

Inflation Risk Factors and Contributory Pension Wealth: Reflections on Nigeria's Old-age Poverty

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Abstract

Purpose of the article: Nigeria's shift to the Defined Contributory Scheme (DCS) is more or less questionable in terms of providing economic security for the senior citizens and preventing old age poverty. The 2004 and 2014 pension reforms sought to conform to pension theory; yet, there could be greater critical risks such as inflation risk factors. This study therefore examined how inflation risk factors impact pension wealth in Nigeria.

Methods: The Structured Autoregressive Distribution Lag (ARDL) to the co-integration approach is employed to determine the relationships between inflation risk factors and investment returns of selected Nigerian pension fund administrators for the period 2009–2014.

Scientific aim: This study sought the evidence to support the impact of inflation risk factors on pension wealth in Nigeria following the switch to the DCS based on the theoretical link between the investment returns and inflation rate.

Findings: Inflation and world oil prices adversely affected the asset returns of pension funds management burgeoning vulnerabilities to old age poverty.

Conclusions: Pension wealth of Nigerians at the cumulating phase is at high risk to inflation risk factors, and is reasonably justified with the negative relationship with the exchange rate factors and world oil prices. The study suggests that inflation, exchange rate risk, and world oil price risk must be strategically tackled with farsighted multi-faceted fiscal and monetary measures to reduce social insecurity and vulnerability to old age poverty. The government should consider promoting the flotation of inflation-indexed bonds and urgently consider imposing a guaranteed returned pension plan (GRPP) to reduce the inflation risk in the accumulating phase of the DCS, while workers should consider increasing their contributions to mitigate inflation risk factors. Insurance life annuities can also provide inflation insurance linked to inflation-indexed bonds.

Keywords: contributory pension wealth, inflation risks factors, old-age poverty

JEL classification: H55, E31, I32

Introduction

The World Bank (1994) pre-empted a global old-age-poverty crisis due to pension risks and therefore advised a switch from the defined benefit scheme (DBS) to the defined contributory scheme (DCS). Although Broadbent *et al.* (2006) alluded the switch to an historical rationale of workers mobility which emanated from the shifting industrial structure and labour composition, inflation and other actuarial risks were identified by the World Bank (1994) as major components of pension risks under the DBS necessitating a major reform. Others like Bodie (1990); Baker *et al.* (2005) identified longevity, investment and inflation risks as the major risks of the money purchase plan, the main variant of the defined contributory scheme (DCS) adopted in Nigeria. According to Maginn *et al.* (2007), inflation erodes values and is used to form expectations of capital market performance and other investment instruments. It is therefore crucial to understand the inflation risk in managing contractual savings such as pension funds in a developing economy such as Nigeria. The popular local business media have consistently screamed on the possible negative effect of inflation and currency risk on pension assets. Barr (1992; 2002) underscored the effects of macro-economic shocks on pension fund.

Unah (2016), citing the "Business Day" analysis, reported that the dollar value of pension assets dropped by US\$ 10 billion (53%; *i.e.* from US\$ 29.3 billion to US\$ 19.3 billion) between 2014 and August 2016. Even though the contributions grew by 28.3%, the inflation rate galloped from single digits to 17.9% almost wiping off the investment gains within the same period. The inflation risk could either be the signals of uncertainty in the general business environment, or the peculiarity of investors' portfolios which is reflected in the exposure (possibility of loss) to economic cycles or the inflation level (Hördahl, Tristani, 2012).

Although one of the objectives of the Pension Reform Act (2004) in Nigeria is to ensure that pensioners are able to get their pensions as at when due; this objective seems not to imbed the inflation risk and adequacy of pension wealth. The systemic reform of 2004 that switched from the DBS to DCS transferred the pension risk from the employer to the employee (Pesando, 1982; Madrid, 2005) with the implication that the employee may suffer the value erosion of the pension wealth. The 2014 pension reform sought to possibly reduce the pension risk by increasing the contribution rate from 15% to 18% without the inflation risk management factored in.

But generally, a universal guiding light to reduce risk impacting the pension fund is propagated by the World Bank's (1994) "averting old age poverty" recommendations which included promoting a sound financial market which presumably should manage inflation. Holzmann, Hinz, (2005) further suggested social and political solutions to ensuring adequacy, sustainability, affordability and a robust pension system. Since then, a plethora of studies have corroborated critical factors that accentuate the pension risks in the DCS (Barr, 2002).

