SYSTEMATIC PENSION PLAN AND ITS PAYOUT PHASE IN FEDERAL UNIVERSITIES IN NIGERIA

[+1]**Joshua S. ADEYELE** (*Ph.D)*
[1]Department of Actuarial Science,
University of Jos, Jos, Nigeria
[+]*Corresponding Author - e-mail:* adesolojosh@gmail.com

[2]**Mohammed N. MAITURARE** (*Ph.D.*)
[2]Professor, Department of Actuarial Science & Insurance,
Ahmadu Bello University, Zaria, Nigeria

Abstract:

Accumulation phase of Defined Contribution (DC) pension represents a critical period where the regulator and DC beneficiaries need to monitor how contributed funds are invested to grow into sufficient funds for old age security. However, more critical in DC pension is the payout phase which has to do with different actuarial models for converting the accumulated funds into streams of retirement income. This has not received much research efforts. This study combines the two phases by modeling accumulated funds for retirement income options. Data for employees' salaries for different grade levels were collected from one of the federal universities in Nigeria. The salaries data collected were used to compute accumulated funds while the 1983 Individual Annuity Mortality Table for males' lives were used to determine annuity rates from 4% to 6%. These rates were used to convert the accumulated funds into annual pension withdrawals for prospective annuitants. The findings revealed that annuity rates decrease with increasing age at any given rate of interest and age. Also, retiring employees with phased withdrawal options have more annual pension income for short payout duration than those with extended years in payout. The study recommends among other things that retiring employees need to ensure that their monthly pension contributions are remitted to their retirement saving accounts as and when due in order to accumulate sufficient funds for retirement.

Keywords: *Accumulated Funds, Annuity Rates, Payouts, Phased Withdrawals*

Classification JEL: G18, G23, J32

INTRODUCTION

Many countries around the world including Argentina, Australia, Chile, Ghana, Colombia, Mexico, Nigeria, Peru, Poland, Sweden, and Switzerland have introduced defined contribution (DC) model into their pension system (Adeyele & Imokhome, 2014). The DC model otherwise known as systematic investment plan by Adeyele (2015a) is a plan whereby both employees and employers jointly contribute defined percentage of the former's salaries throughout years of service and remit same to retirement saving accounts (RSAs) of employees until retirement age is attained. The DC model is divided into two major parts: the accumulation phase and the payout phase of retirement.

The accumulation phase is a period employees save and invest for their old age, while the payout phase otherwise called decumulation phase is the period the employees begin to withdraw funds from their retirement saving accounts (Black & Skipper, 2000). It has been acknowledged by previous studies that accumulation phase of DC represents a critical stage that the contributors as well as regulators need to pay careful attention to especially how contributed funds are invested to grow to sufficient volume for old age income (Adeyele, 2015b; Adeyele & Maiturare, 2012). The regulatory body, National Pension Commission (here after, PenCom), as part of its roles must ensure all funds are well managed and those portion representing funding gaps are depleted within the shortest time so that all statutory contributions go to employees' RSAs (Adeyele, 2015a).

However, the payout phase of DC pension is more crucial and technical than the accumulation phase as issues on how to convert accumulated funds to streams of retirement income is relatively new to the industry players and have not received necessary attention of pension scholars in Nigeria (Adeyele, 2015b). Unlike other countries in which the actuarial profession has grown to a position of prominence, Nigeria has less than 16 years' experience in DC pension, particularly about the choice of retirement income options that beneficiaries of DC pension need to make at retirement.

In the payout phase, there are two options of retirement income, namely, phased withdrawal and retiree's life annuity. Whether retirees will have stable income at retirement is a function of what they have contributed whilst in active service and the choice they make with those funds. The models for converting accumulated funds to choice of retirement income options are not well articulated by many studies in Nigeria due to relative low knowledge.

Many previous studies on pension that attempt to address issues of DC pension have either focused on accumulation phase (Adeyele & Maiturare, 2012; Ibiwoye, 2008; Ibiwoye & Adesona, 2011) or payout phase (Evans & Sherris, 2009; James & Vittas, 1999; Mitchell & Piggott, 2011; Palme & Sandgren, 2008). This implies that there is no evidence of any particular studies that has critically analysed and linked both stages of DC pension. In fact, early studies of DC pension have given more preferences to issues and challenges of the accumulation phase of DC (Ibiwoye, 2014; Palacios, 2005) with limited research on how accumulation phase can be transited to pension income thereby creating knowledge gaps for many beneficiaries of DC as they do not know what ought to be done at payout phase (Adeyele & Olujide, 2016; Adeyele & Ogungbenle, 2019; Adeyele *et al*, 2020).

Following the failure of most employers (plan sponsors) to comply with remittance of 18% of employees' monthly emolument as and when due, the PenCom in 2006 realised the need to regularly value pension assets so as to account for the amount owed to employees by their respective employers. Hence, the agency came up with regulation to standardize the procedures to be followed in carrying out such valuation exercise of pension assets which must be in accordance with the regulations issued by the body. In subsection 2.5, 2.6, and 2.7 of the guidelines issued by PenCom in 2006, the valuation of pension assets which has always been the jurisdiction of actuarial profession was delegated to Pension Fund Administrators (PFAs.).

The regulation also states the manner in which the valuation is to be conducted which is based on actual positive or negative events and not based on expected or planned accomplishment of pension assets by PFAs. The process under their control shows lack of clarity on how the pension asset should be valued. Also, the manner and frequency of the valuation exercise as stated in PenCom (2006) exposed the scheme members to investment risks and subjective opinion of PFAs that are not systematic in nature. To provide for stable and systematic valuation, there is need for actuarial intervention to ensure all past and future contributions are ascertained.

The present study therefore closes this gap by combining the two phases with relevant models for proper conversion of accumulated funds to choice of retirement income. Hence, the focus of this study on payout phase include techniques for annuity rates pricing and the expected annual pension withdrawals for both phased withdrawal and retiree's life annuity. This study will not only be of great importance to policy makers and stakeholders in the pension industry but will contribute to the body of knowledge on pension literature in Nigeria. The research outcome will also guide the current employees especially those who are close to retirement on how to go about their choice of retirement income selection at payout phase.

LITERATURE REVIEW

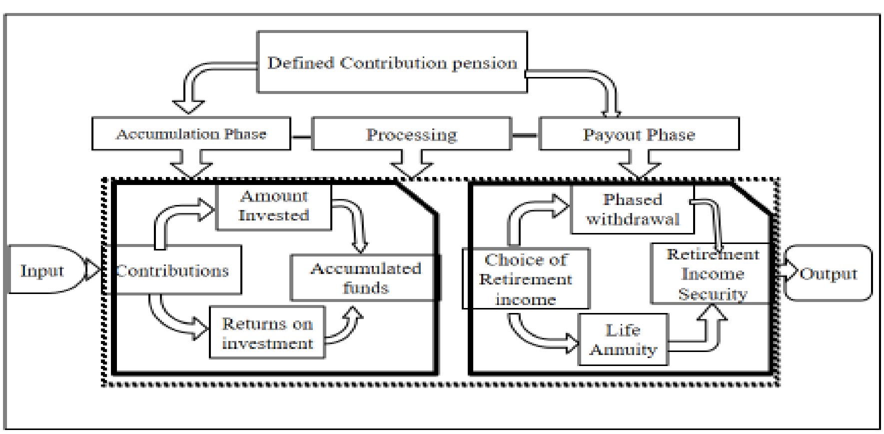
Conceptual Framework

Defined contribution retirement benefits in Nigeria allows retirees to choose from two or more benefit structures (Adeyele, 2015a). For example, in Nigeria and Chile, retiring employees can choose between a programmed withdrawal and a life annuity. Adeyele (2015b) noted that one of the major concerns about payout phase is the credibility of insurance companies and their ability to honour contracts that may last up to 30 or more years. This new retirement system has increased the structure around a benefit plan that mandates among other options the purchase of an annuity upon retirement (Pettinato *et al*, 2005).

