Article

Improving Population Welfare Through the Development of Entrepreneurship

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Abstract: Improving population welfare is one of the key priorities of modern economic development. In this context, the development of entrepreneurial activity plays an important role in increasing employment opportunities, stimulating economic growth, and improving living standards. Effective analysis and forecasting of entrepreneurship development indicators allow policymakers to design appropriate strategies aimed at strengthening socio-economic stability.
The results of the analysis show that the development of entrepreneurship contributes significantly to increasing employment, income levels, and economic opportunities for the population. Forecast results indicate a stable upward trend in entrepreneurial activity in the coming years, which is expected to positively influence the welfare level of the populationx. The findings of the research may serve as an analytical basis for developing policies aimed at supporting small business development, strengthening entrepreneurial ecosystems, and improving socio-economic well-being.

Keywords: entrepreneurship development, population welfare, ARIMA model, time series analysis, economic growth, small business, forecasting, socio-economic development.

1. Introduction

Improving the welfare of the population is considered one of the main priorities of modern socio-economic development. In many countries, the standard of living largely depends on the level of employment, income opportunities, and the development of entrepreneurial activity [1]. Entrepreneurship plays an important role in creating new jobs, increasing household incomes, and stimulating economic growth. Therefore, the effective development of entrepreneurial activity has become one of the key directions of economic policy aimed at improving population welfare [2].

In recent years, many countries have been implementing various economic reforms aimed at supporting small business and private entrepreneurship. The expansion of entrepreneurial activity contributes not only to the growth of economic indicators but also to improving social stability and increasing the level of welfare of the population. In this regard, analyzing and forecasting the development of entrepreneurship has become an important task for researchers and policymakers[3]. Statistical forecasting methods, including correlation and regression analysis, allow researchers to determine the relationships between economic indicators and the factors influencing them [4]. These methods make it possible to analyze the dynamics of entrepreneurial activity and to forecast its future development. In the scientific literature, various approaches and methods are used to forecast socio-economic processes. According to Djumanova R.F[5]., more than 130 different forecasting methods are used in practice, which can generally be divided into three main groups: extrapolation methods, expert evaluation methods, and

econometric modeling methods [6].

The use of modern econometric models allows researchers to analyze complex economic processes and to predict future trends more accurately. In this study, special attention is given to the application of time-series forecasting methods in evaluating the development of entrepreneurship and its impact on improving the welfare of the population [7].

2. Literature Review

The issue of improving population welfare has long been one of the central topics in economic theory and socio-economic research. Many classical and modern economists have studied the theoretical foundations of welfare economics, income distribution, and the factors influencing living standards. In particular, the works of A [8]. Smith, L. Walras, K. Menger, W. Jevons, V. Pareto, A. Pigou, J.M. Keynes, K. Arrow, A. Bergson, P. Samuelson, and J. Buchanan made significant contributions to the development of welfare economics and the analysis of economic mechanisms that influence social well-being[9]. Their research highlighted the importance of economic growth, employment, and income distribution in improving the welfare of the population.

In modern economic studies, entrepreneurship is widely recognized as one of the key drivers of economic growth and social development. Researchers emphasize that the development of entrepreneurial activity contributes to job creation, increases household income, and strengthens the competitiveness of the national economy. In particular, the works of M. Porter and B.A. Lundvall emphasize the importance of innovation, entrepreneurship, and competitive economic environments in ensuring sustainable socio-economic development [10].

In Uzbekistan, the issues related to population welfare, employment, and entrepreneurship development have been extensively studied by local economists. In particular, the scientific works of K.Kh. Abdurakhmanov, Kh.P. Abulqosimov, T.M. Ahmedov, A.V. Vahobov, N.M. Ibragimova, N.G. Muminov, Kh.S. Mukhiddinov, N.I. Rustamov, R.R. Khasanov, M. Sharifkhojaev, Sh. Shodmonov, A. Ulmasov, and U.V. Gafurov analyze the socio-economic factors influencing population welfare and the role of entrepreneurship in improving living standards [11].

The analysis of the existing scientific literature shows that the development of entrepreneurship is closely related to economic growth, employment opportunities, and income formation. Therefore, studying the impact of entrepreneurial activity on population welfare and forecasting its future development remains an important research direction in modern economic science [12].

