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SECURING THE FUTURE: A SENSITIVITY ANALYSIS OF ACTUARIAL MONEY WORTH RATIOS IN DEFINED CONTRIBUTION PENSIONS FOR PUBLIC UNIVERSITY EMPLOYEES

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Abstract

As policymakers scramble to combat pension deficits, defined contribution pensions emerge as a promising solution. But what drives their success? Our study reveals that total contributions and investment returns are the twin engines of this scheme. However, a mismatch between projected and actual returns can have disastrous consequences. Three crucial parameters were identified - rates of return, annuity rates, and life expectancy - that determine the future value of pension contributions. Our findings show that higher interest rates and longer contribution periods significantly boost money worth ratios, while early retirement can lead to a substantial decrease in pension income. Conversely, normal retirement can provide retirees with up to 100% of their final salary. This research highlights the critical role of funding gaps, interest rates, and life expectancy in ensuring retirement income adequacy, making it a must-read for policymakers and stakeholders.

Keywords: money worth ratio, defined contribution, income adequacy, pension deficits
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1. INTRODUCTION

Retirement income adequacy is a critical concern for individuals and policymakers alike. One key measure of retirement income adequacy is the money worth ratio, which enables individuals to compare their future retirement income with their present salaries. Research has shown that annuity products offer a widely acceptable value for money and provide longevity insurance with utility to customers comfortably in excess of the price. However, significant pricing spreads suggest poor competition mechanics, and providers in most markets appear to compete favourably with price. According to Estelle and Dimitri (1999), structural changes in pension systems have shifted attention to the accumulation stage with term insurance riders, providing annuities for retirees and dependent survivors.

The decumulation of capital in workers' retirement savings accounts is a distant concern, but many countries have begun to focus on efficient methods of decumulation, either through gradual withdrawals or annuitisation, which provides longevity insurance. Annuities markets around the world are small in volume, but they are growing due to efficient reforms on social security systems and occupational pensions schemes. At retirement, individuals may choose to annuitise their accumulated earnings, but it is essential to understand how annuities markets operate and the associated market risks. The intent is to quantitatively assess the effect of the actuarial present discounted value (APDV) of cash flows on annuity and the money's worth ratio (MWR), which is the quotient of APDV by the initial premium cost.

In the accumulation phase of defined contribution (DC) pensions, employees and employers initially contributed 7.5% and 7.5% each, respectively, based on the employee's monthly basic salary (Pension Reform Act,

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2004). These rates were revised to 8% for employees and 10% for employers under the Pension Reform Act 2014. Annuitants typically give up a lump sum as a premium to annuity providers in return for the promised stream of payments. The "money's worth (MW) ratio" is a commonly used method for analyzing the extent of divergence of actual prices from actuarially fair levels (Cannon & Tonks, 2008; Aitken, 1994; Deaton & Paxton, 1999). However, previous research efforts have focused on the accumulation phase of pension systems, with limited research on how to cope with challenges in the payout phase.

Roacha and Rudolph (2011) noted that much of the early research on pension systems has focused on the policy challenges of the accumulation phase. Although the two phases of the schemes are both important, policymakers, Pension Fund Administrators, Life insurance companies, and regulatory bodies must fully understand them. The introduction of mandatory defined contribution pension plans in many countries, including Nigeria, has increased the need for careful analysis of transactions and regulation of mandatory annuities. Upon retirement, some members of defined contribution pension benefits accumulate large sums of money to support themselves in old age. However, there is a possibility that a significant portion of that money may be carelessly or mistakenly spent or lost, forcing members to rely on relations or public assistance for their survival.

his type of moral hazard is common because individuals tend to underestimate their life expectancies, avoid the purchase of annuities, and spend down their assets completely before they die (Pettinato et al, 2005). Doyle et al (2001) noted that, in a rush to design effective DC accumulation vehicles, there has been too little attention paid to how the plans will function during the payout phase. Adeyele and Maiturare (2012) examined the solvency of the current pension reform by considering the accumulation phase of retirements.

