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PENSION SCHEME IN KENYA

ANALYSIS OF THE MORTALITY TABLES IN KENYA AND LACK OF LONGEVITY
INSURANCE AS CHALLENGES AFFECTING THE PERFORMANCE OF THE PENSION
SCHEME SYSTEM IN KENYA

Belo Horizonte, MG

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RISK INSURANCE AS CHALLENGES AFFECTING THE PERFORMANCE OF THE
PENSION SCHEME SYSTEM IN KENYA

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ABSTRACT

This paper examines the use of incorrect mortality tables and the lack of longevity risk insurance as challenges affecting the performance of the pension scheme system in Kenya and tries to provide suggestions on ways to mitigate and reduce it.

Keywords: Challenges, Mortality table, Longevity risk, Pension scheme systems, Performance.

CHAPTER ONE: INTRODUCTION

Kenya is a developing African country; it is considered to be one with the largest number of private and individual retirement benefit pension schemes among the East African Community (EAC) countries. An increasing number of African countries have recently initiated reform of their pension and social protection systems. Over the last decade, Kenya has also undertaken a major reform of parts of its pension scheme system and its major driver for reform was to strengthen the governance, management and effectiveness of the existing pensions system. As much as the reforms on the pension system are ongoing, it is still faced with challenges and difficulties that if resolved will make the system more reliable (Sundeeep K Raichura, September 2008).

The population structure of the Kenyan population, like that of other developing countries, has changed drastically in the recent decades due to the proportion of elderly people while the birth rates remain low and continue to decline thus reflecting a country that is advancing in its demographic transition and a country that is continuously going through developments. These new trends have caused tension in the pension scheme system of Kenya.

First of all, it is necessary to clarify how social security can impact a society in terms of age structure and vice versa. The basic concept of social security is that people contribute to the program while they work in order to receive a monthly retirement benefit in old age. These programs take into account the principles of fairness and adequacy, as there must be a balance between the two. Equity can be described using these simple examples, those who can contribute more during their working years should reap more benefits during their retirement than those who contribute less. On the other hand, adequacy refers to the calculation of benefits. Various pension systems, including the Kenyan model, do not take into account years of low income of those insured (Central Bank of Kenya (CBK); NSSF Kenya, 2013). On one hand, according to Gruber and Wise (1998), the drop in participation in the labor market was impacted by the incentive to leave the labor force given the benefits offered by the social security. That is, the individual can decide whether it pays to stay in the job market or to retire depending on the level of benefits they would receive, and in several countries the option to retire from the labor market is more attractive than continuing to work, whether the benefits are of monetary value or not. On the other hand Melis Guven (July 2019) argues that the increase in the informal work market which currently accounts for 83.1% of the work force and an increase in the opportunities of jobs are factor

affecting the labor market, where on one side there is a drop in the formal labor market, but an increase in the informal labor market that at most times is not covered by the pension scheme system while on the other side there is a slight increase in the labor market due to an increase in job opportunities.

In view of the disproportionality between the elderly and the young population (World Bank, 2016), social security is essential in the fight against poverty among the elderly population, because many elderly people, especially those without families, depend on these benefits as it is the only means of resources other than family support (Quashie 2015; Rawlins 1999). As the main focus is to sustain the elderly people, decisions made now about pensions will have an impact on the income for future retirees. Due to longevity risk which is defined as the risk of underestimating the survival probability leading to inappropriate premiums; being risk derived from a future mortality rate which ex-post reflects not the forecasted on, (Brouhns, Denuit, & Vermunt, 2002). With the reality of an expected future graying population and a decreasing youthful population, the raising of funds to pay future benefits has been a challenge and remains a worrying factor on the performance and future sustainability of the pension scheme systems in Kenya. These trends necessitate that the pension funds are shrunk and thus leading to the reform of the pension scheme systems. This in turn gives a chance to redefine the means of capturing resources and granting out the benefits.

The purpose of this study is to model uncertainty about the future based on mortality rates and life expectancy while understanding the challenges caused by the usage of improper mortality tables and the lack of proper longevity risk insurance as shall be seen in the longevity risk trends in the life insurance markets and the pension scheme sector of Kenya through the usage of the Lee Carter projection method.