For this reason, Bodie (1990) noted that social security benefits are inflation-indexed in the United States but many private pensions are not inflation protected and in particular the insurance annuity market (Lazar, 2007). Inflation-indexing aims to ensure that accumulated pension returns prices are immunized from inflation (Lazar, 2007). Furthermore, there is continuing debate on how the inflation risk affects strategic asset allocation, *i.e.* real returns on cash and bonds (Bekaert *et al.* 2010). The study is thus motivated to understand that the extent inflation risk is crucial to contributory pension wealth and avert old age poverty in Nigeria. The study conjectures that pension wealth will be adversely affected by the inflation risk which is factored by the effects of the

foreign exchange risk and world oil prices. The corollary is that inflation risks may be managed by parametric reforms instead of the pragmatic financial architecture. The parametric reform is when parameters of the pension scheme are amended such as the retirement age, contribution rate, commutation rate, *etc.* (Nickel, Almenberg, 2006). The study will significantly uncover extent inflation risk has undermined the salient but unstated objective of the Pension Reform Act (2004, 2014), that is, to ensure adequate and affordable pension wealth which is the global social security objective (Modigliani, Muralidhar, 2005). Studies in the past focused more on the relationship between inflation and the DBS. To the best of the knowledge of the authors none of them has considered the empirics of inflation on the DCS assets particularly in developing economies having double-digit inflation. The paper adds to the pathological studies and extends the knowledge on the challenges of averting old age poverty particularly in developing economies having significant inflation risks which includes world oil prices and exchange rates.

1. Literature Review

The DCS generally describes the financial arrangement where contributions are determined in advance and accumulated in individuals' accounts, invested and used to purchase their pension benefits (Pritchett *et al.* 1996; Booth *et al.* 2005; Nickel, Almenberg, 2006). The accumulated amount prior to run-down as benefits is the pension wealth. According to Burkhauser (1979), the pension wealth consists in the assets representing the present value of future benefits. Thus, the pension wealth is exposed to inflation and investment risks (Bodie, 1990).

Pre and post retirement periods are exposed to the inflation risk. Inflation generally known as "rising prices" and deflation

"falling prices" (Maginn *et al.* 2007, p. 179) has attendant consequences on the erosion of the purchasing value of the domestic currency (Ahlgrim, D'Arcy, 2012), and investment returns. This erodes the value of the pension wealth to the extent that Nigeria's senior citizens are vulnerable to old age poverty. Theoretically, the inflation risk is connected to other risks such as the foreign exchange risk and commodity prices such as oil. Its relationship with the expected investment returns is also established in the finance theory (Brigham, Ehrhardt, 2014). A fundamental study by Bodie (1990) identified five risks – inflation, investment, insurance, longevity, and social security risks – as the chief risks in the DCS. In The implication of unmanaged inflation risk in the DCS regime is a cesspit for old age poverty (Ionescu, 2013), and in particular for a fragile social security system in Nigeria.

1.1 Empirical Review

Nearly all the studies in literature on this subject were conceptual and theoretical discourses and others were empirical analyses of relationship between inflation and various financial assets (see Fama, Schwert, 1977; Gultekin, 1983; Swiss, 2010). Although academics have agreed more or less that real interest tends to be stable and positive over the long period; Leuthold (1981) threw more light on the relationship between the interest rate (returns on portfolios) and the inflation rate, arguing that the interest rate rises above average levels during both periods of inflation and deflation. Evidence of the real interest rate as a natural phenomenon was provided by showing yields on US bonds averaged three per cent less than inflation in 1960–1970. Feldstein (1982) corroborates this idea that pension benefits are eroded by inflation even though Fishers' (1906; 1930) works on the independence of the inflation rate and the real rate of interest has been effectively challenged due to the effect of taxes in modern economy.

A forerunner to understanding the impact of the inflation risk on the pension wealth is to pour through the literature on inflation and financial assets, since the pension wealth arises from the portfolio of these assets. Various studies examined the effect of inflation on various financial assets. From Fama (1975)'s finding that the real interest is approximately stable which has been contested in high inflationary environment; Fama, Schwert (1977) supported by Gultekin (1983), who used 26 countries, considered the real estate as the best hedge against the inflation, government bonds and bills also correlate positively while stocks is negative in the short run and not causal. A moderated view came from Boudoukh, Richardson (1993), who found the relevance for Fisher's effect on the long-run relationship between equity returns, while the short-term relationship conforms to Fama (1975) result. Identically, Solnik, Solnik (1997) confirmed the long run relationship using eight countries; Schotman, Schweitzer (2000) confirmed the relevance of the investment horizon; while Swiss (2010) gave evidence for high correlation of inflation to returns on real estate, commodities and Treasury bills, while correlations with stocks and long-term bonds are negative. It is not surprising that Bekaert *et al.* (2010) infer that hedging against inflation is difficult to achieve using stocks and bonds. From the foregoing, inflation can be mitigated by real estate and bonds in the short term and stocks in the long term but negatively related to short-term investment in equities and long-term investment in bonds.