The result of the findings revealed that the scheme is gradually becoming insolvent due to non-remittance of employees' monthly contributions by employers. By not remitting the contributed funds as and when due into appropriate RSAs of employees, the present reform may not be sustainable. Bruntland cited in Jhgan (1997) defines sustainable development as "meeting the need of present generation without compromising the needs of the future generation." So, if the present reform is to be sustainable, the welfare of the retiring employees must not be compromised by failing to remit their monthly contributions as and when due. Adeyele and Maiturare (2012) put the liabilities of one of the schemes valued at N254,329,938 and revealed that most of those who left the deficit schemes have not been able to get back their personal contributions, let alone the employer's.

The complexity introduced by non-compliance among the employers have generated fresh concerns among the contributors - whether the shift from defined benefit solve the pension crisis in Nigeria. This study determines the money worth ratios within the 10 years guaranteed period of retiree's life annuityThe complexity introduced by non-compliance among the employers have generated fresh concerns among the contributors - whether the shift from defined benefit solve the pension crisis in Nigeria. This study is motivated by the growing importance of annuity markets in ensuring retirement income adequacy. The rationale is to examine the money worth ratio in annuity markets and its impact on retirement income adequacy, filling a knowledge gap and providing insights for policymakers, pension fund administrators, and life insurance companies.

2. MONEY'S WORTH RATIO AND ANNUITY MARKET REVIEW

The old aged means of measuring pension funds' performance has heavily relied on short-term returns. Meanwhile, the aim of compulsory funded scheme is to guarantee adequate retirement income to individuals which can be based on either monthly or annual returns. However, this becomes meaningless if this returns are not based on pension contributions are measured against a benchmark or against set parameters. Alternative ways to measure adequacy of pension funds is to base it on internationally acceptable standards in form of replacement ratio or money worth ratios (Hinz et al, 2010).

Although many policy makers expect market forces to provide most favourable asset allocation. It has been observed that some policy makers have an unquestioning beliefs that the market forces will automatically assist individual members of DC to optimize their pension contribution. There is no universal agreement on what constitute pension adequacy for old age pension benefit. However, some of the metrics for measuring pension adequacy include money replacement ratio and money worth ratio which must be based on objectives of pension. Holzmann & Hinz (2005) opined that the level of pension adequacy should be linked to fundamental objectives of pension system. The World Bank (2005) listed affordability, adequacy, sustainability and soundness as the primary goals of mandatory public pension schemes. The pension adequacy goal is to prevent old age poverty as well as the smoothed lifetime income through protection against longevity risk (Zhao, Li & Wang, 2019).

The rapid growth experience in stock market between 1995 and 2000 has translated to increase accumulated pension wealth and this led to more proportion of workforce early retirement under DC pension (Farhi & Panageas, 2007; Gustman & Steinmeier, 2002). The willingness to retire early in Nigeria irrespective of pension wealth is not anticipated most employees. This is partly due to fear of loss of income and lack of reliable suitable models that can be used to determine the size of future income at retirement based on final salaries of employees.

Adeyele and Igbinosa (2015) developed replacement ratio models to determine the adequacy of pension wealth. The European Commission (2006) examined association between sustainability and adequacy with regards to a lifecycle perspective. This has significant implications in replacement rate adequacy of pension income. Zhao et al (2019) noted that the parameters of the adequacy of pension benefits have emerged from the replacement rate to the pension wealth. Zhao et al (2019) argued that replacement rate has been widely used for measuring pension adequacy based on some chosen criteria.

As pension fund administrators (pension managers) compete for funds, individual contributors will be able to select those fund managers that have better returns on pension investment. In this case, the competitive model assumes individual contributors possess the skills to figure out factors that will provide retirement income adequacy through critical assessment of prevailing market conditions (Hinz et al, 2010). This responsibility is being transferred to their PFAs to carryout for efficient allocation of pension funds to various securities.

