



**Strathmore**  
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**IMPACT OF DYNAMIC PENSION CONTRIBUTION RATES ON  
ADEQUACY OF RETIREMENT BENEFITS.**

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## ABSTRACT.

The retirement income an employee can anticipate is greatly contingent on their salary, contributions, investment strategies and consequently investment returns. Nonetheless, the contributions along with the interest earned are uncertain to be sufficient to cater for the employees' retirement needs. The nature of many pension schemes is to emphasize on the accumulation phase of the contributions with the aim of estimating the retirement benefits, and fail to take into account the forecasting phase of the retirement benefits, by determining the amount of pension a retiree will require in order to cater for their retirement needs. Forecasting retirement needs will ensure pension adequacy by obtaining an adequate target pension income and subsequently an optimum contribution rate that will meet this target pension. This study therefore sought to determine how the contribution rate can be varied, as experience emerges on various parameters including interest earned on contributions and projected retirement salary, with the aim of increasing the likelihood of pension adequacy. However, employers would like stability of their costs, thus they desire to have a fixed contribution rate. It is the member's contribution rate that will be dynamic. Adequacy of the pension income is measured by the degree to which the after-retirement earnings that individuals obtain, can maintain the living standards they had prior to retirement. This measure of adequacy is defined as Income Replacement Ratio(IRR). A stochastic model will be simulated to examine adequacy of retirement benefits and consequently how much the members need to save now in order to achieve that target pension. The study revealed that both the contribution rate and investment strategy adopted in the pension scheme influence the adequacy of retirement benefits. The study recommends that individuals should increase their savings as adequacy of pension income largely depends on how much is being contributed into the pension fund. The pension administrators should also review the investment strategies employed and diversify the investments of the scheme so as to cushion against adverse changes in market conditions.

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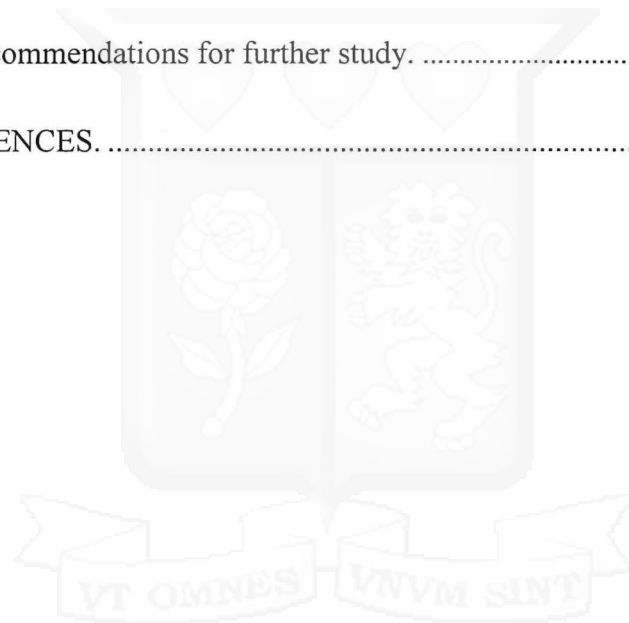
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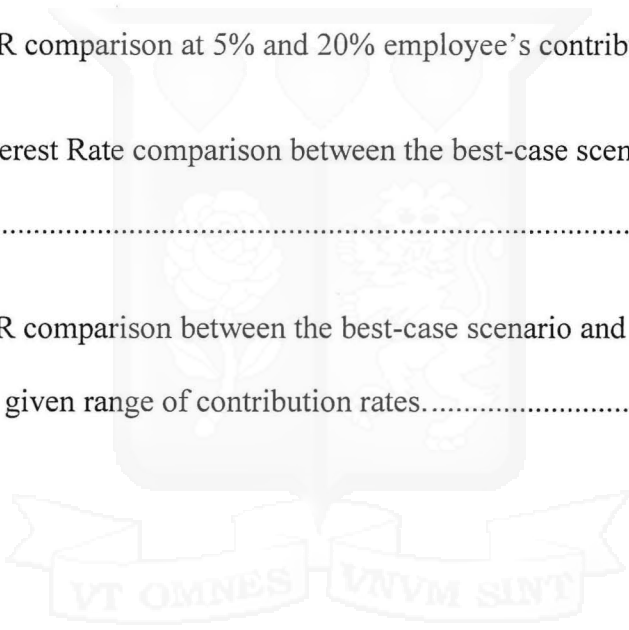
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## **LIST OF ABBREVIATIONS.**

RBA- Retirement Benefits Authority.

AMC- Annual Management Charges.

LCH- Life Cycle Hypothesis.

IRR- Income Replacement Ratio.

NSSF- National Social Security Fund.



# 1 INTRODUCTION

## 1.1 Background to the study.

According to Holzmann and Hinz (2005), there are four principal objectives of a pension plan. These are; consumption smoothing over the life cycles of beneficiaries, offering insurance against risks particularly the uncertainties of life span after retirement, reallocation of wages using public pension schemes to attain a more equivalent distribution of income through transfers from the wealthy to the poverty-stricken and poverty alleviation among the elderly.

Pension scheme members and their employers contribute money into the scheme in order to earn an interest during the members' working lives. Upon retirement, a member's fund is liquidated and then either paid directly to the member, or used to purchase a retirement annuity for the member.

Financial retirement planning has become a major concern for many nations, attributable to the fast ageing working inhabitants. The shift from Defined Benefit to Defined Contribution pension plans increases the significance of personal savings as a source of retirement income and places more task of retirement planning upon the individual. Attaining a financially secure retirement income is a vital objective for employees since financial insecurity can lay a heavy economic burden on society. Thus, individuals must prudently establish how much to save for retirement and how much to invest in savings so as to be prepared financially for retirement.(Yuh, 2011).

The income an employee can expect to receive in retirement is highly dependent on their salary, contributions, investment adoptions and successively the investment returns.(Gardner, 2010).

It is, however, not certain whether the contributions plus interest earned will be adequate to cater for the member's retirement needs. (Paralta, 2010).

There is a renewed focus on what kind of retirement benefits members of the various pension plans can expect in retirement. Will the current pension schemes be able to provide an adequate pension in retirement and how much should the members save now in order to meet this target adequate pension? In view of that, this study seeks to

determine how employees' contribution rates can be varied with the aim of increasing the likelihood of pension adequacy.

#### 1.1.1 Dynamic Pension Contribution Rates.

Total contribution rates in Kenya are between 10 and 30 percent of the member's salary. The maximum contribution that can be made into a fund by both the employer and the employee amounts to 30 percent of the member's salary. Individuals make contributions ranging from 5 to 10 percent of their income towards retirement benefits and have their employers match the same. (Retirement Benefits Authority[RBA], 2011).

The nominal value of the contributions increases over time since the member's salary is expected to increase. However, the member's lifestyle also changes over time hence resulting in greater costs. The lifestyle at retirement is therefore quite costly, and can only be sustained by a significant amount of pension.

AON Consulting (2008) conducted a study which assumed that people save at a certain "average" rate while they are working. Those who save less than that average rate will need higher Income Replacement Ratios. This is because they spend more and have a higher standard of living before they retire. Thus, they need more retirement income to maintain that standard of living. On the other hand, people who save more than the average rate need less retirement income because they only need to support a lower standard of living.

The contribution rates are varied as experience develops on various parameters including interest earned on contributions and projected retirement salary as a result of inflation; and the contribution rates must at all times exceed a pre-stated minimum.

Proposed dynamic contribution levels could start off significantly high and decline over a member's working life. Alternatively, the contribution levels could vary over different phases over the member's working life in a manner that maximizes the possibility of attaining a target pension benefit.

### 1.1.2 Adequacy of Retirement Benefits.

Adequacy in this case can be defined as the extent to which the pension income individuals obtain after retirement, can sustain the standards of living they had prior to retirement.

Yuh (2011) defined retirement income adequacy as a stable nominal level of consumption during retirement as in during the working years referred to as the retirement income replacement ratio.

Bajtelsmit et al. (2013) states that the sufficiency of retirement benefits is measured by their ability to inhibit poverty, the degree to which they replace income before retirement and how they relate to the average incomes of people below the pensionable age. The main approaches to measure adequacy include: poverty thresholds, replacement ratios, projected expenditures and minimum societal standards.