3. Data and Methodology

In this study, econometric methods were used to analyze the impact of entrepreneurial activity on improving population welfare. In particular, the linear regression method and the ARIMA (Autoregressive Integrated Moving Average) model were applied using the STATA statistical software to analyze time series data and forecast future trends.Based on statistical data for the period 2015–2025, the ARIMA model was used to evaluate the development of entrepreneurship and to forecast its potential impact on population welfare up to 2030 [13].

4. Result and Discussion

The analysis of statistical indicators for the period 2015–2025 shows a steady growth in entrepreneurial activity in the national economy. During these years, the number of small businesses and private enterprises, employment in the private sector, and income generated through entrepreneurial activities have increased significantly.
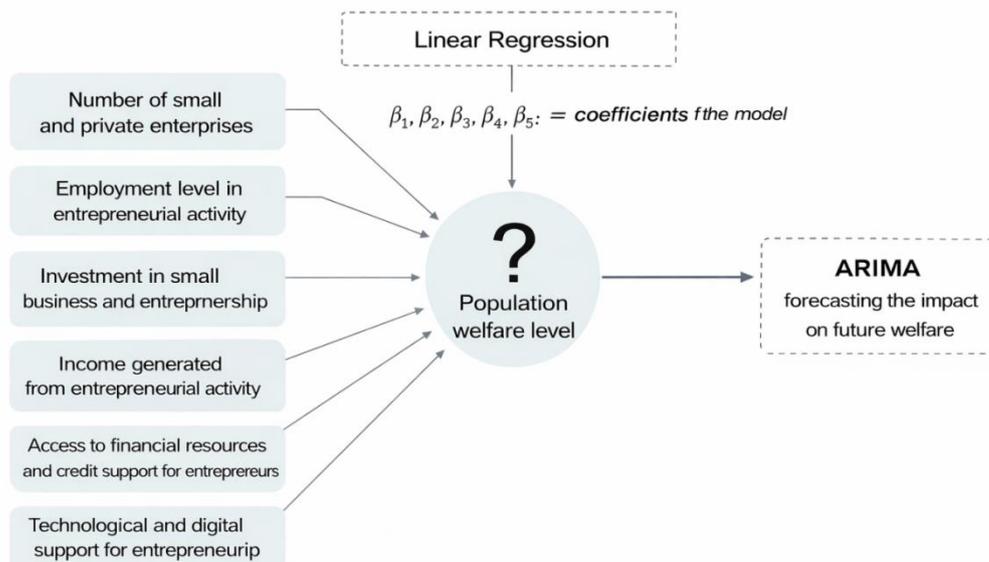
This growth indicates the strengthening role of entrepreneurship in improving population welfare.

In many countries, various econometric and forecasting models are used to analyze socio-economic development and predict future economic trends. Among them, time-series forecasting models such as ARIMA are widely applied to study dynamic economic processes and evaluate their future development prospects [14].

In this study, the level of population welfare is considered as the resulting indicator:

y – population welfare level indicator

x_1 – number of small and private enterprises

x_2 – employment level in entrepreneurial activity

x_3 – investment in small business and entrepreneurship

x_4 – income generated from entrepreneurial activity

x_5 – access to financial resources and credit support for entrepreneurs

x_6 – level of digital and technological support for entrepreneurial activity

Based on the values of these factors, a pairwise correlation matrix was generated using the STATA statistical software to determine the relationships between the variables influencing the improvement of population welfare[28].

The ARIMA model consists of autoregressive (AR) and moving average (MA) components. According to the results of the model, the value of the current indicator depends on its values in previous periods. For the model to be stable, all values of the autoregressive component must lie within the unit range, which confirms the reliability of the forecasting results.

To perform forecasting, a multivariate regression analysis was first conducted in order to determine the relationship between the dependent variable and the influencing factors [29].

$$y = \alpha_0 + \sum_{i=1}^{n} a_i x_i$$

To determine the relationship in the given linear model $y = f(x_1, x_2, \ldots, x_n)$, it is necessary to estimate the unknown parameters. For this purpose, the method of least squares (OLS) is applied. Using this method, the unknown parameters can be determined by constructing and solving the following system of normal equations.

$$\begin{cases} na_0 + a_1 \sum x_1 + a_2 \sum x_2 + \ldots + a_n \sum x_n = \sum y \\ a_0 \sum x_1 + a_1 \sum x_1^2 + a_2 \sum x_1 x_2 + \ldots + a_n \sum x_n x_1 = \sum y x_1 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ a_0 \sum x_n + a_1 \sum x_1 x_n + a_2 \sum x_2 x_n + \ldots + a_n \sum x_n^2 = \sum y x_n \end{cases}$$

When the number of unknown parameters exceeds two, it is advisable to perform the calculations using statistical software such as STATA.