While government payouts will likely continue to increase for many decades, it is now evident that future retirees will not be well off as they had thought (Mitchell & Piggott, 2011) due to demographic trends in almost every country (Brunton & Masci, 2005). This global age wave has heightened awareness of the financial and mortality risk that confront retirees; risk that sometimes take people by surprise (Bodie, 2000), leading to a situation described as pension 'time-bomb' by Blommestein (2000). Many countries have responded to this by reforming their pension systems by shifting to DC model which has become important sources of retirement finance the world over (Palacios & Bowlers'-Miralles, 2000).

The Chilean social security reform of 1981 gave birth to defined contribution scheme which other countries of the world adopted to share burden of pension liabilities (Iyer, 1999). On retirement of a member, the accumulated balance is mandatorily converted into an indexed pension subject to a specified minimum which is guaranteed in Chile, whereas in Nigeria, employees may have to choose between phased withdrawal and retiree's life annuity. Defined contribution pension is a funded scheme that enables both the enrollees and plan sponsors to systematically determine the expected future contributions for retirement based on defined contribution formula. If all contributions are remitted to enrollees' RSAs as and when due, it is hoped funding gap emanating from default remittances will not create any issue between the plan sponsors and beneficiaries.

The conceptual framework adopted for the study explicitly explains various links in defined contribution pension. In theory and practice, DC consists of accumulation phase which deals with the period of accumulating funds for retirement. In this case, the contributed funds are also invested (Black & Skipper, 2000). Both contributions and returns on invested funds give accumulated fund upon which employees make choice about retirement income options: the phased withdrawal and retiree's life annuity. The level of income security depends on a retirees decision. If a retiree thinks he/she has lower expectation of life at retirement and chooses phased withdrawal but eventually lives far beyond his/her expectation of life, such decision leads to financial insecurity. Likewise, if retiree chooses retiree's life annuity with the expectation of living longer but lived below the expected life span, such person will lose money to insurance companies. Whichever case, the ability of a decision maker to precisely reduce the longevity risk determines the amount of financial security.



Authors' Framework
Figure 1: Links between accumulation phased and payout phase of DC pension

Figure 1 shows the linkages in defined contribution pension. In this study, accumulation phase is considered as input while the payout phase is seen as the output stage. Thus, employees' funds in defined contribution go through the input, processing and output stages. If there exists any problem at the input stage which is the accumulation phase, the payout phase will be characterized with issues of delay in payment of funds and sometimes non-payment of pension benefit which has been the order of the day. Both the accumulation and payout phases are combined to denote the processing stage that are virtual in nature because not many pension scholars in Nigeria have found it necessary to examine the intricacies involved in defined pension scheme. Most analyses and investigations conducted among pension scholars only looked at the input stage and resulting in lack of information about the processing stage. Lack of proper understanding of the detailed processing stage of defined contribution has put many researchers on pension at disadvantage in proffering lasting solutions to existing problem with pension in the country.

Consequently, when attempting to solve problem associated with the accumulation phase, the payout phase must be critically analysed so as to identify the key problems that lead to delay in pension payment. At the same time, many pension analysts have tried to solve problems at payout phase without considering the accumulated phase where the problem originated. Consequently, going through the various stages of defined contribution will allow the problems of DC to be addressed systematically.

THEORETICAL REVIEW

Actuarial accumulated value theory in compound interest theory by Kellison (1970) and Ruckman and Francis (2005) provides useful insights into how to determine the accumulated funds of stream of payments. This theory assists in series of payments in the past and future payments. Adeyele et al (2020) redefined the actuarial accumulated value theory and termed it as recovery models to ascertain the expected funds to be remitted to employees' retirement saving accounts.

In order to liquidate the accumulated funds at retirement, scholars from different jurisdictions have advocated for the use of immediate annuities to cushion the effect of longevity risk. Immediate annuity enables DC members to exchange accumulated funds (premiums) for periodic payments of income (annuity) contingent on survival. Consequently, this study adopts two theories: actuarial accumulated value and discrete life annuities for the accumulated phase and payout phase of DC pension, respectively. The discrete annuities theory is analogous, step-by-step to the theory of continuous life annuities, with integrals replaced by sums, integrands by summands, and differentials by differences. For continuous annuities there was no distinction between payments at the beginning of payment intervals or at the end, that is, between annuities-due and annuities-immediate. For discrete annuities, the distinction is meaningful (Bowers et al, 1997), and we give a brief information about annuities-due as they have a more prominent role in actuarial applications For example, most individual life insurances are purchased by an annuity-due of periodic premiums.

We consider an annuity that pays a unit amount at the beginning of each year that the annuitant (x) survives. In the nomenclature this is called a *whole life annuity-due*. The present-value random variable, Y, for such an annuity is given by $Y = \ddot{a}_{:\overline{k+1}|}$, where the random variable k is the curtate-future-lifetime of (x). The possible values of this random variables are a discrete set of values ranging from $\ddot{a}_{:\overline{1}|}$ to $\ddot{a}_{:\overline{\omega\text{-}x}|}$, a value which is less than 1/d. The probability associated with the value $\ddot{a}_{:\overline{k+1}|}$ is

$$\Pr(K = k) = {}_k p_x q_{x+k}$$

Let us now consider $\ddot{a}_{:x}$, the actuarial present value of the annuity:

$$\ddot{a}_{:x} = E[Y] = E\left[\ddot{a}_{:\overline{x+1}|}\right] = \sum_{k=0}^{\infty} \ddot{a}_{:\overline{k+1}|\, t}\, p_x q_{x+k}, \qquad - \quad - \quad - \quad - \qquad 2.2.1$$

Since $\Pr(K = k) = {}_k p_x q_{x+k}$. By summation-by-part with

$\Delta f(t) = {}_k p_x q_{x+k} = {}_k p_x - {}_{k+1} p_x$ and g(k) $= \ddot{a}_{:\overline{k+1}|}$ and use of the relations

Δg(k) $= \Delta \ddot{a}_{:\overline{k+1}|} = v^{k+1}$ and f(k) $= -{}_k p_x$,

(2.2.1) converts to

$$\ddot{a}_{:x} = 1 + \sum_{k=0}^{\infty} v^{k+1}\, {}_{k+1} p_x \qquad - \quad - \quad - \quad - \quad - \quad - \qquad 2.2.2$$

$$= \sum_{k=0}^{\infty} v^k\, {}_k p_x \qquad - \quad - \quad - \quad - \quad - \quad - \qquad 2.2..)$$

The expression (2.3.3) is the current payment form of the actuarial present value for a whole life annuity-due where the ${}_k p_x$ term is the probability of a payment of size 1 being made at time k.