Several studies and research have been conducted both locally and internationally with the aim of establishing the challenges affecting the performance of pension scheme systems. Internationally, some of the studies are; Tingo, Alfred (2014) conducted in Uganda to ascertain the poor implementation of policies and laws in pension funds, the study noted lack of qualified personnel in HR and poor legal framework in the implementation, monitoring and evaluation by the management as the main challenges. Mushi (2017) conducted research in Tanzania to come up with reforms to the pension fund administration to help solve problems caused by increasing life expectancy in the country and came up with the following measures; increasing the retirement age

and increasing the contribution rate. Adesodun Isaac and Raphael Dada (2012) conducted a study in Nigeria to establish the pension fund system in the country, the finding of the study noted challenges of mismanagement by fund managers and ill structured and unfunded schemes.

Some of the local studies include S. K. Raichura (2008) analytical review of the pension system in Kenya and found out that demographic aging, changes in environment structures and change in the social fabric of the country are some of the challenges. A. G. Njuguna (2010) studying strategies to improve pension fund inefficiency in Kenya established that untimely processing of pension benefits, ineffective internal control systems, inefficiency in conducting trustee meetings and compliance with the pension legislation as some of the major challenges. K. C. Ngetich (2012) studying determinants of the growth of individual pension schemes in Kenya found out that regulations, investment strategy, fund ethics, and fund governance as some of the challenges.

Numerous researches have been carried out in the pension industry but I was not cognizant of any of them that have satisfactorily addressed the challenges related to the use of inefficient mortality tables and the lack of longevity risk insurance facing the performance of pension scheme systems in Kenya. There was a research gap in relation to these two challenges facing an effective pension fund system. The study intended to answer the following questions; *how are the challenges affecting the performance of the pension scheme system in Kenya? What measures are being put in place to mitigate these challenges?*

The main research objectives for this study are:

- 1 *To determine how the use of inefficient mortality tables and the lack of longevity risk insurance are challenges affecting the performance of the pension scheme system in Kenya by studying the specific mortality rates by sex and age for the years 1950 to 2015.*
- 2 *Projecting the specific mortality rates in Kenya from the year 2015 to the year 2050 by sex and using the Lee Carter method.*
- 3 *To provide suggestions on ways to mitigate and reduce the effects of the named challenges affecting the pension scheme system in Kenya.*

CHAPTER TWO: LITERATURE REVIEW

This section aims at giving an overview of the correlation between the mortality rate and its projection and usage of wrong mortality tables as well as the reality of the life expectancy at birth and its projection and how it points towards an aging population that causes the risk of longevity and how it directly affects the performance of the pension scheme system in Kenya. Around the world, an aging population which is directly related to the rise in longevity risk is a source of controversy in governments, as it is the main cause of the future instabilities of most pension scheme systems.

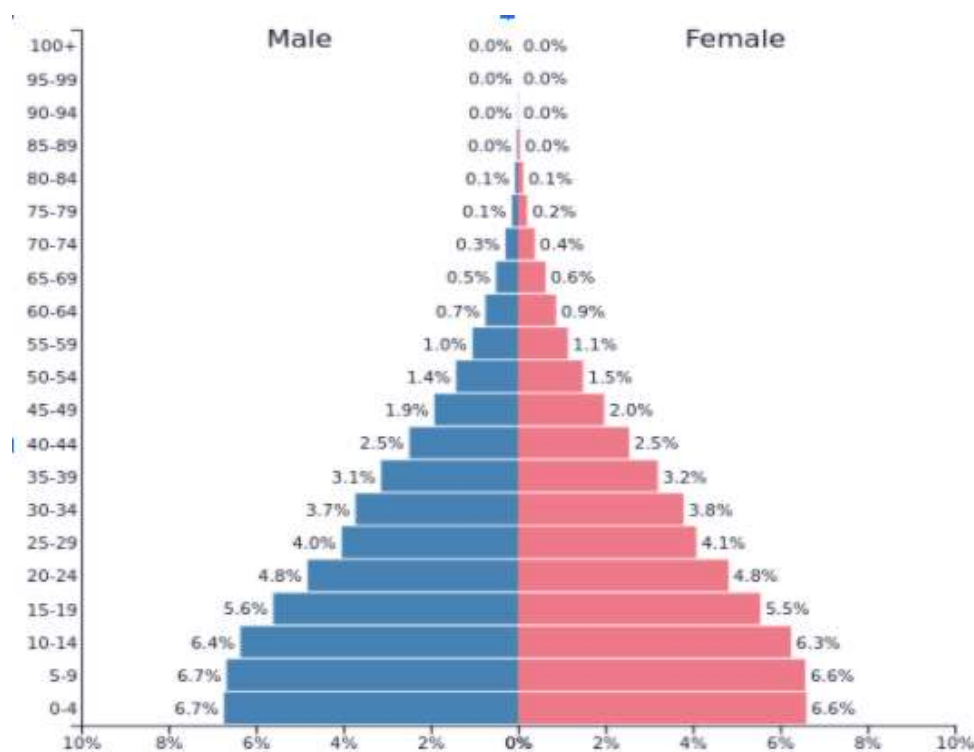
2.1 General view of Kenya.