An adequate retirement income will be susceptible to investment approaches and charges applied. Different investment approaches entail different levels of annual management charges (AMC) applied to an individual's fund. Redwood et al. (2013) consider retirement outcomes under three investment approaches; a traditional lifestyle investment approach, a first alternative approach and a second alternative approach. Under a traditional lifestyle investment approach, the funds in which pension contributions are invested are changed inevitably depending on the length of time until the expected retirement date. Members' funds are invested in equities since early years, as they have more time to reimburse any losses associated with the risky nature of equities, and are then converted to gilts and cash as the individual approaches retirement. A first alternative approach targets to achieve lower volatility in early years at the expense of potential returns. This approach would require the employee to contribute more in order to generate a high amount of accrued contributions upon retirement, as lower returns are expected to be generated due to the lower risk accepted. A second alternative approach aims to moderate volatility as well, but not at the expense of lower returns. This is done by reducing equity volatility within a traditional lifestyle approach. The higher the AMC deducted from the member's fund, the more they are required to contribute towards the fund. Thus, the investment

approach and the AMC paid, could affect the contribution rate needed to achieve an adequate retirement income.

## 1.2 Problem Statement.

The tenacity of retirement planning is to secure sufficient financial resources for retirement in order to maintain the same standard of living.(Schulz, 2001).

The nature of many pension schemes is that they lay emphasis on the accumulation phase of the contributions in order to project the retirement benefits and ignore the forecasting phase of the retirement needs in order to determine the amount of pension that is required to cater for the pensioner's retirement needs and enable them maintain the living standards they had prior to retirement.

The accumulation phase of the contributions does not guarantee whether the accrued benefits will be sufficient to cover the cost of living at retirement. Forecasting retirement needs will ensure pension adequacy by obtaining a target pension income that will be sufficient to cater for the members' post-retirement needs.

This study therefore seeks to forecast the members' retirement needs in order to determine an adequate target pension income and subsequently an optimum contribution rate that will meet this target pension.

## 1.3 Research Objectives.

- 1.3.1 To obtain an adequate target pension by forecasting the members' retirement needs.
- 1.3.2 To determine the manner in which contribution rates will be varied over the members' working years as experience emerges on interest and salary in order to achieve pension adequacy.

## 1.4 Research Questions.

- 1.4.1 What is the adequate target pension that members expect to receive based on their retirement needs?
- 1.4.2 How can contribution rates be varied over the members' working years so as to achieve pension adequacy?

## 1.5 Significance of the Study.

This study will benefit both public and private sector workers to determine whether they are “on course” for an affordable retirement or whether they will need to raise their contributions, modify their expected standards of living in retirement or implicitly accept a lower probability of a “successful” retirement.

The findings of this study will be of immense benefit to trustees, pension administrators, custodians and fund-managers of the pension plans to understand better the outcomes members can expect at retirement and design more appropriate strategies as a result.

Pension Regulatory Bodies such as Retirements Benefits Authority (RBA) in Kenya will benefit from the findings of this study in that the findings will give guidance in formulating rules and regulations governing pension funds.

The government will benefit from this study, in that it could consider a number of strategies to increase pension saving by increasing the contribution levels such as auto-escalation where a member's contribution rate increases in line with earnings increase. It could as well encourage or enable the provision of information and advice to individuals, or provide better incentives for pension saving so that individuals choose to save more.

## **2 LITERATURE REVIEW.**

### **2.1 Introduction.**

This chapter presents the literature review, specifically focusing on the variables of the study. The discussion includes theories that encompass attitudes of people towards retirement planning, measures of determining adequacy of retirement benefits and the various factors that influence adequacy of retirement benefits.

The sources of literature include books, journal articles, reports and previous research work related to the problem at stake.

### **2.2 Theoretical Framework.**

#### **2.2.1 Life cycle Hypothesis.**

Life cycle hypothesis or the life cycle model is the basic framework through which economists think about planning and saving for retirement. It originated with Modigliani and Bumberg (1954), but has been developed and employed extensively since then.

According to Keynes (1936), prior to the life cycle model development, the most common assumption was that households consumed some declining percentage of their annual incomes and saved the remainder.

By contrast, the life cycle model predicts that households plan their consumption over a longer time frame in an effort to produce a standard of living that tends not to vary greatly from one year to the next. More specifically, the life cycle model holds that individuals will borrow and save so that the discounted marginal utility of their consumption, that is the satisfaction derived from the final dollar of spending in a period, is equal from one year to the next. Were individuals not to act in such a way, they could increase their lifetime utility by shifting spending from one period in life to another. (Biggs, 2017).

The life cycle approach in its simplest version implies that financial life of individuals occurs in three phases after starting a professional activity. In the first phase, each person earns a wage from his or her labor supply and has insufficient income to cover their needs; therefore, they become indebted in order to finance their need of durable goods, the purchase of a home and the education of their children. In the second phase, they pay off their debts run up in the previous phase and begin a process of accumulation of wealth to be able to finance their retirement period. In the third phase, they use up what they had saved during retirement.

Biggs (2017) continues to state that over time, the life cycle model has been expanded to account for issues such as precautionary saving, uncertainty regarding future events, the costs of raising children, and the desire to leave an inheritance. Many factors complicate the picture, including the entry and exit of children from the household, the inability to borrow at certain periods of life, the need for precautionary savings and uncertainty about future earnings and investment returns. However, smoothing consumption from one year to the next is the basic story, both in the textbook life cycle model and in how its broad principles are applied in practical retirement planning. A significant body of research finds that control of changes in family size and other factors generates relatively stable individual-level consumption over the life cycle.

Studies on precautionary saving showed that people who are sufficiently prudent and have uncertain future earnings will never borrow wealth, which is build up during working years, in order to finance consumption during retirement in the life cycle theory. They suggested that precautionary, bequest, and other motives must be taken into consideration.

Taking into consideration other motives that may impact the life cycle theory, there are the risks of accidents during the active life such as illness, unemployment and death, which require precautionary savings or specific insurance policies, including unemployment benefits of public welfare. In this scenario, the bequests usually are involuntary assuming a finite life cycle horizon. Secondly, longevity risk associated with the number of years in retirement can result in an undesired level of consumption. Lastly, political risk related to changes in the regulations regarding pensions, for instance, early access of retirement funds may cause uncertainty.

Jeszeck et al. (2016) provides a concise account of the life cycle model and how it plays into retirement planning. Economists broadly agree that a conceptual benchmark measure for adequate retirement saving is an amount that will, along with other sources of retirement income, allow a household to maintain its pre-retirement standard of living into retirement. A key concept underlying such a measure is the life-cycle model of savings, which suggests that individuals will adjust their saving and spending to ensure a consistent level of consumption over their lifetime, that is consumption is smoothed. This broad outlook is the most common framework through which retirement income adequacy is analyzed.

Originally, the LCH had assumptions that recognized that the theorem required individuals to look at an uncertain future. Researchers faced challenges in formulating models of how people would behave in cases of uncertainty. (Deaton, 2005).

While the insights afforded by the life model are intuitive and understandable, solving a life cycle model to maximize lifetime utility through saving and spending decisions is considerably more complex, such that a typical saver would not be expected to do so. Thus, shorthand measures such as replacement rates are more commonly used in retirement planning and retirement policy. (Winter et al, 2012).

### 2.2.2 Income Replacement Ratio Approach.

Kotlikoff (1999) argues that pensions should replace a reasonable fraction of pre-retirement income, that is, they should be consistent with lifetime consumption smoothing.

The most renowned gauge by which to establish retirement income adequacy is the replacement rate, which represents retirement income as a proportion of some measure of pre-retirement earnings as illustrated in equation (2.1). It gauges the degree to which benefits replace earnings before retirement and thereby allowing workers to maintain a reasonable estimate of their pre-retirement standard of living (Munnell and Soto, 2005).

$$\text{Income Replacement Ratio} = \frac{\text{Post-retirement Income}}{\text{Pre-retirement Income}} \dots\dots\dots 2.1$$

The most economically accurate measure would be one comparing an individual's consumption pre-retirement to that of post-retirement. Due to data unavailability, this is approximated by comparing incomes collected on a longitudinal basis. (Grech, 2013).

An important issue when calculating replacement ratios is how to define the pre-retirement income used in the denominator. A final income in the year prior to retirement or permanent income is often used to define the pre-retirement income. The final income just before retirement is used when assuming that people are interested in replacing the earnings they receive immediately prior to retirement. On the other hand, permanent income is used when assuming that people are interested in replacing lifetime income, and this approach is based on a "consumption smoothing" assumption of the life cycle model. The consumption smoothing is defined as the constant marginal utility of consumption over the life cycle; thus permanent income is regarded as the "optimal" or "desired" consumption over the life cycle. (Yuh, 2011).