Starting with the sum in (2.2.2) above we have:

$$\ddot{a}_{:x} = 1 + \sum_{k=0}^{\infty} v^{k+1}\, {}_{k+1} p_x = 1 + v p_x \sum_{k=0}^{\infty} v^k\, {}_k p_{x+1} = 1 + v p_x \ddot{a}_{x+1}. \qquad 2.2.4$$

The models above provide impetus to details of discrete life annuities models considered in Section 3 as applicable to the present study. Whereas the present study focuses on how rates for annuities and phased withdrawals can be determined, following the step-by-step procedures will reduce employees' exposure to unwarranted risk of wrong choice of pension income at retirement options.

EMPIRICAL REVIEW

Hershey and Mowen (2000) revealed that the lack of individual financial preparedness for retirement and the rapidly changing demographic trends associated with the aging of the baby boom generation, together serve to create strong psycho-economic pressures that are felt at both the individual and societal levels. Pugh (2006) finds it counter-productive to be distracted by the current economic challenges. Bernheim *et al* (1997) revealed that the lack of retirement preparedness stems from insufficient educational opportunities aimed at cultivating positive attitudes toward saving, the tendency of individuals to overestimate the quality of their financial decisions (Hershey & Wilson, 1997), and the propensity to incorrectly estimate one's own longevity (Walsh *et al*, 1989).

In a study by Adeyele and Jim-Suleiman (2021) on public universities in Nigeria, it was found that the scheme was significantly underfunded as such funds not regularly remitted lost investment returns. They also found that low investment returns on contributed funds lead to low accumulated funds. A related study by Adeyele and Maiturare (2021) found shortfalls in accumulated funds due to irregular remittances and lack of returns on invested funds which in turn affects the choice of retirement income. For instance, those who wish to purchase retiree's life annuity may not be able to do so due to inadequate accumulated funds. Adeyele (2015b) finds that employees' perception of financial commitment to families and friends significantly leads to selection of phased withdrawal as option of retirement income.

Adeyele and Igbinosa (2015) focused on accumulation phase computation and found that DC model is complicated with irregular remittances to employees' RSAs. The complexities of irregular remittances and employees. Silence shows lack of readiness for the future income. Predictions made by financial and retirement planning experts suggest that an economic crisis looms under DC plan arrangement due to inadequate pre-retirement financial planning that has continued to worsen.

Babbel and Merril (2007) revealed that selection of annuity as old age income protects annuitants against longevity risk since steady income will be guaranteed contingent on annuitants' survival. In their report, they showed that it would cost between 25 percent and 40 percent more to achieve a similar riskless guarantee of income if retirees self-annuitised. Blake *et al* (2006) recognized retiree's life annuity as the mainstay of pension plans throughout the world.

With the tremendous increase in personal longevity witnessed in the past century (Davies & Sparrow, 1985), and given the current rate of medical advances, we can expect this trend to continue. Iyer (1999) noted that the mechanism of indexation of accumulated pension funds may be based on the cost-of-living index relating to index of earnings, and limits may apply to the extent of adjustment either in absolute terms or as a proportion. Richardson and Spence (2010) examined the economic benefit of self-annuitization (or phased withdrawal) plan and discovered that failure of retirees to understand the uncertainty associated with plans may put them into financial difficulty if things do not go according to plan.

The experiments conducted by Tversky and Kahneman (1992) also showed that for both positive and negative prospects, decision makers always overweight low probability events and underweight high probability events which in turn lead to wrong selection of retirement income option. In a study by Chen *et al* (2019), elderly retirees that have a lower possibility of surviving pay a higher price for immediate annuity products due to overestimation in their survival rate. Annuity framing by marketers has been found to make immediate annuities become more preferable for older retirees than younger retirees.

DATA DERIVATIVE AND ASSUMPTIONS

Three stages including computations of accumulated funds, rates for phased withdrawal and annuity and annual pension withdrawals were followed. In order to determine annuity rates, assumptions about expectation of life at retirement from the age of 70 was fixed to 20 years while the highest lifespan for all retirees was pegged to 90 years. The study made use of secondary data which were collected from the bursary department of one of the federal universities in Nigeria. Since the university system is homogenous in nature, data collected from any of the federal universities can be used for generalization for academic staff in all Federal Universities in Nigeria. In order to determine the annual pension withdrawal, the annuity rates computed were used to determine annual pension withdrawals based on the accumulated funds from fixed interest rates of 4% to 6.5% as shown in Table 3.

Following the models developed for accumulated funds, actuarial software was used to compute different annuity rates which were used for annual pension withdrawals.

Mathematical model – the accumulation phase of DC as shown in the conceptual framework deals with accumulation of both the contributions and returns on investment. For purpose of ascertaining pension funds at ith years, the study adopts the following formula developed by Adeyele *et al* (2020):

$$APF_i = \left[\left(1+g_f\right)^m - 1\right] / g_f \times \left\langle \sum_{i=0}^{n} C_m^{n-i} (1+r)^i \right\rangle \qquad - \quad - \quad - \quad \ldots\ldots 3.1a$$

Where

$$\left[(1+g_f)^m - 1\right]/g_f = convertable\ monthly \quad - \quad - \quad - \quad - \qquad \ldots 3.1b$$

$$g_f = r^m / m = \int_{\int} nominal\ \text{rate}$$

APFi = accumulated

$$APF_i = accumulated\ pension\ funds\ for\ i\ years;$$

n is total number of years of contribution while i represents different years of service

This model was used to arrive at pension funds for years in service as employees may retire at different ages due to health reason or other reasons.

Using 6% annual rate of return convertible monthly, accumulated nominal interest convertible monthly is shown as follow:

$$\left[(1+g_f)^m - 1\right]/g_f = \left[\left(1+\frac{0.06}{12}\right)^{12} - 1\right]/\frac{0.06}{12} = 12.34$$

$$APF_{20} = \left[(1+g_f)^m - 1\right]/g_f \times \left\langle \sum_{i=0}^{20} C_m^{20-i}(1+0.06)^{20} \right\rangle =$$

$$\left[(1+g_f)^m - 1\right]/g_f \times \left\langle \sum_{i=0}^{20} C_m^{20-i}(1.06)^{20} \right\rangle$$

If an employee assumed duty as Lecturer I and worked for only 20 years as specified in Table A in the appendix, the monthly contributions size (MCS) for each year of service is calculated as:

$$\text{MCS} = \begin{cases} C_m^{20} \Rightarrow Cr \times m_m^{20} = 0.18 \times 435{,}588.75 = 78{,}405.98 \\ C_m^{19} \Rightarrow Cr \times m_m^{19} = 0.18 \times 422{,}257.25 = 76{,}006.31 \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \\ C_m^{2} \Rightarrow Cr \times m_m^{2} = 0.18 \times 180{,}191.42 = 32{,}434.46 \\ C_m^{1} \Rightarrow Cx \times m_m^{1} = 0.18 \times 173{,}899.58 = 31{,}301.92 \end{cases}$$

Note: Cr = *contribution rate;* C_m^i = *monthly contributions for* $i = 1,2,\ldots,12$