A reflection on Feldstein (1982) is a starting point on pension and inflation relationship. He recalls that the academic discourse on pension and inflation focused on the adverse effect of inflation on performance of pension managers and benefit payments to retirees or their beneficiaries. The later represents the most difficult area in pension and social security reforms (Murthi *et al.* 1999). Feldstein also posited that inflation reduces

the yield on equities but no effect on debts. That implies inflation will erode monthly pension contributions and benefit continually if invested more in equities. On the contrary, Huber (1983), citing Schaafsma's (1981) study, cautions that inflation had no impact on Canadian retirees' income by examining a retired professor and his spouse income in retirement. The computations of 94.7% yield on assets including 3% pension indexation in 10 years outpaced the CPI index of 74.4%. Huber (1983) recomputed the yield and concluded that real benefits fell by 10% despite the Canadian pension indexation. Some countries such as the UK, Australia, Israel, Chile and Mexico therefore offer inflation insurance products. In another approach, Bodie (1990) investigated how to provide inflation insurance using the option pricing theory.

Regan (1980) provided insights to pension managers' investment behaviour by tracking their history in US showing that assets are allocated more to equities (about 69%) during bulls and less during bears. This implies an attitude to mitigate the inflation risk based on actuarial assumptions of projecting pension liabilities. Clark, McDermed (1982) formulated the models and performed the sensitivity analysis for the impact of inflationary effects on the DBS and concluded that inflation alters the pension wealth and erodes benefit payments and affects retirement decisions.

1.2 Theoretical Framing

The theoretical foundation of inflation as the "rise in the general level of prices" can be found in Pigou (1917) accompanied by dire consequences such as a decline in the purchasing power of retirees as they can no longer demand pay rise (Ahlgrim, D'Arcy, 2012). According to him, the meaning and definition of inflation can be attached to four sources: first, a too rapid increase in the volume of currency or bank money; secondly the premium attached to the holding of gold (in a country with the gold standard), and thi-

rdly the movement in foreign exchange and fourth, credit expansion to industrialists during periods of economic boom and concomitant expansion in currency. Sowell (2004) rationalizes these factors to two: supply and demand for production and supply of money. But where there is limitation on money supply, inflation is attributable to 1) cost-push and 2) demand-pull – the basis for Phillips 1958 curve (Baghestani, AbuAl-Foul, 2010). Both factors seems to be quite active in Nigeria with a surging population, weak productive base and highly dependent on oil as its foreign currency earner. Price volatility due to these shocks results in the annual double-digit inflation rate. In addition to these broad drivers, Ahlgrim, D'Arcy (2012) supported the ideational of weakened sources of foreign exchange as a source of inflation. Sheedy (2010) identified economic inertia where the influence of previous inflation regime drives future prices higher. For all monetary economists, money supply is the driving force, while others insist that money supply only affects the interest rate, rather than inflation (Harvey, 2011).

The relationship between inflation and investment returns occupies a long line of research. It rides on Fisher's (1906) model of the interest rate and inflation rate popularly referred to as the Fisher's effect. This is still a sufficient natural law of nominal interest rate equals "real" interest plus inflation rates (Chandra, 2005). Bekaert *et al.* (2010) modelled returns in terms of inflation risk as: nominal return = $\alpha + \beta$ inflation + ε ; where beta (β) is inflation risk premia which investors pay for bearing the inflation risk. Subsequently, return/risk exponents espoused this core to portfolio theory where the return on portfolios equals the risk-free return plus market risk premia (Brigham, Ehrhardt, 2014). The risk premia is allocated to as many sources of market risks depending on the conceptual principles. Even though there were contradictory results on asset returns and inflation due to investment horizon (see Stock, Watson, 2003), Booth *et al.* (2005) illustrated pension return

projections (adjusted for price inflation) and defined the following variables of discrete time which is adopted as the model specification, as well as Bekaert *et al.* (2010)'s inflation risk premia equation:

