Bulletin of the *Transilvania* University of Braşov
Series V: Economic Sciences • Vol. 14(63) No. 2–2021
https://doi.org/10.31926/but.es.2021.14.63.2.10

THE IMPLICATION OF DEMOGRAPHICS ON THE ROMANIAN PENSION SYSTEM

A. G. ENESCU[1] A. G. PETROȘAN[2] G. DINCĂ[3]

Abstract: *This paper aims to analyse the influence of the demographical factors on the short-term sustainability of the pension system from Romania. The data used for econometric modelling consisted of panel data for the period 2009-2019 for 8 European Union member states, together with time series data for autoregressive modelling. The following econometrical models were used: random-effects GLS regression and Box-Jenkins (ARIMA). The results emphasize an increasing demographical pressure on the Romanian pension system and the need of pension system reform.*

Key words: *pension system, sustainability, Box-Jenkins, ARIMA, Romania*

1. Introduction

Currently, the increase in the welfare of developed states is transposed in prolonged life expectancy which represents a challenge for the pensions' systems. Multiple governments identified the urgency to reform the pensions' system to ensure the sustainability and counteract the existing burdens.

The financial sustainability of the pensions' systems is of foremost importance and represents one of the priorities of governments regarding policy making. Regarding the case of Romania, the transition from a communist, centralised economy to a market economy consisted of social and economic reforms which affected the sustainability of the pension system, including the populist measures adopted by politicians to win elections.

This theme was analysed in the specialised literature by Croitoru (2011), Dragotă and Miricescu (2010) and Chiriţoiu (2002). The measures adopted by some states had a positive impact upon the pension systems. However, the evolution of the sustainability of the pension systems in the next years is significantly affected by the incertitude regarding the demography. The present lack of knowledge is disclosed by the low number of studies which analyze and predict the demography of Romania, which are necessary for analyzing the sustainability of the pension system.

This paper intends to identify econometric analysis methods for the sustainability of

[1] *Transilvania* University of Braşov, adrian.enescu@student.unitbv.ro
[2] *Transilvania* University of Braşov, georgiana.petrosan@student.unitbv.ro
[3] *Transilvania* University of Braşov, gheorghita.dinca@unitbv.ro, ORCID ID: 0000-0003-4758-9556

the pension systems and to apply them for the Romanian economy. The analysis methods are used for verifying the short-term sustainability of the pension system in the following five years, up to 2026. The short-term sustainability analysis was preferred to achieve a realistic forecast, to the detriment of a long-term sustainability analysis which implied a high degree of incertitude (e.g., economic, political, demographical, technological).

The methodological approach assumes using adequate econometric models for the establishment of demographic predictions and adaptation of the models for the analysis of the pension system sustainability for Romania.

2. Specialised Literature

The specialised literature section is structed in two subsections which analyse, on one hand, the necessity of reforming the pension system, and on the other hand the evolution and the predictions regarding the Romanian pension system.

Therefore, the first subchapter treats the alarm signals coming from competent institutions and specialists from the economic field regarding the necessity of reforming the pension system due to the demographic factors. This subchapter is concerned also with identification of models used at international level to assess pension systems. The second subchapter analyses the sustainability of the Romanian pension system and the historical evolution of it from 1989 to the present.

2.1. The necessity of reforming the pension systems at European level

Throughout time, international organisations highlighted the necessity of reforming to ensure adequate expenditure with the pension system (World Bank, 1994; European Commission, 2003). One of the reforms adopted by the European states emphasized the privatisation of the pension system to an architecture with multiple pillars of pensions (Ebbinghaus, 2015). The Economic Crisis from 2007-2008 contested the efficiency of this reform by considering the abrupt decline of the assets of private pensions in a relative short period of time (OECD, 2010).

The factors which influenced the sustainability of the pension system include demographical elements (e.g., high longevity and low natality), decrease of the capacity of collecting taxes by the state, and the migration to Western Europe of a significative portion of the active population, but also by the depreciation of the reserves of the pension systems (Dragotă & Miricescu, 2010).

The ageing of the population in developed states implies the necessity of reforming the pension systems to ensure the sustainability (Galasso & Profeta, 2007; Heijdra & Romp, 2009). The results demonstrate that increasing the retirement age is a measure of streamlining the pension system. However, biological constrains must be considered when designing such policies, especially for labor intense workplaces (Bazzana, 2020; McLaughlin & Neumark, 2017).