From equation (3.1), the detailed accumulated pension funds from 1 to 20 years in service are:

$$APF_{20} = \left| \begin{array}{l} \text{Detailed accumulated funds' computation from year 1 to 20} \\ \hline A(F,M)\times C_m^{20}(1.06)^0 \Rightarrow 12.34\times 78{,}405.98\times(1.06)^0 = 967{,}181.80 + \\ A(F,M)\times C_m^{19}(1.06)^1 \Rightarrow 12.34\times 76{,}006.31\times(1.06)^1 = 937{,}380.52 + \\ A(F,M)\times C_m^{18}(1.06)^2 \Rightarrow 12.34\times 73{,}606.62\times(1.06)^2 = 907{,}979.06 + \\ \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \\ \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \\ A(F,M)\times C_m^{2}(1.06)^{18} \Rightarrow 12.34\times 32{,}434.46\times(1.06)^{18} = 400{,}097.25 + \\ A(F,M)\times C_m^{1}(1.06)^{19} \Rightarrow 12.34\times 31{,}301.92\times(1.06)^{19} = 386{,}126.84 \\ \hline APF_{20} = A(F,M)\left\langle \sum_{i=0}^{20} C_m^{20-i}(1+0.06)^{20} \right\rangle = 23{,}837{,}523.75 \end{array} \right.$$

It should be noted that ₦23,837,523.75 was obtained using software. Other computations of accumulated funds from age 50 to 70 used for retiree's life annuity pricing are obtained with the same procedures as above.

Programmed withdrawal (or Annuity Certain) models - According to Mitchell et al (1999) reported in Pettinato et al (2005), the calculations required to understand the life cycle of a single-premium annuity contract is obtained by solving two diverging trends: the compound interest that builds up the account on one side and the depletion of the account (through annuity withdrawals) on the other. Thus the present value to defray accumulated funds is given as:

Present value = $a_n = v^1 + v^2 + v^3 + \ldots\ldots + v^{n-1} + v^n$ - - - 3.2a

$a_n = (1 - v^n)/i$ - - - - - - 3.2b

Equation (3.2b) is used at payout phase to determine the amount retiring employees who favour programmed withdrawal option are likely to access at retirement. For those who would favour programmed withdrawal, their gross contributions are subject to tax only at payout phase.

(i) if the employer regularly remitted all the due contributions as and when due, and the retired employees want their retirement income to commence immediately, then the accumulated pension fund is given as follows:

$A_F^P(1 - T_d^r) - A_W^P a_n = 0 \Rightarrow A_W^P = A_F^P(1 - T_d^r)/a_{nt}$ - - - 3.3

Where A_F^P = *Accumulated pension fund* and

where A_W^P = annual pension withdrawal,
A_F^P = accumulated pension funds, a_{nt} = *present* value of future payments;
T_d^r = Tax deffered at retirement

The amount to be charged as tax on contributed funds is uncertain. As a result, the tax portion will be ignored at this level. If a retiree wishes to use his/her accumulated pension fund of 1 for phased withdrawal income, and the fund 1 is expected to be used up at the end of 15 years, the present value of 1 using equation (1a) is determined as follows:

$$a_{15} = \frac{1}{(1+i)^1} + \frac{1}{(1+i)^2} + \dots\dots + \frac{1}{(1+i)^{14}} + \frac{1}{(1+i)^{15}} = \sum_{t=1}^{15} \frac{1}{(1+i)^t}$$

$\frac{1}{(1+i)^1} = 0.995943$	$\frac{1}{(1+i)^9} = 0.836755$
$\frac{1}{(1+i)^2} = 0.995569$	$\frac{1}{(1+i)^{10}} = 0.8203483$
$\frac{1}{(1+i)^3} = 0.942322$	$\frac{1}{(1+i)^{11}} = 0.8042630$
$\frac{1}{(1+i)^4} = 0.923845$	$\frac{1}{(1+i)^{12}} = 0.788493$
$\frac{1}{(1+i)^5} = 0.905731$	$\frac{1}{(1+i)^{13}} = 0.773033$
$\frac{1}{(1+i)^6} = 0.887914$	$\frac{1}{(1+i)^{14}} = 0.757850$
$\frac{1}{(1+i)^7} = 0.870560$	$\frac{1}{(1+i)^{15}} = 0.7430145$
$\frac{1}{(1+i)^8} = 0.853490$	
$i = 0.02,$	$a_{15} = \sum_{t=1}^{15} \frac{1}{(1+i)^t} = 12.849264$

Another method for this calculation can be obtained using equation (2) as follows:

$$a_{15} = \frac{1-(1+i)^{-15}}{i} = \frac{1-1.02^{-15}}{0.02} = \frac{1-1.02^{-15}}{0.02} = \frac{0.25698527}{0.02} = 12.849264$$

Equation (3.1b) gives detailed procedures employed to perform the calculations. However, the method is rather too slow and space consuming when compared with equation (3.2). At best, equation (3.1) is very efficient and time saving if on spreadsheet.

Life Annuities models **-**A life annuity of 1 payable periodically to life aged x is a periodic payments of 1 commencing at the end of one year if the life aged x is then living and continuing throughout his life time. Its present value, denoted a_x may be expressed as the sum of a series of pure endowment value:

$$a_x = {}_1A_x + {}_2A_x + ...+ {}_{w-x-1}A_x = \sum_{t=1}^{w-x-1} {}_tA_x = \sum_{t=1}^{w-x-1} v^t {}_tP_x \text{ where } v^t = \frac{1}{(1+r)^t}. \qquad -3.4$$

Therefore, $$a_x = \frac{{}_1P_x}{(1+i)^1} + \frac{{}_2P_x}{(1+i)^2} + ...+ {}_{w-x-1}A_x = \sum_{t=1}^{w-x-1} \frac{{}_tP_x}{(1+i)^t} \qquad - \qquad -3.5$$

The ${}_tP_x$ is a probability that live age x will survive to time t. The actuarial present value in equation (3.5) can also be written as:

$$a_x = \sum_{k-1}^{\infty} v^k (1 - F_T(k)) = \sum_{k-1}^{\infty} v^k {}_kp_x \qquad - \qquad - \qquad - \qquad - \qquad 3.6$$

If all payments are kept equal to 1 per annum, the longer the period, the smaller the present value. This is due to two factors:

(1) The payments in discrete annuity are calculated on average half a period later than in the continuous case.

(2) There is no proportional payment for the time in the period of death, i.e. a "loss" of payment for on average half a period.