Smith (2003) argues that it is more appropriate to define earnings based on the actual patterns of work across a lifetime, that is, individuals should pay for their retirement with wages earned over their lifetimes and not just in the peak of their careers.

According to Springstead and Biggs (2008), households can maintain their pre-retirement standard of living without matching their pre-retirement level of income because costs of living decline in retirement.

One big difference before and after retirement is the extent to which income is taxed. After retirement, people pay lower income taxes because only a portion of Social Security benefits is taxable or fully tax-free. A second reason why retirees require less than their full pre-retirement income is that they no longer need to save a portion of that income for retirement. A final factor often mentioned is that work-related expenses, such as clothing and transportation, are either no longer necessary or are much reduced. (Munnell and Soto, 2005).

However, replacement ratios that are required to maintain a person's pre-retirement standard of living are higher for the very lowest paid employees. Some ratios can even be as high as 100 percent. This is primarily because of two reasons. First, before they retire, lower paid employees save the least and pay the least amount in taxes as a

percentage of their income. Thus, they spend a higher percentage of their income and need higher replacement ratios to maintain that level of expenditures. Secondly, age and work-related expenditures do not decrease by as much, as a percentage of income, for the lower paid employees. This also means they need more income after retirement, as a percentage of their pre-retirement income, than the higher paid employees.(AON Consulting, 2008).

A target replacement rate based upon pre-retirement earnings creates a simplified retirement income goal that households can seek to attain. Most financial planners recommend that retirees be able to generate an income equal to roughly 70 percent of their pre-retirement earnings, though both higher and lower target replacement rates have been proposed. (Springstead and Biggs, 2008).

However, this direct measure of adequacy has its limitations. Firstly, it is a historical measure, in that, one needs to wait until retirement to be able to assess replacement rates. Secondly, it is an individual measure and thus may not be representative of the whole population. Thirdly, it is not a prospective measure and so does not give information on future changes in pension system rules; replacement rates would reflect rules as they related to that individual. Fourthly, it is data-intensive and as such longitudinal data is not usually available. Fifthly, it is a single point-in-time indicator, and does not take longevity into account and how it affects transfers to the individual. (Grech, 2013).

Goodin et al. (1999) states that another limitation of the replacement rate is that it has no direct link with poverty; meaning if someone is poor, and the pension system replaces 100 percent of income, while the replacement rate would seem generous, it would still not reduce the risk of poverty.

From a theoretical economic perspective, the replacement ratio approach is less appealing than a life cycle-dynamic programming approach, as it ignores utility theory and behavioural responses to uncertainty.(Yuh, 2011).

Nonetheless, the replacement ratio is a measure that is more robust and less subjected to distortion by the differences in modelling approaches.(Valdez and Chernih, 2003). According to Moore and Mitchell (2000), it is also a popular model among retirement

planning practitioners and can be seen as a relatively tractable approximation to the life cycle model.

## 2.3 Empirical Evidence.

### 2.3.1 Forecasting Retirement Needs.

According to VanDerhei (2015), the three major post-retirement risks are longevity risk, investment risk and long term care. He further states that since very few households annuitize most of their individual accounts in retirement, a replacement-rate focus would overlook the potential longevity risk of outliving one's savings. In addition, one of the biggest obstacles to retirement income adequacy for households who might otherwise have sufficient financial resources at retirement age is the risk of long-term care costs for a prolonged period. In the real world, few retirees have long-term care insurance policies that would cover the potentially catastrophic financial impact of this exposure. Consequently, any attempt to incorporate this into a replacement rate threshold needs to be carefully assessed against actual implications.

### 2.3.2 Varying Contribution Rates.

Pension benefits largely depend on the amount both the employer and employee contribute to the plan. The contribution rate is given as a percentage of current annual earnings.

Savings rates are one of the three major components (along with taxes and expenditure changes) in the Replacement Ratio equation. Higher savings rates reduce both the needed replacement percentages (employees are assumed to cease their savings plans once retired) and provide the employee with the ability to develop the needed savings accounts.(AON Consulting, 2008).

Employers would like stability of their costs so as to have a fixed contribution rate. It is the member's contribution rate that will be dynamic as he is the one interested in earning a decent benefit in retirement.

Deciding how much to save for retirement is a difficult task surrounded by many uncertainties. According to Choi et al. (2015) individuals are very passive in making their decisions. Consequently, individuals often stick to their current savings levels, implicitly holding them back from studying retirement savings information or contributing more to retirement savings accounts.

This has at least two important consequences. First, many individuals do not start preparing and saving for their retirement till very late in life, and do not manage to save enough once they start. (Mitchell and Utkus, 2004). Second, it creates a substantial hurdle for policymakers and for companies selling retirement savings product.

In particular, individuals who do not actively think about their retirement savings cannot be effectively advised about the need for additional savings and the products that match their specific needs.

A rational individual should start saving more when current savings are inadequate to provide financial support during retirement. However, evaluating whether current savings are adequate is a daunting task. It involves a complex and ongoing process of forecasting future needs and resources.

## 2.4 Discussion of Works.

Blöndal and Scarpetta (1999) was one of the primary studies of theoretical replacement rates. Nonetheless, the authors were quick to emphasize that “there is no such thing as a single pension replacement rate in any national retirement scheme”. This is because even with the simplest case, flat-rate universal old-age pensions, the gross replacement rate will still vary for individuals as it is governed by their preceding salaries, while net replacement rates will be influenced by the progressivity of the tax procedure.

Goodin et al. (1999) calculated the effective replacement rate of public transfers in Germany, Netherlands and the United States by finding those people whose principal source of income in one year was market income and whose principal source of

income in the next year was public-transfer income in the national income surveys, and then calculated their income in the second (public-transfer-dependent) year as a proportion of their income in the first (market-dependent) year.

Research done by Broadbent et al. (2006) indicates that on average or at the median of the distribution, U.S. participants contribute five percent of gross salary to their accounts and that about quarter of participants contribute less than four percent of pay. Broadbent et al. (2006) further asserts that an annual contribution of six percent would be sufficient to replace about seventy five percent of earnings in retirement if those contributions were made constantly for forty years, if employers matched one half of the worker's contributions each year, and if the account were to earn, a seven and half percent annual (nominal) return.

Mitchell et al. (2000) postulates that contribution rates to pension plans seem to be affected significantly by particular design features of the plan; in particular, contribution rates tend to rise significantly when employers match a portion of the worker's contributions, offers provisions for workers to take loans against account balances, and give workers arrangement of investment options to choose from.

Heterogeneity in replacement rates poses significant hurdles to use them as pension adequacy measures. To be able to do this, one would need to know to what extent the hypothetical individual, for whom the theoretical replacement ratio is estimated, is representative of the average pension recipient. (Grech, 2013).

On a theoretical level, Blöndal and Scarpetta (1999) point out that the simplifying assumption of a flat earnings profile over the worker's lifetime and full indexation of earnings for benefit calculation may overstate the pension level. Workers tend to move across the wage distribution over their lifetime, starting with low wages and ending with higher wages closer to retirement. Moreover, even if wages did not change with age, it is hardly likely that an individual would always receive the increase observed in average wages.

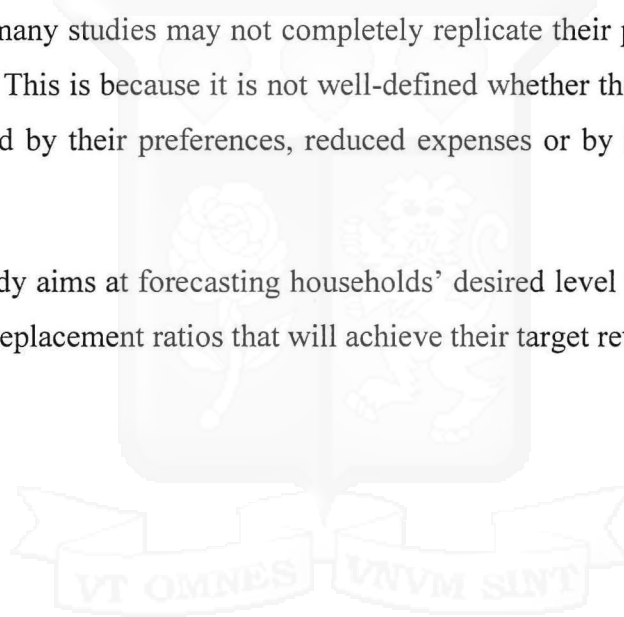
Leaving aside these simplifying assumptions, the main criticism of theoretical replacement rates is the representativeness (or not) of the hypothetical worker.

