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The Effect of Aging Population on Pension Expenditures: A Country Comparative Econometric Analysis

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ABSTRACT

This study aims to reveal the differences in the variables affecting the pension expenditures of selected countries and to determine the variables that cause this difference according to the level of development of the countries. In the study, a panel data set was created by using the World Bank and OECD database as a source and the pension expenditures, working age population, elderly population and per capita income values of the selected countries and econometric analysis was performed. According to the results of the study, it was seen that the independent variables affecting the pension expenditures of South Korea have a positive effect on the working age population and the elderly population, while the per capita income variable has a negative effect. Turkey does not have any independent variable affecting pension expenditures. In the United Kingdom, only the working age population variable has a positive effect on pension expenditures.

Keywords: *Pension Expenditures, Working Age Population, Elderly Population, Per Capita Income, Panel Data Analysis*

INTRODUCTION

Population is the number of people living in a defined territory at a given time. The term is often used as a concept that determines the number of people. Population is the total number of people living in a country, a region or a household at a given time. In the past, countries used to consider a large population as an important factor for being powerful. Today, however, the emphasis is on the quality of the population rather than its quantity. Developed countries have made significant progress by using their qualified population potential very well (Üstün, 2017). In developed countries, low population growth rate or decrease in population threatens the future of the countries. Therefore, these countries carry out various studies to ensure population growth at a certain rate.

The world is experiencing a unique process of population aging. In the last 100 years, the world population has increased 4 times and the elderly population 10 times. The most important reasons for this are better nutrition and health opportunities, increased life expectancy and declining fertility rates. All of these lead to a change in the global age structure and the realization of the "Demographic Transformation". In this context, it is seen that the global aging process, or in other words, demographic transformation is taking place (Günsoy & Tekeli, 2015). Today, while the rate of population growth is decreasing in developed countries, some changes in the age structure of the population are emerging, and most notably the rise in the proportion of the elderly

population draws attention. The phenomenon of population aging, which is a result of the demographic change process that has been ongoing since the second half of the last century, is viewed as a crucial economic and social problem area all over the world.

Chronologically, aging begins at age 65. The World Health Organization (WHO) defines people aged 65 and over as elderly. In 2019, the world population was 7.5 billion and the elderly population was 700 million. Accordingly, the elderly constitute 9.3% of the world population. Aging is one of the most important reasons for the decrease in quality of life (QOL) with its biological, chronological, psychological and social aspects and is an inevitable process. The higher prevalence of chronic diseases and disability in the elderly compared to other age groups and the associated limitations in social activities reduce quality of life (Akyol, Durmuş, Doğan, Bek, & Cantürk, 2010). However, quality of life has become a fundamental concept in previous years and has become a goal in health and medical research. Recently, interest in quality of life has increased and more studies have been conducted on this subject (Haraldstad, et al., 2019).

Population ageing is a change in the age structure of a population, with a declining share of children and young people and an increasing share of older people (over 60 or over 65). The global aging process is also referred to as "demographic transition". In demographic terms, aging refers to the increase in the proportion of the elderly population in the total population. Countries with a proportion of elderly population exceeding 7% are defined as an "old society" and countries with a proportion exceeding 10% are defined as a "very old society" (Ahi & Sirzai, 2022).

The expected evolution of a society's age structure depends on the level of migration flows and age structure, as well as demographic assumptions about future birth rates and life expectancy. Recent projections for OECD countries over the next 50 years assume that life expectancy will increase by an average of 4½ years to 82 years. Over the same period, fertility rates are assumed to recover somewhat in most OECD countries, but on average reach only 1.7 children per woman, well below the 2.1 children needed to maintain a stable population (Visco, 2001). The combination of increasing life expectancy and low fertility is normally associated with rapidly ageing populations.

