QUANTITATIVE METHODS IN ECONOMICS
Volume XXV, No. 1, 2024, pp. 31 – 42

INCOME LEVEL AND POPULATION AGING IMPACT ON RETIREMENT SAVINGS IN OECD COUNTRIES

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Abstract: Increasing old-dependency ratio has essential impact on pension systems which must be reformed and adjusted to actual demographic situation. Applying linear regression, we look for relationships between retirement savings and levels of incomes and old-age dependency ratios in 36 selected OECD countries. Our findings show that the population aging affects pension assets accumulation differently in developed and developing countries although pension assets are increasing in both groups of countries. Concurrently, the regression models let us divide OECD countries into three groups - Countries where the old-age dependency ratio affects per capita investment positively and statistically significant (26 countries), insignificantly (5 countries) and negatively and significant (5 countries).

Keywords: population aging, retirement savings, OECD countries

JEL classification: G11, G23, G51

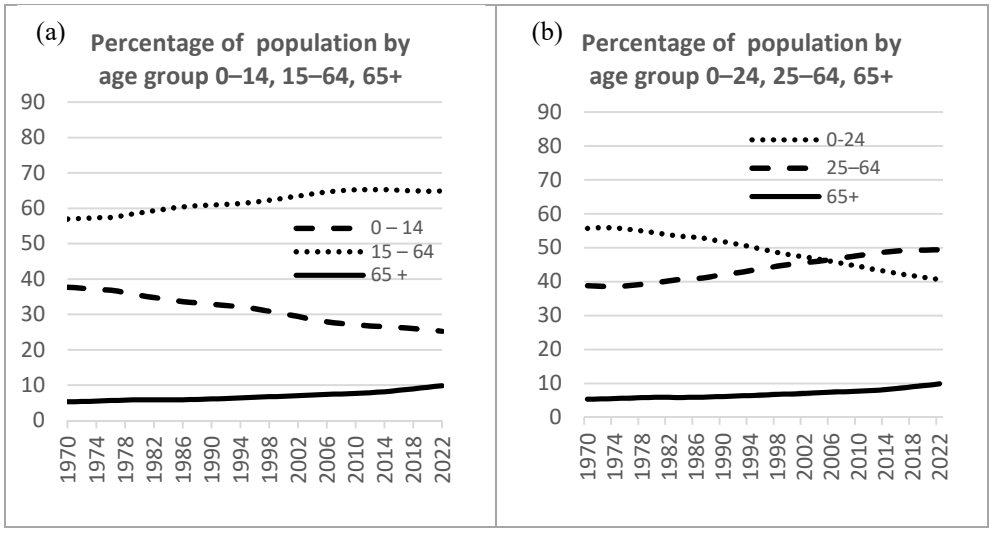
INTRODUCTION

Longer life expectancy and lowering the fertility rate causes ageing of societies all over the world. Therefore, the global population is facing the inverted demographic pyramid. According to the United Nations (2017), the world total dependency ratio of the young, non-working (age 0-14) and elderly (age 65+) to the working age population (age 15-64) dropped to 52.5% in 2015 from 75.2% in 1965. However, there are essential differences in the structure and extent of population aging across countries, particularly between developed and developing countries. The more developed regions show a rising dependency ratios trend. Whereas the less developed regions also show similar trend which is less noticeable due to their higher

