HYBRID PLAN DESIGNED AS POSSIBLE PENSION PLAN FOR NIGERIA

BY

AKALONU, RAPHAEL ONYECHEFULE

(MATRIC. NO. 11/68EQ001)

B.Sc. (Hons) Statistics (UNN), M.Sc. Actuarial Science (Nebraska)

THESIS SUBMITTED FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE DEPARTMENT OF STATISTICS, UNIVERSITY OF ILORIN, ILORIN, KWARA STATE, NIGERIA.

SEPTEMBER 2016

ABSTRACT

The history of pension schemes in Nigeria started with the 1951 Pensions Ordinance. In 1979, the then Military Government established a Defined Benefit Scheme (Old) for civil servants. The scheme failed to meet its objective due to maladministration and lack of funding, resulting in nonpayment of benefits to workers on retirement. Consequently, the government established the Pension Reform Act 2004 (current), a Defined Contribution (DC) plan, aimed at remedying the shortcomings of the old one. Shortly, complaints adorned the media that the 15 percent contribution of the current plan was not enough to provide meaningful benefit after 35 years of service. The main objective of this Study is to design Hybrid Plan as possible Pension Plan for Nigeria. Specifically, the Study focused on: (i) to compare the monetary benefits between the old and the current pension schemes; (ii) to compare the adequacy of the current scheme with those of eight other developed and developing countries' pension schemes selected from five continents; (iii) to determine effects of the Pension Risk Factors (Mortality and Interest Rate Volatility); and (iv) to design three new pension plans. The population for the study was Nigerian employees grouped into seven by Nigeria's National Salaries, Incomes and Wages Commission (NSIWC) as at July 2010. Four groups were randomly selected for the study. Replacement Ratio data for the eight countries whose pension plans were to be compared with that of Nigeria were obtained from 2012 publications of International Monetary Fund and Organization for Economic Cooperation and Development. The schedule for calculating pension benefits under the old scheme was obtained. Such schedule does not exist for the current scheme. Actuarial method for estimating such benefits was used. The pension benefits of the two pension schemes were then compared. Replacement Ratio was calculated for the current scheme to compare its adequacy with those of the eight countries whose Pension Replacement Ratios had been obtained. Assumed simulated interest rates, salary incremental and annuity values were used and combined with mortality functions. The results showed that:

(i) the ratio of gratuity paid by the old and current schemes was 3.5 to 1, while that of pension benefits was 2.3 to 1, implying that the old scheme paid at least twice as the current;

(ii) the eight other countries had adopted the World Bank's (1994) three-pillar pension models in their respective reforms while Nigeria has the mandatory Defined Contribution plan for workers and no social security or voluntary plan for either formal or informal sectors;

(iii) increase in interest rate increased the amount available for purchase of annuity while decrease in mortality rate improved life expectancy and hence annuity rate resulting in decrease in amount of pension receivable;

(iv) three pension plans, namely, Minimum Guaranteed Money Purchase Plan, Cash Balance Plan and Hybrid Plan were designed for the formal sector and a Mandatory Collective Personal Plan was also proposed for the informal sector. The study concluded that the Hybrid Plan had higher replacement ratio, even at 20% volatility, than others. It was therefore recommended that the Hybrid Plan with higher replacement ratio be adopted by Nigerian Government for its workers.

CERTIFICATION

This is to certify that this doctoral thesis was carried out by Akalonu, Raphael Onyechefule (11/68EQ001) in the Department of Statistics in partial fulfillment of the requirements for the award of Doctor of Philosophy in Statistics of the University of Ilorin, Ilorin, Kwara State, Nigeria and has not been presented elsewhere for the award of a degree or any other purpose.

…….. ……

Prof. R. A. Ipinyomi Date
Supervisor

……. ……

Prof. B. L. Adeleke Date
Head of Department and
Chief Examiner

…… ……

Dr. O. O. M. Sanni Date
Departmental Postgraduate
Programme Coordinator

DEDICATION

To my dear and ever-loving wife, Christiana Ngozi, for her support and fervent prayers throughout the period of this work.

ACKNOWLEDGEMENTS

My unreserved gratitude goes first to my creator, the Almighty God and Father of my Savior and Lord Jesus Christ through whose Mercy I have been kept alive to this day to complete this thesis. In Him I have had life, for, when He says “Yes”, no one can say “No”. He remaineth God forever.

I remain grateful to my Supervisor, Professor R. A. Ipinyomi, for his open-mindedness towards me from my first visit to this University and the Department..He was like a brother and a confidant, always listening patiently and advising on the steps and diection the research should proceed; and above all, his unprecedented accessibility was a great source of inspiration to me.

I am unreservedly grateful to my Head of Department, Professor B. L. Adeleke, for his wonderful contributions in shaping this thesis, ensuring that necessary statistical tools were not left out and that every fact contained therein was in conformity with acceptable standards.

The same gratitude goes to both the External Examiner, Professor J. N. Mojekwu of the University of Lagos and the Internal/External Examiner, Dr. I. B. Abdullahi, for their useful suggestions regarding the format of this thesis. Dr. Abdullahi worked tirelessly with me even at times of my very serious health challenges. I am also indebted to my current Departmental Post Graduate Coordinators, Dr. O. O. M. Sanni and Dr. G. M. Oyeyemi for their contributions to the work and for giving me audience whenever I needed their attention.

My special gratitude goes to the entire staff of the Department of Statistics for rallying round and taking wonderful care of me at a time of my helplessness as a result of sudden ill-health challenges. The Almighty God knows you all and will come to your aid at your time of need.

TABLE OF CONTENT

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

The purpose for establishing a pension scheme of any form by an employer is to provide streams of regular monthly or annual payments to employees when they retire from the services of their employer at old age. The payments are usually less than the salaries they earned in the last years of their employment. This is purely employment related and covers only those who are employed, with levels of benefits differing between employers, whether private or public. In the case of public or state, differences also abound between nations. According to Cannon and Tonks (2011), the primary purpose of a pension is to ensure that an individual's consumption does not fall after the retiring from work: ideally the pension achieves this by providing an income in retirement which is similar to previous labour income. In their opinion, the pension replacement ratio (which is the percentage of the last salary earned that is being paid as pension) should be close to unity if the pension should smooth consumption effectively.

Recent trends point to the fact that people who are not employed or are self-employed need also to be provided for in their old age. Different countries have different levels of provision in the form of social security for this class while some countries like Nigeria have no provision whatsoever for this class in their old age.

Today, pension reformation has become a world-wide problem; each country is reforming its existing pension plan with a view to enhancing the benefits of retirees or old people and consequently the standard of living in the society.

Pension is called different names in different countries but all are referring to payments after retirement. According to Clare (2013), the term “Occupational superannuation” first emerged in Australia in mid-nineteenth century and since then, the term “superannuation” has been in common usage to refer to the pension received after retirement from the former employer. Continuing, Clare added that the process of making employee superannuation a more or less universal entitlement began in September 1985. In the reformation process and discussions, the Australian Council of Trade Unions and Government in that year recognized (i) the implications arising from the trend towards an ageing of the population including the workforce, (ii) the effects of the trend towards an earlier retirement, (iii) the existing dependency on age pensions and the projected significant increase in the dependency of the aged on the working population with an explosion of age pension costs, and (iv) the fact that a large percentage of the workforce was not covered by existing superannuation scheme and that wide disparities existed in coverage according to sex, industry, occupation and income levels. Claire added that four years after the negotiation, superannuation coverage grew from around 40% to 79% in the Public sector and from 32% to 68% in the private sector in 1991. Thus, the superannuation scheme has continued to undergo such series of reformation that Evans (2013) referred to it as one of “the best pensions in the world”. He added that the Australian Superannuation scheme is often cited as a model for Britain’s new workplace pension programme under which all workers will be enrolled automatically in a company’s pension scheme subject to earnings and age limits.

According to Williamson, Shen and Yang (2007), China has one of the most rapidly increasing rates of old-age dependency in the world. This trend poses a major problem for pension policy experts in China. The People's Republic of China was established in late 1949 and by 1951, an old-age pension scheme had been set up, but the scheme was largely limited to certain urban workers, those working in state-owned enterprises (SOEs) and employees of large urban collectives. Continuing, Williamson, Shen and Yang noted that the old-age security system in China is continually undergoing changes. The current scheme is described by the government as having three pillars; the first is made up of two mandatory components while the second and third pillars are voluntary. The third pillar is basically a private savings scheme and is being managed by private sector insurance companies with little or no government involvement.

According to Eich, Gust and Soto (2012), Russia's current pension was introduced in 2002 and before 2010, the system had had three components: a basic pension, an insurance benefit based on a notional defined contribution account and a funded defined contribution scheme. After 2010, the basic pillar has been folded into the pay-as-you-go portion of pensions. In addition to old-age labour pension schemes, disability and survivor labor pension schemes are also part of the system. As of 2010, the basic pension scheme was indexed the same way as the insurance portion; that is, annually to average wages, but limited to the annual growth of the Pension Fund of Russia's (PFR) income, expressed per pensioner. The labour insurance component is a notional defined contribution pension scheme, at the same time a pay-as-you-go scheme that includes old-age, disability and survivor benefits while the third component is a funded defined contribution system.

Historically, the United Kingdom (UK) is one of the earliest countries in the world to establish a pension scheme (Trebilcock and Reeve, 1988). The basic state pension, then known as the “Old Age Pension”, was introduced in the United Kingdom (including Ireland) in January 1909 following the passage of the Old Age Pensions Act 1908. The qualifying age was 70, and the payments of pensions were subject to a means test; that is, if an employee’s pension amount falls below a specified level, he will receive an additional sum to bring his pension up to the specified minimum amount.

The UK Pension Scheme has gone through several legislations; for example, the legislation establishing state pensions in the Social Security Contributions and Benefits Act came into being in 1992 while occupational pension schemes were established by comprehensive statutes in the Pension Schemes Act 1993 and the Pensions Act 1995. Other reviews of the UK pension scheme have been carried out in 2004 updating Regulations. They are the 2007 Pensions Act which updated the state pension and raised retirement ages, and the Pension Act 2008 which set up automatic enrolment for occupational pensions. According to GOV.UK (https://www.gov.uk/) retrieved on August 05, 2013, the new law stipulates that every employer must automatically enroll workers into a workplace pension scheme if they are aged between 22 and State Pension age of 70 years, earn more than 9,440 British pounds a year and work in the United Kingdom.

Pension was introduced in South Africa in the nineteen twenties (1920s) as social pensions for the ruling white South Africans, Theo van der Merwe (2004). Coverage was later extended to black South Africans with discriminatory benefits in favor of the whites. Merwe (2004) quotes Pollak (1981) as writing that some of the discriminating differences were gradually phased out between 1960 and 1968.

According to Nevondwe (2010), the South African Pension Funds Act has been promulgated into law in 1956 during the apartheid system of government, over 54 years ago and has been the system of pension till date, although with minor modifications. Although, efforts have been on for total overhaul in line with the World Bank (1994) recommendations, as at today, South Africa has three types of pension systems consisting of occupational pensions, social pensions and voluntary saving, such as contributions to annuity funds or other forms of investment. Of these three, Vander den Heever (2007) groups them into two: those that are non-contributory flat rate (that is, the State Old Age Pension (SOAP) which are means tested and targeted at those who have virtually no income at retirement, and the contributory system which is earnings-related. South Africa operates social pensions, known as State Old Age Pension (SOAP) for both men (above 65 years old) and women (above 60 years old) as part of its efforts to comply with the World Bank (1994) directives that redistribution should be addressed as many individuals are unable to contribute towards retirement provision. According to Merwe (2004), social pensions in South Africa do not require contributions. However, the beneficiaries are identified through the means test. Benefits from social pensions are relatively low. As at the year 2002, the amount was 640 Rand per month per person. The South African National Treasury second discussion paper (2007) on Social Security and Retirement Reform puts the figure at 870 Rand per month per person. Any Old Aged person earning less than the minimum amount receives a smaller state pension to make the person's income up to the minimum State Old Age Pension amount.

The voluntary savings scheme enables individuals who may or may not be members of any work-related or occupational pension scheme to make provision or additional provision towards their retirement. This is particularly important for those who are employed in industries that do not have pension schemes, the self-employed, and the low-income persons.

An aspect that is lacking in the South African pension system despite that it appears to follow the World Bank's (1994) benchmark is that none of the tiers is mandatory.

The history of pension in Ghana dates back to the colonial era. Kpessa (2011) recorded that an unfunded pension scheme known as "CAP 30" covering mainly civil servants in the formal sector was inherited from the colonial era while policy makers in the early post-independent era introduced provident funds that was later converted into a social insurance scheme in 1992. The social insurance scheme was known as the Social Security and National Insurance Trust (SSNIT), and it operates as a pay-as-you-go type of scheme in which the contributions from current workers and the returns from the investment of such contributions were used to pay the benefits of those who retired. The retirement benefits of those under "CAP 30" were paid from funds factored into the national budget. Both schemes were Defined Benefit schemes and ran parallel until a new pension scheme came into being in the year 2008. Kpessa (2011) argued that it was against the challenges posed by institutional fragmentation and inequality of the "CAP 30" and the SSNIT that the three-tier pension plan was introduced to provide an organized and well-coordinated framework for pension retirement income security management in the country. Thus, in the year 2004, the Ghanaian government initiated

a reform which led to signing into Law a new three-tier pension system for the people of Ghana in December 2008, (Mensah, 2013).

The World Bank (1994) came with a model regarded as a three-pillar model to serve as a benchmark for the world. The last of the three-pillars is a “Voluntary Pension” plan which is to encourage people to save towards their old age: for those who are employed to enhance their income on retirement and those who are not employed to have some savings, also in their old age. The World Bank (1994) went further to suggest a minimum level of adequacy of 67% replacement ratio. This means that a retiree should have a minimum of 67% of his last salary just before retirement as the person’s pension income.

The first Defined Benefit Pension Scheme established in Nigeria was the 1979 Pension Act. It was a non-contributory pension scheme, that is, only the employer contributed to fund whatever benefits that employees would be paid as pension when they retired. Being a Defined Benefit pension scheme, actuarial valuations were required to be carried out at the commencement of the scheme and triennially thereafter, to determine the annual, quarterly or monthly payments necessary to fund the scheme. The Act provided, among other benefits prescribed in a schedule attached to it (the Act), a pension amount of eighty percent and a gratuity amount of 300% of the last annual emolument of the retiring employee after 35 years of continuous service with the employer.

The problems associated with the 1979 Pensions Act (Old Scheme) seem to be mainly on implementation. Prior to the enactment of the 2004 Pension Reform Act, PRA,

(Current Scheme), Legal brief Africa (2004) observed that the collection of retirement benefits in Nigeria appears to have been causing a lot of sufferings to retirees, their dependants and next of kin, especially the retirees in the public sector of the economy. The Legal brief Africa added that there were reports of many beneficiaries who died in retirement benefit queues after waiting for days, without food or water, to collect their benefits. Still on the same situation, Ezeala (2004) added that the issue of rewarding Nigerian workers after years of active service had been a source of concern to the various tiers of government. The author observed that in a country where life expectancy approximates to the commencement of real active life in other climes, the issue of pension and gratuity had become even more challenging; and that many died even before they were due for retirement while some others slumped and died on queues while waiting to process their pension and gratuity.

In tracing the problems that made the old pension scheme unpopular, Odia and Okoye (2012) cited demographic challenges, funding of outstanding pensions and gratuities, administrative bottlenecks, bureaucracies, corrupt tendencies and inefficiencies in the public service as some of the challenges that led to the non-payment of pension and gratuity benefits as and when due.

Orifowomo (2006) cited the comments of Ihonvbere (2004) as saying that despite efforts made by the Federal Government of Nigeria to mop up the backlog of the liabilities, it still owed about ₦2 trillion to its workers. In December 2005, the Director-General of National Pension Commission reportedly put the Federal Government's pension liability at ₦2.56 trillion. Retired Federal Ministry and Parastatal workers were owed ₦2 trillion,

while the accumulated pension arrears for military, police and paramilitary retirees amounted to ₦56 billion.

While the foregoing gloomy pictures existed for the public sector workers, their counterparts in the private sector of the multinational companies who were operating the same Defined Benefit schemes were promptly receiving their pensions and gratuities because the operators of the schemes may have maintained regular actuarial valuations advising on funding levels and solvency which is a fundamental legal requirement of pension funding to ensure solvency of the fund.

As laudable as all the arguments were, a fundamental problem that appear not to have received a deserved attention is the regular or triennial actuarial valuation of the scheme. An initial and subsequent triennial actuarial valuation of a defined benefit pension scheme would have informed the sponsors, Federal and State governments, of all the liabilities for past and future services and the proper amortization schedules for the unfunded liabilities which continued to mount from year to year. In pension funding, actuarial valuations are usually advised to be carried out triennially and also whenever there are demographic changes as major recruitments into the workforce or general salary awards/increases. With the passage of time, problems of lack of payment of pensioners' benefits resulting from lack of, or inadequate funding were commonplace (Odia and Okoye, 2012).

The foregoing problems associated with the running of the old pension scheme seems to have necessitated the enactment of the Pension Reform Act (PRA) in 2004 with the

sole objective of removing the aforementioned bottlenecks and have a smooth running pension system.

The 2004 pension plan, which is a Defined Contribution pension plan, was a replica of the pension and social security scheme operated in Chile from 1981, (James, Edwards and Iglesias, 2011). While Nigerians were still commending this scheme with little or no complaints, Odia and Okoye (2012) cited Dostal and Cassey (2007) to have noted that Nigerian Government went ahead to copy the Chilean model of pension and social security at a time the government of Chile was about changing to an alternative pension model because of the criticism by supporters of the scheme. Similarly, the World Bank (1991) had concluded that the reform model of Chile (which Nigeria had copied) had not, from the beginning, delivered the anticipated benefits due to many assumptions embodied in the planning.

A major problem of a Defined Contribution pension scheme is that the level or amount of pension income payable at retirement will not be known prior to retirement. The amount has to be computed at retirement taking into consideration the total amount of contribution of the individual into the scheme or his/her retirement savings account (RSA), and the accumulated investment income earned. This is unlike the Defined Benefit pension scheme where the level of benefit is known from the on-set.

1.1 Statement of the Research Problem

The benefits under the 1979 Act (Old Scheme) met the World Bank's (1994) benchmark of 67% replacement ratio but were for Federal Government employees only (Ministries, Boards and Parastatals). Its implementation was marred by maladministration and

corruption resulting in delay for months or years, or non-payment at all, of pension benefits to retirees. There were also reports of lack of funding to enable the administrators of the scheme meet with payment of the mounting liabilities that had accrued. Consequently, reports of pensioners dying on queues while waiting to collect their pension monies were commonplace (Legal Brief Africa, 2004: Odia and Okoye, 2006; Orifowomo, 2006) in response to remedy the situation, the Federal Government of Nigeria enacted the Pension Reform Act of 2004. The Act established a Defined Contribution (DC) Pension scheme (Current Scheme) wherein the employer and employee contributed 7½% each of the employee's monthly salary into a retirement savings account for the purpose of securing pension income for the employee on retirement. Initially the Act was seen as laudable because it was made mandatory for both the public and private sectors of the economy. Coverage was, again, limited to persons in employment with the self-employed persons excluded. The extent of the financial benefits, that is, the take-home cash benefits in the pockets of employees when they retire cannot be known until after retirement. As noted earlier, this is a problem with DC pension plans. Over time, different Labour Unions, including the Academia, mounted complaints that the benefits from the current scheme of 15% employer and employee contributions was not likely to provide any significant level of pension and gratuity benefits or even up to the level of benefits of the old scheme after 35 years of service (Orifowomo, 2006). With the above situation, it was difficult to determine which of the two pension schemes (the old and the current) would be better in terms of retirement benefit provision to retirees. Again, research publications by different authors as Orifowomo (2006), Ihonvbere (2004), Legal Brief Africa (2004) Odia

and Okoye (2006, 2012), Adebayo and Dada (2012), among others, dwelt mainly on the problems caused by the maladministration of the 1979 Pension Act and the attendant grief on retired Nigerian workers. None attempted to either quantitatively compare the two schemes (old and current) or suggest an alternative pension scheme. By the World Bank's (1994) expectation of minimizing or "Averting the Old Age crisis", the pension reforms carried out so far in Nigeria seem not to have addressed some of the major issues on improvement in levels of pension benefit and coverage which other countries of the world are focusing on to improve the welfare of the generality of their people, particularly at old age. Given the foregoing precarious situations, there is the need for a pension design plan that will meet the world standard pension scheme.

1.2 Research Questions

Apart from all the qualitative advantages that were orchestrated regarding the Pension Reform Act of 2004 in particular, based on the Statement of the Research Problems of this Study, the following research questions were addressed:

i. Are the monetary benefits to retirees from the old scheme equal to those of the current scheme?
ii. How adequate is the current Nigeria's pension scheme in relation to those of other countries?
iii. What effect does interest rate volatility have on the amount of pensions payable to retirees?

iv. Given that annuity values are functions of mortality and interest rates, what is the effect of changing values of annuity on the amount of pensions that retirees may purchase from the annuity market?

1.3 Aim and Objectives of the Study

The main aim of this study was to design Hybrid Pension plan as a possible Plan for Nigeria. The specific objectives of the study were to:

i. compare the monetary benefits provided by the two major pension plans – the pension plan of Decree 102 of 1979 referred to as “Old” and the Reformed Pension Act of 2004 referred to as ‘Current’;
ii. compare the adequacy of the current pension scheme with those of eight other countries selected from five continents spread over developed and developing countries;
iii. investigate the effect of interest rate volatility on the amount of pensions payable to retirees;
iv. examine the effect of changes in annuity values on the amount of pension that retirees may receive.

1.4 Hypotheses

In attempting to reach decisions, it is useful to make assumptions (or guesses) about the populations involved. Such assumptions, which may or may not be true, are called statistical hypotheses. The foregoing subsidiary hypotheses will be examined and tested to implement the major purpose of the study.

i. There is no significant difference in the quantum of benefits provided by the old pension scheme and the current pension scheme

ii. There is no significant difference between the adequacy (explained in 'Definition of Terms') of Nigeria's current pension scheme and those of other selected eight countries of the world.

iii. There is no significant effect of interest rate volatility on the amount of pensions payable to retirees.

iv. Changes in annuity values have no significant effect on the amount of pension received by retirees.

1.5 Justification for the Study

Averting the 'Old-Age Crisis' is a major issue confronting the world. As is the case with other countries, Nigeria's population is ageing. A good pension plan providing over 90% replacement rate and over, as intended to be achieved in this study, will smooth out old-age poverty among retirees and improve their standard of living if the results of the study are implemented. This study will advance the knowledge about the replacement rate of current Nigerian pension plan and that of the recommended plan if adopted by Nigeria. The replacement rate computed in the course of this study will also provide data on Nigeria's replacement rate for international researchers to be able to compare with those of other nations. Information on pensions about countries such as Cape Verde, Benin Republic, Togo and Ivory Coast, which may easily be seen in publications of IMF, OECD and the World Bank are not readily available about Nigeria. For example, data on the replacement ratio of Nigeria's pension was not available in publications of these organizations as at the time of this research, whereas they were

available for the countries just mentioned above. Again, in the World Bank publication (2012) titled “Africa Social Protection Policy Briefs: Pensions” on Coverage of Social Security Schemes in 36 Sub-Saharan African countries, Nigeria was in the 33rd position with less than 2% coverage. The rest of the African Countries, except Burkina Faso, had higher percentages of coverage with Mauritius, Cape Verde and Zimbabwe taking the first three positions respectively. While all Nigeria’s reformation of pension Acts had the problem of poor coverage and implementation, the replacement rates of the 2004 and the amended 2014 Acts remain undetermined and cannot be compared with other schemes in the world. However, with the replacement rates of the provisions of the two Acts, 2004 and 2014 Acts, being calculated in this study, a possible solution is being provided for the comparison. It is hoped that, in the future, academicians and professional Actuaries will provide better and more enduring pension plan for the country. Similarly, suggestions have been made in this study, on improvement regarding the level of coverage, that is, to include the self-employed and the unemployed in the pension arrangement through the poverty eradication voluntary pillar of the World Bank (1994) three-pillar model. Having more or every qualified Nigerian in the Country’s pension plan will, in turn, improve on the problem of Averting Old-Age poverty crisis in Nigeria. Studies are continuously going on in most parts of the world on pension reformation and this study is hoped to provide a basis for future studies and improvement of Nigeria’s pension scheme by other researchers.

1.6 Scope/Delimitation of the Study

This study focuses on the operations of pension in Nigeria from 1979 up to, and including 2014. It x-rayed the provisions and operations of the two major Pension

Schemes that existed within the period of the Pension Decree 102 of 1979 and the Pension Reform Act of 2004.

In particular, the activities which fall directly under the supervision of the Director General (DG) of the Pension Commission (PENCOM) or his officers or agents as stipulated by the Act are not covered or investigated by this study. These include the activities of the Pension Fund Administrators (PFAs) and the Pension Fund Custodians (PFCs) established by the 2004 Pension Reform Act.

Regarding the level of their compliance with the investment guidelines, the Act stipulated guidelines for investigation and penalties to be imposed by the Commission on erring PFAs and PFCs.

The Act stipulated that there shall be a Compliance Officer for each PFA reporting to the DG PENCOM which is the Government's Regulatory Authority. It could, therefore, amount to unnecessary interference for this study to attempt investigating such highly regulated activities.

This study in no way attempted to determine the performance level of the activities of the Compliance Officers who report directly to the DG, PENCOM.

The study did not also consider the compliance level of the States and other employers of labour in terms of their participation in the 2004 Pension Reform Act which made it mandatory for all organizations employing five or more persons to establish a pension scheme for their employees in line with the provisions of the Act. These fall into the responsibilities of the Compliance Officers who report directly to the DG PENCOM and who is statutorily vested with powers to sanction erring organizations as stipulated by

the Act. These activities come within the purview of the DG PENCOM and his Compliance officers.

1.7 Limitations of the Study

It was necessary to compute the salary replacement rate of the current pension scheme and the newly designed scheme for a meaningful comparison to be made with the pension plans of other countries. The data for the study was taken from only the latest published salaries of government workers by the National Salaries, Incomes and Wages Commission covering 1st July 2010 to date. Further, data published in 2012 by the Organization for Economic Cooperation and Development (OECD), the International Monetary Fund (IMF) and the International Journal for Research and Review in Applied Sciences (IJRRAS) on the eight countries, the United Kingdom (UK), Russia, the United States of America (USA), China, Australia, Chile, South Africa and Ghana, were used to make appropriate comparisons. It was not possible to involve all the countries of the world in a study by an individual for reasons of costs and time. The eight countries were selected from among developed and developing countries covering the five continents of the world. Another limitation is that the mortality table in use in Nigeria and which was used in this study, the a(55) mortality table, is based on the mortality studies of the groups of lives in the UK, because there was not yet a mortality table based on studies of groups of lives of Nigerian citizens. The results of such studies based on foreign mortality table(s) may not reflect the exact situation in Nigeria.

Also most countries covered in this study only discussed the pillar models. The pension replacement rates shown by Organization for Economic Cooperation Development

(OECD) and International Monetary Fund (IMF) were calculated on average earnings from mandatory pensions only. Earnings from non-mandatory and social security contributions were not included. Nigeria has only one mandatory pillar pension and replacement ratio calculation was based on that

1.8 Definition of Terms

Accrual Rate: (in pension) is defined as the proportion of employee's salary that he gets for each year he is a member of a pension scheme. They are usually expressed as fractions, ($\frac{1}{60}th$ or $\frac{1}{80}th$ is common), or sometimes as a percentage; for example $\frac{1}{60}th$ = 1.67%. In investments, this term means the rate of interest that is added to the principal

Actuarial Valuation is a mathematical analysis to determine the financial condition of a pension plan and the future contribution rates needed to ensure its long-term funding. The actuary determines how much money the Plan needs to pay pension benefits by making assumptions about future investment returns, future inflation rates, future increases in salaries, retirement ages, life expectancy and other factors.

Adequacy (of pension amount) This is normally measured as the ratio of an employee's retirement income to the level of his or her earnings just prior to retirement The resultant "net income replacement ratio" is seldom 100%. This is because it is expected that income needs in retirement are usually lower than when one is in regular employment as expenses incurred on commuting to work, cost of meals away from home and on office attire are normally excluded.(National Pensions Regulatory Authority of Ghana, Sept. 2013),

Annuitant: This means a person who is receiving annuity payments

Annuity : This is defined as series of payments made to a life at equal intervals of time if the life is still living, (Jordan, 1982). In respect of Defined Contribution in pension, annuity refers to a situation whereby an individual exchanges his pension accumulation at retirement for regular payments for the rest of his or her life, thus allowing people to insure against the risk of outliving their pension savings, (Barr and Diamond, 2006). Annuities depend mainly on two factors, namely, the Life Table (that is, mortality functions) and the prevailing Discount Rate at the time of purchasing annuities.

Life Tables are subject to improvement from improved longevity while Discount Rates depend upon the prevailing economic climate.

Annuity-due: This means the present value of an annuity which pays at the beginning of each interest conversion period (Kellison, 1970)

Annuity-immediate: This refers to the present value of an annuity which pays at the beginning of each interest conversion period (Kellison, 1970)

By legislation an actuarial valuation must be conducted at least once every three years.

Defined Benefit (DB) Pension plan This identifies the specific benefit that will be payable to the employee at retirement. The basic retirement benefit is usually based on a formula that takes into account factors like the number of years a participant works for the employer (years of service) and the participant's salary (for example, average of highest three or five years of earnings). The retirement benefit is generally provided in

the form of regular payments over the retiree's lifetime beginning at what the plan designates normal retirement age.

Defined Contribution (DC) Pension plan This is occupational pension plan where the employee's contributions and the employer's contributions (on behalf of the employee) are both invested and the proceeds are used to buy a pension and/or other benefits at retirement. The value of the ultimate benefits payable from the DC scheme depends on the contributions paid, the investment return achieved less any fees and charges, and the cost of buying the benefits.

Emolument This refers to the sum of an employee's basic salary, housing allowance, transport allowance, utility allowance and all the other allowances approved by the employer for the purpose of his/her pension or retirement benefit calculation (1979 Pensions Act)

Funded Ratio (in pension) This means the value of pension fund's assets plus the present value of contributions needed to meet the current costs divided by the current value of projected benefits. (Mehr, 1977)

Interest Rate Volatility This refers to the sudden changes in values of interest rates in a way that may be adverse to investments (such as in stocks and equities).

Gratuity This is an amount paid as a lump to an employee at cessation of employment. The amount is usually based on the number of years of service to the employer and the leaving salary of the employee.

Mortality Table: This is a convenient method of expressing probabilities of living and dying. It is not the recorded mortality history of a group but a series of relationships between the propable numbers dying and living at any given age (Mehr, 1977)

Past service benefits (in pension) These are the benefits which relate to the number of years an employee has worked for an organization and the proportion of his/her salaries for those years before he/she joined to be a member of the pension scheme of the employer.

