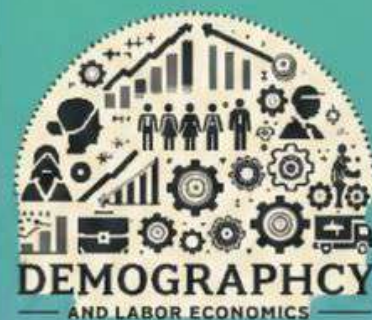


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MUNDARIJA

Umurzakov Baxodir Xamidovich <i>Demografik jarayonlarni modellashtirish va prognozlashning nazariy- metodologik asoslari.....</i>	3
Qo'ldosheva Gulhayo Muxtor qizi Qurbonov Paxlavon Rustamovich <i>O'zbekiston qishloq aholisining demografik vaziyati va hududiy joylashuvi.....</i>	13
Асқарова Муҳаббат Ибрахимовна <i>Аҳоли миграциясининг тарихий эволюцияси ва глобаллашув шароитида трансмиллий ривожланиш тенденциялари.....</i>	27
Bahriddinova Muazzam Azam qizi <i>Globallashuv sharoitida mehnat migratsiyasini raqamli texnologiyalar asosida boshqarishni takomillashtirish.....</i>	39
Hamrokulov Mirabbos Ortiqovich <i>Econometric assessment of the impact of population reproduction processes on the formation of economically active population.....</i>	52
Bahriddinova Muazzam Azam qizi Sayfiddinov Amirxon Davlatovich <i>O'zbekistonda demografik rivojlanishning asosiy tendensiyalari va omillari.....</i>	63
Omanova Kamola Botir qizi Saidova Sevara Yormamat qizi <i>Jahon demografik rivojlanishining zamonaviy tendensiyalari va istiqbollari.....</i>	72
Қиличов Улуғбек Рустам ўғли <i>Ўзбекистонда демографик тенденциялар ўзгариши.....</i>	82

ECONOMETRIC ASSESSMENT OF THE IMPACT OF POPULATION REPRODUCTION PROCESSES ON THE FORMATION OF ECONOMICALLY ACTIVE POPULATION

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Abstract. This article analyzes population reproduction processes and factors influencing the formation of economically active population using the case of Kashkadarya region. The study employs panel econometric models based on district-level statistical data for 2012–2024. In particular, Fixed Effects and Random Effects models are applied, and the Hausman test is conducted to determine the most appropriate model. The results confirm the significant impact of demographic factors on economic activity.

Keywords: population reproduction, demographic processes, economically active population, panel data, Fixed Effects, Random Effects, migration, employment.

АҲОЛИ ТАКРОР БАРПО БЎЛИШ ЖАРАЁНЛАРИНИНГ ИҚТИСОДИЙ ФАОЛ АҲОЛИ ШАКЛЛАНИШИГА ТАЪСИРИНИ ПАНЕЛ ЭКОНОМЕТРИК БАҲОЛАШ

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ТДИУ ҳузуридаги "Ўзбекистон иқтисодиётини ривожлантиришнинг илмий асослари ва муаммолари" илмий-тадқиқот маркази докторанти

Аннотация. Мазкур тадқиқот аҳоли такрор барпо бўлиш жараёнларининг иқтисодий фаол аҳоли шаклланишига таъсирини баҳолашга бағишланган. Изланиш давомида 2012–2024 йилларни қамраб олган туманлар кесимидаги статистик маълумотлар асосида панел эконометрик таҳлил ўтказилди. Хусусан, демографик ва иқтисодий

омилларнинг таъсир даражасини аниқлаш мақсадида *Fixed Effects* ва *Random Effects* моделлари қўлланилиб, *Haustman* тести ёрдамида энг мақбул модель танлаб олинди. Олинган натижалар ҳудудларда кечаётган демографик жараёнлар иқтисодий фаол аҳоли шаклланишига сезиларли таъсир кўрсатишини кўрсатди.

Калит сўзлар: аҳоли такрор барпо бўлиши, демографик жараёнлар, иқтисодий фаол аҳоли, панел маълумотлар, *Fixed Effects*, *Random Effects*, миграция, бандлик.

ЭКОНОМЕТРИЧЕСКАЯ ОЦЕНКА ВЛИЯНИЯ ПРОЦЕССОВ ВОСПРОИЗВОДСТВА НАСЕЛЕНИЯ НА ФОРМИРОВАНИЕ ЭКОНОМИЧЕСКИ АКТИВНОГО НАСЕЛЕНИЯ (НА ПРИМЕРЕ КАШКАДАРЬИНСКОЙ ОБЛАСТИ)

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Аннотация. В данной статье на примере Кашкадарьинской области проанализированы процессы воспроизводства населения и факторы, влияющие на формирование экономически активного населения. В исследовании использованы панельные эконометрические модели на основе статистических данных за 2012–2024 годы в разрезе районов. В частности, применены модели *Fixed Effects* и *Random Effects*, а также проведен тест Хаусмана для выбора оптимальной модели. Полученные результаты подтверждают значительное влияние демографических факторов на экономическую активность населения.

