

Evaluation of economic variables on pension fund performance of selected countries

Mitra Ghanbarzadeh¹, Nasrin Hozarmoghadam², Asma Hamzeh³

¹ Personal Insurance Department, Insurance Research Center, Tehran, Iran
ghanbarzadeh@irc.ac.ir

² Personal Insurance Department, Insurance Research Center, Tehran, Iran
hozarmoghadam@irc.ac.ir

³ Modern Insurance Technologies Department, Insurance Research Center, Tehran, Iran
hamzeh@irc.ac.ir

Abstract:

Since pension funds are part of the social security system and have a socio-economic function, to maintain the value of the insured's savings, they should invest them, which will have a direct relationship with the money market and the capital market of each country. Due to the significant resources they have, pension funds affect the country's economic variables and, of course, are mostly affected by economic variables. This issue reveals the importance of examining how macroeconomic variables affect pension funds and the intensity of each one's impact, as well as the management of funds' resources in the face of the fluctuations of these variables. Therefore, in this paper, the impact of pension funds on economic variables in 8 countries is investigated. Based on the results obtained in this research, the variables of short-term interest rate, exchange rate, and unemployment rate affect the ratio of pension fund assets to GDP (as an indicator of performance).

Keywords: Pension Fund; Panel Regression Model; Stationarity; Macroeconomic Variables.

JEL Classifications: H55, C50, C23, B22.

1 Introduction

Many external and internal factors affect the performance of pension funds. Therefore, the success and failure of a pension system cannot be searched only in its internal features and elements. An important part of the challenges of pension funds is rooted in developments outside the pension system. Undoubtedly, the macroeconomic situation is one of the important components affecting the performance of pension funds and it affects the resources and expenses of the funds. For example, the increase and decrease of insured persons are strongly affected

¹Corresponding author

Received: 07/05/2024 Accepted: 12/06/2024

<https://doi.org/10.22054/JMMF.2024.79648.1134>

by macroeconomic developments. Recession, unemployment, and other economic problems cause a decrease in the number of employees and as a result, a decrease in the number of insured persons. Also, economic prosperity and employment growth will increase the number of employees and consequently the number of insured persons. Examining the trend of important macroeconomic variables such as economic growth rate, employment rate, inflation rate, exchange rate, etc. shows that in recent decades, the macroeconomy of the country has not had a stable trend and the financial and economic status of pension funds have also been affected by these economic changes [8].

Considering the importance of the financial performance of pension funds, it is very important and necessary to identify and explain the factors that determine and affect this performance and the role of each of them. The available literature in this field shows that the financial performance of funds is affected by two groups of factors. The first group is related to the internal policies and regulations, especially the fund management system, whose roots should be sought in the departmental and upstream laws and regulations related to this field, which can be divided into three components (fund managers, investment management fund, and subscribers). The second group of factors affecting the fund's financial performance is related to trans-sector factors and macroeconomic conditions. The purpose of this research is to investigate the impact of economic variables on the performance of pension funds in some prominent countries in this field. For this purpose, the countries of Türkiye, India, United Kingdom, Netherlands, Germany, Japan, Canada, and Russia have been selected and an attempt has been made to extract a suitable time series for each of the countries. Also, the performance index of pension funds in this article is considered as the ratio of pension fund assets to GDP, and based on the panel regression model; we investigate the significance of economic variables on the performance of pension funds in the mentioned countries.

The rest of the paper is outlined as follows. Section 2 offers a brief review of the pension fund performance, economic variables affecting the performance of pension funds, and the literature review. Section 3 presents the methodology of this paper. In Section 4, the results of modeling are described. Finally, a conclusion is provided in Section 5.

2 Theoretical framework

2.1 Pension fund performance indicators

Considering the important position of pension funds from an economic and social point of view, monitoring and investigating the performance and status of these funds are necessities for policymakers in this field; because their functional impairment or weakness can directly affect the livelihood of people. There are several indicators to investigate the performance of pension funds, which are discussed

below.