Pension This is an amount of money paid regularly by a government or company to somebody who is considered to be too old or too sick to work

probable numbers dying and living at any given age, (Mehr, 1977).

bears to the last salary earned (OECD, 2008).

Salary Rates: This refers to where the retirement benefit is related to the employee's compensation, the rate at which that compensation increases affects the plan's cost and should be considered in cost projections Changes in compensation rates are not easily anticipated; actuaries attempt to do so (Mehr, 1977).

Years Certain This is used with annuity payment and means that, for the indicated period, the annuity must continue to be paid whether the annuitant is living or dead, for example, "5-years annuity certain".

CHAPTER TWO

The objective of this chapter is to set the theoretical base for the research. The chapter is in three parts: the conceptual framework which seeks to provide a strong background or foundation on where the methodology is based, the theoretical framework to cite studies done by earlier researchers on similar works and then, the empirical framework to mainly review the studies done on the same subject matter so as to highlight the gap this current study seeks to fill.

2.1 Pension Plans

Pension plans can be broadly divided into two major groups: the Defined Benefit (DB) pension plan and the Defined Contribution pension plan. Retirees receiving pension benefits from Defined Benefit (DB) schemes receive gratuities as a percentage of final salary with pensions based on length of service and final salary. These factors are not subject to volatility.

The present pension scheme in Nigeria is a Defined Contribution (DC) pension scheme, that is, a scheme based on the accumulated assets and the rates of annuities and whose quantum of benefits can only be known at the time of retirement when it is calculated. It may be possible to project the value at any interval of time, but because investment incomes (interest rates) are volatile over an employee's period of service, any quantum of benefit so projected may not be reliable.

Accumulated assets at retirement depend upon the investment returns of equities and fixed interest securities throughout the working life of the employee. Investment returns are probabilistic. During periods of economic boom, investment returns are good but are bad and discouraging during periods of depression. Shortfalls of accumulated assets at retirement will affect the amounts available for gratuities and the amount available for purchasing pensions through annuities.

Annuities depend mainly on two factors, namely, the Life Table (that is, mortality functions) and the prevailing Discount Rate at the time of purchasing annuities.

Life Tables are subject to improvement from improved longevity while Discount Rates depend upon the prevailing economic climate.

The retiree faces the risks of volatility of investment returns, vagaries in the expectancy of life and Discount Rate changes. Defined Benefit scheme does not experience any of these pension risks (of interest rate volatility and mortality) because the benefits are computed to accrue annually..

The modern concept of a well-organized pension plan implies that there should be an advance promise that money should be set aside and invested, on some legally defined bases, for the payment of future benefits as they fall due. Such funds should be separated from the general assets of the employer.

2.2 PENSION PLANS IN INDUSTRIAL NATIONS

Petrie and Storm (1991), Armando Barrientos (2008) noted that the formulation of a system which ensures adequate and sustainable pension benefits for the labour force

as a whole has proven problematic in many industrialized nations, and more so in less developed ones. The authors added that the search for an appropriate pension framework has led to a variety of schemes on offer and to a continued debate on their relative effectiveness. The key objective is providing adequate post-retirement income. Furthermore, Orszag and Stiglitz (1999) emphasized that the problems that have motivated pension reforms across the globe are real.

Today, several countries of the world are confirming that reforms are needed by carrying out the necessary reforms on their pension plans. Writing on this issue, Impavido, Hu and Li (2009) noted that, faced with growing financial pressures arising from changing demographics, several countries around the world have decided in the past fifteen years to modernize existing pension funds or to create new public pension funds with substantial reserves to help finance the rising cost of public pensions. They, Impavido et al (2009) cited countries as Japan, Korea and Sweden as countries that have taken steps to remove or relax existing restrictions on the investment policies of their public pension funds while other diverse countries as Australia, Canada, France, Ireland, New Zealand and Norway have similarly taken such initiatives. On the same pension reformation, Vilela (2013) informed that the Chinese have long been carrying out pension reforms in phases; the first phase lasting from 1949 – 1978, the second from 1978 – 2001 and the third coded “gear change” lasting from 2003 to the present date. The United Kingdom (UK) which originated pension plans (Trebilcock and Reeve; 1988) and has three major divisions and seven sub-divisions of pensions continues to carry out reforms. According to Adams (2013), the UK government carried out reforms to increase retirement ages to 66 for both genders by 2020, to 67 by 2028 and will rise

in line with life expectancy thereafter. In the same vein, a former Minister of State for Pensions, Steve Webb, was quoted in a paper presented to the UK Parliament by the Secretary of State for Works and Pensions as saying, “2012 has been a major milestone in the development of the UK’s pension system. It has seen the introduction of automatic enrollment into workplace pensions, a reform which will result in millions of people saving privately for their retirement. The reformation has also seen the confirmation of our intention to fundamentally reform the State Pension”.

The Russian Federation is not left out of this reform. In the year 2002, as a way of improving the sustainability of future pensions for individuals, the Federation introduced a mandatory defined contribution (DC) pension system (Rudolph and Holtzer: 2010) which attracted an enrolment of 50 million individuals by 2009 with accumulated assets amounting to Roble 570 million. Thus, within seven years of the reformation, both the enrolment and the pension fund increased implying that old age poverty crisis has been reduced among the 50 million persons.

It might have been in realization of the foregoing need for reformation that the World Bank (1994) in a conference on “Averting the Old Age Crisis”, trenchantly rolled out its path-breaking publication introducing a “three pillars” pension plan model to the world (Orszag and Stiglitz; 1999). The authors explained that the “three pillars” so delineated are expansive enough to reflect any potential combination of policy measures. Holzmann (1997) added that the Bank recommends a multi-pillar pension system optimally consisting of a mandatory publicly-managed unfunded and mandatory but privately managed funded pillar, as well as supplemental voluntary private funded schemes. The supplemental voluntary funded pillar is seen as an avenue to cater for

the self-employed in particular and most countries attach generous tax incentives in addition to state subsidy to low-earnings workers who make voluntary individual or collective payments (Berstein, Castañeda, Fajnzylber and Reyes, 2009).

2.3 PENSION PLANS IN DEVELOPING NATIONS

In many developing countries, reforms are indeed needed, in that soaring deficit gaps between pension funds obligations and revenues not only threaten economic stability, but also crowd out necessary investments in education, health and infrastructure (Orszag and Stiglitz, 1999).

.Most of the current pension reforms, particularly in the Latin American and some other developing countries, are modeled after the World Bank's (1994) three pillar plans.

Chile, one of the developing countries of the world, has had three major pension reforms – in the 1920s, 1980 and 2008 – each one addressing observed particular problem. The latest reforms of 2008 by the Bachelet government to address the criticisms on the uncovered sector have been acclaimed as one of the best in the world (Evans, 2013; Behrman et al, 2011; Barrientos, 2008). Butler (2011) cited the reforms as a model for the world and added that overall, the system has been a fantastic success. It gave people choice on how they saved and also gave incentives to do so. Personal savings in Chile are up from a few hundred million dollars to tens of trillions of dollars today. New rules were introduced to make sure that pensioners did not exhaust their accounts before they died. Berstein et al (2009) highlighted, among others, the issue of coverage through the poverty-prevention pillar, the mandatory contribution pillar and the voluntary pillar as part of the series of objectives identified as being of prime

importance in the diagnosis drawn up prior to the reforms. This was corroborated by James, Edwards and Iglesias (2010). The 2008 reform is particularly important because it touched on three essential aspects of pension: the coverage, level of benefit and level of expected investment to be achieved by the pension administrators. On the third issue, the new Chilean Private Pension Fund Administrators (PPFA), the counterparts of Nigeria's Pension Fund Administrators (PFA), are given minimum and maximum levels of investment income to be achieved and credited to the pension funds they administer each year as a way to ensure that sufficient funds are built up for retiring employees. Such investment-earning targets do not exist for Nigeria's PFAs nor were issues of coverage considered in any form in the 2014 Amended Pension Reform Act. All the three tiers of the Chilean pension are Defined Contribution (DC) plans. Regarding investment returns in DC Pension plans, a famous Ghanaian Actuary Mensah (2013) stated one of the most significant variables affecting the benefit outcome under a DC scheme is the investment return achieved. This is reflected in the fact that at the end of a typical career of 30 – 40 years, as much as two-thirds (67%) of the member's final retirement account could be made up of accumulated investment returns, with just one-third (33%) made up of total contributions paid. He concluded that DC schemes succeed when investment returns are adequate and that this is a major challenge of privately managed schemes.

In discussing pension reforms in some African countries, South African pension introduced in the 1920s as social pensions for the ruling whites (Merwe, 2004) has undergone series of reforms. Coverage was later extended to black and coloured South Africans with discriminatory benefits in favour of the whites. Merwe (2004) quoted Pollak

(1981) by stating that some of the discriminating differences were gradually phased out between the years 1960 and 1981.

South Africa today, has three main types of pension, according to Heever (2007), as Occupational Pension scheme, Social Pensions known as State Old Age Pension (SOAP) for both men (above 65 years old) and women (above 60 years old) and the Voluntary Savings scheme. According to Merwe (2004), SOAP is part of South Africa's efforts to comply with World Bank (1994) requirements that redistribution should be addressed as many individuals are unable to contribute towards retirement provision.

With Nigeria's closest neighbor, Ghana, Kpessa (2011) recorded that an unfunded pension scheme known as "CAP 30" covering mainly civil servants in the formal sector was inherited from the colonial era while policy makers in the early post-independent era introduced provident funds that was later converted into a social insurance scheme in 1992. The scheme, known as the Social Security and National Insurance Trust (SSNIT), was a pay-as-you-go type of scheme. The pension reformation wind brought about a new pension scheme in Ghana in 2008 with effect from 1st January 2010. According to Kpessa (2011) it was against the challenges posed by institutional fragmentation and inequality of the "CAP 30" and the SSNIT that the three-tier pension plan was introduced to provide an organized and well-coordinated framework for pension retirement income security management in the country. Thus, in 2004, the government initiated a reform which led to signing into Law a new three-tier pension system for Ghanaians in December 2008 (Mensah, 2013). The third tier of the Ghanaian reformed pension was supported by tax benefit incentives for workers in the informal sector in particular and was not geared towards those who are employed

alone, as has been the case with all the reformations in Nigeria, disregarding the World Bank benchmark framework to improve the percentage of the population covered under the pension scheme. The Ghanaian Actuary, Mensah estimates that the first and second tiers contributions of 18.5% in the new scheme would provide replacement rate of 74% to 79% while a third tier voluntary contribution of 5% will provide a further 20% to 25%.

2.4 PENSION PLANS AND THE NIGERIAN SITUATION

While the 1979 Pension Act provided the format or schedule for the calculation of the benefit amount which was tied to the years of service and final emolument at the time of retirement, the 2004 Pension Reform Act has no such format. As a Defined Contribution pension scheme, the benefit amount to any retiring employee has to be calculated and depends on the total amount of contribution into the pension scheme and the accumulated amount of investment returns on the scheme.

On investment, the Act stated that all contributions (made up of 7½% of employee's salary paid by both the employer and employee totaling 15%) shall be invested by the PFAs with objectives of safety and maintenance of fair returns on amount invested. The investment instruments to be invested in were clearly spelt out by the Act. These include bonds, bills and other government securities, debentures, redeemable preference shares or ordinary shares of companies listed on the Stock Exchange and with good track records in the last five years. Also included are bank deposits and bank securities among others. There are also restrictions/exclusions regarding where the funds may be invested, which include shares and securities issued by the PFA or PFC or the shareholder of the PFA or PFC among others. In making investment choices, the Act warns the PFA to have due regard to the risk rating of the instrument by a risk rating company registered under the Investment and Securities Act 1999. Regarding the

investment of pension funds outside Nigeria, the Act added that the Pension Commission may recommend to the president for approval of pension assets outside the territory of the Federal Republic of Nigeria. However, apart from the safeguards put around the manner and class of investment of these funds and assets, Orifowomo (2006) noted that there should have been a stipulation of a minimum return on investment which these funds should attract for the benefits of the beneficiaries of the RSAs. The Act did not set any target regarding the minimum or maximum level of investment return that the PFAs should credit annually to the RSAs of employees. The current DC pension plan of Chile established in 2008 set up maximum and minimum levels of investment returns to be achieved and credited to the RSAs of employees by their AFPs, the Chilean counterparts of our PFAs, with attendant sanctions of withdrawal of the pension funds from defaulters. The reason for such stringent action was to ensure that enough funds were accumulated that would not be exhausted by the retirees before death.

2.5 EXISTING PROCEDURES FOR ESTIMATING PENSION BENEFITS

The concept of estimating pension benefit under the DC pension plan was developed. According to Jordan (1982), Lee (1986), Bowers, Gerber, Hickman, Jones and Nesbitt (1997), applying basic probability to the a(55) mortality table (Appendix I) to develop annuity factors which will be later combined with the salary scale factors (Appendix IIB) and other compound interest values, we have the following:

Let l_x represent the number of lives, who, according to the mortality table, survive to age x in service next birthday.

The probability that a life aged x will survive to age $x+t$ is denoted by $\frac{l_{x+t}}{l_x}$ which is also denoted as ${}_t p_x$.

The value of ₦1 (one Naira) payable annually for n years can be discounted to the present time at interest rate i with value as $(1+i)^{-n}$ also be denoted as v^n.

Hence, $(1+i)^{-n} = v^n$. (2.1)

The present value at age X of one Naira (₦1) paid to a life every year he survives is the sum of all the probabilities that he survives each year, multiplied by ₦1 for each of the years, (i.e. his expectation), discounted to the present age X and is given by

$$\sum_{t=0}^{\infty} v^t {}_t p_x = \frac{1}{l_x} \sum_{t=0}^{\infty} v^t l_{x+t} = \sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x} \quad (2.2)$$

We define $v^x l_x = D_x$ *and* $D_{x+t} = v^{x+t} l_{x+t}$.

Hence equation (2.2) can be written as $\sum_{t=0}^{\infty} \frac{D_{x+t}}{D_x}$ (2.3)

Again, we define $\bar{D}_x = \frac{1}{2}\left(D_x + D_{x+1}\right)$, and $\sum_{t=0}^{\infty} D_{x+t} = N_x$. while (2.3a)

$$\sum_{t=0}^{\infty} \bar{D}_{x+t} = \bar{N}_x . \quad (2.3b)$$

Salary scale functions were introduced with the assumption that whatever type of earnings is involved, the salary scale will provide a basis for the projection of future earnings. The type of function used in practice is a relative scale representing the ratio of average annual earnings in each future year to present average annual earnings. It consists of a series of numbers s_x defined for all X such that, for a group of members

of exact age x, $\frac{s_{x+t}}{s_x}$ is the assumed ratio of the average earnings in the year of age $x+t$ to $x+t+1$ to the average earnings in year of age x to $x+1$.

This scale in practice usually covers those increases which would, on average, be expected because of the progress of individuals within their career if overall levels of earnings remained stable as well as increases representing changes in the general levels of earnings on account of inflation. We then have

$$s_{x-1}D_x = {}^sD_x \text{ and } s_xN_x = {}^sN_x . \qquad (2.4)$$

The earnings expected to be received during the year of age y to y+1 by a member now aged x are $\frac{(AS)_x S_y}{S_{x-1}}$ where AS_x is the member's annual emolument at age x. .

Applying the above concepts in equations (2.1) to (2.4), the **accumulated value** at age x of a contribution equal to 15% of earnings is thus given by equation (2.5) below

$$(.15)(AS)\frac{\sum_{t=0}^{60-x} v_{x+t+\frac{1}{2}} s_{x+t} l_{x+t+\frac{1}{2}}}{{}^sD_{60-x}} \qquad (2.5)$$

The 2004 Act further stipulated that 75% of the amount calculated in equation (2.5) will be credited to the RSA of the employee. The resultant value is given in equation (2.6) below,

$$(0.75)(.15)(AS)\frac{\sum_{t=0}^{60-x} v_{x+t+\frac{1}{2}} s_{x+t} l_{x+t+\frac{1}{2}}}{{}^sD_{60-x}} \qquad (2.6)$$

Where past service benefit has been estimated, the resulting benefits were added to the future benefits.

In calculating the pension amount payable under the Reformed Pension Act 2004, the accumulated contribution at retirement shown in equation (2.6) above was divided by the sum of two annuity values to discount to the retirement age of 60:

(a) $a_{\overline{5}|} = \frac{1-v^5}{i}$ for $i = 3\%$ has value equal to 4.98 (2.6a)

to take care of the 5-year annuity certain, and

(b) $\frac{D_{65}}{D_{60}}\ddot{a}_{65} = \frac{D_{65}}{D_{60}}a_{65+\frac{1}{2}}$ = 3.6672 (computed from Appendix "11A") (2.6b)

representing the present value at age 60 of a **life annuity due** commencing at the end of the certain period at 65. The calculated combined value from (2.6a) and (2.6b) was 8.2470.

The value of equation (2.6) divided by 8.247 will give **the total amount at age 60** for the retiring individual. To get the annual pension amount, the total amount at age 60 is further divided by the value of the prevailing annuity $\ddot{a}_{\overline{60}|}$, resulting in equation (2.7)

below

$$(0.75)(.15)(AS)\frac{\sum_{t=0}^{60-x} v_{x+t+\frac{1}{2}} s_{x+t} l_{x+t+\frac{1}{2}}}{{}^{s}D_{60-x}} / (8.247\ddot{a}_{\overline{60}|}) \qquad (2.7)$$

Equation (2.7) represents the **annual pension amount** to the retiree under the 2004 PRA.

To estimate the benefit amount under the 1979 Act, the total pensionable emolument of an employee at retirement will be estimated and 80% (shown in Appendix "A" attached to the Act) being the percentage of final pensionable emolument after 35 years of service will be calculated. The resulting value, which will now be the amount of pension under the 1979 Pension Act, would be compared with the value obtained under the 2004 PRA shown (equation (2.7) to ascertain which of the two Pension Acts that pays higher pension amount to retirees.

To illustrate the calculation of the 1979 Pension benefit, consider a pension plan providing an annual pension of $k\%$ of one year salary at the rate of pay in the year of retirement to an employee aged x with an annual pensionable salary of $(As)_x$.The equation of value is given by

where $\ddot{C}^r_{x+t} = \dfrac{v^{x+t+\frac{1}{2}} r_{x+t}}{l_x}$ (2.8a)

is the probability of retirement at time $x+t$ discounted to age x , and

$\ddot{a}^r_{x+t+\frac{1}{2}}$ is a retirement annuity-due at age $x+t+\frac{1}{2}$ (2.8b)

while $\ddot{C}^r_{x+t}$ is a retirement commutation function at age x+t. (2.8c)

2.6 COMPARISONS OF DIFFERENT PENSION EARNINGS INDICATORS.

The OECD (2006) states that replacement rates at average earnings is perhaps the most familiar indicator in pension analysis. The organization went further to define 'old-age pension replacement rate' as a measure of how effectively a pension system provides income during retirement to replace earnings which were the main source of income prior to retirement. Finnish Center for Pensions (2006) asserted that the concept of 'replacement ratio' is usually used to compare the starting pension to the earnings received prior to retirement and as a consequence the concept of gross and net replacement ratio was introduced. The Center further defines gross replacement ratio as the starting pension in relation to the person's own last wage from which no taxes or contributions have been deducted. The Center also added that net replacement ratio refers to the pension in hand in relation to the person's own last wage from which taxes and contributions have been deducted. Colomeischi (2012) stated that the gross rate of pension revenues replacement is usually defined as the "report" between the gross retiring pension and the last wage taken before the retirement. Such report shows how the revenues offered at the retirement by the pension systems will replace the revenues earned before retiring". Investopedia (2014) described Replacement Rate as the percentage of a worker's pre-retirement income that is paid out by a pension programme upon retirement In 2008 Replacement Ratio Study, Aon Consulting referred to replacement ratio as a measurement tool for Retirement Planning and went on to define it as a person's gross income after retirement divided by his or her gross income before retirement.

Through the IMF Working Paper, Eich, Gust and Soto (2012) provided data on the replacement rates for all the eight countries whose pensions were compared with that of Nigeria. The same information was also available from OECD (2013) on some of the countries which are members of the organization.

The mortality table used in the calculation of annuity and other probability calculations was the American Commissioners 1958 Standard Ordinary usually referred to as '1958 CSO Mortality Table'.

2.7 NIGERIAN PENSION REFORM ACT (PRA) 2004.

The Pension Reform Act 2004 stipulated that a total of 15% of employee's salary be paid monthly into the employee's retirement savings account, RSA, during his/her working life. At retirement, 75% of the accumulated savings in the employee's Retirement Savings Account (RSA) will be used to purchase a life annuity with 5 years certain period as pension.

The deductions from the employee's salary would be invested through his/her Pension Fund Administrator (PFA) and expected to attract a rate of return. It was assumed that a minimum net rate of interest return of 7.5% per annum would be achieved and credited to the RSA. This long-term yield expected to be earned on the investment during the long future period of employment was denoted by i

The data used for this computation was the latest salaries published in January 2010 and reviewed to be effective 1st July 2010 by the Nigerian National Salaries, Incomes and Wages Commission for Federal and State employees in Nigeria. The Commission grouped Nigerian workers into seven professional groups as shown below and four of

the groups were randomly selected in the belief that they would together constitute over 50% of the entire Nigerian workers. The seven groups included the following:

i) Consolidated Top Federal Public Office Holders' Salary Structure (CONTOPSAL)
ii) Consolidated Public Service Salary Structure(CONPSS)
iii) Consolidated Research and Allied Institutions Salary Structure (CONTAISS)
iv) Consolidated Tertiary Institutions Salary Structure (CONTISS II) which also covers the Non-Academic Staff of Universities
v) Consolidated University Academic Salary Structure (CONUASS)
vi) Consolidated Health Salary Structure (CONHESS)
vii) Consolidated Judicial Salary Structure (CONJUSS)

The average rate of salary progression that would take into account the annual wage and promotional increases were calculated for each of the four salary groups selected which included:

i). the Public Service Salary Structure – CONPSS

ii). the Tertiary Institutions which includes Non-Academic Staff of Universities

- CONTISS II

iii). the University Academic Salary Structure – CONUASS, and

iv). the Health Salary Structure – CONHESS

2.8 Bayesian Application to Replacement Ratio

A statistical method of obtaining a replacement ratio uses the application of Bayesian and Credibility theory. Assume there exist observations, X , representing the replacement ratio of each group of employees of the same age, the same salaries and the same length of service. X is thus a random variable differing between groups and organizations and has a density function, d.f., $f_{\Phi}(x)$. Often the difficulty is that the parameter Φ is not known and has to be estimated with the maximum likelihood method and with the method of moments which are purely observation methods. Bayesian methods come in when there is no past knowledge or only scarce past observations. We specify a prior distribution or density $\pi(\phi)$ for the parameter Φ . The joint density of the observation X and the parameter Φ is then given by

$$f(x,\Phi) = f_{\Phi}(x)\ \pi(\Phi). \tag{2.9}$$

Bayes Rule helps in the calculation of the posterior distribution of Φ given the observation x as given in equation (2.10) below:

$$\pi(\theta / x) = \frac{f_{\Phi}\theta(x)\pi(\theta)}{\int f_{\theta}(x)\pi(\theta)\partial\theta} \cong f_{\theta}(x)\pi(\theta) \tag{2.10}$$

The prior distribution is obtained from an expert knowledge on portfolio of similar business. The prior belief $\pi(\phi)$ can be modified to obtain the posterior distribution $\pi(\theta / x)$ that reflects both prior knowledge $\pi(\theta)$ about Φ and experience x that the prior belief $\pi(\theta)$ is improved by the new observation x . Thus, when there is a new

observation, we can update our knowledge about Φ which constantly improves our estimation of the unknown model parameter. This is exactly what Bayesian and Credibility Theory do. In this study, consider a sample N comprising of employees of the same age and the same length of service but of different Pension Fund Administrators (PFAs). The PFAs will provide different investment returns and employers will give different salary incremental rates. Hence the pension replacement ratio will vary from the expected or average. There will then be a prior knowledge or probability of the replacement ratio which is improved upon from each observation of X

2.9 The Poisson – Gamma (general) Model

Assume that fixed volumes (of data) $V_t > 0$, are given and $t \in N$ where N =number of replacement ratios. Conditionally, given the observation, Λ , the replacement ratio components $N = (N_1, N_2, ..., N_T)$ are independent with $N_t \sim Poi(\Delta, v_t)$ and $\Delta \sim \Gamma(\gamma, c)$, with parameters $\gamma > 0, c > 0$, that is, N_t follows a Poisson distribution and Λ follows a Gamma distribution. $N_1, N_2, ..., N_T$ belong to the same Λ , Poisson distribution. If we assume that $N = (N_1, N_2, ..., N_T)$ follows the Poisson – Gamma model, the posterior distribution of Λ , conditional on N is given by

$$\Lambda / \{N\} \sim \Gamma(\gamma + \sum_{t=1}^{T} N_t, c + \sum_{t=1}^{T} v_t) \qquad (2.11)$$

Proof: The posterior is given by equation (1.12) below:

$$\pi(\lambda / N) \propto \prod_{t=1}^{T} \frac{e^{-\lambda v_t} (\lambda v_t)^{N_t}}{N_t!} \frac{c^{\gamma}}{\Gamma(\gamma)} \lambda^{\gamma - 1} e^{-c} \lambda.$$

$$\propto \lambda^{\gamma} + \sum_{t=1}^{T}(N_t - 1)e^{-(c+\sum_{t=1}^{T} v_t)\lambda} \qquad (2.12)$$

This is a gamma density with the required properties. The posterior is also a gamma distribution with modified parameters. For the parameters, we obtain the updates (in the estimation of the parameters) as

$$\gamma \rightarrow \gamma_T^{post} = \gamma + \sum_{t=1}^{T} N_t \text{ , and} \qquad (2.13)$$

$$c \rightarrow c_T^{post} = c + \sum_{t=1}^{T} v_t \qquad (2.14)$$

Often, γ and c are called prior parameters and γ_T^{post} are called posterior parameters. A property of the Poisson – Gamma model is that the posterior distribution stays in the same family of distributions as the prior distribution.

For the estimation of the unknown parameter Λ, the prior and posterior estimations in equations (2.15) and (2.16) are appropriate:

$$\lambda_0 = E[\Lambda] = \frac{\gamma}{c} \qquad (2.15)$$

$$\text{'and } \lambda_T^{post} = E[\Lambda / N] = \frac{\lambda^{post}}{c_T^{post}} = \frac{\gamma + \sum_{t=1}^{T} N_t}{c + \sum_{t=1}^{T} v_t} \qquad .(2.16)$$

The posterior γ_T^{post} is analyzed to provide the basic credibility formula. Assume

N = $((N_1, N_2, ..., N_T)$ follows the Poisson – Gamma model. Then

N ⊔ Poisson (Λ, v_t) and $\Lambda \sim \Gamma(\gamma, c)$ with $\gamma > 0, c > 0$.

The posterior estimator, $\hat{\lambda}_T^{post}$ has the following credibility form:

$$\hat{\lambda}_T^{post} = \alpha_T \hat{\lambda}_T^{post} + (1-(1-\alpha_T)\lambda_0 \qquad (2.17)$$

The credibility weight α_T and the observation based estimator $\hat{\lambda}_T$ is given by:

$$\alpha_T = \frac{\sum_{t=1}^{T} v_t}{c + \sum_{t=1}^{T} v_t} \quad \epsilon(0,1) \quad \text{and} \quad \hat{\lambda}_T = \frac{1}{\sum_{t=1}^{T} v_t} \sum_{t=1}^{T} N_t \qquad (2.18)$$

The Mean Squared Error of this estimator is given by

$$E_{\frac{1}{N}}[(\Lambda - \hat{\lambda}_T)^2] = \frac{\gamma^{post}}{(c_T^{post})^2} = (1-\alpha_T)\frac{1}{c}\hat{\lambda}_T^{post} \qquad (2.19)$$

It follows that the posterior estimator $\hat{\lambda}_T^{post}$ is a credibility weighted average between the prior guess λ_0 and the purely observation-based estimator $\hat{\lambda}_T$ with credibility weight $\alpha_T \epsilon(0,1)$.

The posterior estimate of pension replacement ratio is a credibility weighted average between the prior estimate of replacement ratio and the observed estimate. The credibility weight α_T has the following properties:

1. As the number observed $T \to 0$, $\alpha_T \to 1$ since $v_t \geq 1$, for all t,
2. $V_t \to \infty; \alpha_T \to 1$
3. For the prior uncertainty tending to infinity, that is $c \to 0, \alpha_T \to 1$
4. For the prior uncertainty going to infinity, that is, $c \to \infty, \alpha_T \to 0$

For c large, informative prior distribution is considered; for small c, vague prior distribution is obtained and for $c = 0$, non-informative or improper prior distribution is obtained. The latter means absence of prior knowledge.

2.10 Actuarial Application

In general, consider an employee on a starting salary N X and who attains a salary of N Y, his average salary progression rate, r, after t years can be denoted by the equation

$$X(1+r)^t = Y \tag{2.16}$$

Disregarding the 15% and 75% for now, the equation of value, with accumulation after n-years of service becomes:-***

$$\left\{(1+i)^{\mathrm{n}} + (1+r)(1+i)^{\mathrm{n}-1} + (1+r)^2(1+i)^{n-2} + \cdots + (1+\mathrm{r})^{\mathrm{n}}\right\} \tag{2.20}$$

Multiplying equation (2.17) by $\dfrac{(1+r)^n}{(1+r)^n}$, gives equation (2.21)

$$(1+r)^n\{\frac{(1+i)^n}{(1+r)^n} + \frac{(1+r)(1+i)^{n-1}}{(1+r)^n} + \frac{(1+r)^2(1+i)^{n-2}}{(1+r)^n} + \ldots + \frac{(1+r)^n}{(1+r)^n}\}$$

$$= (1+r)^n\{\frac{(1+i)^n}{(1+r)^n} + \frac{(1+i)^{n-1}}{(1+r)^{n-1}} + \frac{(1+i)^{n-2}}{(1+r)^{n-2}} + \ldots + 1\} \tag{2.21}$$

Let $$\frac{(1+i)}{(1+r)} = (1+i'') \tag{2.22}$$

The series expression in the bracket in (2.21) can be expressed as:

$$(1+r)^n\{(1+i'')^n + (1+i'')^{n-1} + (1+i'')^{n-2} + ... + 1\} \tag{2.23}$$

at a new accumulation rate, i'', where

$$i'' = \frac{1+i}{1+r} = \frac{i-r}{1+r}, \quad \text{for } i > r \tag{2.24}$$

can be calculated easily from the above relationship since i is known (=0.075) and r has been computed for each salary group.

