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# DOES THE MECHANICS OF MACRO-ECONOMIC VARIABLES EXPLAIN THE PERFORMANCE OF PENSION FUNDS IN THE FUND INDUSTRY? A QUESTION ON PENSION FUNDS RISK MANAGEMENT

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#### Abstract

A number of economic miracles are being birthed out from the joint meeting of economic business cycles and the physics of macro-economic variables. Some of the impacts of these miracles have been looked at with no serious attention paid to other important functional units like funds industries. However, the macro-economic variables do stimulate some risks that greatly affect the pension returns and performance. This study looked at the impacts of selected macro-economic variables on pension funds. We aim to see how these factor variables affect the performance of pension funds. We actually posed a question on whether there are cause and effect relations between pension returns and these variables as a way to manage well the associated risks and to ensure healthy performance of the fund. We conjectured that the movements associated with the macro-variables have some risks that cause shifts to the pension returns. Such shifts and movements are surely important in planning and risk management. We used a newly formulated linear model to answer our

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question. We analysed the impacts of each selected variable using the data collected from 2000-2018. We coined our model with powerful statistical test to strongly evaluate the effect of each variable on the performance of pension funds. Among these, we used the Hotelling t test, correlation test and the Akaike's Information Criterion (AIC). Results were computed and noted down. From the variable analysis done, inflation rates greatly affect the performance pension fund assets in a negative way. Other variables presented weak effects on the pension fund performance as indicated by positive correlation coefficients, AIC values and the obtained t test values. We then concluded that, all macro-economic variables present unhealthy conditions on the performance of pension funds and therefore special attention should be given to these. Consequently, fund managers should make all necessary adjustments to keep up on track and to ensure smiling returns from the pension funds. This helps much on reserve calculations by actuaries and fund valuators. This is also our contribution. We finally recommended progress checks of the pension funds asset performance against the prevailing rates of the macro-variables.

#### 1. Introduction

Investment has considerably grown and expanded for the past period and industrial mirror do testify that it is still in the growth phase with more than double investments being made on daily basis. Theoretical and industrial practical records indicate a number of different and diversified investment choices available and the ones being chosen by individuals at certain times for each particular situation. However, all the investments that are being executed are purely associated with some risks both systematic and non-systematic ones. From such, different fund portfolios has been organised within financial societies so as to ensure a better return for investors at lowest possible risk level. Examples of such fund portfolios include mutual funds, hedge funds, pension funds, fund of funds among others. This study in particular shall focus on pension funds' performance given all the constraints in an economy like South Africa. "Over the past two decades, pension industry witness incessant reforms globally, with many countries shifting from government managed pension systems to privately managed pension systems", Shehu (anon). This is so mainly because of the need to operate at minimum possible risk level. A

pension fund is a representative of a long standing obligation to retirees to support sustainability of their consumption in retirement (Millar and Devonish [11]). More commonly there are two ways of managing pension funds and these are defined benefit (DB) and defined contribution (DC) plans.

Defined benefit entails that fixed benefits are set in advance by the sponsor and the contributions are initially set and subsequently adjusted to keep it in balance and defined contribution consists of fixed contributions and benefits depend on the returns of the fund portfolio and contributors has a chance to review and to know the value of their fund. One of the main aims of the fund members and their managers is to operate at very minimal risks and maximum return point. However, the reverse seems to be happening to the fund teams due to a number of driving and impacting factors. Interestingly, this paper is going to examine the effect of the physics of macro-economic variables on the pension fund performance. We shall consider economic factors such as inflation rates, interest rates, exchange rates, unemployment and fiscal (tax) rates against pension fund asset returns in particular. We hypothesize that, the movement of such variables induces risks which retard the well being of pension funds and consequently its return performance. We aim to analyse and measure the performance of pension funds based on a DC system against macro-economic variables in the South African economy. We aim to see whether these factors have long term or short term impacts on the fund's asset return using a well constructed asset return model.