In reality, these factors presumed to be well known to individual are not easily available or understood. Even when available, most members including lecturers do not easily understand it. The absence of information on these factors therefore increases the risk of performance which the DC members need to bear (Hinz et al, 2010).

Consequently, since long-term forecast on pension performance cannot be undertaking easily by members, their PFAs or fund managers rely on existing short-term returns emphasis to devote their efforts on short-terms returns.

It should be noted however, that best short-term returns are not necessarily those aligned with the long-run performance of a pension system (Hinz et al, 2010).

Structural reforms of social security and occupational pensions systems with inbuilt funded individual retirement savings accounts is a nascent concept evolving around the world in the last 30 years. From that time attention of the actuaries and pensions managers are drawn to the accumulation phase of the active period during which mandatory retirement savings accounts were updated with earnings but in final analysis the retirement accumulations together with the earnings will be dissimulated. Because of the attendant problems unforeseeable in the accumulation stage, the second generation of withdrawal phase reforms has begun paying special attention to decumulation stage. Annuitisation is quite motivated with incentives and a number of employees would likely prefer this trajectory towards insured withdrawal phase.

In the high income economies such as U.S where social security reform involving personalized retirement savings accounts is at the fore, questions have been asked on the corresponding risk and modulus operandi of the annuity markets. Several papers have already analyzed US annuity markets, including analyses of money's worth ratios, adverse selection and re-distributional effects (examples are Mitchell, Poterba,Warshawsky and Brown 1999, Brown Mitchell and Poterba 2000, Poterba and Warshawsky 1999, James and Vittas 1999 and Brown 2000).

The MWR is the ratio of the actuarial discounted lifetime benefits to the initial capital cost of the Annuity. The attention is to focus on annuities that provide longevity insurance. While we present this paper as a search for the calculations of MWR, it is advisable that life offices, consumers, regulators, pension trustees and policy-makers compute same search for their own personal use. Life offices should find out in volumes the payouts they can offer, annuitants must compute the expected value due to them of an alternative annuity products parallel to a comparative condition of no annuitisation, market and annuity regulators should ensure that the system is solvent and policymakers should understand the annuity industry well so as to set the operational rules.

Annuities markets are up till now undeveloped in low income economies such as Nigeria. The underdevelopment of the annuities markets is anchored in both small size and volume as compared to other types of life policies. The absence of mortality tables for correct pricing and funding policies and the relative inadequate long term financial instruments with which to match assets and liabilities result in substantial investment risk volatilities. It is anticipated that random variations in the payouts structures exists and low money's worth ratios implying high costs for annuitants considering the underdeveloped nature of annuity market.

If employees choose to smoothen consumption over their life cycle, then it is anticipated that a higher level of annuitisation is yielded given these MWRs. It is important to know how do the life offices obtain financial resources to cover administrative costs, risk premium and profits despite high MWRs, However, analysts have defined administrative costs as the deviation of MWRs from100% of premiums and the share that is returned to annuitants. The direct measurements indicate that the present value of administrative costs such as marketing and operational expenses over the lifetime of an average annuity is a small percentage of the premium. Life offices incur investment and longevity risk and bear an opportunity cost of equity capital which brings total costs, capitalized to certain percentage of initial premiums or of assets per year. In the annuities market, a life office is a risk absorbent institution for risk and term intermediation and earns a spread in the process. The annuitant pays a large sum of money ahead of time in exchange

for a guaranteed fixed periodic actuarially fair payments computed at the risk-free discount rate. The life office invests the single premium lump sum mainly in long term debt instruments, mortgages, equities to earn high return. The spread between the actual risky return and the guaranteed payout is then retained by the life office. The spread using data on investment portfolios and returns of insurance companies usually is more than a defined percentage of assets per year.

