DEVELOPMENT OF THE ECONOMETRIC MODEL FOR ASSESSING THE SOCIAL EXCLUSION OF THE ELDERLY PEOPLE IN THE REPUBLIC OF MOLDOVA

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Abstract: *Researching the phenomenon of social exclusion of the elderly people is complex. In economics, the vulnerability to social exclusion of the population is seen as the presence of a low level of income and accumulated property; the likelihood of welfare loss due to exposure to risks that households cannot adequately respond to or insufficient access to tangible and intangible assets. The significant factors of exclusion are the inaccessibility for the elderly people of such effective social problem-solving mechanisms as the availability of a stable and paid job, access to social networks and effective social support from the state. Most often, temporary or permanent incapacity, age and other characteristics associated with an individual's inability to work and, as a result, the loss of a source of livelihood, are identified as the main factors of exclusion. Evaluating the level of social exclusion of the elderly people involves developing a model of the dependence of the material situation on the impact factors of social exclusion. A factor system was formed for the study based on the survey investigation data conducted by the author. The hypothesis that there is an interdependence between social exclusion and the factor system was formulated and tested.*
Keywords: *social exclusion, elderly people, econometric model.*
JEL Classification : *C10, D63, J14.*

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1. Introduction

Socially vulnerable groups of the population, including the elderly people, are part of society, so the exclusion of certain groups increases the risks to society (lack of solidarity, uneven budget burden, social discontent). In order to reduce the risks, measures must be taken to include social groups and give everyone access to basic rights. But today, negative attitudes and prejudices towards socially vulnerable groups of the population are strong in society. The existence of mental barriers, which both aggravate exclusion and prevent inclusion, requires the development of mechanisms to overcome them. The inclusion of all social groups in society will activate the processes of integration of society and serve as a basis for its modernization.

In economics, vulnerability to social exclusion of the population is defined by several interconnected factors:

1. Low level of accumulated income and property. People with low incomes and no accumulated property are more likely to experience social exclusion. Lack of stable financial resources and material assets can limit access to essential opportunities such as education, health and adequate housing.

2. Likelihood of welfare loss. Households exposed to economic risks, such as unemployment, financial crises, or health problems, and lacking the means to respond adequately to these risks, are vulnerable to social exclusion. Without financial reserves or social support, these households can suffer a significant drop in quality of life.

3. Insufficient access to tangible and intangible assets. Tangible assets include property, savings and other physical assets, while intangible assets refer to education, skills, social networks and social capital. Lack of access to these assets can prevent individuals from participating fully in economic and social life, thus amplifying the risk of social exclusion.

Thus, vulnerability to social exclusion is not only a question of income, but also of the ability to cope with risks and access the resources needed to maintain and improve well-being. It is a complex phenomenon that requires multidimensional interventions to be tackled effectively.

The article was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union", institutional funding and as part of PhD thesis research.

2. Data sources and methodology

The following general scientific research methods were used in the research process: empirical observation and dynamic analysis of reality, monographic method, induction and deduction, comparison, analysis and synthesis, statistical analysis, logical analysis, critical analysis of materials; economic diagnostic methods: economic-mathematical modelling, comparison, grouping, graphical and tabular illustration of studied materials; and study-specific methods: descriptive method (survey investigation). The scope of survey research is particularly broad, seeking to determine the current opinions of a specific population group. Survey research is thus a research tool with wide applicability (Epuran, 2005).

3. Development of an econometric model to assess the social exclusion of elderly people

In order to evaluate quantitatively and qualitatively the impact factors on the phenomenon of social exclusion, a mathematical-econometric mechanism was developed, including 2 questionnaires for 2 categories of elderly people according to the level of involvement in economic activity and a survey of the population was conducted in the northern, central, southern and Chisinau municipality. The sample of the investigation constituted 207 persons, of which 82 elderly persons employed in the labor force and 125 elderly persons not employed after reaching the retirement age according to the legislation in force (Heghea, 2020).

Assessing the level of social exclusion of elderly people requires a systematic approach involving the development of a model of the dependence of the material situation on various social exclusion impact factors. In the study on the vulnerability to social exclusion of elderly people, a system of factors was formed based on data collected through survey research carried out by the author. These factors are essential for understanding and assessing the material and social situation of elderly people and for testing the hypothesis of interdependence between social exclusion and these factors. The material situation of elderly people (SIT) is used as the dependent variable.