Therefore, the equations in (2.23) can be actuarially written as equation (2.25):

$$(1+r)^n S_{\overline{n}|i''} \tag{2.25}$$

where

$$S_{\overline{n}|i''} = \left[\frac{(1+i'')^n - 1}{i''}\right] \tag{2.26}$$

$n =$ maximum length of service

and i'' is calculated as shown in equation (2.24) above for each salary group.

The interest rate i was constant with a value equal to 7.5% and equation (2.25) is simplified to obtain equation (2.27)

$$(1+r)^n\left[\frac{(1+i'')^n - 1}{i''}\right] \tag{2.27}$$

Equation (2.27) represents the total earning for an employee in any group after n years of service, with the appropriate value of i'' derived for each group.

Incorporating the fact that 15% of the value in equation (2.27) represents the total contribution to pension out of which 75% of the 15% goes for purchase of annuity or scheduled withdrawal, the value in the retiring employee's RSA for purchase of annuity or for scheduled withdrawal is given by:

$$(0.15)(0.75)(1+r)^{n}\left[\frac{(1+i'')^{n}-1}{i''}\right] \tag{2.28}$$

This is to be divided by the annuity rate which has been calculated separately using the American Commissioners 1958 Standard Ordinary Mortality Table.

The estimated salary in the year of retirement is given as equation (2.29) below.

$$(As)_{x}(\frac{s_{n}}{s_{x-1}})\left(1+r\right)^{n} \tag{2.29}$$

where r has been earlier defined in subsection 2.10 (line 2) as rate of salary increase and computed for each salary group and $\frac{s_{n}}{s_{x-1}}$ is the salary progression rate immediately following retirement at age x .

For each salary group, therefore, the replacement rate is obtained as a ratio of equation (2.28) and equation (2.29) multiplied by 100.

The pooled replacement ratio is used to compare with those of other countries named earlier.

2.11 The Effect of Change in Mortality on Annuity and Pension Values

We noted earlier that annuity is a function of mortality and interest rate, that is, $a_{x}=f(l_{x},i)$ .The effect on a_{x} of a change in the rate of mortality at a single age, $x+n$,

can be investigated by considering that $a_x = a_{x:\overline{n}|} + v^n{}_n p_x a_{x+n}$, (Jordan, 1982) Since

$a_{x+n} = vp_{x+n}a_{x+n+1}$ and $p_{x+n} = 1 - q_{x+n}$, then $a_x = a_{x:\overline{n}|} + v^{n+1}{}_n p_x (1 - q_{x+n})\ddot{a}_{x+n+1}$.

If now q_{x+n} is replaced by $q_{x+n} + c$, we then see that the change in a_x will be

$-cv^{n+1}{}_n p_x \ddot{a}_{x+n+1}$

(2.30)

implying that increase in mortality produces an inverse effect on annuity

2.12 The effect of Change of Interest Rate on Annuity:

The effect of change in interest alone on annuity was estimated (Jordan, 1982) by

considering the derivative of annuity $a_x = \sum_{t=1}^{\infty} v^t{}_t p_x$ (2.31)

Then $\frac{d}{di} a_x = \frac{d}{di}\left\{\sum_{t=1}^{\infty} v^t{}_t p_x\right\} = \frac{d}{di}\left\{\sum_{t=1}^{\infty} (1+i)^{-1}{}_t p_x\right\}$

$= \sum_{t=1}^{\infty} -t(1+i)^{-t-1}{}_t p_x = -v\sum_{t=1}^{\infty} tv^t{}_t p_x = -v(Ia)_x di$. (2.32)

The negative sign reflects the fact that a_x decreases as i increases.

2.17 Stochastic Modeling of Interest Rates

According to Bowers et al (1997), data from some segments of the capital markets support the hypothesis that annual interest rates can be modeled as independent and identically distributed random variables,. Actuaries model the forces of interest as

$$\log(1+I_k)=\delta+\varepsilon_k,\ \ k=1,2,.....\tag{2.33}$$

,where δ is a non-negative constant and ε_k are independent and identically distributed random variables with $N(0,\sigma^2)$ distributions.

Model (2.33) can be viewed as a long-term mean force of interest subject to random shocks. Because of the assumption of random shock terms, negative forces of interest are possible and are observed in investment operations. The random variables, $\log(1+I_k)$ have identical $N(\delta,\sigma^2)$ distributions and the $(1+I_k)$ random variables have lognormal distributions. Hence

$$E(1+I_k)=\exp(\delta+\tfrac{\sigma^2}{2})\geq 1\tag{2.34}$$

,and $$Var(1+I_k)=(e^{\sigma^2}-1)\exp(2\delta+\sigma^2)\geq 0\tag{2.35}$$

Where the interest accumulation function $(1+i)^n$ is viewed as deterministic, the logarithm of the random variable, $(1+I_k)$ is

$$\log\prod_{k=1}^{n}(1+I_k)\ =\ \sum_{k=1}^{n}\log(1+I_k)\tag{2.36}$$

This random variable follows $N(n\delta,n\sigma^2)$ distribution with

$$E\left[\prod_{k=1}^{n}(1+I_k)\right]=\ e^{n(\delta+\frac{\sigma^2}{2})}\tag{2.37}$$

,and Variance $\left[\prod_{k=1}^{n}(1+I_k)\right]=(e^{\sigma^2}-1)e^{n(2\delta+\sigma^2)}$ (2.38)

If $\sigma^2=0$, the expected interest accumulation is $e^{n\delta}$ and its variance is zero.

Lee (1986) introduced equation (2.20) as suitable for accumulation of assets. This has been used to illustrate the effect of volatility of investment returns on pension values.

i). As before, let lx be the number of lives at age x from the Life Table,

ii). r_x the percentage of salary increment per annum for a life aged x.

r_x is assumed to be 5% for the period.

iii). Let i be the investment rate of return for the period. 8%, 10%, 12% and 14% rates of investment return will be considered in this study.

iv). Retirement is assumed to take place at age 60

v). Let Cx be the rate of pension contribution of salary assumed to be 15% and salary at age x be represented by $(As)_x$.

The value for the accumulated assets, ACS, at retirement, is given by equation (2.39)

$$ACS=(\mathrm{As})_x[(1+i)^n+(1+i)^{n-1}(1+r)+...+(1+i)(1+s)^{n-1}+(1+r)]$$

$$=(AS)_x(1+i)^n\left[1+\frac{(1+r)}{(1+i)}+\frac{(1+r)^2}{(1+i)^2}+...+\frac{(1+r)^{n-1}}{(1+i)^{n-1}}\right]$$

$$=(As)_x(1+i)^n\left[1+(1+i'')+(1+i'')^2+...+(1+i'')^{n-1}\right] \quad (2.39)$$

Recall from equation (2.24), that $i''=\frac{i-r}{1+r}$; $i>r$

$$ACS = (As)_x (1+i)^n \ddot{a}_{\overline{n}|} = (As)_x (1+i) a_{\overline{n}|} (1+i'') \quad (2.40)$$

where $a_{\overline{n}|} = \left[\frac{(1-v^n)}{i''} \right]$ and $v = \frac{1}{1+i''}$. (2.40a)

vi). The final salary between ages 59 and 60, is given as equation (2.41) below:

$$FS = (As)_x (1+r)^{n-1} \quad (2.41)$$

vii). The annuity rates at the age of retirement of 60 years, a_{60} , were taken as 9.768, 9.804, 10.497 and 11.797 to reflect various life expectancies of different Life Tables.

viii). If g be the percentage of accumulated assets allocated to gratuities, the balance that would be available for pensions, $BAL = (1-g)ACS$,

would be the amount available to purchase pensions, given as equation (2..42)

$$PEN = (1-g)\,\mathrm{ACS} \quad (2.42)$$

ix) The amount of pension, CP, that can be purchased by the above amount is

$$CP = \frac{(1-g)ACS}{AN_x} = \frac{(1-g)ACS}{a_x} \quad (2.43)$$

'where AN_x or more commonly a_x is the annuity at age x

Annuity at age x was earlier calculated as

$$AN_x = a_x = \sum_{t=0}^{\infty} \frac{l_{x+t}(1+i)^{-t}}{l_x} = \sum_{t=0}^{\infty} \frac{v^t l_{x+t}}{l_x} = \sum_{t=1}^{w-x-1} \frac{v^{x+t} l_{x+t}}{v^x l_x}$$

,where we defined

$$v = (1+i)^{-1},\ l_{x+t} v^{x+t} = D_{x+t}\ ,\ \text{and}\ \sum_{t=0}^{w-x-1} D_{x+t} = N_x$$

Here, i is the discount rate and we can see that $N_x = f(l_x, i)$; (2.44)

Similarly, $PEN = f(\mathrm{r}_x, l_x, i)$. (2.45)

Pensions, therefore, depend on salary incremental rates, investment returns and life expectancy or mortality..

(x). Then, the Replacement Ratio,

$$RR = \frac{CP}{FS} * 100 = \frac{(1-g)ACS}{(As_x)(1+r)^{n-1} a_x} * 100 \qquad (2.46)$$

The replacement ratio obtained here was used in a case study in chapter 4.

2.2 Theoretical Frame work

There are two major theories underpinning the establishment of pension schemes; the economics theory and the financial theory. On the economics theory, Barr and Diamond (2006) stated that, from an individual viewpoint, income security in old age requires two types of instrument: a mechanism for consumption smoothing and a means of insurance. On consumption smoothing, they informed that people seek to maximize their well-being not at a single point in time but over time. Continuing, Barr and Diamond added that someone who saves does so not because extra consumption today has no

value, but because he values extra consumption in the future more highly than extra consumption today. Pointing to the fact that most people hope to live long enough to be able to retire, they contended that a central purpose of retirement pensions is consumption smoothing – a process which enables a person to transfer consumption from his productive middle years to his retired years, allowing him to choose his preferred time path of consumption over working and retired life.

Regarding insurance and pensions, Barr and Diamond explained that people face a range of uncertainties, including how long they are going to live. As a result, a pension based on individual saving faces the person with the risk of outliving those savings, or of consuming very little to prevent that happening. Given that no one person knows how long he is going to live, Barr and Diamond pointed out that the life expectancy of a large group of people is better known and thus in principle, the members of the group could agree to pool their pension savings with each person drawing a pension based on (a) the group‘s life expectancy and (b) the total amount he or she had contributed to the pool. Barr and Diamond added that this is the essence of annuities, whereby an individual exchanges his pension accumulation at retirement for regular payments for the rest of his or her life, thus allowing people to insure against the risk of outliving their pension savings. Continuing, they also added that pension systems can redistribute incomes on a lifetime basis, complimenting the role of progressive taxes on annual income. This, in their view, can be achieved by paying pensions to low earners at the level of what are a higher percentage of their previous earnings, thus subsidizing the consumption smoothing of lower earners.

On the financial theory of pensions, Exley, Mehta and Smith (1977) observed that there are many companies across the world running occupational pension schemes of one form or another. They added that these companies do not exist purely for the purpose of *providing pension benefits but are set with a core business in mind; for example, supplying goods or services to customers. The authors stated three most common reasons why a large number of private sector organizations make pension provisions as (i) a wish to provide for employees at old age, (ii) recruitment and retention of skilled employees and (iii) reward of particular group of employees.

2.3 Empirical Framework

This section looks at some of the studies other researchers have carried out in the area under study.

2.3.1 The World Bank (1994) Model

The model proposed by the World Bank (1994) did not impose any mathematical, statistical or parametric format to be adopted by countries. In making the proposal, the Bank recognized the demographic, cultural, economic and social differences between peoples and countries and advised policy makers to bear such differences in mind in the application of their proposals and to adopt best practices for the benefit of their people. In interpreting the World Bank's (1994) model, Stiglitz et al (1999) noted that the 'three-pillars' delineated in *Averting the Old Age Crisis* were expansive enough to reflect any potential combination of policy measures. Stiglitz et al. (1999) further asserted that the three pillars are a publically managed, unfunded, defined benefit pillar, a privately managed, funded, defined contribution pillar and a voluntary private pillar.

2.3.2 The Chilean Model

Although the mathematical or statistical model design was not revealed in the publication by Berstein et al (2009) on the Chilean (2008) reformed pension, the diagnoses carried out by the Council for Pension Reform and included in the Reformation Bill indicates that proper analysis of the previous 1981 pension scheme was a painstaking one. The sets of objective of the reform were, among others, to:(i) increase the level of the system's coverage through the poverty-prevention pillar, (ii) increase the level and quality of coverage through the mandatory contribution pillar, (iii) improve the quality of the coverage provided through the voluntary pillar, (iv) increase competition and efficiency in the Pension Fund Administration industry in order to optimize the risk-return ratio of the pension savings (of employees) managed by the Pension Administrators.

2.3.3 The Chinese Model

The Chinese have three-pillar pension schemes (Impavido, Hu and Li; 2009). The benefit of the Basic Old Age Insurance system (1A), according to Impavido, Hu and Li; (2009) is estimated by:

!A benefit = 1%(no. of years of contribution) x (pension base), where pension base = ½(average local salary of last year + indexed salary),

Indexed salary = (last year salary of the person before retirement) * (average index of

the person over his career),

Average index of the person = $\frac{x_n}{\frac{1}{c_2}(c_n - 1 + ... + x_3)} + \frac{x_2}{c_1 + c_0 + N}$ (2.47)

where X_n denotes salary of the person in year n; c_{n-1} denotes average local salary in year $n-1$, and N denotes total number of years of contribution.

Model (2.47) applies to the Basic Old Insurance System for urban workers, not to the generality of workers in China and cannot, therefore, be used in Nigeria where a single model is required for all Nigerian workers. To buttress the assertion, Impavido et al (2009) explained that the Chinese pension system is highly fragmented due to the decentralized nature of the Chinese economy, the large size of the population that should be covered, the large size of the informal labour market and the tradition of local pilot projects or trial programs for the development of social pension policies that for one reason or another have not been replicated at the country level. Impavido et al (2009) further added that as a result, financing, administration, and other parameters are often defined at the provincial or municipal level in China.

2.3.4 The United Kingdom

Some other countries' reforms have been in phases. For example, the UK government, according to Adams (2013), carried out reforms in 2012 to increase retirement ages to 66 for both genders by 2020, to 67 years by 2028 and will still raise it in line with life expectancy thereafter. In the same 2012, it introduced automatic enrollment of employees into the workplace pensions.

2.3.5 South Africa and Brazil

In a comparative study of the impact of pensions in South Africa and Brazil, Barrientos and Lloyd-Sherlock (2009) observed that, in both countries, non-contributory pensions function more as an income transfer to poorer households rather than individual retirement income. The authors revealed that analysis of household survey status between 2002 and 2008 showed a high incidence of movement in and out of poverty. Twenty-three percent of households in Brazil and forty-three percent in South Africa changed their poverty status over the six-year period. Barrientos and Lloyd-Sherlock (2009) added that both countries achieved broad-coverage pension systems that reached the majority of older people who had been living in poverty. In both cases, they reached approximately 80 percent of people at eligible ages and paid out a minimum rate of US$3 per day.

2.3.6 EMPIRICAL STUDIES FROM NIGERIA.

A lot of studies have been done on pensions in Nigeria by Nigerian researchers particularly on the provisions and problems in the implementations of the 1979 Pensions Act which gave rise to the 2004 Pension Reform Act. All the research works seen in the course of this study discussed mainly the performance and the associated problems of the Acts. Writing under the title, “Public Sector Pension Reform in Nigeria”, Legal Brief Africa (2004), while dwelling mainly on the problems associated with the administration of the pension scheme, observed that the collection of retirement benefits in Nigeria had continued to cause a lot of sufferings to the retirees, their nexts-of-kin, especially the retirees in the public sector of the economy. In his work titled “Nigeria: Pension Reform Act 2004 and Deregulation”, Ezeala (2006) discussed the provisions of the 1979 Pensions Decree and those of the 2004 Pension Reform Act. Ezeala (2007) observed

that in a country where life expectancy approximates to the commencement of real active life in other climes, the issue of pensions and gratuity had become even more challenging in that pensioners are made to undergo severe hardships while waiting to process their pension and gratuity benefits. Odia and Okoye (2012) outlined the history of pension system in Nigeria, the problems and the characteristic features associated with the old pension scheme and the provisions of the Pension Reform Act of 2004. Adebayo and Dada (2012) also cited the problems retirees were experiencing in collecting their pension benefits and informed that as at the commencement of the 2004 Pension Reform Act, the 1979 Pension Act had a pension deficit of about ₦2.3 trillion. To solve the problems, they advocated the setting up of independent central data management system and advised that Government should bear the contribution of low income earners. Further, Orifowomo (2006) lamented on the sufferings of retired Nigeria workers under the implementation of the 1979 Pension Act and advocated that there should be a stipulation of a minimum return on investment of pension assets for the benefit of the beneficiaries of retirement savings accounts.

Given the foregoing observed problems and shortcomings of the 1979 Pension Act and the PRA 2004, expectations would have been that future reforms or amendments of the Acts would take necessary steps to improve on the shortcomings. However, in the reforms of 2011 and 2014 that followed the 2004 Act, it seemed that there were no serious diagnoses of the problems of the 2004 Pension scheme that was to be amended. Such diagnoses would have revealed some of the shortcomings such as coverage and enhanced replacement ratio, as seen in today's pension reformation efforts in other countries. The diagnoses would equally have revealed the need to

stipulate a minimum investment return to be achieved by the PFAs on the funds for the benefit of the RSAs of Nigerian workers as has happened in other countries as Chile.

\

2.4 The Research Gap

Based on the foregoing studies seen so far, it would appear that none of the past studies in Nigeria, at the time of this study, had attempted to estimate the amount of pension at retirement under the DC plan for the benefit of employees, employers and the general public; nor did they quantitatively compare the benefit amounts of the 1979 Pension Act and the 2004 PRA. or, with those of other countries. Similarly, there were no suggestions by way of new plan design or other, of improving the benefit amounts the Nigerian worker could earn as pension on retirement, or even extending the coverage of the current Act to the unemployed. These were the research gaps this study identified and attempts to fill.

In this study, two of the sets of objective of the Chilean model which some authors referred to as ‘a model for the world were applied. These are, to: (1) increase the level of the system’s coverage through the poverty-prevention pillar, and (ii) increase the level and quality of coverage through the mandatory contribution pillar.

The 2004 Pension Reform Act seemed to have touched on (i) above by extending pension coverage to the private sector but still excluded the unemployed and self-employed. In the 2014 Amended Pension Act, (ii) above was also partly touched and

the total level of annual contribution by employer and employee was raised from 15% to 18% of the employee's total emolument. As stated earlier, being a DC Pension Plan, the quantum of benefit payable at normal retirement remained un-estimated by all the previous research studies. This study, therefore, filled this research gap.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter presents the formulae and models used in this study.

3.1 Research Design

T he research was divided into four different sections

3.1.1 Comparison of Benefits of DB and DC

The first section compared the monetary benefits payable to employees at retirement in Nigeria by the provisions of the 1979 Pensions Act (Old scheme) which is a defined benefit (DB) plan and those of the Reformed Pension Act of 2004 (Current scheme) which is a defined contribution (DC) plan. The ratio of DB to DC was also to be determined accordingly Furthermore, the variables of interest and retirement benefit amounts which will be denoted by Y and which, in the case of the DC plan, is dependent on the amount contributed into the fund A, the prevailing rate of interest

throughout the period of employment i and mortality denoted by l_x, therefore, the resultant expression, $Y = f(\mathrm{A}, i, l_x)$. The DB plan is not affected by these factors.

3.1.2 Comparison of Adequacy of benefits

Section 3.1.2 compared the adequacy of the benefit provisions of the 2004 Reformed Pension Act (Current) with those of eight countries selected from the developed and developing countries spread through the five continents of the world, using the World Bank's (1994) model as a benchmark. The important variable of interest here is the Replacement Ratio Φ which has been defined as the percentage which the amount of the starting pension bears to the last salary of the retiree, (Colomeischi, 2012).

3.1.3 Effect of Pension Risk Factors (Mortality, l_x and Volatility of Interest, i)

The research focused on the two main pension risk factors, mortality l_x and volatility of interest rate, i, which are functions of annuity and have impact on the value of the benefits employees receive at retirement. This was to assess the effects they could have on a new pension model desired to be proposed. This was followed by a proposal for old age voluntary pension plan for the unemployed persons under the World Bank's (1994) poverty-prevention pillar.

3.1.4 Presentation and Analysis of Data

In this section of the study, the concepts built under conceptual framework were employed to present and analyze the data that were collected and results obtained for

discussion. New pension models were also proposed for each of the work-place retirees and the non-employed at their old age.

3.2 Population of the Study

The population for this study includes all persons employed within the territory of the Federal Republic of Nigeria whether in the private or public sector of the economy.

3.3 Sample and Sampling Technique

Two different samples assumed to have come from normal populations were required for this study. The first one was required for comparison of the pension benefits of the old and new pension schemes while the second was for the calculation of the replacement ratio needed for comparison of the adequacy of the current pension scheme in relation to those of eight other countries selected for the study. In the first case, three groups or samples of employees with different ages, years of services and salaries were randomly simulated to serve as different work-organizations and their benefits at the retirement age of 60 or maximum service period of 35 years (whichever came first) were computed under the 2004 Reformed Pensions Act. To obtain the second sample, it was observed that the National Salaries, Incomes and Wages Commission had grouped Nigerian workers into seven professional groups as shown below:

i) Consolidated Top Federal Public Office Holders' Salary Structure (CONTOPSAL)

ii) Consolidated Public Service Salary Structure(CONPSS)

iii) Consolidated Research and Allied Institutions Salary Structure (CONTAISS)

iv) Consolidated Tertiary Institutions Salary Structure (CONTISS II) which also covers the Non-Academic Staff of Universities

v) Consolidated University Academic Salary Structure (CONUASS)

vi) Consolidated Health Salary Structure (CONHESS)

vii) Consolidated Judicial Salary Structure (CONJUSS)

Four groups out of the seven were randomly selected. The reason for choosing four out of seven groups was to have a fairly large sample because salary data from the private sector which are usually not made public would be impossible to obtain except by legislative compulsion. The Current Act and its amendment in 2014 stipulated that any group of employee of five or more persons must be registered under the provisions of the Act for the purposes of pension contributions towards their retirement. Accordingly all private sector employees are beneficiaries of this study even though their data were not included.

Non-probability method of sampling was used to select the eight countries whose pension plans were to be compared with that of Nigeria. The reason was that it would take undue effort to list all the countries of the world and identify those who were classified as developed, developing or third world. Again, method of classification would not be clear or standard about some countries. Hence, the countries already known

through the media and press to have been so classified were chosen to minimize research bias.

3.4 Method of Data Collection

As was noted earlier, the first set of data comprised of three groups or samples of employees with different ages, years of services and salaries were randomly simulated to serve as different work-organizations. The second set of data was secondary data of the salaries of all the seven groups of professionals published by the Nigerian National Salaries, Incomes and Wages Commission with effective date of July 01, 2010and was the most current at the time of this study. The salaries were published for each group and so, those relating to the groups for this study were obtained.

The replacement ratio data for the eight countries whose pension plan adequacy was compared with that of the current pension plan of Nigeria was obtained from the 2012 publications of the Organization for Economic Cooperation and Development (OECD) and the International Monetary Fund (IMF).

3.5 Method of Data Analysis

3.5.1 Comparison of the Old and Current Pension Acts

The first section deals with the comparison of the amounts paid as retirement benefit to retirees under two different pension Acts: the Pension Act of 1979 referred to as ‘Old’ and the Pension Reform Act of 2004 referred to as ‘Current’. The Old pension scheme, being a Defined Benefit (DB) pension scheme, had a schedule attached to the Act (Appendix “A”) for easy computation of the amount of pension and gratuity of any

employee on retirement. That schedule was used in this study. The Current pension scheme is a Defined Contribution (DC) scheme and did not have such a schedule attached to the Act. An actuarial method for estimating benefits on retirement based on mortality and assumed prevailing but conservative interest rate was applied to develop the model for such computation. Three different groups of employees with ages spread between 20 and 60 and with different years of service and salaries were randomly generated to represent three organizations. The pension benefits of the employees in these organizations were estimated. A mortality Table titled 'Multiple Decrement Table a(55)' from the Institute of Actuaries of the United Kingdom (UK) was obtained for the calculation. Similarly, a 'Relative Salary Scale' from the same institute was obtained (Appendices 2 and 3 respectively). The Relative Salary Scale shows the salary progression from age x+t to age x+t+1. In practice, it usually covers (i) those increases which would, on average, be expected because of the progress of individuals within their career if overall levels of earnings remained stable, and (ii) increases representing changes in the general levels of earnings on account of inflation.

The amount of pension from the contributions by employee and employer of 7½% each as stipulated by the 2004 PRA and which were invested at an assumed minimum net rate of interest return of 7.5% is given by (3.1) below. The model was developed under the conceptual framework as:

$$(0.15)(0.75)(1+r)^{n}\left[\frac{(1+i'')^{n}-1}{i''}\right] \div \{\sum_{t=0}^{\infty}\frac{v^{x+t}l_{x+t}}{v^{x}l_{x}}\} \qquad (3.1)$$

where

15% (0.15) is the total contribution by both employer and employee to fund the employee's pension as provided by the 2004 Act,

75% (0.75) is the percentage of the accumulated amount in the employee's RSA that should be used to purchase annuity for the monthly or annual pension payment,

r is a salary incremental rate,

r'' is as defined in equation (2.24) and the last part of the equation represents the annuity factor.

The above equation (3.1) represents the value of the pension amount payable under the 2004 Pension Act. For the value of the pension under the 1979 Act, we applied the appropriate percentage (80% after 35 years of service) to equation (2.29) developed under the conceptual framework as follows:

$$(As)_x\left(\frac{s_n}{s_{x-1}}\right)(1+r)^n * 80\% \qquad (3.2)$$

Equation (3.2) represents the amount of pension due to an employee at retirement under the 1979 Pensions Act. The amounts from equations (3.1) and (3.2) were compared in accordance with our first and second objectives in this study.

3.5.2 Comparison of the PRA 2004 with those of eight other Selected Countries

The eight countries whose pension schemes were to be compared with that of Nigeria were mentioned in chapter two. It was also shown that the pension replacement ratio of each country would provide the parameter for the comparison. While the replacement ratio for other countries was available, that of Nigeria was not at the time of this study

and had to be estimated. The data used for this estimation was the latest salary publication of July 01, 2010 by the Nigerian National Salaries, Incomes and Wages Commission (NSIWC). The Commission classified salaries into 7 professional working groups. A sample of four of the seven groups was simple randomly selected for the study and include:

(i) the University Academic Salary Structure (CONUASS),

(ii) the Public Service Salary Structure (CONPSS),

(iii) the Tertiary Institutions which includes Non-Academic Staff of Universities (CONTISS II), and

(iv) Consolidated Health Salary Structure (CONHESS).

In general an employee on a starting salary of X Naira (₦X) per annum and attains a salary of Y Naira (₦Y) per annum would have a salary progression rate,

r , after t years denoted by the equation:

$$X(1+r)^t = Y \tag{3.3}$$

From equation (3.3) the resulting equation (3.4) for the Academic Staff is as follows:

$$AL_{(1)}(1+r_A)^{21} = PR_{(1)} \quad . \tag{3.4}$$

where

$r_A =$ average rate of salary progression for the Academic Staff

$AL_{(1)} =$ first step of Assistant Lecturer's salary

$PR_{(1)} =$ first step of Professor's salary

For the Federal Public Service senior staff, equation (3.5) below is obtained:

$$L08_{(1)}\left(1+r_{fs}\right)^{27} = D16_{(1)} \tag{3.5}$$

where,

r_{fs} = average rate of salary progression for senior public service staff

$L08_{(1)}$ = first step of fresh graduate's salary

$D16_{(1)}$ = first step of Director's salary

For the Junior staff, the equation is

$$L01_{(1)}(1+r_{fj})^{27} = L07_{(1)} \qquad (3.6)$$

where

r_{fj} denotes salary progression rate for Federal junior staff.

For the tertiary institutions, the equation is

$$L08_{(1)}\left(1+r_{ts}\right)^{27} = D15_{(1)} \qquad (3.7)$$

where

r_{ts} = average rate of salary progression for tertiary institutions senior staff.
(Note that the highest salary grade level for tertiary institutions is 15)

Under the Consolidated Health Salary Structure, CONHESS, the equation, for the Junior Staff who will progress from step one of Grade Level 01 (GL01) to step one Grade Level 07 (GL07) is given as:

$$GL01_1(1+r_{hj})^t = GL07_1 \qquad \ldots \qquad (3.8)$$

where

r_{hj} = average rate of salary progression for the Junior Staff in the Health Sector

$t = 27\,years$ is the duration to progress to the top of the salary grade.

For the Senior employees, the progression from step one of Salary Grade Level 08 ($GL08_1$) to the first step of Grade Level 16 ($GL16_1$) is assumed to last, on the average, 21 years. Hence, the equation is given as:

$$GL08_1(1+r_{hs})^{t} = GL16_1 \tag{3.9}$$

where

r_{hs} = average rate of salary progression for Senior Staff in the Health Sector, and

$t = 21$ years is assumed to be the duration to progress to step one of Salary Grade Level 16. This includes the medical consultants.

3.5.3 Pension Risks

The effect of volatility of investment returns on annuity (2.32) and hence on pensions was illustrated with a case study as follows:

Asset volatilities of 10%, 20%, 30% and 40% were assumed for an employee aged 25, who has 35 years of service to age 60 with an annual salary incremental of 5% per annum and on a beginning salary of N840,000 per annum.

(a) The values of assets for investment returns of 8%, 10%, 12% and 14% were computed and the effects of 10, 20, and 40% volatilities on the values of the assets were estimated. The computation of the asset value was carried out using the equation restated below:

$ACS = (As)_x(1+i)^n \ddot{a}_{\overline{n}|} = (As_x(1+i)a_{\overline{n}|}(1+i'')$ from equation (2.40)

(b) Also the monthly pensions at three different annuity levels of 9.768, 10.497 and 11.797 and at investment returns of 8%, 10% 12% and 14% were calculated to demonstrate the effects of changes in mortality and investment rates on the values of pension receivable.

(c) Again the Replacement Ratios at the three levels of annuity rates and investment rates were calculated as above to evaluate their effects.

An example of such computations and comparisons is analyzed in chapter four

.

3.5.4 Pension Coverage for the Unemployed

Assumptions

i. It is assumed that most of the women/men in the markets pay N100 daily into their “ajo” or “isusu” (whatever other local name) contribution fund. Aggregating this for an individual for one year will translate to 100 x 313 days (selling 6 days in a week) =N31,300.
ii. This amount will be invested, at an assumed 8% investment return a year.
iii. A counterpart/contributory portion of equal amount will be matched by the government. This will bring the total amount to N62,600 in a year.
iv. Eligibility to this pension will require a minimum contribution period of 20 years.
v. There will be a refund of contributions and interest in the event of earlier death or total incapacitation resulting to inability of the individual to pursue his/her normal business.
vi. Receipt of benefits will be at a minimum age of 65 or older

vii. The annuity value to be used will be that of the USA CSO 1958 Mortality Table.

viii. Take the case of a person who started contribution at age 27 and maintained the same amount of contribution until age 65 (i.e. after 38 years).

