FACTORS INFLUENCING THE DEFICIT OF SOCIAL SECURITY SYSTEMS
- a panel data analysis*

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Abstract

This paper analyses a number of factors that affect the deficit of social security funds. For the statistical analysis, we used a **data panel** covering ten countries in Central and Eastern Europe. The variables analysed were: migration, unemployment and dependency ratio of the elderly. All states analysed are characterised by a similar pattern in terms of social security systems' configuration. The pension system, as basic component of the social security system, is of the PAYG type, being vulnerable to demographic changes. Also, all these countries have experienced the transition from socialist to the capitalist system, facing socio-economic and demographic problems such as unemployment, migration or population aging. The results show that **all these factors influence the volume of the deficit of social security funds.**

Key words: social security, migration, unemployment, demographic aging, time series analysis, panel type data analysis

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Social security states its specificity as a basic concept that includes all collective measures established by legislation to maintain individual or family income, to ensure an income when some or all sources of income have been lost or exhausted, or in situations in which the individual must cope with increased costs[1]. Any imbalance occurring on this component degrades the quality of life, and induces economic discomfort individually and socially that creates instability and discontent. Since its main role is social risk prevention, social security is addressed to very different areas, influencing their development strategy. **Social security** acquires value especially considering the fact that it is a state's way to protect its nationals when confronted with the risks induced by various adverse social contexts. Every person and every family needs protection against risks and uncertainties arising from everyday work. When this need is not satisfied

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for the individual and his/her family, released implications have considerable negative effects on the individual's comfort, on his/her work motivation and, above all, on the durability and functionality of economic systems.

Social security is a broad concept that incorporates both social insurance and social assistance. By their configuration way, social security systems are highly vulnerable to socio-demographic and economic changes.

Population aging is the factor with the greatest impact on social security systems, its effects being obvious: decrease in contributions due to the reduction in the number of contributors and increase in costs due to the increased number of beneficiaries. In terms of number of beneficiaries and amounts related, the pension system is the most significant component of the entire social security system. Due mainly to pension schemes' funding under PAYG, tax burden is placed especially on employees and employers. Therefore, any reduction in the mass of employees (taxpayers) affects the amounts collected for the social security budget. So the issue is not tied only to the increasing number of pensioners, but especially to the decline of contributors. The International Monetary Fund estimated that the ratio of pensioners and active population will halve in Europe by 2050, from four to two active individuals for every pensioner. Likewise, the European Commission (2006) estimates that employment in the EU will decrease between 2010 and 2050 by 48 million people, i.e. approximately 16%, while the number of elderly will increase by 77%, (58 million people).

Migration is added to this issue, whose extent has increased continuously after 1990. In Europe, migration has increased with the socio-political changes that have occurred since the '90s, countries of the former socialist camp becoming important suppliers of migration. Europe currently absorbs 2 million migrants every year – more as proportion of population than anywhere else in the world, including North America. For example, according EUROSTAT (2010) approximately 13 percent of total population of Romania living abroad. Thus, when we speak of social security and, especially, pensions, migration becomes a phenomenon that can cause significant effects on this component. The most significant makes reference to the decrease in contributions due to the reduction in the number of contributors.

Besides migration and population aging, unemployment plays a decisive role in shaping social security spending and hence deficits resulting from the imbalance between receipts and spending. The unemployed represent non-contributory population to the social security systems, as well as consumers of social security. All these variables (aging, migration, unemployment), by affecting the volume of economically active population, can disrupt the optimal operation of social security systems.

Social security issues, especially the sustainability of social security systems, are found in numerous studies. Most of the time, they analyse the role of macroeconomic factors that contribute to the development of social security spending and thus make a contribution either to the sustainability of the system, or to its unbalancing[2].

Population aging is almost always invoked in any study that addresses the issue of social security. The importance of invoking aging comes primarily from the fact that most social security systems, by their configuration, are extremely vulnerable to this phenomenon. Holzmann (1988) highlights the role of demographic factors on pension and healthcare spending. He argues that the demographic impact of these types of expenses is low and more than that, in time, the effects of aging on social security spending can be reduced by state interventions. The approach is somewhat atypical to what is circulated at present in the scientific world. We should, however, keep in mind that Holzmann's study was published in 1988; the socio-political changes which occurred since then substantially changed the role of demographic factors. Also it should be noted that the study was conducted in OECD countries. Jimeno, Rojas and Puente (2008) conducted an econometric model that highlights the role of aging on social security spending in Spain. The results are much closer to what is being discussed on aging. The research highlights the massive impact of aging on the evolution of social security spending. We have emphasised in this context only two approaches invoking the role of aging, one considering that this phenomenon affects social security spending, and the other that it does not influence them. However, we should also mention other studies, conducted by Börsch-Supan (1992), Galasso and Profeta (2002), Boldrin, Dolado, J. Jimeno and Peracchi (1999), etc. On the coordinates of this study, it should be noted that there is an important part of studies aimed at the problem of unemployment and its impact on social security. This subject is found approached in a number of researches undertaken by international or European bodies (OECD 1994, 2004, 2006; European Commission 2006, World Bank 2007). Authors who have also studied this issue are Esping-Andersen (2000), Heckman (2000), Addison and Texeira (2003), Breen (2005). More applied studies were conducted on the relationship between social security and the labour market[3] or on the relationship between social security, unemployment and economic growth[4]. In the current approach's logic, we should also mention Lingens's study, it invoking unemployment as the effect of taxes on salary and of economic growth/downturn. However, it should be noted that there is limited research that emphasises the direct link between unemployment and social security. The study conducted by Corneo and Marquardt (2000) addresses the role of social security in configuring unemployment, but, in their case too, the

