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Factors Affecting the Development of Voluntary Pension Schemes in CEE Countries: A Panel Data Analysis

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Abstract: The study provides some quantitative information on voluntary pension plans in 10 CEE countries obtained from various local sources. The comparative analysis shows that there is a considerable variation in this group in terms of participation and contributions to the voluntary pension plans. In addition, this study empirically examines several factors that can possibly affect the development of voluntary pensions: income per capita and poverty rate, income inequality, replacement rate from the pension system, education attainment, interest rate and demographic burden. It uses a panel regression framework for the period of 2006–2014. The results reveal that, in the case of participation in voluntary pension plans, only income level per capita is associated with a greater number of pension plan members. As far as contributions are concerned, education seems to be the most important determinant of additional pension savings. Other factors do not seem to explain well both of the studied variables reflecting the development of voluntary pension schemes. However, as individual fixed effects are proven to be significant in the estimated models, one could conclude that country-specific characteristics play a significant role in explaining the development of voluntary pension schemes. They can be referred to the design and parametric settings of the non-mandatory pension system.

Keywords: CEE countries, pension system, third pillar, voluntary pensions, panel regression, cross-country analyses.

JEL Codes: H31, H55, O16

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1 Introduction

In the late 1990s and at the beginning of the 2000s, most of the countries from Central and Eastern Europe (CEE) started reforming their pension systems, urged by the high fiscal pressure on public finances as a result of unfavourable demographics. Their old pension systems, based solely on the PAYG formula and inherited from the era before democratic and economic transformation, were no longer sustainable. Most of the CEE countries implemented a three-pillar pension model, promoted by the World Bank (see World Bank 1994; Holzmann and Hinz 2005). Its main core is the diversity of the sources of pension provision, which constitute the pillars: publicly managed PAYG scheme (first pillar) and privately managed mandatory as well as voluntary funded schemes (second and third pillars). Nonetheless, after the global financial crisis in 2008, the majority of countries in the region reformed their pension systems and the changes involved mostly, but not solely, a partial reversal from pension privatisation (see, e.g. Chybalski 2011; Hirose 2011; Milos and Milos 2012; Aslund 2012; Żukowski 2013; Hinrichs 2015; Naczyk and Domonkos 2016 for a review). However, as pointed out by Mrsik and Lazarevski (2012) and Berk *et al.* (2013), the future pension benefits (expressed as the projected ratio of benefits and the economy-wide wage, as well as projected net replacement rate) from the reformed pension systems in the CEE region will be lower than today. In fact, negative changes in the benefit ratios projected in the long run are expected for the majority of the European countries (European Commission 2015b). To avoid a substantial drop in the standard of living in the old age, the current working generation should prolong their working lives or/and make additional savings. In the past decade, many CEE countries took measures to boost the supplementary savings for retirement. They included introducing new types of voluntary pension schemes and more favourable financial incentives. Nonetheless, according to OECD simulations of the modelled pension replacement rates, the voluntary pensions in CEE countries, except for Czechia, are still not developed enough to substantially increase the average adequacy of future pension benefits (OECD 2013).

As presented in further sections of this article, countries in the CEE region differ significantly when it comes to the development of voluntary pension schemes. This study aims at identifying the sources of these differences. The research question is whether they can be explained by several factors, such as systemic, economic, demographic and social conditions. The paper contributes to the literature on the determinants of savings, with reference to the voluntary pension savings. This topic is not sufficiently explored in the previous literature. The novelty of this study is its macro perspective, as it includes data aggregated at the country level.

The study presents a cross-country comparative analysis that uses the quantitative approach. First, it provides some quantitative information on the voluntary pension plans in the CEE region that include the main indicators of the relevance of the voluntary pension schemes at the aggregated country level, that is, pension plan membership and annual contributions paid to voluntary pension plans. Second, in the panel regression framework, it analyses whether there is a relationship between these indicators and several distinguishing factors. The data cover 10 countries (Bulgaria, Croatia, Czechia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) studied in the period of 2006−2014.

The paper is structured as follows. First, it discusses previous studies that are related. Then, it presents an overview of the funded pension schemes in the countries under investigation, as well as some quantitative information on voluntary pension plans in the CEE region. Next, the description and the results of empirical research are provided. The study ends with synthetic conclusions.