The payout phase is a period where all accumulated funds are used up. Hence, the annual pension withdrawal based on (3.6) is given as:

$$A_F^P\left(1 - T_d^r\right) - A_W^P \times a_x = 0 \Rightarrow A_W^P = A_F^P\left(1 - T_d^r\right) / a_x \qquad - \qquad - \qquad - \qquad - \qquad -3.7a$$

Where A_F^P =accumulated pension funds while A_W^P = annual pension withdrawal

$$A_F^P\left(1 - T_d^r\right) - A_W^P \times \sum_{k-1}^{\infty} v^k {}_kp_x = 0$$

$$A_F^P\left(1 - T_d^r\right) - A_W^P \times \sum_{k-1}^{\infty} v^k {}_kp_x = 0 \Rightarrow A_W^P = A_F^P\left(1 - T_d^r\right) / \sum_{k-1}^{\infty} v^k {}_kp_x \qquad - \qquad - \qquad -3.7b$$

From equation (3.7b), it is easy to compute the annual pension withdrawal for different rates of return. For example, if an employee retires at age 50, the annuity rate at this age is given as follow:

$$a_{50} = {}_1P_{50} \times \frac{1}{(1+i)^1} + {}_2P_{50} \times \frac{1}{(1+i)^2} + \dots + {}_{41}P_{50} \times \frac{1}{(1+i)^{41}} = \sum_{t=1}^{41} \frac{{}_tP_{50}}{(1+i)^t}$$

$$ {}_1P_{50} \times \frac{1}{(1+i)^1} \rightarrow 0.995943 \times 0.98039216 = 0.976415$$

$$ {}_2P_{50} \times \frac{1}{(1+i)^2} \rightarrow 0.995569 \times 0.961168\,78 = 0.956910$$

$$\dots\dots\dots \qquad \dots\dots\dots \qquad \dots\dots\dots$$

$$\dots\dots\dots \qquad \dots\dots\dots \qquad \dots\dots\dots$$

$$ {}_{40}P_{50} \times \frac{1}{(1+i)^{40}} \rightarrow 0.874606 \times 0.45289042 = 0.396101$$

$$ {}_{41}P_{50} \times \frac{1}{(1+i)^{41}} \rightarrow 0.865113 \times 0.44401021 = 0.384119$$

$$i = 0.2, \qquad \sum_{t=1}^{40} \frac{{}_tP_{50}}{(1+i)^t} = 26.95402$$

If retirement takes place at age 51, the actuarial equivalent annuity rate is calculated as follow:

$$a_{51} = {}_1P_{51} \times \frac{1}{(1+i)^1} + {}_2P_{51} \times \frac{1}{(1+i)^2} + \dots + {}_{40}P_{51} \times \frac{1}{(1+i)^{41}} = \sum_{t=1}^{40} \frac{{}_tP_{50}}{(1+i)^t}$$

$$ {}_1P_{51} \times \frac{1}{(1+i)^1} \rightarrow 0.995569 \times 0.98039216 = 0.976048$$

$$ {}_2P_{51} \times \frac{1}{(1+i)^2} \rightarrow 0.995188 \times 0.96116878 = 0.956544$$

$$\dots\dots\dots \qquad \dots\dots\dots \qquad \dots\dots\dots$$

$$\dots\dots\dots \qquad \dots\dots\dots \qquad \dots\dots\dots$$

$$ {}_{39}P_{51} \times \frac{1}{(1+i)^{39}} \rightarrow 0.874606 \times 0.461948223 = 0.404023$$

$$ {}_{40}P_{51} \times \frac{1}{(1+i)^{40}} \rightarrow 0.865113 \times 0.45289042 = 0.391801$$

$$\sum_{t=1}^{40} \frac{{}_tP_{51}}{(1+i)^t} = 26.49716$$

However, if retirees are to retire at age 70, the detailed computation of annuity rate is given as follow:

$$a_{70} = {}_1P_{69} \times \frac{1}{(1+i)^1} + {}_2P_{69} \times \frac{1}{(1+i)^2} + \ldots + {}_{21}P_{69} \times \frac{1}{(1+i)^{21}} = \sum_{t=1}^{21} \frac{{}_tP_{69}}{(1+i)^t}$$

$${}_1P_{69} \times \frac{1}{(1+i)^1} \rightarrow 0.978629 \times 0.980392 = 0.95944$$

$${}_2P_{69} \times \frac{1}{(1+i)^2} \rightarrow 0.976353 \times 0.961169 = 0.93844$$

$${}_3P_{69} \times \frac{1}{(1+i)^3} \rightarrow 0.973869 \times 0.942322 = 0.917699$$

$${}_4P_{69} \times \frac{1}{(1+i)^4} \rightarrow 0.971165 \times 0.923845 = 0.897206$$

$${}_5P_{69} \times \frac{1}{(1+i)^5} \rightarrow 0.968206 \times 0.905731 = 0.876934$$

$${}_6P_{69} \times \frac{1}{(1+i)^6} \rightarrow 0.964954 \times 0.887971 = 0.856852$$

$${}_7P_{69} \times \frac{1}{(1+i)^7} \rightarrow 0.961369 \times 0.870560 = 0.83693$$

$${}_8P_{69} \times \frac{1}{(1+i)^8} \rightarrow 0.957413 \times 0.853490 = 0.817143$$

$${}_9P_{69} \times \frac{1}{(1+i)^9} \rightarrow 0.953049 \times 0.836755 = 0.797469$$

$${}_{10}P_{69} \times \frac{1}{(1+i)^{10}} \rightarrow 0.948245 \times 0.820348 = 0.777891$$

$${}_{11}P_{69} \times \frac{1}{(1+i)^{11}} \rightarrow 0.942974 \times 0.804263 = 0.758399$$

$${}_{12}P_{69} \times \frac{1}{(1+i)^{12}} \rightarrow 0.937209 \times 0.788493 = 0.738983$$

$${}_{13}P_{69} \times \frac{1}{(1+i)^{13}} \rightarrow 0.930919 \times 0.773033 = 0.719631$$

$${}_{14}P_{69} \times \frac{1}{(1+i)^{14}} \rightarrow 0.924092 \times 0.757875 = 0.700346$$

$${}_{15}P_{69} \times \frac{1}{(1+i)^{15}} \rightarrow 0.91677 \times 0.743015 = 0.681174$$

$${}_{16}P_{69} \times \frac{1}{(1+i)^{16}} \rightarrow 0.909013 \times 0.728446 = 0.662167$$

$${}_{17}P_{69} \times \frac{1}{(1+i)^{17}} \rightarrow 0.900878 \times 0.714163 = 0.643373$$

$${}_{18}P_{69} \times \frac{1}{(1+i)^{18}} \rightarrow 0.892423 \times 0.700159 = 0.624838$$

$${}_{19}P_{69} \times \frac{1}{(1+i)^{19}} \rightarrow 0.883684 \times 0.686431 = 0.606588$$

$${}_{20}P_{69} \times \frac{1}{(1+i)^{20}} \rightarrow 0.874606 \times 0.672971 = 0.588585$$

$${}_{21}P_{69} \times \frac{1}{(1+i)^{21}} \rightarrow 0865113 \times 0.659776 = 0.570781$$

$$\sum_{t=1}^{21} \frac{{}_tP_{69}}{(1+i)^t} = 15.97087$$

The computations do not include the cost of annuity loading in the annuity rates computed for pricing exercise under the retiree's life annuity but rather based on actuarial fairness principle. Meanwhile, the purchase of annuity can take place at any point in time. It may even be at the age of 75 or so depending on the prevailing situation. For the purpose of this study, the annuity rates computed in this work are based on age 50 to 90. It is being assumed that the life span will not exceed 90 years for all annuitants[1].The use of hand calculator to perform this exercise may become boring if the period is longer than 21. Hence, spreadsheet makes the calculations from any given period of time faster, easier, optimal and efficient.

RESULTS AND INTERPRETATION

Phased Withdrawal Computation Approaches

The method of performing the calculation is very simple after the schedules for the highest payout are entered into spreadsheet. Table 1 shows the computation results of present value annuity at rates of 4% to 6.5% interest rates.