Kenya, which is officially known as the Republic of Kenya since the year 1963, is a country in Eastern Africa. At 580, 367 square kilometers, Kenya is the 48th largest country by total area and with a population of about 47,56 million as of 2019 according to the Kenya National Bureau of Statistics and stands at the position of the 29th most populous country. As of 2020, Kenya is the third largest economy in sub-Saharan Africa after Nigeria and South Africa. Kenya is bordered by South Sudan to the northwest, Ethiopia to the north, Somalia to the east, Uganda to the west, Tanzania to the south, and the Indian Ocean to the southeast. A major achievement for the country is the fact that it is a member of the United Nations, Commonwealth of Nations, World Bank, International Monetary Fund, COMESA, International Criminal Court and other international organizations. Kenya is a lower-middle-income economy, but it still has the largest economy in eastern and central Africa, with Nairobi which is the capital city serving as a major regional commercial hub. Agriculture is the largest sector: tea and coffee are traditional cash crops, while fresh flowers are a fast-growing export. The service industry is also a major economic driver, particularly tourism. Kenya is a member of the East African Community (EAC) trade bloc, though some international trade organizations categorize it as a part of the Greater Horn of Africa. (Wikipedia, <https://en.wikipedia.org/wiki/Kenya> ; Kenya National Bureau of Statistics).

2.1.1 Demography of Kenya.

Like most African countries, Kenya has a young population as illustrated in graph 1 below. With a fertility rate of about 3.41 births per woman as of 2020, which is a 1.5% decline as of 2019 (United Nations- World Population Prospects, 2020, <https://population.un.org/wpp/>). As much as it is dominated with a young population the reality of an aging population and that of longevity risk is constantly clear as the country is undergoing a demographic transition phase.

Graph 1: Population pyramid of Kenya as of the year 2019



Font: <https://www.populationpyramid.net/kenya/2019/>

The fact that as of 2019 there were still many births gives the population an opportunity to rejuvenate its young population and in the long run reduce the risk of a highly aging population that is a transition the country is currently experiencing and is projected to even get intensified in the future as shall be seen in the study.

2.2 Overview of the Pension scheme system of Kenya.

The pension scheme system of Kenya is divided into different structures, namely: i) the National Social Security Fund (NSSF), ii) Public Service Pension Scheme (PSPS), iii) Private Occupational Pension Schemes or Voluntary Occupational Pension Schemes, iv) Individual Retirement Savings or Individual Personal Pension Plans (IPPS). These structures are regulated by the Retirement Benefits Authority (RBA) and tax implications controlled by the Kenya Revenue Authority (KRA). In recent years insurance companies have entered the pension scheme market by establishing their pension fund management as a separate department in their individual firms. New regulations were in turn introduced to govern the management of pension funds. The fundamental principles of the new regulation by the RBA are founded on the basis of ensuring the protection of members and the improvement of the governance of the schemes.

The National Social Security Fund (NSSF) was established in 1965 by an Act of parliament Cap 258 of the laws of Kenya in order to administer a provident fund scheme for all workers in Kenya. Initially the fund operated as a government department under the ministry of labor but as its membership grew and its operations became complex, the NSSF Act was amended in 1987 to transform it into an autonomous state corporation. Since 1988 the fund has been operating under a board of trustees, which is contributed by representatives of three key stakeholders; the government, workers and employees, (NSSF, Kenya Website). The scheme membership is mandatory for workers in the formal sector which accounts for 17% of the total work sector where they are employed by an employer with more than five employees. The civil service workers, those of state corporations which were under the previous East African Community and senior categories of employees of local authorities and public universities are covered by separate pension schemes. The scheme is financed entirely by employer/employee contribution set at 5% of wages based on a ceiling of kshs.400 per month. (Source: NSSF Act laws of Kenya). Legally the fund is expected to comply with the regulation of the Retirement Benefits Authority (RBA); the arbitrator in case of disputes is the Retirement benefits authority. The second pillar of pension scheme in Kenya is the Pension Scheme for public service employees and Armed Forces which are governed under Pension Act and regulations. The Public Service Pension Scheme (PSPS) covers approximately 406,000 civil servants, teachers, police and prison staff and just over 180,000 pensioners. Separate arrangements apply for the Armed Forces and other military personnel, PSPS operates as a defined benefit basis and is noncontributory other than modest contributions at 2% of salaries by male