## 2.5 Research Gap.

The income replacement ratio, as a measure of adequacy of retirement benefits, assumes that consumption needs are anticipated to fall during retirement since retirees do not pay payroll taxes, they no longer need to save for retirement, their mortgage is generally paid off and they no longer have work-related expenses.

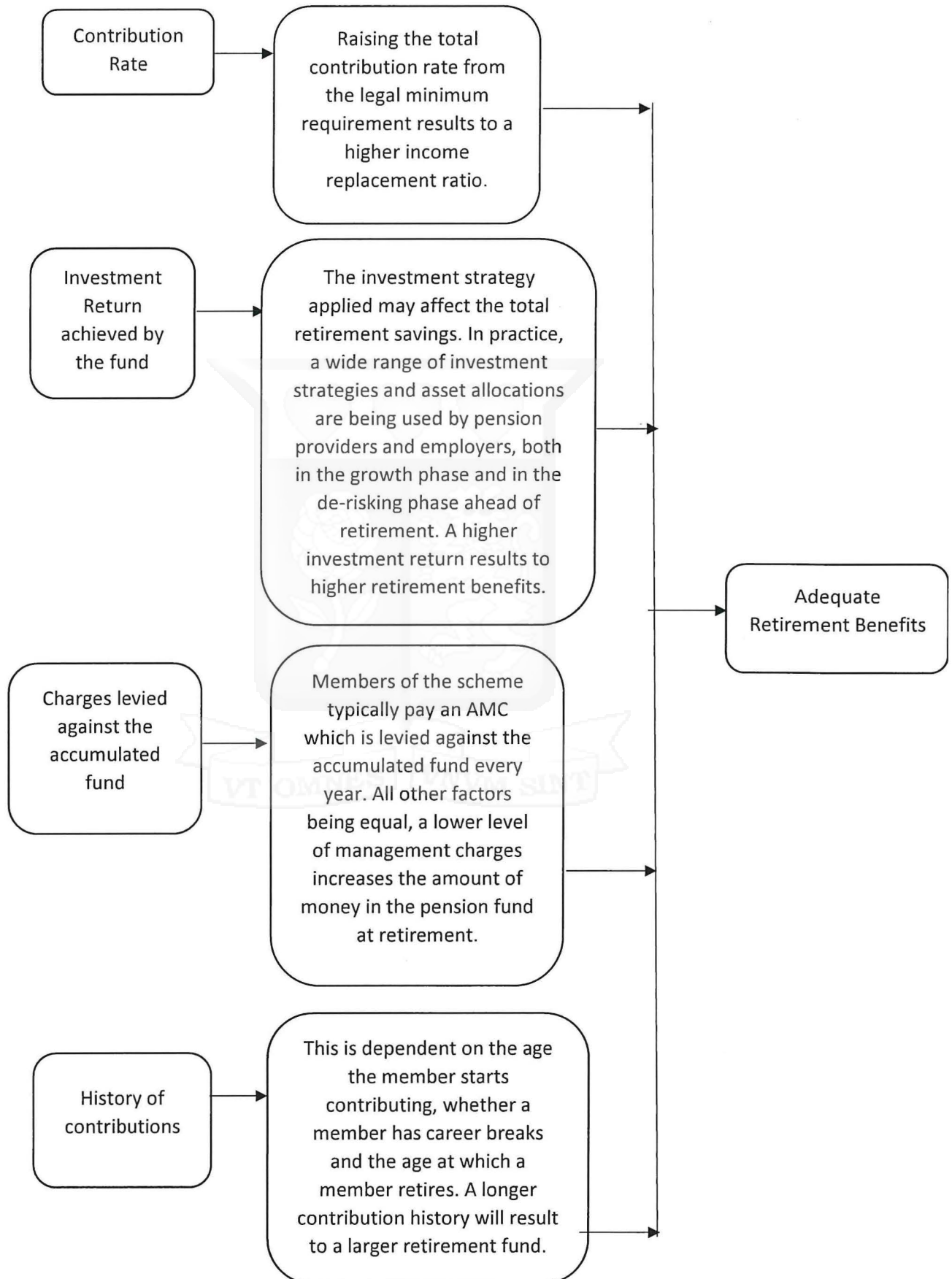
However, there is an enduring argument on whether pensioners need to spend more or less than younger employees to attain a similar standard of living. As stated by Bernheim et al. (2001), several writers have inferred the fall in consumption at the beginning of retirement as being evidenced by some households not preparing adequately for retirement. Thus, the reduced consumption of retired households presented in many studies may not completely replicate their planned level of living in retirement. This is because it is not well-defined whether their lower consumption level is caused by their preferences, reduced expenses or by insufficient retirement savings.

Thus, this study aims at forecasting households' desired level of living in retirement based on the replacement ratios that will achieve their target retirement benefits.



## 2.6 Conceptual Framework.

Figure 2.1 Conceptual Framework.



### **3 RESEARCH METHODOLOGY.**

#### **3.1 Introduction.**

This chapter details how the proposed study will be carried out. It entails the design to be adopted to conduct the study, the simulation model specification, the target population of study, how the data will be collected and simulated, and eventual analysis of the data in order to generate research findings.

#### **3.2 Research design.**

The study will adopt a descriptive and cross-sectional survey research design. Saunders (2009) defines a descriptive survey as being concerned with finding out who, what, where, when and how variables. It is a descriptive research design because it aims at investigating how varying pension contribution rates impact the adequacy of retirement benefits. Cross-sectional studies form a class of research methods that involve observation of all of a population, or a representative subset, at one specific point in time where by data is collected once. Data is quantitative in nature.

The independent variable in this study is the dynamic pension contribution rates while the dependent variable is adequacy of retirement benefits. The unit of analysis targeted by the study is pension schemes in Kenya.

#### **3.3 Target Population of the study.**

The data that will be employed to develop the stochastic model will be simulated using various parameters. The model will be used to predict the adequacy of retirement benefits that pensioners can anticipate to obtain and consequently how much they need to save now in order to achieve that target pension. In accordance, no data will be collected on a population or a representative of a population. Instead, the findings of the study can be applied to members of the pension schemes. Therefore, the targeted population of the study is pension scheme members.

### 3.4 Data Simulation.

The member's contribution rate will be varied as experience emerges on parameters such as interest and projected retirement salary due to inflation. As a result, the model developed will incorporate simulated rates of interest and inflation. The simulation process will involve collection of historical data on interest and inflation rates for the past ten years, so as to capture the reality aspect of how contributions in a pension scheme are made and invested over the member's working years. The source of data involved is secondary data. The data will be obtained from the Central Bank of Kenya website in order to ensure accuracy in terms of validity and reliability of the data.

### 3.5 Data analysis.

The collected data on interest and inflation rates will be summarized and analyzed using the Microsoft Excel program by use of descriptive statistics such as the mean, mode and median prior to simulation. This is to ensure that the data simulated captures the reality aspect of how the inflation and interest rates vary due to changes in the economic and market conditions over the years.

The data will thenceforth be used to develop a predictive stochastic model to examine the adequacy of retirement benefits and consequently how much pension scheme members need to save now in order to achieve that target pension.

Presentation methods will include tables, charts, graphs and measures of central tendency. These methods are preferred because they are easy to understand and summarize.

### 3.6 Model specification.

To investigate adequacy of retirement benefits, a simulation model of retirement expenditure will be developed, including lifestyle goals as well as investment and inflation. The optimal contribution level is determined by the change in interest rate and salary growth due to inflation.

The model incorporates a wide selection of retirement-related risks e.g. longevity risk, by accounting for the possibility of one outliving their savings after retirement. It also facilitates estimation of the impact of various combination of factors and decisions on achieving desired retirement outcomes such as sustaining a standard of living. This is done by computing the desired Income Replacement Ratio(IRR).

Over and above presenting the results of the model, several common retiree decisions that are expected to impact adequacy such as buying an annuity will be tested.