https://doi.org/10.22630/MIBE.2024.25.1.4

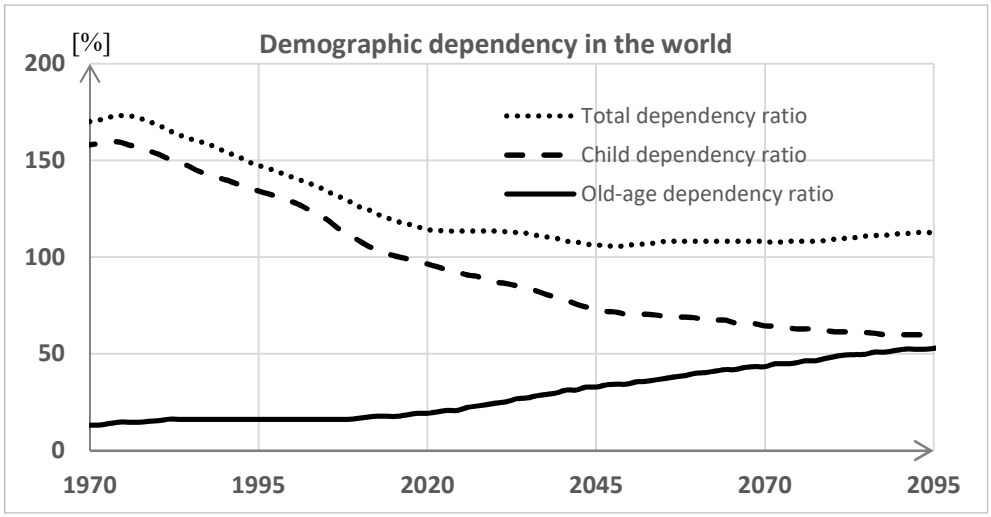
younger population and higher fertility rate. Even among industrialized developed countries, U.S. and Canada have younger population aging than western European countries like Germany, France and Italy.

Figure 1. Percentage of total population by broad age group
(a) working-age population 15–64, (b) working-age population 25–64



Source: prepared in-house based on UN Population Division (2022)

Figure 2. Evolution of the demographic dependency ratio in the world in 1970-2095



Source: quoted from The Social Observatory of the "la Caixa" Foundation [Lee, Mason 2021] as in-house compilation based on Mason et al. [2017]

The old-age dependency ratio is usually defined as the ratio of the number of elderly (65 and older) to the number of adults aged (15 - 64) in a given population (see Fig. 1a). In 2015, the old-age dependency ratio for the developed regions was 26.7% compared to the less developed regions of 9.7%. Using the United Nations probabilistic projections of the aging population to the working age population, the old-age dependency ratio is expected to rise rapidly, especially for the more developed regions, from 2015-2100. The old-age dependency ratio in the more developed regions is expected to rise to 52.97% in 2100 while the ratio for the less developed regions is expected to rise to 34.49% over the same period. The old-age dependency ratio is fundamentally different if the lower working age limit is taken as the upper educational age limit [GUS Methodical Notes] (see Fig. 1b). And in this case, demographic long-term projections indicate a rapid aging of the population and an increase in the global old-age dependency ratio above 50% before 2090 (cf. Fig.2).

Population aging caused unsustainability of the traditional PAYG pension system and resulted in reforms in many (especially developed) countries. The majority of pension systems are hybrid ones with a great variety of pension plans and retirement vehicles. Therefore, it is difficult to compare total retirement saving in different countries since pension assets may be hidden in taxes, treated as budget revenue or hidden government debt, or reported as savings in funded and private pension systems.

The literature suggests that the population aging crisis and its impact on saving behaviors, pension funds accumulation and capital markets and returns is a dynamic process as population demographics keep changing and that they are not the same for developed and developing counties. In our study, we investigate changes in retirement savings (accumulated in funded and private pension systems) in OECD countries in the years 2006-2017 with available, consistent data. We look for relationships between pension savings accumulation behavior and levels of incomes and old-age dependency ratios in the selected OECD considered countries, by applying linear regression models.

This study adds to the literature by linking and comparing the income level and the population aging process and the accumulation of financial assets behavior through institutional investors between developed and developing countries. Developed and developing countries and regions differ by many factors but two of them stand out, the level of income and life longevity. In our research we investigate the influence of both these factors on pension assets. The results would shed light on the ongoing pension system reforms and policies needed to be implemented differently to avert a global population aging crisis.

LITERATURE REVIEW

A consequence of the aging population is the fear of the elderly welfare, the financial sustainability and strains on the fiscal budget. Population aging crisis also

rises burden of the working population and future generations, and the drag on economic productivity and growth. These concerns have been well documented in the literature [Börsch-Supan, Ludwig 2009; Bloom et al. 2011] and cause that many countries reformed their pension systems making them the multi-pilar ones. Although countries that focus more on long-term financial sustainability reforms to contain rising government pension spending may increase old-age poverty instead [Hindrichs 2021]. Dalen and Henkens [2023], based on survey among Dutch pension fund participants, show that the level of funding is positively related to the degree of trust of contributors and is strongly positive for older (i.e., 55+) retired participants. Postkute et al. [2022] argue that despite different initiation and inconsistent pension reform paths and objectives undertaken by the Central and Eastern European countries the outcomes of the reforms are similar but still inadequate.