emphasis was more on the relationship between unemployment and economic growth. However, unlike Bräuninger, Corneo and Marquardt believe that there is no connection between unemployment and economic growth. Khan (2004) **conducted a panel type analysis** to examine the relationship between macroeconomic conditions (including unemployment rate) and social security spending. The study conducted on a panel of 13 OECD countries showed that certain social security spending is influenced by macroeconomic conditions. Aaron H. J. (1982), in Economic Effects of Social Security, talks about the importance of social security and the fact that, due to difficulties to keep an effective social security system economically (with a surplus of receipts to ensure appropriate benefits to all contributors), taxes are getting higher and higher. Their effect is reflected on other dimensions, such as income level and net savings.

Regarding migration as a form of damage to the sustainability of social security systems, the literature does not abound with studies on this issue. Most studies are found in the United States and mainly treat the Mexican immigrants' issue: Taylor (1987), Sana and Massey (2000), or Martin (2003). But it is difficult to make a comparison between this phenomenon in the United States and what is happening in Europe, mainly because of the large difference between the American and the European social security system.

Often the discussion on migration and social security invokes the phenomenon of working under the table[5]. **Working under the table** undermines the financing of social security systems and impedes consistent economic policies. The approach is quite relevant when one considers that migration is accompanied by working under the table, especially in the country of destination, things get complicated, and the negative effect doubles. On the short term, the country of destination is affected (the person working under the table does not contribute to social security systems), but on the long term – the country of origin (if the person returns home, he/she will not be eligible for pension due to lack of contributions). Thus, when those working under the table or those not working at all (significant in number) will reach retirement age without being insured, they will burden the social assistance system, requiring from public money guaranteed minimum income or other forms of social support. At that time, the active age population (who pays the costs through taxes and contributions to insurance funds) will be less numerous, which will enhance the social security system's imbalance and lead, for example, to a significant increase in taxes. Rubenstein (2011) points out that, at present, the diminishing of the economically active population's volume (due to ageing and immigration) is the major problem of ensuring the sustainability of social security systems.

Based on these theoretical supports, we wanted to identify to what extent the old age dependency ratio, the volume of migration and unemployment affect the development of social security funds' deficit.

The data used refer to the period from 2000 to 2009. They include the values of the following variables: demographic aging, unemployment and migration. States considered are part of a Central and Eastern European panel. They were Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia.

Population aging (also known as demographic aging) is a term that indicates changes occurring in the distribution of population by age groups. Population aging has become a serious problem in all industrialised countries. Mainly it was generated by the waning rate of fertility and a decline of the mortality rate. Population aging is the factor with the greatest impact on pension systems, the effects being obvious: decrease in contributions due to the reduction in the number of contributors and increase in pension spending due to the increased number of beneficiaries. In the past 20 years, the evolution of the active population, i.e. those aged between 15 and 65, was down compared with the evolution of the population aged 65+. These developments have led to an increase in the 65 + population segment. This phenomenon is expected to continue at EU level and cause extensive imbalances on the social security component. A relevant indicator of the degree of population aging is the age dependency ratio (ADR) which refers to the number of individuals of retirement age compared to the number of economically active population, i.e. the ratio of those aged 65+ and those aged between 15 and 65. This is also the indicator that was considered in this study.

Regarding unemployment, it refers, according to EUROSTAT, to all persons aged 15 +, unemployed, and not engaged in for-profit activities, who are looking for a job and using in the last 4 weeks different methods to find one, and who are ready to start work within the next 15 days, if they would find a job immediately. Unemployment rate was the variable used in the analyses conducted in this research.