Of much significant interest, we are backed with a sounding bag of literature confirmations related to our conjecture and study. Abebrese et al. [1] carried out a study which sought to assess the impact of some major economic indicators in the Ghanaian environment on pension benefits. Setting: This study was carried out in Ghana by obtaining quarterly data frequencies on pension benefits and economic indicators spanning the period 2000Q1 to 2014Q4. They used Auto-regressive

Distributed Lag Model was utilised to examine the long run and short run dynamics of some major economic indicators and pension benefit and their results suggested that inflation deteriorates total pension benefits. Increasing monetary policy rate and depreciation of the domestic currency should be an issue to contend with only in the short run rather than in the long run. Also, Bulow [4], Munnell and Muldoon [13], Karam et al. [8] and Feldstein [5] examined private pension and inflation in the United States and they reached out that private pension funds deteriorates with rising prices. Additionally, Clark and McDermed [14] further looked at inflation, pension benefits at retirement and found increasing rates of inflation to lower the present value of pension benefits and hence the accumulated pension compensations in the long run. In the same line, United Nations Joint Staff Pension Board [17] explored the impact of currency fluctuations on the United Nations Joint Staff Pension Board and pension benefits across the globe. Making use of the data from United States, France, Italy, Switzerland, United Kingdom and Austria and on the basis of a 36-month average local currency exchange as a measure of exchange rate and income replacement ratio (I/R) as a measure of staff pension benefits, the study found in the United States a constant I/R with respect to the US dollar, indicating a no-currency effect on such benefits. Despite the fact that most of the literature proved inflation to be the most factor in effect, other scholars such as Karam et al. [8] assessed the macro-economic effects of public pension reforms using the Global International Monetary and Fiscal dynamic stochastic equilibrium model. On the same note, it should not be carelessly noted that, the negative effects of all, the economic factors on pension fund systems is often referred as risks. This risk component is more worrisome especially to the fund managers and in consequence the pension members at large. Therefore, despite the risks posed by factors like inflation, exchange rates and interest rates, other risks such as labour income risks, longevity risks and investment and annuity risks should be taken into account. Wage fluctuations and possible job termination are one of

the risk factors that affect contributions of workers to pension fund. Since salary is the determining factor of contribution particularly in DC plan, which is commonly, practiced by most countries (Shehu). On the other hand, a recent model for DC pension scheme in discrete time is proposed by Vigna and Haberman [7]. In particular, they studied both the "investment risk", that is the risk of incurring a poor investment performance during the accumulation phase of the fund and the "annuity risk", that is the risk of purchasing an annuity at retirement in a particular recessionary economic scenario involving a low conversion rate. Also, from the other risking factors such as asset mix investment for pension funds, Battacchio and Menoncin [3] suggest that, the wealth percentage of pension fund invested in stock shall decrease through time. In his working paper, Antolin [2] compared pension funds across countries according to total assets under management and asset allocation, and briefly discusses certain issues surrounding the data reported by pension funds and regulators on investment returns.

Despite all such elegant works by various scholars, we rarely found exact matching contributions to our conjecture. Our aim in particular is to investigate, analyse and to explore the resulting impacts of the physics of macro-economic variables on performance of pension funds in the fund industry. We shall consider in specific, the physics and effects of interest rates. inflation rates, exchange rates, income tax rates and unemployment rates on pension fund performance as measured by the assets return. As we aim to explore the cause and effect relationships in an Euclidean space, we shall use multiple linear statistical regressions (MLR). We are to build our model from the capital asset pricing model (CAPM). Also, we shall build our model based on the Akaike's information criterion (AIC) and the *p*-values using backward approach. To validate our model, we shall use a simple but powerful approach where we will be comparing the deviances for our fitted model with the null model. Above all, we aim to see which among the variables affect the pension fund performance much and to make relevant recommendations based on

these results. In addition, we conjectured that, after finding the cause and effect between pension returns and macro variables, it will be necessary and easy to manage any associated risks. We shall in this paper give an insight on the risks posed to the pension funds by these variables. So, in short, we put forward a question on whether the selected variables affects pension fund returns as a way to risks management. If the question is answered well, then risks management will be made so easy. This forms the basis of this paper.