Demographic trends and their savings behavior have a significant impact on capital markets [Liu, Spiegel 2011]. A study by Luhrmann [2003] of 141 countries from 1960-1997 shows that demographic changes, in particular the differences in age structure across countries, affect global capital flows and that future demographic changes have a strong determination on current investment decisions by forward-looking households. As the population aging trends continue, financial institutions will become more important as conduits in channeling funds from savings to capital markets as the working population accumulates funds in their life-cycle for retirement (see [Brav et al. 2010; McCahery et al. 2016; Appel et al. 2016; Lewellen, Lewellen 2018]).

DATA AND METHODS

In our study we look at relationships between pension retirement savings per capita measures as pension funds' assets or all retirement savings (y) and levels of incomes and old-age dependency ratios (x) in the selected OECD countries, using

1. simple linear regression models estimated for
   - cross-sectional data:
   $$y_i = \alpha + \beta x_i + \varepsilon_i \quad (1)$$
   - time series:
   $$y_t = \alpha + \beta x_t + \varepsilon_t \quad (2)$$
   $$y_t = \alpha + \beta x_{t-k} + \varepsilon_t \quad (3)$$
2. pooled regression models estimated for panel data:
   $$y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} \quad (4)$$
3. trend function:
   $$y_t = \alpha + \beta t + \varepsilon_t \quad (5)$$

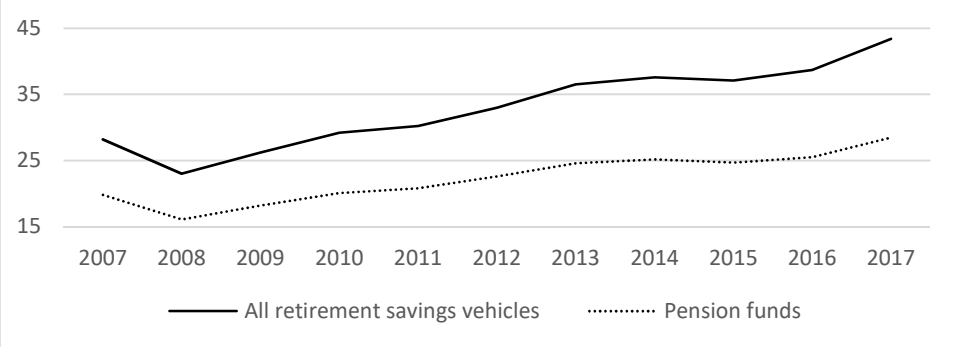
Financial assets in funded and private pension systems for retirement savings are accumulated by workers in countries where incomes are sufficient for personal savings for investment retirement. As a measure of the income levels, we apply gross

national income (GNI) per capita converted to international dollars using purchasing power parity (constant 2011 international in thousands of USD). In the model, total pension assets in funded and private pension arrangements are the dependent variable. Models are estimated using four sets of observations i.e., the level of data from years 2006, 2017, 2016-2017, and the growth rate 2017 in comparison to 2006 for OECD countries, except for Greece and Lithuania because of the lack of data for both countries. The missing data for GNI from the World Bank for Iceland, Japan, New Zealand and Switzerland are imputed using real data for the previous year.

The OECD pension data reports on funded and private pension system are based on annual surveys from national authorities. Unless specified otherwise, comparison between different countries is not fully comparable since in some countries like Australia, Canada, Switzerland and USA, the private pension sector dominates, while in Austria, Belgium, France, Germany, Italy, and Japan, the public (state) pension sector dominates. This means that for the latter group of countries only a smaller part of the retirement savings is presented in the OECD reports. There are seven countries (P7) with the largest pension assets which in 2020 totaled US$48,221 billion. This value is equal to 92% of assets from P22 group of countries[1]. Among the P7 countries, USA has the biggest pension market containing nearly 62% of P22 pension assets, followed by Japan and United Kingdom with 6.9% and 6.8%, respectively [Global Pension Assets Study 2021].