Regarding migration, it refers to the movement of a person or a group of persons outside his/her/their community of residence within a given reference period in order to change domicile. The gross figures on migration flows in the analysed countries were used. Data analysis was performed using SPSS and EViews. To analyse the relationship between these variables, we used the regression calculation. Thus, we estimated the following regression equation:

$$y_{it} = \alpha_i + \sum \beta_{it} x_{it} + \varepsilon_{it} \quad (1)$$

In the model, we considered as the dependent variable the deficit of social security funds (SOC_DEF). The independent variables were considered to be: the age dependency ratio (ADR), the unemployment rate (UNR) and migration (MIGR). Following the explanations given above, the basic model takes the following form:

$$SOC\_DEF_{it} = \alpha_i + \beta_1 (UNR)_{it} + \beta_2 (MIGR)_{it} + \beta_3 (ADR)_{it} + \varepsilon_{it} \quad (2)$$

Given that the observations regarding one or other variable were obtained at several time points and for several countries, they were analysed in a panel. The descriptive statistics of variables included in the model is shown in the table below:

The descriptive statistics of variables analysed

Table 1

	SOC_DEF	UNR	MIGR	ADR
Mean	0.065455	10.27909	49570.33	21.58000
Median	0.100000	8.250000	17481.50	22.05000
Maximum	2.800000	20.00000	553162.0	25.40000
Minimum	-3.300000	4.300000	1231.000	16.30000
Std. Dev.	0.836708	4.600500	84546.23	2.623283
Skewness	-0.834100	0.752107	3.102274	-0.463455
Kurtosis	6.927877	2.249858	14.76854	2.274864
Jarque-Bera	83.46760	12.94962	811.2273	6.347838
Probability	0.000000	0.001542	0.000000	0.041839
Sum	7.200000	1130.700	5452736.	2373.800
Sum Sq. Dev.	76.30873	2306.942	7.79E+11	750.0960
Observations	110	110	110	110

SOC_DEF = deficit of social security funds, UNR = unemployment rate, MIGR = migration, ADR = age dependency ratio 65+/15-65,

Given that the time series composing the dependent variable (the deficit of social security funds) has negative values for the period under review, we used raw data, and thus we were unable to look up their logarithms. The deficit of social security funds is expressed as a percentage of GDP. Unemployment is expressed in rates. Migration refers to the flow of people leaving each year the countries included in the panel.

The first aspect evaluated was stationarity. Stationarity of data series does not mean that it stays in place, but that it follows a set of rules that do not change over time; these rules characterise statistically the series considered. Thus, even if the values of variables considered can have different trends (sometimes they increase and sometimes they decrease, while in other cases they stand still), the

data series is stationary if parameters such as variations frequency distribution remains relatively constant. If we find that they are stationary, then the statistical rules according to which these data series evolve do not change fundamentally. In other words, we can successfully use methods of analysis and assessment. If series' evolutions are stationary, namely they are characterised by development and heteroskedasticity, i.e. they change in unpredictable ways and at unexpected moments, then, whatever models we use, they are useful only accidentally, with no particular relevance for the analysis conducted. To stationarise analysed time series we used a series of tests to identify whether or not a unit root exists. Stationarity tests used were the LLC test[6], the IPS test[7], the ADF – Augmented Dickey-Fuller, and the PP – Phillips-Perron[8]. The results are shown in table .

Unit Root Tests

Table 2

Unit Root Test		**LLC[a]**	**IPS[b]**	**ADF Fisher[b]**	**PP Fisher[a]**
Variable	Series in:	t*	W-stat	χ^2	χ^2
SOC_DEF	Levels	-3.64531***	-2.32051**	36.5390**	21.9450
	First Diff.	-8.49049***	-6.05139***	71.6893***	58.4583***
UNR	Levels	-3.25747***	1.35388*	32.6580**	11.4404
	First Diff.	-4.07139***	-1.80092**	32.5511**	24.1401
MIGR	Levels	-4.06295***	-1.78809**	30.0615*	33.2261**
	First Diff.	-7.29901***	-3.25001***	50.7541***	67.8098***
ADR	Levels	-3.99345**	-1.23611*	51.9234**	56.5829**
	First Diff.	-3.52335***	-0.56403**	31.8308**	20.5393***

(***), (**) and (*) denotes rejection of the unit root hypothesis at the 1%, 5% and 10% levels.