f(T) is the projected fund after *T* periods in real units, *c(t)* is the real contribution paid at end of period *t*, *i* is the projected real investment return per period, *aR* is the projected value of annuity at retirement age, *T* is the number of periods up to retirement age, *e₁* is the expense fraction for contributions, and *e₂* is the expense loading for annuity purchase. The projected fund at retirement in real currency units is given by *T* and,

$$f(T) = f(0)(1+i)^T + (1-e_1) \sum_{t=1}^T cr(t)(1+i)^{T-t}. \quad (1)$$

For some individuals, it may be reasonable to assume that the contribution will grow broadly in line with price inflation. If so, then *c(t)* will be a constant in real currency units; hence, we can write *c(t) = c*. Then the Future Value of *c* in *T* period is represented by .

$$FV_c = c \left[\frac{(1+i)^T - 1}{i} \right]. \quad (2)$$

The formula for the projected fund then simplifies to

$$f(T) = f(0)(1+i)^T + (1-e_1)FV_c. \quad (3)$$

In the case of Nigeria, the contribution is currently fixed at 18% (employer –10% and employee 8%) of the salary (Pension Reform Act, 2014) without any regulation on price valorisation. It implies that the pension wealth is open to the vagaries of inflation. The projected pension wealth at retirement is given by real projected pension wealth:

$$f(T) = \frac{f(0)(1+i)^T + (1-e_1)FV_c}{aR(1+e_2)}. \quad (4)$$

To project the member's benefits as a fraction of final salary we require the following additional variables.

Where:

- $S(t)$ the member's real salary after t periods;
- j the real rate of salary escalation (including promotional increases);
- $cr(t)$ the contribution as a fraction of salary paid at the end of period t .

The projected fund as a fraction of final salary is paid by

$$f(T) = f(0)(1+i)^T + \sum_{t=1}^T cr(t)s(t)(1+i)^{(T-t)}. \quad (5)$$

We assume that the member's salary grows at the fixed real compound rate j , so that:

$$s(T) = s(0)(1+j)^T \quad t=1 \quad s(T).$$

Using the above formula to substitute for $s(t)$ and $s(T)$ in the expression for the projected fund gives:

$$\frac{f(T)}{s(T)} = \frac{f(0)}{s(0)} \frac{(1+i)^T}{(1+j)^T} + (1-e_1) \sum_{t=1}^T cr(t) \frac{(1+i)^{T-t}}{(1+j)^T}. \quad (6)$$

According to Clark, McDermed (1982), modelling inflationary effects implies that the above equation becomes:

$$\frac{f(T)}{s(T)} = \frac{f(0)}{s(0)} \frac{(1+i)^T}{(1+j)(1+r)^T} + (1-e_1) \sum_{t=1}^T cr(t) \frac{(1+i)^{T-t}}{(1+j)^T}. \quad (7)$$

Where r above represents the inflation risk. This projection also implies that the pension wealth is inversely related to inflation rate changes or inflation risk theoretically.

2. Data and Methodology

Data on pension asset prices on a monthly basis were obtained for 2009–2014 from 14 out of the 21 licensed PFAs (about 67%) on the voluntary basis because some of the pension managers were very reluctant to release

their asset values. From this, the monthly asset returns were calculated. The monthly inflation rate, exchange rate, and world oil prices were obtained from the Central Bank of Nigeria statistical bulletins. The Structured Autoregressive Distribution Lag (ARDL) econometric technique was adopted to test the short-term and long-term dynamic relationships in view of the mixed stationarity that may occur.

In general, pension funds administrators' hold the portfolio of securities with ex ante target return and diversified risk base as follows:

$$E(R_p) = \sum_{j=1}^n w_j E(R_j), \quad (8)$$

where:

- w_i represents weights of investment assets subject to risks-commodity, currency, and inflation (Fabozzi, Modigliani, 2003).

Since this study follows the ARDL approach to co-integration, I will first determine the optimum lag length using Akaike information criterion (AIC) and Schwarz information criterion (SIC), which is based on the determinant of the covariance matrix derivable from the VAR contemporaneous error term (Ω). Thus:

$$|\hat{\Omega}| = \sum_t \frac{u_t u_t'}{T}. \quad (9)$$

The maximum likelihood function for equation 9 can be defined as:

$$like = 0.5(\log 2\pi + 1)TK - 0.5T \left(\log |\hat{\Omega}| \right). \quad (10)$$

