were conducted on the regression equation. In particular, the impartiality and stability of the estimated coefficients were checked by determining the presence of autocorrelation and multicollinearity in the model [14]. First of all, the Durbin–Watson test was used to determine the presence of autocorrelation between the residual terms. According to the test results, it was found that the Durbin–Watson statistic was close to 2, which indicates the absence of first-order autocorrelation in the residuals of the model. This result confirms that the relationship between the variables in the regression equation is correctly specified and that the distortions inherent in the time series do not significantly affect the model results. As a second important diagnostic step, Variance Inflation Factor (VIF) indicators

were calculated to identify the problem of multicollinearity. According to the results, it was found that the VIF values for all independent variables included in the model are below the critical level (usually 10). This indicates that there is no strong linear relationship between the independent variables and the estimates of the regression coefficients are stable. Also, the analysis of the correlation matrix between the variables showed a low level of multicollinearity. The pairwise correlation coefficients between the independent variables did not exceed the critical limits, which allows the impact of each factor on industrial development to be determined separately and independently in the model. The results of diagnostic tests confirm that the selected econometric model is methodologically sound, and the estimates of regression coefficients are objective and reliable. This allows us to draw scientific and practical conclusions from the results obtained in empirically identifying investment and institutional factors affecting industrial development in the Kashkadarya region.

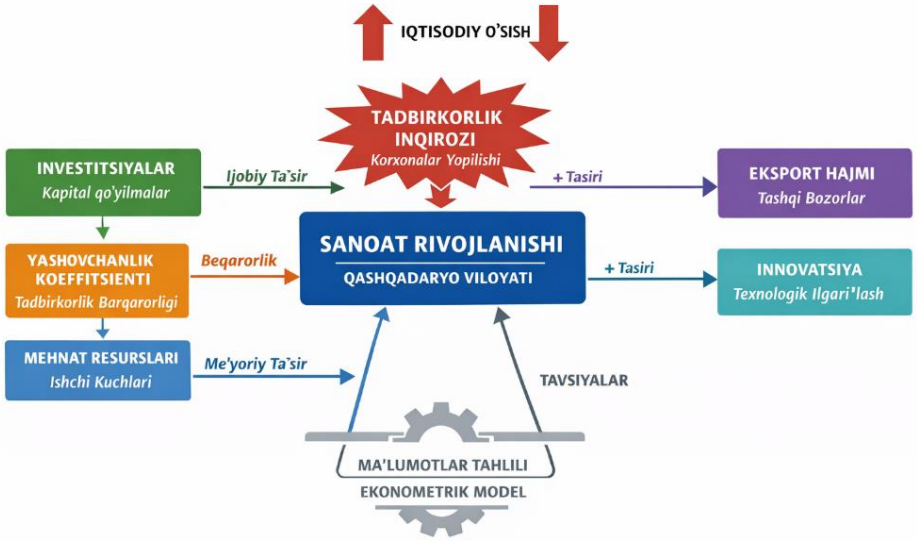

Figure 1. Simulation model of factors influencing industrial development in Kashkadarya region

Figure 3.2.1 shows the interrelationship between the main investment, institutional and innovation factors affecting industrial development in the Kashkadarya region based on a simulation model. The model considers industrial development as a central element of the system, and shows the direct and indirect impact of investments, business viability, labor resources, export potential and innovative activity on it. The figure shows investments as the main driver of industrial development, which has a positive impact on the growth of the industry through the expansion of production capacities and technological innovation. The viability coefficient of business entities is expressed as an important institutional factor determining the stability of industrial development. The model highlights the negative impact of a decrease in this indicator on industrial development through disruptions in production processes and the closure of enterprises. Also, labor resources are presented as a factor that has a normative impact on industrial development, and the level of labor supply is characterized by the creation of conditions for the growth of production volumes [15]. Export volume and innovative activity are shown as factors that ensure the expanded reproduction stage of industrial development, reflecting the fact that they serve to increase the c The results of the correlation analysis showed that there is an almost zero correlation between the key indicators characterizing the development of entrepreneurial activity in the Kashkadarya region - the viability coefficient of enterprises and organizations and the level of entrepreneurial activity. This situation scientifically justifies the low effectiveness of current measures aimed at developing entrepreneurship in the region. Because the presence of a strong or at least

moderate positive correlation between viability and activity should mean a healthy development of the entrepreneurial environment. The identified weak correlation can be considered one of the main reasons for the low explanatory power (relatively low R^2) observed in the third econometric model. That is, an increase in the number of newly established enterprises does not automatically ensure a stable growth in the volume of industry and production in the region. This indicates that the measures being implemented to develop entrepreneurship are mainly aimed at increasing quantitative indicators, but their qualitative and sustainability aspects are not sufficiently taken into account. In other words, it can be observed that a significant part of newly established enterprises and organizations in the Kashkadarya region are being established not on the basis of clear strategic goals, thorough business plans and in-depth analysis of market conditions, but in order to ensure short-term statistical growth. As a result, a large number of such entities fail to achieve economic stability at the initial stages of their activities, which leads to a low level of viability of business entities. These conclusions are consistent with the results of the above regression and diagnostic analyses and scientifically substantiate the need to shift the policy of supporting entrepreneurial activity in the region from a quantitative approach to a qualitative and result-oriented approach. In particular, in the process of establishing business entities, special attention should be paid to the development of factors that ensure their long-term sustainability - investment support, innovative potential, management competencies and market infrastructure.ompetitiveness of the industry through foreign markets and technological progress.

4. Conclusion

The comparative econometric analysis draws a conclusion: investment factors are decisive in shaping the development path of industrial enterprises. The findings show that infrastructure investment, technological upgrading, and stable (institutional) climates have the largest positive impact on industrial sector growth. Several other indicators such as financial accessibility or foreign direct investment are also quite significant, just with a varying contribution by region driven by their economic structure. The research underlines the need for integrated investment policies to strengthen financial systems that create an effective and incentivised institutional framework and promote capital allocation to innovation. Policymakers should prioritize targeted investment strategies that enhance industrial competitiveness and ensure balanced regional development. Future research may expand the dataset and incorporate panel econometric techniques to deepen analytical precision.

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