Annuity market such as the market in Nigeria is voluntary whereas, in the other countries annuities markets are part of their mandatory social security systems.

3. FRAMEWORK AND METHOD

Money's Worth Ratio framework- Annuity pricing available in market are very expensive as it does not offer actuarially fair value (net present value) but rather incorporate loading which include profits, overheads, and using of life insurance mortality experience rather than the general population. (Knox, 2000; Brown, Mitchell, Poterba & Warshawsky, 2001) The incorporation of these spread makes the product very expensive and unattractive to many potential annuitants. The loading in annuity products is designed to take care of profit margin and other administrative expenses thereby making it significantly reducing the money worth of the pension income that will be available to retirees. A study by St John (2003) shows that annuity product approximately cost twice of present value of single premium (which the accumulated funds made available to underwriters). In order to determine money worth ratio, the values of accumuted pension funds and annuity rates must be known. As annuity is most time not actuarially fair priced, there is need to include loading which is the cost of purchasing annuity. This purchase price is called premium and in the context of defined contribution represents the accumulated funds of employees during active years of service. On this premise, the accumulation fund models for computing accumulated pension funds developed by Adeyele and Maiturare (2021) will be useful. The detailed model for pension computation which is based on grade levels of employees with career growth of n years of service is given as follows:

$$AF_n = \begin{cases} a_{(f,m)} AF_{1,s_{(1,t)}} (1+f_r)^{n-s_{(1,t)}} + \\ a_{(f,m)} AF_{2,s(2,t)} (1+f_r)^{n-s_{(2,t)}-s_{(1,t}} + \\ a_{(f,m)} AF_{3,s(3,t)} (1+f_r)^{n-s_{(3,t)}-s_{(2,t)}-s_{(1,t)}} + \\ a_{(f,m)} AF_{4,s(4,t)} (1+f_r)^{n-s_{(4,t)}-s_{(3,t)}-s_{(2,t)}-s_{(1,t)}} + \\ a_{(f,m)} AF_{5,s(5,t)} (1+f_r)^{n-s_{(5,t)}-s_{(4,t)}-s_{(3,t)}-s_{(2,t}-s_{(1,t)}} + \\ a_{(f,m)} AF_{6,s(6,t)} (1+f_r)^{n-s_{(6,t)}-s_{(5,t)}-s_{(4,t)}-s_{(3,t)}-s_{(2,t)}-s_{(1,t)}} + \\ a_{(f,m)} AF_{7,s(7,t)} (1+f_r)^{n-s_{(7,t)}-s_{(6,t)}-s_{(5,t)}-s_{(4,t)}-s_{(3,t)}-s_{(2,t)}-s_{(1,t)}} \end{cases} \quad (1)$$

$$a_{(f,m)} = \left[\left(1+\frac{f_r^{\,m}}{m}\right)^{m} - 1\right] / [f_r^{\,m}/m] = \text{convertable monthly} \quad (2)$$

where

$a_{(f,m)}$ = *Annual pension contribution convertible monthly*

AF_n = *accumulated* funds for n - years

n = total number of years in service; $i = 1$ *to m grade levels throughout years in service*

$s_{(i,t)}$ = number of years spent at ith grade levels,

$\sum_{i=1}^{m} s_{(t,t)} = s_{(1,t)} + s_{(2,t)} + s_{(3,t)} + s_{(3,t)},,,+s_{(i,t)}$ represent total number of years served in grade level 1, 2, …, *ith*.