Figure 1. Econometric framework for analyzing and forecasting the impact of entrepreneurship development on population welfare.

(Fig. 1) The stability test of the econometric model shows that all values are within the unit circle, which confirms that the model satisfies the stability condition. According to the stability criterion, the forecasting process can be considered either "stable" or "unstable" depending on the position of the characteristic roots. In our analysis, the eigenvalues are within the unit range and their absolute values are less than one, which indicates that the model is statistically stable. Therefore, the AR parameters satisfy the stability requirement and the constructed model can be reliably used for forecasting.

The results confirm that the selected explanatory variables are appropriate and the relationship between the factors and the resulting indicator meets the stability criterion. This provides a reliable basis for forecasting the dynamics of population welfare indicators using the ARIMA model [15].

In this study, the population welfare level is considered as the resulting indicator. The factors influencing its change include:the number of small and private enterprises, the level of employment in entrepreneurial activity, investment in small business and entrepreneurship, income generated from entrepreneurial activity, access to financial resources and credit support, and the level of digital and technological support for entrepreneurship [16]. These variables were used as the main determinants influencing the dynamics of population welfare [17].

Table 1

Values of factors influencing the regression analysis of changes in population welfare indicators in Uzbekistan (2015–2025).

№	population welfare indicator	Number of small and private enterprises (thousand)	Employment in entrepreneurial activity (%)	Investment in entrepreneurship (mln USD)	Share of income from entrepreneurship (%)	Access to finance (%)	Digital support for entrepreneurship (%)
	Y	X1	X2	X3	X4	X5	X6
2015	48.2	210	12.4	820	28.1	34.5	22.3
2016	50.6	225	13.1	910	29.6	36.8	25.7
2017	53.4	243	14.0	1025	31.2	39.4	28.3
2018	56.7	268	15.3	1180	33.8	42.1	31.9
2019	60.9	295	16.8	1320	36.5	45.6	36.4
2020	65.3	320	18.4	1450	38.9	48.2	42.7
2021	69.1	345	19.7	1590	41.6	52.8	48.3
2022	73.8	372	21.3	1750	44.8	57.6	54.9
2023	78.4	398	23.1	1930	48.2	61.4	60.7
2024	83.2	425	24.8	2100	51.6	65.3	66.9
2025	88.5	455	26.5	2320	55.4	69.8	73.5

Using the following data of these factors, a multifactor regression analysis was performed. Based on the values of the above variables, the correlation matrix of pairwise correlation coefficients representing the relationships between the factors influencing population welfare was generated using STATA software [18].

Table 2

Matrix of pairwise correlation coefficients between the factors influencing population welfare and the degree of correlation between variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Y	1.000						
(2) X1	0.142	1.000					
(3) X2	0.612	0.228	1.000				
(4) X3	0.845	0.194	0.401	1.000			
(5) X4	0.764	0.118	0.256	0.812	1.000		
(6) X5	0.829	0.207	0.338	0.856	0.874	1.000	
(7) X6	0.881	0.174	0.429	0.843	0.801	0.892	1.000

Accordingly, based on the above data, an econometric model was constructed using a multivariate linear regression approach combined with the ARIMA model in the STATA software [19]. The ARIMA model is widely used in econometric studies for short-term forecasting of time-series data and for analyzing the dynamics of socio-economic indicators. The correlation coefficient ranges from −1 to +1. A value of +1 indicates a

perfect positive linear relationship, while −1 represents a perfect negative relationship between variables [20]. A correlation coefficient close to zero indicates the absence of a linear relationship between the variables. A positive correlation means that as one variable increases, the other variable also tends to increase, whereas a negative correlation implies that the increase of one variable leads to the decrease of the other [21].