2 Literature review

It seems that savings accumulated in the voluntary pension schemes are somewhat of a different nature than the so-called 'ordinary savings'. They are characterised by a higher net rate of return (after taxation) because of financial incentives and less risk resulting from a more strict financial authorities supervision comparing to other forms of saving (more guarantees for pension plan members, more restrictions and regulations for pension plan providers). Moreover, especially (but not solely) in the form of occupational plans, they involve also employer's contribution, which makes this form of saving even more attractive. However, at the same time, the scope of choice and freedom, when it comes to the plan member's decisions, is much smaller. An important issue is also the accessibility of voluntary pension products, their diversity as well as the development of financial market in general. All these facets may

imply that voluntary pension savings could be more systemic driven and less conditioned by socio-economic and demographic factors than ordinary savings. As mentioned before, the CEE countries are similar in terms of the architecture of their pension systems. However, not only the design itself but also, to a large extent, the parametric settings reflect the principles underlying the social policy, which could potentially influence the performance of the non-mandatory pension system in terms of coverage and accumulated pension savings. The issue of the similarity of pension systems in the CEE region and their outcomes can be regarded with reference to the more general term of the social model. Some studies suggest that the post-communist countries form a separate unified welfare state regime (see, e.g. Castles and Obinger 2008; Aidukaite 2011). However, other studies support the view that they differ significantly from Western European countries but are still very diversified as a group. For example, Fenger (2007) states that they do not fit to the classical typology of welfare state regimes by Esping-Andersen (1990), but they can be divided into three separate groups: (1) *former USSR type* (Belarus, Estonia, Latvia, Lithuania, Russia and Ukraine), (2) *post-communist European type* (Bulgaria, Croatia, Czechia, Hungary, Poland and Slovakia) and (3) *developing welfare states type* (Georgia, Romania and Moldova). A similar view is also presented by Deacon (2000) and Sengoku (2004). With respect to the pension regime, which refers solely to the pension system, there are also different views on the homogeneity of CEE countries. For example, on the basis of the cluster analysis, Soede and Vrooman (2008) assign Czechia and Slovakia to the 'moderate pensions' model, whereas Poland and Hungary to the 'mandatory private' model. According to Marcinkiewicz and Chybalski (2017) who conducted a study of the pension models in OECD countries (as of the year 2012), the CEE countries are located in three distinctive groups: 'mandatory public' regime (Hungary and Slovenia), 'mandatory private' regime (Slovakia, Estonia and Poland) and 'voluntary private' regime (Czechia). Summarising the overview of studies presenting various judgements about the similarity of the CEE countries with respect to welfare state models, one must bear in mind that they correspond to different periods of time. Thus, their comparability is somewhat limited because of the fact that CEE welfare states, especially in the field of pensions, evolved in time as a result of conducted reforms. In particular, the reversals from mandatory private pensions in some of the countries (such as Hungary, Poland or Slovakia) could influence

the further diversification of the pension systems in the CEE region.

There are not many comparative studies that strictly address the issue of the development of voluntary pensions in the CEE region. Pieńkowska-Kamieniecka (2013) provides an overview of voluntary pension schemes in eight CEE countries (Bulgaria, Croatia, Czechia, Hungary, Poland, Romania, Slovakia and Slovenia) in the qualitative analysis framework. Similarly, Rutecka-Góra (2016) reviews the supplementary old-age pension systems in Bulgaria, Poland, Czechia, Slovakia and Romania with a special focus on the financial aspect of the pension plans' functioning. Marcinkiewicz (2016) compares the quantitative data on the membership, assets and contributions to the voluntary pension plans in Bulgaria, Croatia, Czechia, Hungary, Poland, Romania and Slovenia.

There is also a very limited literature body on the factors influencing voluntary pensions in the CEE region. Pieńkowska-Kamieniecka (2013) states that the factors that affect the insufficient participation in the supplementary pension systems in the CEE region are at the low level of financial knowledge and inefficient fiscal incentives. Also, the findings of Szczepański and Brzęczek (2016) based on the empirical analysis of voluntary pension plans in Czechia, Slovakia, Hungary and Poland suggest that a greater fiscal stimulation fosters a wider coverage of plans in the working age population. Rutecka-Góra (2016) argues that generous fiscal incentives in the CEE countries may have a positive impact on the pension plan coverage, but only for a short and medium term; however, it does not necessarily apply to saving rates. Some studies refer to single country cases. For example, Urean (2016) examines the impact of demographic and social factors on the spread of voluntary pension plans in Romania. The results of a survey data analysis conducted for a sample of 1700 persons imply that education, income and region of residence (urban areas) may enhance the demand for voluntary pension plans.