Thus, $n - \sum_{i=1}^{m} s_{(i,t)}$ is the remaining years in service, i.e., the difference between numbers of years individual is expected to serve and total past years' service. Thus the genaralised model for equation (1) for maximum of 7 grade level for those in professorial cadre is as follows:

$$AF_n = a_{(f,m)} \sum_{t=1}^{m} AF_{i,s_{(i,t)}} (1+f_r)^{n-\sum_{i=1}^{m} s_{(i,t)}} \quad (3)$$

It must be noted that formula (3) was first derived by using academic grade level of university lecturers where for instance accumulated pension funds for graduate assistant is

$AF_{1,s(1,t)}, AF_{2,s(2,t)},..., AF_{7,s(7,t)}$ are accumulated pension funds at grade level 1 to 7. Equation (3) reveals that years in service at previous grade levels are deducted from the expected total number of years in service so as to arrive at the remaining years in service. For retirees who prefer retiree's life annuity, the prevailing annuity rates at a given age will be used to divide equation (3) to arrive at annual pension withdrawals. Hence, the annual pension withdrawal of accumulated funds, AF_n is given as:

$$APen = a_{(f,m)} \sum_{t=1}^{m} AF_{i,s_{(i,t)}} (1+f_r)^{n-\sum_{i=1}^{m} s_{(i,t)}} / a_x \quad (4)$$

where

$$a_x = \frac{{}_1\mathrm{P}_x}{(1+f_T)^1} + \frac{{}_2\mathrm{P}_x}{(1+f_T)^2} + ... = \sum_{t=1}^{w-x-1} \frac{{}_t\mathrm{P}_x}{(1+f_T)^t} \quad (5)$$

Hence, formula (4) becomes:

$$APen = \frac{a_{(f,m)} \sum_{t=1}^{m} APF_{i,s_{(i,t)}} (1+f_r)^{n-\sum_{i=1}^{m} s_{(i,t)}}}{\sum_{t=1}^{w-x-1} \frac{{}_t\mathrm{P}_x}{(1+f_T)^t}} \quad (6)$$

Models for determining the adequacy of 18% contribution rate to meet up with 75% money worth ratio at payout phase is defined as:

$$\text{Money's worth ratio} = \frac{\text{APV of Payouts}}{\text{Annuity cost}} \quad (6)$$

where APV represents actuarial present value. The numerator is the sum of all future annuity payments, weighted by the probability that an individual will be alive to receive the payments, and discounted back to the present at a suitably chosen interest rate. The denominator represents premium (i.e. the money paid to receive the numerator). This cost of the annuity is equivalent to the pension funds modelled in Model (3). When the MWR is equal to 1.0, the annuity is actuarially priced. A MWR of less than 1.0 suggests that annuitant does not receive monetary equivalent paid to the annuity providers. If we assume that the lump sums resulting from past contributions are unitized, this will represent premium paid to the annuity underwriter and the MWR is given by Adeyele and Olujide (2016) as:

$$\text{MWR} = \frac{\left[A_{\text{Pen}} \sum_{t=1}^{\infty} \frac{{}_t p_x}{(1+f_T)^t} \times \text{n}\right]}{(1+\ell)\left(E_{PenC}^{m} \times \text{s}_{\text{m}}^{\text{n}}\right)} \quad (7b)$$

If there is no load applied, then the net MWR is

$$\text{MWR} = \frac{\left[A_{\text{Pen}} \sum_{t=1}^{\infty} \frac{{}_t p_x}{(1+f_T)^t} \times \text{n}\right]}{\left(E_{PenC}^{m} \times \sum_{t=1}^{m} AF_{i,s_{(i,t)}} (1+f_r)^{n-\sum_{i=1}^{m} s_{(i,t)}}\right)} \quad (7c)$$

where E_{PenC}^{m} = expected monthly pension contribution and n is the number of years retiree is expected to live in retirement.

In the present pension reform, section 2.22 of the guidelines issued by the NAICOM and

PENCOM states that life annuity will be guaranteed for 10 years. That is, if the annuitant dies before the 10 years elapse, his/her named beneficiary will be entitled to the balance for the guaranteed period.