employees towards widows and orphans' benefits. Benefits vest after ten years of service and there is no portability of benefits and individuals who resign from service before retirement are not entitled to any benefits. (Source: Pensions Act, Cap. 286 Kenyan law). Another pillar for pension schemes in Kenya is the Voluntary occupational schemes. Occupational schemes are schemes set up by employers for the benefit of their staff. Such schemes are voluntary and are established under trust. Occupational pension schemes are regulated by the Retirement Benefits Authority under the Retirement Benefits Act. There are no minimum requirements in relation to the levels of contribution by employers and staff, (Source: RBA ACT, laws of Kenya). The total number of occupational schemes is currently indicated at 1,379 of which 10.4% are defined benefit schemes and 89.6% are defined contribution schemes. The total contributing membership of pension schemes is estimated at about 300,000 (or 16% of the formal sector employment) all of whom are also required to be members of the NSSF and make statutory contribution to NSSF. (Source: RBA website). The total Assets of occupational schemes are estimated at Kshs.181 billion and are more than double those of NSSF. Thus, the occupational retirement schemes sector in Kenya whilst smaller in terms of membership than NSSF is larger in terms of invested assets reflecting the higher average contribution to occupational schemes. The last pillar of the pension scheme system in Kenya is the individual Personal Pension Plans (IPPPs). They comprise schemes set up by institutional providers to target individual members not necessarily tied to an employer or any formal setting. Although the numbers of IPPPs in the market have grown from 1 to 17 in a ten-year period; the membership is currently less than 10,000. Individual lives have failed to track this growth. The majority (11 out of 13) of the IPPPs in the market are offered by insurance companies.

Retirement Benefits Authority has been promoting and encouraging the growth of such schemes as a means to increase coverage amongst the self-employed and the estimated Individual Pension Plans asset value of kshs.2 billion is expected to grow with more focus and strategic action by stakeholders and market players. The pre - RBA era in Kenya saw a retirement benefits sector with little effective regulation and supervision. The interests of retirement scheme members and their beneficiaries were not sufficiently protected, (Source: RBA Kenya website).

As much as we have an established pension scheme system in Kenya, they face a range of challenges that have an impact on their performance. According to research formerly done and stated previously, millions of retirees all over the world depend mainly on pension funds. Due to

their ability to pool resources together, these funds ensure that capital is available for investment thus making a significant close relationship with the government to develop the industry and provide advice on necessary reforms contribution to the gross domestic products.

The pension scheme system in Kenya as stated earlier on is divided into different segments, but it is important to note that the availability of a variety of divisions does not allow us to ignore the fact that a large part of the population is not included in it and hence the effort to ensure constant developments and changes in order to enable it to be accessible to the larger population. This is a problem that is faced in most developing countries due to inaccessibility to proper information by the population at large. One of the main reasons for the low uptake is that pension services are designed for workers in the formal workplace who are less than 20 percent of the working population. More than 80 percent of Kenyan employees work in the informal sector where they lack proper channels for contributing to retirement schemes. The other hurdle is that most Kenyans, especially in rural areas lack knowledge about saving for retirement. In an effort to increase awareness, the Retirement Benefits Authority regularly conducts educational tours throughout the country.

The Pension Schemes have a number of benefits to the common citizen if rightfully accessed and properly administered. When those people who are included in the pension scheme systems come to retire they will experience a reduction in income, in the case where a pension makes up for some of the loss of income in retirement; the pension schemes can provide protection in the form of lump sums and pensions to beneficiaries and dependents in the event of a member's death and in order to encourage pension schemes, the State provides tax relief on contributions made to pension schemes and the growth in their investments:-

(https://www.pensionsauthority.ie/en/lifecycle/why_save_for_retirement/the_importance_of_pensions/).

In the rural areas the Pension scheme programs are being introduced to the people through the banks being established and various insurance companies. It is important to note that the masses in the rural area are not well informed on the pension scheme programs available as well as proper insurance and that in turn makes it difficult for the proper running of the pension scheme system in Kenya and its performance in general (Melis Guven, No.1993, July 2019).