The analyses for the above assumptions have been demonstrated in chapter four.

3.6 Pension Models

The Defined Benefit Pension Scheme is expensive to maintain, although it is not subject to volatility of assets, and in most cases, not subject to longevity of retirees as the pensions and gratuities are based on final salaries at retirement and have been guaranteed from inception.

The present Nigerian Pension Scheme being operated by the formal sector is a Defined Contribution scheme which is subject to volatility of assets and longevity of retirees. The life expectancies affect or determine the annuity rates that can be purchased at retirement. Similarly, the amount of contribution into the scheme and volatility of interest rates during the working life of a retiree will determine the quantum of cash that will be used to purchase pensions from the prevailing annuity rates. The effects of these two, longevity of life and volatility of assets, have been demonstrated earlier.

The three new pension models proposed in this study were stated as:

i. The Minimum Guaranteed Money Purchase Plan
ii. The Cash Balance Plan
iii. The Hybrid Plan.

3.6.1 Procedures used in Formulating the Models

The following assumptions were used:

i) Retirement age was assumed to be 60;

ii) Salary increment per year denoted by r was taken as 5% ;

iii) Investment income or rate of accumulation per annum denoted by i ;

iv) The pension and gratuity provisions of the 1979 Pension Act were taken as the standard rate by the employee;

v) The annuity rates at age 60 were taken as 9.768, 10.955 and 11.797 to reflect various Life Tables;

vi) For the combined defined benefit and defined contribution plans, let g be the percentage of salary appropriate with the defined benefit rates of the 1979 Pension Act. g was assumed to be any percentage such as 100, 200, or so, of the 1979 Pension Act rates which employer and employees may elect to be applicable for the calculation of the retirement benefits of the employee.

Let x be the age of an employee; hence the remaining year to retirement at age 60 is $60 - x$ denoted by n .

Again, let salary at age x be denoted by As_x .

With the foregoing notations, and as shown in chapter two, the accumulated assets, ACS, at age 60 is given as

$$ACS_{60} = (As)_x[(1+i)^n + (1+i)^{n-1}(1+r) + (1+i)^{n-2}(1+r)^2 + .. + (1+i)(1+r)^{n-1}] \quad (3.10)$$

$$= (As)_x(1+i)^n[1 + \frac{(1+r)}{(1+i)} + \frac{(1+r)^2}{(1+i)^2} + .. + \frac{(1+r)^{n-1}}{(1+i)^{n-1}}]$$

$$= (As)_x (1+i)^n [1 + (1+i'') + (1+i'')^2 + ... + (1+i'')^{n-1}]$$

$$= (As)_x (1+r)^n \ddot{a}_{\overline{n}|} \quad (3.11)$$

where $\ddot{a}_{\overline{n}|} = a_{\overline{n}|}(1+i'')$ (3.12)

and $i'' = \dfrac{(i-r)}{(1+r)}$, $i > r$ as given before.

And if $i < r,$ then $i'' = \dfrac{(r-1)}{(r+i)}$

The final salary, in the year of retirement, as given before, is given by:

$$(As)_x \frac{s_n}{s_{x-1}} (1+r)^n \ . \quad (3.13)$$

All the variables have been defined in chapter two and above.

3.7 The Models

i) Minimum Guaranteed Money Purchase Pension Model:

It has been shown earlier in chapter two that the benefits, both gratuity and pension, of the 1979 Pension Act were not only higher than those of the 2004 Pension Reform Act but also compared adequately with the minimum standard of 67% Replacement Ratio stipulated by the World Bank (1994). The 1979 Act provides 80% of final emolument as retirement income after 35 years of service.

In this plan, an employee agreed with his employer that, at retirement, he wished $k\%$ of g (percentage of the 1979 Pension Act benefit rate) to be applied to his Accumulated Assets as his gratuity while the balance would be used to purchase annuity for pension.

From assumption vi)., if F_p was denoted as the employee's gratuity at retirement, then

$$F_p = \frac{k}{100} g(As)_x (1+r)^{n-1} \tag{3.14}$$

The balance of the accumulated asset available for purchase of annuity for payment of pension was given by

$$BAL = ACS - F_P \tag{3.15}$$

$$= (As)_x (1+i)^n a_{\overline{n}|}(1+i'') - \frac{k}{100} g(As)_x (1+r)^{n-1}$$

$$= (As)_x \left[\{(1+\mathrm{i})^n a_{\overline{n}|}(1+\mathrm{i}'')\} - \{\frac{k}{100} g(1+r)^{n-1}\} \right] \tag{3.16}$$

where the $a_{\overline{n}|}$ was evaluated at rate i'' as defined.

The balance was used to purchase pension, CP, at the prevailing annuity rate, a_x, and the value of this pension is $CP = \frac{BAL}{a_x}$ (3.15)

,and this is equal to

$$(As)_x\left[\{(1+\mathrm{i})^n a_{\overline{n}|}(1+\mathrm{i}'')\}-\{\frac{k}{100}g(1+r)^{n-1}\}\right]\frac{1}{a_x} \quad (3.16)$$

all the variables having been described above and within the conceptual framework in chapter two.

ii). The Cash Balance Pension Model

In the Cash Balance Pension model, a replacement ratio was specified at a rate considered appropriate for a retiring employee after a long service with the employer, for example, 60%. This would represent the percentage of the final salary payable to the employee as pension. The balance of the total asset accumulation would then be paid as gratuity. Extra voluntary contribution would increase the gratuity value.

The pension replacement ratio was set at $k\%$ and formed a string of annual pensions. The string (of annual pensions) will, on retirement at age 60, have a present value (PV) given by:

$$PV=\frac{k}{100}(As)_x(1+r)^{n-1}a_{\overline{60}|} \quad (3.17)$$

where the annuity at age 60, $a_{\overline{60}|}$ may be 9.768, 10.955, and so on.

The balance from the total asset accumulation *(TAC)*was then paid as gratuity, that is,

$$\text{Gratuity}=TAC-\frac{k}{100}(As)_x(1+r)^{n-1}a_{\overline{60}|} \quad (3.18)$$

all the variables having been described above.

iii) The Hybrid Pension Model

The Hybrid Pension Plan gives the employee the choice between the pension benefits of the Defined Benefit (DB) Scheme and those of the Defined Contribution (DC) Scheme. The employee is at liberty to choose whichever is higher.

Normally, the retirement benefit in the DB plan is arrived at by multiplying the number of years worked by the member's salary at retirement and a factor known as the **accrual rate**. In other words, the benefit under the DB scheme is the sum of all the benefits earned in each year of employment. If the accrual rate is denoted by, y , then the pension, P, is given by:

$$P = \sum_{t=1}^{34} y(As)_t (1+r)^t = y\sum_{t=1}^{34} (As)_t (1+r)^t \ , \qquad (3.19)$$

all the variables having been described in the 'Procedure used in formulating the Models'.

The Hybrid Pension scheme does not have individual accounts.

The benefit of the Defined Contribution Scheme is made up of the pensions purchased, using the accumulated assets, from the annuities prevailing at the age and time of retirement. The annuity rates depend upon the state of the economy especially the prevailing interest rates (i) and the Life Table,(l_x) shown earlier as:

,annuity$= \sum_{t=0}^{\infty} \frac{(\frac{1}{1+i})^t l_{x+t}}{l_x} = \sum_{t=0}^{\infty} \frac{v^t l_{x+t}}{l_x}$, as before in (2.1).

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter shows the data presentation and their analyses that followed. Three different groups of employees were randomly generated with ages, annual emoluments, and the number of years of past services. These were assumed to represent employees of organizations, for the purpose of evaluating the efficacy of the models proposed in chapter three

4.1 Presentation of Data

Tables 4.1, 4.2 and 4.3 below show the randomly generated three different groups of employees assumed to have come from normal populations. In each of these three Tables, the first column shows the ages of the employees within the age group (starting from age 20), the second column shows the numbers of the employees within the age group, the total annual emoluments of each age group is shown in the third column while the last column shows number of years of past service (service rendered to the organization before the establishment of the pension scheme).

Table 4.1 First Group of Employees with Past Service Benefits

Age group of Employees	No. of Employees (Ees) in age group	Annual Emolument of each Employee (N'000)	Years of past Service
20	30	2,400	0
25	20	2,800	4
25	35	3,000	5
30	30	3,000	6
35	20	3,200	6
35	15	3,400	4

35	5	6,800	10
40	20	3,400	19
40	10	3,600	24
45	20	3,400	23
45	30	3,600	21
45	5	6,000	23
50	30	4,000	26
50	35	5,000	31
55	5	10,000	28
55	10	6,000	37
60	10	6,000	30
60	5	6,200	39
60	5	10,000	33

Source: Pension initial membership data (Lee, E. M.,1986)

The above Table (4.1) shows the distribution of three hundred and forty members of a pension scheme into age groups, the number of members within each age group (column 2), the annual emolument of each member in the age group (column 3) and the number of years the member had served the organization before enrolment as a member of the pension scheme. For example, there are 30 members in age group 30, each member has an annual emolument of three million Naira and had been employed for six years before enrolling into the pension scheme.

Table 4.2 **Second Group of Employees with Past Service Benefits**

Age group of Employees	No. of Ees in age group	Annual Emolument per Ee (N'000)	Yrs of Past Service
20	15	420	0

23	12	780	0
25	10	1,656	0
25	8	1,800	3
30	53	1,980	4
30	28	2,112	3
35	23	2,280	7
40	61	2,460	12
40	85	2,580	5
43	35	2,760	15
45	33	3,720	22
50	5	4,272	29
50	18	4,440	25
50	14	4,800	18
55	8	4,920	30
55	9	5,160	28
60	15	5,520	33
60	8	5,700	37

A derivation from Table (4.1) to create a second group of employees

Table (4.2) is derived from Table (4.1) with different characteristics to create a second group of employees. There are 440 members of the pension scheme spread into eighteen age groups with different numbers of employees, emoluments and years of past services within each age group and different from those of the parent table

Table 4.3 Group of Employees without Past Service Benefits

Age of Group of Employees	Number of Employees	Annual Emolument Per Employee (N'000)
20	3	216
20	4	300
25	7	360
25	8	1,560
27	21	1,800

30	50	2,268
33	41	3,300
35	55	3,840
38	34	3,216
40	17	3,372
43	12	4,140
45	6	10,200
45	8	6,120
50	5	5,904
53	3	8,040
55	6	8,040
60	10	8,040

Table (4.3) above is also a derivation from table (4.1). It has a total of 290 members of the pension scheme spread into seventeen age groups. The pension scheme is assumed to have commenced at the establishment of the organization and so there are no past service benefits. Also, no member of this scheme is assumed to have transferred earned past service benefit from previous pension scheme.

Past service contributions were estimated as a ratio of mean past service salaries to current salaries to represent the average salaries for previous years. An accumulation rate is given by: $S_{\overline{n}|} = (1+i)^{n-1} + (1+i)^{n-2} + ... + 1.$ (4.1)

The following formulae have already been explained in chapter two, equations (2.1) to (2.2b)

$$\sum_{t=0}^{\infty} v^t {}_t p_x = \frac{1}{l_x} \sum_{t=0}^{\infty} v^t l_{x+t} = \sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x} \quad (4.2)$$

,and defined $v^x l_x = D_x, D_{x+t} = v^{x+t} l_{x+t}.$

Hence $\sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x} = \sum_{t=0}^{\infty} \frac{D_{x+t}}{D_x}$ in commutation function.

Similarly $\bar{D}_x = \frac{1}{2}\left(D_x + D_{x+1}\right)$ and $\sum_{t=0}^{\infty} D_{x+t} = N_x$.

while $\sum_{t=0}^{\infty} \bar{D}_{x+t} = \bar{N}_x$.

Finally the salary scale function shown in (Appendix 'C') was incorporated to obtain

$s_{x-1}D_x = {}^{s}D_x$ and $s_x N_x = {}^{s}N_x$. .(4.3)

Applying these functions in the analysis of the randomly generated employee data, the following analytical tables for the three groups of employees were obtained, where

Tables 1A - 1E correspond to the analysis of the first group of employees in Table (4.1)

Tables 2A – 2E correspond to the analysis of the second group of employees in Table (4.2) while,

Tables 3A – 3D correspond to the analysis of the third group of employees in Table (4.3). Details of the analyses are shown in these Tables and are shown in APPENDICES 1A to 3D.

TABLE 4.4 CALCULATION OF ANNUITY USING CSO 1958 MORTALITY TABLE

x	n	l_x	l_x/l_{65}	v^n, (i=6%)	col.4 x col.5
65	1	6,800,531.00	1	0.943396226	0.943396226
66	2	6,584,614.00	1	0.88999644	0.88999644
67	3	6,355,865.00	1	0.839619283	0.839619283
68	4	6,114,088.00	1	0.792093663	0.792093663

69	5	5,859,253.00	1	0.747258173	0.747258173
70	6	5,592,012.00	0.82229049	0.70496054	0.579682352
71	7	5,313,586.00	0.78134869	0.665057114	0.519641506
72	8	5,025,855.00	0.73903861	0.627412371	0.463681969
73	9	4,731,089.00	0.69569406	0.591898464	0.411780243
74	10	4,431,800.00	0.65168441	0.558394777	0.363897168
75	11	4,129,906.00	0.6072917	0.526787525	0.319913689
76	12	3,826,895.00	0.56273473	0.496969364	0.279661922
77	13	3,523,881.00	0.51817733	0.468839022	0.242941753
78	14	3,221,884.00	0.47376947	0.442300964	0.209548696
79	15	2,922,055.00	0.42968042	0.417265061	0.179290626
80	16	2,626,372.00	0.38620102	0.393646284	0.152026596
81	17	2,337,524.00	0.34372669	0.371364419	0.127647862
82	18	2,058,541.00	0.30270298	0.350343791	0.10605011
83	19	1,792,639.00	0.2636028	0.3305130	0.087124154
84	20	1,542,781.00	0.22686184	0.311804727	0.070736595
85	21	1,311,348.00	0.19283024	0.294155403	0.056722056
86	22	1,100,037.00	0.16175752	0.277505097	0.044888535
87	23	909,929.00	0.13380264	0.261797261	0.035029165
88	24	741,474.00	0.10903178	0.246978548	0.026928511
89	25	594,477.00	0.08741626	0.232998631	0.020367869
90	26	468,174.00	0.06884374	0.219810029	0.015132545
91	27	361,365.00	0.05313776	0.207367952	0.011019069
92	28	272,552.00	0.04007805	0.195630143	0.007840474
93	29	200,072.00	0.02942006	0.184556739	0.00542967
94	30	142,191.00	0.02090881	0.174110131	0.003640435
95	31	97,165.00	0.01428785	0.16425484	0.002346849
96	32	63,037.00	0.00926942	0.154957397	0.001436366
97	33	37,787.00	0.00555648	0.146186223	0.000812281
98	34	19,331.00	0.00284257	0.137911531	0.000392023
99	35	6,415.00	0.00094331	0.130105218	0.000122729
				TOTAL ($a_{\overline{65}\rceil}$)	8.558097602

Table 4.4 above shows the calculation of annuity payable at age 65 with 'five years certain' period. The 'five-years-certain' period implies that once the annuity payment starts at age 65, it must continue to be paid for five years whether the annuitant is alive or not. The second column denoted by n, shows the number of years. The third column denoted by l_x gives the number of lives at age x (x=65, 66,..,99). The fourth column titled

($l_x/_{65}$) gives the probability of survival at age x. Because of the 'five-years-certain' period of payment of the annuity built into the pension plan, ($l_x/_{65}$) is assumed to have value equal to unity for those five years for the payment to be certainly made. The fifth column is the compound interest column: v^n $= \left(\frac{1}{1+i}\right)^n$ is a discount factor. The value of i, the interest rate, is taken as 6%. The last column refers to the expectation, that is, the amount of one Naira (N1), multiplied by the probability ($l_x/_{l_{65}}$) of being alive at that age, multiplied by the discount factor $v^n = \left(\frac{1}{1+i}\right)^n$ in each age. The sum total from the last age up to age 65 gives the value of the annuity at that age (65).

As an example from Table (4.4), retirement starts at age 65 and the duration, from the beginning of the year to its end is n=1. In the second year, n=2 and so on. l_x has already been defined as the number of lives at age x . For example, at age $x =$ 70, there are 5,592,012 persons surviving. The probability of survival from age 65 to age 70 is given by $\frac{l_{65+5}}{l_{65}} = \frac{l_{70}}{l_{65}} = \frac{5592012}{6800531} = 0.8222904$. Discounting this value to age 65 at 6% interest gives the value as $v^n = \left(\frac{1}{1+i}\right)^n = \left(\frac{1}{1+.06}\right)^6 = 0.70496054$. The value of the expectation of one Naira discounted to age 65 is given by column 4 multiplied by column 5 which is 0.8222904 x 0.7049604 = 0.579682352 or approximately six Naira. The total value of the expectation is the sum of all column 4 multiplied by column 5. = 8.558 approximately, as shown in the table.

Future Contributions

The earnings expected to be received during the year of age y to y+1 by a member now aged X are $(As)_x \frac{s_y}{s_{x-1}}$ where As is the member's annual emolument

The **accumulated value** of a contribution equal to 15% of earnings is thus given by

$$(.15)(As)_x \frac{\sum_{t=0}^{60-x} v_{x+t+1/2} s_{x+t} + l_{x+t+\frac{1}{2}}}{{}^{s}D_{60-x}} \qquad (4.4)$$

Where past service benefit has been estimated, the resulting benefits were added to the future benefits.

4.1.1 Comparison between the provisions of the old and current pension schemes

The 15% of the salary of each employee was estimated using the above formula. The value so obtained was then divided into two: 25% of the total (past and future benefits) is calculated to be paid as gratuity under the2004 Pension Reform Act while the balance of 75% was used to purchase a life annuity.

For the Old Pension Scheme, the percentages for Pension and Gratuity as contained in the table shown as Appendix 'A' were applied to the estimated accumulated earnings.

For each set of employees, retirement benefits were calculated for every employee under the Old and Current schemes.

The ratios of the Gratuity and Pension (Old scheme Versus Current scheme) were calculated in each case.

Statistical Analysis

The benefits under the two schemes were subjected to the Student's t-distribution test to determine if the differences in the benefits were significant, using significance level of 0.05 (5%). We assumed, in our null hypotheses, that there were no differences between the pensions and gratuities calculated under the old and the current pension plans, and also the pension benefits under the old and new plans within each group of employees.

The t-score used is given by the equation:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sigma\sqrt{{}^{1}\!/_{N_1} + {}^{1}\!/_{N_2}}} \qquad .(4.5)$$

$$\text{where } \sigma = \sqrt{\frac{(N_1-1)s^2{}_1+(N_2-1)s^2{}_2}{N_1+N_2-2}} \qquad (4.6)$$

and where the sigma is the estimate of the population standard deviation, N_1 and N_2 are the sample sizes with two degrees of freedom while $\bar{X}_1, \bar{X}_2$ are the sample means for the first and second samples respectively. The null hypothesis is stated thus:

H_0 : There is no significant difference between the benefits payable by the 1979 Pension Act and those of 2004 PRA.

Using equations (4.5) and (4.6), with the decision rule to:

Reject H_o if t-calculated values are greater than the table values at $\alpha = 5\%$ level of significance.

Results of the analyses

All the calculated t-values (13.42, 12.89, 7.50, 6.61, 7.50 & 4.86) were greater than the table values at the 5% level of significance. Consequently, the null hypothesis was rejected and the alternative hypothesis was accepted, that there were significant differences in the level of benefits provided by the provisions of the two Pension Acts.

1. From the calculations of the pension benefits for the three groups of employees, the ratio of the old pension scheme to the current pension scheme is as follows:

Group 1

Old Gratuity/New Gratuity = 3.27: 1. Old Pension/New Pension = 2.4 : 1

Group 2

Old Gratuity/New Gratuity = 5.55 : 1. Old Pension/New Pension = 4.1 : 1

Group 3

Old Gratuity/New Gratuity = 3.60 : 1. Old Pension/New Pension = 2.4 : 1

4.1.2 Comparison of the Current Scheme with those of Eight other Countries

In this section, the replacement ratio of the benefit provisions of the 2004 Reformed Pension Act is estimated and compared with the results of eight other countries. Substituting the published salary figures from the Salaries, Incomes and Wages Commission, the following salary progression rates for the different salary groups were computed and presented as follows:

$r_A = 5.62\%,$ $r_{fs} = 4.56\%,$ $r_{fj} = 3.41\%$

$r_{ts} = 4.45\%$, $r_{tj} = 4.92\%$ $r_{hs} = 6.60\%$ and

$r_{hj} = 5.20\%$

where r is as defined and computed for each salary group: $r_A, r_{fs}, r_{fj}, r_{ts}, r_{tj}, r_{hs}, r_{hj}$.

The estimated contribution to pension was calculated using the formula:

$$(0.15)(0.75)(1+r)^n \left[\frac{(1+i'')^n - 1}{i''} \right] \quad (4.7)$$

This was divided by the annuity rate with value 9.67 which was calculated separately using the American Commissioners 1958 Standard Ordinary Mortality Table.

The estimated salary in the year of retirement was given by

$$\frac{s_n}{s_{x-1}} (1+r)^{n-1} \quad (4.8)$$

For each salary group, therefore, the **replacement rate** was calculated as shown:

$$[(0.15)(0.75)(1+r)^n \left[\frac{(1+i'')^n - 1}{i''} \right] / (a_n + 1)] * 100 \quad (4.9)$$

In setting up the equation of value (4.9), we considered an employee on a unit (e.g. ₦1.00) of salary with an annual progression rate r and a pension contribution rate of 15% of annual salary according to the Pension Reform Act 2004. The 15% pension contributions were invested and assumed to earn a **net** annual rate of return, i .

The 2004 Pension Reform Act stipulated that 75% of the accumulations in individual RSA should be utilized to purchase pension in form of annuity or programmed

withdrawal. The mortality table and assumed interest rate value were combined to calculate the annuities. As has been shown earlier, the total asset available for purchase of annuity from the current pension scheme was given by formula (2.28) while the amount of pension payable in the year of retirement was given by (3.1).

Replacement Ratio has been defined as the ratio of the pension payable and the final emolument in the year of service. Thus, the Replacement Ratio of the Current Nigerian pension scheme, the PRA 2004 was given by

$$[\frac{(3.1)}{(2.29)}]*100 \tag{4.10}$$

Equation (2.29) represents the estimated salary of the employee in the year of retirement.

The value obtained from (4.10) was then used to compare with those of the eight countries selected for comparison with the replacement ratio of the 2004 Pension Act. The replacement ratios of all the nine countries are shown in Table 4.5 below.

To find out if these results were significantly different from the internationally recommended minimum percentage of 67, with the Null Hypothesis that the results of the different salary groups were equal and that any observed variation was due to chance, we applied the Chi-Square test using 5% significance level, thus:

$$x^2 = \sum_{j=1}^{n} \frac{(O_j - e_j)^2}{e_j} \tag{4.11}$$

where O_j and e_j respectively refer to the observed and expected values.

With six degrees of freedom, ($v = 6$), the table value $x^2_{0.05} = 12.6$ was greater than the calculated value, $x^2_{cal} = 8.09$. Thus the null hypothesis that there were no significant differences in the replacement rates could not be rejected but accepted.

Consequently the average of these replacement rates was used as a single replacement rate for Nigeria (as shown in Table 4.5).

Table 4.5 Summary of the Pension Plans Provided by each of the 9 Countries

S/N	Country	Basic Pension or Pillar 1	Pillar 2 or Second Pension	Pillar 3 or Other Name	Replacement Rate (average earnings from mandatory pensions)
1	United Kingdom (UK)	Basic State Pension	Occupational Pension	State Second Pension or S2P (Voluntary)	42**
2	Russia	Basic Pension (pension from this is 12% of average wage)	Funded DC Plan	Insurance Component (notionally funded)	40**
3	USA	Employment-Based Pension	Social & State Pension	Hybrid Cash Balance Plan(Voluntary)	40**
4	China	Pillar 1: Tier 1 & Tier 2 (Mandatory)	Pillar 2 – Enterprise Annuity (EA)	Complimentary Individual Plan	30 (OECD,IMF)
5	Australia	Govt. Mean-Tested Age Pension	Mandatory Contribution	Voluntary Contribution	68**
6	Chile	Govt. Mean-Tested Age Pension	Mandatory Contribution	Voluntary Contribution	52**
7	South Africa	Social Pensions	Occupational Pension Plan	Voluntary Savings Plan	15*
8	Ghana	Mandatory Social Security Plan paying pensions & survivorship benefits	Mandatory Occupational Pension plan	Voluntary Provident Fund	74 (from Ghanaian Actuary on 2008 Pension Reform)
9	Nigeria	Not available	Mandatory contributory pension	Not available	67 (own calculation)

Sources: **International Journal for Research and Review in Applied Sciences, IJRRAS (2012)*

*** OECD (2012) Replacement Rate is calculated on average earnings from mandatory pensions only; earnings from non-mandatory and social security contributions are not included.*

On the basis of the last result of the test of significance at 5%, the average of the seven rates which is 66.71% was accepted as the replacement rate of the benefits of the Nigerian Pension Reform Act 2004.

Having obtained the replacement rate of the Nigerian Pension Reform Act 2004, the appropriate comparisons were made with the pension plans of the other eight countries mentioned using their replacement rates.

Using the World Bank's (1994) benchmark replacement ratio of 67% as our expected value and the calculated replacement ratios as our observed values, and the Chi-Square distribution test, the replacement ratios of the sampled eight countries and that of Nigeria were then compared under the null hypothesis that there was no significant difference between these nine values at 5% level of significance.

Applying the Chi-Square test to ascertain if the replacement rates are significantly different on the basis of a null hypothesis that they are not, we find

$$\sum_{j=1}^{n} \frac{(O_j - e_j)^2}{e_j} = 96.94 \text{ where } n = 9 \text{ .} \qquad \text{.....(4.12)}$$

At $v = 8$ (eight degrees of freedom), $x^2_{0.05} = 15.5$ while $x^2_{0.01} = 20.1$ being less than the calculated Chi Square value of 96.94.

Thus, the null hypothesis was rejected and we concluded that the replacement rates were very significantly different.

The third set of the objectives of this study was to to investigate the effect of interest rate volatility on the amount of pension payable to retirees. The null hypothesis was that

there is no significant effect of interest rate volatility on the amount of pensions payable to retirees. For the statistical analysis of this test, the under-listed yield rates shown below were obtained:

Table 4.6 Average yields to maturity for United States Treasury Bonds from 1978 to 1988.

Rates (%)
8.18
8.94
10.60
12.14
14.22
14.95
10.63
11.75
11.45
9.40
7.39

Source: "Economic Statistics for Employee Benefit Actuaries" April 1996. Society of Actuaries

Using the above yield rates published by the Society of Actuaries on yields and formula (4.13) below, the estimated amount of pension payable for each corresponding yield rate is shown in Table (4.7).

$$(0.15)(0.75)(1+r)^{n}\left[\frac{(1+i'')^{n}-1}{i''}\right] \div \{\sum_{t=0}^{\infty}\frac{v^{x+t}l_{x+t}}{v^{x}l_{x}}\} \qquad (4.13)$$

Table 4.7 Interest Rates and Corresponding Amounts of Pension

Yield Rates (%)	Absolute Rate Values (X)	Corresponding Amount of Pension receivable(₦) (Y)
8.18	0.0818	3.86
8.94	0.0894	4.45
10.60	0.106	6.15
12.14	0.1214	8.41
14.22	0.1422	13.04
14.95	0.1498	15.37
10.63	0.1063	6.19
11.75	0.1175	7.76
11.45	0.1145	7.30
9.40	0.0940	4.86
7.39	0.0739	3.34

In Table 4.7 above, the first column shows the interest/yield values in percentage. The second column shows those percentage figures converted to absolute figures by dividing them by 100 before using them in equation (4.13) to estimate the corresponding amount of pension (shown in the third column). For example, the first value in Table 4.7 is 8.18%. This is converted to absolute figure by dividing it by 100 to get 0.0818. This is done for all the other values in that column to obtain the values in column two.

The values in column two are used to calculate the value in column three, that is, the amount of pension receivable corresponding to each absolute rate value in the second column in this table.

Calculation of the amount of pension receivable involves two steps both of which are imbedded in equation (4.13). The divisor in this equation, that is, $\sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x}$, is the annuity value. It is first computed for each yield or interest rate in column two of Table 4.7. From the divisor, $v = \frac{1}{1+i}, \text{and} \, v^n = (\frac{1}{1+i})^n$, equation (2.1), where $i =$ 0.0818, 0.0894,..,0.0739 in column two of Table 4.7. l_x values are taken from column three of Table 4.4 which is the number of lives surviving at each age x, according to the CSO 1958 Mortality Table of the Society of Actuaries (APPENDIX "III b"). A life annuity at age 65, a_{65}=7.86 has been computed for i =0.0818 as shown in Table 4.7a (APPENDIX "IIIa"). Carrying out the same calculation with the other yield/interest rate values in column two of Table 4.7, the annuity values in Table 4.8 were obtained which were used to calculate the amount of pension receivable, APR.

The amount of pension receivable for any given rate of interest is given by equation (4.13), which is $(0.15)(0.75)(1+r)^n \left[\frac{(1+i'')^n - 1}{i''} \right] (1+r'') \; \div \; \{ \sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x} \}$

where r = 5% is a salary incremental rate explained in section 3.5.1 and i'' is defined in equation (2.24). Using i = 0.0818 (or 8.18%) from column two of Table 4.7, i'' = $\frac{i-r}{1+r}$ = $\frac{0.0818-0.05}{1+0.05}$ = 0.030286. Substituting this and other values in the above equation, the fund available for purchase of annuity after 35 years of service is given by:

$$(0.15)(0.75)(1+0.05)^{35}\left[\frac{(1+i'')^{35}-1}{i''}\right](1+i'')=30.339.$$

This represents the amount available in the member's RSA for the purchase of annuity valued at 7.86. The value of annual pension receivable will be equal to 30.339 ÷ 7.86 = 3.86.

For all the other yield/interest rate values, i , the same process will be repeated to get the amounts of annual pension receivable, APR, shown in Table 4.7.

The above data, being annual data, in particular, suggest the need to test and analyze them for the existence or otherwise, of autocorrelation and or heteroscedasticity to ensure that the results of the regression estimations and the tests derived there-from will be efficient. Autocorrelation is a systematic pattern in the errors resulting from omitted variables, misspecification or measurement of variables.