Some more studies that focus on the determinants of voluntary pension savings in countries other than CEE can be found. For example, Le Blanc (2011) analyses factors influencing savings in the individual retirement accounts (IRA) across 11 EU countries. She used microdata from the SHARE survey. The results suggest that the diversity in the agents' willingness to make additional savings for the old age through supplementary pension plans can be explained by the differences in the generosity of public pension systems in the studied

group of countries. Also, the expectations as to the future pension reforms reducing pension system generosity matter. The additional factors increasing the propensity to save in IRAs are individual household characteristics: higher education and high income. Stinglhamber *et al.* (2007) use microdata covering a large sample of French households. As a result of the empirical analysis, they distinguished various factors affecting the participation and contributions to voluntary personal pension plans, such as income, home ownership, age, unemployment and self-employment. Their findings also imply that voluntary pension plans and other forms of long-term savings (life insurance products) are not substitutes but rather complements. Sousa-Poza (2003) studies the determinants of coverage of voluntary personal pensions in Switzerland. He uses probit modelling in order to analyse a sample of 11,000 observations. Amongst the identified determinants, there are household income and education, as well as several other personal characteristics (gender, age, marital status, region of residence, etc.). Education, home ownership and location are also found as important factors determining coverage in the voluntary pension plans in Ireland (Nivakoski and Barrett 2012).

As mentioned at the beginning of this section, the nature of voluntary pension savings is different from the nature of the ordinary long-term savings. Therefore, the institutional and systemic determinants can play a greater role in this case. In the previous literature on the determinants of voluntary pension savings, all over the world, often the issue of the impact of fiscal incentives (towards the participants of the supplementary pension schemes as well as their employers) is discussed (see, e.g. Börsch-Supan *et al.* 2008; Ayuso *et al.* 2007; Rutledge *et al.* 2014; Bosi and Guerra 2002). Moreover, some studies also suggest that the existence of private mandatory schemes can influence the development of non-mandatory schemes (see Beetsma *et al.* 2012; Simonovits 2011).

3 Voluntary pension schemes in CEE countries

Most of the CEE countries implemented a pension system design that includes PAYG public scheme, mandatory funded scheme administered by the private sector, and voluntary private pensions (see Tab. 1 for a review). Somewhat modified solutions were implemented only in

Czechia and Slovenia. In Czechia, the mandatory private scheme was started relatively late and operated only for a very short time (years 2014–2015). In Slovenia, it was never mandatory for all employees but only for certain groups (hazardous professions, public sector). In the past two decades, many CEE countries reformed their pension systems. These changes, particularly implemented as a result of the financial crisis, were aimed at reducing the importance of the mandatory private pension funds and strengthening the role of the PAYG system. For example, in 2010, in Hungary, mandatory private pension funds were nationalised, and in Poland, in 2014, they became optional for all employees within the mandatory system. Simultaneously, in many countries, the voluntary pensions were also being reformed. Tab. 1 presents different categories of voluntary pension plans available for agents willing to make additional savings for the old age. In almost all of the studied CEE countries (except from Romania), voluntary personal plans are offered; in most of them, an employer can also contribute to the plan. Furthermore, in some countries such as Bulgaria, Croatia, Latvia, Poland and Slovenia, simultaneously voluntary occupational schemes operate. There are some differences between countries in terms of the length of the time of operation of voluntary pension plans. Czechia and Hungary introduced non-mandatory pension schemes in 1994. The majority of countries followed this path in the late 1990s or in the early 2000s. The last one was Romania, where, in 2007, the occupational pension scheme was established. In many countries, the voluntary pension system was further developed: some new types of pension plans were introduced and the scope of financial incentives for supplementary savings was broadened.

Quantitative information on voluntary pension plans in the CEE region requires the compilation of data on different types of pension schemes. The data presented in Fig. 1, as well as in Fig. 2, are obtained from various local sources, such as financial supervision agencies, central government ministries, central banks, associations of pension funds and statistical offices (see Tab. A1 in Appendix for more detailed information). It includes voluntary pension schemes, both personal and occupational, which are considered to form supplementary pension provision. It does not include pension schemes that are optional within the mandatory funded scheme. Nonetheless, in the case of a few particular kinds of pension plans, the information is not available, so they are not included in the aggregated figures. For example, pension plans in Lithuania comprise solely

Tab. 1. Private funded pension schemes in CEE countries

Country	Mandatory private occupational		Mandatory private personal		Voluntary private occupational		Voluntary private personal	
				Contributions				
	Employee	Employer	Employee	Employer	Employee	Employer	Member	Employer
Bulgaria			✓	✓	✓	✓	✓	✓
Croatia				✓	✓	✓	✓	
Czechia							✓	✓
Hungary[1]					✓	✓	✓	✓
Lithuania			✓	✓			✓	✓
Latvia			✓		✓	✓	✓	✓
Poland[2]			✓	✓	✓	✓	✓	
Romania			✓		✓	✓		
Slovakia				✓			✓	✓
Slovenia		✓			✓	✓	✓	✓

[1] Pensions were mandatory until 2010.

[2] Opening pension funds are optional within the mandatory contribution since July 2014.

Source: Author's own elaboration.

pension funds but not insurance contracts. The data set also excludes occupational pension plans (their popularity in Lithuania is marginal). For Slovak pension plans in the form of pension funds (DDS), the information is aggregated, and it also includes mandatory employer's contribution paid for employees of hazardous professions. For Slovenia, there is a data gap in the case of contributions to the plans in the form of life insurance. The information on Hungary is also incomplete. It lacks data on the occupational pension plans (of negligible importance) as well as data on NYESZ accounts.