In principle, age-based measures of economic dependency may not accurately capture the shares of the working and retired population. Indeed, a small share of the population over 65 is still active in the labor force. More importantly, increasing numbers of older workers - those aged 55 to 64 - have permanently withdrawn from the labor force over the past two decades, especially in countries with high unemployment. In 1960, the average retirement age in the OECD area was about 65 for both men and women. By 1995, men were retiring on average at 62 and women at 60. In most of the major continental European economies, the decline was larger and usually started from a lower level. In line with the decline in retirement ages and the difficulties that older workers have in keeping their old jobs or finding new ones, the employment rate for this group has fallen to very low levels in some OECD countries. Today, less than half of the population between 55 and 64 years of age is employed in the OECD area, and in some countries the figure is less than one third. However, dependency ratios, which seek to correct these trends by substituting the employed for the working-age population, have a similar profile.

Economic impacts of aging populations

Fiscal problems are likely to arise as public pensions and health expenditures take up an increasing share of total social spending. These increases will put significant pressure on government budgets and public debt. To prevent them from increasing, it will be necessary to increase taxation or reduce social security benefits and other non-age-related expenditures.

Besides fiscal impacts, ageing populations will have a range of other potentially large economic and distributional consequences. For example, fewer workers and shorter working lives would reduce the population's consumption possibilities, compared to the levels that could be achieved with unchanged dependency ratios. A related question, then, is how much production and living standards will change, and by what path. The answer to this question will vary depending not only on long-term uncertain demographic and technological developments, but also on the structural and institutional conditions of different countries, their basic fiscal

situation, private welfare arrangements, trade, capital and labor flows.

The rise in tax rates or reductions in benefits to counter the negative fiscal effects of ageing will change the distribution of income between working and retired people today and between present and future generations. A cut in benefits is moving towards a shift from a pay-as-you-go pension system to a more overfunded system. In fact, an extreme form of financing would be to reduce pensions to zero and provide all retirement income through personal savings, which raises the question of intergenerational equity quite sharply. Alternatively, in the absence of a fiscal policy response, current generations would certainly benefit at the expense of future generations. On the other hand, during the transition to a funded system, current generations could suffer significantly.

Regardless of how pensions are financed, it should be borne in mind that a large part of the population can only consume from existing capital and labor production. It is likely that the transition to a fully financed system will be accompanied by an increase in saving as a result of an increase in capital intensity and per capita output. However, it seems inevitable that future workers will have to give up a larger share of investment and consumption than current workers in order to maintain the income of retirees. (Johnson, 1996).

Challenges for policy

A move towards more funding is one component of the strategy proposed by the OECD in response to the structural changes and financial pressures associated with an ageing population. But the need for action on many fronts is emphasized. The specific combination of measures will depend on countries' circumstances and needs to be formulated within well-balanced national frameworks. But as shown, demographic trends offer only a narrow window of opportunity before reform becomes much more painful. As a matter of fact, while the effects of ageing are likely to unfold several decades from now, the biggest challenge for policymakers is to anticipate problems and build support for reforms.

The OECD strategy targets several broad areas for reform. The first is a shift to more diverse sources of pension income with a greater role for fully financing pension liabilities. Secondly, changing public pension generosity and eligibility criteria to increase the number of years individuals spend actively in the labor force. These are incentive policies that promise to improve productivity performance and allow for higher levels of migration.

In this study, it is aimed to reveal the differences in the variables affecting the pension expenditures of selected countries and to determine the variables that cause this difference according to the level of development of the countries. Three countries in particular were chosen because they are in different categories. South Korea from the advanced economies group, Turkey from the newly industrialized countries (NIC) group and the United Kingdom from the developed countries group.

METHOD AND MATERIALS

In this study, a panel data set was constructed by using the World Bank and OECD database as a source and the pension expenditures, working age population, elderly population and income per capita of the selected countries. The following model is constructed with pension expenditures as the dependent variable and working age population, elderly population and income per capita as independent variables.