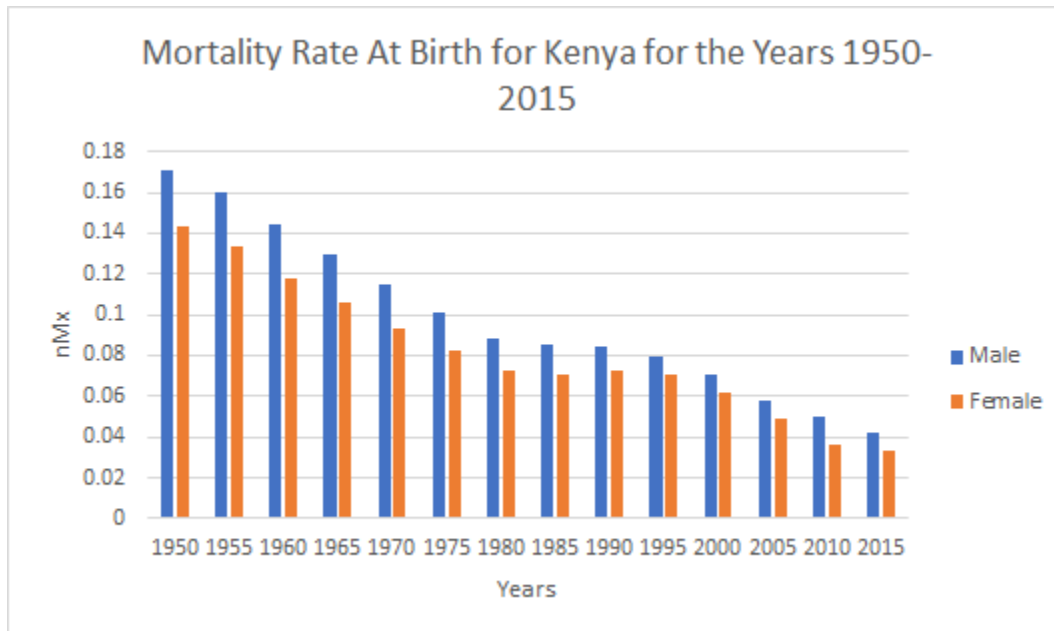
This study may end up contributing to the body of knowledge relating to challenges facing the performance of Pension Schemes' in Kenya. The findings of this study in relation to the current functioning of the pension scheme systems in Kenya that is faced with the challenge of a growing and aging population that is currently not adequately catered for will enhance in the betterment of the performance of the area of the pension scheme system in Kenya. Findings from this study may be useful in the following ways: The findings might be of benefit to the managers of the Pension Scheme in that the study seeks to determine how the challenges are affecting the pension funds' system and recommend possible solutions to the challenges. The study might help members of the Pension Schemes in that they might understand exactly what is happening in the institutions managing their funds thus able to take necessary action such as demand for more transparency in the fund's management.

The study in the long run will also be fundamental to both government and the regulators, Retirement Benefits Authority (RBA) in the formulation, development, and supervision of guidelines and policies that will be crucial in addressing the stated challenges that influence the performance of pension systems, leading to the development of the pensions sector in the country. This will be made possible if the RBA keenly considers the effects and challenges caused by the usage of incorrect mortality tables and the lack of proper longevity risk insurance on the performance of the pension scheme systems and in turn coming up with policies and regulations that make sure the problems are catered for and solved so as so help in properly accommodating the aging population that is currently not properly covered by the present regulations.

2. 3 Mortality rates in Kenya.

Information on a country's mortality has come to play an important and diversified role in national planning. Mortality data help to identify a country's current demographic situation and to make clear its immediate demographic future. But beyond their role in demographic accounting, mortality data are serving as important indicators of socio-economic and health progress. They chart progress in one of the areas of most universal human concern, the lengthening of life and avoidance of premature death. They are also sensitive indicators of differences, within a national population, in the degree of progress towards modern conditions, thereby helping to identify target groups for special health and development programs as well as pension scheme systems.