- **Sufficiency of benefits:** Sufficiency of benefits seeks to ensure the protection and support of the pensioners (from the channel of paid premiums) against poverty and a severe drop in living standards during retirement. Pension sufficiency can be examined from two dimensions; first, maintaining the level of consumption during retirement compared to the period of employment, and second, pension adequacy to achieve the minimum standard of living. The first dimension of sufficiency is mainly measured by the replacement rate and the second dimension by the ratio of pension to household expenses [8].
- **Ratio of resources to expenses:** It indicates the financial status of the fund and the higher this index is, the more financial stability the fund will have. A ratio of less than one means that the fund's resources are not enough to cover its expenses and the fund has a resource deficit [4, 8].
- **Support ratio:** It shows the status of the financial flow of the funds' inflow and outflow and is equal to the ratio of the number of insurance payers to the number of pensioners. Based on international experience (and taking into account factors such as the replacement rate), a stable pension fund has a support ratio of at least 3 and an optimal level of 5 to 7 [4, 8].
- **Investment return:** An important indicator to check the performance of any pension fund is the fund's investment return rate. Sometimes, instead of the return rate, the effective return rate of investments is used, which means the nominal return minus the inflation rate [4, 8].
- **Ratio of pension fund assets to GDP:** Pension fund assets are defined as assets purchased by participation in a pension plan for the sole purpose of financing pension plan benefits. This index is measured in terms of each country's currency or as a percentage of GDP, and its higher value indicates the stability of pension funds [1].

2.2 Economic variables affecting the performance of pension funds

In recent decades, the widespread and continuous shocks of the macroeconomic and demographic structure and the labor market have played a very effective role in aggravating the alarming situation of pension funds, because the performance of pension funds is strongly affected by macroeconomic and social trends. Considering the purpose of the research, in the following, the investigation of economic variables affecting the performance of pension funds has been discussed [1, 4, 6, 8].

- **Economic growth rate:** The economic growth rate shows the rate of increase or decrease of the gross domestic product (GDP). Economic growth has a significant effect on increasing stock market returns, investment growth, and

employment growth, and as a result, it will increase resources and reduce the deficit of pension funds. In periods of economic prosperity and increased total demand, pension funds usually provide acceptable financial performance and their access to financial resources to cover their obligations is facilitated. In other words, their asset portfolio is improved in terms of amount and diversity and increases their profitability opportunities. In periods of low growth and economic fluctuations, the labor market and the demand for labor are challenged and thus the entry of funds is limited. On the other hand, high fluctuations in economic growth and resulting instabilities can affect the efficiency of economic activities of funds.

- **Real exchange rate:** The exchange rate will affect the resources and expenses of the fund through the channel of stimulating inflation, followed by the adjustment of salaries and pensions, and through that, it will also affect the amount of surplus resources that can be invested. Therefore, it is expected that the direction of the exchange rate effect from this channel on the income from the economic activities of the fund will be negative. However it should be noted that despite the decreasing effect of the exchange rate on the fund's income from investments due to its inflationary effects, the income of this fund will increase with the increase in the exchange rate and the dollar to Rial exchange rate. With the increase of the real exchange rate, the expenses of the pension funds, which include the provision of services to the target society (such as medical services, welfare, etc.), also increase.
- **Labor market variables:** The labor market situation is closely related to the pension system. Boom and recession in the labor market, by changing the sources of income and costs of the funds, greatly affect their financial performance. In the research literature, periods of prosperity by reducing the number of unemployed and increasing the number of employed strengthen the financial power of pension funds and provide a suitable basis for fund investment, and periods of recession cause financial deficit. Three key labor market indicators that are more related to pension systems are: participation rate, unemployment rate, and wage level.
- **Interest rate of bank deposits:** Bank interest rate affects the tendency to invest and in this way, it will affect the income from the economic activities of the funds. It is expected that the increase in the interest rate of bank deposits will reduce the income from the economic activities of the funds by limiting the investment resources.
- **Inflation rate:** On the one hand, inflation affects the investment return rate of the funds and greatly reduces the real value of the cash resources of the

The participation rate shows the share of the working-age population who are either active in the labor market and have a job or are looking for work, out of the total population.

funds; because the collection of the fund is not increased proportionally and at the same time as inflation. On the other hand, if pensions increase in line with inflation, the obligations of pension funds will increase. Inflation also affects medical expenses and increases the obligations of pension funds to the target society.