Based on the estimated likelihood, the value in Equation 10, the AIC and SIC, can be represented as follows:

$$SIC = n \left(\log \frac{T}{T} \right) - 2 \left(\frac{like}{T} \right), \quad (11)$$

$$AIC = -2 \left(\frac{\text{like} + n}{T} \right). \quad (12)$$

The results of these information criteria are reported in Table 2. While the SIC selects one as the optimal lag time, the AIC supports three lag optimal times. The SIC selection is considered and the ARDL representation is expressed in lag one as follows:

$$pfp_t = \chi + \lambda_1 pfp_{t-1} + \alpha_1 erp_{t-1} + \beta_1 inf_{t-1} + \phi_1 wop_{t-1} + v_t, \quad (13)$$

where:

pfp_t , erp_t , inf_t , wop_t represent equally weighted monthly prices of PFA, the monthly exchange rate price; monthly inflation and monthly oil commodity price respectively.

In applying the ARDL approach to co-integration, certain assumptions must not be violated. These are:

- (i) Any of the interested variables in Equation 12 must not be integrated of order two.
- (ii) The ARDL process of Equation 12 must be covariance or weakly stationary.
- (iii) The residual term (v_t) of the ARDL process of equation 12 must be truly white noise with zero mean and constant variance positively finite over time. That is $v_t \sim WN(0, h)$.

These three assumptions are considered as pre bound test to co-integration and they are tested using the Augmented Dickey Fuller (ADF) test, stability test and Breusch-Godfrey serial correlation LM test respectively. Each of these tests is discussed as follows:

The ADF test is conducted under the assumption of drift no deterministic time trend. The structure of the ADF equation is given as:

$$\Delta x_t = \alpha_0 + \phi_1 x_{t-1} + \theta_1 \Delta x_{t-1} + \mu_t, \quad (14)$$

where:

x_t the interested variable and the DF statistic is given as:

$$DF = \frac{\hat{\phi}_1}{SE}. \quad (15)$$

The DF statistic must be greater than the asymptotic Mackinnon critical value for the null hypothesis of unit root to be rejected. The results of this test are reported in (Table 1).

Test for ergodicity or stability of the ARDL process is based on covariance stationary test which can be conducted using the following equations:

$$x_t = \lambda_0 + \lambda_1 x_{t-1} + e_t. \quad (16)$$

Impose additional one lag to Equation 16:

$$x_{t-1} = \lambda_0 + \lambda_1 x_{t-2} + e_{t-1}. \quad (17)$$

Substitute the value of x_{t-1} in Equation 16:

$$x_t = \lambda_0 (1 + \lambda_1 + \dots) + (e_t + \lambda_1 e_{t-1} + \dots). \quad (18)$$

Continue the process and factor the similar terms to have:

$$x_t = \lambda_0 (1 + \lambda_1 + \dots) + (e_t + \lambda_1 e_{t-1} + \dots) \quad (19)$$

$$x_t = \lambda_0 \left(\sum_i \lambda_1^i \right) + \left(\sum_j \lambda_1^j e_{t-j} \right); i = j = 0, 1, \dots \quad (20)$$

Take the expectation of Equation 20 to have:

$$E(x_t) = \lambda_0 \left(\sum_i \lambda_1^i \right) + 0 \equiv \mu, \quad (21)$$

$$E(x_t) = \lambda_0 \left(\sum_i \lambda_1^i \right) \equiv \mu. \quad (22)$$

The ARDL process of Equation 17 would be stable or ergodic if $|\lambda_1^i| < 1$. That is $\sum_i \lambda_1^i$ converges to the finite limit

$$\frac{1}{(1 - \lambda_1^i)}$$

and all the roots λ_i^i 's lie in the unit interval. The results of this test is reported in Table 4. The LM serial correlation test is conducted based on the residuals of Equation 13 and it can be expressed as:

$$v_t = c + p_1v_{t-1} + p_2v_{t-1} + p_3v_{t-3} + p_4v_{t-4} + p_5v_{t-5} + w_t. \tag{23}$$

Obtain the coefficient of determination R^2 and multiply it by (N) . Compare the outcome with chi-square (x^2) statistic at lag one to five. The results of this test are reported in Table 4.

At the climax of these three tests, the ARDL approach to co-integration can be conducted based on the following specifications.