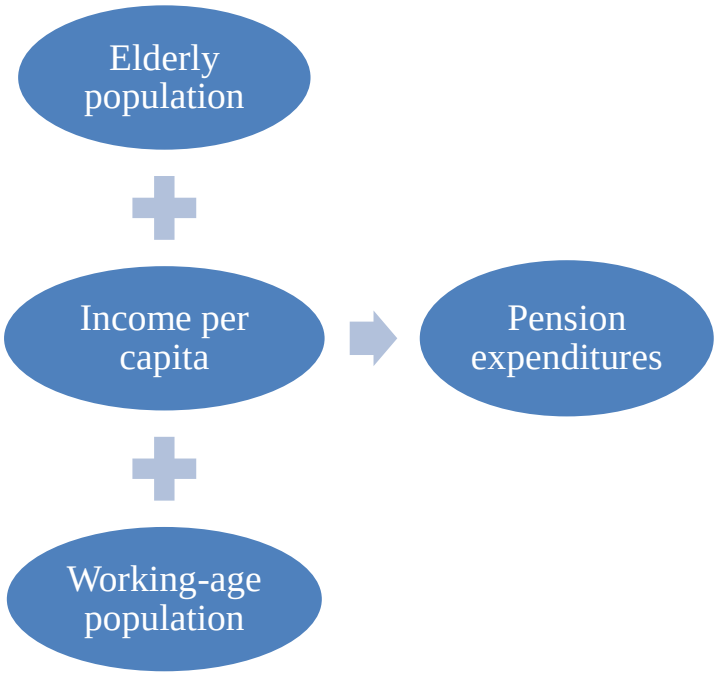

FIGURE 1: The Research Model

The countries included in the dataset consist of data from 3 countries, namely the United Kingdom, South Korea and Turkey. The dataset covers 3 countries and 11 periods between the years 2010-2021, each period being annual.

TABLE 1: Variables Used for Panel Data of Selected Countries

Variable	Code Description
Income Per Capita	Working-age population
Elderly Population	Per capita income
Pension Expenditures	Elderly population
Income Per Capita	Pension expenditures

In this study, the effects of working age population, elderly population and per capita income on pension expenditures are analyzed using panel data techniques.

TABLE 2: Descriptive Statistics for Selected Countries Panel Data

	Variables	Aged Population	Population	Working Age Population	Per Capita Income	GDP	Pension Expenditure
United Kingdom	N	12,00	12,00	12,00	12,00	12,00	12,00
	Minimum	16.352,00	62.759,00	63,46	39.693,19	36.583,00	4.919,00
	Maximum	18.835,00	67.351,00	66,04	47.447,59	49.815,00	6.329,00
	Mean	17.768,50	65.242,92	64,50	42.912,24	43.217,42	5.810,42
	Std. Deviation	813,30	1.553,78	0,92	2.428,35	4.585,91	468,58
	Skewness	- 0,55	- 0,19	0,55	0,62	- 0,05	- 0,76
	Std. Error	0,64	0,64	0,64	0,64	0,64	0,64
		- 0,76	- 1,34	- 1,02	- 0,40	- 1,34	- 0,60

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	Kurtosis Std. Error	1,23	1,23	1,23	1,23	1,23	1,23
Turkey	N	12,00	12,00	12,00	12,00	12,00	12,00
	Minimum	7.117,00	73.142,00	67,09	8.561,07	17.346,00	7.038,00
	Maximum	9.625,00	84.147,00	67,93	12.507,59	30.680,00	7.637,00
	Mean	8.216,33	78.766,58	67,67	10.577,13	24.977,75	7.231,92
	Std. Deviation	804,53	3.683,75	0,26	1.212,59	4.149,51	198,33
	Skewness	0,33	- 0,02	- 1,36	- 0,11	- 0,59	0,98
	Std. Error	0,64	0,64	0,64	0,64	0,64	0,64
	Kurtosis	- 0,90	- 1,29	1,03	- 0,83	- 0,79	0,22
	Std. Error	1,23	1,23	1,23	1,23	1,23	1,23
South Korea	N	12,00	12,00	12,00	12,00	12,00	12,00
	Minimum	10.829,00	49.554,00	71,56	23.087,23	31.737,00	1.967,00
	Maximum	16.565,00	51.836,00	73,42	34.997,78	46.875,00	3.611,00
	Mean	13.239,17	50.949,42	73,00	29.314,91	38.655,58	2.657,67
	Std. Deviation	1.846,58	773,45	0,60	3.609,97	5.172,87	498,54
	Skewness	0,43	- 0,53	- 1,64	- 0,20	0,13	0,36
	Std. Error	0,64	0,64	0,64	0,64	0,64	0,64
	Kurtosis	- 0,80	- 1,00	2,05	- 0,79	- 1,47	- 0,33
	Std. Error	1,23	1,23	1,23	1,23	1,23	1,23