The pension market has been growing since 2009, after a small decrease observed in 2008, in comparison to 2007 (Fig. 3). All retirement savings vehicles increased by 54% from 2007-2017, (a 4.4% geometric average growth annually) and pension funds' assets rose by 44% over the same period, or 3.7% annually.

Figure 3. Total amount of assets in retirement savings vehicles (including pension funds) in the OECD countries (USD trillion)

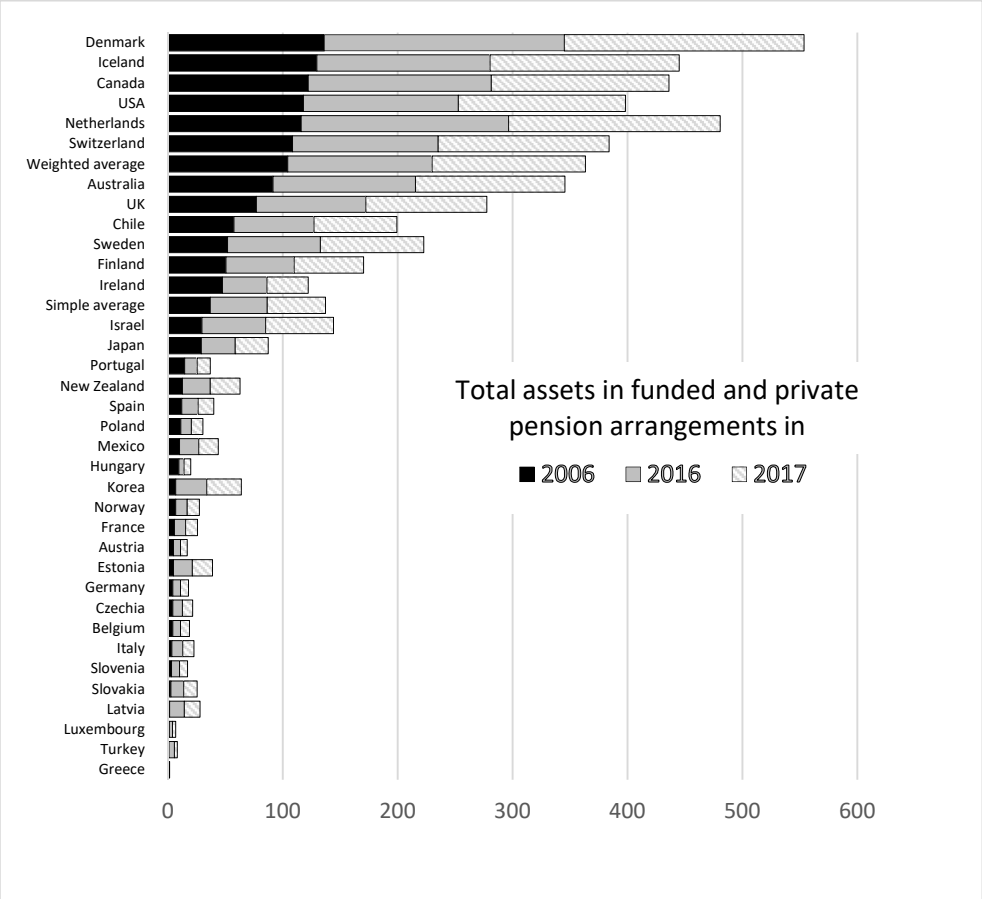


Source: own preparation on the basis of [OECD 2018]

[1] All countries are ranked according to the value of pension assets creating groups of countries P7, P22, etc. For example, P22 contains countries from P7 plus the subsequent 15 countries with the highest pension assets.

In analyzing the changes in total pension assets (Fig. 4), the simple average increase in 2017 is 2% in comparison to the previous year 2016 and 38% in comparison to 2006. The increase of weighted averages in 2017 are 6% and 28%, respectively in comparison to 2016 and 2006. The biggest increase over the eleven years is observed for Latvia and Greece where the pension assets in these countries started small in 2006. However, there are also countries where pension assets decreased: Hungary, Ireland, Portugal, Poland and Japan.