We can now develop the unrestricted error correction model (ECM) from Equation 13 which is a typical long run equation.

$$\begin{aligned} \Delta pfp_t &= \chi + \lambda_1 \Delta pfp_{t-1} + \alpha_1 \Delta erp_{t-1} + \\ &+ \beta_1 \Delta inf_{t-1} + \phi_1 \Delta wop_{t-1} + \lambda_1 pfp_{t-1} + \\ &+ \alpha_1 erp_{t-1} + \beta_1 inf_{t-1} + \phi_1 wop_{t-1} + v_t. \end{aligned} \tag{24}$$

Equation 24 is called the unrestricted ECM because the parameters of the long-term component of the equation are not yet restricted to one. We can restrict these parameters to one and have the restricted ECM. Thus:

$$v_t = pfp_t - \lambda_1 pfp_{t-1} - \alpha_1 erp_{t-1} - \beta_1 inf_{t-1} - \phi_1 wop_{t-1}, \tag{25}$$

$$\begin{aligned} \Delta pfp_t &= \chi + \lambda_1 \Delta pfp_{t-1} + \alpha_1 \Delta erp_{t-1} + \\ &+ \beta_1 \Delta inf_{t-1} + \phi_1 \Delta wop_{t-1} + v_{t-1}, \end{aligned} \tag{26}$$

where:

v_{t-1} the ECM parameter and Equation 26 is called the restricted ECM.

The estimations of this equation are reported in Tables 5 and 6 respectively. We then conduct the Wald test and obtain the F-statistic which is compare with the Paseran's lower and upper bound statistic to ascertain the long-term relationship of the system. The test results are reported in Table 7.

3. Results and Discussion

The ADF test was conducted and the results are shown in Table 1.

The ADF test results in Table 1 show that the data series of the pension fund return (PFR), inflation (INF) and exchange rate (EXP) prices display absolute ADF values $-9.16, -10.43$ and -8.00 respectively at the first difference or when integrated to order 1 [I(1)] and world oil prices -2.90 critical value is observed at 5 per cent level. This suggests that the three variable series are I(1) stationary. But the world oil price attain stationarity at the level and so it is I(0) stationary. This is a clear case of multi-levelled stationarity or multi-cointegration which the Johansen multivariate co-integration technique cannot handle, I therefore resort to a special case of univariate co-integration called the ARDL approach to co-integration. Since the ARDL is a distributed lag process, the optimal lag time using information selection criteria are determined and the results are reported in (Table 2).

Table 2 reports the statistics of the final prediction error (FPE), Akaike Information

Table 1. ADF Unit Root Test on the Series of WOP, PFP, INF and ERP.

Data Series	ADF-Stat	0.5 Critical-Value	P-Value
WOP I(0)	-2.942991	-2.904198	0.0456
PFR I(1)	-9.159966	-2.904198	0.0000
INF I(1)	-10.42736	-2.904198	0.0001
EXP I(1)	-7.999229	-2.904848	0.0000

Source: Author's computation using E-view Window 9.

Table 2. Optimum lag selection for the ARDL process containing WOP, PRP, INF and ERP over a sample size (Jan 2009 – Dec 2014).

Lag	Logl	LR	FPE	AIC	SIC	HIQ
0	-497.5602	NA	46.86608	15.19879	15.33150	15.25123
1	-193.6093	561.8486	0.007617	6.473009	7.136541*	6.735202*
2	-182.4723	19.23664	0.008877	6.620373	7.814730	7.092320
3	-158.8998	37.85887*	0.007156*	6.390903*	8.116086	7.072605
4	-148.5154	15.41926	0.008713	6.561073	8.817081	7.452529
5	-139.0336	12.92973	0.011094	6.758594	9.545427	7.859804

Source: Author's computation using E-view Window 9.

Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan Quinn Information Criteria (HIC).

In each case, the smallest statistic gives the maximum/optimum lag. In view of this, the SIC and HIC choose lag one while the FPE and AIC select lag three. However, to keep our model precise, I developed the ARDL model of order one. That is the ARDL (1, 1, 1, 1) model. We check for the ergodicity or stability of the model and the results are

shown in Table 3 and Figure 1 respectively.

The value of the modulus 0.22 is relatively very small and less than unity. Therefore, the ARDL model developed for this study is stable. We corroborate this test by virtually examining the root in the cycle below:

The AR root marked in blue colour is found to be located in or within the unit cycle and by indication the process is stable confirming my earlier position. The next step is to test if the residual of the ARDL is identically and independently distributed (IID) with zero mean and constant variance. (Table 4) reports the results of this test.

As shown in Table 4, I examined the residuals of the ARDL for serial correlation test up to lag five. In the first lag, the hypothesis of no serial correlation is rejected because

Table 3. Stability test of the ARDL process containing WOP, PRP, INF and ERP.