Fig. 1 presents the level of participation in voluntary pension schemes. It is expressed as the number of plan members (total number of participants in each type of plan) relative to the number of employed persons. Such ratio allows to account for differences in employment rates, and these are diversified across the countries studied. Nevertheless, it cannot be identified with the coverage of voluntary pension plans, which refers to the number of agents enrolled. In many countries, one agent can be a member of two or more pension plans, both occupational and personal. Data aggregated at the country level do not allow to distinguish such multi-

ple cases. As reported in Fig. 1, there are large differences among the 10 studied countries in terms of the membership in voluntary pension schemes. Voluntary pension plans are very much widespread in Czechia. Their number corresponds to the number of employed persons. Also, in Slovenia, they are very popular, as the number of plans is higher than 50% of the number of employees. Romania and Lithuania are placed at the very end of the ranking. These are the countries with the lowest level of participation, as the presented ratio does not exceed 5% in their cases.

Fig. 2 presents the level of annual contributions paid to voluntary pension plans expressed as a share of the GDP. In this respect, Czechia and Slovenia are the leading countries in the CEE region. However, the distance between them in 2014 was considerable. In Czechia, the contributions in 2014 amounted to 0.83% of the GDP, and in Slovenia, it was 0.30%. There are three countries where contributions are below 0.05% of the GDP. These are Slovakia, Lithuania and Romania. The relation between the number of voluntary pension plans and the value of the contributions indicates the extent to which pension products are used for making savings
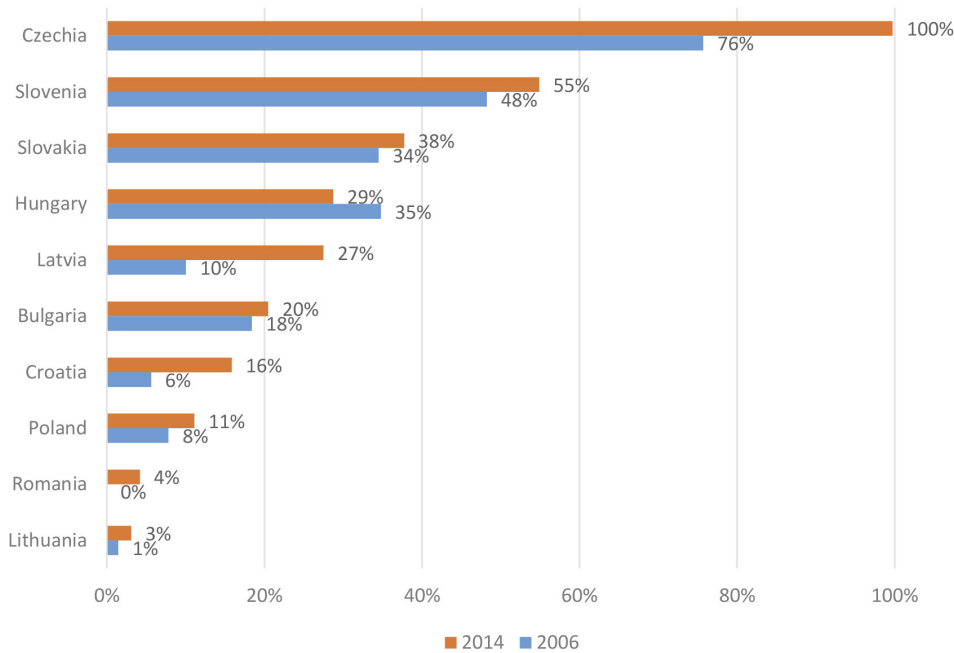
Fig. 1. Number of voluntary pension plan members as percentage of the number of employed persons.