When the data of all countries are included in the panel data set, the number of observations is 12. In the study, it was calculated that the distribution of working age population, elderly population, per capita income and pension expenditure variables showed normal distribution according to skewness and kurtosis values. For econometric analysis, Eviews 10 program was used to investigate the separate effects between variables.

Pension expenditure is defined as all cash expenditures (including lump sum payments) on old-age and survivors' pensions. Old-age cash benefits provide an income for people retiring from the labor market or guarantee incomes once a person reaches a 'standard' retirement age or fulfills the required contribution requirements. This category also includes early retirement pensions: pensions paid before the beneficiary reaches the 'standard' retirement age relevant to the program. It excludes schemes related to early retirement for labour market reasons. Old-age pensions include surcharges for dependents paid to old-age pensioners with dependents under old-age cash benefits. Old-age also includes social expenditure on services for the elderly, such as day care and rehabilitation services, home assistance services and other in-kind benefits. It also includes expenditure on the provision of residential care in an institution. This indicator is measured as a percentage of GDP broken down by public and private sector. Private pension expenditure covers post-retirement payments to members or dependents of private pension plans and includes both public and private sector employees (OECD, 2023).

Population is defined as all citizens present or temporarily absent in a country and foreigners permanently settled in a country. This indicator usually shows the number of people living in a region. Growth rates are the annual population changes over the year resulting from births, deaths and net migration. The total population includes national armed forces stationed abroad; merchant seafarers at sea; diplomatic personnel stationed abroad; civilian foreigners residing in the country; displaced persons residing in the country. However, it excludes foreign armed forces stationed in the country; foreign diplomatic personnel stationed in the country; civilian foreigners temporarily in the country. Population projections are a common demographic tool. They form a basis for other statistical projections and help governments in

their decision-making. This indicator is measured in annual growth rate and in thousands of people (OECD, 2023).

The elderly population is defined as persons aged 65 and over. The share of the dependent population is calculated as the total elderly and young population expressed as a ratio to the total population. The elderly dependency ratio is defined as the ratio between the elderly population and the working-age population (15-64 years). The comparability of older population data is affected by differences in how the geography of regions and rural and urban communities are defined, both within and between countries. Older people tend to be concentrated in a few areas in each country, which means that a small number of regions will have to face a number of specific social and economic challenges due to population ageing. These demographic trends have a number of implications for government and private spending on pensions, health and education, and more generally for economic growth and prosperity. This indicator is measured as a percentage of the population (OECD, 2023).

The working-age population is defined as the population aged 15-64. This indicator measures the share of the working-age population in the total population (OECD, 2023). When the gross national product (GNP) of a country is divided by the population of that country, GNP per capita is calculated. Similarly, dividing a country's gross domestic product (GDP) by its population yields GDP per capita (Worldbank, 2023).

Findings

According to the ADF and PP unit root test results for the working-age population, elderly population, per capita income and pension expenditure variables of the selected countries, it is observed that while the variables are mostly unit rooted at their level values in the models with constant and trend with constant, they become stationary when first order differences are taken. In other words, it is determined both graphically and by analysis that the data are not stationary in their initial state but become stationary when first order differences are taken.