- Interest rate: with interest rate changes, variables such as inflation, production growth, and employment will be affected, which will affect both the fund's resources through insurance premiums and the increase or decrease of employees, as well as its consumption due to the change in the welfare state and the necessary resources to compensate for the changes. The welfare of pensioners will be affected. On the other hand, with changes in interest rates, the value of securities, including debt and stocks, will change, which will lead to changes in the resources of the funds.

2.3 Literature Review

Najafi et al. [6] investigated the impact of the shock of macroeconomic variables on the resilience of pension funds for the years 1971-2017 using the structural vector autoregression (SVAR) method. In this research, the total expenses of the social security organization are considered as dependent variables, and inflation, unemployment and government debt fluctuations are considered as independent variables. Mokri et al. [4] investigated the effect of macroeconomic variables on the financial burden created by pension funds for the government. For this purpose, seasonal data for the period of 2005-2019 and the non-linear regression model of mild transition STR have been used. Safarzadeh [8] investigated the effect of macroeconomic variables on pension funds in a study using VAR models. It has studied the variables of inflation, unemployment rate, exchange rate, economic growth, liquidity volume, labor market participation rate, bank deposit interest rate, etc. Mousavian Anarki et al. [5] investigated the effect of macroeconomic variables on pension funds and asset management solutions. The data used in the econometric model are time series data, and the results of the model processing show that the growth of the operating profit of the national pension fund as an indicator for measuring the fund's condition is one of the three factors of the gross domestic product (economic growth), the growth of economic participation and the growth of the number of companies in which the fund invests favorably. Jafari [2] investigated Iran's labor market from the perspective of key indicators such as participation rate, unemployment rate, wage level, etc. and their effect on the pension system. Ofori-Abebrese et al. [7] investigated the effect of some macroeconomic indicators on retirement benefits in Ghana. The independent variables in this study are: interest rate, exchange rate and inflation rate, the effect of these variables on the total benefits paid by pension funds in a period of 14 years (for the years 2000-2014) with the auto-regression method with a lag (ARDL) has been investigated.

Estrada et al. [1] investigated how the inflation rate and exchange rate affect the real value of pension funds in Malaysia. The time frame examined in this study is 1980-2030 and the data analysis was done with a new method called the real value box of the pension fund. The result of this study showed that the inflation rate and exchange rate affect the value of pension funds. Mazreku et al. [3] evaluated the financial performance of pension funds in Kosovo, Albania and North Macedonia by using standard multiple regression, fixed effect model, random effect and Hausman-Taylor regression to analyze the relationship between the dependent (performance) and independent variables.

3 Methodology

The purpose of this research is to investigate the impact of macroeconomic variables on the performance and stability of the pension fund (focusing on the ratio of pension fund assets to GDP) in Türkiye, India, United Kingdom, Netherlands, Germany, Japan, Canada, and Russia. The criteria for selecting countries in this paper are based on the success of the pension system as well as the similarity of economic conditions with each other. Mercer global pension index shows the success rate of countries in the pension system. This index consists of three sub-indices of adequacy, stability, and integration, which is a compilation of more than 50 indicators, and is a comprehensive and suitable index for examining the pension systems of countries and comparing them with each other. Considering that the macroeconomic conditions of a country also affect the conditions and performance of the pension system of that country, therefore, the analysis of the experience and performance of a pension system without considering these conditions cannot provide a proper description and picture of that system. Therefore, another consideration that to select the countries investigated in this study, the similarity of their macro conditions is taken into consideration. Economic growth, inflation, financial market performance, labor force participation, unemployment rate and population indicators can be mentioned among the most important macroeconomic indicators that can provide an acceptable picture of the economic situation of a country.