Source: Author's own elaboration based on FSC, HANFA, APS CR, MNB, OSP, FKTK, KNF, APAPR, NBS, MPSVR, AZN, ATVP, MDDSZ and Eurostat LFS.
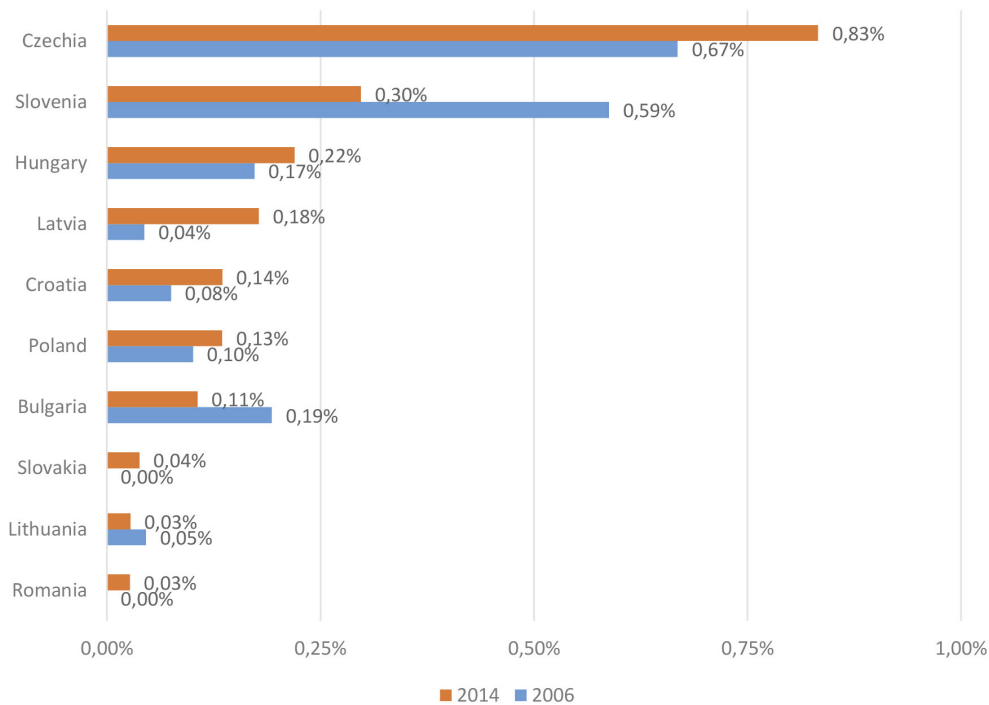

Fig. 2. Contributions as percentage of GDP.

Source: Author's own elaboration based on FSC, HANFA, APS CR, MNB, OSP, FKTK, KNF, APAPR, NBS, MPSVR, AZN, ATVP, MDDSZ and Eurostat.

for the old age. A good example is Slovakia, which is the third country in the studied group in terms of participation in voluntary pension plans, with the number of plans equal to 38% of the number of employees. At the same time, in terms of the contributions paid, Slovakia is very close to Lithuania and Romania, where the membership does not exceed 5% of the employment. This may imply that the voluntary pension scheme in Slovakia is inefficient.

4 Data and methods

As presented earlier in this study, there is a huge diversity in terms of membership and contributions paid to the voluntary pension plans in CEE countries. In the empirical research presented in this study, the factors that can possibly explain such different levels are examined. The study covers 10 countries, such as Bulgaria, Croatia, Czechia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. It uses panel data from 2006 to 2014. Panel regression is used to model the relationships between variables reflecting the development of voluntary pension schemes and variables that refer to the systemic, social, economic and demographic conditions in a given country.

The panel regression framework used in this study is based on the following formula:

$$Y_{it} = \beta X_{it} + \alpha_i + \varepsilon_{it} \qquad (1)$$

where Y_{it} denotes the dependent variable, X_{it} stands for the vector of regressors, β stands for the vector of structural parameters, α_i is a time-invariant individual effect and ε_{it} denotes the error term.

Formula (1) refers to the simple one-way model that only includes time-invariant effects. In this study, both cross-section fixed effects (FE) and cross-section random effects (RE) are used. They correspond to certain country characteristics, which are stable in time. In addition, the two-way FE model is also estimated. It accounts for both the time-invariant country-specific characteristics and the time-specific characteristics, which are invariant across units (countries). The latter can be identified with the influence of common global factors, such as the financial crisis in 2008.

There are two dependent variables: number of plan members as the percentage of the number of employed persons (data on employment collected from Eurostat-

LFS database), and annual contributions to voluntary pension schemes (% GDP). As discussed in the previous section, the information on both is provided by various local sources (see Tab. A1 in Appendix). The reasoning behind the selection of these two variables is based on the assumption that they reflect the development of voluntary pension schemes in a more comprehensive manner than the accumulated assets (as percentage of GDP), which are typically referred to when the relevance of pension schemes is considered. The level of assets is sensitive to the situation on the financial market, and this influence is particularly strong in schemes where the portfolio is, to a greater extent, based on the stocks. Moreover, the amount of assets depends on how long the savings were accumulated. In schemes operating for a very long time, they will be naturally greater than those in schemes operating shortly.

With reference to the chosen regressors, their list is as follows: *ARR* − aggregate replacement ratio: the ratio of income of persons aged between 65 and 74 years to the income from work of persons aged between 50 and 59 years; *ARP* – at-risk-of-poverty rate: people aged 18–64 years at risk of poverty or social exclusion (percentage of people aged 18−64); *ODR* – old-age dependency ratio: the ratio of people aged 60 or older to people aged 20−59; *EDU* – the percentage of working-age population (15–64) with tertiary education level (levels 5−8); *GDP_cap* – GDP per capita; *S80S80* – S80/S20 income quintile share ratio: ratio of the total income received by 20% of the population with the highest income to that received by the 20% of the population with the lowest income; *Intr_rate* – interest rate: long-term government bonds yield (EMU convergence criterion bond yields). The data for all the explanatory variables was taken from the Eurostat database.