## 2. Pension Fund Performance in South Africa

Pension funds are considerably increasing and growing in dominance by day across the globe. Their coverage in emerging markets like South Africa is now appearing in much significant volumes. According to Towers Watson [16], South African pension funds have been rising substantially in the last decade and stands out as the fastest growing fund globally. Historically, pension funds emerged in South Africa as a result of a number of reforms which can be categorised as infancy, institutionalisation, separation and its continuation and amalgamation. Each of the phases reflects to transitions happening in the legislation, structure and systems within pension funds in the South African economy. In trending terms, according to Van der Berg [18] pension funds came into South Africa in 1882 and became more visible in 1911. The South African government was the key player in activating and promoting pension funds by that time with industrial council formations by industrial members. By 1958 a total number of 2771 funds existed with a total membership of 675,404. From these, 11 were state controlled funds, 599 privately administered funds, 2147 were underwritten (FSB, 1959). The pension fund schemes developed further in South Africa from 1959 rapidly up to mid 1984 where the recoded asset value was R21.1 billion. This value was from a total membership of 5,124,439 from 11,929 registered pension funds. Consequently, the pension funds grew by large significant numbers up to the levels of being listed as the top country with highest growth figure of 14% by 2011 followed by other countries like Australia (12%) and United

Kingdom (11%). According to the FSB (2012) report the number of members has risen from 675,404 to 15 million individuals between 1959 and 2012. Currently, the statistics avail a great and promising an ever growing of the pension funds in South Africa. This is so happening as the majority are having a better appreciation of the benefits derived from such powerful schemes. Records suggested that, South Africa's pension funds experienced a steady rise to the 15 million members in the last decade. Notable scholars like Van der Berg [18] and Kaniki and Ntuli [9] stated that South Africa's labour force do rely on tested social covers and government plans. A clear clarification is well explicitly presented through the following graphical representations.



Figure 1. Registered funds versus membership accumulations (1959-2014).

Source: Moleko and Ikhide [12] with additional author's remarks.

The above graph shows the trending behaviour of pension funds in South African. During the early years, the pension funds proved to be growing well and increasing in terms of both membership totals and registered funds. A fall down was only for the number of registered funds and it started in late years around 2012. A fall in the number of registered funds is well explained by the fluctuations in the value of the funds and related assets. It is of noble use and importance for us to display the types of funds and these are well explained in Table 1 below.

	Privately/self administered funds	Underwritten fund/exempt funds	Industrial agreements	State controlled funds GEPF	Official funds	Transnet	Telkom	Post office
1959	662	2358	16	14				
1960	674	2768	17	15				
1970	810	5548	28	14				
1971	798	6046	25	14				
1980	788	10265	35	11				
1985	1032	10953	30	10	8			
1990	1375	13198	19	9				
1995	2094	12970	16		5	1	1	1
2000	3056	12509	13		4	1	1	1
2005	3487	9888			3	3	1	1
2010	3340	6776		1	3	3	1	1
2011	3292	6204		1	2	3	1	1
2012	3128	3444		1	2	3	1	1

Table 1. Types and number of registered funds (1959-2012)

Source: Moleko and Ikhide [12] with additional author's remarks.

In a nutshell, the information provided in Table 1 indicates that Insurance policies receive the largest percentage of total assets investments in the last 2 decades. During 1992-2005, an average rate of 23 percent was invested in the asset class, rising to an average 47 percent in the last five years. This is because all fund types were reported on by the Registrar post 2005, prior investment allocation up to the year 2005 reflects the allocation of only self-administered funds in their Annual Reports. The inclusion of underwritten, foreign and state controlled funds has strongly influenced the rise in allocation. Investment in shares in companies during the period 1992-2005 averaged 32 percent, however when additional fund allocation (inclusion of underwritten, foreign and state controlled funds) the average drops to 22 percent. There is no significant shift between privately administered funds and all other funds. Additionally, we found it weakly valued if we forget to display the link between economic growth and pension funds. We did quote data on the pension funds assets to GDP for South Africa from International monetary fund (IMF). Figure 2 below is a complete nexus show for the two.