[1] It is possible for some retirees to exceed the age of 90 while a great majority will not attain this age. For any risk of longevity, annuity underwriters will be responsible for financial loss as there will be gains/losses which are inevitable.

Table 1: Present value annuities at different of rate of returns from 4% to 6.5%

Years in payout	4%	4.50%	5%	5.50%	6%	6.50%
5	4.7134595	4.8780488	4.5797072	4.5150524	4.4518223	4.3899767
6	5.6014309	5.8536585	5.4171914	5.328553	5.2421369	5.1578725
7	6.4719911	6.8292683	6.230283	6.114544	6.0020547	5.8927009
8	7.3254814	7.804878	7.0196922	6.8739555	6.7327449	6.5958861
9	8.1622367	8.7804878	7.7861089	7.6076865	7.4353316	7.2687905
10	8.982585	9.7560976	8.5302028	8.3166053	8.1108958	7.9127182
11	9.7868481	10.731707	9.2526241	9.001551	8.7604767	8.5289169
12	10.575341	11.707317	9.954004	9.6633343	9.3850738	9.1185808
13	11.348374	12.682927	10.634955	10.302738	9.9856478	9.6828524
14	12.106249	13.658537	11.296073	10.92052	10.563123	10.222825
15	12.849264	14.634146	11.937935	11.517411	11.118387	10.739546

Source: Authors' computation

Table 1 contains present values of annuity immediate between 4% and 6.5% from 5 to 15 years for retirees who may wish to use their accumulated funds for phased withdrawal. As shown in the table, increase in interest rate reduces the accumulated present values for any given years. For instance, accumulated present value for interest rates of 4% and 6% in the payout of 10 years are 8.982585 and 7.9127182 respectively. This means that annual pension withdrawals for phased withdrawal increases with increasing interest rate.

Table 2: Annual phased withdrawal at rate of returns from 4% to 6.5%

Years in payout	Accumulated pension fund	4%	4.50%	5%	5.50%	6%	6.50%
5	48,610,337.35	10,919,200.58	11,073,027.80	11,227,762.00	11,383,396.83	11,539,918.52	11,697,327.28
6	48,610,337.35	9,273,000.18	9,424,494.70	9,577,085.72	9,730,766.78	9,885,526.63	10,041,354.42
7	48,610,337.35	8,098,949.00	8,249,245.52	8,400,830.25	8,553,689.89	8,707,814.34	8,863,189.00
8	48,610,337.35	7,219,987.89	7,369,796.47	7,521,079.28	7,673,822.86	7,828,011.26	7,983,630.36
9	48,610,337.35	6,537,749.40	6,687,541.85	6,838,991.94	6,992,084.85	7,146,800.73	7,303,121.67
10	48,610,337.35	5,993,214.23	6,143,317.30	6,295,261.02	6,449,024.85	6,604,587.33	6,761,926.12
11	48,610,337.35	5,548,823.12	5,699,473.61	5,852,144.78	6,006,811.38	6,163,447.16	6,322,027.81
12	48,610,337.35	5,179,536.93	5,330,910.30	5,484,481.02	5,640,219.97	5,798,096.60	5,958,080.14
13	48,610,337.35	4,868,020.32	5,020,249.96	5,174,850.65	5,331,788.54	5,491,028.80	5,652,534.38
14	48,610,337.35	4,601,890.69	4,755,078.69	4,910,809.21	5,069,042.93	5,229,738.68	5,392,854.38
15	48,610,337.35	4,372,067.40	4,526,293.51	4,683,231.12	4,842,833.88	5,005,054.68	5,169,844.58

Source: Authors' computation.

Table 2 shows retiring employees with identical accumulated funds but with different years which accumulated funds are to be used up. Considering the different rates of returns, the higher the rate, the higher the annual pension withdrawal and vice versa. However, the retirees with lesser years to use up accumulated funds have more annual pension withdrawal than those with more payout years. Consequently, retirees with 5 years' payout at the rate of 4% has almost twice of retirees with 11 years' payout option (5,548,823.12) at the same rates.

In negotiating rate of returns, it is advisable for retirees to get returns that will give them annuity rates closer to expected number of years at retirement. If employees are expected to commence retirement from age 55 and the expectation of life in retirement is 20 years, then the rate of returns to be sought should start from 3% upwards. Anything less than this rate limits will lead to overcharging of annuitants.

Table 3: Retiree's life annuity rates computation results

Age	4%	4.50%	5%	5.50%	6%	6.50%
65	15.25129	14.47038	13.74907	13.0819	12.46396	11.89085
66	14.87419	14.1344	13.44938	12.81426	12.22465	11.6766
67	14.48336	13.78465	13.13605	12.53324	11.97233	11.44978
68	14.07841	13.42067	12.80857	12.23829	11.70639	11.20974
69	13.65896	13.04202	12.46641	11.92881	11.42618	10.95578
70	13.22462	12.6482	12.10902	11.60419	11.13105	10.6872
71	12.77497	12.23874	11.73585	11.26379	10.82028	10.40324
72	14.7222	11.81313	11.34629	10.90694	10.49315	10.1031
73	11.82813	11.37086	10.93973	10.53296	10.14887	9.78594
74	11.33009	10.91138	10.51555	10.1411	9.78664	9.45086
75	10.81509	10.43419	10.07312	9.73066	9.40563	9.09696
76	10.28274	9.93877	9.61183	9.30089	9.00501	8.7233
77	9.73268	9.42465	9.13105	8.85107	8.58394	8.32895
78	9.16458	8.90454	8.64326	8.39341	8.15439	7.92561
79	8.57811	8.36607	8.13605	7.91548	7.70389	7.50084
80	7.97299	7.80889	7.60892	7.60892	7.23165	7.05365
81	7.34894	7.02079	6.8356	6.65775	6.48687	6.32264
82	6.70568	6.60916	6.46529	6.32615	6.19155	6.0613
83	6.04299	5.97752	5.85923	5.74449	5.63319	5.52518
84	5.36062	5.23705	5.13594	5.03792	4.94285	4.85063
85	4.65828	4.62871	4.5504	4.47421	4.40007	4.32791
86	3.93559	3.98603	3.92883	3.87297	3.8184	3.76509
87	3.19214	3.30745	3.26942	3.23208	3.19544	3.15947
88	2.4274	2.5591	2.53522	2.51171	2.48856	2.46577
89	1.64081	1.74932	1.73695	1.72474	1.71267	1.70076
90	0.83184	0.89685	0.89258	0.88835	0.88416	0.88001

Source: Authors' computation

In Table 3, the annuity rates decrease with increasing rates of returns for different ages. The annuity rate at age 65 is 14.470380 with 4.5% returns on interest and decreased to 11.890850 at 6.5% rate of returns on investment. Annuity rates decrease with increasing age at a constant rate of interest. This decreasing pattern at fixed interest rates with increasing ages conforms to reality as those who purchase annuity at age 65 have up to 25 years to continue to access annul pension income than someone who purchased annuity at age 70 but has only 20 years to enjoy the equivalent annual pension income in line with accumulated funds. As shown in Table 3, it can be seen that the cost of annuity is higher at age 65 than age 70 which means that those who purchase annuity at younger ages pay higher cost than those who purchase annuity at more advanced ages. Consequently, when employees are making decision with respect to retirement annuity, they need to be furnished with prevailing rates and cost of annuity so as to make wise choice on any given rate of returns.