Graph 2: Mortality rate at birth for Kenya for the years 1950-2015

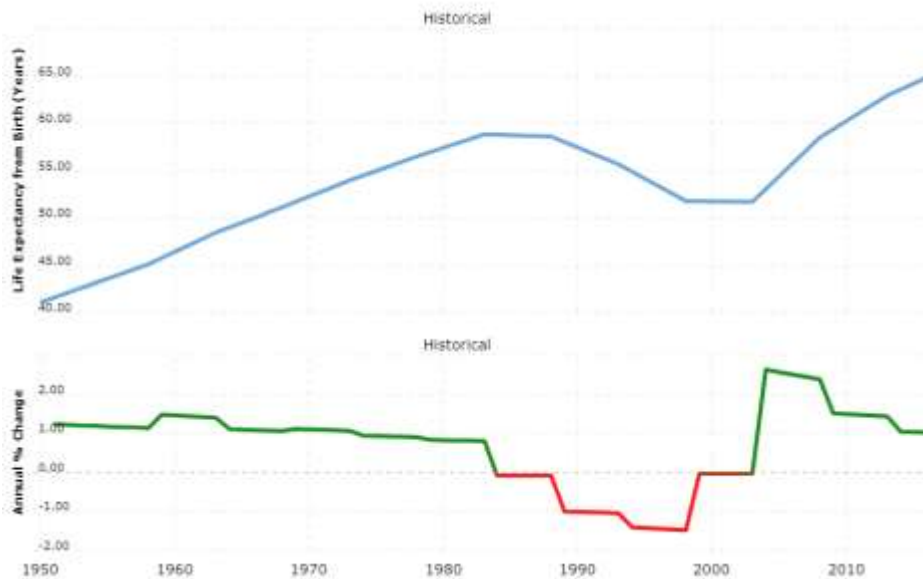


Font: United Nations 2019, <https://population.un.org/wpp/> ;and elaborated by the author.

Graph 2 illustrates the mortality rate at birth for the Kenyan population for both men and women from the years 1950 to 2015. Upon analyzing the graph, we can note that there is a consistent drop in the mortality rate at birth for both sexes over the years. It is also important to note that as much as the mortality rates are dropping for both sexes, there is also consistency in the fact that the mortality rate for the men is higher throughout all the years. In graph 3 we see the life expectancy at birth as well as the variations in the changes over the years for the population of Kenya where in the year 1950 the life expectancy at birth was that of 42.6 years and it rises over the years, but we cannot ignore the drop in life expectancy between the years of 1995 to 2005 where the life expectancy at birth is of about 51.8 years. The life expectancy thereafter continues to rise and is at 62.9 years in the year 2015. Other than the drop in the life expectancy at birth for the years between 1985 to 2005 we can say that Kenya was already in a process of declining mortality rates at birth and an increasing life expectancy at birth for the population. It is important to mention the adverse effects of the pandemic that is HIV/AIDS when it affected the Kenyan population from the years 1985 up until 2000 and caused a huge drop in the life expectancy at birth and a high mortality rate amongst the Kenyan population. This is because when the pandemic first hit Africa it came with a lot of stigma, thus those who got infected shied away from seeking the little medical help that was

available and in turn that increased the rate of infection amongst people resulting in high mortality rates.

Graph 3: Life expectancy at birth for Kenya and its variations over the years of 1950-2015



Font: United Nations, <https://population.un.org/wpp/Graphs/>

2.4 Performance and its measurements.

Performance is the prospective for the successful execution of actions in the future so as to achieve set goals or targets (Lebas, 1995). It has quite a number of meanings that are used freely in society and that tells something to everyone (Otley, 2001). Lebas categorically describes it as future-oriented and not so much about past accomplishments. Otley gives the definition of a business context classifying it into two dimensions, effectiveness and efficiency.

Practically, the effectiveness of achieving the desired outputs and the efficiency of utilizing fewer but optimum inputs in obtaining the desired outputs. Performance management systems can either be control systems or decision-support systems depending on their usage (Malmi & Brown, 2008). Therefore, the use of performance measurement systems can be categorized and analyzed for various perspectives. With suggestions from Malmi & Brown, performance measurement systems can be evaluated based on their utility either in influencing decision making or control processes.

Traditionally, performance measurement was mostly linked to diagnostic controls as they included monitoring and evaluation of performance, decision making and finally communication and feedback on performance. In Simon's framework, there is a contrast in the inclusion of communication under diagnostic controls whereas communication is essential in promoting learning and provoking interactions through conversations and discussions. (Tuomela, 2005). To this study, there is relevance in the distinction of uses of control both diagnostic and interactive.

In conclusion, performance measurement is a crucial part of monitoring the organization's progress. It basically entails comparing the actual performance outcomes with the intended goals. (Michael Stanleigh, 2015) and for an organization to effectively measure its performance there is a need to identify the various performance measures to be used which are appropriate to their core business (Kirkendall, 2009).

2.5 Challenges affecting performance.

Organizations today face numerous challenges that may cripple their operations and in some extreme cases may render some organizations outdated and the pension scheme system of Kenya is not an exemption. These challenges are common among all the entities but they can also be unique depending on the industry or type of service they offer and in the case of the Pension scheme system of Kenya the two main challenges to be discussed are the lack of longevity risk insurance and the lack of proper mortality tables as shall be seen below.