Table 1. System of determinants characterizing social exclusion of elderly people

Exogenous variable	Determining factors
AF	Claims made by pensioners about employment
DM	Field of activity (type of economic activity)
ED	Level of education
EV	Who provides help in case of need (relatives, neighbors, state, own possibilities, etc.)
MP	Size of pension received by the elderly
PR	Problems faced by the elderly (lack of money for basic needs, rest, health problems, etc.)
PS	Sufficient size of pension to meet needs (according to respondents)
RS	Residence (town, village)
SN	Health status (respondent's assessment)
SX	Gender (male, female)
SPR	Solution of problems of the elderly (state assistance, benefits in medical and other services, cash assistance, etc.)
ST	Employed or not employed after retirement
VPP	Average monthly income before retirement
VR	Age

Source: Elaborated by the author.

A mathematical model of the dependence of the dependent variable SIT on the allied variables X_n in the following consecutivity was constructed in the research:

- Constructing correlation matrix for the allied variables and evaluating the statistical significance of the correlation between them.
- Based on the existence of a linear relationship between the endogenous variable and the exogenous variables, evaluate the parameters of the regression model using the least squares method. Calculate the vector of regression values of the endogenous variable and random deviations.
- In the econometric research the student test was used to test the statistical significance of the model parameters using a significance level of 0.05 (i.e. 95% reliability).

A multifactor regression model was constructed, and the coefficients of the regression equation determined:

$$\mathbf{У = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_n * X_n} \quad (1)$$

where:

Y - dependent variable;

X - independent variable;

β - regression coefficient.

The results of multiple regression are presented numerically below.

Table 2. Multifactor linear regression model of social exclusion of elderly people in the Republic of Moldova

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.382400	0.827806	1.669956	0.0966
RS	-0.148924	0.199960	-0.744766	0.4573
SX	-0.144308	0.143151	-1.008078	0.3147
VR	0.025357	0.055209	0.459288	0.6465
ED	0.097191	0.040056	2.426403	0.0162
DM	0.013671	0.028049	0.487399	0.6265
VPP	0.221132	0.077992	2.835306	0.0051
MP	0.191085	0.069264	2.758799	0.0064
PR	-0.190570	0.085952	-2.217163	0.0278
SN	0.282398	0.092418	3.055655	0.0026
PS	0.105639	0.071046	1.486896	0.1387
EV	-0.067483	0.090412	-0.746395	0.4563
SPR	0.043257	0.044308	0.976278	0.3302
ST	-0.114493	0.195936	-0.584337	0.5597
AF	0.086371	0.061566	1.402886	0.1623

Source: Elaborated by the author.

As follows from the data obtained using the EViews least squares method, the resulting multifactor model looks like this:

$$\mathbf{SIT = 1.38 - 0.15*RS - 0.14*SX + 0.03*VR + 0.10*ED + 0.011*DM + 0.221*VPP + 0.19*MP - 0.19*PR + 0.28*SN + 0.11*PS - 0.07*EV + 0.04*SPR - 0.11*ST + 0.09*AF} \quad (2)$$

Null hypothesis H0 - there is no multifactor linear regression between material status and the indicators in Table 2. According to alternative hypothesis H1, the described relationship exists. Three multifactor linear regression models were developed.

Table 3. Testing the null hypothesis that the regression parameters are equal to zero

Exogenous variable	Model I		Model II		Model III	
	t-statistic	p-value	t-statistic	p-value	t-statistic	p-value
RS	1.669956	0.0966	-1.068521	0.2866	-	-
SX	-0.744766	0.4573	-1.038638	0.3002	-	-
VR	-1.008078	0.3147	-	-	-	-
ED	0.459288	0.6465	2.460626	0.0147	2.541268	0.0118
DM	2.426403	0.0162	-	-	-	-
VPP	0.487399	0.6265	3.108962	0.0022	2.898337	0.0042
MP	2.835306	0.0051	2.726982	0.0070	2.944583	0.0036
PR	2.758799	0.0064	-2.751881	0.0065	-2.530054	0.0122
SN	-2.217163	0.0278	3.083492	0.0023	3.065353	0.0025
PS	3.055655	0.0026	1.365937	0.1735	-	-
EV	1.486896	0.1387	-	-	-	-
SPR	-0.746395	0.4563	-	-	-	-
ST	0.976278	0.3302	-	-	-	-
AF	-0.584337	0.5597	1.488586	0.1382	-	-

Source: Elaborated by the author.