Figure 4. Total assets in funded and private pension arrangements in 2006, 2016 and 2017 (as a % of GDP)



Source: own calculations on the basis of [OECD 2017 and 2018]

RESULTS

The modelling results presented in Table 1 show that the relation between GNI per capita and total pension assets, expressed as percentage of GDP, is insignificant

for 2006 but in the models estimated for 2017 and 2016-2017 this relation is significantly positive, meaning that an increase of GNI per capita by one thousand dollar causes the increase of total pension assets by 0.18% of GDP. Regression estimated for rates of changes of total assets and GNI in 2017, in comparison to 2006, shows that changes of earnings per capita significantly influence the pension assets. Pearson coefficient between both variables is not high but positive (from 0.25 in 2006 and 0.34 for 2016 and 2017). The determination coefficients are also small showing that there are other factors influencing pension assets.

Table 1. Parameters of regression models: dependent variable is total assets in funded and private pension arrangements in OECD countries in selected years

Model	Sample	Number of observations	Parameter	Parameter estimate	t-Student	R^2	Pearson coefficient
Dependent variable y_i: total assets in funded and private pension arrangements as % of GDP							
(1)	2006	34	beta	0.7146	1.4846	0.0644	0.2538
			constant	12.0232	0.6324		
(1)	2017	34	beta	0.1761	**2.0597**	0.1171	0.3421
			constant	-14.913	-0.4295		
(4)	2016-2017	68	beta	0.1752	**2.9977**	0.1198	0.3462
			constant	-15.0817	-0.6419		
Dependent variable y_i: growth rate of total assets in funded and private pension arrangements as % of GDP in 2017 in comparison to 2006							
(1)	2017	34	beta	3.141	**1.8091**	0.0928	0.3046
			constant	0.6837	1.9331		

Source: own calculations. Note: bold letters denote values of t-Student statistics bigger than critical value for the significance level α=0.05.

We estimate regression models to explain retirement savings and pension funds' assets by population ageing, measured by population age 65+ as percentage of the total, applying observations from years 2007-2017. All models are estimated using eleven observations[2]. The former dependent variable, pension assets, is explained by the share of the population age 65+ measured not only in the current year, but also in the previous year (explanatory variable is lagged by one year) or five and seven years earlier (explanatory variable is lagged by five and seven years i.e., the first observation of explanatory variable is taken from 2007, 2006, 2002 and 2000, respectively). The results presented in Table 2 show that the determination coefficients are very high and the share of the population age 65+ in the total population significantly influences the amount of retirement savings and pension funds' assets when all OECD countries are considered. This result shows that an

[2] In other words, current relation means that both dependent and independent variables are measured in the same years 2007-2017 whereas for lagged explanatory variables observation periods are: years 2006-2016 for k=1, years 2002-2012 for k=5 and years 2000-2010 for k=7.

increase of the old-age dependency ratio causes an increase of total pension assets and pension fund assets in all OECD countries. It is visible that the aging societies increase their retirement savings early enough by noticing the need to save for old age. Applying trend function, it is noticeable that both variables increase significantly, pension funds' assets by 1.04 and all retirement savings 1.77 every year, and the increase of the former is significantly smaller than the latter.

Table 2. Parameters of regression models - dependent variables: all retirement savings or pension funds' assets in OECD countries and trend function

Model	Dependent variable y_t	Lags	Para-meter	Parameter estimate	t-Student	R^2	Pearson coef.
Linear regression model							
(2)	All retirement savings in OECD countries	current	beta	6.1647	**9.6999**	0.9127	0.9553
			const.	-61.2054	**-6.2890**		
(3)	All retirement savings in OECD countries	1	beta	6.5449	**9.2771**	0.9053	0.9515
			const.	-65.2670	**-6.1500**		
(3)	All retirement savings in OECD countries	5	beta	9.4624	**8.8235**	0.8964	0.9468
			const.	-100.3754	**-6.6332**		
(3)	All retirement savings in OECD countries	7	beta	10.9747	**9.2631**	0.9051	0.9514
			const.	-100.3754	**-6.6332**		
(2)	Pension funds' assets in OECD countries	current	beta	3.6251	**8.2394**	0.8830	0.9397
			const.	-33.0353	**-4.9032**		
Linear trend function							
(5)	Pension funds' assets in OECD countries		beta	1.0430	**7.8909**	0.8737	
			const.	16.1200	**17.9813**		
(5)	All retirement savings in OECD countries		beta	1.7706	**9.0021**	0.9000	
			const.	22.4033	**16.7938**		

Source: own calculations. Note: bold letters denote values of t-Student statistics bigger than critical value for the significance level α=0.05.