AR-Root	Modulus	Cycle
-0.215296	0.215296	

Source: Author's computation using E-view Window 9.

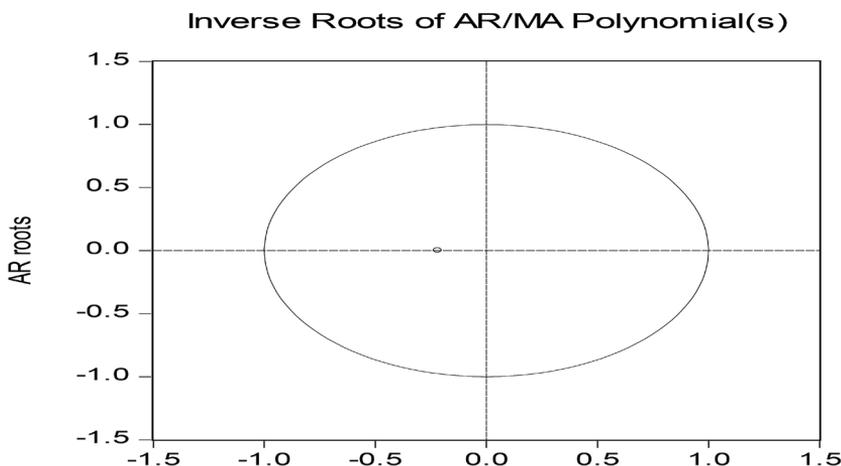


Figure 1. AR root of the ARDL process containing WOP, PFR INF and EXP.

Source: Author's output using E-view Window 9.

Table 4. LM Test on the residual of the ARDL process containing WOP, PRF, INF and EXP.

Lag	LM-Stat	P-Value
1	5.724600	0.0167
2	0.050403	0.8224
3	1.098316	0.2946
4	0.009604	0.9219
5	2.656176	0.1031

Source: Author's computation using E-view Window 9.

Table 5. Results of the bound test to co-integration among WOP, PFR, EXP and INF based on t-Value.

Test statistic	Value	DF	P-Value
F-statistic	3.801878	(4, 52)	0.0087
Chi-square	15.207510	4	0.0043

Source: Author's computation using E-view Window 9.

the p-value 0.01 corresponding to this lag is less than the alpha value at 1 per cent. However, the p-values of the subsequent lags or LM statistics are larger than the alpha value at 1 per cent or even at 10 per cent. Thus, there is strong evidence that the residuals are not serially correlated. Since our specified variables are stationary at levels but none of them is I(2), the ARDL process is stable and the residuals are independent, we can proceed to the ARDL or bound test to co-integration. Table 5 shows the results of this test.

The observed F-statistic is approximately 3.80 as revealed in Table 5; the lower bound I(0) and upper bound I(1) from the Pesaran, Shin, Smith (2001). F-statistics are 2.72 and 3.77 at 10%, 3.23 and 4.35 at 5%, 4.29 and 5.61 at 1% based on unconstrained intercept and no trend assumption. It is obvious that the observed F statistic falls above the 10%

upper bound suggesting that at this level of significance, there is a long-term relationship between changes in the pension fund return, exchange rate price, inflation and world oil price. In essence, the return on pension portfolio or investment co-integrates with the inflation risk, exchange rate risk and world oil price risk. Therefore, in Nigeria, pensioners' wealth which is strongly rooted in their long-term investment returns in the pool of pension fund returns maintains the long-term relationship with certain macroeconomic risks which are identified as the inflation risk, exchange rate price risk and world oil price risk. The dynamic nature of this relationship can be examined in two ways as short-term and long-term. We consider the long-term first and the results are reported in Table 6.

Table 6 shows that the coefficients of immediate previous values of (PFR), (EXP), (WOP) and (INF) are 0.001, -0.0002 and 0.001 respectively. This means a one per cent increase in lag one month PFR, EXP, WOP and INF increases the current return on the pension fund portfolio by 99%, 0.1%, and 0.05% respectively but a 1 per cent increase in lag one month WOP decreases the current return on the pension fund portfolio by 0.02%. As indicated by p-value, it is only the lag one month PFR that has a significant long-term relationship. Therefore, previous prices in the pension fund significantly increase future returns of the pension wealth. Previous inflation, the exchange rate and inflation have no significant long-term influence on the current return on the pension fund portfolio. Impliedly, it means investment strategies of the pension managers are

Table 6. Long-term dynamic relationship between PFR, WOP, EXP and INF.