Figure 2. Pension funds assets to GDP growth nexus.

Source: Author's own compilation online data sourced from IMF.

Figure 2 above shows the growth contribution of pension funds on economic growth in South Africa. Since its inception, pension funds have been enhancing economic welfare especially for the elderly which bears a positive effect on overall economic growth. The fusion of pension funds and other fund types (mutual or hedge) funds is fundamental too. From the figure above, the pension funds growth contribution increased at a decreasing rate since 2000 and rose abruptly for the past 10 years in South Africa. This evidenced by its GDP-Pension fund assets ratios.

## 3. Methodology

# 3.1. Data

We shall use our selected macro-economic variables data and pension fund returns data, collected from the World Bank. Our study period spanned from 2000 to 2018.

# 3.2. Model

Our model is quite unique in its form. We build it from the capital asset pricing model and multiple linear regressions (MLR). The model is constructed as below.

$$\boldsymbol{E}(\boldsymbol{P}_{f}|\boldsymbol{I}_{t}) = P_{0}f + [|\boldsymbol{\phi}_{\boldsymbol{m}} - P_{0}f|]\boldsymbol{\beta}, \tag{1}$$

where

 $E(P_f|I_t)$  is the vector for expected pension fund asset returns given information set  $I_t$ ;

 $P_0 f$  is the market free asset return of the pension fund. This is the fund return with a zero market exposure;

 $|\phi_m - P_0 f|$  is a vector measuring of market factor effect on the pension fund performance. It is obtained by taking the deviance of each market factor from the zero market exposure asset return; and

 $\beta$  is a vector of coefficients corresponding to each market variable as defined above. The model simplification results as:

$$P_{return} = \alpha + \rho \beta + \varepsilon, \tag{2}$$

where  $\mathbf{\rho} = |\mathbf{\phi}_m - P_0 f|$  and  $\alpha = P_0 f$ .

We shall use the constructed model to run our special regressions and to make special statistical inferences. Our dependent variable is the pension fund returns.  $\phi_m$  is the vector comprising of interest rates, inflation rates, exchange rates, income tax rates, and unemployment rates. We are to use market prevailing data in South Africa for all other market factor variables. Our analysis are presented in the section below.

#### 4. Statistical Analysis

#### 4.1. Statistical test

It is part of statistical integrity to make sure that, the data being used meets the pre-defined conditions which are termed modelling assumptions. By nature our model belongs to the linear regression family models. Thus by recommendation we are to test whether the basic assumptions hold or not. In this case we shall test the normality, heteroscedasticity, multicollinearity and the linearity assumption.

# 4.2. Normality test

This is done by using several methods. However, in this case we shall use the Shapiro-wilk normality test. The procedure is performed using stata and the results are presented. The test rejection criteria is based on that, if the obtained sk coefficient is greater than the level of significance, then we reject the stated null claim and deduce the non-normality of our data. Other alternative approaches are the qq plots and the sk test. All of them are highly efficient.

#### 4.3. Heteroscedasticity test

This happens when the standard errors of a variable, monitored over a specific amount of time, are non-constant. For viable regression analysis, our data should have a constant variance which we term homoscedasticity. Therefore, heteroscedasticity is highly not recommended and should be controlled. To test this assumption, we shall use the white test. Along this, we shall also use the Cameroon and the Trivedi's decomposition of the *im* white test and make our conclusions. Our decisions are based on the level of significance of our test which normally happens to be  $\alpha = 0.05$ .