At first, it is necessary to identify macroeconomic variables affecting pension funds, which is done by using library study and reviewing national and international scientific papers and reports in this field in Section 2.2. In this paper, the ratio of pension fund assets to GDP is considered a symbol indicating the performance of countries' pension funds, and the significance of economic variables is evaluated through the panel regression model. The economic variables used in this research are economic growth rate, real exchange rate, unemployment rate, interest rate of bank deposits, inflation rate, and interest rate. The symbols used in this research are described in Table 1.

The panel regression model that we are trying to estimate is as follows. This model investigates the significance of economic variables affecting pension fund

Table 1: Variable Symbols Used in the Model

Category	Symbol	Definition
Performance index of pension funds	AssetasGDP	Ratio of pension fund assets to GDP
Economic Variables	Inflation	Inflation rate
	Longterminterest	Interest rate
	Shortterminterest	Interest on bank deposits
	Unemployment	Unemployment rate
	Gdpgrowth	Economic growth
	Exchangerate	Exchange rate

performance.

$$\begin{aligned} \log(\text{AssetasGDP})_{it} &= a_{it} * \text{Inflation}_{it} + b_{it} * \text{Longterminterest}_{it} + c_{it} * \text{Shortterminterest}_{it} \\ &+ d_{it} * \text{Unemployment}_{it} + f_{it} * \text{Gdpgrowth}_{it} \\ &+ g_{it} * \text{Exchangerate}_{it} + e_{it} \end{aligned}$$

where index i belongs to country and index t belongs to the year. The data used for Germany, Netherlands, Türkiye, and United Kingdom in the years 2005 to 2021, for India from 2010 to 2020, and for Russia, Japan, and Canada from 2013 to 2020 have been collected and included in the mentioned models.

4 Findings

As mentioned, the purpose of this section is to evaluate the impact of economic variables on the ratio of pension fund assets to GDP of the Netherlands, Germany, Türkiye, India, United Kingdom, Russia, Japan, and Canada. Stationarity is one of the prerequisites for estimating a suitable regression model. Therefore, the stationarity test or unit root test of panel data is performed respectively for the variables of the above model, which is the results of Levin, Lin and Chow (LLC) unit root test for the relevant indicators are described in Table 2. As can be seen, consid-

Table 2: Results on Stationarity Test of Variables

Variable	Statistics	P-value	Result
$\log(\text{AssetasGDP})$	-2.6488	0.0040	<i>stationary</i>
Inflation	-4.4684	0.0000	stationary
Longterminterest	-1.6180	0.0500	<i>stationary</i>
Shortterminterest	-39.7827	0.0000	<i>stationary</i>
Unemployment	-4.4803	0.0000	<i>stationary</i>
Gdpgrowth	-4.6226	0.0000	<i>stationary</i>
Exchangerate	-2.5785	0.0050	<i>stationary</i>

ering that the p-value of the unit root tests in all variables is less than 0.05, it is concluded that the statistical assumption of having a unit root in all the mentioned variables is rejected, and therefore these variables are stationary.

To choose the best model, there are two general models of aggregated (pooled) and panel data analysis, which can be distinguished with appropriate tests. In the case that the data is aggregated, the width from the origin is the same for all sections, in which case the data is analyzed by the aggregated method. In the second case, the width from the origin is different for all sections, in this case, the panel method is chosen. To identify the two mentioned cases, F-Limer test is used. Therefore, before estimating the model, it should be checked whether the model is panel or aggregated, or in other words, whether the model has fixed or random effects or not. In this test, the null hypothesis, which means that the width of the origins is the same, is placed against the alternative hypothesis, which means that the width of the origins is unequal. If the null hypothesis is accepted, it means that the width of the origins is the same for different sections, and the ability to aggregate data and use the pooled regression model is statistically verified. But if the null hypothesis is rejected, the panel method is accepted and the research hypotheses are tested using the panel data method. The results of this test, which examines the homogeneity of the width from the origin in the model in terms of section and period separately, are shown in Table 3. Since the p-value of the F-