Analyzing the t-statistic and p-value, we conclude that only in the case of model III the null hypothesis that the parameters are equal to zero is rejected and the alternative hypothesis that the linear regression coefficients are non-zero is accepted. As a result, models I and II are rejected and model III is accepted. The regression analysis allowed to identify the most significant factors affecting social exclusion of elderly people in the Republic of Moldova.

Using stepwise algorithms to include significant variables and exclude insignificant ones, a regression model of social exclusion of elderly people in the Republic of Moldova was obtained:

SIT = 1.57 + 0.09*ED + 0.21*VPP + 0.18*MP - 0.21*PR + 0.25*SN (3)

Further testing of the null hypothesis was performed on a set of statistical tests: the R-squared coefficient of determination, the Adjusted R-squared, the F-statistic, the Akaike Information Criterion (AIC), the Schwarz Criterion (SC) and the Durbin-Watson statistic (Gutium, 2020, p. 194).

Table 4. Statistical testing of regressions

Statistical tests	*SIT = f(RS,SX,VR,ED, DM,VPP, MP, PR,SN, PS,EV, SPR,ST,AF*	*SIT=f(ED,VPP,MP,PR,SN)*
R-squared coefficient of determination	0.795323	0.772961
Adjusted coefficient of determination (Adjusted R-squared)	0.751232	0.757363
F-statistic	8.966082	23.91086
Probability (F-statistic)	0.000000	0.000000
Akaike Information Criterion	2.680165	2.629524
Schwarz Criterion	2.921667	2.726124
Durbin-Watson statistic	1.769346	1.796835

Source: Elaborated by the author.

"Log-likelihood" is the indicator that quantifies how good the model developed is, i.e. the higher its value, the better the model (Horvath, Huskova, Kokoszka, 2010).

The *SIT=f(ED,VPP,MP,PR,SN)* regression performed best, the coefficients of determination had comparatively higher values, and the Akaide and Schwarz criteria - comparatively lower values.

Fisher statistic and probability (F-statistic) are used to assess the significance of linear regression. According to the obtained results (Table 5), the null hypothesis that all coefficients of both regressions are zero is rejected, and the significance of multifactor linear regression (equation 3) is relatively higher compared to that of simple linear regression (equation 2). Therefore, the best-fit regression model is *SIT=f(ED,VPP,MP,PR,SN)*.

After checking the residuals for autocorrelation using the Durbin-Watson statistic test we obtained a value of 1.796835, which shows that autocorrelation occurs and leads to biased estimates of the regression parameters.

Let's test for autocorrelation using the Breusch-Godfrey test. The test is based on the following idea: if there is a correlation between neighbouring observations, then it is natural to expect that in the equation: $e_t = \rho \times e_{t-1} + v_t,$ $t = 1, \ldots, n$

where e_t are the regression residuals obtained by the usual least squares method, the coefficient ρ will be significantly different from zero.

Table 5. Breusch-Godfrey test with 2 lags

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.279010	Prob. F(2,199)	0.2806
Obs*R-squared	2.627085	Prob. Chi-Square(2)	0.2689

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/14/23 Time: 12:25
Sample: 1 207
Included observations: 207
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.094482	0.559374	-0.168908	0.8660
ED	-0.001821	0.037120	-0.049053	0.9609
VPP	-0.011908	0.072934	-0.163271	0.8705
MP	0.007312	0.061726	0.118453	0.9058
PR	0.012129	0.081568	0.148704	0.8819
SN	0.014489	0.081719	0.177304	0.8594
RESID(-1)	0.094468	0.071725	1.317084	0.1893
RESID(-2)	0.056765	0.072070	0.787630	0.4319

R-squared	0.012691	Mean dependent var	-5.58E-17
Adjusted R-squared	-0.022038	S.D. dependent var	0.877445
S.E. of regression	0.887061	Akaike info criterion	2.636075
Sum squared resid	156.5886	Schwarz criterion	2.764876
Log likelihood	-264.8338	Hannan-Quinn criter.	2.688161
F-statistic	0.365431	Durbin-Watson stat	1.971521
Prob(F-statistic)	0.921462		

Source: Developed by the author in Eviews 9 software.

In our case, lag 2 is Prob. = 0.4319, so the probability of accepting the null hypothesis is greater than 5% of the significance level, so lag 2 is insignificant.

We obtain at a significant level of 5% Prob. = 0.1651, this is greater than 5% of the relevance level (Table 6). So we can accept the null hypothesis of no autocorrelation, i.e. there is no autocorrelation. This is also indicated by the overall significance of the equation using the F-statistic Prob. = 0,1651. Probability of accepting the null hypothesis = 16.51%, i.e. more than 5%. It means that we can state that there is no autocorrelation of random deviations in this model.