# 4.4. Multicollinearity

This is of interest and should be paid enough attention as it can mislead us in making conclusions and inferences. This refers to the existence of such a high degree of correlation between supposedly independent variables being used to estimate a dependent variable that the contribution of each independent variable to variation in the dependent variable cannot be determined. Before building any regression or linear model the covariates should be tested for this. We shall use the correlation matrix analysis and point down the Pearson correlation coefficient of the variables. Further, we shall use the variance inflation factor (VIF). VIF shows us the extent to which the variance or standardised error is inflated upwards or downwards.

#### 4.5. Linearity assumption

Last but not least linearity between the dependent variable and the covariates should be tested to see whether it exists or not. Any covariate that is not in linear form with the dependent variable should be safely dropped. This is done using a scatter plot. We shall plot a scatter graph for the variables and check the linearity or non-linearity behaviour from the data. Above all, it should be noted that, if our data is failing to meet our model assumptions we may be required to transform it until the point of satisfaction.

# 5. Results and Findings

#### 5.1. Correlation analysis

We shall run our correlation analysis on our variables. We aim to see whether the market factor variables have an impact on the pension fund returns and if so by how much and how strong the nexus is. Our variables are pension fund asset returns, interest rates, inflation rates, income tax rates, unemployment rates, and exchange rates. Since our data is continuous, we shall use the Pearson correlation approach to construct our matrix.

# Table 2. Correlation matrix table

.correlate (pensionfundreturns inflation Erates unemployment taxrates interestrates)

(obs = 19)

	Pensio~s	Inflat~n	Erates	Unempl~t	taxrates	Intere~s
Pensionfun~s	1.0000					
Inflation	- 0.2081	1.0000				
Erates	0.4849	0.2001	1.0000			
Unemployment	0.3371	- 0.0932	0.3428	1.0000		
Taxrates	0.4919	- 0.2129	0.3145	0.7112	1.0000	
Interestrates	0.2245	- 0.0061	- 0.0252	0.2969	0.4890	1.0000

Pearson correlation shows the degree of liner relationship between variables. In our case we aim to compare our pension asset returns with the market factor variables. So, the results of correlation are, there is negative relationship between pension returns and inflation rates. This suggests that, inflation rates highly affect the performance of pension funds. Additionally, other variables suggested positive but weak relations with pension asset returns. This means that, as the variables increases in value so it does to the pension funds. Interestingly, the results suggested that, although the coefficients are positive, they do affect the performance pension funds. This further implies that, pension funds do perform in a healthy state when all these variables are kept to the minimum.

## 5.2. Regression analysis and model fitting

We used Stata Software to build our regression model with the summary presented below.

## Table 3. Regression summary table

.req	pensionreturns	inflationrates	exchange_rates	unemployment_rates
incon	netax rates inter	est rates		

Source	SS		df		S	
Model	379.06705	5		75.	75.81341	
Residual	514.684645		13	39.59	11265	
Total	Total 893.751695		18	8 49.6528719		
				40		
Nui	mber of obs	=		19		
F (5	5, 13)	=		1.91		
Prob > F		=	0.1601			
R-squared			0.4241			
Adj R-squared		=	0.2026			
Ro	Root MSE		6.2921			

Pensionreturns	Coef.	Std. Err.	t	P >  t	[95% Conf.	Interval]
inflationrates	0.6422185	0.5955051	1.08	0.300	- 0.6442921	1.928729
Exchange_rates	- 1.1733	0.5975271	- 1.96	0.071	- 2.464179	0.117579
Unemployment_rates	0.421064	1.289604	0.33	0.749	- 2.364956	3.207084
Incometax_rates	- 1.321971	1.527963	- 0.87	0.403	- 4.622935	1.978993
Interest_rates	- 0.5298348	1.150407	- 0.46	0.653	- 3.015139	1.955469
_cons	212.1271	106.5648	1.99	0.068	- 18.09222	442.3464