Variable	Coefficient	St-error	t-Value	P-Value
PFR(-1)	0.992333	0.021206	46.794600	0.0000
EXP(-1)	0.001461	0.001601	0.912426	0.3649
WOP(-1)	-0.000176	0.000243	-0.722342	0.4726
INF(-1)	0.000520	0.001917	0.271156	0.7871

Source: Author's computation using E-view Window 9.

Table 7. Short-term dynamic relationship between PFR, WOP, EXP and INF.

Variable	Coefficient	St-error	t-Value	P-Value
D(PFR(-1))	2.097160	1.022240	2.051534	0.0443
D(EXP(-1))	-0.003528	0.002488	-1.418048	0.1610
D(WOP(-1))	0.000494	0.000482	1.025663	0.3089
D(INF(-1))	0.001733	0.002690	0.644281	0.5217
ECM(-1)	-2.247712	1.032650	-2.176645	0.0332

Source: Author's computation using E-view Window 9.

stable or passive with little or no portfolio balancing particularly in view of the tight investment regulation. The long-term relationship may have been affected by the period of study 2009–2014 monthly returns. It is worth noting that there is a long-term relationship even though it is marginal between the inflation risk factors and pension wealth. In particular, changes in world oil prices will negatively affect the pension wealth.

The results of the short-term dynamic relationship are reported in Table 7 and they reveal a significant p-value only on lag one month changes in PFR. Also, there is a significant short-term dynamic between lag one month changes in PFR and the current changes in PFR. The EXP has a negative and insignificant dynamic short-term impact on the current changes in the PFR while the WOP and INF maintain an insignificant positive influence. However, the equilibrium parameter ECM (-1) -2.25 has the a priori sign (-) and significant at 5 per cent level. This suggests that about 225 per cent disequilibrium in the relationship between the PFR, EXP, WOP and INF will be corrected or restored within a period of one month. This represents mixed results except for the lag one month on current value of pension wealth confirm the long run behaviour. Only the exchange rate has a negative effect on changes in pension wealth while world oil prices and inflation may be bolstering interest rates in the short term to influence the pension wealth positively. But worrisomely, they are all insignificant, suggesting that returns or the interest rate are independent of inflation risk

factors. Or possibly, the Fisher's theory is less applicable to the Nigerian financial environment, or it concurs to Wicksellian's view that the interest rate is determined naturally and exogenously.

4. Conclusion

The ARDL model chosen for the study is found to be suitable at $\alpha = 0.05$ and $F = 3.8$. There is supporting evidence that there is the short- and long-term relationship between changes in the pension fund returns or wealth with inflation risk factors (the exchange rate, inflation rate and world oil price changes). While the exchange rate and world oil prices are significant, the inflation rate was not significant. Even though the result of short- and long-term influence of the inflation rate on pension wealth are insignificant but a priori signs are noteworthy. The dynamic relationship indicates that previous prices of pension assets influence future prices by 99%. This means that the pension wealth has been incremental. Implicitly, the investment decision-making strategy by the PFAs may have been significantly stable and progressive. However, the pension wealth is associated negatively with changes in world oil prices and the exchange rate in the long term, which aligns with a-priori expectation of the grounded theory. Strangely enough, the inflation rate was not significant, which suggests that investment returns are more linked to the exchange rates and world oil prices. The hypothetical position of this stu-

dy that the pension wealth of Nigerians at the cumulating phase is at high risk to the inflation risk factors is reasonably justified with the negative relationship with the exchange rate factors and world oil prices.

Even though the result of short- and long-term influence of the inflation risk on the pension wealth is insignificant but a-priori signs are noteworthy. The inflation rate, oil price movement and the exchange rate in particular must be managed in a DCS in Nigeria, because it is the employee-risk pension plan with the concomitant exposure to old age-poverty. Otherwise, the pension wealth is further endangered. The pension reform in Nigeria should urgently consider imposing

a guaranteed returned pension plan (GRPP) as projected in Modigliani and Muralidhar's (2005) DCS management. Inflation-indexed bonds should be floated by the Federal Government that mirrors the inflation rate or world oil prices or exchange rates to protect the investment returns of pensions from the ravages of inflation risk factors. Retirement account holders should be empowered through financial literacy programmes to understand and set up their pension targets and wealth and as such to be able to opt to take up an additional private pension plan. Insurance life annuities can also provide inflation insurance linked to inflation-indexed bonds (Barr, 1992).

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