The findings obtained as a result of the least squares method and regression analysis of the data of South Korea selected from the developed economies group are shown in the table below.

TABLE 3: Analysis Results for South Korea

Dependent Variable: LOGPENSION_EXPENDITURE				
Method: Least Squares				
Date: 05/23/23 Time: 15:37				
Sample: 2010 2021				
Included Observations: 12				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Logworking_Age_Population	22.99699	5.215247	4.409569	0.0023
Logper Capita Income	-1.547108	0.600522	-2.576271	0.0328
Log Elderly Population	3.611762	0.726832	4.969186	0.0011
C	-109.1416	23.96820	-4.553598	0.0019
R-squared	0.921767	Mean dependent variable		7.869123
Adjusted R-squared	0.892430	S.D. dependent variable		0.187498
S.E. of regression	0.061495	Akaike info criterion		-2.478506
Sum squared resid	0.030254	Schwarz criterion		-2.316871
Log likelihood	18.87104	Hannan-Quinn criterion		-2.538349
F-statistic	31.41975	Durbin-Watson statisitic		2.058312
Prob (F-statistic)	0.000089			

Since the Prob (F-Statistic) value in the above model is less than 0.05, our model is significant. Accordingly, it is seen that the independent variables affecting South Korea's pension expenditures have a positive effect on the working age population and the elderly population, while the per capita income variable has a negative effect. R Squared in the table shows what percentage of the dependent variable is explained by the independent variables.

Therefore, 92.17% of the dependent variable, pension expenditures, is explained by the variables included in the model. The remaining 7.83% belongs to the variables not included in the model through the error term.

The findings obtained from the least squares method and regression analysis of the data of Turkey, which is selected from the newly industrialized countries (NIC) group, are shown in the table below.

TABLE 4: Analysis Results for Turkey

Dependent Variable: LOGPENSION_EXPENDITURE				
Method: Least Squares				
Date: 05/23/23 Time: 15:37				
Sample: 2010 2021				
Included Observations:12				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGWORKING_AGE_POPULATION	5.329545	3.647696	1.461071	0.1821
LOGPER CAPITA INCOME	-0.249277	0.129012	-1.932194	0.0894
LOG ELDERLY POPULATION	-0.338805	0.217184	-1.559990	0.1574
C	-8.214983	13.27644	-0.618764	0.5533
R-squared	0.353685	Mean dependent variable		8.885919
Adjusted R-squared	0.111317	S.D. dependent variable		0.027136
S.E. of regression	0.025581	Akaike info criterion		-4.232702
Sum squared resid	0.005235	Schwarz criterion		-4.071067
Log likelihood	29.39621	Hannan-Quinn criterion		-4.292546
F-statistic	1.459289	Durbin-Watson statitic		2.878164
Prob (F-statistic)	0.296768			

Since the Prob (F-Statistic) value in the above model is greater than 0.05, our model is not significant. Accordingly, it can be concluded that the independent variables affecting Turkey's pension expenditures such as working age population, elderly population and per capita income do not have any effect.

The findings obtained from the least squares method and regression analysis of the data of the United Kingdom selected from the developed countries group are shown in the table below.

TABLE 1: Results of Analysis for the United Kingdom

Dependent Variable: LOGPENSION_EXPENDITURE				
Method: Least Squares				
Date: 05/23/23 Time: 15:38				
Sample: 2010 2021				
Included Observations: 12				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGWORKING ELDERLY POPULATION	28.44962	11.63558	2.445054	0.0402
LOGPER CAPITA INCOME	0.287044	0.271837	1.055939	0.3218
LOG ELDERLY POPULATION	7.266011	3.619845	2.007271	0.0796
C	-184.0249	81.79190	-2.249916	0.0546
R-squared	0.878773	Mean dependent variable		8.664304
Adjusted R-squared	0.833313	S.D. dependent variable		0.083130
S.E. of regression	0.033940	Akaike info criterion		-3.667260
Sum squared resid	0.009215	Schwarz criterion		-3.505625
Log likelihood	26.00356	Hannan-Quinn criterion		-3.727103