In regression context, the classical linear regression model (CLRM) assumes that there is no autocorrelation in the errors or disturbances, μ_i relating to any variable or observation. Symbolically

$$E(\mu_i, \mu_j) = 0, \qquad i \neq j \tag{4.14}$$

that is, the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation. If there is such dependence then there is autocorrelation, and we have

$$E(\mu_i, \mu_j) \neq 0, \qquad i \neq j \tag{4.15}$$

The estimates from ordinary least squares (OLS) are said to be linear and unbiased but they are not efficient and therefore no longer best linear unbiased estimator (BLUE). Usual formulae give incorrect standard errors and confidence intervals and hypothesis tests based on the standard errors may be wrong.

Testing for Autocorrelation

Three different tests exist for different situations as have been shown below.

i. The Durbin – Watson d Test

The Durbin-Watson (DW) test referred to as Durbin Watson d test is, perhaps the most common formal test for detecting autocorrelation and is based on the assumption that

i). The regression model includes a constant

ii). Autocorrelation is of first-order only, and

iii). The equation does not include a lagged dependent variable as an explanatory variable.

Using the general equation for the two-variable least squares

$$Y_i = \beta_o + \beta_1 X_i + \mu_t \qquad (4.16)$$

the Durbin-Watson test statistic, d, is given by

$$d = \frac{\sum_{2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^{\,2}} = \frac{\sum_{2}^{n}(\hat{\mu}_t - \hat{\mu}_{t-1})^2}{\sum_{1}^{n} \hat{\mu}_t^2} \qquad (4.17)$$

where e_t represents proxies for u_t and is the estimated residual from a sample regression model. The equation means that the test statistic equals the ratio of the sum of squared differences in successive residuals to the residual sum of squares.

To see that this test statistic is related to first order autocorrelation case, the above equation can be rewritten

$$\text{DW, d} = \frac{\sum_{2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^{\,2}} = \frac{\sum_{t=2}^{n} e_t^{\,2}}{\sum_{t=1}^{n}(e_t)^2} + \frac{\sum_{t=2}^{n} e_{t-1}^{\,2}}{\sum_{t=1}^{n}(e_t)^2} - \frac{2\sum_{t=2}^{n} e_t e_{t-1}}{\sum_{t=1}^{n}(e)^2} \approx 1+1+2\hat{\rho} = 2(1-\hat{\rho}) \quad (4.18)$$

where $\hat{\rho}$ is the autocorrelation coefficient from a first order autocorrelation scheme. The larger the values of n, the better is the approximation.

II. The Durbin's h Test Statistic

The Durbin's h test is used when there are lagged dependent variables as:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 X_t + u_t \quad (4.19)$$

The Durbin's h statistic is given by:

$$h = \left(1 - \frac{DW}{2}\right)\sqrt{\frac{T}{1 - T[Var(b_1)]}} \quad (4.20)$$

where DW is the standard DW -test, T the number of observations and $Var(b_1)$ is the square of the standard error of the estimated parameter for the lagged

dependent variable. The test statistic is standard normally distributed under the null hypothesis of no autocorrelation and the test value should be compared with a critical value from the standard normal table.

III. The Breusch – Godfrey Test or The LM - Test

The Breusch – Godfrey test, also referred to as Lagrange Multiplier (LM) test, allows for a test of autocorrelation of higher order than one and can be used even when lagged dependent variables are included in the model. It is also a large sample test and should be treated as an approximation when using small samples; compared to DW-test that can be seen as an exact test. In using the LM – test, the residual term in the original model:

$$Y_t = \beta_0 + \beta_1 X_t + u_t \tag{4.21}$$

Is created and lagged and the original model in (4.21) is extended by including the lagged residual to obtain:

$$Y_t = \beta_0 + \beta_1 X_t + \rho e_{t-1} + v_t \tag{4.22}$$

with null hypothesis H_0 : $\rho = 0$ which is tested using simple t-test.

Applying the Durbin-Watson d-test for autocorrelation on the data in Table 4.7, the value of the d-test statistic was 1.45. The null hypothesis, H_0: = No Autocorrelation

The decision Rules was that if: $d_U < d < 4 - d_U$: there is no autocorrelation.

And from the Durbin – Watson Table at $\alpha = 5\%$, the number of variables, k = 2, and n=11, we obtained d_L = 0.519 while d_U =1.297

Since the test statistic d = 1.45 lies between d_U = 1.297 and 4-d_U = 2.703, it was concluded that the variables in the data set were not autocorrelated

Heteroscedasticity

.According to Gujarati (2008), one of the assumptions of the CLRM is that the variance of each disturbance term u_i , conditional on the chosen values of the explanatory variables, is some constant number equal to σ^2 , that is, equal variance. Symbolically,

$$E(u_i^2) = \sigma^2 \qquad i = 1, 2, ..., n \tag{4.23}$$

In contrast, when the conditional variance of *Yi* increases as *X* increases, then there is heteroscedasticity, that is, unequal variance. Symbolically, this is written as

$$E(u_i^2) \neq \sigma_i^2 \qquad i = 1, 2, ..., n \tag{4.24}$$

If heteroscedasticity is ignored in ordinary least squares (OLS) procedure, though the forecasts based on them will still be unbiased and consistent but they will not be efficient. The estimated variances and covariances of the regression coefficients will be biased and inconsistent, and hence the t- and F-tests will be invalid.

Both Gujarati (2008) and Andren (2013) state that the three most common statistical test procedures to identify a problem of heteroskedasticity are the Goldfeld-Quant test, the Breusch-Pagan test, and the White's test.

I. The Goldfed-Quant (GQ) test

This test works under the assumption that the error variance is equal for all observations, that is, $Var(u_i) = \sigma^2$, for all *i*. This means that the error term is homoskedastic. In this case, the variance of one part of the sample must be the same as the variance of another part of the sample independent of how the sample is sorted. In applying the GQ test, the sample is sorted according to a variable say X_i, believed to drive the size of the variance and the data set is sorted in an increasing order of X_i. For small samples the sample data can be divided into two groups without omitting any observation unlike in large samples. The regression model is run for each sub sample and the residual sum of squares (RSS) is run for each group, thus:

$$RSS_1 = \sum_{i=1}^{n_1} e^2{}_i \quad \text{and} \quad RSS_2 = \sum_{i=n_1+1}^{n} e^2{}_i \tag{4.25}$$

The residual sum of squares are used to calculate the variance of the two sub samples and form the test statistic, F, given by:

$$F = \frac{S_1^{\,2}}{S_2^{\,2}} = \frac{RSS_1/(n_1-k)}{RSS_2/(n_2-k)} \approx F_{(n_1-k,n_2-k)} \tag{4.26}$$

The F value is compared with table F (F_{cr}) at a chosen significance level α under the appropriate null hypothesis. Andren (2013) advises that as a rule of thumb, the larger variance should be the numerator.

II. The Breusch-Pagan (BP) Test

The BP test is slightly more general than the GQ-test as it allows more than one variable to be tested at a time. It starts with a set of explanatory variables believed to

drive the size of the variance of the error term, denoted by $X_1, X_2, ..., X_n$. The error variance will be given by:

$$E\left(U_i^2\right) = \sigma_i^2 = \sigma^2 f(A_0 + A_1 X_1 + A_2 X_2 + ... + A_h X_h) \quad (4.27)$$

The hypothesis of this test would be: $H_o : A_1 = A_{2=} ... A_h = 0$

The explanatory variables are used to run an OLS regression model, and the residuals are squared, saved and used to run an auxiliary regression. However, a Lagrange Multiplier is used to test the hypothesis:

$$LM = nR^2_e \sim X^2 h \quad (4.28)$$

where n is the number of observations used in the auxiliary regression model, and R^2_e is the coefficient of determination from the auxiliary model. The product of the two terms is X^2 (chi-squared) distributed with *h* degrees of freedom and *h* is the number of restrictions. The test value is compared with a critical value from the Chi-square table for a suitable level of significance.

Consequently we needed again to test the data for heteroscedasticity using the White General Homoscedasticity Test method.

The White General Homoscedasticity Test

The test is based on the regression of $\hat{u}^2$ on all the explanatory variables (X_j), their squares $(X_j{}^2)$, and all their cross products. For example, when the model contains k=2 explanatory variables X_1, X_2, the test is based on an estimation of the model:

$$\hat{u} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1{}^2 + \beta_4 X_2{}^2 + \beta_5 X_1 X_2 + v \quad \text{.....(4.29)}$$

The test on the data was based on one explanatory variable, X, and the regression model is of the form:

$$Y_i = \beta_o + \beta_1 X_i + \mu_i \quad (4.30)$$

and so we have:

$$\hat{u}^2 = \beta_1 + \beta_2 X_1 + \beta_3 X_1{}^2 + v \quad (4.31)$$

where the v is a constant that can be ignored in the analysis.

Denoting $X_1{}^2$ as X_3 and $\bar{X}_1^2$ as $\bar{X}_3$ for ease of computation, we estimated

$$\hat{\beta}_1 = \bar{Y} - \hat{\beta}_2 \bar{X}_2 - \hat{\beta}_3 \bar{X}_3 \quad (4.32)$$

$$\hat{\beta}_2 = \frac{(\sum y_i x_{2i})(\sum x^2{}_{3i}) - (\sum y_i x_{3i})(\sum x_{2i} X_{3i})}{(\sum x^2{}_{2i})(\sum x^2{}_{3i}) - (\sum x_{2i} x_{3i})^2} \quad (4.33)$$

and

$$\hat{\beta}_3 = \frac{(\sum y_i x_{3i})(\sum x^2{}_{2i}) - (\sum y_i x_{2i})(\sum x_{2i} x_{3i})}{(\sum x^2{}_{2i})(\sum x^2{}_{3i}) - (\sum x_{2i} x_{3i})^2} \quad (4.34)$$

The estimates of the partial coefficients were:

$$\hat{\beta}_1 = -0.706, \qquad \hat{\beta}_2 = 0, \text{ and } \hat{\beta}_3 = 66.25$$

Using values from computation tables, (RD1&2 in the Appendix) the value of the d-test statistic was 1.45.

And from the Durbin – Watson Table at $\alpha = 5\%$, the number of variables, k = 2, and n=11, we obtained d_L = 0.519 while d_U = 1.297

The decision Rules stated was if: $d_U < d < 4 - d_U$: no autocorrelation

Since the test statistic d = 1.45 lies between d_U = 0.519 and 4- d_U = 2.703, we concluded that the variables in the data set are not autocorrelated

To test the data for heteroscedasticity, we apply the White General Heteroscedasticity test. The test requires the estimation of $R^2_{\hat{u}^2}$ which is the unadjusted R^2 estimated from computation tables RD1 and RD2:

$$R^2_{\hat{u}^2} = 1 - \frac{\sum \hat{u}_i^{\,2}}{\sum y_i^{\,2}} = 1 - \frac{4.05865}{13.799} = \text{ 1- 0.2941= 0.7059} \quad (4.35)$$

Under the null hypothesis H_0 : the variables in the data set are not heteroscedastic.

$n.R^2_{\hat{u}^2}$ has an asymptotic x^2 (chi-squared) distribution with k degrees of freedom (d.f) where k is the number of all explanatory variables in the auxiliary model. Thus the decision rule was:

Reject H_0 if $x^2_{\alpha} \geq x^2_{cal} = n.R^2_{\hat{u}^2}$

= 11x 0.7049 = 7.7649 while $x^2_{\alpha=0.05 with 2 d.f} = 5.99$

Since the tabulated chi-square is less than the calculated chi-square value, the null hypothesis is rejected and the alternative hypothesis, that the data are homoscedastic is accepted.

With the above test confirmations that the data are not autocorrelated and are also not heterostadastic, the OLS analysis was applied. Using the absolute values of interest rate (X) as the independent variable and the corresponding amounts of pension receivable (Y) as the dependent variable, a regression analysis of Y on X was carried out to study the relationship between the two variables using the simple Linear Regression Equation given by:

$$Y_i = \beta_o + \beta_1 X_i + \mu_i \qquad (4.36)$$

where β_o is the intercept of the regression line on the Y – axis, β_1 is the coefficient of regression or the gradient of the regression line and μ_i is the error of estimation. β_o and β_1 are estimated using:

$$\hat{\beta}_o = \frac{(\sum Y)(\sum X^2) - (\sum X)(\sum XY)}{N\sum X^2 - \left(\sum X\right)^2}\ , \tag{4.37}$$

and $$\hat{\beta}_1 = \frac{N\sum XY - (\sum X)(\sum Y)}{N\sum X^2 - (\sum X)^2} \tag{4.38}$$

The values obtained were $\hat{\beta}_o$ = -9.485 and $\hat{\beta}_1$ = 154.63, and the regression equation was given as:

$$Y = -9.485 + 154.63X \tag{4.39}$$

The two samples of X and Y were assumed to have come from populations with normal distribution N(0,1). The null hypothesis that there is no significant effect of interest

rate volatility on pensions payable to retirees was rejected and the alternative hypothesis that interest rate volatility has effect on pensions payable to retirees was accepted. Estimated or predicted values from the regression equation were computed and used the values for the analysis.

Let Y_0 be the predicted value of Y corresponding to $X = X_0$ as estimated from the sample regression equation $Y_0 = \beta_o + \beta_1 X_0$. (Spiegel and Stephens, 1999). Let Y_p be the predicted value of Y for the population corresponding to $X = X_0$.

Then the statistic

$$t = \frac{Y_o - Y_p}{s_{y.x}\sqrt{N + 1 + (x_o - x)^2 / s_x}}\sqrt{N-2}$$

$$= \frac{Y_o - Y_p}{\hat{S}_{y.x}\sqrt{1+\frac{1}{N}+(x_0-\bar{x})^2/(Ns_x{}^2)}} \quad (4.40)$$

follows the student's t - distribution with v (=N-2) degrees of freedom

where $\hat{S}_{y.x} = S_{y.x}(\sqrt{\frac{N}{N-2}})$ (4.41)

[Spiegel and Stephens(1999) noted that $s_{y.x}(\sqrt{\frac{N}{N-2}})$ is a better estimate than $\hat{s}_{y.x}$.]

and $s_x = \sqrt{\frac{1}{n}(x-\bar{x})^2}$ (4.42)

s_x is the standard deviation of the independent variable X and

$$s_{y.x} = \sqrt{\frac{\sum y^2 - \beta_0\sum y - \beta_1\sum xy}{n}} \quad (4.43)$$

is the standard error of estimate, while N is the number of data. Using equation (4.17), for $X_0 =$ 0.1175, $Y_o =$ 8.684, N=11 and Y_p = 0, the above calculations resulted in calculated value of *t*=2.462, which is greater than tabulated *t at* α =0.05 which is 1.835

With a one-tailed test of the Student's t - distribution at α =0.05 level of significance and $v = n-2$ = 9 degrees of freedom, the null hypothesis that interest rate volatility has no effect on the amount of pension received by retirees was not accepted and the alternative hypothesis was accepted that interest rate volatility has significant effect on the amount of pension retirees receive.

To test the fourth null hypothesis stated in section 1.4, that changes in annuity values have no effect on the amount of pension received by retirees, twelve such annuity values were simulated using the equation: $\ddot{a}_x = \sum_{t=0}^{\infty} \frac{v^{x+t} l_{x+t}}{v^x l_x}$ (4.44)

and applied each of them to the same asset value of ₦43.5 computed using the formula:

$$(0.15)(0.75)(1+r)^n \left[\frac{(1+i'')^n - 1}{i''} \right] (1+i'') \quad (4.45)$$

The resulting annuity values and corresponding pension amounts are as shown below:

Table 4.8 Annuity Values and corresponding Amounts of Pension.

Annuity Values (X)	7.86	8.90	9.77	9.90	10.1	10.50	11.80	11.96	12.57	13.5	13.96	14.6
Amount of Pension (Y)	5.54	4.89	4.45	4.40	4.31	4.14	3.69	3.64	3.46	3.22	3.12	2.99

The calculation of annuity values and the corresponding amounts of pension have been fully demonstrated under Table 4.7 where interest rate figures were provided. The same equations and methods are used for the figures in this table

The above two-variables data were tested for autocorrelation and heteroscedasticity. The assumptions leading to equations (4.14) to (4.16) also apply here. Again, using the Durbin-Watson test statistic for autocorrelation given in equation (4.17) as:

$$d=\frac{\sum_{2}^{n}(\hat{\mu}_t-\hat{\mu}_{t-1})^2}{\sum_{1}^{n}\hat{\mu}_t^2}=\frac{\sum_{2}^{n}(e_t-e_{t-1})^2}{\sum_{t=1}^{n}e_t^{\,2}} \qquad (4.46)$$

where $\sum_{2}^{n}(e_t-e_{t-1})^2$ =0.011485521 and $\sum_{t=1}^{n}e_t^{\,2}$ = 0.0126076 and the ratio

=(0.011485521)/(0.012606) to get the calculated d = 0.9109998 0.911. The table showing full computations is marked “RD2” in the Appendix..

The null hypothesis is:

H_0 : There is no autocorrelation among the variables in the data.

The decision Rules is: using the Durbin – Watson Table if: $d_L < d < 4-d_U$: accept Ho.

The computed d = 0.911. and from the Durbin – Watson Table at $\alpha = 5\%$, the number of variables, k = 2, and n=11, d_L = 0.812 while d_U = 1.579

Since the test statistic d = 0.911 lies between d_L = 0.812 and 4-d_U = 2.421, the null hypothesis is accepted that the variables in the data are not autocorrelated.

Heteroscedasticity Test

The White test method was used to test for heteroscedasticity. Applying equations (4.22) to (4.25). to estimate the partial beta coefficients, the following equations were obtained:

$$\hat{\beta}_1 = \bar{Y} - \hat{\beta}_2 \bar{X}_2 - \hat{\beta}_3 \bar{X}_3 \qquad (4.47$$

$$\hat{\beta}_2 = \frac{(\sum y_i x_{2i})(\sum x^2{}_{3i}) - (\sum y_i x_{3i})(\sum x_{2i} x_{3i})}{(\sum x^2{}_{2i})(\sum x^2{}_{3i}) - (\sum x_{2i} x_{3i})^2} \qquad (4.48)$$

and $$\hat{\beta}_3 = \frac{(\sum y_i x_{3i})(\sum x^2{}_{2i}) - (\sum y_i x_{2i})(\sum x_{2i} x_{3i})}{(\sum x^2{}_{2i})(\sum x^2{}_{3i}) - (\sum x_{2i} x_{3i})^2} \qquad (4.49`)$$

The computations with the above equations produced:

$$\hat{\beta}_1 = 3.99 \square 4.0; \quad \hat{\beta}_2 = 0; \quad \hat{\beta}_3 = -0.0008$$

The second step of the White test requires the estimation of $R^2{}_{\hat{u}^2}$ which is the unadjusted R^2 estimated from the OLS:

$$R^2{}_{\hat{u}^2} = 1 - \frac{\sum \hat{u}_i{}^2}{\sum y_i{}^2} \qquad (4.50)$$

$n.R^2{}_{\hat{u}^2}$ has an asymptotic X^2 (chi-squared) distribution with k degrees of freedom, (d.f) where k is the number of all explanatory variables in the auxiliary model. The null hypothesis was:

H_0 : All the variances, σ^2, are equal, that is, the data are homoscedastic.

Thus the decision rule under the null hypothesis was to reject the null hypothesis if the calculated chi-squared test statistic is greater than the tabulated chi-squared value at

5% level of significance. Symbolically, this is stated as: reject H_0 if $x^2 = n.R^2_{\hat{u}^2}$ > $x^2_{\alpha=.05}$

$n.R^2_{\hat{u}^2}$ =12x 0.3435 = 4.122 while $X^2_{\alpha=0.05 with 2 d.f} = 5.99$

The calculated statistic, $nR^2_{\hat{u}^2}$ =4.122 is less than the tabulated x^2 at $\alpha = 0.05$ and with 2 degrees of freedom (2 d.f), which is equal to 5.99.

The decision, therefore, is that the null hypothesis of equal variance among the variables was accepted.

Having concluded from the two tests of autocorrelation and heteroscedasticity on the data of Table (4.8) that the variables are not autocorrelated and are homoscedastic OLS analysis of these data was continued in the assurance that the estimators based on them would be unbiased and efficient and hence, the t-, F- and X^2 –tests based on them would be valid.

The relationship between the two sets of data of Table (4.8) was established by regressing the pension values as the dependent variable (Y) on the values of annuity as the independent variable (X). Using equations (4.32) to (4.34) on the values of Table (4.8), the values: β_0 = 8.045 and β_1 = - 0.3598, were obtained giving the regression equation as:

$$Y = 8.045 - 0.3598X \qquad (4.51)$$

Equation (4.51) shows a negative gradient indicating that, as the value of the independent variable (X) which is the annuity value increases, the dependent variable (Y) or amount of pension purchased decreases

The standard error of the estimates using equation (4.43) was obtained giving $Sy.x$ = 0.1509 and $\hat{S}_{y.x} = S_{y.x}(\sqrt{\frac{N}{N-2}})$ = 1.31 while the standard deviation of X was obtained using equation (4.42), as was shown earlier, with value $s_x = \sqrt{\frac{1}{n}(x-\bar{x})^2} = 2.018$.

Let Y_0 be the predicted value of Y corresponding to $X = X_0$ as estimated from the sample regression equation, $Y_0 = \beta_o + \beta_1 X_0 + e_0$. Let Y_p be the predicted value of Y corresponding to $X = X_0$ for the population, or when X_0 =9.768, Y_o = 4.5383

To test the hypothesis regarding the effect of annuity changes on the amount of pensions purchased, the null hypothesis is stated as:

H_0: changes in the values of annuity have no effect on the amount of pensions purchased.

The decision rule is: reject Ho. if the calculated value of the test statistic, t, Is greater than the tabulated value of t at α= 0.05 level of significance and 10 (=12-2) degrees of freedom. The calculated t is given by the equation below:

$$t = \frac{Y_o - Y_p}{\hat{S}_{y.x}\sqrt{1+\frac{1}{N}+(x_0-\bar{x})^2/(Ns_x{}^2)}}$$

$$= \frac{4.538 - Y_p}{1.653\sqrt{1+\frac{1}{12}+(9.768-11.278)^2/12(2.018)^2}}$$

$= 1.7800267 \approx 1.78$

The result of the computations showed that the calculated value of t was 1.78 while the tabulated value at α= 0.05 level of significance and 10 (=12-2) degrees of freedom was 1.83. Symbolically stated, the decision rule is Reject Ho if

: *t* - calculated = 1.78 < $t_{0.95}$= 1.81.

Consequently, the null hypothesis that a change in the value of annuity has significant effect on the amount of pension to be received was accepted. In conclusion, a change in annuity value causes a change in the amount of pension a retiree can purchase.

4.1.3 Pension Risks

In this section, the effect of the factors which affect the amount of pension a retiree will receive is illustrated. The two major factors identified were changes in the value of annuity and the volatility of interest rates. We set up a case study to enable us appreciate the effects of these two factors. The model specifications and formulae have been provided in chapters two and three. For ease of comprehension, the case study details and assumptions have been restated.

4.1.4 Evaluation of the Effects of the Pension Risks

Asset volatilities of 10%, 20% and 40% were assumed. Taking an employee aged 25, who has 35 years of service to age 60 with an annual salary incremental of 5% and on a beginning salary of N638,259 per annum.

i. Values of the assets for investment returns of 8%, 10%, 12% and 14% were calculated to estimate the effects of 10, 20, and 40% volatilities on the values of the assets.

ii. The monthly pensions at three different annuity levels of 9.768, 10.497 and 11.797 of annuity and at investment returns of 8%, 10% 12% and 14% were calculated to demonstrate the effects of changes in mortality and investment rates on the values of pensions receivable

iii. Replacement Ratios at the three levels of annuity rates and the investment rates as above were also computed to study their effects.

Table 4.9 below shows 15% of the values of the accumulated assets at different investment rates of 8%, 10%, 12% and 14%. The values were estimated using equation (2.28) given as $(As)_x\,(0.15)(0.75)(1+r)^n\left[\frac{(1+i'')^n-1}{i''}\right]$. As an example, using 8% interest rate with an annual salary of N840,000, the accumulation of fund for pension in the year preceding retirement is given as ACS = $840000(1.05)^{35}\left\{\frac{(1+0.0286)^{35}-1}{0.0286}\right\}(.15)$ out of which 75% is used to purchase annuity while 25% is used to pay for gratuity. The same calculation is repeated for interest rates of 10%, 12% and 14%. In each case, i'' has to be estimated from the relationship of equation (2.22) while 75% of the total accumulated amount is used to purchase pension and 25% of the same amount is used for the payment of gratuity. Under 10% volatility, the accrued amount is reduced by 10% and by 20% when the volatility is 20%, and so on.

Table 4.9 15% of Accumulated Assets at different Investment Returns and Interest Rate Volatility.

	Value of Assets			
Volatility of Assets	Investment Return 8%	Investment Return 10%	Investment Return 12%	Investment Return 14%
0%	40,900,148	59,764,676	90,012,981	136,085,223
10%	36,810,133	53,788,208	81,011,683	122,476,701
20%	32,720,118	47,811,741	72,010,385	108,868,178
40%	24,540,081	35,858,806	54,077,789	81,651,134

Table 4.10 Balance of Assets (75%) Available for Annuity Purchase

	Investment Return			
Volatility	8%	10%	12%	14%
0%	30,675,111	44,823,507	67,509,735	102,063,917
10%	27,607,600	40,341,156	60,758,762	91,857,252
20%	24,540,089	35,858,806	54,007,788	81,651,134
40%	18,405,067	26,894,104	40,505,841	61,238,350

Table 4.10 shows the funds available for purchase of annuity (that is, 75% of the values in Table 4.9) after the 25% of the total funds in Table 4.9 have been withdrawn for payment of gratuity in accordance with the Pension Reform Act 2004.

Table 4.11 Monthly Pensions at Annuity Rate of 9.768

	Investment Return			
	8%	10%	12%	14%
Volatility				
0%	261,697	382,401	575,943	870,734
10%	235,528	344,161	518,349	783,661
20%	209358	305921	460754	696,587
40%	157,018	229,441	345,566	522,440

The monthly pension amounts are obtained by dividing the amounts available for purchase of annuity in Table 4.10 by the values of annuity shown on top of the table and also dividing by 12. For example, the monthly pension of 261,697 Naira under 0% volatility and 8% investment return on Table 11 was obtained by dividing the 'balance of asset available for annuity purchase' under 8% investment return and 0% volatility of Table 4.10 by the annuity value in the title of the table, (Table 4.11 in this case). Hence 261,697 was obtained from {30,675,111 ÷ (9.768*12)}. All the other monthly pension values were obtained using the same method. The monthly pensions increase as the percentages of investment return increases. Also, as the annuity values increase, the amount of pension purchased decrease. This also applies to volatility rates.

Table 4.12 Monthly Pension at Annuity Rate 10.497

	Investment Return			
Volatility	8%	10%	12%	14%
0%	243,523	474,458	535,945	810,263
10%	219,171	427,012	482,351	729,237
20%	194,818	379,566	428,756	648,210
40%	146,114	284,675	321,567	486,158

Table 4.13 Monthly Pension at Annuity Rate 11.797

	Investment Return			
Volatility	8%	10%	12%	14%
0%	216,687	316,631	476,885	720974
10%	195,019	284,968	429,196	648,876
20%	173,350	253,305	381,508	576,779
40%	130,012	189,978	286,131	432,584

Pair-wise comparison of Tables 4.11 to 4.13 shows the following results:

i). the amount of pension payable decreases with increasing value of annuity and hence mortality

ii). Notwithstanding the value of annuity, the amount of pension payable increases as investment return increases but decreases with rising volatility rate.

The pension replacement ratio defined as the percentage of pension in payment to the final salary at retirement was also calculated. The World Bank (1994) recommended minimum Replacement Ratio to be 67%, implying that a retiree should receive, at least, 67% of his final salary as pension after he has reached the maximum service period of 35 years in the employment of the employer.

It will be recalled, from chapter 2, that the Replacement Ratio was calculated using equations (2.40) to (2.46) as shown below:

Replacement Ratio, $RR = \frac{CP}{FS} * 100 = \frac{(1-g)ACS}{a_x(As_x)(1+r)^{n-1}} * 100$ (2.46)

all the parameters were appropriately defined. As a reminder, however, (1-g)ACS =75% of the accumulated asset, a_x is the annuity at age x=65 and $(As_x)(1+r)^{n-1}$ is the salary at age x increased to time n-1= 34th year of service

For a given final emolument at retirement, the effects of varying levels of annuity and investment returns on Replacement Ratios are illustrated as follows:

Table 4.14 Replacement Ratios with Final emolument at Retirement = N4,412,812

	Investment Return			
Annuity Rates	8%	10%	12%	14%
9.768	71.03%	104.96%	158.08%	238.99%
10.497	66.22%	96.77%	145.74%	220.34%
11.797	58.92%	86.10%	129.68%	196.06%

Table 4.14 shows that the Replacement Ratio increases as the rate of investment return increases but decreases as the Annuity Rate increases. To illustrate the derivation of the replacement ratio under 8% investment return and annuity rate of 9.768 of Table 4.14, the final emolument which is $(As)_x(1+r)^{n-1}$ was given as N4,412,812. From Table 4.10, the balance of assets available for purchase of annuity under 8% investment return and zero volatility is $(1-g)ACS$ = 30,675,111 and a_x, the annuity at age x = 65 was given as 9.768. The computation gave the replacement ratio, RR as $\frac{30675111}{4412812*9.768}*100 = 71.03$ as in the table. The other figures in the table were similarly calculated. From the table, at an investment return of 8%, the replacement ratio decreases as the annuity value increases from 9.768 to 11.797. The table also shows that as the rate of return on investment of pension funds increases, the amount of pension receivable by retiring employees also increases for a given annuity rate. However, decrease in mortality rate and hence improvement in life expectancy

increases the value of annuity rates and therefore reduces the amount of pension receivable.

Table4.15 Replacement Ratios at different Annuity and Volatility Rates

	Annuity Rates			
Volatility	8.904	10.085	11.859	Defined Benefit (%)
0%	78.07%	68.93%	58.62%	64.47
20%	62.46%	55.14%	46.90%	64.47
40%	46.84%	41.36%	35.17%	64.47

The Replacement Ratios, RR, of Table 4.15 are calculated using the final emolument of ₦4,412,812 and the fact that the balance of assets available for purchase of annuity is ₦30,675,111, and then applying the formula in equation (2.46) restated on page 114. This equation is also used in all RR calculations.

Table 4.15 shows the following important results:

i) The pension replacement ratios decrease as the annuity values increase

ii) With increasing volatility rates, the pension replacement ratios decrease

iii) The defined benefit rates (fifth column) are stable whatever the rates of annuity or interest rate volatility.

The choice between the defined benefit and defined contribution pension plans will depend on the volatility of assets and the prevailing annuity rates at retirement which affect the defined contribution.

At 0% and 40% volatility of interest, the defined contribution pensions are higher than the defined benefit rate while at 40% volatility, the defined benefit rate is higher at high values of annuities except when annuity is 8.904 and it is only slightly higher at that value.