In Table 3, the regression results show that there is a slightly an insignificant negative relation between exchange rates and pension fund asset returns with a value of 0.071. There is an insignificant positive relationship between inflation rates and pension returns with values 0.3 and another insignificant positive with unemployment rates with a value of 0.749. Finally, there is insignificant negative links between pension fund asset returns with income tax rates and interest rates with values 0.403 and 0.653, respectively. R Squared is 0.4241 and adjusted R

squared is 0.2026. This means that our dependent variable (pension fund performance) is grossly 40.3% explained by independent variables and effectively explained by 20.26%. Therefore, our fitted model is

 $P_{returns} = 212.12 + 0.64 inflation \_rates - 1.17 exchange \_rates + 0.42$ 

unemployment \_ rates - 1.32inctax \_ rates - 0.529interest\_rates. (3)

According to our covariate selection procedures, exchange rates proved to be better in explaining the performance of pension funds in the South African economy. This is supported by a small p value close to 0.05 and a small AIC value of 10.5975. On the other hand, although inflation rates have a larger p-value, they have small AIC values which suggest their strength in explaining pension fund performance. Other variables have quite large both AIC values and p-values but they are also important in explaining the pension fund performance. The summary for variable-AIC values is shown in Table 4.

Table 4. AIC values summary

Variable	deviance	2 <i>n</i>	AIC
Inflation_rates	0.5955051	10	10.5955051
Exchange_rates	0.5975227	10	10.5975227
Unemployment_rates	1.28904	10	11.28904
Income_tax_rates	1.527963	10	11.527963
Interest_rates	1.150407	10	11.150407

The table above is a summary result of Akaike information criterion (AIC) used to select our model and to establish the significance of our selected market factors in explaining pension fund performance. AIC is calculated as AIC = deviance + 2n, where *n* the number of parameters in the model. The criterion is based on selecting the model with lowest possible AIC value. So we did apply the same criterion to fit our model by

evaluating each covariate based on the generated AIC values. We singly generated our values as summarised in the table above. So, from our results, we can safely consider inflation, exchange rates, interest rates, unemployment and income tax rates, respectively when fitting our model.

# Pension risk management

As part of our contribution, we identified that, there are some associations between pension returns and macro-economic variables. Such associations present some risks to pension funds and such risks should be managed. It is healthy for a pension fund to have separate and independent valuators who at regular times review and manage the fund through risks assessment. The macro-variables do present different forms of risks to pension funds. For example, inflation does reduce the value of the fund. This loss of fund value does inconvenience the fund members and trustees. As such, after analysing the cause and effect between pension returns and inflation rates, action if necessary should be quickly and well done.

Interest rates if they increase; that is if the cost of investment increases, the fund assets may lose value. This is detrimental to the fund status in the long run. Changes in interest rates normally affects the fund asset returns and overall fund investments in the long run. This means that the fund members may lose or get less than their expectations. This normally put pressure to the fund administrators. This means that, any mis-relations between pension returns and interest rates should be paid attention better at an earlier stage. On the other hand, tax rates do appear risky to the pension returns and performance in some way. Income tax and value added tax (VAT) in particular do affect the pension performance. If these tax forms increases, usually the contributions from both the employer and employee does fall. This affects the fund returns and performance in the long run. As such, an attention should be paid to the tax rates deemed to be of effect to the funds.

Other risks may rise against the pension funds. For example, the longevity risks, increases in unemployment rates. This means that, investigating the links between the variables and pension returns at first glance is of value. This gives an insight on the possibility of risks pop ups that will affect the funds. Managing such related risks, helps safeguard the retirement benefits or draw down sums of the members of the funds. Loss reserves can be calculated and projected based on the exposure of the fund to the changes in the macro-economic variables. Calculation of reserves helps to keep the fund liquid so that at any time the retirement claim comes, the members gets his benefit. Therefore, we provided an insight on the management of risks associated with macro-economic variables that normally emanates from the movements associated with variables.