As discussed in the literature review section, there are a very limited number of prior studies corresponding to the issue of the determinants of voluntary pension savings in terms of membership and contributions, and they are mainly based on microdata analyses. Nonetheless, their results – as well as the results of prior studies on the determinants of household savings in general – can be referred to when it comes to the expected relationships between the dependent variables and the regressors in this study. We would anticipate a positive influence of the income level (*GDP_cap*) and a negative influence of the at-risk-of-poverty rate (*ARP*). Education level (*EDU*) is expected to foster the coverage of voluntary pension plans and the amount of contributions. As shown by previous empirical studies, the income ine-

quality (*S80S20*) in the case of ordinary savings should positively influence savings rates (see Stierle and Rocher 2015 for a review). However, it seems that, referred to the subject of this study, it can both negatively influence the participation in pension plans and positively influence the saving rates per plan member, according to the view that the richer save more. Therefore, the total effect of this combination is ambiguous. Similarly, the impact of long-term interest rates is unclear. Generally, according to savings and consumption theories that originate from Fisher's model (Fisher 1930), low real interest rates discourage people from saving. However, numerous empirical studies on household savings rates do not confirm this (Stierle and Rocher 2015). Nonetheless, low interest rates can make saving in voluntary pension plans more attractive because of special financial incentives and thus higher net rates of return (resulting from favourable taxation). There is also an explanatory variable corresponding with the adequacy of current pension benefits (*ARR*). A greater pension system generosity in terms of benefit adequacy is expected to discourage people from saving for the old age on a voluntary basis, which implies the negative influence on both dependent variables. *ARR* is used in this study as a proxy of pension system adequacy with reference to current beneficiaries. It is obtained from EU-SILC database and includes gross incomes from public and private pensions. However, given the fact that current pension beneficiaries in the CEE countries are mostly the beneficiaries of the 'old' systems, that is, they never joined private pension schemes introduced in course of the first wave of pension reforms in late 1990s and at the beginning of the 2000s, one must take into account that the incomes included in *ARR* are mostly public pensions. The situation of current beneficiaries potentially can influence saving behaviour of the current working-age generation. A part of this generation can be driven by naïve expectations about their future pensions and can anticipate that the generosity of the pension system will be maintained in the future (see Chybalski 2017). Nonetheless, (projected) pension adequacy can be also referenced to the current working-age generation. As such, it corresponds with the rational expectations, but its possible influence on the development of the supplementary pension schemes is also negative. However, it is very difficult to include variables denoting projected adequacy explicitly in a panel regression framework because of the methodological issues. First, the information on such projected (theoretical) replacement rates (e.g. given by European Commission 2015a; European Commission

2015b; OECD 2013) is not provided in a form of time series, as required in this method. Second, time-invariant variables are not allowed in FE models. Therefore, it is assumed that individual effects account for all pension system institutional settings, which are also reflected in theoretical replacement rates calculated for a modelled worker with theoretical career and earnings profile. The negative effect on the voluntary pension savings is also expected in the case of demographic burden borne by the current working generation. ODR ratio accounts for the relation of both populations: working age and retirees. According to the Life Cycle Hypothesis (Modigliani and Brumberg 1954), the first one saves, whereas the other dissaves. Numerous studies suggest that there is a negative relationship between private savings and unfavourable demographics (see, e.g. Grigoli *et al.* 2014; Keho 2012; Loayza *et al.* 2000; Kelly and Schmidt 1996; Bayoumi *et al.* 1996).

5 Empirical results

Tab. 2 presents the result of panel regression modelling for the first dependent variable, namely the number of plan members as percentage of the number of employed persons. There are four estimated models: pooled OLS model, cross-section FE model, cross-section RE and two-way FE model. The first one (pooled OLS model) can be considered as a reference. Estimating this model, we assume that the countries studied are homogeneous, that is, they lack individual characteristics that have any influence on the dependent variable. It serves as a basis for the statistical verification of the other models. Tab. 2 also provides the results for three diagnostic tests (see Gruszczyński 2012; Kufel 2011). The null hypothesis in the Breusch–Pagan test states that the individual effects do not occur, which makes the pooled OLS a more suitable model, and the alternative hypothesis stands for the RE model as a better solution. The Hausman test verifies the null hypothesis that both FE and RE estimators are consistent, although the RE estimator may be considered as more efficient, in contrast to the alternative hypothesis that only the FE estimator is consistent. The Wald test refers to the hypothesis that individual effects can be neglected, and its alternative, the FE model, is appropriate.