Method of data analysis **-** Annuity mortality tables of 1986 which is still very relevant and used by many insurance companies in United State were extracted and modified to determine the expectation of life at retirement based on incidences and retirement pattern in Nigeria. The data it is assumed that all the people under defined contributions will remain in service until retirement. Nominal rates than real rates, ages at retirement and expectation of life at retirement were used determine annuity rates. The assumed age longevity is 90. Equation (5) was used to compute annuity rates starting from the age of retirement. Equation (6) was used to determine annual pension withdrawals (see Adeyele nd.) and Equation (7b) was used for the computation. We assume actuarial fair value and no loading factor assumed in our models.

4. RESULTS AND DISCUSSION

Results on future income compared with the present salaries are presented in this section. Money worth ratio as earlier mentioned shows the actuarial value of pension contributions at retirement. The equivalent money worth at prevailing interest rates is used to multiply the accumulated funds to arrive at retirement income for retirees with annuity options. This is multiplied to get the actuarial value for year and age of retirement. Details of these money worth are presented in Tale 1a and 1b.

Table 1: Sensitivity analysis of accumulated funds and corresponding money worth ratios from 3% to 5%.

Retirement Age	Years of Contribution	Accumulated funds at 6% p.a	Money worth ratio (funds invested)				
			3%	3.50%	4%	4.50%	5%
54	22	24,242,507.13	0.47	0.50	0.537683	0.61	0.65
55	23	27,038,325.68	0.47	0.51	0.545023	0.62	0.66
56	24	30,081,834.04	0.48	0.52	0.55286	0.63	0.67
57	25	33,399,528.92	0.49	0.53	0.561241	0.64	0.68
58	26	37,013,345.42	0.5	0.53	0.570216	0.64	0.68
59	27	40,946,973.09	0.51	0.54	0.579845	0.65	0.69
60	28	45,225,996.61	0.52	0.55	0.590193	0.66	0.7
61	29	49,878,048.07	0.53	0.57	0.601334	0.67	0.71
62	30	54,932,969.65	0.54	0.58	0.613351	0.69	0.72
63	31	60,422,991.20	0.56	0.59	0.62634	0.7	0.74
64	32	66,382,920.12	0.57	0.61	0.640409	0.71	0.75
65	33	72,850,349.21	0.59	0.62	0.655682	0.73	0.76
66	34	79,835,172.63	0.6	0.64	0.672306	0.74	0.78
67	35	87,378,781.92	0.62	0.66	0.690448	0.76	0.8
68	36	95,525,879.95	0.64	0.68	0.710307	0.78	0.82
69	37	104,324,745.83	0.67	0.7	0.73212	0.8	0.84
70	38	113,827,520.98	0.69	0.72	0.756165	0.83	0.86

Source: Authors' computation

Table 1 shows the sensitivity analysis of accumulated funds and money worth ratios of employees' retirement income based on the present contribution rate of 18.5% of gross salary. As it is evidenced in the Table 1, increasing interest rates also lead to increase in employees' future income depending on the age of retirement. Generally speaking, early retirement lead to low money worth ratios. For instance, the money worth ratios of employees retiring at the age of 54 using annuity interest rates of 3%, 3.5%, 4%, 4.5 and 5% are 0.47, 0.50, 0.537683, 0.61 and 0.65 respectively. Using the same interest rates of annuity computation in Table 22a, the money worth ratios for employees who retire at the age of 60 are 0.52, 0.55, 0.590193, 0.66 and 0.70 respectively which showed an increase in what retirees can get if they purchase life annuity from insurance companies. Commencing the analysis from the normal age of retirement of 65 where individual employees are expected to retire if such employees are not university professors with N72,850,349.21funds of 33 years of service at retirement, the money worth ratio at interest rates of 3%, 3.5%, 4%, 4.5 and 5%are 0.59, 0.62, 0.655682, 0.73 and 0.76 respectively. It should be noted that the money worth ratios are not determined by the amount of pension funds at retirement. Rather, they depend on annuity rates and age of retirement. As the retirement and rate of interest used for annuity computation increased, the money worth ratios also increased and vice versa.