Table 3: Results of F-Limer's Test on the Model

Model	Section		Period		Result
	F-statistic	p-value	Chi2 statistic	p-value	
$\log(AssetsGDP)$	280.5168	0.0000	58.4769	0.0000	Panel in section and period

Limer's test in the model is less than 0.05, therefore, the null hypothesis of the existence of pooled or aggregated regression (regression without fixed or random effects) is rejected, and therefore, the appropriate model for estimating under study has fixed or random effects and is not aggregated. If, based on the results of F-limer's test, the use of the panel data method is accepted, to determine which method (fixed or random effects) is more suitable for estimation, Hausman's test is used. In this test, the acceptance of the null hypothesis means the superiority of the model with random effects (there is no correlation between individual effects and explanatory variables) and the acceptance of the alternative hypothesis means the superiority of the model with fixed effects (there is a correlation between individual effects and explanatory variables). In this regard, the result of Hausman's test for the above-mentioned model for the section is shown in Table 4. Considering

Table 4: Results of Hausman's Test on the Model

Model	Type	Chi2 statistic	P-value	Result
Model 1	cross section	0.6161	0.9961	random effects

that the p-value of Hausman's test in the model is less than 0.05, as a result, the statistical assumption that the model has fixed effects is rejected at a significance

level of 5%. Therefore, it is concluded that the model has fixed effects on sections (countries), and with these assumptions, panel regression models is estimated. The fitting result of the panel model, in which the dependent variable is the logarithm of ratio of pension fund assets to GDP, is shown in Table 5. Based on the results

Table 5: Panel Regression Results in the Model

Dependent variable	Independent variable	Coeff.	Statistic	P-value	Significance	Goodness of fit
log(<i>AssetsGDP</i>)	Inflation	0.012840	0.632610	0.5285	No	$F = 14.38$ $p - value = 0.000$ $R^2 = 0.86$ $R^2_{adjusted} = 0.83$ $DW = 1.29$
	Longterminterest	0.035759	1.012978	0.3136	No	
	Shortterminterest	-0.111836	-3.367931	0.0011	Yes	
	Unemployment	-0.044759	-1.735295	0.0858	No	
	Gdpgrowth	-0.015468	-1.453849	0.1492	No	
	Exchangerate	-0.014128	-3.762184	0.0003	Yes	
	C	4.579858	4.137316	0.0001	Yes	

of Table 5, the values of Fisher's statistic and p-value indicate the significance of the model, at a significance level of 5%. Also, the coefficient of determination and adjusted coefficient of determination in the model show that the model has provided an acceptable fit. In this model, the value of Durbin-Watson (DW) statistic is calculated, which is within the allowed range and shows that the residuals do not have a significant correlation and the fitted model is appropriate. Also, the cross-sectional correlation test of Pesaran CD is calculated, which has a value of 2.35 and a p-value of 0.02. According to the null hypothesis, which is based on the absence of correlation between the residuals of the model, and according to the p-value, at a significance level of 5%, the existence of correlation in the residuals of the model is not accepted, and the fitted model is appropriate.

One method to detect the autocorrelation of the residuals is to use the correlogram chart. In this diagram, we use the autocorrelation function (ACF) and partial autocorrelation (PACF) to detect the autocorrelation of the residuals of the model. If the bars shown in the figure are protruding from the dotted lines around them, then the model has some kind of autocorrelation, and if the bars are inside the dotted lines, the model has no autocorrelation. Figure 1 shows its results. The normality of the residuals is also examined through Jarque-Bera test, and the result indicates that the residuals of the model have a normal distribution (because the p-value of Jarque-Bera statistic is not less than 0.05).