Table 4: Accumulated pension funds and payout annuity rates based on investment returns from 4% to 6.5%

Age	Service years	Accumulated funds at 6% p.a.	Annual pension withdrawal of fund invested at computed annuity rates:					
			4%	4.50%	5%	5.50%	6%	6.50%
65	35	82,452,695.24	5,406,276.80	5,698,032.48	5,996,965.27	6,302,807.33	6,615,288.82	6,934,129.62
66	36	88,515,046.64	5,950,915.42	6,262,384.44	6,581,347.74	6,907,542.58	7,240,701.91	7,580,549.70
67	37	94,941,139.11	6,555,187.41	6,887,453.73	7,227,525.71	7,575,147.30	7,930,046.96	8,291,961.86
68	38	101,752,797.14	7,227,577.34	7,581,797.12	7,944,118.44	8,314,298.58	8,692,073.06	9,077,177.27
69	39	108,973,154.64	7,978,144.36	8,355,542.67	8,741,342.11	9,135,291.34	9,537,146.68	9,946,635.90
70	40	116,626,733.60	8,818,910.00	9,220,816.69	9,631,393.26	10,050,398.49	10,477,603.96	10,912,749.23

Source: Authors' computation

Table 4 is the results of accumulated pension funds and payout annuity rates based on investment returns form 4% to 6.5%. As it can be seen in Table 4, an employee who retires at age 65 after 35 years of service will accumulate ₦82,452,695.24 for retirement funds. Given the different rate of returns, the higher the rate of returns, the higher the annual pension withdrawal and vice versa. For instance, the annual pension withdrawal at the rate of 4% is ₦5,406,276.80 while the annual rate at the rate of 5% is ₦5,996,965.27 for the same accumulated pension funds. This shows that the higher the rate of returns, the more the annual pension income the retiree's life annuity option is able to access. The same interpretations go for other accumulated funds at ages 66 to 70.

CONCLUSIONS AND RECOMMENDATIONS

This study was designed to link the accumulated phase of DC pension with its payout phase. Life data were used to determine the future pension contributions. The annual rates of withdrawal for phased withdrawal and retiree's life annuity were computed. These rates were used to determine the annual pension withdrawals for two pension income options. It is expected that those in *under average lives* (those with substandard health) will go for phased withdrawal while those in sound health should go for retiree's life annuity.

The findings from this study revealed that annuity rates decrease with increasing age at any given rate of interest. These rates at younger ages reduce the accumulated pension funds of retirees with life annuity. Hence, pension income under the DC scheme depends on the accumulated funds. To have adequate protection at retirement, employees must have accumulated sufficient funds whilst in active years of service. However, retirees with lesser years to use up accumulated funds under phased withdrawal have more annual pension incomes than those with extended years in payout. The phased withdrawal options with consumption period exceeding 10 years expose retirees to inflation erosion.

On the basis of the above findings, it is recommended that retiring employees need to ensure that their monthly pension contributions are remitted to their RSAs as and when due in order to accumulate sufficient funds for retirement. Similarly, the study recommends that when employees are making decision with respect to retiree's annuity, they need to be informed about prevailing rates and cost of annuity so as to make wise choice on any given rate of returns.

Although retiring employees may choose any retirement income option irrespective of health status, phased withdrawal option of retirement income exposes them to risk of inflation and longevity. A retiree's life annuity which is designed to protect against the risk of inflation and longevity is recommended for those in sound health. The loading to be used by the annuity underwriters may depend on prevailing market conditions. However, there will be need for the market to be transparent so as not to discourage potential annuitants. If the pricing rates are high, many retirees will be forced to self-insure, i.e. by taking phased withdrawal option.

This study is not without limitation, however. In the annuity rates computed, actuarial fair value, i.e. equivalent principle was employed and no loading was used in the computations. Despite the non-incorporation of loading into annuity rates computations, this study contributes to the existing body in knowledge by guiding practitioners by showing step by step approach on how annuity rates were computed, unlike other studies that relied on already computed annuity rates that are abstract or alien to the economic realities in Nigeria. The study also contributes to existing literature by demonstrating how the accumulation models relate to payout models.

REFERENCES

Adeyele, J.S. (2015a). Systematic Investment Plan and Retirement Income Security of Selected Universities in Southwest Nigeria (University of Ilorin: Ph.D. Thesis).

Adeyele, J.S. (2015b). Retirement Income Security Options and Uncertain Lifetimes of University employees in South-West Nigeria. *Sokoto Journal of the Social Sciences, 5*(1), 98-110

Adeyele, J.S., & Igbinosa, S.O. (2015). Models and Computations of Accumulated Funds ofDefined Contribution. *Advances in Management, 14*(1), 82-114.

Adeyele, J.S., & Imouokhome, E.O. (2014). Determinants of Annuity Market Development: A Review. *LAPAI Journal of Management and Social & Sciences, 7*(2),25-37.

Adeyele, J.S., & Maiturare, M.N. (2012). Solvency of Pension Reform: Issues and Challenges of Accumulation Phase of Retirements in Nigeria. *Canadian Social Science*, *8*(2), 90-95.

Adeyele, J.S., & Maiturare, M.N. (2021). Pension Shortfall Recovery Techniques in Federal Universities in Nigeria. . *Daffodil International University Journal of Business and Entrepreneurship, 14*(1), (Forthcoming)

Adeyele, J.S., & Ogungbenle, G. M. (2019). Actuarial Modeling of Pension Liabilities and Computations. *Journal of the Nigerian Association of Mathematical Physics*, *51*, 25-34

Adeyele, J.S., & Olujide, J.O. (2016). Retirement Determinants and Money Worth Ratio of Defined contribution pension in Nigeria. *The Nigerian Journal of Economic and Social Studies*, *58* (3), 411-435.

Adeyele, J.S., Olujide, J.O, Jim-Suleiman, S.L, Ogungbenle, G.M., Ikeobi, N.R., Jugu, Y.G,

Adamu, D.K., & Angyak, J.A. (2020). Defined Contribution's Funding Gaps and Loss Recovery Models in Federal Universities in Nigeria. *Ilorin Journal of Management Sciences*, *6*(1), 90-110.

Black, K., & Skipper, H.D. (2000). Life and Health Insurance, Pearson education, Inc.

Bodie, Z. (2000). Life-Cycle Finance in Theory and in Practice. Boston University School of Management Working Paper #2002-02

Blommestein, H. (2000). *Ageing, Pension Reform, and Financial Market Implications in the OECD AEREA.* Working paper 9/01 October 2000

Brunton, P.D., & Masci, P. (2005). Pension Reforms in Devloping Countries: Policies and Politics. In P. Bruton, & P. Bruton (Ed.), *Workable Pension System* (pp. 3-20). Washington, DC: Inter-American Development Bank and Caribbean Development Bank.

Chen, A., Haberman, S., & Thomas, S. (2019). Cumulative Prospect Theory and Deferred Annuities. *Review of Behavioural Finance*, 1-24.