4.1.5 Evaluation of the Proposed Models

In chapter two, we provided the conceptual framework of the three models that have been designed, including the assumptions and the formulae, and also provided case studies above. With the replacement ratios computed therein, the comparison of the three models in respect of their changes under given values of interest rate volatility and differing annuity values are as shown hereunder:

Table 4.16 Replacement Ratios of the Three Models at Annuity Rate of 8.904

Volatility	Guaranteed Money Purchase Scheme	Cash Balance Pension Scheme	Hybrid Pension Scheme
0%	84.62%	60%	112.87%
20%	60.96%	60%	90.29%
40%	8.08%	60%	67.72%

Table 4.17 Replacement Ratios of the Three Models using Annuity Rate of 10.085

Volatility	Guaranteed Money Purchase Scheme	Cash Balance Pension Scheme	Hybrid Pension Scheme
0%	80.29%	60%	99.65%
20%	60.22%	60%	79.72%
40%	8.08%	60%	59.79%

Table 4.18 Replacement Ratios of the Three Models using Annuity Rate of 11.797

Volatility	Guaranteed Money Purchase Scheme	Cash Balance Pension Scheme	Hybrid Pension Scheme
0%	77.62%	60%	84.74%
20%	59.70%	60%	69.79%
40%	8.08%	60%	50.85%

In Tables 4.16 to 4.18, the effects of three varying but increasing values of annuity on the replacement ratios of the three newly designed pension schemes – the Minimum Guaranteed Money Purchase pension scheme (shortened as 'Guaranteed Money Purchase scheme' in the table), the Cash Balance pension scheme and the Hybrid pension scheme - were compared.

For all values of annuity, the Hybrid Pension Scheme showed higher Replacement Ratio than the other Pension Schemes up to 20% volatility of interest rate. However, in the most unlikely event that the volatility level hits 40% mark, the Cash Balance pension

scheme is better than the Hybrid and the Minimum Guaranteed Money Purchase schemes.

Figure 4.1 Bar chart showing replacement ratios at different volatility rates

Annuity Rates	8.904	10.085	11.797
Cash balance plan	60	60	60
Hybrid value	112.87	99.65	84.74
Minimum guaranteed plan	84.62	80.29	77.2

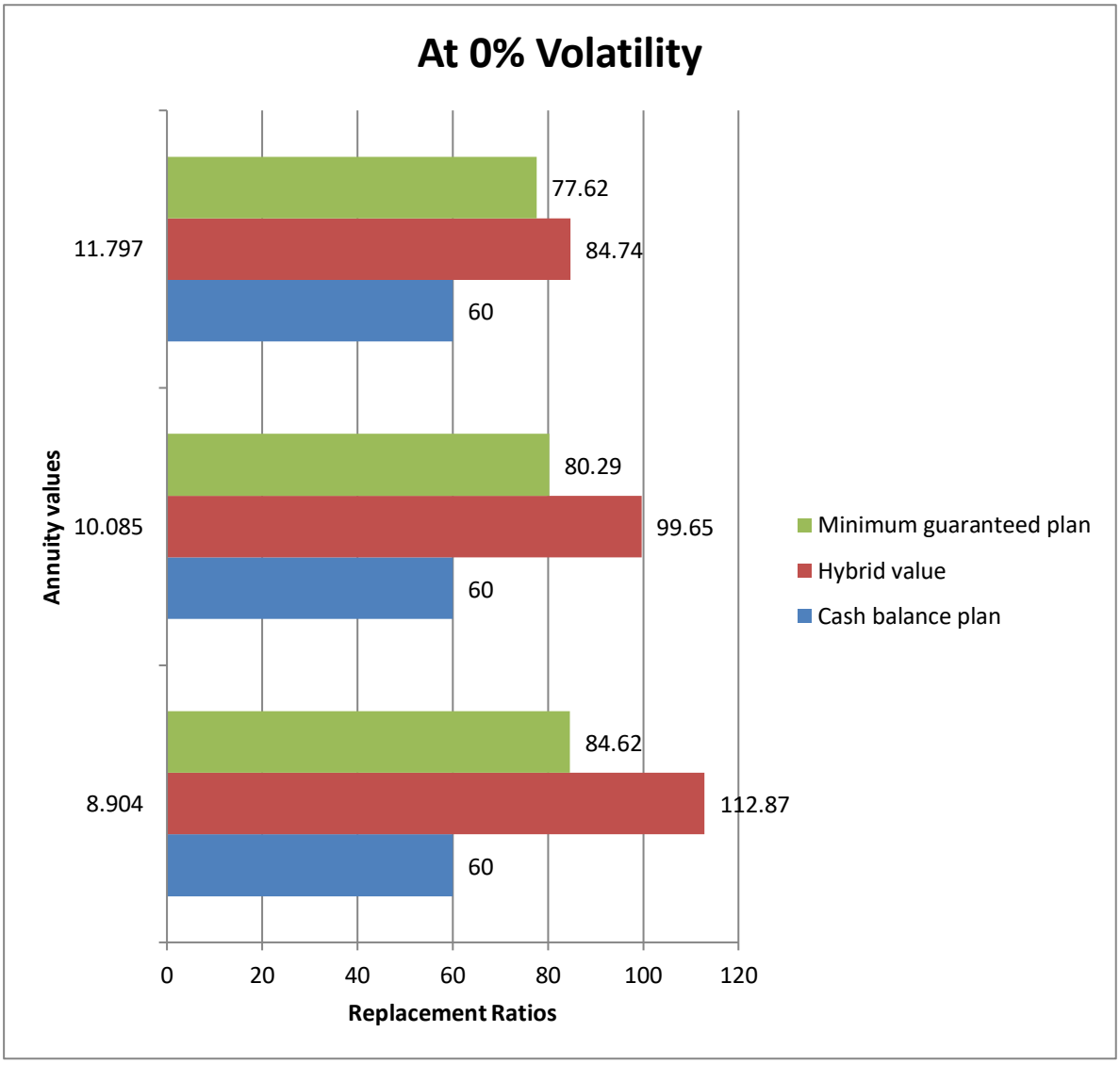


Figure 4.2 Bar chart showing replacement ratios at different volatility rates

	8.904	10.085	11.797
Cash balance plan	60	60	60
Hybrid value	90.29	79.72	69.79
Minimum guaranteed plan	60.96	60.22	59.70

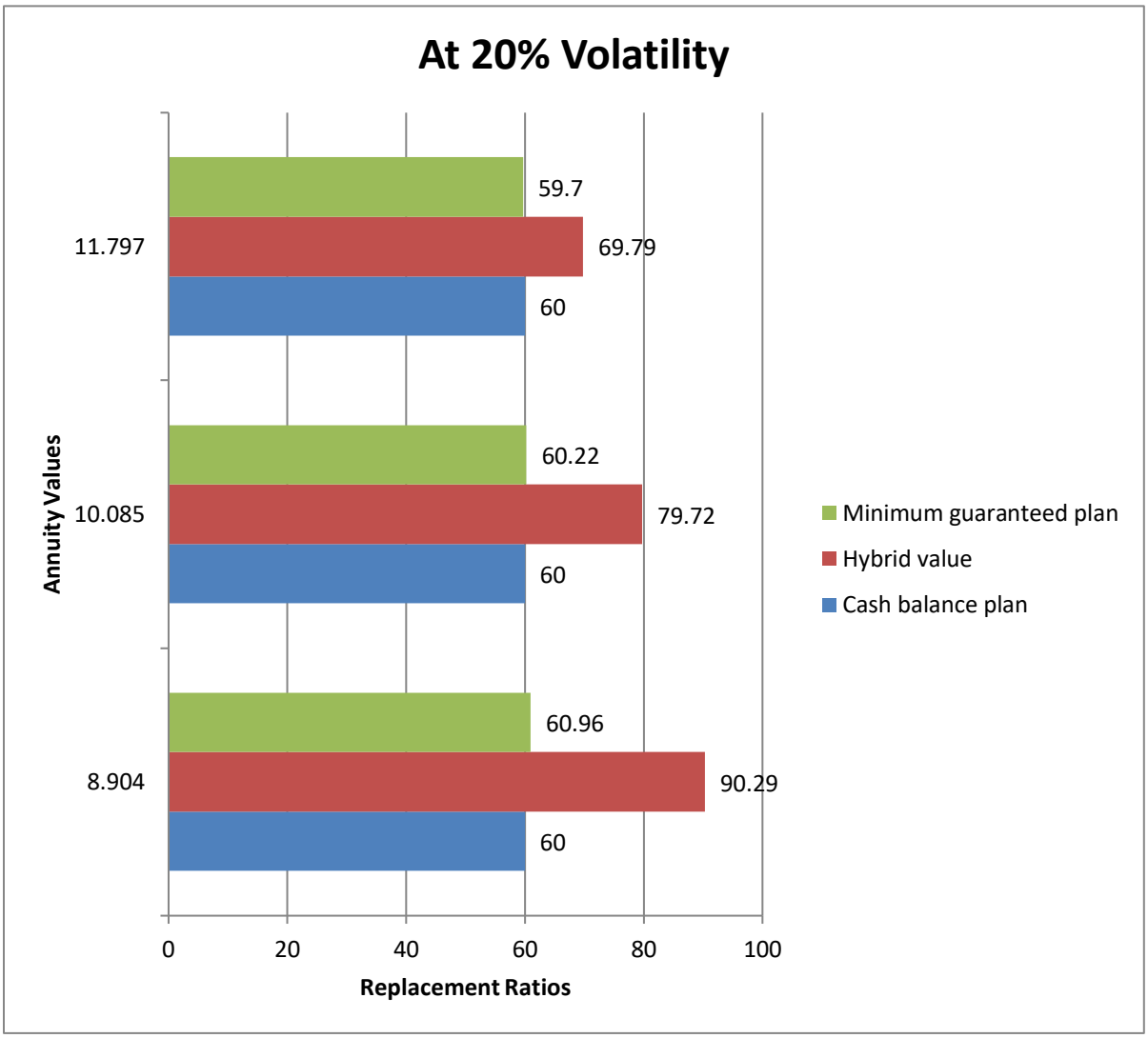
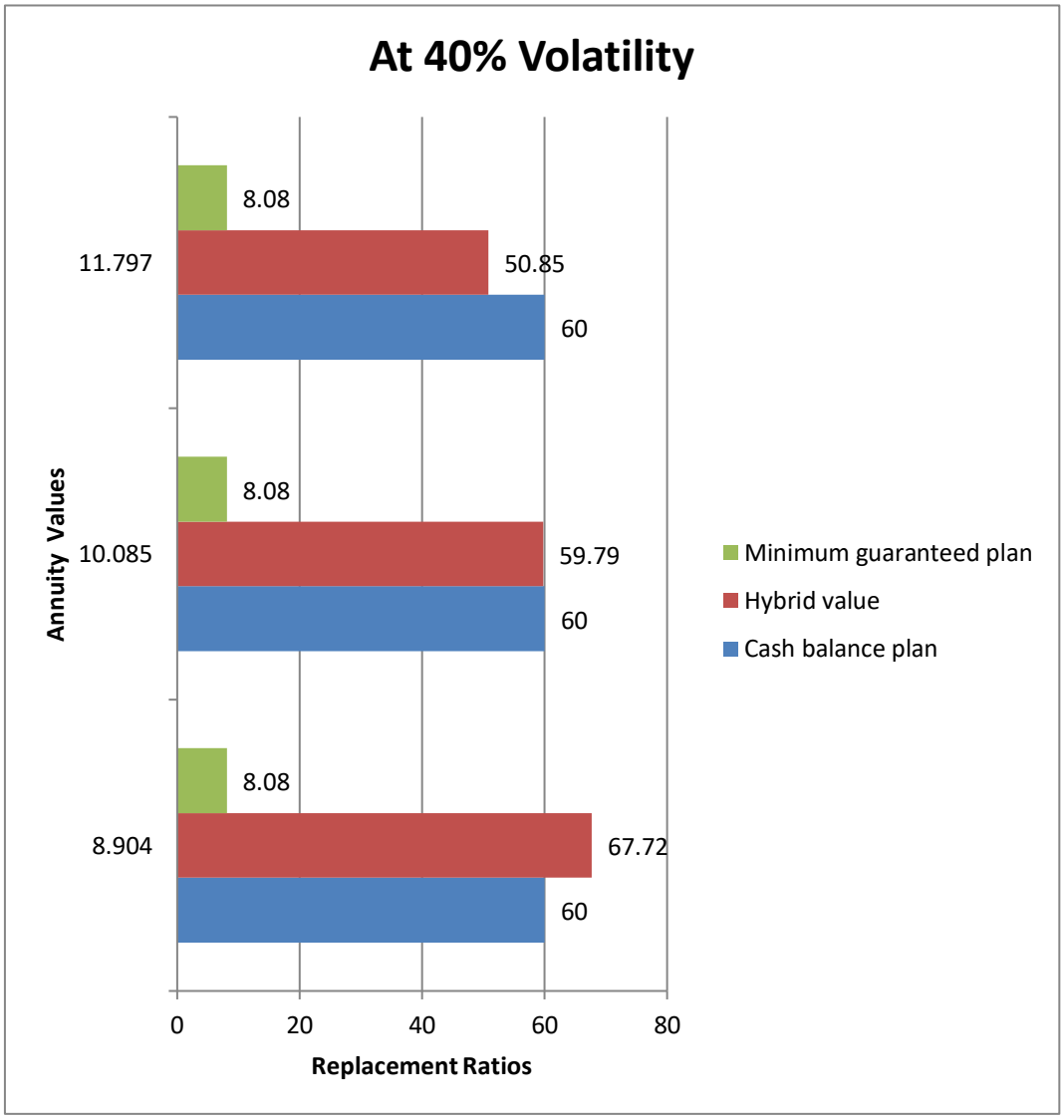


Figure 4.3 Bar chart showing replacement ratios at different volatility rates

	8.904	10.085	11.797
Cash balance plan	60	60	60
Hybrid value	67.72	59.79	50.85
Minimum guaranteed plan	8.08	8.08	8.08



4.1.6 Pension Coverage for the Unemployed.

With the assumptions developed in chapters 2 and 3, the accumulated amount in the account of each participant was given as:

I) Without Government's counterpart contribution:

$$31300\left[1+(1+i)+(1+i)^2+..+(1+i)^{36}\right]$$

$$=31300\frac{(1+i)^{38}-1}{i} \qquad (4.44)$$

= 6,895,889 at age 65

The sum of N6,895,889 would be available for purchase of annuity. At an annuity rate of 8.558, an annual pension of about 805,000 Naira or, a monthly pension of about 67,000 Naira will be guaranteed.

ii). With Government Portion or participation, the amount of pension under i).

above would be doubled

If the resources available in Nigeria were well managed, the government would be in a position to contribute its part fully and implement the above calculation backed with the proper legal framework for the safe management of the fund.

Employees in the formal sector could similarly set aside extra money monthly under Additional Voluntary Contribution to increase their pension benefits at retirement.

4.1.7 Results of Hypotheses Tested and of Evaluation of the Models

Our first set of objective was to find out which of the 'Old' and 'Current' Pension schemes provided higher pension benefit to a retiring employee. The test of the null hypothesis that there was no difference in the quantum of benefits provided by the two

was not accepted at 5% level of significance. In fact, the result showed that the quantum of benefit from the Old scheme was higher than that of the Current scheme.

In the comparison of the provisions of the Current scheme with those of eight countries selected among developed and developing countries in the five continents of the world, it was discovered that the provisions of the pension schemes of those eight countries including South Africa, Ghana and Cile followed the World Bank's (1994) model of three pillars while the Current scheme had only one pillar. The pillars were identified in chapter two of this Study. The replacement ratio of the current scheme was also computed and the value was slightly less than that stipulated by the World Bank (1994).The replacement ratios available on the other countries were based on the mandatory pensions only, excluding values from the non-mandatory (voluntary) and social security benefits. If such values were available and added, comparison with replacement ratios would have been meaningful.

Our data for the third and fourth objectives were also tested for autocorrelation and heteroscedasticity: the data were not autocorrelated and were not heterscedastic.

In the third set of objectives, the null hypothesis that interest rate volatility had no effect on the amount of pension payable to retirees was tested but was rejected at 5% level of significance using a one tailed test of the Student's t–distribution. This implied that volatility of interest rates significantly affect the amount of pensions payable to employees when they retire.

In a similar manner, changes in the value of annuity rates have significant effect on the amount of pension a leaving employee would receive when he purchases annuity with

the accumulated fund in his retirement savings account. The null hypothesis that changes in the values of annuity rates had no effect on the amount of pension payable to retirees was not accepted at 5% level of significance using the t-distribution test. These last two results were highlighted by the case study illustrations in this chapter.

The results of the evaluation using different values of interest rate volatility and differing values of annuity on the proposed three pension models showed that the Hybrid Pension Scheme maintained a higher replacement rate than other pension models except at the very unlikely event that the interest rate volatility hit the 40% mark. This means that the Hybrid Pension model will provide higher pension amount to retirees than the Cash Balance Model and the Minimum Guaranteed Money Purchase Model.

Finally, a proposal was made for the establishment of a pension scheme for the self-employed where self-employed would include the market men and women. The calculations showed that a contribution of N100 per day for six days in the week and for 38 years, invested at a minimum rate of return of 8%, would create an amount of about N6.8 million in the RSA of the contributor without a counterpart contribution from the government. This could purchase a monthly pension of about N50,000.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of major findings of this research work. It also presents some recommendations based on the findings, and suggestions for further research on this subject matter.

5.1 Summary

This research was necessitated by the problems associated with the two major previous pension schemes in Nigeria: the 1979 Pension Scheme (Old) and the 2004 Pension Reform Act (Current). The latter came into being to 'reform' the anomalies observed in the former, the Old Pension scheme. Several articles outlined in section 2 had been written by different researchers on the causes that gave rise to the establishment of the PRA 2004 and thereafter, on the perceived anomalies associated with the PRA 2004 itself. Part of the criticisms centered on what was perceived as the likely inadequacy of the quantum of benefits a retiree would receive after maximum length of service of 35 years.

All the research works seen up to the commencement of this study centered on the administrative lapses or maladministration of the two Pension schemes

This study started by comparing the benefit amounts provided by the two pension schemes mentioned earlier: the Old and the Current pension schemes. While the format for the computation of benefit for a retiring employee was formally spelt out in the schedule attached to the old scheme, the 1979 Pension, the PRA 2004, being a DC

plan did not contain such a schedule. The benefit, after 35 years of service, had to be estimated using actuarial and statistical methods. Various authorities cited in this work had stated that the best tool for comparing pension schemes or their adequacies are their replacement ratios. The benefit amounts and their replacement ratios from the two pension plans at retirement were then computed. The results of the comparison showed that the amount of pension and gratuity payable after 35 years of service by the 1979 Pension plan was more than double the amount payable under the PRA 2004. The pension replacement ratio of the 1979 Pension (80%) was also higher than the minimum standard (67%) proposed by the World Bank (1994) and the (66.7%) estimated for the PRA 2004.

Similarly, the pension replacement ratio of the PRA 2004 which had been estimated was used to compare its adequacy with those of eight other countries named in chapter two..This comparison could not be sustained because it was discovered that the replacement ratios of those other countries obtained from publications of OECD and IMF were computed using benefit values of two out of three pension pillars. All the eight countries, including Ghana, South Africa and Chile were operating three pillar pension schemes as advised by the World Bank (1994), whereas Nigeria operates only a single pillar. Consequently, the comparison was not on equal basis. But of importance is the finding that Nigeria's pension replacement ratio is low compared with those of other countries including its African neighbors, Ghana and South Africa, and also including Chile, all of which are classified as developing. The World Banks's (1994) three-pillar model is considered as a panacea for the world's pension problem and that is why most

countries' pension reformations are geared towards it particularly to solve the problems of pension coverage and to enhance their replacement rates.

The effects of some factors, (interest rate volatility and variations in mortality) considered as "pension risk factors" identified as affecting the quantum of benefits retirees receive under DC pension schemes were evaluated. Statistical tests of hypothesis, using the t-distribution of the simple regression methods were used. The results were important for the designing and evaluation of pension models particularly the effect of annuity (which is a function of interest and mortality) changes on the amount a retiree would receive as pension.. The mortality tables used in this study are the a(55) tables of the Institute and Faculty of Actuaries of the UK.

Three new pension models were proposed in this study: the Guaranteed Money Purchase Pension Plan, the Cash Balance Pension Plan and the Hybrid Pension Plan. The Replacement Ratios of the three pension models were evaluated at different annuity and interest rate volatility levels. The Hybrid Pension Plan was adjudged to be better than the other two plans because it will provide higher replacement rate (112%) Several tests were carried out on the replacement ratios of the three pension plans with varying combinations of interest rate volatility and annuity levels. In each case the Hybrid Pension Plan produced higher result. This means that, with the Hybrid Pension plan, the amount of benefit an employee will receive as pension will be higher than in any of the other plans under the same conditions of interest rate volatility and annuity levels.

In terms of sustainability, the Hybrid Plan does not entail extra contribution. Interestingly the Federal Government increased the pension contribution rate from 15% to 18% in Nigeria's Pension Reform Bill 2014 consolidating all previous amendments to the 2004 Act (Ukaa, 2014)

Finally, the study proposed sample pension coverage for the unemployed using the market women as a starting point. The proposal showed that, with a contribution of one Naira (₦1.00) a day for six days in a week starting from age 27 and given an investment return of 8%, a fund of about ₦6.89millio can be achieved at age 65. At an annuity rate of 8.558, the fund could provide an annual pension of about ₦67,000 (sixty-seven thousand Naira.

5.2 Conclusions

Fitting Pension models have demonstrated the utility of combining statistical and actuarial techniques in the study of pensions. It has also demonstrated that such techniques are useful in order to give clear direction in the behavior of such variables as interest rates and mortality (both of which are functions of annuity) on pension amounts payable at retirement. The combined technique has helped to confirm that the Pension Decree 102 of 1979, though not operational in Nigeria anymore, provided higher pension and gratuity benefit amounts to retirees than the Pension Reform Act (PRA) of 2004 which replaced it. The technique also helped in the computation of the replacement ratio of the 2004 PRA so that employees who are operating under the Act can have a rough estimation of their pension amounts at retirement through the replacement ratios. By the use of the combined technique, the effects of the pension

risk factors (interest rate volatility and annuity rates) were determined: that both of them have decreasing effects on the amounts of pension payable at retirement. Increase in interest rate alone increases the amount available for the purchase of annuity while increase in annuity decreases the amount of pension that can be purchased.

Of the three pension models designed, which is the major objective of this study and whose pension replacement rates were tested, the Hybrid Pension Model showed higher replacement ratio over others, implying that the model would provide higher retirement pension amount over the others, including the current pension scheme, the 2004 PRA. It is hoped that these models can serve as a benchmark for future research works on pension.

5.3 Recommendations

From the findings of this study, the following recommendations are made.

The mortality tables used by actuaries to carry out valuation of pension and life funds in Nigeria and even in this study are those based on the life and mortality experiences of other countries, notably the United Kingdom (the a(55) mortality table) and the United States of America (the CSO mortality table). There is compelling need to have a mortality table that will reflect the mortality experiences and other demographic and economic changes of Nigerians so that pension and life fund valuations carried out in Nigeria will not require mortality rate adjustments of those foreign mortality tables which, at the end, may or may not be correct.

Again, in the construction of home-based mortality tables, there is need to construct tables of ‘salary scale functions’ such as has been used for this study. This table is important for the estimation of future benefits in pension computations.

Among the nine countries whose pension provisions were compared, it was noted that Nigeria was the only country that had one pension pillar as opposed to the World Bank’s (1994) proposed three-pillar model. There is need to increase the number of pension pillars in Nigeria to comply with the advice of the World Bank for the good of Nigerians, just as some of the other African countries like Ghana and South Africa have complied. Additional pillar such as the Voluntary pillar of the World Bank (1994) model will also help to improve the total amount of pension each retiree will earn.

It was noted that the benefit provisions of the 1979 Pensions Act had 80% replacement ratio even though it is no longer in operation. It is quite possible to resuscitate and restructure the model, reduce its cost of funding, perhaps by 50% and channel the excess fund to create another pillar. The reduced pillar would provide a replacement ratio of 30% to 40% while the replacement ratio from the balance could be up to 35% and above. With the addition of the existing one pillar (the 2004 PRA) there will be an increase in pension replacement ratios for retirees and Nigeria would achieve an increase in the number of pension pillars. The total pension contribution into Ghana’s three pillar pension is 18.5%. with a pension replacement rate of over 100% (Mensah, 2013). With the Pension Amendment Bill of 2014, Nigeria now has 18% contribution into a single pension plan and if something goes wrong with the fund, there will be hues and cries as in the 1979 Pension.

5.4 Suggestions for Further Research

The following suggestions for further research are made in order to broaden the scope of available knowledge in pensions and even improve, perhaps, the pension models proposed in this study:

(i) Issues surrounding Pension are very evolving; demography, mortality, investment returns, salary increases, retirement ages and so on. In the developed and some developing countries, researches are constantly going on resulting in changes to some of the variables on pension from to time. Reforms in pension are carried out through research Apart from the need for Nigeria to have an acceptable home-grown mortality table that will reflect the mortality, demographic and economic changes in the country as recommended earlier, current economic situation calls for adjustments in the amount of pensions in payment to grow in line with current consumer price index (CPI). This is an important area for research as most pension amounts in payment remain static for years in Nigeria. This study discovered that some developed countries as the UK, Russia and others have already, through research, determined the level of contributions to their pension schemes in 2022 and beyond, or the new retirement age in 2027.

(ii) Research in pension reform is carried out by a group of professionals in the relevant areas gathered by a government with appropriate mandate and direction. That was what the government of Chile did that resulted into a pension plan that was acclaimed by the World Bank and referred to as a 'Model for the world' (Butler, 2011). The government of Nigeria needs to do the same. The

.issue of non-coverage of the unemployed in the past and current pension plans has received more than enough comments and criticism in the press and individuals through journals publications. Yet there were amendments to the 2004 PRA in 2011 and 2014. The kernel of this discussion is that there is need to include the unemployed and the self-employed in Nigeria's pension plan. This study has made a proposal using the market women and men as a benchmark and illustrated possible fund accrual and annual pension amount. More research and legal backing will be needed if required to bring it to fruition

(iii) Further research will be required on the models presented in this study or the existing pension models to include such areas as healthcare for retirees. In terms of sustainability, the research will take funding into account.

(iv) The Bayesian method mentioned in sections 2.1.2 and 2.1.3 will require further studies so that it can be fully utilized in the analysis of the myriads of data from the different PFAs

REFERENCES

Adams, R. (2013). *How does the UK state pensions compare worldwide? Assessed at* http://conversation.which.co.uk/money/uk-state-pension on September 12.

Adegbayi, A. (2006). *Pension industry development in Nigeria – The thrust of the pension reform Act 2004* Assessed at http://www.leadway.com/pensiondev.pdf retrieved on July 10.

Akalonu, R. O. (2016). *Replacement ratio of the benefits of amended Nigerian pension reform Act 2014*, Proceedings of African Regional Conference on sustainable development 14 (1) 59-63.

Akalonu, R. O. & Ipinyomi, R. A. (2014).*Comparative analysis of the benefits of the Nigerian pension act No. 102 of 1979 and the pension reform act of 2004*. International Journal of scientific research and management 2 (3) 579-598.

Akalonu, R. O. & Ipinyomi, R. A. (2015). *Replacement ratio of the provisions of the Nigerian pension reform act 2004*.Developing country studies, 5 (8) 58-64.

Amadeo, K. (2013). *Social security trust fund.* Assessed at http://useconomy.about.com/od/glossary/g/soc_security-Trust.htn on September 17.

Amaechi, O. & Alban, O. (2009). *Four years of pension reforms in Nigeria: Any hope for retiree?* Daily Sun, September, 29.

Armando, B. (2008). *Pension reform and economic development in Chile.* Development policy review, 11: 91 – 108. Doi:10.1111/j.1467-7679.1993.tb00030.x

Barr, N. & Diamond, P. (2006). *The economics of pensions*. Oxford Review of Economic Policy, 22 (1). 15 – 39.

Barrientos, A. & Lloyd-Sherlock, P. (2002). *Pensions, poverty and wellbeing: The impact of pensions in South Africa and Brazil, a comparative study.* Pension watch, Briefing no. 7, Help Age International

Behrman, J. R., Calderon, M. C., Mitchell, O. S., Vasquez, J. & Bravo, D. (2011). *First-round impacts of the 2008 Chilean pension system reform,* Philadelphia, PA, The Wharton School of the University of Pennsylvania

Bowers, N. L., Gerber, H. U.,Hickman, J. C., Jones, D. A. & Nesbitt, C. J. (1997). *Actuarial mathematics* (2nd ed.). Schaumburg, Il: The Society of Actuaries.

Butler, E. (2011). *Chile's pension system: a Model for the world.* The Christian Science Monitor AllAfrica.com April 26

Cannon, E. & Tonks, I. (2011). The value and risk of defined contribution pension schemes: International evidence. Pensions Institute; Discussion Paper PI-1114, http://www.pensions-institute.org/

Casey, B. H. & Dostal, J. M. (2008).Pension reform in Nigeria. Global Social Policy, 8 (2), 238 – 266.

Clare, R. (2013). 'Australian superannuation: An equitable and sustainable arrangement in a post crisis world?' Association of Superannuation Funds of Australia, Sydney, NSW Australia.

Dickson, D. C. M. (2010). *Actuarial mathematics for life contingent risks,* Cambridge University Press.

Ehijeagbon, O. O. (2004). *Analysis of Nigeria's new pension reform act, 2004.* Cape Town Legal brief Africa,.

Eich, F., Gust, C., & Soto, M. (2012). *Reforming the public pension system in the Russian Federation*, Washington, DC IMF Working Paper No. WP/12/201,.

Evans, R. (2013). *The best pensions in the world.* Assessed at http://www.telegraph.co.uk/finance/personalfinance/pension/9902745. on August 12.

Exley, C. J., Mehta, S. J. B. & Smith, A. D. (1997).*The financial theory of defined benefit pension schemes*. B.A.J. **3**, IV, 835 – 966.

Ezeala, P. (2006) *Nigeria: pension reform act 2004 and deregulation*, Assessed at AllAfrica.com on August 30.

Gregorio, I., Yu-Wei, H., & Xiaohong, L. (2009). *'Governance and fund management in the Chinese pension system'*, Washington, DC IMF Working Paper No. WP/09/246,.

Gujarati, D. N. (2008). *Basic econometrics.* 4th. Ed. Chicago. The McGraw-Hill Companies.

Haminat, L. T. (2010). *The performance of the pension reform act, 2004*, unpublished research project at Redeemer's University, Ogun State.