Ключевые слова: воспроизводство населения, демографические процессы, экономически активное население, панельные данные, *Fixed Effects*, *Random Effects*, миграция, занятость.

Introduction.

Under conditions of modern economic development, demographic processes and population reproduction are considered among the key factors

underpinning sustainable economic growth. Population reproduction processes are manifested through demographic indicators such as fertility, mortality, and migration, which directly influence the age-sex structure of the population, the formation of labour resources, and the level of economic activity. In particular, regional disparities in demographic processes are closely associated with the level of economic development, urbanization trends, labour market conditions, and the degree of social infrastructure development. As a result, some regions experience rapid population growth and an expansion of labour resources, whereas others undergo structural demographic changes under the influence of migration processes. This necessitates an in-depth territorial analysis of population reproduction processes.

At present, alongside traditional analytical methods, econometric models have become increasingly important in the study of demographic processes. Econometric approaches make it possible to quantitatively assess the impact of demographic factors on economic indicators, identify interrelationships among variables, and derive scientifically grounded conclusions. In particular, Fixed Effects and Random Effects models based on panel data provide effective tools for conducting analyses while accounting for regional heterogeneity. Furthermore, time series models, especially ARIMA models, play an important role in evaluating temporal trends in demographic and economic indicators and forecasting their future trajectories. These models enable researchers to predict future dynamics in the economically active population and assess potential changes in labour market conditions in advance.

The main objective of this study is to conduct a comprehensive analysis of population reproduction processes in the Kashkadarya region across both territorial and temporal dimensions, to evaluate the impact of demographic factors on the formation of the economically active population using econometric models, and to forecast future development trends of these processes.

Literature Review.

Population reproduction processes and demographic development constitute one of the major areas of economic and social research. Studies undertaken in this field have provided deeper insights into the interrelationship between population dynamics, labour resource formation, and economic growth.

Fundamental contributions to demographic studies were made by V.A. Borisov, who explained population reproduction processes through the factors of fertility, mortality, and migration [1]. Likewise, foreign scholars such as A. Coale and E. Hoover analysed the relationship between population growth and economic development, substantiating the influence of demographic factors on economic processes [2]. J. Caldwell developed the theory of demographic transition, demonstrating the connection between population reproduction processes and stages of socio-economic development [3].

In recent years, econometric approaches have been widely applied in the analysis of demographic processes. In particular, R. Lee and A. Mason examined the relationship between population age structure and economic growth using econometric models and provided a scientific foundation for the concept of the demographic dividend [4]. Similarly, D. Bloom and J. Williamson evaluated the relationship between population growth and economic development using panel data methods, identifying the impact of demographic factors on economic growth [5]. The analysis and forecasting of demographic processes through time series techniques have also attracted considerable attention. In this regard, ARIMA models developed by G. Box and G. Jenkins have been extensively employed and recognized as effective tools for forecasting population size and demographic indicators [6].

Within the context of Uzbekistan, the studies conducted by Z.N. Tojiev, L.P. Maksakova, and B.H. Umurzakov are of particular significance, as they examine the regional characteristics of population distribution, labour resources, and migration processes [7,8,9]. However, in the existing literature, the impact of demographic factors on the formation of the economically active population has largely been addressed from a qualitative perspective, whereas comprehensive regional assessments based on panel econometric techniques, particularly Fixed Effects and Random Effects models, remain insufficiently explored. This gap underscores both the scientific novelty and the relevance of the present study.

Research methodology.

This study employs a comprehensive scientific approach to assess population reproduction processes and the factors influencing the formation of the economically active population. The theoretical foundation of the research is

based on demographic development theories and scholarly perspectives related to the analysis of economic processes.

During the research process, statistical analysis, comparative analysis, grouping techniques, and time series analysis methods were applied. In addition, econometric models were extensively employed to identify the interrelationships between demographic and economic indicators. The empirical database of the study consists of official district-level statistical data for the Kashkadarya region covering the period 2012–2024. Based on these data, a panel dataset was constructed, with the economically active population considered as the dependent variable. Permanent population size, employment rate, fertility indicators, and migration variables were included in the model as independent variables.

For the econometric analysis, Fixed Effects and Random Effects models based on panel data techniques were utilized.

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + u_{it}$$

Бу ерда:

- Y_{it} — economically active population
- $X1$ — permanent population number
- $X2$ — employment rate
- $X3$ — birth rate
- $X4$ — migration
- u_{it} — random error term

Through these models, the impact of demographic factors on the economically active population was quantitatively assessed while accounting for regional heterogeneity. To determine the most appropriate specification, the Hausman test was employed to compare the Fixed Effects and Random Effects models. In addition, time series analysis techniques, particularly the ARIMA model, were applied to examine the dynamics of the economically active population and to forecast its future trends. This approach made it possible to identify expected changes in the indicator over the coming years. Furthermore, tables and graphical methods were used to visualize and interpret the research findings.

