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Solving Pension System Problems through Econometric Modeling

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Abstract: In the article, the effect of changes in the weight of the population of retirement age in the total population on the number of old-age pensions awarded by the pension fund in Uzbekistan is analyzed through econometric modeling. Econometric modeling analyzes were performed in the Gretl software complex. The influence of the factors was evaluated and an appropriate econometric model was built. The statistical significance of the model was assessed by Fisher's F-test and Student's t-test. Appropriate inductive analysis of the model was carried out and conclusions were drawn.

Keywords: pension, pension fund, econometric modeling, correlation coefficient, pensioners, least squares method, retirement age, multicollinearity, Darbin-Watson statistics, pension system, demography

Introduction

Sustainable development of the pension system of citizens in the Republic of Uzbekistan implies providing enough pensions for citizens to live comfortably in the future and at the same time ensuring the financial stability of the pension system. At the same time, the insufficient amount of pensions to meet the needs of pensioners and the lack of income of the fund(s) formed to finance pension payments are among the main problems in the pension system today.

The reform of the state pension system involves long periods, primarily because it depends on demographic changes. Changes and updates made in this regard will have a positive or negative effect after a very long time.[1] The proof of this can be seen in the results of pension system reforms implemented in many countries of the world. It is known from international experience that changes made during a short period of time will either cause dissatisfaction in the society or be a heavy burden on the economy.

Material and method

Reform of the pension system should be carried out in parallel with demographic factors. An important factor affecting the pension system, in particular the number of pensioners, is undoubtedly the life expectancy of the population.[2] In our research, we will try to analyze the influence of life expectancy on the change in the number of pensioners on the example of Uzbekistan. To do this, we

[1] Achilov U. Ўзбекистонда пенсия таъминоти тизими муаммолари ва ҳал этиш йўллари //MOLIYA VA BANK ISHI. – 2022. – Т. 8. – №. 4. – С. 42-49.

[2] Ulugbekovich A. U. ISSUES OF SOLVING THE PROBLEMS OF THE PENSION SYSTEM IN THE DEVELOPMENT STRATEGY OF THE NEW UZBEKISTAN //Open Access Repository. – 2023. – Т. 4. – №. 3. – С. 390-393.

first sort out the factor and outcome variables. As indicators representing changes in life expectancy, we selected the indicators of the share of women and men of retirement age in the total number of women and men for 2010-2021. As the outcome variable, we take the number of pensions assigned in those years. Theoretically, we assume that the change in the share of the population of retirement age in the total population affects the number of pensions to be assigned (Table 1).

Table 1. The number of pensions granted in Uzbekistan during 2010-2021 and the share of the population of retirement age in the total population[3]

Years	Number of assigned pensions (TP), person	Share of women aged 55 and over in the total number of women (A55), in percent	Share of men aged 60 and over in the total number of men (E60), in percent
2010	193188	9.5569	5.1964
2011	116363	9.8792	5.3639
2012	129112	10.2072	5.4949
2013	139219	10.571	5.6738
2014	157491	10.9941	5.8219
2015	195928	11.4081	5.9937
2016	225317	11.8595	6.2052
2017	251894	12.3291	6.4598
2018	277397	12.7774	6.7351
2019	277261	13.2056	7.0674
2020	275109	13.6006	7.3919
2021	330450	13.929	7.662

Based on the econometric analysis of table data, we will be able to forecast the effect of changes in the share of pensioners on the number of pensions.

Result and Discussion

At the first stage of the analysis, we can check whether there is a correlation between the selected factor signs and the resulting sign through the correlation coefficient (Table 2).

Table 2. Correlation coefficients between the number of pensions granted in Uzbekistan during 2010-2021 and the share of the population of retirement age in the total population[4]

TP	A55	E60	Indicators
1.0000	0.9158	0.9131	TP
	1.0000	0.9907	A55
		1.0000	E60

The correlation coefficient indicates whether the change of one indicator has an effect on the change of another factor and varies in the range (-1;1), if the correlation coefficient between two factors is higher than 0.7 or lower than -0.7, there is a strong relationship between the factors.[5] In our example, the correlation coefficient between the number of assigned pensions and the share of women over 55 (A55) and the share of men over 60 (E60) is 0.9158 and 0.9131, respectively. So there is a very strong correlation between the factors. The correlation between A55 and E60 is 0.9907, but there is actually no interaction between them, so we do not need to consider the issue of multicollinearity (generally, the issue of multicollinearity arises when there is an assumed linear relationship between two or more independent variables[6]).