Hauner, D. (2008). *Macroeconomic effects of pension reform in Russia*. IMF Working Paper, WP/08/201

Heever, A. M. V.D. (2007) *Pension reform and old age grants in South Africa*,. (http://www.eldis.org/go/country-profiles&id=42168&type=Document) retrieved Oct. 01.

Holzmann, R. (1997). A world bank perspective on pension reform. Paris, Joint ILO – OECD Workshop.

James, E., Edwards, A. C., & Iglesias, A. (2010). *Chile's new pension reforms.* Dallas, Texas National Center for Policy Analysis Publishing, Policy Report No. 326,.

Jordan, C. W. (1982). *Life contingencies*. (2nd ed) Chicago, IL: The Society of Actuaries Publishing.

Kellison, S. G. (1970). *The theory of interest.* Homewood, IL: Richard D. Irwin, Inc.

Klugman, S. A., Panjer, H. H. & Willmot, G. E. (2008). *Loss models from data to decisions,* (3rd. ed.). N.Y. John Wiley & Sons, Inc.

Kpessa, M. W. (2011). *Retirement income security under Ghana's three-tier pension model: Assessment of risks options for reform'. Pensions 16*(2) 127 – 136.

Kudma, G. & Woodland, A. (2011). *An inter-temporal general equilibrium analysis of the Australian age pension means test.* Journal of Macroeconomics 33(1), 61 – 79.

Lee, E. M. (1986). *An introduction to pension schemes.* London: The Chameleon Press Ltd.

Mehr, R. I. (1977). *Life insurance: Theory and practice.(revised ed.)* Dallas, Texas: Business Publications, Inc.

Mensah, D. A. (2013). *The new three-tier pension scheme.* Sun, pp 1 -6 (http://npra.gov.gh/site/index.php?option=content&view=article&id retrieved September 22.

Merwe, T. V. D. (2004). *'The occupational pillar of the South African pension system'.* Development Southern Africa, 21(2), 303 - 327.

Meyer, P. L. (1974). *Introductory probability and statistical applications* (2nded.). Reading, MA: Addison-Wesley Publishing Company.

Nevondwe, L. (2010). *South African social security and retirement reform: A long journey towards the redrafting of the new pension funds act, Pensions, 15*(4), 287 – 296.

Odia, J. O. & Okoye, A. E. (2006). *Comparison between the old and new pension schemes.* Afro Asian Journal of Social Science, 32(5)

Odia, J. O. & Okoye, A. E. (2012). Pensions reform in Nigeria: a comparison between the old and new scheme. Afro Asian Journal of Social Sciences, Vol. 3 No. 3.1.

OECD (2006). “Replacement Rates”, in OECD Pensions at a glance 2005: Public policies across OECD countries. OECD Publishing. http://dx.doi.org/10.1787/pension_glance.2005-6-en

Omorodion, M. O. & Akalonu, R. O. (2014). The effect of longevity on pensions in the Nigerian pension scheme. IOSR journal of business and management, 16 (4).

Orifowomon, O. A. (2006). *A critical appraisal of pension system reforms in Nigeria.* .Gonzaza Journal of International Law, assessed at https://www.law.gonzaga.edu/giil/2006/12/a-critical-appraisal-of-pension...on March 11

Orszag, P. R. & Stiglitz, J. E. (1999).*Rethinking pension reform: ten myths about social security systems*. Washington D.C. World Bank,

Osuala, E. C. (2005). *Introduction to research methodology* (3rd ed.). Onitsha, Anambra State: Africana-first Publishers Ltd.

Palacios, R. J. (1996). *Averting the old-age crisis* :Washington D.*C.* Technical annex. World Bank WPS

Pension Decree (1979).*The Federal Republic of Nigeria official gazette.* Lagos: Government Press.

Pension Reform Act (2004).*The Federal Republic of Nigeria official gazette.* Lagos: Government Press.

Publication Manual of the American Psychological Association, (6th ed.).(2010) Washington, DC: American Psychological Association

Republic of South Africa National Treasury (2007). *‘Social security and retirement reform’,* Second Discussion Paper.

Rodriguez, L. J. (1999). Chile’s private pension system at 18: It’s current state and future challenges, available at http://www.socialsecurity.org/pubs/sps/ssp-17es.html.

Rofman, R. & Lucchetti, L. (2006). *Pension systems in Latin America: Concepts and measurements of coverage.* Washington D.C: The World Bank..

Rudolph, H. P. & Holtzer, P. (2010). *Challenges of the mandatory funded pension system in the Russian federation.* The World Bank Policy Research Working Paper, WPS5514, Washington DC.

Solange, B., Pablo, C., Eduardo, F., & Gonzalo, R. (2009). *Chile 2008: A second-generation pension reform.* Superintendence of Pensions, Santiago, Chile.

Spiegel, M. R. & Stephens, L. J. (1999).*Theory and problems of statistics* (3rd ed.). NY, McGraw-Hill.

Steven, D. & Vivek, A. (2007). *Pension reform in China: The need for a new approach.* IMF Working Paper No. WP/07/109, Washington, DC.

The Basic State Pension (2012). GOV.UK. Assessed at http://www.gov.uk/state-pension.

The National Pensions Regulatory Authority (2012). *Background to the pension reforms in Ghana.* Press Release (http://npra.gov.gh/site/index.php?option=content&view=article&id retrieved July 12, 2013.

Turner, J. A. & Hughes, G. (2008). *Large declines in defined benefit plans are not inevitable: The experience of Canada, Ireland, the United Kingdom, and the United States.* Pensions Institute; Assessed at http://www.pensions-institute.org/ on14 May..

Ukaa, G. (2014). President Jonathan signs Nigeria's pension reform bill 2014. Assessed at http://www.voiceofnigeria.org/index.php/nigeria2/items/1843-president on July 17

Whitehouse, E. (2001). *Pension systems in 15 countries compared: the value of entitlements*. Munich Personal RePEc Archive, online at http://mpra.ub.uni-muenchen.de/14751/.

Williamson, J. B., Shen, C. & Yang, Y. (2009). Which pension model holds the most promise for China: a funded defined contribution scheme, or a universal social pension. Benefits. The journal of poverty and social justice 17 (2): 101 – 111.

Woodland, I., Harttgen, K. & Klasen, S. (2010). *The evolution and impact of social security in South Africa.* South African Labor and Development Research Unit, University of Cape Town.

World Bank (1994) *Averting the old age crisis: Policies to protect the old and promote growth,* New York; Oxford University Press.

Yaya, D. (2008). *Pension reform and the fate of Nigerian workers*, available at http://www.socialistNigeria.org/page.php?article=1345.

APPENDIX I

Table I: Pensions and Gratuity Benefits– 1979 Pensions Act (Public Service Scheme)

YEARS OF QUALIFYING SERVICE	GRATUITY AS PERCENTAGE OF FINAL PENSIONABLE EMOLUMENT	PENSION AS PERCENTAGE OF FINAL PENSIONABLE EMOLUMENT
5	100	-
6	108	-
7	116	-
8	124	-
9	132	-
10	100	30
11	108	32
12	116	34
13	124	36
14	132	38
15	140	40
16	148	42
17	156	44
18	164	46
19	172	48
20	180	50
21	188	52
22	196	54
23	204	56
24	212	58
25	220	60
26	228	62
27	236	64
28	244	66
29	252	68
30	260	70
31	268	72
32	276	74
33	284	76
34	292	78
35 and above	300	80

Emolument = Annual salary + Annual vehicle Allowance + Annual launch + Housing.

Source: Schedule attached to Pension Act 1979

APPENDIX II

Table II MULTIPLE DECREMENT TABLE a(55)

AgeX	l_x	w_x	d_x	i_x	r_x	Age X
20	100 000	2 998	155			20
21	96 847	2 613	155			21
22	94 079	2 256	155			22
23	91 668	1 923	156			23
24	89 589	1 611	157			24
25	87 821	1 316	159			25
26	86 436	1 035	161			26
27	85 150	766	163			27
28	84 221	505	165			28
29	83 551	250	168			29
30	83 133		172	8		30
31	82 953		176	17		31
32	82 760		180	25		32
33	82 555		183	33		33
34	82 339		187	41		34
35	82 111		191	49		35
36	81 871		196	57		36
37	81 618		203	65		37
38	81 350		211	74		38
39	81 065		211	84		39
40	80 760		232	96		40
41	80 432		246	109		41
42	80 077		262	125		42
43	79 690		280	142		43
44	79 268		301	161		44
45	78 806		325	182		45
46	78 299		351	205		46
47	77 743		379	230		47
48	77 134		408	258		48
49	76 468		439	291		49
50	75 738		472	328		50
51	74 938		507	371		51
52	74 060		546	419		52
53	73 095		590	472		53
54	72 033		639	530		54
55	70 864		692	592		55
56	69 580		748	657		56
57	68 175		807	725		57
58	66 643		868	795		58
59	64 980		929	865		59
60	63 186		900	842	12 463	60
61	48 981		796	742	7 232	61
62	40 211		754	689	3 949	62
63	34 819		741	655	3 412	63
64	30 011		734	617	2 934	64
65	25 726				25 726	65

Source: The Institute of Actuaries and the Faculty of Actuaries

APPENDIX II A

Table II A **CONTRIBUTIONS FUNCTION** **3 PERCENT**

Age x	$D_x = V^x l_x$	$\overline{N}_x = \frac{\sum D_x + D_{x+1}}{2}$	${}_sD_x = \frac{S_x D_x + D_{x+1}}{2}$	$\overline{N}_x = \sum^s \overline{D}_x$	Age x
20	35 308	1 102 282	53 714	2 479 326	20
21	52 060	1 048 568	35 839	2 425 612	21
22	49 099	997 980	57 624	2 369 773	22
23	46 447	950 226	59 308	2 312 159	23
24	44 072	904 957		2 255 951	24
25	41 944	862 940	61 487	2 192 665	25
26	40 038	820 958	62 462	2 131 281	26
27	38 335	781 772	63 348	2 068 719	27
28	36 611	744 399	64 172	2 065 371	28
29	33 455	708 066	64 966	1 941 199	29
30	34 250	673 223	63 744	1 826 233	30
31	33 180	639 498	66 428	1 800 480	31
32	33 439	006 839	66 985	1 744 065	32
33	31 120	575 200	67 270	1 622 126	33
34	30 139	544 573	67 447	1 699 856	34
35	20 282	524 923	67 480	1 541 499	35
36	28 248	486 198	67 373	1 474 929	36
37	27 340	458 404	67 140	1 492 550	37
38	26 457	433 505	66 705	1 340 410	38
39	45 596	405 475	66 316	1 273 633	39
40	24 758	380 391	65 742	1 207 345	40
41	23 539	355 052	65 062	1 245 533	41
42	23 439	332 413	64 283	1 920 511	42
43	22 356	309 660	63 434	1 012 220	43
44	22 590	287 693	62 457	948 804	44
45	20 839	266 478	61 413	886 357	45
46	20 100	246 007	60 286	824 944	46
47	10 378	206 267	59 082	264 658	47
48	18 666	202 245	57 805	795 570	48
49	17 966	188 920	56 458	647 721	49
50	17 277	171 308	55 245	599 393	50
51	26 596	455 371	53 560	536 266	51
52	15 044	430 111	52 012	482 705	52
53	15 499	122 540	50 400	430 696	53
54	24 699	107 591	48 722	380 296	54
55	13 944	93 320	46 986	334 535	55
56	13 293	79 701	45 284	284 560	56
57	12 644	66 732	43 344	239 405	57
58	12 000	54 410	41 447	196 981	58
59	11 360	44 230	39 468	154 664	59
60	10 725	31 687	33 836	115 196	60
61	8 022	22 288	86 285	86 360	61
62	6 433	13 925	21 588	55 975	62
63	5 420	9 114	18 200	33 467	63
64	4 526	4 147	15 275	15 276	64
65	3 762		12 795	12 995	65

Source: The Institute of Actuaries and the Faculty of Actuaries London

APPENDIX III

Table III RELATIVE SALARY SCALE – (INSTITUTE OF ACTUARIES (UK))

Age X	S_x	Z_x+½	Age X	S_x	Z_x+½
20	1.002		45	3.000	2.854
21	1.104		46	3.054	2.913
22	1.206		47	3.106	2.970
23	1.30		48	3.156	3.025
24	1.404		49	3.204	3.078
25	1.500		50	3.250	3.129
26	1.594		51	3.294	3.178
27	1.686		52	3.336	3.225
28	1.776		53	3.376	3.270
29	1.864		54	3.414	3.313
30	1.950	1.729	55	3.450	3.354
31	1.992	1.818	56	3.484	3.393
32	2.116	1.905	57	3.516	3.430
33	2.196	1.990	58	3.546	3.465
34	2.274	2.073	59	3.574	3.498
35	2.350	2.154	60	3.600	3.529
36	2.424	2.233	61	3.624	3.558
37	2.496	2.310	62	3.646	3.585
38	2.566	2.385	63	3.666	3.610
39	2.634	2.458	64	3.684	3.633
40	2.700	2.529			
41	2.764	2.598			
42	2.826	2.665		Z_{65}=3.644	
43	2.886	2.730			
44	2.944	2.793			

S_x is ratio of salary between ages x and x+1 to salary between ages 20 and 21.
$Z_{x+1} = ½ (Z_x+Z_{x+1})$, and $Z_x = 1/5 (S_{x-5}+S_{x-4}+…S_{x-1})$
Source: The Institute of Actuaries and The Faculty of Actuaries

APPENDIX IV

Table IV CONSOLIDATED SALARY STRUCTURE (CONPS)

Conps	1 N	2 N	3 N	4 N	5 N	6 N	7 N	8 N	9 N	10 N	11 N
01	204878	209347	213816	218285	222755	227224	231693	236162	240631	245101	249570
02	208206	214049	219893	228736	231579	237423	243266	249110	254953	260796	266640
03	211048	218230	225412	232595	239777	246989	254142	261324	268506	275689	282871
04	221072	229701	236329	246956	255587	254215	272844	281472	290101	298729	307358
05	250498	290522	270546	280570	290595	300619	310643	320668	330692	340716	350740
06	305429	317648	329867	342086	354305	366524	378743	390962	403181	415400	427619
07	507165	525918	644671	563423	562176	600928	619681	636433	657188	675938	694691
08	655384	677704	700024	722344	744663	766983	789303	811623	833943	856263	878583
09	769856	796430	823006	849579	876154	902728	929303	955877	982451	1009026	1035600
10	903711	932934	962157	991381	1020604	1049827	1079050	1108273	1137496	1166719	1195942
11	1042406	1087737	1133066	1178394	1223722	1269051	1314379	1359708	1450336	1450365	1495642
12	1163433	1211355	1259277	1307199	1355121	1403034	1450965	1498587	1546809	1594731	1642653
13	1285018	1336609	1388199	1439790	1491381	1542971	1694562	1646162	1697743	1749334	1800924
14	1767818	1840882	1913947	1987013	2060076	2133144	2206208	2279275	2352340		
15	2186877	2274688	2362501	2450313	2538125	2625937	2713749	2801561	2889373		
16	4172800	4331367	4489334	4648501	4807066	4965635	5124202	5282769	5441336		

Source: National Salaries, Incomes and Wages Commission

APPENDIX V
CONSOLIDATED TERTIARY INSTITUTIONS SALARY STURCTURE II

CNTISS	1 N	2 N	3 N	4 N	5 N	6 N	7 N	8 N	9 N	10 N	11 N	12 N	13 N	14 N	15 N
01	293050	301404	309755	318108	326460	334811	343162	351515	359867	368218	376571	384923	393274	401627	409978
02	297110	307376	317642	327908	338175	348440	358706	368973	379240	398505	399771	410038	420303	430569	440836
03	311442	323773	336106	348437	360769	373100	385432	397764	4100096	422427	434759	447090	459422	471752	484085
04	353500	367832	382165	396497	4100830	425162	439494	453827	468159	482492	496824	511157	525489	539821	554154
05	698251	724282	750313	776344	80232374	828405	854436	880467	906498	932529	958560	984591	1010621	1036652	1062683
06	698251	724282	759313	776344	802374	828405	854436	880467	906498	932529	958560	984591	1010621	1036652	1062683
07	1073217	1110095	1146973	1183851	1220729	1257606	1294484	1331362	1368240	1405118	1441995	1478875	1515753	1552630	1589508
08	1247854	1291257	1334661	1378066	1421470	1464875	1508279	1551684	1595088	1638493	1681897	1725302	1768706	1818109	1855515
09	1449363	1496525	1543687	1590849	1638010	1685171	1732334	1779495	1826657	1873818	1920981	1968142	2015303	2062465	2109627
10	1632502	1703912	1775323	1846733	1918144	1989554	2060965	2132375	2203786	2275196	2346607				
11	1823167	1898670	1974171	2049673	2125176	2200677	2276180	2351682	2427183	2502686	2578127				
12	2014717	2095999	2177279	2258559	2339840	2421120	2502402	2583682	2664963	2746263	2827525				
13	2723069	2836736	2950403	3064070	3177737	3291403	3405070	3518737	3632404						
14	3352334	3489726	3627119	3764511	3901903	4039295	4176687	4314079	4451471						
15	4047462	4204744	4362027	4517776	4676592	4833873	4991157	5148438	5305720						

Source: National Salaries, Incomes and Wages Commission

APPENDIX VI

CONSOLIDATED UNIVERSITY ACADEMIC SALARY STRUCTURE II (CONUASS II)

CONUASS	1 N	2 N	3 N	4 N	5 N	6 N	7 N	8 N	9 N	10 N	11 N	12 N	13 N
01	1263377	1300255	1337133	1374011	1410889	1447767							
02	1451072.30	1494474	15378792.82	1581284	1624688	1668093	1717497	1754902					
03	1649509	1696671	1743832	1790994	1838156	1885317	1932479	1979640					
04	2079995	2155479	2230998	2306501	2382003	2457504	2533007	2608509	2684010				
05	3091505	3205172	3318838	3432505	3456172	3659859	3773506	3887172	4000839	4114506	4228173	4341840	4455506
06	3768221	3905613	4043005	4180397	4317789	4455181	4592573	4729965	4867357	5004750			
07	4580349	4740328	4900308	5060287	5220265	5380245	5540225	5700206	5860184	6020163			

Source: National Salaries, Incomes and Wages Commission

APPENDIX VII

CONSLOIDATED HEALTH SALARY STRUCTURE (CONHNESS)

EFFECTIVE DATE: 1ST JANUARY, 2010

CONH NESS	1 N	2 N	3 N	4 N	5 N	6 N	7 N	8 N	9 N	10 N	11 N	12 N	13 N	14 N	15 N
01	25707	264331	271692	279003	286314	293626	300937	308248	315559	322870	330181	337492	344804	352115	359428
02	260623	269609	278596	287583	296570	305570	314543	3233530	332517	341504	350491	359477	368464	377451	386438
03	273169	283964	294759	305554	316349	327144	337939	348734	359529	370324	381119	391913	402708	413503	424298
04	309986	322533	335079	347626	360172	372719	385265	397812	410359	422905	435452	447998	460545	473091	485638
05	378719	394008	4092907	424586	43875	455164	470453	435742	501031	516320	531609	546898	562187	577476	592765
06	612256	535053	657851	680648	703445	725243	749040	771837	794635	817432	840230	863027	885824	908622	931419
07	949119	981712	1014304	1046896	1079488	1112080	1144672	1177265	1209857	1242449	1275041	1307633	1340225	1372818	1405410
08	1102850	1141189	1179527	1217866	1256205	1294543	1332882	1371221	1409560	1447898	1486237	1524576	1562914	1601253	1639592
09	1305668	1342232	1384510	1426787	1460965	1511343	1553621	1595898	1638176	1680454	1722731	1765009	1807287	1849564	1891842
10	1551786	1591117	1628448	666779	1705109	1743440	1781771	1820102	1858432	1896763	1935094				
11	1845557	1887305	1929053	970800	2012548	2054296	2098044	2137792	2179540	2221288	2263037				
12	2193425	2251604	2309783	2367963	24226142	2484321	2542500	2600679	2658859	2717038	2775217				
13	2775425	2858442`	2941458	2024474	3107490	3190506	3273522	3356538	3439555						
14	34194118	35178663	3616314	3714761	3813209	3911657	4010105	4108553	4207000						
15	4222544	4335751	4448958	4562165	4675372	4788579	4901786	5014993	5128200						

Source: National Salaries, Incomes and Wages Commission

TABLE 1 A: CALCULATION OF PAST SERVICE BENEFITS

AGE	No. of Ees	Current Ann. Sal. per Ee('000)	Current Total salary ALL Empl'ees col. 2*3('000)	Yrs of Past service of each group	Current Total Past Service Salary ALL Ees cols. 4*5	Ratio of mean past sal to current salary	ESTIMA'D SAL for past service cols(.6*7)	Duration to Ret. Age 60 - col. 1	Accumulation to Ret. @ 3% c.8*(1.03)^c.9 *1000	Estimated salary at retirement/Ee col.10 ÷ col. 2	Contrib. to Pension (2004 Act) at 15% = col. 11*0.15
20	30	2,400	72,000	0	-	1.0000	-	35	-	-	-
25	20	2,800	56,000	4	224,000	0.8350	187,040	35	526,304,833	26,315,242	3,947,286
25	35	3,000	105,000	5	525,000	0.8300	435,750	35	1,226,140,564	35,032,588	5,254,888
30	30	3,000	90,000	6	540,000	0.8260	446,040	30	1,082,656,153	36,088,538	5,413,281
35	20	3,200	64,000	6	384,000	0.8260	317,184	25	664,112,859	33,205,643	4,980,846
35	15	3,400	51,000	4	204,000	0.8350	170,340	25	356,654,133	23,776,942	3,566,541
35	5	6,800	34,000	10	340,000	0.7500	255,000	25	533,913,372	106,782,674	16,017,401
40	20	3,400	68,000	19	1,292,000	0.7150	923,780	20	1,668,449,436	83,422,472	12,513,371
40	10	3,600	36,000	24	864,000	0.6900	596,160	20	1,076,731,274	107,673,127	16,150,969
45	20	3,400	68,000	23	1,564,000	0.6950	1,086,980	15	1,693,479,422	84,673,971	12,701,096
45	30	3,600	108,000	21	2,268,000	0.6950	1,576,260	15	2,455,761,720	81,858,724	12,278,809
45	5	6,000	30,000	23	690,000	0.6950	479,550	15	747,123,275	149,424,655	22,413,698
50	30	4,000	120,000	26	3,120,000	0.6570	2,049,840	10	2,754,813,551	91,827,118	13,774,068
50	35	5,000	175,000	31	5,425,000	0.6400	3,472,000	10	4,666,077,669	133,316,505	19,997,476
55	5	10,000	50,000	28	1,400,000	0.6450	903,000	5	1,046,824,489	209,364,898	31,404,735
55	10	6,000	60,000	37	2,220,000	0.6200	1,376,400	5	1,595,624,836	159,562,484	23,934,373
60	10	6,000	60,000	30	1,800,000	0.6440	1,159,200	0	1,159,200,000	115,920,000	17,388,000
60	5	6,200	31,000	39	1,209,000	0.5500	664,950	0	664,950,000	132,990,000	19,948,500
60	5	10,000	50,000	33	1,650,000	0.6350	1,047,750	0	1,047,750,000	209,550,000	31,432,500
										1,820,785,581	**273,117,837**

Source: Author's computation2016

TABLE 1B: FUTURE SERVICE CONTRIBUTION

		Ann. Sal.	Ann. Salary	Duration			contrib	Estimated contr.	Estimated Salary	Salary per	Pension Contrib.
AGE	No. of	of each	for all Ees	to	$^{s}D_{x}$	$^{s}\bar{N}_{x}$	$\frac{^{s}\bar{N}_{x} - {}^{s}\bar{N}_{60}}{^{s}D_{60}}$	with interest	for each age	Employee at	(by 2004 Act)
(x)	Ees	Ee(N'000)		Retirem't			functions	& survivorship	group at age	age 60	at 15% sal
			col. 2 x col. 3	60 - (1)				benefit	col. 9 x 1000	(col.10/col.2)	(col. 11*15%)
								col.4 x col.8			
20	30	2,400.00	72,000.00	35	58,889	2,479,326	45	3,248,352	3,248,352,000	108,278,400	**16,241,760**
25	20	2,800.00	56,000.00	35	58,889	2,192,668	52	2,889,534	2,889,534,350	144,476,718	**21,671,508**
25	35	3,000.00	105,000.00	35	58,889	2,192,668	52	5,417,877	5,417,876,906	154,796,483	**23,219,472**
30	30	3,000.00	90,000.00	30	63,842	1,876,233	44	3,936,549	3,936,548,855	131,218,295	**19,682,744**
35	20	3,200.00	64,000.00	25	66,358	1,542,409	35	2,268,681	2,268,680,940	113,434,047	**17,015,107**
35	15	3,400.00	51,000.00	25	66,358	1,542,409	35	1,807,855	1,807,855,124	120,523,675	**18,078,551**
35	5	6,800.00	34,000.00	25	66,358	1,542,409	35	1,205,237	1,205,236,749	241,047,350	**36,157,102**
40	20	3,400.00	68,000.00	20	65,213	1,207,315	27	1,844,521	1,844,520,689	92,226,034	**13,833,905**
40	10	3,600.00	36,000.00	20	65,213	1,207,315	27	976,511	976,510,953	97,651,095	**14,647,664**
45	20	3,400.00	68,000.00	15	61,350	886,357	19	1,302,443	1,302,442,700	65,122,135	**9,768,320**
45	30	3,600.00	108,000.00	15	61,350	886,357	19	2,068,585	2,068,585,465	68,952,849	**10,342,927**
45	5	6,000.00	30,000.00	15	61,350	886,357	19	574,607	574,607,074	114,921,415	**17,238,212**
50	30	4,000.00	120,000.00	10	55,356	591,313	12	1,419,056	1,419,056,182	47,301,873	**7,095,281**
50	35	5,000.00	175,000.00	10	55,356	591,313	12	2,069,457	2,069,456,932	59,127,341	**8,869,101**
55	5	10,000.00	50,000.00	5	47,605	331,575	5	268,714	268,713,675	53,742,735	**8,061,410**
55	10	6,000.00	60,000.00	5	47,605	331,575	5	322,456	322,456,411	32,245,641	**4,836,846**
60	10	6,000.00	60,000.00	0	40,262	115,196	0	0	60,000,000	6,000,000	**900,000**
60	5	6,200.00	31,000.00	0	40,262	115,196	0	0	31,000,000	6,200,000	**930,000**
60	5	10,000.00	50,000.00	0	40,262	115,196	0	0	50,000,000	10,000,000	**1,500,000**
										1,667,266,086	**250,089,913**

Source: Author's computation2016

TABLE 1C: SUMMARY OF CONTRIBUTIONS 2004 PENSION & GRATUITY CALCULATIONS

	Ann. Sal.	PAST SERVICE	FUTURE SERVICE	Grand total	25% OF TOTAL	75% PAYABLE	AMOUNT OF
	of each	CONTRIBUTION	CONTRIBUTION	Contributions	**AS GRATUITY**	AS PENSION	ANNUAL PENSION
AGE	Ee(N'000)	OF 15%	OF 15%	per employee	(2004 PEN ACT)	(2004 ACT)	
					25% OF col.5		
							(col. 7÷ 8.2470)
20	2,400	-	16,241,760	16,241,760	**4,060,440**	12,181,320	**1,477,061**
25	2,800	3,947,286	21,671,508	25,618,794	**6,404,698**	19,214,095	**2,329,828**
25	3,000	5,254,888	23,219,472	28,474,361	**7,118,590**	21,355,770	**2,589,520**
30	3,000	5,413,281	19,682,744	25,096,025	**6,274,006**	18,822,019	**2,282,287**
35	3,200	4,980,846	17,015,107	21,995,953	**5,498,988**	16,496,965	**2,000,360**
35	3,400	3,566,541	18,078,551	21,645,093	**5,411,273**	16,233,819	**1,968,451**
35	6,800	16,017,401	36,157,102	52,174,504	**13,043,626**	39,130,878	**4,744,862**
40	3,400	12,513,371	13,833,905	26,347,276	**6,586,819**	19,760,457	**2,396,078**
40	3,600	16,150,969	14,647,664	30,798,633	**7,699,658**	23,098,975	**2,800,894**
45	3,400	12,701,096	9,768,320	22,469,416	**5,617,354**	16,852,062	**2,043,417**
45	3,600	12,278,809	10,342,927	22,621,736	**5,655,434**	16,966,302	**2,057,270**
45	6,000	22,413,698	17,238,212	39,651,910	**9,912,978**	29,738,933	**3,606,030**
50	4,000	13,774,068	7,095,281	20,869,349	**5,217,337**	15,652,011	**1,897,904**
50	5,000	19,997,476	8,869,101	28,866,577	**7,216,644**	21,649,933	**2,625,189**
55	10,000	31,404,735	8,061,410	39,466,145	**9,866,536**	29,599,609	**3,589,136**
55	6,000	23,934,373	4,836,846	28,771,219	**7,192,805**	21,578,414	**2,616,517**
60	6,000	17,388,000	900,000	18,288,000	**4,572,000**	13,716,000	**1,663,150**
60	6,200	19,948,500	930,000	20,878,500	**5,219,625**	15,658,875	**1,898,736**
60	10,000	31,432,500	1,500,000	32,932,500	**8,233,125**	24,699,375	**2,994,953**
		273,117,837	250,089,913		**130,801,938**		**-**
							47,581,643

Source: Author's computation2016

TABLE 1D: CALCULATION OF PENSION & GRATUITY UNDER OLD SCHEME

AGE	Ann. Sal. of each Ee (N'000)	No. of years to Retire (35 yrs max)	FINAL SALARY AT AGE 60	No. of past service yrs	Future years of Service	Total Service Years	Age Pension Percentage Rate (%)	Gratuity Percentage Rate (%)	GRATUITY payable at age 60 (OLD PENSION ACT) (col.4 x col.9)/100	ANNUALPENSION payable from from age 60 (col.4 x col.8)/100
20	2,400	35	**6,753,270**	0	40	40	80	300	**20,259,810**	**5,402,616**
25	2,800	35	**7,878,815**	4	35	39	80	300	**23,636,445**	**6,303,052**
25	3,000	35	**8,441,587**	5	35	40	80	300	**25,324,762**	**6,753,270**
30	3,000	30	**7,281,787**	6	30	36	80	300	**21,845,362**	**5,825,430**
35	3,200	25	**6,700,089**	6	25	31	72	268	**17,956,240**	**4,824,064**
35	3,400	25	**7,118,845**	4	25	29	68	252	**17,939,489**	**4,840,815**
35	6,800	25	**14,237,690**	10	25	35	80	300	**42,713,070**	**11,390,152**
40	3,400	20	**6,140,778**	19	20	39	80	300	**18,422,335**	**4,912,623**
40	3,600	20	**6,502,000**	24	20	44	80	300	**19,506,001**	**5,201,600**
45	3,400	15	**5,297,089**	23	15	38	80	300	**15,891,268**	**4,237,671**
45	3,600	15	**5,608,683**	21	15	36	80	300	**16,826,048**	**4,486,946**
45	6,000	15	**9,347,804**	23	15	38	80	300	**28,043,413**	**7,478,244**
50	4,000	10	**5,375,666**	26	10	36	80	300	**16,126,997**	**4,300,532**
50	5,000	10	**6,719,582**	31	10	41	80	300	**20,158,746**	**5,375,666**
55	10,000	5	**11,592,741**	28	5	33	76	284	**32,923,384**	**8,810,483**
55	6,000	5	**6,955,644**	37	5	42	80	300	**20,866,933**	**5,564,516**
60	6,000	0	**6,000,000**	30	0	30	70	260	**15,600,000**	**4,200,000**
60	6,200	0	**6,200,000**	39	0	39	80	300	**18,600,000**	**4,960,000**
60	10,000	0	**10,000,000**	33	0	33	76	284	**28,400,000**	**7,600,000**
			144,152,071						**421,040,302**	**112,467,679**

Source: Author's Computation 2016.