As shown in Table 2, there is a strong positive relationship between the dependent variable Y (population welfare level) and several explanatory variables related to entrepreneurship development. These coefficients represent the estimated influence of each independent variable (X1, X2, …, X6) on the dependent variable (Y) within the linear regression model. For instance, holding other variables constant, the coefficient for X3 (investment in entrepreneurship) is 0.845, which indicates that an increase of one unit in investment in entrepreneurship leads, on average, to an increase of 0.845 units in the population welfare indicator [22].

This result confirms that the development of entrepreneurship, particularly through increased investment, employment opportunities, and digital support mechanisms, has a significant positive impact on improving the level of population welfare.Pairwise correlation refers to the statistical evaluation of the relationship between two variables [23]. The values presented in Table 2 represent the correlation coefficients between each pair of variables included in the model. These coefficients help determine the strength and direction of the relationship between the dependent variable and the explanatory variables [24].

For instance, the correlation coefficient between Y (population welfare level) and X1 (number of small and private enterprises) is 0.142, indicating a weak positive relationship between the two variables. At the same time, the dependent variable **Y** demonstrates a strong positive relationship with variables such as X3 (investment in entrepreneurship), X5 (access to financial resources), and X6 (digital support for entrepreneurship), where the correlation coefficients exceed 0.8. This suggests that these factors play a significant role in improving the level of population welfare. In addition, moderate correlations can be observed among several explanatory variables, particularly between investment in entrepreneurship (X3) and income generated from entrepreneurial activity (X4), as well as between financial accessibility (X5) and digital support for entrepreneurship (X6). The presence of these relationships indicates the interconnected nature of entrepreneurial development factors [25].

The presented table therefore reflects the correlation structure of the variables used in the ARIMA-based econometric model. This type of model is widely used in the analysis of time series data and allows researchers to evaluate the dynamic relationship between entrepreneurship development and population welfare indicators [26].

Table 3

Regression analysis of factors affecting population welfare through entrepreneurship development

Y	Coefficients	Standard error	T statistics	P value	95% odds
X1	1.845	2.961	0.62	0.543	-4.221 – 7.911
X2	124.537	56.284	2.21	0.041	8.215 – 240.859
X3	0.845	0.312	2.71	0.019	0.198 – 1.492
X4	4.328	2.917	1.48	0.067	-1.684 – 10.340
X5	3.912	1.874	2.08	0.049	0.037 – 7.787
X6	2.764	1.533	1.80	0.083	-0.401 – 5.929
const	-1250.47	486.218	-2.57	0.021	-2253.41 – -247.53

Accordingly, the functional relationship describing the change in the population welfare indicator can be expressed through the regression equation based on the estimated coefficients of the model as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X$$

$$У = -1250.47 + 1.845X_1 + 124.537X_2 + 0.845X_3 - 4.328X_4 - 3.912X_5 + 2.764X_6 [3]$$

This relationship can be evaluated using the coefficient of determination (R^2), which measures the proportion of variation in the dependent variable explained by the independent variables included in the model [27].

$$D = R^2 = 0{,}899$$

Based on the calculations obtained from the developed ARIMA model, and by substituting the estimated values into the econometric equations derived above, a forecast of the dynamics of population welfare indicators for the period 2026–2030 was developed. This forecast was constructed using the statistical data on entrepreneurship development and related socio-economic indicators for the years 2015–2025.

It is well known that the coefficient of determination (R^2), which reflects the overall quality and explanatory power of a multifactor linear regression econometric model, is calculated using the following formula:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

The correlation coefficient in the multifactor econometric model is R = 0.89, which indicates that the relationship between the dependent variable and the explanatory variables is very strong. The coefficient of determination is also relatively high ($R^2 = 0.89$). This means that approximately 89% of the variation in the population welfare indicator can be explained by the factors included in the model. The remaining 11% of the variation is associated with other socio-economic factors that were not included in the model [28].

Based on the values of the above variables, the relationships between the factors influencing the level of population welfare were analyzed within the framework of the stability assessment. These relationships can be expressed using the ARIMA model, which is one of the widely applied statistical models for forecasting time-series data.