F-statistic	19.33071	Durbin-Watson statistic		1.868384
Prob (F-statistic)	0.000505			

Prob (F-Statistic) value in the above model. Since it is less than 0.05, our model is significant. Accordingly, it is seen that only the working age population variable has a positive effect among the independent variables affecting the pension expenditures of the United Kingdom. R Squared in the table shows what percentage of the dependent variable is explained by the independent variables. Therefore, 87.87% of the dependent variable, pension expenditures, is explained by the variables included in the model. The remaining 12.13% belongs to the variables not included in the model through the error term.

When the assumptions are analyzed in the models of the selected countries, the Multicollinearity Assumption is met for all three. According to the Jarque-Bera value, the normality assumption is also met. According to the auto-correlation assumption, there is no auto-correlation in lag lengths. Finally, the White method was used for the assumption of changing variance and it was found that there is no changing variance.

RESULTS

The results of the study show that the effects on pension expenditures for the three selected countries are different. Moreover, under current institutional arrangements, where public pensions are paid by contributions from today's workers, fewer workers supporting a larger number of older retirees will put budget positions under increasing pressure in OECD countries. In addition, health expenditures are also likely to increase significantly. Overall, the most recent and comprehensive estimates conducted in OECD countries suggest that budgetary pressures from an ageing population could add, on average, about 7 percentage points as a share of GDP to government spending on the elderly (Visco, 2001).

In the context of ageing, reversal of demographic trends is possible as a result of technological, economic and social developments. Nevertheless, it should be recognized that population ageing trends in OECD countries are largely due to demographic changes that have already taken place or are unlikely to be reversed. Projections of fiscal and economic impacts help to better understand whether and how policy should respond.

The analysis of three selected countries (South Korea, the United Kingdom and Turkey) yielded different results. OECD countries and regions are likely to see a significant decline in savings rates and a concomitant reduction in the annual growth of per capita income. This is a critically important situation indicator. Three issues in particular are highlighted as needing further research and discussion, as they depend on a number of factors, including the general equilibrium resolution of imbalances in factor markets. These are: i) the channels through which aging affects households' life-cycle saving decisions; ii) the response of factor prices and capital intensity to demographic shocks and technological developments; and iii) the effects of demographic changes on technical progress.

However, the fiscal effect of aging populations is expected to be very difficult to escape. Moreover, this impact and possible social policy responses to it are likely to have important intra- and intergenerational distributional effects. Social policy responses should therefore also be assessed in light of the potential political and social costs of particular reforms.

The OECD is publishing studies on the most appropriate strategies to address the challenges arising from population ageing. It suggests that two lines of action are fruitful, the first aimed at increasing the financing of pensions and the second at extending working life and increasing employability. It concludes that even if the possibility of beneficial effects linked to higher productivity growth and net migration rates cannot be ruled out, these effects - for reasonable changes and trends - are unlikely to significantly alleviate the future financial pressures of ageing populations.

A significant and universal element of the OECD strategy is to reorganize the structure of retirement income to take account of all sources available to older people, including public and private pensions, earnings and assets. A more diversified retirement income structure is needed so that sources other than public pension payments play an increasing role in providing for retirement and help spread the burden across

generations. A wider range of income sources will also help reduce the risk of future income losses.

In conclusion, while aging need not be perceived as a problem in itself, its fiscal and economic consequences may be such that action may be needed on many fronts. It is certainly possible that technological progress, supported by an endogenous response to the demographic shock, could help reduce the burden of necessary reforms. However, reforms will need to be announced in advance and implemented gradually to minimize the distributional burden. It is worth noting that the challenges for social policymakers are significant, as they need to anticipate problems and build support for reforms, even though their effects may only be visible ten or twenty years down the road.

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