TABLE 1E: COMPARISON OF OLD & NEW GRATUITY & PENSION

AGE(X)	GRATUTY	GRATUITY	RATIO	PENSION	PENSION	RATIO
	OLD SCHEME	NEW SCHEME	OLD V NEW	OLD SCHEME	NEW SCHEME	OLD V NEW
20	20,259,810	4,060,440	4.99	5,402,616	1,477,061	3.66
25	23,636,445	6,404,698	3.69	6,303,052	2,329,828	2.71
25	25,324,762	7,118,590	3.56	6,753,270	2,589,520	2.61
30	21,845,362	6,274,006	3.48	5,825,430	2,282,287	2.55
35	17,956,240	5,498,988	3.27	4,824,064	2,000,360	2.41
35	17,939,489	5,411,273	3.32	4,840,815	1,968,451	2.46
35	42,713,070	13,043,626	3.27	11,390,152	4,744,862	2.40
40	18,422,335	6,586,819	2.80	4,912,623	2,396,078	2.05
40	19,506,001	7,699,658	2.53	5,201,600	2,800,894	1.86
45	15,891,268	5,617,354	2.83	4,237,671	2,043,417	2.07
45	16,826,048	5,655,434	2.98	4,486,946	2,057,270	2.18
45	28,043,413	9,912,978	2.83	7,478,244	3,606,030	2.07
50	16,126,997	5,217,337	3.09	4,300,532	1,897,904	2.27
50	20,158,746	7,216,644	2.79	5,375,666	2,625,189	2.05
55	32,923,384	9,866,536	3.34	8,810,483	3,589,136	2.45
55	20,866,933	7,192,805	2.90	5,564,516	2,616,517	2.13
60	15,600,000	4,572,000	3.41	4,200,000	1,663,150	2.53
60	18,600,000	5,219,625	3.56	4,960,000	1,898,736	2.61
60	28,400,000	8,233,125	3.45	7,600,000	2,994,953	2.54
	421,040,302	130,801,938	62.09	112,467,679	47,581,643	45.60
			3.27			2.40

Source: Author's computation2016

TABLE 2A: PAST SERVICE CONTRIBUTION – NEW PENSION SCHEME

						Current					
		Current	Current	Yrs of Past	Ratio of mean	Total salary	Duration to	Accum of	ESTIMATED	Contrib. to	PAST SERVICE
	No. of	Monthly	Ann. Sal.	service/Ee	pastsal. To	for past serv.	Retirement	col. 7 to Ret.	SALARY	new pension	CONTRUBUTION
AGE	Ees	Sal./Ee	per Ee	in age group	currentsal.	cols. 2x4x5x6	60/55-col. 1	@ 3% int. rate	AT RETIREMENT	at 15%	PER EMPLOYEE
		(N'000)	(N'000)			(N'000)		(N'000)	col.9*1000		at 15%
								(7)*(1.03)^(8)			
20	15	35	420	0	1	-	35	-	-	-	**-**
23	12	65	780	0	1	-	35	-	-	-	**-**
25	10	138	1,656	0	1	-	35	-	-	-	**-**
25	8	150	1,800	3	0.835	36,072	35	101,502	101,501,646	15,225,247	**1,903,156**
30	53	165	1,980	4	0.835	350,500	30	850,755	850,754,525	127,613,179	**2,407,796**
30	28	176	2,112	3	0.835	148,136	30	359,564	359,564,177	53,934,627	**1,926,237**
35	23	190	2,280	7	0.7925	290,911	25	609,103	609,102,822	91,365,423	**3,972,410**
40	61	205	2,460	12	0.755	1,359,544	20	2,455,487	2,455,486,970	368,323,045	**6,038,083**
40	85	215	2,580	5	0.835	915,578	20	1,653,635	1,653,634,809	248,045,221	**2,918,179**
43	35	230	2,760	15	0.7413	1,074,144	17	1,775,396	1,775,395,871	266,309,381	**7,608,839**
45	33	310	3,720	22	0.695	1,877,000	15	2,924,305	2,924,305,464	438,645,820	**13,292,298**
50	5	356	4,272	29	0.64	396,442	10	532,784	532,784,360	79,917,654	**15,983,531**
50	18	370	4,440	25	0.6575	1,313,685	10	1,765,483	1,765,482,789	264,822,418	**14,712,357**
50	14	400	4,800	18	0.7225	873,936	10	1,174,497	1,174,496,905	176,174,536	**12,583,895**
55	8	410	4,920	30	0.64	755,712	5	876,077	876,077,329	131,411,599	**16,426,450**
55	9	430	5,160	28	0.645	838,706	5	972,291	972,290,585	145,843,588	**16,204,843**
60	15	460	5,520	33	0.638	1,743,271	0	1,743,271	1,743,271,200	261,490,680	**17,432,712**
60	8	475	5,700	37	0.62	1,046,064	0	1,046,064	1,046,064,000	156,909,600	**19,613,700**
										2,826,032,018	**153,024,485**

Source: Author's computation2016

TABLE 2B: FUTURE SERVICE CONTRIBUTION – NEW PENSION SCHEME

AGE	No. of Ees	Current Monthly salary/Ee N'000	Current Ann. Sal. of each Ee in age group (N'000)	Duration to Retire't 60/55-col.1	Current Total salary for age group (N'000) col.3 x col.4	$^{s}D_{x}$	$^{s}\bar{N}_{x}$	Contrib. Function $\frac{^{s}\bar{N}_{x} - {}^{s}\bar{N}_{60}}{^{s}D_{60}}$	Accum to age Ret. With int. & SURVIVORSHIP cols. (6 x 9) (N'000)	ESTIMATED ANNUAL SALARY AT RETIREMENT col. 10 *1000	ESTIMATED ANNUAL SALARY AT RETIREMENT PER EMPLOYEE col.11 ÷ col. 2	Contrib. to pension per Ee at 15% SAL (9)*.15*1000/(2)
20	15	35	420	35	6,300	55,368	2,479,326	45	283,500	283,500,000	18,900,000	**2,835,000**
23	12	65	780	35	9,360	56,015	2,312,159	48	449,280	449,280,000	37,440,000	**5,616,000**
25	10	138	1,656	35	16,560	58,889	2,192,668	52	854,477	854,476,586	85,447,659	**12,817,149**
25	8	150	1,800	35	14,400	58,889	2,192,668	52	743,023	743,023,119	92,877,890	**13,931,683**
30	53	165	1,980	30	104,940	63,842	1,876,233	44	4,590,016	4,590,015,965	86,604,075	**12,990,611**
30	28	176	2,112	30	59,136	63,842	1,876,233	44	2,586,575	2,586,575,034	92,377,680	**13,856,652**
35	23	190	2,280	25	52,440	66,358	1,542,409	35	1,858,900	1,858,900,445	80,821,758	**12,123,264**
40	61	205	2,460	20	150,060	65,213	1,207,315	27	4,070,423	4,070,423,157	66,728,248	**10,009,237**
40	85	215	2,580	20	219,300	65,213	1,207,315	27	5,948,579	5,948,579,224	69,983,285	**10,497,493**
43	35	230	2,760	17	96,600	63,178	1,012,228	22	2,152,235	2,152,235,140	61,492,433	**9,223,865**
45	33	310	3,720	15	122,760	61,350	886,357	19	2,351,292	2,351,292,145	71,251,277	**10,687,692**
50	5	356	4,272	10	21,360	55,356	591,313	12	252,592	252,592,000	50,518,400	**7,577,760**
50	18	370	4,440	10	79,920	55,356	591,313	12	945,091	945,091,417	52,505,079	**7,875,762**
50	14	400	4,800	10	67,200	55,356	591,313	12	794,671	794,671,462	56,762,247	**8,514,337**
55	8	410	4,920	5	39,360	47,605	331,575	5	211,531	211,531,405	26,441,426	**3,966,214**
55	9	430	5,160	5	46,440	47,605	331,575	5	249,581	249,581,262	27,731,251	**4,159,688**
60	15	460	5,520	0	82,800	40,262	115,196	0	82,800	82,800,000	5,520,000	**828,000**
60	8	475	5,700	0	45,600	40,262	115,196	0	45,600	45,600,000	5,700,000	**855,000**
											989,102,708	**148,365,406**

Source: Author's computation2016

TABLE 2C: SUMMARY OF CONTRIBUTIONS – 2004 PENSION & GRATUITY CALCULATIONS

	Ann. Sal.	PAST SERVICE	FUTURE SERVICE	GRAND TOTAL	25% G. TOTAL	75% PAYABLE	AMOUNT OF
	of each	CONTRIBUTION	CONTRIBUTION	CONTRIBUTIONS	**AS GRATUITY**	AS PENSION	ANNUAL PENSION
AGE	Ee ('000)	OF 15%	OF 15%	PER EMPLOYEE	(2004 RP ACT)	2004 RP ACT	col.7/8.2470
				col. 3 + col. 4	col. 5 * 25%	col.5 * 75%	
20	420,000	-	2,835,000	2,835,000	**708,750.00**	2,126,250.00	**257,821.03**
23	780,000	-	5,616,000	5,616,000	**1,404,000.00**	4,212,000.00	**510,731.17**
25	1,656,000	-	12,817,149	12,817,149	**3,204,287.20**	9,612,861.60	**1,165,619.21**
25	1,800,000	1,903,156	13,931,683	15,834,839	**3,958,709.84**	11,876,129.51	**1,440,054.51**
30	1,980,000	2,407,796	12,990,611	15,398,407	**3,849,601.76**	11,548,805.29	**1,400,364.41**
30	2,112,000	1,926,237	13,856,652	15,782,889	**3,945,722.16**	11,837,166.47	**1,435,330.00**
35	2,280,000	3,972,410	12,123,264	16,095,673	**4,023,918.37**	12,071,755.11	**1,463,775.33**
40	2,460,000	6,038,083	10,009,237	16,047,320	**4,011,830.00**	12,035,489.99	**1,459,377.95**
40	2,580,000	2,918,179	10,497,493	13,415,672	**3,353,917.96**	10,061,753.87	**1,220,050.18**
43	2,760,000	7,608,839	9,223,865	16,832,704	**4,208,176.08**	12,624,528.25	**1,530,802.50**
45	3,720,000	13,292,298	10,687,692	23,979,989	**5,994,997.28**	17,984,991.85	**2,180,792.03**
50	4,272,000	15,983,531	7,577,760	23,561,291	**5,890,322.70**	17,670,968.10	**2,142,714.70**
50	4,440,000	14,712,357	7,875,762	22,588,118	**5,647,029.60**	16,941,088.79	**2,054,212.29**
50	4,800,000	12,583,895	8,514,337	21,098,233	**5,274,558.13**	15,823,674.38	**1,918,718.85**
55	4,920,000	16,426,450	3,966,214	20,392,664	**5,098,165.94**	15,294,497.83	**1,854,552.91**
55	5,160,000	16,204,843	4,159,688	20,364,531	**5,091,132.70**	15,273,398.09	**1,851,994.43**
60	5,520,000	17,432,712	828,000	18,260,712	**4,565,178.00**	13,695,534.00	**1,660,668.61**
60	5,700,000	19,613,700	855,000	20,468,700	**5,117,175.00**	15,351,525.00	**1,861,467.81**
							-
	COL. TOTALS	153,024,485	148,365,406	301,389,891	**75,347,472.70**	226,042,418.11	**27,409,047.91**

Source: Author's computation2016

TABLE 2D: CALCULATION OF PENSION AND GRATUITY UNDER OLD PENSION

	Ann. Sal.	No. of yrs.	Years of	Maximum	ESTIMATED	Age Pension	Gratuity	GRATUITY payable	PENSION payable
	of each	of past	Future	Service	SALARY AT	Percentage	Percent	at Retirement	at Retirement
AGE (X)	Ee (N'000)	service	service	Yrs	RETIREMENT	Rate (%)	Rate (%)	Old Pension Act	Old Pension Act
								(cols.6*8)/100	(cols. 6*7)/100
20	420,000	0	40	35	1,181,822	80	300	**3,545,467**	**945,458**
23	780,000	0	37	35	2,194,813	80	300	**6,584,438**	**1,755,850**
25	1,656,000	0	35	35	4,659,756	80	300	**13,979,269**	**3,727,805**
25	1,800,000	3	35	35	5,064,952	80	300	**15,194,857**	**4,051,962**
30	1,980,000	4	30	34	5,409,172	78	292	**15,794,784**	**4,219,155**
30	2,112,000	3	30	33	5,601,732	76	284	**15,908,919**	**4,257,316**
35	2,280,000	7	25	32	5,871,189	74	276	**16,204,481**	**4,344,680**
40	2,460,000	12	20	32	6,334,704	74	276	**17,483,782**	**4,687,681**
40	2,580,000	5	20	25	5,401,947	60	220	**11,884,284**	**3,241,168**
43	2,760,000	15	17	32	7,107,228	74	276	**19,615,950**	**5,259,349**
45	3,720,000	22	15	35	10,467,568	80	300	**31,402,705**	**8,374,055**
50	4,272,000	29	10	35	12,020,820	80	300	**36,062,461**	**9,616,656**
50	4,440,000	25	10	35	12,493,549	80	300	**37,480,648**	**9,994,839**
50	4,800,000	18	10	28	10,982,053	66	244	**26,796,209**	**7,248,155**
55	4,920,000	30	5	35	13,844,203	80	300	**41,532,610**	**11,075,363**
55	5,160,000	28	5	33	13,686,050	76	284	**38,868,382**	**10,401,398**
60	5,520,000	33	0	33	14,640,891	76	284	**41,580,129**	**11,127,077**
60	5,700,000	37	0	35	16,039,016	80	300	**48,117,048**	**12,831,213**
								438,036,421	**117,159,179**

Source: Author's computation2016

TABLE 2E: COMPARISON OF THE PENSION & GRATUITY BENEFITS BETWEEN THE OLD & NEW PENSIONS SCHEMES

AGE (X)	GRATUITY	GRATUITY	RATIO	PENSION	PENSION	RATIO
	OLD SCHEME	NEW SCHEME	OLD/NEW	OLD SCHEME	NEW SCHEME	OLD/NEW
20	3,545,467	708,750	5.00	945,458	257,821	3.67
23	6,584,438	1,404,000	4.69	1,755,850	510,731	3.44
25	13,979,269	3,204,287	4.36	3,727,805	1,165,619	3.20
25	15,194,857	3,958,710	3.84	4,051,962	1,440,055	2.81
30	15,794,784	3,849,602	4.10	4,219,155	1,400,364	3.01
30	15,908,919	3,945,722	4.03	4,257,316	1,435,330	2.97
35	16,204,481	4,023,918	4.03	4,344,680	1,463,775	2.97
40	17,483,782	4,011,830	4.36	4,687,681	1,459,378	3.21
40	11,884,284	3,353,918	3.54	3,241,168	1,220,050	2.66
43	19,615,950	4,208,176	4.66	5,259,349	1,530,803	3.44
45	31,402,705	5,994,997	5.24	8,374,055	2,180,792	3.84
50	36,062,461	5,890,323	6.12	9,616,656	2,142,715	4.49
50	37,480,648	5,647,030	6.64	9,994,839	2,054,212	4.87
50	26,796,209	5,274,558	5.08	7,248,155	1,918,719	3.78
55	41,532,610	5,098,166	8.15	11,075,363	1,854,553	5.97
55	38,868,382	5,091,133	7.63	10,401,398	1,851,994	5.62
60	41,580,129	4,565,178	9.11	11,127,077	1,660,669	6.70
60	48,117,048	5,117,175	9.40	12,831,213	1,861,468	6.89
			99.99			73.52
	438,036,421	75,347,473	5.81	117,159,179	27,409,048	4.27
			5.5549025			4.084514

Source: Author's computation2016

TABLE 3A: PROJECTION OF FUTURE BENEFITS: NO PAST SERVICE BENEFITS

					TABLE 3A: PROJECTION OF FUTURE BENEFITS - (NO PAST SERVICE BENEFITS)									
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Current	Current	Current	Duration	COMMUTATION FUNCTIONS							
		Monthly Sal.	Annual	Total annual	to Retire't					$\frac{{}^{s}\bar{N}_x - {}^{s}\bar{N}_{60}}{{}^{s}D_{60}}$	Projected sal with	Estimated sal.	2004 Pen. Act
AGE	No. of	of each	Salary of	sal in age	age (35yrs	S_{X1}	D_X	$S_{x-1}D_x$	${}^{s}\bar{N}_x$	or	int. & surviv'ship	per Ee in age	Contribution
x	Ees	Ee (N'000)	each Ee N'000)	group(N'000)	max serv.)					${}^{s}D_{55}$	benefit at age 60.	group at Ret.	at 15% of sal.
				(cols.2*4)							(col.4 x col.11)	(col.12/col.2)	col.13 x 15%
20	3	18	216	648	35	1.000	55,368	55,368	2,479,326	45.12	29,237,760	9,745,920	**1,461,888**
20	4	25	300	1,200	35	1.000	55,368	55,368	2,479,326	45.12	54,144,000	13,536,000	**2,030,400**
25	7	30	360	2,520	35	1.404	41,944	58,889	2,192,668	52.58	132,500,555	18,928,651	**2,839,298**
25	8	130	1,560	12,480	35	1.404	41,944	58,889	2,192,668	52.58	656,193,226	82,024,153	**12,303,623**
27	21	150	1,800	37,800	33	1.594	38,334	61,104	2,068,719	49.44	1,868,926,866	88,996,517	**13,349,478**
30	50	189	2,268	113,400	30	1.864	34,250	63,842	1,876,233	44.57	5,054,329,068	101,086,581	**15,162,987**
33	41	275	3,300	135,300	27	2.116	31,126	65,863	1,677,126	39.53	5,348,615,044	130,454,025	**19,568,104**
35	55	320	3,840	211,200	25	2.274	29,181	66,358	1,542,409	36.12	7,628,948,536	138,708,155	**20,806,223**
38	34	268	3,216	109,344	22	2.496	26,457	66,037	1,340,416	31.01	3,390,712,857	99,726,849	**14,959,027**
40	17	281	3,372	57,324	20	2.634	24,758	65,213	1,207,315	27.64	1,584,486,081	93,205,064	**13,980,760**
43	12	345	4,140	49,680	17	2.826	22,356	63,178	1,012,228	22.70	1,127,902,350	93,991,863	**14,098,779**
45	6	850	10,200	61,200	15	2.944	20,839	61,350	886,357	19.52	1,194,478,834	199,079,806	**29,861,971**
45	8	510	6,120	48,960	15	2.944	20,839	61,350	886,357	19.52	955,583,067	119,447,883	**17,917,183**
50	5	492	5,904	29,520	10	3.204	17,277	55,356	591,313	12.05	355,723,060	71,144,612	**10,671,692**
53	3	670	8,040	24,120	7	3.336	15,259	50,904	430,696	7.99	192,601,048	64,200,349	**9,630,052**
55	6	705	8,040	24,120	5	3.414	13,944	47,605	331,575	5.48	132,091,354	22,015,226	**3,302,284**
60	10	812	8,040	24,120	0	3.684	10,725	39,511	115,196	0.00	24,120,000	2,412,000	**361,800**
													202,305,548
	290											1,348,703,654	

Source: Author's Computation, 2016

TABLE 3B: CALCULATION OF GRATUITY & PENSION UNDER PENSION REFORM ACT 2004

AGE x	No. of Ees	Current annual Salary of each Ee N'000)	Duration to Retirement age (35 yrs max. serv.)	Estimated sal. per Employee at Retirement	Contribution to pension at 15% of sal.	**GRATUITY:** 25% of Col. 8 (2004 Pen Act) (col.8*0.25)	75% BALANCE TO BE PAID AS PENSION (col. 8*0.75)	Amount of **ANNUAL PENSION/EE** (col.10/8.2470)
20	3	216	35	9,745,920	1,461,888	365,472	1,096,416	132,947
20	4	300	35	13,536,000	2,030,400	507,600	1,522,800	184,649
25	7	360	35	18,928,651	2,839,298	709,824	2,129,473	258,212
25	8	1,560	35	82,024,153	12,303,623	3,075,906	9,227,717	1,118,918
27	21	1,800	33	88,996,517	13,349,478	3,337,369	10,012,108	1,214,030
30	50	2,268	30	101,086,581	15,162,987	3,790,747	11,372,240	1,378,955
33	41	3,300	27	130,454,025	19,568,104	4,892,026	14,676,078	1,779,566
35	55	3,840	25	138,708,155	20,806,223	5,201,556	15,604,667	1,892,163
38	34	3,216	22	99,726,849	14,959,027	3,739,757	11,219,270	1,360,406
40	17	3,372	20	93,205,064	13,980,760	3,495,190	10,485,570	1,271,440
43	12	4,140	17	93,991,863	14,098,779	3,524,695	10,574,085	1,282,173
45	6	10,200	15	199,079,806	29,861,971	7,465,493	22,396,478	2,715,712
45	8	6,120	15	119,447,883	17,917,183	4,479,296	13,437,887	1,629,427
50	5	5,904	10	71,144,612	10,671,692	2,667,923	8,003,769	970,507
53	3	8,040	7	64,200,349	9,630,052	2,407,513	7,222,539	875,778
55	6	8,040	5	22,015,226	3,302,284	825,571	2,476,713	300,317
60	10	8,040	0	2,412,000	361,800	90,450	271,350	32,903
							-	
	290			1348703654	202,305,548		151,729,161	18,398,104

Source: Author's computation 2016

TABLE 3C: CALCULATION OF PENSION & GRATUITY – OLD PENSION SCHEME

	Total yrs	Annual	Estimated sal	Gratuity	Pension	Value of	Value of
AGE	of service	Salary of	per Ee at	Benefit	Benefit	annual Pension	Gratuity Benefit
x	at age 60	each Ee N'000)	Retirement	%	%	OLD SCHEME	OLD SCHEME
			{3*(1.03)^col.2}			(4)*(6)/100	(4)*(5)/100
20	35	216	607,794	300	80	486,235.43	1,823,383
20	35	300	844,159	300	80	675,326.99	2,532,476
25	35	360	1,012,990	300	80	810,392.39	3,038,971
25	35	1,560	4,389,625	300	80	3,511,700.34	13,168,876
27	33	1,800	4,774,203	284	74	3,532,910.54	13,558,738
30	30	2,268	5,505,031	260	68	3,743,421.27	14,313,081
33	27	3,300	7,330,254	236	64	4,691,362.38	17,299,399
35	25	3,840	8,040,107	220	58	4,663,262.20	17,688,236
38	22	3,216	6,162,189	196	52	3,204,338.05	12,077,890
40	20	3,372	6,090,207	180	48	2,923,299.40	10,962,373
43	17	4,140	6,842,789	156	42	2,873,971.46	10,674,751
45	15	10,200	15,891,268	140	40	6,356,507.06	22,247,775
45	15	6,120	9,534,761	140	40	3,813,904.24	13,348,665
50	10	5,904	7,934,482	100	30	2,380,344.69	7,934,482
53	7	8,040	9,888,186	116	0	-	11,470,296
55	5	8,040	9,320,564	100	0	-	9,320,564
60	0	8,040	8,040,000	0	0	-	-
			112,208,609			**43,666,976.45**	**181,459,955**

Source: Author's computation 2016

TABLE 3D: COMPARISON OF PENSION & GRATUITY BETWEEN THE NEW & OLD PENSION SCHEMES

AGE (X)	GRATUITY OLD SCHEME	GRATUITY NEW SCHEME	RATIO OLD/NEW	PENSION OLD SCHEME	PENSION NEW SCHEME	RATIO OLD/NEW
20	1,823,383	365,472	4.99	486,235	132,947	3.66
20	2,532,476	507,600	4.99	675,327	184,649	3.66
25	3,038,971	709,824	4.28	810,392	258,212	3.14
25	13,168,876	3,075,906	4.28	3,511,700	1,118,918	3.14
27	13,558,738	3,337,369	4.06	3,532,911	1,214,030	2.91
30	14,313,081	3,790,747	3.78	3,743,421	1,378,955	2.71
33	17,299,399	4,892,026	3.54	4,691,362	1,779,566	2.64
35	17,688,236	5,201,556	3.40	4,663,262	1,892,163	2.46
38	12,077,890	3,739,757	3.23	3,204,338	1,360,406	2.36
40	10,962,373	3,495,190	3.14	2,923,299	1,271,440	2.30
43	10,674,751	3,524,695	3.03	2,873,971	1,282,173	2.24
45	22,247,775	7,465,493	2.98	6,356,507	2,715,712	2.34
45	13,348,665	4,479,296	2.98	3,813,904	1,629,427	2.34
50	7,934,482	2,667,923	2.97	2,380,345	970,507	2.45
53	11,470,296	2,407,513	4.76	-	875,778	0.00
55	9,320,564	825,571	11.29	-	300,317	0.00
60	-	90,450	0.00	-	32,903	0.00
	181,459,955	50,576,387	3.59	43,666,976	18,398,104	2.37

Source: Author's computation 2016

Table RD 1 REGRESSION COMPUTATION TABLES

Yi	Xi	YiXi	Xi sq	Xi	yi	xi sq.	xi.yi	Yi est	Yi-Yiest
1	2	3	4	5	6	7	8	9	10
3.86	0.0818	0.31575	0.0067	-0.027	-3.4736	0.00073	0.09379	3.1639	0.6961
4.45	0.0894	0.39783	0.0080	-0.0194	-2.8836	0.00038	0.05594	4.3391	0.1109
6.15	0.106	0.65190	0.0112	-0.0028	-1.1836	0.00001	0.00331	6.9060	-0.7560
8.41	0.1214	1.02097	0.0147	0.0126	1.0764	0.00016	0.01356	9.2873	-0.8773
13.04	0.1422	1.85429	0.0202	0.0334	5.7064	0.00112	0.19059	12.5036	0.5364
15.31	0.1498	2.29344	0.0224	0.041	7.9764	0.00168	0.32703	13.6788	1.6312
6.19	0.1063	0.65800	0.0113	-0.0025	-1.1436	0.00001	0.00286	6.9524	-0.7624
7.76	0.1175	0.91180	0.0138	0.0087	0.4264	0.00008	0.00371	8.6842	-0.9242
7.3	0.1145	0.83585	0.0131	0.0057	-0.0336	0.00003	-0.00019	8.2203	-0.9203
4.86	0.094	0.45684	0.0088	-0.0148	-2.4736	0.00022	0.03661	5.0504	-0.1904
3.34	0.0739	0.24683	0.0055	-0.0349	-3.9936	0.00122	0.13938	1.9424	1.3976
80.67	1.1968	9.64349	0.1358	-1.25E-16	0.0004	0.00562	0.86660	80.7284	-0.0584
7.3336	0.1088								

TABLE RD2 Estimation of Variable for Autocorrelation and Heteroscedasticity Tests

	Pension Amount (Yi)	Annuity Rates (Xi)	YiXi	Xi sq	Xisq - Xisq bar=x3i	(Xi-Xbar) xi	(Yi-ybar) yi	yix3i
	1	2	3	4	5	6	7	8
	5.54	7.86	43.544	61.7796	-69.6672	-3.425	1.5525	-108.158
	4.89	8.904	43.541	79.28122	-52.1656	-2.381	0.9025	-47.079
	4.45	9.77	43.477	95.4529	-35.9939	-1.515	0.4625	-16.647
	4.4	9.9	43.560	98.01	-33.4368	-1.385	0.4125	-13.793
	4.31	10.1	43.531	102.01	-29.4368	-1.185	0.3225	-9.493
	4.14	10.5	43.470	110.25	-21.1968	-0.785	0.1525	-3.233
	3.69	11.8	43.542	139.24	7.7932	0.515	-0.2975	-2.318
	3.64	11.96	43.534	143.0416	11.5948	0.675	-0.3475	-4.029
	3.46	12.57	43.492	158.0049	26.5581	1.285	-0.5275	-14.009
	3.22	13.5	43.470	182.25	50.8032	2.215	-0.7675	-38.991
	3.12	13.96	43.555	194.8816	63.4348	2.675	-0.8675	-55.030
	2.99	14.6	43.654	213.16	81.7132	3.315	-0.9975	-81.509
	47.85	135.424	522.370	1577.362	0.0002	0.004	2.22-E15	-394.291
Means	3.9875	11.285		131.4468	1.8E-05			

Yest = Bo + B1*Xi

TABLE RD 2 CONDT.

xi sq.	xix3i	xi.yi	Yi est	Ui est Yi-Yiest	Ui^2	Ui-Ui-1 et - e(t-1)	(et - e(t-1))^2
9	10	11	12	13	14	15	16
11.7306	238.61	-5.31731	5.217	0.323	0.1043		
5.6692	124.21	-2.14885	4.841	0.049	0.0024	-0.1020	0.010399792
2.2952	54.53	-0.70069	4.530	-0.080	0.0064	0.0040	1.59439E-05
1.9182	46.31	-0.57131	4.483	-0.083	0.0069	0.0005	2.75604E-07
1.4042	34.88	-0.38216	4.411	-0.101	0.0102	0.0033	1.10182E-05
0.6162	16.64	-0.11971	4.267	-0.127	0.0162	0.0059	3.5395E-05
0.2652	4.01	-0.15321	3.799	-0.109	0.0120	-0.0042	1.75964E-05
0.4556	7.83	-0.23456	3.742	-0.102	0.0104	-0.0016	2.5536E-06
1.6512	34.13	-0.67784	3.522	-0.062	0.0039	-0.0065	4.1972E-05
4.9062	112.53	-1.70001	3.188	0.032	0.0010	-0.0028	8.06415E-06
7.1556	169.69	-2.32056	3.022	0.098	0.0096	0.0085	7.26435E-05
10.9892	270.88	-3.30671	2.792	0.198	0.0392	0.0297	0.000880266
49.0568	1114.243	-17.6329	47.814	0.036	0.2224	-0.06511	0.011485521

Uiest = Yi - Yest