5 Conclusions and recommendations

In this paper, using econometric models, the impact of macroeconomic variables on the ratio of pension fund assets to GDP (as an indicator of pension fund performance) was evaluated. The countries under investigation are Türkiye, India, United Kingdom, Netherlands, Germany, Japan, Canada and Russia. Based on the results of estimations, short-term interest rate and exchange rate at 5% level

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		1	0.056	0.056	0.3116	0.577
		2	-0.074	-0.077	0.8667	0.648
		3	-0.067	-0.058	1.3198	0.724
		4	-0.073	-0.072	1.8699	0.760
		5	-0.083	-0.086	2.5878	0.763
		6	-0.147	-0.158	4.8823	0.559
		7	-0.017	-0.029	4.9138	0.670
		8	-0.028	-0.074	5.0009	0.757
		9	0.009	-0.028	5.0090	0.834
		10	0.005	-0.042	5.0113	0.890
		11	-0.028	-0.071	5.0997	0.926
		12	-0.038	-0.084	5.2669	0.948

Figure 1: Correlogram of Residuals

and short-term interest rate, unemployment rate and exchange rate at 1% level have significant effects on the ratio of pension fund assets to GDP; specifically, the effects of them are negative.

The most important political lesson of this research is that it is not possible to examine the issue of pension funds and increasing their financial wealth outside of the general economic environment of the country. The fact is that pension funds, as part of the economic system of countries, are affected by economic variables and can have an effect on them. Due to the direct impact of pension funds on the macroeconomic environment of the country, a prosperous and flourishing economy with low inflation and close to full employment will benefit social insurance funds. Therefore, any action by the government that leads to economic growth, reducing inflation and improving labor market variables will benefit pension funds. These measures, in the form of measures to stimulate the economy and labor demand, are considered an important pillar in improving the state of the country's pension funds and include active financial policies and consistent monetary policies. It seems that the fastest possible way to create an opening in the state of the pension fund is to improve the state of economic variables; where the control of inflation leads to a reduction in the growth of the fund's expenses, as well as economic growth and a prosperous economic environment, it improves the prospects of the fund's investment returns, increases insurance revenues, and improves the government's capacity to help the fund.

Bibliography

- [1] Estrada, M., Khan, A., Staniewski, M., Mansor, N. (2017). How inflation and the exchange rate affect the real value of pension plan systems: the case of Malaysia. SSRN Working Paper Series. 2 (201), 127.
- [2] Jafari, H. (2017). Key indicators of the labor market and its effect on pension funds in Iran, Saba Pension Strategies Institute.

- [3] Mazreku, I., Morina, F., Curraj, E. (2020). Evaluation of the financial performance of pension funds. Empirical Evidence: Kosovo, Albania and North Macedonia. *European Journal of Sustainable Development*, 9 (1), 161.
- [4] Mokri F, Zandi F, Hosseini S S, Khezri M. (2021). Applying the nonlinear mild transition regression (STR) model in determining the relationship between macroeconomic variables and the financial burden of pension funds for the government. *Quarterly Journal of Economic Research and Policies*; 29 (98) :447-477
- [5] Mousavian Anarki, S. A., Tamasoki Bidgoli, M., and Rahimi, F. (2019). The effect of macroeconomic variables on pension funds and the correct management of assets. *Second International Conference on Innovation in Business Management and Economics*.
- [6] Najafi, H., Damankeshideh, M., Mohammadi, T. (2021). The effect of macroeconomic variables on the resilience of pension funds and the achievement of social rights in terms of jurisprudence, *Strategic Studies of Jurisprudence and Law*, 3 (2), pp. 77-98. doi: 10.22034/ejs.2021.140726
- [7] Ofori-Abebrese, G., Becker Pickson, R., Abubakari, S. (2017). Assessing the impact of macroeconomic variables on pension benefits in Ghana: A case of social security and national insurance trust. *South African journal of economic and management sciences*, 20 (1), 1-10.
- [8] Safarzadeh, A. (2019). The effect of macro variables on the national pension fund, Saba Pension Strategies Institute.

How to Cite: Mitra Ghanbarzadeh¹, Nasrin Hozarmoghadam², Asma Hamzeh³, *Evaluation of economic variables on pension fund performance of selected countries*, Journal of Mathematics and Modeling in Finance (JMMF), Vol. 4, No. 1, Pages:115–125, (2024).



The Journal of Mathematics and Modeling in Finance (JMMF) is licensed under a Creative Commons Attribution NonCommercial 4.0 International License.