  According to the results reported in Tab. 2, better estimates are obtained from the FE model than from the RE model. The Breusch–Pagan test and the Wald tests

Tab. 2. Panel regression results (dependent variable: number of plans)

Dependent variable: **Number of plan members as percentage of the number of employed persons**
Periods included: 9
Cross-sections included: 10
Total panel (unbalanced) observations: 85

Independent variables	Pooled OLS	Fixed effects (cross-section)	Random effects (cross-section)	Two-way Fixed effects
Constant	0.63	−20.88	−28.74	−57.23
	(28.72)	(19.98)	(18.72)	(45.12)
ARP	**−0.73***	0.10	0.07	0.14
	(0.40)	(0.17)	(0.17)	(0.19)
ARR	0.09	0.10	0.16	0.11
	(0.20)	(0.13)	(0.13)	(0.16)
EDU	**−2.14*****	0.25	−0.32	0.61
	(0.44)	(0.64)	(0.55)	(0.80)
GDP_cap	**2.56****	**2.61*****	**3.26*****	**2.61****
	(1.10)	(0.76)	(0.72)	(1.11)
Intr_rate	**−1.46***	**0.60***	**0.61***	0.06
	(0.86)	(0.33)	(0.33)	(0.52)
ODR	**2.46*****	0.19	0.48	0.91
	(0.45)	(0.65)	(0.54)	(0.94)
S80S20	**−5.51*****	−0.22	−0.74	0.29
	(1.89)	(1.09)	(1.07)	(1.16)
Model summary				
Adjusted R-squared	0.70	0.97	0.34	0.97
Breusch–Pagan test	LM = 122.25; p-value ≤ 0.001			
Hausman test	H = 20.85; p-value = 0.004			
Wald test	F = 84.99; p-value ≤ 0.001			

Note: ***, **, * represent values significant at 1%, 5% and 10% level, respectively.

Source: Author's own elaboration.

reveal that pooled OLS should not be taken into consideration, so it is not interpreted in this analysis. In the cross-section FE model, there are two statistically significant parameters: the *GDP_cap* variable and the *Intr_rate* variable. The relationship between the income level and the number of voluntary pension plans is positive, as expected. So is the relationship between long-term interest rates and the membership in pension schemes. However, in the case of the latter, the significance level applied for parameter testing is quite high (10%) and the results are not confirmed by two-way FE model.

In the same manner, the analysis is conducted for the second dependent variable, that is, contributions paid to the voluntary pension schemes. Tab. 3 presents the results of the estimation. In the case of all three tests verifying the statistical properties of the models (Breusch–Pagan test, Hausman test and Wald test), the null hypotheses are rejected. These results also indicate, similarly as in previous models presented in Tab. 2, that FE models are more appropriate for the analysis. In the cross-sectional FE model, there are two variables that are statistically significant at the 5% level: *EDU* and *Intr_rate*. Education is considered to be a factor positively influencing the amounts saved in voluntary pension plans, as expected. However, the relationship between long-term interest rates and contributions is negative. This may imply that the impact of interest rates on the amounts saved is somewhat different from

Tab. 3. Panel regression results (dependent variable: contributions)

Dependent variable: **Annual contributions to voluntary pension schemes (% GDP)**
Periods included: 9
Cross-sections included: 10
Total panel (unbalanced) observations: 85

Independent variables	Pooled OLS	Fixed effects (cross-section)	Random effects (cross-section)	Two-way Fixed effects
Constant	−0.081	**1.033*****	0.451*	0.891
	(0.266)	(0.354)	(0.0266)	(0.80)
ARP	−0.0002	−0.0009	−9.01E−05	−0.0005
	(0.004)	(0.03)	(0.003)	(0.01)
ARR	−0.001	−0.0006	−0.0002	0.0013
	(0.01)	(0.02)	(0.002)	(0.01)
EDU	**−0.013*****	**0.0248****	−0.0015	**0.0264***
	(0.004)	(0.011)	(0.007)	(0.01)
GDP_cap	**0.0266****	**−0.0270***	0.0036	−0.0300
	(0.010)	(0.013)	(0.011)	(0.02)
Intr_rate	−0.012	**−0.0149****	**−0.0116****	−0.0075
	(0.008)	(0.006)	(0.006)	(0.01)
ODR	**0.015*****	**−0.021***	−0.001	−0.020
	(0.04)	(0.011)	(0.006)	(0.02)
S80S20	**−0.042****	−0.013	−0.028	−0.020
	(0.017)	(0.019)	(0.018)	(0.02)
Model summary				
Adjusted R-squared	0.54	0.85	0.02	0.84
Breusch–Pagan test	LM = 55.64; p-value ≤0.001			
Hausman test	H = 30.22; p-value ≤0.001			
Wald test	F = 17.65; p-value ≤0.001			

Note: ***, **, * represent values significant at 1%, 5% and 10% level, respectively.