The total fund upon retirement is determined as;

*Fund at retirement = Total amount of contributions + Investment growth - applicable charges*

#### 3.6.1 Baseline Scenario.

A hypothetical employee is assumed to work continuously from age 25 to the pensionable age of 60. Thus, the investment time horizon is 35 years.

The employee earns a gross salary of say 60,000 per month. Wages grow each year in line with national average earnings. The inflation rate is simulated for the 35 years assuming 35 scenarios to represent the thirty-five years that the individual is assumed be working and earning a salary. Thus, in each year, the inflation rate takes 35 random values between the minimum and maximum values obtained from the historical data on inflation rates for the past ten years.

According to National Social Security Fund[NSSF] (2013), an employer shall pay to the pension fund in respect of each employee his or her employment; the employer's contribution at six per centum of the employee's monthly pensionable earnings<sup>1</sup> and

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<sup>1</sup> Pensionable earnings mean for a pension fund member, the lower of the member's monthly wages and the upper earnings limit.

the employee's contribution at six per centum of the employee's pensionable earnings deducted from the employee's earnings. However, the minimum contribution rate for the employee is five percent. The contribution rate is initially set at fifteen percent (ten percent for the employer and five percent for the employee). Contributions are invested and earn a net rate of return which is simulated in Excel for the 35 years, once more assuming 35 scenarios to represent the thirty-five years that the individual is assumed be working and contributing money towards the pension fund. Therefore, in each year, the interest rate takes 35 random values between the minimum and maximum values obtained from the historical data on interest rates for the past ten years. The 35 scenarios can be assumed to be different investment strategies adopted that generate different investment returns. The interest rates are compounded semi-annually since contributions are made throughout the year.

At retirement, an assumption is made that the accrued funds are converted into an annuity with the purchase of a single whole life annuity payable in arrears. The annuity factor is computed using commutation functions and the Kenyan mortality tables (KE 07-10 mortality tables). This is computed for both male and female annuitants in order to generate comparisons between the two.

$$\text{Annuity factor} = \frac{N_{x+1}}{D_x}$$

The pension income (annuity amount) that the retiree expects to receive per annum is given by;

$$\text{Annuity amount (p.a)} = \frac{\text{Accrued contributions at age 59}}{\text{Annuity factor}}$$

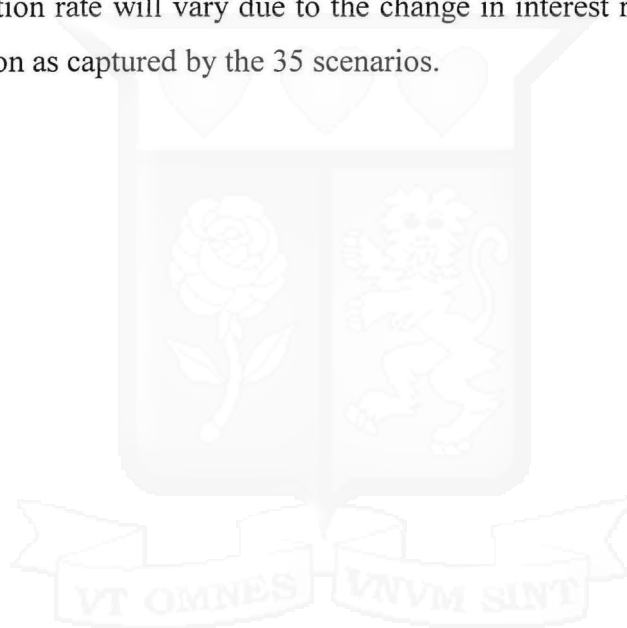
The Income Replacement Ratio (IRR) is then computed on a final-salary basis as;

$$\text{IRR} = \frac{\text{Annuity amount}}{\text{Final Salary at age 59}}$$

Most financial planners recommend that retirees be able to generate an income equal to roughly 70% of their pre-retirement earnings. This recommended Income Replacement Ratio is assumed to be adequate to sustain the standards of living they had prior to retirement.

Therefore, using excel data tools such as solver, the computed IRR will be set at the recommended value of 70% by changing the employee's contribution rate. However, constraints such as the minimum employee's contribution rate of 5% and the maximum of 20% have to be set. The employer's contribution rate is required to remain constant, 10%, as they have no desire to change their contribution levels. Thus, the total minimum contribution rate is the initial contribution rate of 15% while the total maximum contribution rate is set at 30%. This fulfils the objective of computing an optimal contribution rate that will achieve the adequate target pension. The employee's contribution rate is varied between 5% and 20% to examine how the IRR shifts with change in the contribution rate between the different scenarios.

The contribution rate will vary due to the change in interest rates and salary growth due to inflation as captured by the 35 scenarios.



## **4 DATA ANALYSIS, FINDINGS AND DISCUSSIONS.**

### **4.1 Introduction.**

This chapter discusses the presentation and interpretation of the research findings based on the objectives of the study.

### **4.2 Data Analysis.**

The purpose of this study was to determine how the employee's contribution rate can be varied with the aim of increasing the likelihood of pension adequacy. Among the variables investigated were the contribution rate, inflation rate, interest rate, mortality rate and the IRR.

The data that was collected was analyzed using the Microsoft Excel program, simulated and then used to develop a predictive stochastic model to examine the adequacy of retirement benefits and consequently how much pension scheme members need to save now in order to achieve that target pension.

#### **4.2.1 Inflation Rates.**

In the model, inflation rates were simulated for the period that the employee is assumed to be working and earning a salary, i.e. for 35 years, assuming 35 scenarios. In order to simulate the inflation rates, historical inflation rates data from 2006-2016 was collected from the Central Bank of Kenya website and analyzed by use of descriptive statistics as shown in tables 4.1 and 4.2.

Table 4.1 Central Bank of Kenya 12-month Inflation Rates from 2006-2016.

		12-month Inflation Rates										
	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Month	January	8.39	4.63	9.40	13.22	5.95	5.42	18.31	3.67	7.21	5.53	7.78
	February	9.39	3.02	10.58	14.69	5.18	6.54	16.69	4.45	6.86	5.61	6.84
	March	8.85	2.19	11.90	14.60	3.97	9.19	15.61	4.11	6.27	6.31	6.45
	April	5.44	1.85	3.66	12.42	3.66	12.05	13.06	4.14	6.41	7.08	5.27
	May	4.47	1.96	18.61	9.61	3.88	12.95	12.22	4.05	7.30	6.87	5.00
	June	4.28	4.07	17.87	8.60	3.49	14.48	10.05	4.91	7.39	7.03	5.80
	July	4.16	5.48	17.12	8.44	3.57	15.53	7.74	6.03	7.67	6.62	6.40
	August	4.92	5.30	3.22	7.36	3.22	16.67	6.09	6.67	8.36	5.84	6.26
	September	5.93	5.53	18.73	6.74	3.21	17.32	5.32	8.29	6.60	5.97	6.34
	October	6.55	5.38	18.74	6.62	3.18	18.91	4.14	7.76	6.43	6.72	6.47
	November	6.64	6.08	19.54	5.00	3.84	19.72	3.25	7.36	6.09	7.32	6.68
	December	7.98	5.70	4.51	5.32	4.51	18.93	3.20	7.15	6.02	8.01	6.35

2

Using the 12-month average inflation rates per year, the maximum and minimum values were computed and then random values between the lower and upper bounds were generated for the 35 years assuming 35 scenarios.

Table 4.2 Inflation Rates analysis.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sparkline
12-month average inflation	6.42	4.27	12.82	9.39	3.97	13.98	9.64	5.72	6.88	6.58	6.30	
Minimum value = 3.97												
Maximum value = 13.98												
mean = 7.81												
median = 6.58												

#### 4.2.2 Interest Rates.

Similarly, the interest rates were simulated for the period that the employee is assumed to be working and contributing a percentage of their salary towards the pension fund, i.e. 35 years assuming 35 scenarios. Past data on the 91-Day T-bill rates from 2006-

<sup>2</sup> Source: Central Bank of Kenya

2016 was collected from the Central Bank of Kenya website and analyzed by use of descriptive statistics as shown in tables 4.3 and 4.4.

Table 4.3 Central Bank of Kenya 91-Day T-bill Rates from 2006-2016.