## 6. Discussions and Recommendations

Our paper proved to be a different and a unique one in relation to the existing ones in literature. This paper investigated by using South African data, the impact of selected macro-economic variables on pension funds performance. We aimed to see the sensitivity of pension fund assets to various time to time physics of interest rates, exchange rates, inflation, income tax, and unemployment rates in the South African economy. To meet our objectives we used our newly formulated cause and effect model merged with a number of statistical nonparametric tests such as the correlation test, independent t-test, ANOVA, among others. From the results obtained, the performance of pension funds is greatly affected by the factors. Whenever, financial reviews are done, actuaries and fund trustees should factor in the effect of these factors. They do affect the performance of the returns in the long run. Adjustments if necessary should be done to accommodate them. As a better option, investments can be put to property and less volatile assets than equities. This can help ensure large and better returns from the funds.

#### References

 Grace Ofori-Abebrese, Robert Becker Pickson and Sherifatu Abubakari, 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) (2017).

DOI: https://doi.org/10.4102/sajems.v20i1.1703

[2] P. Antolin, Pension Fund Performance, OECD Working Papers on Insurance and Private Pensions, No. 20, OECD Publishing, © OECD, 2008.

#### DOI: https://doi.org/10.1787/240401404057

[3] P. Battacchio and F. Menoncin, Optimal pension management in a stochastic framework, Insurance: Mathematics and Economics 34(1) (2004), 79-95.

DOI: https://doi.org/10.1016/j.insmatheco.2003.11.001

- [4] J. Bulow, The Effects of Inflation on the Private Pension System, University of Chicago Press, 1982.
- [5] M. Feldstein, Private pensions and inflation, The American Economic Review 71(2) (1981), 424-428.
- [6] Financial Services Board, Annual Reports of Registrar of Pension Funds, Pretoria, Retrieved From, 1959-2014.

www.fsb.co.za/communication/reports.htm

[7] E. Vigna and S. Haberman, Optimal investment strategy for defined contribution pension schemes, Insurance: Mathematics and Economics 28(2) (2001), 233-262.

DOI: https://doi.org/10.1016/S0167-6687(00)00077-9

- [8] P. Karam, D. Muir, J. Pereira and A. Tudlashar, Macroeconomic Effects of Public Pension Reform, International Monetary Fund Working Paper, WP/10/97, International Monetary Fund, Washington, DC, 2010.
- [9] S. Kaniki and M. Ntuli, Determinants of participation in occupational pension funds by private sector workers in South Africa, The African Finance Journal 13(2) (2011), 54-79.
- [10] K. Keasy, S. Thompson and M. Bright, (Ecls), Corporate Governance, Economic Management, and Financial Issues, Oxford University Press, Oxford, 18-53.
- [11] Michael Millar and Dwayne Devonish, Attitudes, savings choices, level of knowledge and investment preferences of employees toward pensions and retirement planning: Survey evidence from Barbados, Pensions: An International Journal 14(4) (2009), 299-317.

#### DOI: https://doi.org/10.1057/pm.2009.17

[12] Nthabiseng Moleko and S. Ikhide, Pension funds evolution, reforms and trends in South Africa, International Journal of Economics and Finance Studies 9(2) (2017), 134-151.

- [13] A. H. Munnell and D. Muldoon, The impact of inflation on social security benefits, Centre for Retirement Research 2 (2008), 8-15.
- [14] Robert L. Clark and Ann Archibald McDermed, Inflation, pension benefits, and retirement, The Journal of Risk and Insurance 49(1) (1982), 19-38.

#### DOI: https://doi.org/10.2307/252574

- [15] A. Shehu, A study on financial risk analysis in pension funds investment: An implication of exchange rate exposure, Proceedings of the 8th International Conference on Innovation & Management (2011), 1301-1308.
- [16] Towers Watson, Towers Watson Global Pension Assets Study, 2014.

Retrieved from: http://www.towerswatson.com/en-AU/Press/2014/02/Global-pensionfundassets-hit-record-high-in-2013

- [17] United Nations Joint Staff Pension Board, 2008.
- [18] S. Van der Berg, Issues in South African Social Security, (Bureau for Economic Research, Stellenbosch: Working Paper 1/2002), University of Stellenbosch, Department of Economics, 2002.