2.5.1 Lack of longevity risk insurance.

The term longevity risk has been widely spoken of over the years globally, but it cannot be discussed without being linked with the reality of an aging population. This is because the rapid aging of the population and longevity continue to put great pressure on the future sustainability of the pension scheme system (Gruber and Wise, 1998). Longevity risk can be defined as the risk of the members of a pension plan or policy holders of certain annuities and life policies living longer than expected (Julian Kagan, <https://www.investopedia.com/terms/l/longevityrisk.asp>). One important risk to individuals who are spending down savings is that they are going to live longer than expected and thus exhaust their savings, dying in poverty or burdening relatives.

Mortality improvements, uncertainty in future mortality trends and the relevant impact on life annuities and pension plans constitute important topics in the field of actuarial mathematics and life insurance techniques. In particular, actuarial calculations concerning pensions, life annuities and other living benefits (provided, for example, by long-term care insurance products and whole life sickness covers) are based on survival probabilities which necessarily extend over a long-time horizon. In order to avoid underestimation of the related liabilities, the insurance company (or the pension plan) must adopt an appropriate forecast of future mortality. Great attention is currently being devoted to the management of life annuity portfolios, both from a theoretical and a practical point of view, because of the growing importance of annuity benefits paid by private pension schemes. In particular, the progressive shift from defined benefit to defined contribution pension schemes has increased the interest in life annuities with a guaranteed annual amount (Pitacco and Denuit, ANO).

Substantial improvements in longevity at older ages during the 20th century have challenged longevity risk management in pension funds that originally reserved using what would now be considered incorrectly diminished mortality rates. A 2006 study of the companies in the United Kingdom's index found that many companies had based their estimates of pension liabilities on mortality tables that underestimated expected lifetimes by not recognizing improving longevity, and that recognizing this underestimation of expected lifetimes would cause the aggregate deficit in pension reserves, to more than double from £46 billion to £100 billion (Jardine Lloyd Thompson, 2006). This in the long run will be the case of Kenya if the mortality rates are not accurately calculated and the pension funds are not properly managed to cater for longevity risk. In turn we can say that the lack thereof of proper longevity risk insurance affects the performance of the pension scheme system where it is unable to properly cater for the people who are registered and in turn causes a strain on the finances. The effect is thereafter transferred to the actively working and contributing population so as to be able to try and give a decent pension to the older and ageing population that lives longer than is expected and has no form of insurance cover for the risk.

2.5.2 Lack of proper mortality tables.

A key challenge in the performance of the pension scheme system in Kenya is that of estimating life tables due to lack of proper mortality data, which in turn leads to inefficient mortality tables. This in turn makes it hard to have full confidence and validity of the values to be applied and thereafter projected.

Mortality tables can be defined as tables that show the rates of deaths occurring in a defined population during a selected time interval, or survival rates from birth to death in the most accurate form possible. Therefore, inefficient mortality tables can be defined as the inability of the tables to show the rates of deaths occurring in a defined population during a selected time interval, or survival rates from birth to death in an accurate manner. Having inefficient mortality tables developed from Kenya's mortality experience forced the country to use mortality tables from countries such as South Africa and the United Kingdom. The tables specifically used were from the years of 1985 to 1990 in South Africa and the years 1950 to 1955 in the United Kingdom. The Kenyan insurance industry developed the first mortality tables based on the experience of assured lives in Kenya in 2009 that is the KE2001-03, but due to the inconsistency in regular updates the mortality assumptions at most times end up not matching the mortality experience of the Kenyan population.

As mortality is a factor affecting all countries around the world, studies in Africa show different variations in relation to topics related to mortality. Menashe-Oren, Ashira, and Guy Stecklov discuss the urban-rural disparities in adult mortality in Sub-Saharan Africa (SSA) where there is higher survivorship in urban areas which supports a theory of rural disadvantage. The evidence is mostly built on infant or child mortality and there is practically no empirical evidence comparing adult mortality levels across urban and rural sectors. Based on country averages over all time periods, the mean mortality rate is 0.274 and 0.265 among adult women and 0.307 and 0.292 among adult men in urban and rural populations, respectively. The average urban to rural probability of dying ratio from the most recent data between 2000 and 2010 is 1.08 for females and 1.11 for males in SSA as a whole, indicating an urban penalty. Multiple checks highlight the robustness of the findings by the authors to methodological limitations inherent in the method. Multivariate regression models suggest that as countries develop, excess adult mortality is likely

to shift from the urban to the rural sector. Based on another study carried out by Reniers, Georges, Bruno Masquelier, and Patrick Gerland that was primarily driven by the HIV/AIDS epidemic, but it is still observed that extremely high adult mortality rates in some southeastern African countries are due to the triple burden of infectious and chronic diseases and the relatively high level of deaths due to external injuries. In some countries severely affected by the HIV/AIDS epidemic, adult mortality started to decline again, and that occurred well before the large-scale availability of antiretroviral therapy.