		Central Bank Rates(91-Day Tbill)										
	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Month	January	8.23	6.00	6.95	8.46	6.56	2.46	20.56	8.08	9.26	8.59	11.36
	February	8.02	6.22	7.28	7.55	6.21	2.59	19.70	8.38	9.16	8.59	10.63
	March	7.60	6.32	6.90	7.31	5.98	2.77	17.80	9.88	8.98	8.49	8.72
	April	7.02	6.65	7.35	7.34	5.17	3.26	16.01	10.38	8.80	8.42	8.92
	May	7.01	6.77	7.76	7.45	4.21	5.35	11.18	9.46	8.82	8.26	8.15
	June	6.60	6.53	7.73	7.33	2.98	8.95	10.09	6.21	9.81	8.26	7.25
	July	5.89	6.52	8.03	7.24	1.60	8.99	11.95	5.92	9.78	10.57	6.16
	August	5.96	7.30	8.02	7.25	1.83	9.23	10.93	10.03	8.29	11.54	8.48
	September	6.45	7.35	7.69	7.29	2.04	11.93	7.77	9.58	8.38	14.61	8.06
	October	6.83	7.55	7.75	7.26	2.12	14.80	8.98	9.72	8.67	21.65	7.76
	November	6.41	7.52	8.39	7.22	2.21	16.14	9.80	9.94	8.64	12.34	8.22
	December	5.73	6.87	8.59	6.82	2.28	18.30	8.30	9.52	8.58	9.81	8.44

3

Using the average interest rates per year, the maximum and minimum values were computed and then random values between the lower and upper bounds were generated for the 35 years assuming 35 scenarios.

Table 4.4 Interest Rates analysis.

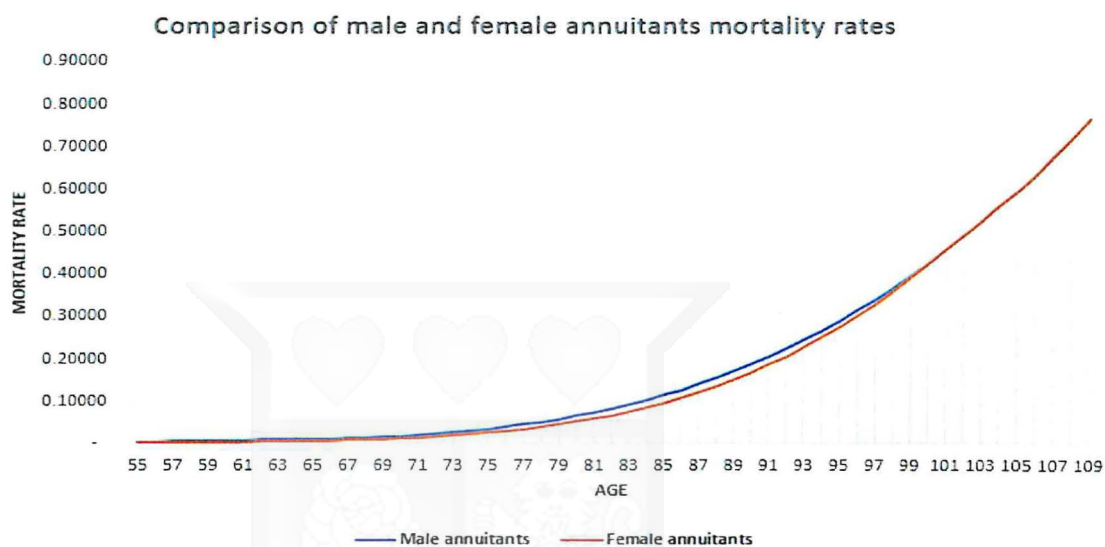
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sparkline
Average rate per year	6.81	6.80	7.70	7.38	3.60	8.73	13.76	8.93	8.93	10.93	8.51	
minimum value = 3.60												
maximum value = 13.76												
mean = 8.37												
median = 8.51												

<sup>3</sup> Source: Central Bank of Kenya

### 4.2.3 Mortality Rates.

The mortality rates used to compute the annuity factor were obtained from the Kenyan 2007-2010 mortality tables.

Figure 4.1 Comparison between male and female annuitants' mortality rates.



4

### 4.3 Findings of the Study.

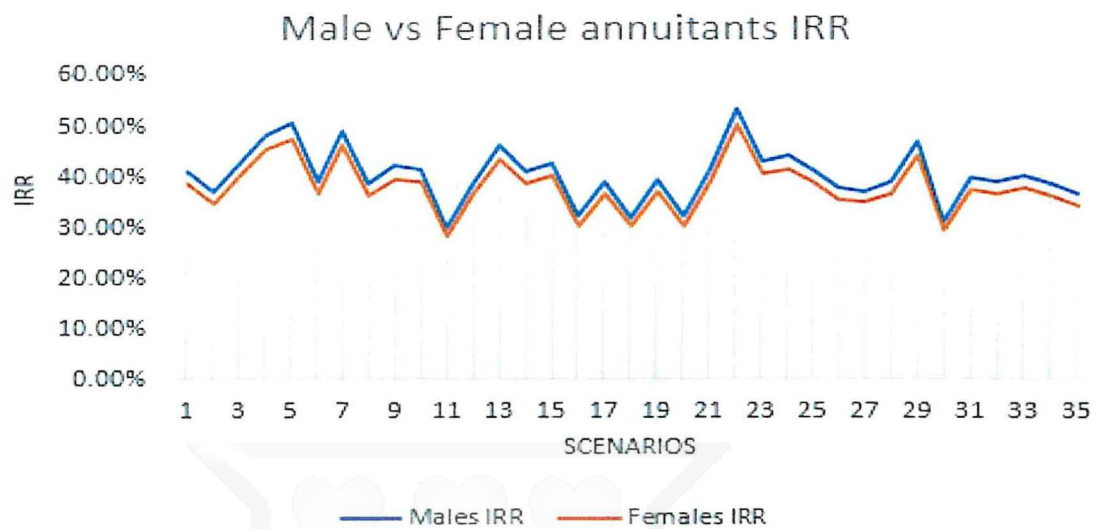
The purpose of this study was to determine how the employee's contribution rate can be varied with the aim of increasing the likelihood of pension adequacy.

#### 4.3.1 Male and Female Annuitants' Income Replacement Ratio.

In every scenario and at any contribution rate, the male annuitants IRR was higher than the female annuitants IRR as illustrated in figure 4.2.

<sup>4</sup> Source: KE 07-10 Mortality Tables

Figure 4.2 Comparison between male and female annuitants' Income Replacement Ratio.



This is due to the fact that the male annuitants' mortality rate is higher than that of the female annuitants. As a result, the annuity factor at the retirement age, i.e.  $\frac{N_{x+1}}{D_x}$  for males is lower than that of females as indicated in figure 4.3.

Figure 4.3 Comparison between males' and females' annuity factors.

i		v											
4%		0.961538462											
Annuitants( Males)						Annuitants(Females)							
x	qx(males)	Lx	Dx	Nx	$\frac{N_{x+1}}{D_x}$	x	qx(females)	Lx	Dx	Nx	$\frac{N_{x+1}}{D_x}$		
55	0.00366	100,000	11,566	189,113	15.35142	55	0.00201	100,000	11,566	198,858	16.19402		
56	0.00463	99,634	11,080	177,548	15.02413	56	0.00259	99,799	11,098	187,293	15.87570		
57	0.00543	99,173	10,605	166,468	14.69777	57	0.00310	99,541	10,644	176,194	15.55361		
58	0.00610	98,634	10,141	155,863	14.36914	58	0.00354	99,232	10,203	165,551	15.22605		
59	0.00667	98,033	9,692	145,722	14.03562	59	0.00393	98,881	9,776	155,348	14.89135		
60	0.00718	97,379	9,257	136,030	13.69506	60	0.00431	98,492	9,363	145,572	14.54811		

Consequently, the annuity amount for the male annuitants is higher than that of the female annuitants for the same level of accrued contributions at age 59. This therefore means that the male annuitants will receive a higher post-retirement income than the