Using data from the OECD Pension Statistics and the World Bank, we evaluate the total investment of contributors of funded and private pension arrangements (in thousands of USD) per capita for years 2007-2017, which we treat as proxy of retirement savings per capita and look for the relationship between this variable and the share of the elderly in the population. We estimate several models using different samples. The biggest sample used for estimation the pooled regression model contains 396 data (for 36 OECD countries and eleven years). We also analyze all OECD members for different years for the growth rates where these samples contained 36 observations, and we estimated models for the countries using eleven annual observations.

Table 3. Investment contributors of pension funds and age +65

Model/ sample	Years	Sample country	Parameter	Parameter estimate	t-Student	R^2
Dependent variable y_i or y_t: retirement savings per capita in thousands of USD						
(4)/ 396	2007-2017	OECD countries	beta	0.0295	0.0745	0.0000
			constant	20.3253	**3.1361**	
(1)/ 36	2017	OECD countries	beta	-0.2013	-0.1207	0.0004
			constant	30.1987	1.0122	
(2)/ 11	2007-2017	USA	beta	11.6051	**9.3015**	0.9058
			constant	-93.2605	**-5.4382**	
(2)/ 11	2007-2017	Australia	beta	9.5721	**4.1577**	0.6576
			constant	-76.7139	**-2.3557**	
(2)/ 11	2007-2017	Japan	beta	-0.2772	-1.3614	0.1708
			constant	18.5028	**3.7879**	
(2)/ 11	2007-2017	Finland	beta	-2.7019	**-3.0044**	0.5007
			constant	81.0865	**4.8410**	
(2)/ 11	2007-2017	Poland	beta	-0.1323	-1.0096	0.1017
			constant	3.5695	**1.8736**	
(2)/ 11	2007-2017	Turkey	beta	0.1657	**14.9876**	0.9615
			constant	-1.0922	**-13.2369**	
(2)/ 11	2007-2017	Canada	beta	5.2560	**3.1286**	0.5210
			constant	-17.0303	-0.6729	
(2)/ 11	2007-2017	Hungary	beta	-0.3460	**-1.9579**	0.2987
			constant	6.7951	**2.2846**	
(2)/ 11	2007-2017	Switzerland	beta	23.7013	**9.8114**	0.9145
			constant	-316.5420	**-7.5564**	
(2)/ 11	2007-2017	Austria	beta	0.2691	**3.2613**	0.5417
			constant	-2.3464	-1.5641	
(2)/ 11	2007-2017	Belgium	beta	1.1384	**6.7340**	0.8344
			constant	-17.9582	**-5.9894**	
(2)/ 11	2007-2017	France	beta	0.2644	**2.2264**	0.3551
			constant	-1.1503	-0.5437	
(2)/ 11	2007-2017	Germany	beta	0.6404	**6.1185**	0.8062
			constant	-10.6598	**-4.9186**	
(2)/ 11	2007-2017	Italy	beta	0.5024	**9.4812**	0.9090
			constant	-8.4297	**-7.4577**	
(2)/ 11	2007-2017	Spain	beta	-0.0892	-1.0306	0.1056
			constant	5.5253	**3.5518**	

Source: own calculations. Note: bold letters denote values of t-Student statistics bigger than critical value for the significance level α=0.05

The selected model results presented in Table 3 indicate that it is difficult to identify general relationship between total investment of providers of pension funds and the population age 65+ when the data concerning savings per capita for each country are taken into account. It may be explained by different relationships between both

variables in each country. For instance, in Australia, Austria, Belgium, France, Germany, Turkey and U.S.A the increase of percentage share of population age 65+ years causes a significant rise in retirement savings whereas in Finland and Portugal the relation is opposite, and in Japan, Poland and Ireland it is insignificant. Also, the level of the model fitting is completely different for models estimated using different samples.