Blake & Mathew (2006) established a dynamic and a static econometric model for predicting the pension system from Great Britain, which is a “pay-as-you-go” (PAYG) system.

2.2. The evolution and predictions regarding the Romanian pension system

The principal type of pension from Romania in 1989 consisted of the pension of the industry personnel. This type of pension was sustained by the social security contributions. At that time, the rapport between contributions and beneficiaries was 3.5, indicating that the PAYG pension system was sustainable in communist Romania (Croitoru et al., 2011). However, the pension system required consolidation and harshening of the laws to ensure a smooth transition towards a decentralized economy since the system was unsustainable in that form (Menil & Sheshinski, 2002).

In the 1990s, the Romanian state awarded pensions to a considerable part of the population who never contributed to the pension system and introduced facilities for earlier retirement. At that time, the first negative effects of the communist public pension system were encountered, when the number of pension beneficiaries was high, and the number of contributors was decreasing. The unemployment rate and the migration were surging at that time (Croitoru et al., 2011). The PAYG system supposes that pensioners are paid from the contributions of present employees, therefore, the level of pensions is correlated with the level of income (Chiriţoiu, 2002).

The before-mentioned issues are specific for Eastern European countries since they shared a common historical evolution under the communist regime. The solution for the problems consisted in the creation of pension pillars (II and III). The I pillar of the pension system represents the public pension offered by the state, while the II pillar comprises the pensions which are privately administered, the contributions are mandatory for persons up to 35 years old and options for persons aged between 35 and 45. The pillar III is administered by private companies and represents the optional pension system (ASF, 2021).

The sustainability of the present pension system from Romania was analyzed in the context of increased life expectancy and decrease of natality. Considering the demographic decline, the lack of capital, the high taxes which do not attract immigrants and the deterioration of the dependency rate, the pension system from Romania is unsustainable (Bărbulescu, 2012; Croitoru et al., 2014; Mladen, 2012; Bodogai et al., 2013).

The analysis of the sustainability of the Romanian pension system consisted of applying diverse econometric models. The study conducted by Menil & Sheshinski (2002) utilized statistical tests for determining the increase of the private pensions as a percentage of the Romanian GDP between 1996-2036. The share of private pension is expected to increase in that period based on the results of the study and the success of the private pensions depends on the regulating capacity of institutions for ensuring prudency.

Croitoru et al. (2014) created the following econometric model for testing the long-term sustainability of the pension system:

$$RDPS_t=a+bNV_t+cD_t+dSV65_t+eI_t+fE_t+\varepsilon_t$$

and the data was collected for the period 1990-2010.

The results of the econometric model depict that the dependency rate will deteriorate since the increase of the life expectancy has a significative impact.

Mladen (2012) utilized an aggregate indicator for computing the performance of the pension systems from Romania, Hungary, Bulgaria, Poland, Slovakia, Spain, Lithuania, Estonia, Slovenia, and Latvia. According to this study, Romania is one of the worst performers regarding the pension systems since the pension system is confronting with major risks.

Pânzaru (2015) analyzed the sustainability of the Romanian pension system up to 2060, considering the demographic decline. The fertility and mortality rates were computed using the Lee-Carter method, while for the migration phenomenon ARIMA model was used. The lack of sustainability of the Romanian pension system was highlighted, as well as the difficulty of ensuring the sustainability of it. The pessimist scenario illustrated that the sole solution for a sustainable Romanian pension system is increasing the number of immigrants in the following 50 years, being necessary between 200,000 and 500,000 immigrants.

3. Method

3.1. Random-effects GLS regression

The econometric modelling implied establishing a panel database for the analysis period 2009-2019 for the following Eastern European states: Bulgaria, Czech Republic, Croatia, Hungary, Poland, Romania, Slovenia, and Slovakia. These states are situated in a geographical proximity and present a similar level of development. The data was retrieved from the following Eurostat debases: *tps00198, migr_emi2, migr_imm8, and demo_mmonth*. The econometric modelling was conducted using Stata MP 13.0 software.