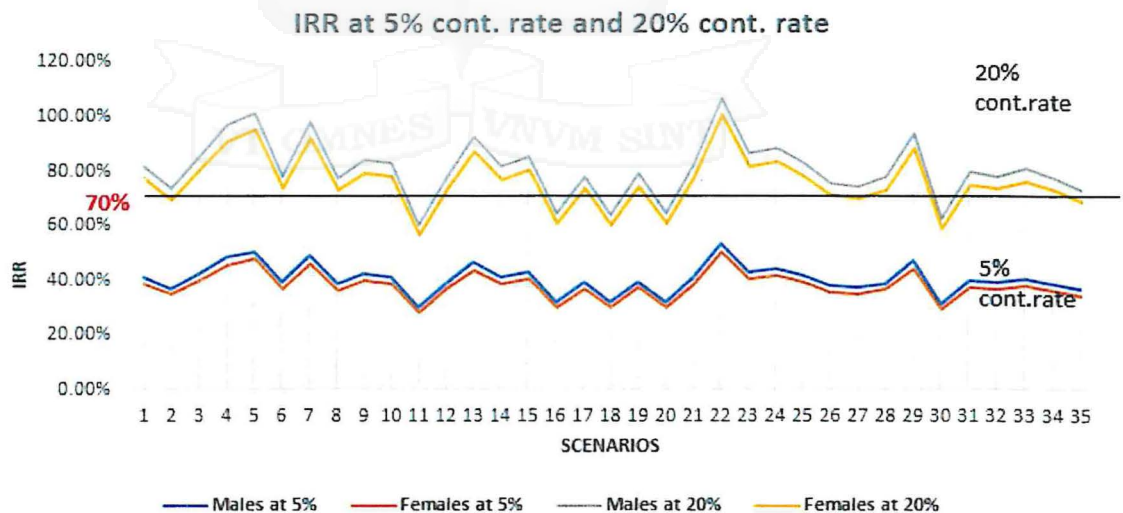
female annuitants for the same level of pre-retirement income, thus the higher the Income Replacement Ratio.

#### 4.3.2 Income Replacement Ratio at the minimum contribution rate and at the maximum contribution rate.

The maximum contribution that can be made into a fund by both the employer and the employee amounts to 30 percent of the member's salary. Employers would like stability of their costs so as to have a fixed contribution rate. It is the member's contribution rate that will be dynamic as they are the ones interested in earning a decent benefit in retirement. In the model, the employer's contribution rate was set at a constant 10%. Therefore, the employee's contribution will vary from the minimum contribution rate of 5% according to the National Social Security Fund[NSSF] (2013) and maximum contribution rate of 20% so as not to exceed the total maximum contribution rate of 30%.

An employee's contribution rate of 20% yields a higher IRR at every scenario as compared to that of 5% as specified in figure 4.4.

Figure 4.4 IRR comparison at 5% and 20% employee's contribution rates.



This is because, a higher contribution rate will result to a higher amount of accrued contributions upon retirement. In turn, an employee who contributes a higher amount will receive a higher annuity amount when all the accrued contributions are used to purchase an annuity. A higher annuity amount for a given level of annual salary will

result to a higher IRR which is deemed to be adequate for the pensioner. As shown in figure 4.4, a contribution rate of 5% will result to an IRR that is deemed to be inadequate (i.e. below the recommended IRR of 70%) in all the scenarios. However, a contribution rate of 20% results to IRRs of above the adequate level (70%) in most of the scenarios.

#### 4.3.3 Comparison between scenarios where the Income Replacement Ratio is the highest and the lowest for every contribution rate ranging from 5% to 20%.

Every employee desires an adequate IRR that will be enough to cater for their retirement expenditure and maintain the living standards they had prior to retirement. Therefore, the scenario where IRR is the lowest is referred to as the worst-case scenario while the scenario where the IRR is the highest is referred to as the best-case scenario.

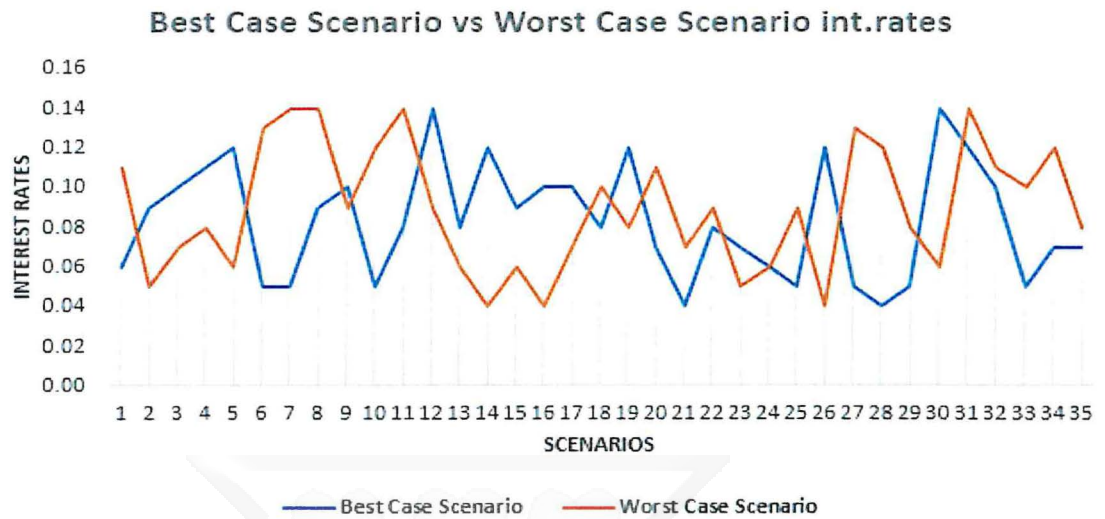
##### *4.3.3.1 Worst-case scenario.*

This is the scenario where by the IRR was the lowest compared to all the scenarios. In the model, this is scenario 11. The IRR was the lowest in this case due to the unfavorable interest rates as illustrated in figure 4.5, thus the contributions made into the pension fund accumulated at the lowest rates compared to the other scenarios.

##### *4.3.3.2 Best-case scenario.*

This is the scenario where by the IRR was the highest compared to all the scenarios. In the model, this is scenario 22. The IRR was the highest in this case due to more favorable interest rates thus the contributions made into the pension fund accumulated at higher rates compared to the other scenarios. A higher amount of accrued contributions will result to a higher annuity amount received in retirement assuming that all the funds are used to purchase a whole life annuity upon retirement. This will therefore result to a higher IRR as compared to the scenario where the interest rates are less favorable.

Figure 4.5 Interest Rate comparison between the best-case scenario and the worst-case scenario.



In the worst-case scenario, a minimum contribution of 5% will result to an IRR of 30.04% for male annuitants and 28.27% for the female annuitants while a maximum contribution of 20% will result to an IRR of 60.07% for male annuitants and 56.55% for the female annuitants as denoted in table 4.6.

In the best-case scenario, a minimum contribution of 5% will result to an IRR of 53.30% for male annuitants and 50.18% for the female annuitants while a maximum contribution of 20% will result to an IRR of 106.61% for male annuitants and 100.36% for the female annuitants.

Table 4.4 IRR comparison between the best-case scenario and the worst-case scenario.

	Contribution rate	Worst Case Scenario		Best Case Scenario	
		Males IRR	Females IRR	Males IRR	Females IRR
(min. cont.rate)	5%	30.04%	28.27%	53.30%	50.18%
	6%	32.04%	30.16%	56.86%	53.52%
	7%	34.04%	32.04%	60.41%	56.87%
	8%	36.04%	33.93%	63.96%	60.21%
	9%	38.05%	35.81%	67.52%	63.56%
	10%	40.05%	37.70%	71.07%	66.90%
	11%	42.05%	39.58%	74.63%	70.25%
	12%	44.05%	41.47%	78.18%	73.59%
	13%	46.06%	43.35%	81.73%	76.94%
	14%	48.06%	45.24%	85.29%	80.29%
	15%	50.06%	47.12%	88.84%	83.63%
	16%	52.06%	49.01%	92.39%	86.98%
	17%	54.07%	50.89%	95.95%	90.32%
	18%	56.07%	52.78%	99.50%	93.67%
	19%	58.07%	54.66%	103.05%	97.01%
(max. cont. rate)	20%	60.07%	56.55%	106.61%	100.36%

This therefore illustrates that adequacy of retirement benefits is unfeasible when the contributions are invested in strategies that earn unfavorable interest.

#### 4.4 Discussions.

The study found out that in every scenario and at any given contribution rate, the male annuitants IRR is higher than that of female annuitants'. This is due to the fact that the mortality rate for the male annuitants is higher than that of the female annuitants at the point of purchasing the annuity, i.e. at age 60. Therefore, the annuity amount for the male annuitants will be higher than that of the female annuitants at any given point since they are expected not to live longer than the female annuitants. For that reason, the male annuitants are able to receive an annuity amount that is more adequate compared to that of the female annuitants, and that is able to maintain their pre-retirement living standards. As a result, the female annuitants are required to save a higher percentage of their salary than the male annuitants during their working life so as to be able to earn a pension that will be sufficient enough to cover their retirement needs.