Davies, D. R., & Sparrow, P. R. (1985). Age and Work Behaviour. In N. Charness (Ed.), Aging and Human Development of a Life Annuity Market in Australia: An Analysis of Supplier Risks and their Mitigation. *The Financial Journal of Applied Finance*, 11-15.

Hershey, D. A., & Wilson, J. A. (1997). Age Differences in Performance Awareness on a Complex Financial Decision-Making Task. *Experimental Aging Research*, 23, 257–273.

Hershey, D. A., & Mowen, J.C. (2000). Psychological Determinants of Financial Preparedness for Retirement. *The Gerontological Society of America. 40*(6), 687–697.

Hupfeld, S. (2009). Rich and Healthy—Better than Poor and Sick: An Empirical Analysis of Income, Health, and the Duration of the Pension Benefit Spell, *Journal of Health Economics*, 28, 427-443.

Ibiwoye, A. (2008). Issues in the Pension System. *Journal of Research in National Development. 6*(2), 195-202.

Ibiwoye, A. (2014). Pensions: The Promise, the Perils, the Expectations in Actuarial Perspective. Inaugural Lecture (University of Lagos)

Ibiwoye, A., & Adesona, T.A. (2011). Analyzing the Cost of Minimum Guarantee in Mandatory Capitalized Pension System: A Nigerian Example. *Insurance Markets and Companies: Analyses and Actuarial Computations. 2*(2), 55-65.

Iyer, S. (1999). Actuarial Mathematics of Social Security Pensions: Quantitative Methods in Social Protection Series. Geneva: International Labour Office/International Social Security Association.

James, E., & Vittas, D. (1999). The Decumulation (payout) Phase of Defined Contribution Pillars. Development Research Group: The World Bank

Kellison, S.G. (1970). *The Theory of Interest. Illinois.* Richard D. Irwin, Inc.

Mitchell, O. S & Piggott, J. (2011). Turning Wealth into lifetime Income: The Challenge ahead. In: Mitchell, O. S, Piggott, J. and Takayama, M. (2011) ed. Oxford University press: United States, New York

Mitchell, O. S., Poterba, J.M, Warshawsky, M., & Brown, J.R. (1999). New Evidence on the Money's Worth of Individual Annuities. *American Economic Review*. *89*(5), 1299-1318.

Palacios, R. (2005). Systemic Pension Reform in Latin America: Designs and Early Experiences. In P. &. Bruton, & P. &. Bruton (Ed.), *Workable Pension System:Reform in the Caribbean* (pp.127-176). Washington, DC: Inter-American Development Bank and Caribbean Development Bank.

Palme, M., & Sandgren, S. (2008). Parental Income, Lifetime Income, and Mortality, *Journal of the European Economic Association*, 6(4), 890-911

Pension Reform Act (2014) .*Federal Republic of Nigeria Official Gazette.* Lagos: The Federal Government of Nigeria.

Pension Reform Act (2004) .*Federal Republic of Nigeria Official Gazette.* Lagos: The Federal Government of Nigeria.

Pettinato, S., Sowers, K., & Masci, P. . (2005). Annuities and Pension Reform: Main Issues in Developing Countries. In P. &. Bruton, & P. &. Bruton (Ed.), *Workable Pension*

System:Reform in the Caribbean (pp. 269-323). Washington, DC: Inter-American Development Bank and Caribbean Development Bank.

Pugh, C. (2006). Funding Rules and Actuarial Methods, OECD Working Papers on Insurance and Private Pensions, No. 1, OECD Publishing. doi:10.1787/274307371724.

Richardson, P.D., & Spence, C.S (2010).Increased Longevity and the Annuity Solution: How Retirement Benefit Can Reduce Longevity Risk. TIAA-CREF Institute, Policy Brief.

Ruckman, C., & Francis, J. (2005). Financial Mathematics: A practical guide for Actuaries and other Business Professionals. Bpp Professional Education.

Turner, J. (1999). Retirement Income Systems for Different Economic, Demographic and Political Environments. Working paper AWP 3.8. Organisation for Economic Co-operation and Development.

Tversky, A., & Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty*, 5(4):297–323.

Walsh, R. P., Walsh, D. A., & Pennington, P. G. (1989). Knowledge of Factors affecting Personal Longevity. Paper presented at the International Conference on Health Psychology. Cardiff, England.

APPENDIX

Table A: Data on academic staff salaries form Lecturer I to Professorial Grades

S/N	Entry Age	Expected years of service	Years of Contribution	Grade	Step	Monthly Consolidated
1	30	39	1	CN01	1	173,899.58
2	30	38	2	CNO1	2	180,191.42
3	30	37	3	CNO1	3	186,483.17
4	30	36	4	CN01	4	258,192.08
5	30	35	5	CN02	1	267,664.33
6	30	34	6	CNO2	2	277,136.50
7	30	33	7	CN02	3	286,608.75
8	30	32	8	CN02	4	296,081.00
9	30	31	9	CN03	1	305,553.25
10	30	30	10	CN03	2	314,585.08
11	30	29	11	CN03	3	326,034.42
12	30	28	12	CN03	4	337,483.75
13	30	27	13	CN04	1	348,933.08
14	30	26	14	CN04	2	360,382.42
15	30	25	15	CN04	3	371,831.75
16	30	24	16	CN05	1	382,262.42
17	30	23	17	CN05	2	395,594.00
18	30	22	18	CN05	3	408,925.67
19	30	21	19	CN05	4	422,257.25
20	30	20	20	CN05	5	435,588.75
21	30	19	21	CN05	6	448,920.42
22	30	18	22	CN06	1	462,252.08
23	30	17	23	CN06	2	475,583.83
24	30	16	24	CN06	3	488,915.33
25	30	15	25	CN06	4	502,246.92
26	30	14	26	CN06	5	502,246.92
27	30	13	27	CN06	6	502,246.92
28	30	12	28	CN07	1	502,246.92
29	30	11	29	CN07	2	502,246.92
30	30	10	30	CN07	3	502,246.92
31	30	9	31	CN07	4	502,246.92
32	30	8	32	CN07	5	502,246.92
33	30	7	33	CN07	6	502,246.92
34	30	6	34	CN07	7	502,246.92
35	30	5	35	CN07	8	502,246.92
36	30	4	36	CN07	9	502,246.92
37	30	3	37	CN07	10	502,246.92
38	30	2	38	CN07	10	502,246.92
39	30	1	39	CN07	10	502,246.92
40	30	0	40	CN07	10	502,246.92

Source: Authors' computation

Table B: **1983 annuity mortality data**

Retirement age	p(x)	Retirement age	p(x)
50	0.995943	71	0.976353
51	0.995569	72	0.973869
52	0.995188	73	0.971165
53	0.994802	74	0.968206
54	0.994409	75	0.964954
55	0.994006	76	0.961369
56	0.993591	77	0.957413
57	0.993161	78	0.953049
58	0.99271	79	0.948245
59	0.992218	80	0.942974
60	0.991662	81	0.937209
61	0.991017	82	0.930919
62	0.99026	83	0.924092
63	0.98937	84	0.91677
64	0.988336	85	0.909013
65	0.987149	86	0.900878
66	0.985801	87	0.892423
67	0.984283	88	0.883684
68	0.982586	89	0.874606
69	0.980704	90	0.865113
70	0.978629		

Source: Black and Skipper, 2000

.