The econometric model used in this subchapter was retrieved from Croitoru et al. (2014) research and it was adapted by modifying one of the independent variables as a logarithm. Therefore, the model is the following:

$$RDPS_t = a + bln(NV)_t + c(D)_t + d(SV65)_t + e(I)_t + f(E)_t + \varepsilon_t, \quad (1)$$

where:

RDPS = dependency rate pensioners/employees
ln (NV) = natural logarithm of number of live births
D = number of deaths
SV65 = life expectancy at age 65
I = number of immigrants
E = number of immigrants
t = analysis period 2009-2019
a = the coefficient of the natural logarithm of number of live births
b = the coefficient of the number of deaths
c = the coefficient of the life expectancy at age 65
d = the coefficient of the number of immigrants
e = the coefficient of the number of emigrants

f = the coefficient of the number of live births
ε = residuals.

3.2. Box-Jenkins (ARIMA)

The Autoregressive integrated moving average (ARIMA) model was applied for the prediction of multiple variables regarding Romania: total population, mortality rate of females, mortality rate of males, number of females over 65 years old, and the number of males over 65 years old. The timeframe for the predictions was 2026.

An adequate ARIMA model was applied for each variable, the parameters of ARIMA varied for achieving the lowest root-mean square error (RMSE) and to maintain a normal distribution of residuals. The predictions used data from the period 1960-2019, data which was retrieved from the World Bank database. The econometric modelling was conducted in RStudio 4.1.1.

4. Results

4.1. Random-effects GLS regression results

The descriptive statistics regarding the applied model are presented in fig. 2, the variables being analyzed in terms of the number of observations, average, standard deviation, minimum and maximum.

Variable	Obs	Mean	Std. Dev.	Min	Max
RDPS	88	25.27045	3.793072	17	33.2
ln_NV	88	11.34625	.8653151	9.86931	12.94225
D	88	139952.1	117263.4	18609	414200
SV65	88	17.38295	1.119854	15.6	20.1
I	85	67295.46	71597.09	4829	226649
E	85	75474.82	89833.28	1863	276446

Fig. 2. *Descriptive statistics on the variables used*

Following the application of the random-effects GLS regression, R square indicates that the independent variables explain the variation of the dependency rate in proportion of 78%. All variables present in this model are statistically significant at the level of 10%, but the variable ln (NV) has a fixed significance level of 10%, very close to the significance threshold.

The model includes two variables with a negative coefficient: ln (NV) and E. The negative coefficient of the variable ln (NV) shows the inverse proportional relationship between the number of live births and the dependency rate pensioners / employees, an increase in the number of live births with one unit will lead to a decrease in the dependency rate by 4.79 units. Also, an increase in the number of emigrants (E) by one unit will decrease the employee / pensioner dependency rate by 0.0000163, the impact of this variable being relatively small.