From the analysis, it is evident that a higher contribution rate will result to a higher IRR for a given level of salary. This is because a higher contribution rate will result to

a higher amount of accrued contributions upon retirement. This value of accrued contributions will be used to purchase a whole life annuity which will result to a high annuity amount received as a pension after retirement. The higher the annuity amount, the higher the likelihood of pension adequacy as the annuitant is at a better position to cater for his retirement expenditure and maintain their standards of living prior to retirement, hence the higher the IRR. It therefore goes to show that employees who save more during their working life will be able to achieve a pension that is adequate.

In the worst-case scenario i.e. when the IRR is the lowest due to unfavorable interest rates, all the IRRs for both male and female annuitants fall below the adequate IRR of 70% for the given range of minimum and maximum employee's contribution rates. In this case therefore, a male annuitant who contributed 20% of his salary during his working life will only be able to generate 60.07% of his pre-retirement income. Similarly, a female annuitant who contributed the maximum rate of 20% of her salary will only be able to generate 56.55% of her pre-retirement income. This therefore illustrates that the interest earned by the contributions made towards the pension fund influences the adequacy of the retirement benefits.

In the best-case scenario, i.e. when IRR is the highest due to favorable interest rates, some of the IRRs are above the adequate IRR of 70% for a given level of contributions. For instance, a male annuitant who contributed a minimum of 10% of his salary during his working life will generate an IRR of 71.07% while a female annuitant who contributed a minimum of 11% will be able to generate an IRR of 70.25%. Since the interest rates are more favorable in this case, the employee will be required to contribute less in order to achieve an adequate pension unlike in the worst-case scenario where by the employee is required to contribute more due to the less favorable interest rates in order to achieve pension adequacy.

## 5 CONCLUSIONS AND RECOMMENDATIONS.

### 5.1 Introduction.

This chapter consists of conclusions relating to the research objectives, suggestions or recommendations on the adequacy of retirement benefits and finally areas that need further research.

### 5.2 Conclusions.

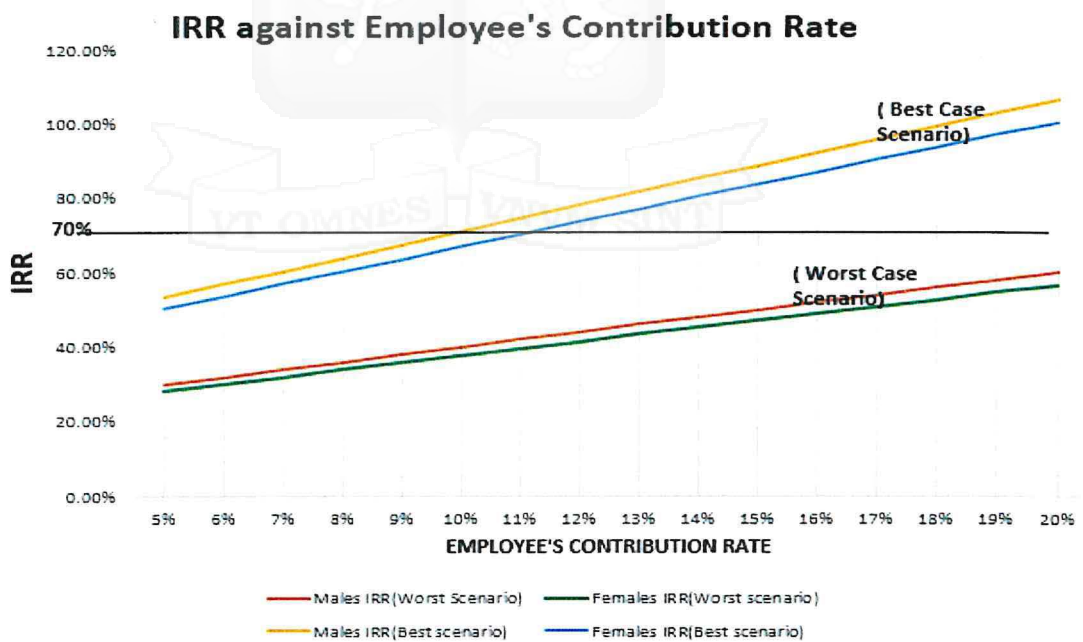
The purpose of this study was to determine how the employees' contribution rates can be varied, as experience emerges on various parameters including interest earned on contributions and projected retirement salary, with the aim of increasing the likelihood of pension adequacy.

The first objective was to obtain an adequate target pension by forecasting the members' retirement needs. This was obtained from computing the replacement rate, which represents post-retirement income as a percentage of some measure of pre-retirement earnings. It gauges the extent to which benefits replace earnings before retirement and thereby allowing workers to maintain a reasonable approximation of their pre-retirement standard of living. (Munnell and Soto, 2005). A target replacement rate based upon pre-retirement earnings creates a simplified retirement income goal that households can seek to attain. Most financial planners recommend that retirees be able to generate an income equal to roughly 70% of their pre-retirement earnings, though both higher and lower target replacement rates have been proposed.(Springstead and Biggs, 2008).

The second objective was to determine the manner in which the employee's contribution rate can be varied over the member's working years in order to achieve the target pension which is deemed to be adequate. The study illustrated this using two scenarios; one where the IRR generated was the lowest i.e. worst-case scenario, and the other where by the IRR was the highest, i.e. best-case scenario. In the worst-case scenario, all the IRRs for both male and female annuitants fall below the target IRR of 70% for the given range of minimum and maximum employee's contribution rates.

This therefore means that the employee must contribute more than the maximum contribution rate of 20% in order to achieve an adequate pension, which is not achievable as contribution rates must not exceed a pre-stated maximum. Consequently, the dynamic aspect of contribution rates is not achievable in this scenario. In the best-case scenario, some of the IRRs are above the target IRR of 70% for a given level of contributions. This therefore means that adequacy of retirement benefits is achievable for certain levels of contributions. The male employees need to contribute a minimum of 10% while the female employees need to contribute a minimum of 11% in order to achieve an adequate pension of at least 70% of their pre-retirement salary as indicated in figure 5.1. Therefore, with a pre-stated maximum contribution rate of 20%, the dynamic aspect of contribution rates is achievable in this scenario. The males' contribution rate will vary between 10%-20% while that of the females will vary between 11%-20%. These ranges ensure that the IRR is at least 70% which means that the retirement benefits will be adequate at those contribution rates.

Figure 5.1 IRR comparison between the best-case scenario and the worst-case scenario for a given range of contribution rates.



### 5.3 Recommendations on adequacy of retirement benefits.

On the basis of the findings of the study, the following recommendations can be made;

Both public and private sector workers should actively think about their retirement savings by starting to prepare and save for their retirement early enough. They should also not stick to their current contribution levels, but rather increase their savings as adequacy of pension benefits largely depends on the amount that both the employer and employee contribute to the pension plan.

The trustees, pension administrators, custodians and fund-managers of pension plans should review the investment strategies adopted in the scheme in order to determine how much interest is earned by the contributions made towards the pension fund. This is because the interest earned influences the adequacy of the retirement benefits. They should also diversify their investments in order to cushion against adverse changes in market conditions.

Pension Regulatory Bodies such as Retirements Benefits Authority (RBA) in Kenya should formulate rules and regulations governing pension plans, that will ensure that the amount of pension that the retirees receive is adequate. For instance, they can formulate a rule to increase the minimum contribution rate from 5% to say 10%. This will increase the amount of contributions made towards the pension fund, thus increasing the amount of accrued contributions upon retirement. They could also compel pension providers to diversify their investments so as to cushion against adverse changes in market conditions.

The government should incorporate a number of strategies to increase pension saving by increasing the contribution levels such as auto-escalation where a member's contribution rate increases in line with earnings increase. It could as well encourage or enable the provision of information and advice to individuals, or provide better incentives for pension saving so that individuals choose to save more.

#### 5.4 Recommendations for further study.

Studies need to be conducted using more variables that seem pertinent to the study, for instance tax. Members contributions and retirement benefits are usually taxed, with members who contribute more receiving tax relief incentives. The studies should be conducted to investigate the interaction of these other variables that impact the adequacy of retirement benefits.

A replication of this study needs to be done using real life pension schemes' data so as to cover a larger sample and give more realistic insight on how the model can be applied to a pension scheme.



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