Table 3. (cont.) Investment contributors of pension funds and age +65

Model/ sample	Years	Sample country	Parameter	Parameter estimate	t-Student	R^2
Dependent variable y_i or y_i: retirement savings per capita in thousands of USD						
(2)/ 11	2007-2017	Portugal	beta	-0.2749	**-2.3902**	0.3883
			constant	7.8169	**3.4729**	
(2)/ 11	2007-2017	Chile	beta	1.9198	**4.6917**	0.7098
			constant	-10.2904	**-2.5772**	
(2)/ 11	2007-2017	Israel	beta	8.4565	**10.8086**	0.9284
			constant	-74.6188	**-8.8492**	
(2)/ 11	2007-2017	South Korea	beta	1.7836	**15.7497**	0.9650
			constant	-15.9974	**-12.0598**	
(2)/ 11	2007-2017	New Zealand	beta	0.6099	**2.3949**	0.3892
			constant	-1.5190	-0.4339	
Dependent variable: growth rate of retirement savings per capita in 2017 in comparison to 2007						
(2)/ 36	2007-2017	OECD countries	beta	-12.4573	-0.8425	0.0205
			constant	4.8121	1.4921	

Source: own calculations. Note: bold letters denote values of t-Student statistics bigger than critical value for the significance level α=0.05

Table 4. Groups of countries with different effects of old age dependency ratio on investment per capita

Countries where old-age dependency ratio affects investment per capita:					
Positively and statistically significant				Insignificantly	Negatively and significant
Australia	Denmark	Israel	New Zealand	Ireland	Finland
Austria	Estonia	Italy		Japan	Hungary
Belgium	France	Korea	Norway	Luxembourg	Mexico
Canada	Germany	Latvia	Slovakia	Poland	Portugal
Chile	Greece	Lithuania	Slovenia	Spain	Sweden
Czechia	Iceland	Netherlands	Switzerland		
Turkey	United Kingdom		United States		

Source: own calculations. Note: the significance level α=0.05

Regression models estimated separately for 36 countries[3] let us construct three groups of countries where old-age dependency ratio affects investment per capita differently, that is (a) the effect is positive and statistically significant (26 countries), (b) insignificant (5 countries) and (c) negative and statistically significant (5 countries). We can observe from Table 4 that there is no direct connection between this classification of countries and the recognition of these countries as developed and developing ones.

SUMMARY

Our paper looks at the population aging crisis and the impact on pension funds accumulation by retirees between the developed and developing countries and the impact on the capital pension funds markets. The results show that the population aging affects developed and developing countries differently and that pension accumulation asset growth is increasing in OECD countries. Gross national income per capita significantly influences the total investment of providers of funded and private pension arrangements in years 2016-2017, and 2017 since the relation is significant and positive. In 2006, this relation was insignificant.

The population age 65+ as percentage of the total population significantly influences total amount of assets in retirement savings choices (including pension funds) in the OECD and pension asset accumulations in years 2007-2017, when we use aggregated data for all OECD countries. The results show that there is a positive relationship between old-age dependency ratio and total pension assets and pension funds' assets growth in all OECD countries. This positive relationship is true for current and lagged relationships, although the increase of old-age dependency ratio 5 and 7 years earlier causes significantly bigger increase of pension assets in the current year than current and lagged by one old-age dependency ratio.

However, in looking at the population age 65+, whether an increase of old-age dependency ratio causes an increase of investment per capita of the total, the results are different in different countries in the eleven years analyzed. For most of the countries, the effect is significantly positive: in Americas – the USA, Canada and Chile; in Western Europe – Austria, Belgium, France, Germany, Switzerland, UK, the Netherlands; in Southern Europe: Italy, Greece, Slovenia; in Northern Europe – Denmark, Iceland, Norway; in Central and Eastern Europe – Czechia, Estonia, Lithuania, Latvia, Slovakia, and in other non-European countries – Israel, South Korea, New Zealand, Turkey and Australia. In Finland, Sweden, Hungary, Mexico and Portugal it is significantly negative, and for Japan, Spain, Luxemburg, Poland and Ireland, it is insignificant. The different results observed in different countries means that in general the relationship is insignificant for all the OECD countries and the analyzed years.

[3] Results for selected countries are presented in Table 3.

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