As shown, the stationarity test results indicate that most variables can be considered to be stationary in levels. The computation of the first differences shows that the unit root hypothesis could be rejected at the better level of relevance. Therefore, we chose to use the model in first difference:

$$\Delta(SOC\_DEF)_{it} = \alpha_i + \beta_1 \Delta(UNR)_{it} + \beta_2 \Delta(MIGR)_{it} + \beta_3 \Delta(ADR) + \varepsilon_{it} \quad (3)$$

We conducted the assessment with both fixed effects and with random effects. For the fixed effects assessment we used the regression with dummy variables (LSDV). The results are shown in columns 1 and 2 of Table 3. We chose this path on the assumption that the fixed effects assessment allows the free coefficient to vary cross-sectionally by generating a dummy variable for each section (the number of sections is given by the number of countries included in the panel); the slope parameter remains constant in time and space. The fixed effects assessment was performed both for section and period. The use of the fixed effects assessment tests the null hypothesis that the free

parameter is the same for the entire population (e.g., the same effect for all countries), and its rejection shows that the deficit of social security funds varies in the section. By using the F test, we were able to eliminate the fixed effects version for the section and keep it only for the period.

To estimate random effects, we used the GLS (Generalized Least Square) estimator. Random effects assessment allows the free coefficient to change, meaning to increase or decrease, to a base with a varying degree (a cross-sectional error term). In other words, we assumed that $\varepsilon_{it} = \lambda_t + u_{it}$ şi $Cov(x_{it}, \lambda_t) = 0$ (where λ is the individual effect for the period). The results are shown in column 3 of Table 3.

To differentiate between fixed effect and random effect, we used the Hausman test (1978). For this test, the null hypothesis considers that both methods (fixed effects and random effects) are appropriate. The alternative hypothesis is that only fixed effects assessment is appropriate, and random effects assessment is not. Given the value of the Hausman test, we found that data analysis can be done most appropriately using the fixed effects assessment. The Hausman test's result is shown in column 3 of Table 3.

To identify the absence or presence of autocorrelation, we used the Durbin Watson test. The test's value allowed us to believe that there is no autocorrelation of errors.

Regarding the issue of heteroskedasticity, we used the White standard errors. The results are shown in Table 3.

Assessment of the effect on the deficit of social security funds

Table 3

	LSDV	**LSDV**	**GLS**
	Cross-section Period	Period	Period
Constant	-0.12*	-0.14***	-0.14
	(-1.48)	(-2.93)	(-1.05)
Δ(UNR)	0.17***	0.16***	0.16***
	(3.17)	(2.70)	(2.74)
Δ(MIGR)	1.58**	1.48**	1.68**
	(1.98)	(1.80)	(1.82)
Δ(ADR)	0.26	0.31*	0.33*
	(1.00)	(1.44)	(1.51)
Observations	100	100	100
Number of countries	10	10	10
R-squared	0.48	0.45	0.21
F-test	3.47***	6.11***	8.98***
DW-stat	1.94	1.87	1.86
F-test $\alpha_i = 0$	0.43	-	-
F-test $\lambda_t = 0$	2.98***	-	-
Hausman χ^2			2.03

(***), (**) and (*) are significant respectively at 1% 5% and 10%, t statistics in parentheses. For GLS it is used White cross-section standard errors & covariance (d.f. corrected).

Conclusions

The results show that all variables included in the model contribute to the configuration of the deficit of social security funds. Assuming that the sustainability of social security systems is given primarily by the mass of contributors, the result was somewhat predictable. Obviously, migration leads to the reduction of the economically active population and therefore it damages proceeds to the social security systems.

The elderly dependency ratio is another factor that, according to the results, affects the social security system. The more the ratio of people aged 65+ and those aged between 15 and 64 increases, the more the deficit of social security funds increases. Older people are consumers of social security in all respects. Their mass's influence on the social security system is passed on to all its dimensions, not only on the pension component.

A result in line with our expectations was obtained also regarding the influence of unemployment. Given the fact that the unemployed are non-contributory population and, at the same time, consumers of social security, we expected that the direct influence of this variable on the deficit of social security funds be present. The results have confirmed this. Thus, as the unemployment rate increases, the deficit of social security funds increases as well.

If, in studies conducted so far, both the dependency ratio and unemployment were considered to be variables that affect social security systems[9] in the sense they unbalance them, demonstrating the influence of migration in this respect is unique. To date, most studies have relied on immigration only as a form of social security systems balancing by adjusting the volume of economically active population[10]. This study invokes migration, along with unemployment and population aging, as a possible determinant of the sustainability of social security systems.

Notes

1. The New Encyclopedia Britannica, 1993
2. World Bank 1994, Roseavare et al. 1996
3. Zhang Qiong, 2009
4. Michael Bräuninger, 2005
5. Jandl, 2011; Portes and French, 2005; Düvell, 2006
6. Levin, Lin and Chu, 2002
7. Im, Pesaran and Shin, 2003
8. Maddala and Wu, 1999; Choi, 2001
9. Khan, Gerdtham and Jansson, 2004, Bräuninger, 2004; McLaughlin, 1994; Turner 1984; Jimeno, Rojas and Puente, 2008
10. Rubenstein, 2011; Hagen and Walz, 1995

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