Table 6. Breusch-Godfrey test with 1 lag

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.941344	Prob. F(1,200)	0.1651
Obs*R-squared	1.989975	Prob. Chi-Square(1)	0.1583

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/17/23 Time: 16:16
Sample: 1 207
Included observations: 207
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.073319	0.558198	-0.131350	0.8956
ED	-0.002852	0.037062	-0.076953	0.9387
VPP	-0.006072	0.072487	-0.083766	0.9333
MP	0.004213	0.061542	0.068451	0.9455
PR	0.011462	0.081486	0.140662	0.8883
SN	0.008817	0.081324	0.108421	0.9138
RESID(-1)	0.099452	0.071377	1.393321	0.1651

R-squared	0.009613	Mean dependent var	-5.58E-17
Adjusted R-squared	-0.020098	S.D. dependent var	0.877445
S.E. of regression	0.886219	Akaike info criterion	2.629526
Sum squared resid	157.0767	Schwarz criterion	2.742226
Log likelihood	-265.1559	Hannan-Quinn criter.	2.675101
F-statistic	0.323557	Durbin-Watson stat	1.995674
Prob(F-statistic)	0.924129		

Source: Developed by the author in Eviews 9 software.

The next thing to do is to test for heteroscedasticity using White's test, which assumes that the dispersion of regression errors is a quadratic function of factor values.

We see that depending on the value of the probability of accepting the null hypothesis all variables are not statistically significant, since the probability of accepting the null hypothesis is much higher than 0.05 (5%), i.e. the hypothesis can be accepted.

We look at the presence of significance of the regression as a whole, which is greater than 5%.

F-statistic Prob. = 0.2146

We can accept the null hypothesis.

This model has no heteroscedasticity, i.e. the model residuals are homogeneous and have constant dispersion.

Table 7. Heteroskedasticity test

Heteroskedasticity Test: White

F-statistic	1.255151	Prob. F(20,186)	0.2146
Obs*R-squared	24.61512	Prob. Chi-Square(20)	0.2166
Scaled explained SS	19.77998	Prob. Chi-Square(20)	0.4718

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/23 Time: 12:29
Sample: 1 207
Included observations: 207

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.066139	6.534935	0.469192	0.6395
ED^2	-0.002809	0.024268	-0.115765	0.9080
ED*VPP	-0.089986	0.070960	-1.268115	0.2063
ED*MP	0.064262	0.052492	1.224225	0.2224
ED*PR	0.000269	0.076016	0.003540	0.9972
ED*SN	-0.018586	0.053368	-0.348265	0.7280
ED	0.130969	0.522808	0.250511	0.8025
VPP^2	0.006423	0.073885	0.086931	0.9308
VPP*MP	0.121358	0.087539	1.386322	0.1673
VPP*PR	-0.084125	0.166363	-0.505671	0.6137
VPP*SN	-0.094998	0.133568	-0.711235	0.4778
VPP	0.805616	1.093254	0.736898	0.4621
MP^2	-0.051960	0.050641	-1.026036	0.3062
MP*PR	0.253050	0.114628	1.407578	0.1285
MP*SN	0.072653	0.130417	0.557084	0.5781
MP	-1.874455	0.803229	-1.413649	0.1207
PR^2	0.003405	0.060861	0.055948	0.9554
PR*SN	0.009248	0.284151	0.032545	0.9741
PR	-0.551820	1.371682	-0.402294	0.6879
SN^2	-0.033444	0.106050	-0.315358	0.7528
SN	0.283678	1.758684	0.161301	0.8720

Source: Developed by the author in Eviews 9 software.

The variable obtained through this model is compared with the indicators reflected in the scale of criteria that determine the level of social exclusion and depending on this the responsible authorities decide which policies should be promoted to improve the situation of elderly people.

Conclusions

The multifactor linear regression model of social exclusion of elderly people reflects the quantitative estimation of the size of pension, education level and health status on the material situation of elderly people or the most important problems faced by elderly people. This model is simple and can be used in the practice of public authorities dealing with these problems. The assessment of the impact of the factors in question (endogenous factors such as the level of education, the amount of pre-retirement income and the amount of pension, health status) are those that largely affect the situation of elderly people and require the improvement of public policies. The correlational analysis carried out confirmed the presence of correlations between the action of impact factors and the problems faced by elderly people, as well as the current state of social exclusion of elderly people.

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