On the other hand, the model also implies three variables with a positive coefficient, the increase of which is reflected in the increase in the dependency rate of pensioners / employees. With an increase in the number of deaths by one unit (D), the dependency rate for pensioners / employees will increase by 0.0000485, and with an increase in the life expectancy of people over 65 (SV65) by one unit, the dependency rate will increase by 3,824 units. An increase in the number of immigrants (I) by one unit will influence the increase in RDPS by 0.0000386. The results of applying the random-effects GLS regression are illustrated in fig. 3.

```
Random-effects GLS regression                   Number of obs      =        85
Group variable: i                               Number of groups   =         8

R-sq:  within  = 0.7812                         Obs per group: min =         8
       between = 0.0862                                        avg =      10.6
       overall = 0.0011                                        max =        11

                                                Wald chi2(5)       =    226.96
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

RDPS	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln_NV	-4.79138	2.91691	-1.64	0.100	-10.50842	.9256585
D	.0000485	.0000217	2.23	0.026	5.86e-06	.0000911
SV65	3.824041	.4605121	8.30	0.000	2.921454	4.726628
I	.0000386	9.24e-06	4.18	0.000	.0000205	.0000567
E	-.0000163	7.54e-06	-2.16	0.031	-.0000311	-1.52e-06
_cons	5.095243	36.10938	0.14	0.888	-65.67783	75.86832
sigma_u	5.1081698					
sigma_e	1.0152283					
rho	.96200099	(fraction of variance due to u_i)				

Fig. 3. *The results of random-effects GLS regression*

4.2. Box-Jenkins (ARIMA)

The result of the modelling depicts that the mortality rate for both males and females follow a downward trend. A significant evolution is observed in the case of women, this rate decreasing considerably over the analyzed period, this aspect being illustrated in fig. 4.

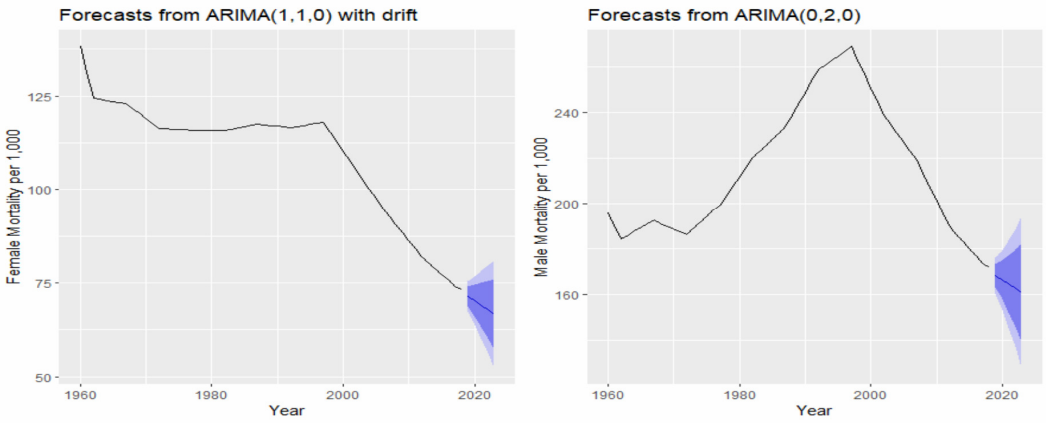

Fig. 4. *Prediction on the mortality rate for females (left) and males (right) per 1,000 in Romania until 2026*

The number of women over 65 is about higher than that of men, this aspect being illustrated in fig. 5. Both categories have a high share in the total population, especially given the expected demographic decline, which is shown in fig. 6.

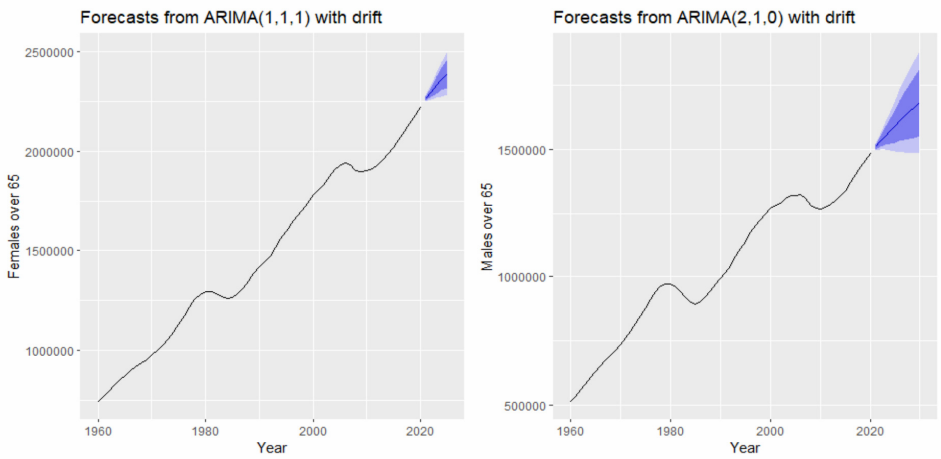

Fig. 5. *Predictions regarding the number of females (left) and males (right) over 65 in Romania until 2026*

As a result of making a prediction, which focuses on the population of Romania in the next 5 years, it was found that the results obtained resemble those provided by Eurostat. Both predictions predict a demographic decline, illustrated in fig. 6.

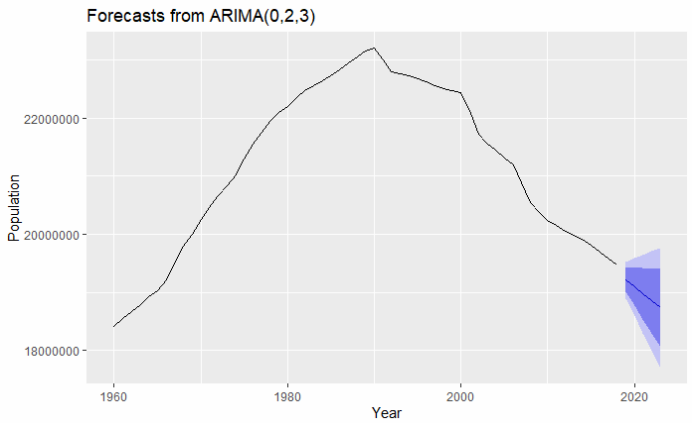

Fig. 6. *The prediction regarding the population of Romania until 2026*

5. Discussions

The results of the application of the econometric model taken from Croitoru et al. (2014) and adapted indicates an overwhelming impact of the number of live births on the rate of social dependence (pensioners / employees), the relationship being a reverse one.

On the other hand, the aging of the population is a variable with a positive coefficient, which has a strong influence on the rate of social dependence, demonstrating

unambiguously that demographic variables influence the sustainability of the pension system. Migration phenomena (immigration and emigration) influence on a relatively small extent the sustainability of pension systems during the analyzed period for the countries in the panel database, according to the regression results, the influence of migration being significantly lower than the demographic one.

The demographic pressure is highlighted by the application of the autoregressive model (ARIMA), indicating a decrease in the mortality rate in men and women, a decrease in mortality of people over 65, and a decrease in population by 2026. The results on the demographic decline in Romania are also reported by Eurostat (tps00002), indicating an alarm signal for the competent authorities and decision makers.