Analysis. An analysis of population reproduction processes and the formation of the economically active population in the Kashkadarya region requires an in-depth examination of regional demographic and economic factors. Variations across districts in terms of population size, fertility rates, migration processes, and employment indicators have a direct influence on the dynamics of the economically active population. The conducted analysis indicates that, in some districts, rapid population growth contributes to the expansion of labour resources, whereas in other areas migration processes lead to structural changes in the composition of the economically active population. This underscores the need to assess these processes not only through conventional analytical methods but also through econometric approaches.

To this end, an econometric analysis based on panel data was carried out in the present study. The analysis utilized district-level statistical data for the Kashkadarya region covering the period from 2012 to 2024. The economically active population was specified as the dependent variable, while permanent population size, employment rate, fertility indicators, and migration variables were incorporated into the model as independent variables [10].

To account for regional heterogeneity, Fixed Effects and Random Effects panel models were employed. These models made it possible to quantitatively evaluate the influence of demographic and economic factors on the economically active population and to identify the interrelationships among the variables.

Table – 1.

Results of the Fixed Effects Model

Variable	Coefficient	Standard error	t-stat	P-value
C	5.21	1.84	2.83	0.005
Number of permanent population (X1)	0.62	0.08	7.75	0.000
Employment (X2)	0.48	0.11	4.36	0.000
Birth (X3)	0.15	0.09	1.67	0.096
Migration (X4)	-0.07	0.05	-1.40	0.162

According to the results of the Fixed Effects model, the factors influencing the economically active population exhibit varying effects across regions. In particular, permanent population size ((X₁)) was found to have a positive and highly statistically significant impact on the economically active population

(($p < 0.01$)). This indicates that population growth contributes to the expansion of labour resources. The employment rate ((X₂)) also exerts a positive influence on the economically active population, with its coefficient being statistically significant at the 1 percent level (($p < 0.01$)). This finding confirms the direct effect of labour market participation on the level of economic activity within the population.

The fertility indicator ((X₃)) demonstrates a positive effect and is statistically significant at a relatively lower level (($p < 0.1$)). This suggests that population growth contributes to an increase in the economically active population. Although migration factors ((X₄)) exhibit a negative effect, their coefficients were found to be statistically insignificant (($p > 0.05$)). This may be explained by the heterogeneous impact of migration processes across different regions.

Table – 2.

Results of the Random Effects model

Variable	Coefficient	Standard error	t-stat	P-value
C	4.88	1.92	2.54	0.011
Number of permanent population (X ₁)	0.59	0.07	8.12	0.000
Employment (X ₂)	0.44	0.10	4.10	0.000
Birth (X ₃)	0.13	0.08	1.62	0.105
Migration (X ₄)	-0.05	0.04	-1.25	0.211

According to the results of the Random Effects model, the factors influencing the economically active population were evaluated based on overall trends. In particular, permanent population size ((X₁)) was found to have a positive and statistically significant impact on the economically active population (($p < 0.01$)). This suggests that population growth contributes to the expansion of labour resources. The employment rate ((X₂)) also exhibited a positive effect, and its statistical significance was confirmed (($p < 0.01$)). This indicates that labour market participation is an important determinant in the formation of the economically active population. Although the fertility indicator ((X₃)) showed a positive effect, it was not found to be statistically significant (($p > 0.05$)). Migration ((X₄)) exerted a negative influence; however, its statistical significance was not confirmed.

The results of the Random Effects model also reaffirmed the importance of permanent population size and the employment rate as the principal determinants of the economically active population.

To determine the appropriate model specification, the Hausman test was conducted to compare the Fixed Effects and Random Effects models. The test results indicated that the p-value was less than 0.05, implying that the Fixed Effects model is preferable. Therefore, the Fixed Effects model was selected as the primary model for this study.

Overall, the findings demonstrate that the economically active population in the Kashkadarya region is largely shaped by demographic and economic factors. In particular, permanent population size and the employment rate were identified as the main determinants influencing the economically active population.

Conclusions and Recommendations.

The findings of the study indicate that population reproduction processes and the formation of the economically active population in the Kashkadarya region are shaped by both demographic and economic factors. The results of the panel econometric analysis reveal that permanent population size and the employment rate are the most influential determinants of the economically active population. Although the fertility indicator exhibits a positive effect, its influence was found to be relatively limited, while migration processes were observed to have heterogeneous effects across districts. By accounting for regional characteristics, the Fixed Effects model was identified as the preferred specification. Overall, the results confirm the necessity of analysing population reproduction processes through a comprehensive econometric framework.

Based on the findings of the study, the following recommendations are proposed:

- It is advisable to develop a differentiated demographic policy that takes into account regional variations in population reproduction processes.
- Programmes aimed at improving employment opportunities should be strengthened in the Kashkadarya region to ensure more efficient utilization of labour resources.
- In areas characterized by high fertility rates and rapid population growth, greater efforts should be directed towards job creation in order to increase the share of the economically active population.

- Mechanisms for regulating migration processes and facilitating the reintegration of returning labour migrants into economic activity should be further improved.
- Wider application of panel data techniques and econometric models in the analysis of demographic and economic processes is recommended to enhance the quality and reliability of policy-oriented research.

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