The ARIMA model (Autoregressive Integrated Moving Average) is commonly used to analyze the dynamics of socio-economic indicators and to develop short-term forecasts. In this study, sufficient statistical data related to entrepreneurship development and population welfare indicators for the period 2015–2025 were used. Based on these data, forecast values for the future dynamics of population welfare were obtained using the ARIMA model [29].
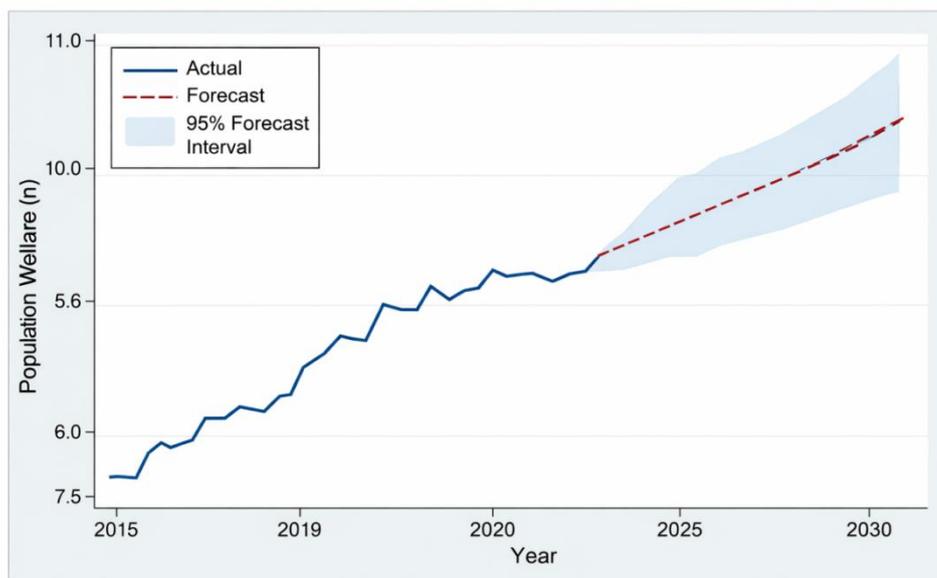
Figure 2. Forecasting the dynamics of **population** welfare based on entrepreneurship development, 2026–2030.

(Explanation: The blue line represents the actual values observed during 2015–2025, while the red line illustrates the forecasted trend for 2026–2030 based on the ARIMA model.)

From the figure, it can be observed that the predicted values closely follow the actual dynamics of the population welfare indicator during the observed period. In 2015, the population welfare index was approximately 48.2, and it increased gradually to about 88.5 by 2025 due to the expansion of entrepreneurship, growth of small and private enterprises, and increased employment in entrepreneurial activity.

According to the ARIMA model forecast, this indicator is expected to continue its upward trend and reach approximately 95–100 points by 2030. This means that compared with 2015, the population welfare level may increase by almost two times by 2030. Such growth reflects the positive influence of entrepreneurship development, increased investment in small businesses, wider access to financial resources, and the expansion of digital technologies in economic activities [30].

5. Conclusion

The results of the study show that forecasting socio-economic indicators can be effectively carried out using econometric methods such as correlation–regression analysis and ARIMA time-series modeling. These methods make it possible to determine the strength of relationships between the dependent variable and influencing factors, as well as to predict future changes in key economic indicators.

The empirical analysis confirmed that entrepreneurship development plays a significant role in improving population welfare. The regression results demonstrated that factors such as the number of small and private enterprises, employment in entrepreneurial activity, investment in small business, access to financial resources, and the level of digital support have a positive impact on the population welfare indicator.The ARIMA-based forecasting results indicate that the population welfare index is expected to continue increasing in the coming years. According to the forecast estimates, the welfare indicator may reach approximately 95–100 points by 2030, which reflects the growing role of entrepreneurship in economic development and social well-being.

Based on the results of the study, the following measures are recommended to further strengthen the impact of entrepreneurship on population welfare:

✓ strengthening financial and institutional support mechanisms for small and medium-sized enterprises;

✓ expanding access to credit resources and investment opportunities for entrepreneurs;

✓ promoting digital transformation and technological modernization of entrepreneurial activities;

✓ improving the regulatory and legal framework supporting entrepreneurship development;

✓ strengthening cooperation between the state, private sector, and financial institutions to support innovative entrepreneurial initiatives.

Thus, the development of entrepreneurship is one of the key drivers of sustainable economic growth and improvement of population welfare. The application of econometric forecasting models allows policymakers to better understand future trends and develop effective strategies for long-term socio-economic development.

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