The results of the research coincide with those in the specialty literature, which indicate a demographic pressure, thus requiring a reform. The alarm signal on the reform of European pension systems came from both independent researchers and the competent institutions.

The strengths of this research are represented by the several econometric methods used to analyze the short-term sustainability of the pension system. However, the application of econometric models depended on the available data. The lack of data on the number of emigrants and immigrants from the communist regime period or the credibility of the data had to be considered (from 1960 to 1989).

In this paper, migration had far too little impact to influence the outcome of the regression. What should be further investigated is the way in which the pension system in Romania is affected by employees with temporary employment contracts, who choose to work in the developed countries of the European Union.

6. Conclusions

In the next five years the pension system from Romania will face considerable demographical pressure. Even though the short-term sustainability of the pension system is not likely endangered, the competent authorities have the establish solutions to transform the pension system from Romania to ensure medium and long-term sustainability.

References

Angrisani, M., Attias, A., Bianchi, S. and Varga, Z., 2012. Sustainability of a pay-as-you-go pension system by dynamic immigration control. *Applied mathematics and computation,* 219(5), pp.2442-2452. Available at: https://doi.org/10.1016/j.amc.2012.08.080 (29.03.2021)

Autoritatea de Supraveghere Financiară. *Sistemul de pensii private din România*. Available at: https://asfromania.ro/consumatori/pensii-private/despre-pensiile-private (23.03.2021)

Barbulescu, R., 2012. Romania's demographic decline-what's next. *Romanian Economic and Business Review*, 7(2), p.77. Available at: http://www.rebe.rau.ro/ RePEc/rau/journl/SU12/REBE-SU12-A7.pdf (24.03.2021)

Bazzana, D., 2020. Ageing population and pension system sustainability: reforms and redistributive implications. *Economia Politica*, 37, pp.971-992. Available at: https://link.springer.com/content/pr Available at: https://doi.org/10.1093/geront/gnt080 (23.03.2021)

Bodogai, S.I. and Cutler, S.J., 2014. Aging in Romania: Research and public policy. *The Gerontologist,* 54(2), pp.147-152. Available at: https://academic.oup.com/gerontologist/article/54/2/147/635740?login=true (25.03.2021)

Blake, D. and Mayhew, L., 2006. On the sustainability of the UK state pension system in the light of population ageing and declining fertility. *The Economic Journal*, 116(512), pp. F286-F305. Available at: https://doi.org/10.1111/j.1468-0297.2006.01100.x (30.03.2021)

Cairns, A.J.B., Blake, D., Dowd, K., Coughlan, G.D. and Khalaf-Allah, M., 2011. Bayesian stochastic mortality modelling for two populations. *ASTIN Bulletin-Actuarial Studies in non LifeInsurance*, 41(1), p.29. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.819.4002&rep=rep1&type=pdf

Croitoru, E.L., Baranga, L., Predescu, A. and Pricopi, A., 2011. The public pension system in Romania–analysis before and after 1999. *EuroEconomica*, 30(4). Available at: https://www.ceeol.com/search/article-detail?id=279876 (19.03.2021)

Croitoru, E.L., Alexandru, F. and Toader, S.A., 2014. Sustainability of the public pensions system in terms of demographic factors. Case Study: Romania. *International Journal of Economics and Statistics*, 2. Available at: https://pdfs.semanticscholar.org/f89c/6005adef1448158c09ce64bc988b5e268c29.pdf (23.03.2021)

Chiritoiu, B.M., 2002. *Păşind cu greutate–Reforma pensiilor în România*. Available at: http://www.policy.hu/chiritoiu/reformapensiilor.pdf (19.03.2021)