Table 2: Sensitivity analysis of accumulated funds and corresponding money worth ratios from 5.5% to 7%.

Retirement Age	Years of Contribution	Accumulated funds at 6% p.a	Money worth ratio (funds invested)			
			5.50%	6%	6.50%	7%
54	22	24,242,507.13	0.65	0.69	0.74	0.778992
55	23	27,038,325.68	0.66	0.70	0.74	0.78485
56	24	30,081,834.04	0.67	0.71	0.75	0.791191
57	25	33,399,528.92	0.68	0.72	0.76	0.798064
58	26	37,013,345.42	0.68	0.72	0.76	0.805523
59	27	40,946,973.09	0.69	0.73	0.77	0.813631
60	28	45,225,996.61	0.7	0.74	0.78	0.822456
61	29	49,878,048.07	0.71	0.75	0.79	0.832075
62	30	54,932,969.65	0.72	0.76	0.80	0.842573
63	31	60,422,991.20	0.74	0.77	0.81	0.854049
64	32	66,382,920.12	0.75	0.79	0.83	0.866612
65	33	72,850,349.21	0.76	0.80	0.84	0.88039
66	34	79,835,172.63	0.78	0.82	0.86	0.895532
67	35	87,378,781.92	0.8	0.84	0.87	0.912208
68	36	95,525,879.95	0.82	0.85	0.89	0.930623
69	37	104,324,745.83	0.84	0.88	0.91	0.951014
70	38	113,827,520.98	0.86	0.90	0.94	0.973668

Source: Authors' computation.

Starting the analysis from 65 to 70 years of retirement in Table 2, the money worth ratios significantly increased as the interest rate of returns increased. With 33 years of pension contributions and retirement age of 65, employees with homogenous contributions will accumulate 72,850,349.21. The money worth ratios for this fund at 5.5%, 6%, 6.5% and 7% are 0.76, 0.80, 0.84 and 0.88039 respectively. In other words, retirees with 72,850,349.21 fund under life annuity will have access to the sum of 55,687,896.41, N58,448,798.95, 61,265,888.65 and 64,136,732.70. If retiree was able to accumulate 113,827,520.98 fund during active years of service and retired at age 70 with the following interest rates of 5.5%, 6%, 6.5% and 7%, the corresponding money worth ratios are 0.86, 0.90, 0.94 and 0.973668. If this ratios are corresponding multiplied with 113,827,520.98 the amount of funds the retiree value for money are 98,091,741.84; 102,261,261.05, 106,508,272.49 and 110,830,228.29 respectively. Hence, the higher the money worth ratio the money funds the retirees will receive.

4. CONCLUSION

The pension contributions made to retirement saving accounts today can be transformed into a guaranteed retirement income tomorrow. By applying different rates of interest and annuity rates, this study has unlocked the secret to determining the amount of pension funds and money worth ratios. The results reveal that increasing rates of interest and age can significantly boost money worth ratios, making normal retirement a more attractive option. In contrast, early retirement can lead to a decrease in pension income, while normal retirement can provide access to up to 100% of the final salary. The study also sheds light on the retirement income of pensioners with life annuity, which is guaranteed for 10 years. This means that there is a provision for surrendered value to be paid to the beneficiary if the retiree passes away before living up to 10 years in retirement. Furthermore, the results highlight the importance of funding gaps and life expectancy in determining employees' choice of retirement income. By using actuarial equivalent principle, the study provides a framework for determining annuity rates, but notes that loading and other expenses were not incorporated into the models.

In reality, the actuarial equivalent principle may lead to the insolvency of annuity underwriters, highlighting the need for indigenous annuity rates that take into account economic and market realities. This study provides a valuable tool for DC members to estimate their retirement income based on current contribution rates. However, the choice between phased withdrawal and life annuity remains critical, and future research should focus on the gains and losses experienced by annuitants. By doing so, DC members and regulators can be better guided on the sustainability of the DC pension scheme in the country.

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