[3] Information from the Statistical Agency under the President of the Republic of Uzbekistan.
[4] Calculated by the researcher in the Gretl software complex.
[5] Safaralievich M. B., Ulugbekovich A. U., Askarbek K. Analysis of factors influencing the volume of investments //Academicia Globe: Inderscience Research. – 2021. – Т. 2. – №. 05. – С. 208-214.
[6] Mamatov B. S., Achilov U. U. Strengthening Financial Stability of the Off-budget Pension Fund. – 2015.

Table 3. Descriptive statistics of the number of pensions granted in Uzbekistan in 2010-2021 and the share of the population of retirement age in the total population[7]

Indicators	Average	Median	Minimum	Maximum
TP	214061	210623	116363	330450
A55	11.693	11.634	9.5569	13.929
E60	6.2555	6.0994	5.1964	7.6620
Indicators	**Standard deviation**	**Variation**	**Asymmetry**	**Excess**
TP	69521.	0.32477	0.058059	-1.2313
A55	1.4901	0.12743	0.067083	-1.3229
E60	0.81426	0.13017	0.39938	-1.0937

At the next stage of our analysis, we form the descriptive statistics of the obtained factors and the resulting signs (Table 3). Table 3 shows that the average annual number of pensions awarded during 2010-2021 is 214,061, the lowest number of pensions awarded in one year is 116,363, and the highest number of pensions is 330,450. The average share of women over the age of 55 in the total number of women is 11.693 percent, the minimum is 9.5563 percent, and the maximum is 13.929 percent, while in men these indicators are 6.2555, respectively; 5.1964 and 7.6620 percent. By conducting analyzes with the participation of selected factors according to the hypothesis, we create a regression equation that satisfies all the necessary conditions (Table 4)

Table 4. The regression equation of the effect of the number of pensions granted in Uzbekistan during 2010-2021 and the share of the population of retirement age in the total population[8]

Indicators	Coefficient	Standard error	t-statistic	P-value	Confidence level
const	2.24609	1.30165	1.726	0.0985	*
Ln A55	6.87069	1.38887	4.947	0.0008	***
Ln E60	−3.79362	1.20408	−3.151	0.0117	**
Sum of Squares of Residuals		12.80837	Standard deviation		1.192959
R-squared		0.945712	Adjusted R-squared		0.933649
F-statistics (2, 12)		78.39196	R-value (F)		2.02e-06
Logorithmic approximation to truth		−17.41841	Akaike criterion		40.83683
Schwartz criterion		42.29155	Hannan-Quinn criterion		40.29824
Rho параметри		0.072050	Darbin-Watson statistic		0.888299

*Note: *** Statistically significant at 1 percent significance level; ** Statistically significant at the 5 percent significance level; *Statistically significant at the 10 percent significance level.*

When constructing the model, we used logarithmic values of the indicators, since the variation indicators are smaller in the natural logarithmic values of the indicators. By performing the least squares analysis, we selected the optimal regression equation for ourselves (Table 4).

Here, the natural logarithm values (LnTP) of assigned annual pensions are taken as the dependent variable. The natural logarithmic value of the share of women of retirement age in the total number of women (LnA55) and the natural logarithm value of the share of men of retirement age in the total number of men (LnE60) were taken as independent variables.

Inductive analysis of the model: the Fisher-Snedekor F-test value is less than 0.05, indicating that the constructed regression equation is indeed valid, and our constructed model is valid for application. The coefficients of the selected factor variables LnA55 and LnE60 were confirmed to be less than 0.05 when tested by Student's t-test, which indicates their applicability. Darbin-Watson statistic (0.8883), which verifies the absence of autocorrelation problem in the constructed model, is also in

[7] Calculated by the researcher in the Gretl software complex.
[8] Calculated by the researcher in the Gretl software complex.

the required range (0.569;1.274), which confirms that there is no autocorrelation problem in our model. Therefore, this model is suitable for inductive analysis. Interpretive analysis of the model:

LnTP = 6.87069*LnA55 − 3.79362LnE60 + 2.24609+e (1)

Here: LnTP is the natural logarithmic value of pensions assigned during the year; LnA55 is the natural logarithmic value of the share of women of retirement age in the total number of women; LnE60 is the natural logarithmic value of the share of men of retirement age in the total number of men; const – initial value; e - unaccounted factors.

Conclusion

The coefficient of determination of the created equation is equal to 0.9336, and 93.36% of the change in the number of pensions assigned during the year can be explained through the created model. The coefficient in front of LnA55 (6.87069) - a 1% increase (decrease) in the share of women of retirement age in the total number of women leads to an increase (decrease) in the number of pensions awarded by 6.87%, the coefficient in front of LnE60 (-3.79362) is the total number of men of retirement age A 1 percent increase (decrease) in the number of men represents a 3.79 percent decrease (increase) in the number of assigned pensions.

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