Source: Author's own elaboration.

that in the case of the number of pension plans. Nonetheless, this impact is not confirmed by the two-way FE model, similar to the impact of income (*GDP_cap*) and the current demographic situation (*ODR*). In addition, the respective parameters estimated for *GDP_cap* and *ODR* in the one-way FE model are not statistically significant at the 5% level.

As the results of diagnostic tests report, in the case of both dependent variables, FE models (one-way FE and two-way FE) are considered to be more suitable than RE models. However, apart from statistical verification, also the substantive analysis allows to indicate both FE models as better. In the case of RE models, the assumption that the individual effects are random and mean-ingless in the context of the issue under consideration, which is obviously not true, is taken. Individual effect in FE models can be interpreted as institutional and systemic settings that differ over units, that is, countries (in one-way FE). In addition, in two-way FE models, the time effects that influence equally all the units are included. These effects, as stated in the previous section, may be identified with the effects of global factors related to the financial market situation. However, the crisis that hit in 2008 did not equally affect all the countries; that is why the prevalence of two-way FE model over one-way FE model cannot be fully substantively justified.

6 Conclusions

The comparisons conducted in a group of 10 CEE countries show that there is a considerable variation in terms of the participation and contributions to the voluntary pension plans. As discussed, the factors affecting the development of voluntary pensions can be of a systemic and institutional nature, or they can be driven by other facets associated with the economic, demographic or social background. This study empirically examines the possible determinants of both kinds, such as income per capita and poverty rate, income inequality, replacement rate from the pension system, education attainment, interest rate and demographic burden. It uses quantitative information on voluntary pension plans in the CEE region obtained from various local sources. The results reveal that in the case of participation in voluntary pension plans, only the income level per capita is associated with a greater number of pension plan members. As far as contributions are concerned, education seems to be the most important determinant of additional pension savings. Current pension system generosity, income inequalities, old-age dependency ratio or poverty rates do not seem to explain well both studied variables, reflecting the development of voluntary pension schemes. However, one must bear in mind that contributions (as percentage of GDP) in fact include two facets: the actual saving activity of enrolled individuals and their employers and the coverage. Hence, some more in-depth analysis is required to examine which one has a greater impact on the contributions accumulated across voluntary pension plans in each country.

The panel regression framework used in this study has a substantial advantage over cross-section regression or time series regression, namely, it allows to avoid the bias associated with the omitted variables. Panel regression accounts for the unobservable or difficult-to-quantify individual characteristics. They may be interpreted as country-specific systemic and institutional settings that encourage or discourage voluntary pension savings. As individual effects are proven to be significant in the estimated models, one could conclude that country-specific characteristics play an important role in explaining the development of voluntary pension schemes. They can be directly referred to the pension system design (both mandatory and voluntary), its parameter settings, financial incentives for an individual and for an employer to save on voluntary basis, non-mandatory contributions caps, competition on the voluntary pension products market and so on. The results of this study indicate that the role of these factors is significant. It means that comparing to other long-term savings, savings in voluntary pension schemes depend on somewhat different determinants, and they are more vulnerable to policy measures. Consequently, a more profound qualitative analysis is required to conclude about the particular solutions that effectively promote the extensive participation and high contributions in voluntary pension plans.

The limitation of this study is that it disregards the substitutional nature of voluntary savings in the dedicated pension plans and other long-term savings. It especially matters with reference to the impact of the economic, social and demographic characteristics of particular countries. Therefore, one must bear in mind that the lack of a direct influence of the selected factors on the participation rates and the amount of additional pension savings does not imply that they do not determine savings for the purpose of retirement. They may be collected in the form of ordinary savings, not savings in voluntary pension schemes.

7 References

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Appendix

Tab. A1. Sources of information on voluntary pension plans.

Country	Data sources
Bulgaria	Financial Supervision Commission (FSC)
Croatia	Croatian Financial Services Supervisory Agency (HANFA)
Czechia	The Association of Pension Funds of the Czech Republic (APS CR)
Hungary	The Magyar Nemzeti Bank (MNB)
Lithuania	Official Statistics Portal (OSP)
Latvia	Financial and Capital Market Commission (FKTK)
Poland	Financial Supervision Authority (KNF)
Romania	The Romanian Pension Funds' Association (APAPR)
Slovakia	National Bank of Slovakia (NBS) The Ministry of Labour, Social Affairs and Family of the Slovak Republic (MPSVR)
Slovenia	Securities Market Agency (ATVP) Insurance Supervision Agency (AZN) Ministry of Labour, Family, Social Affairs and Equal Opportunities (MDDSZ)

Source: Author's own elaboration.