De Menil, G. and Sheshinski, E., 2002. Romania's pension system: from crisis to reform. In *Social security pension reform in Europe* (pp. 401-438). University of Chicago Press. Available at: https://www.nber.org/system/files/chapters/c10680/c10680.pdf (19.03.2021)

Dragotă, I.M. and Miricescu, E., 2010. The Public Pension System of Romania between Crisis and Reforms. The Case of Special Pensions System. *Theoretical & Applied Economics,* 17(9). Available at: http://store.ectap.ro/articole/514.pdf (19.03.2021)

Ebbinghaus, B., 2015. The privatization and marketization of pensions in Europe: A double transformation facing the crisis. *European Policy Analysis*, 1(1), pp.56-73. Available at: https://onlinelibrary.wiley.com/doi/abs/10.18278/epa.1.1.5 (19.03.2021)

Eurostat. *General government gross debt (EDP concept), consolidated - annual data*. tipsgo10. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tipsgo10&lang=en (07.04.2021)

Eurostat. *Projected old-age dependency ratio*. tps00200. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tps00200&lang=en (07.04.2021)

Eurostat. Population projections. tps00002. Available at: https://ec.europa.eu/eurostat/databrowser/view/tps00002/default/table?lang=en (09.04.2021)

Gardner Jr., E.S., 1985. Exponential smoothing: The state of the art. *Journal of forecasting,* 4(1), pp.1-28. Available at: https://doi.org/10.1002/for.3980040103 (12.04.2021)

European Commission, 2003. *Joint report by the Commission and the Council on Adequate and Sustainable Pensions*. Brussels. Available at: https://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A5-2003-0259+0+DOC+XML+V0//EN&language=EN (19.03.2021)

Heijdra, B.J. and Romp, W.E., 2009. Retirement, pensions, and ageing. *Journal of Public Economics,* 93(3-4), pp.586-604. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0047272708001709?via%3Dihub (19.03.2021)

McLaughlin, J.S. and Neumark, D., 2018. Barriers to later retirement for men: Physical challenges of work and increases in the full retirement age. *Research on Aging*, 40(3), pp.232-256. Available at: https://journals.sagepub.com/doi/abs/10.1177/0164027517697114 (19.03.2021)

Mladen, L., 2012. A comparative review over the pension systems performance in Central and Eastern European countries. *Journal of Knowledge Management, Economics and Information Technology*, 5(11). Available at: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.683.6406&rep=rep1&type=pdf (23.05.2021)

Ministry of the Interior and Kingdom Relations., 2004. Sustainability of Pension Schemes for Public Sector Employees in EU Member States. *European Public Administration* Network. Available at: https://www.eupan.eu/wp-content/uploads/2019/05/2004_2_NL_Sustainability_of_Pension_Schemes_for_Public_Sector_Employees_in_EU_Member_States.pdf (07.04.2021)

OECD. 2010. *Pension Market Focus*. No. 7, Paris: OECD. Available at: https://www.oecd.org/finance/private-pensions/45637367.pdf (19.03.2021)

Pânzaru, C., 2015. On the sustainability of the Romanian pension system in the light of population declining*. Procedia-Social and Behavioral Sciences*, 183, pp.77-84. Available at: https://www.sciencedirect.com/science/article/pii/S1877042815031237 (23.03.2021)

World Bank, 1994. *Averting the Old-age Crisis: Policies to Protect the Old and Promote Growth*. Oxford University Press, New York. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/973571468174557899/averting-the-old-age-crisis-policies-to-protect-the-old-and-promote-growth (19.03.2021)

World Bank, 2021. *Mortality rate, adult, female (per 1,000 female adults) - Romania*. Available at: https://data.worldbank.org/indicator/SP.DYN.AMRT.FE?locations=RO (13.04.2021)

World Bank, 2021. *Population ages 65 and above, female and male - Romania*. Available at: https://data.worldbank.org/indicator/SP.POP.65UP.FE.IN (13.04.2021)

World Bank, 2021. *Population, total - Romania*. Available at: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=RO (13.04.2021)