In this specific study we look at a different dimension related to the mortality rate as used for the calculations of future pension benefits and we will use the mortality table from the United Kingdom to show that the inefficiency of mortality tables in the long run affects the functioning of the pension scheme administration in Kenya.

2.6 Summary.

The mortality rate at birth and the life expectancy at birth in Kenya are constantly changing where the latter is decreasing and the former is increasing. With these changes that are expected to continue into the projected future, it is assured that there shall be a strain on the pension scheme system in Kenya if no measures are taken. Therefore, the intentional investment in longevity risk insurance programs and making it a point to educate the masses on the importance of getting the same is a rising issue that requires to be addressed to help better the pension scheme system in Kenya. In the same breath, the implementation of the usage of proper and relevant mortality data to create the mortality tables used is a major factor that affects the overall functioning of the pension scheme system in Kenya.

CHAPTER THREE: RESEARCH METHODOLOGY

The method selected for the research was quite important and this section identified and justified the research methods selected to answer the research question. The research data for this project was centered on secondary data collection primarily from the World Population Prospects 2019 (WPP) which is compiled by the United Nations

3.1 Research design.

This study employed a population projection analysis on the behavior of different segments of the transitioning population of Kenya while considering both age and sex. The idea is to outline a profile of what the future contingent population in Kenya will look like. In this case, the choice of research design is by sex, with a quinquennial age group from Kenya for the years of 2015-2050 while using a base population and following the cohort over time considering fertility and the mortality limit tables in the United Kingdom for the years between 1950-1955. The mortality limit tables for the years of 1950 to 1955 for the United Kingdom were obtained from the United Nation, World Population Prospects 2019 (WPP) and have a life expectancy at birth of 66.77 and 71.94 for men and women respectively in the year 1950. A population is an entire pool from which a statistical sample is drawn (Will Kenton, 2019). The study population in this case is that of Kenya in general for both sexes, with a focus in using the data from the year 1950 to the year 2015 and projecting it till 2050.

In this study the sample size selected is that of the population of Kenya with focus in the years of 1950 to the year 2015 and thereafter projected using Lee Carter to the year 2050. In the same study the data projected to 2050 is to be compared against a sample of mortality data selected from the United Kingdom for the year 1950.

Secondary data was solely used in this research. The data was obtained from the United Nations site under the World Prospect Population 2019 (WPP) and was limited to that related to mortality of both sexes in Kenya for the years ranging from 1950 to 2015. The decision to use secondary data was brought about by the inaccessibility to first hand data from the Kenyan data portal as well as the Ministry of Health in Kenya. The use of secondary data has no expenses at all as it is

accessed from a site with already pre-existing data. The method, though not the best, has advantages in the sense that there is minimal inconvenience as the data is accessed at the comfort of the researcher. It also permits the collection of a lot of data as the data is readily available.

3.2 Lee Carter model.

The Lee-Carter model was developed to predict mortality in the United States for the period of 1933-1987 to 2065 by Ronald D. Lee and Lawrence R Carter. Years later H. Booth and L. Tickle (2008) classified this method in the group of extrapolative methods. Lee-Carter (1992) considers available information and builds up a stochastic model of mortality, which accounts for a mortality level that varies over time as per a single index. The technique is anchored firmly on long term past trends and gives probabilistic certainty regions to its forecasts. This strategy varies from others in that it permits age-specific death rates to decay exponentially unbounded. The model structure is given by:

$$\ln[m_x(t)] = a_x + b_x k_t + e_{x,t}$$

Where:

$m_x(t)$: observed central death rate in the year t

a_x : mean age-specific level of mortality

k_t : a time-trend index of general mortality level

b_x : relationship factor from the age of profile as the k_t varies

$e_{x,t}$: residual; the error term at age x and time t .

The time index k_t captures the key time trend on the logarithmic central death rates at every age. The age element b_x alters the main time pattern in accordance to the rate of change at a specific age against the main trend. The model assumes that b_x does not change over time.

The Lee-Carter model has a number of advantages, among which are its simplicity and that the parameters are parsimonious and easily interpretable. Additionally, the model fits US data for the period 1933-1987 and the G7 countries for the period 1950-1995 very well (Tuljapurkar et al., 2000) and hence allowing it to be applied in other countries at different periods. However, there are shortcomings of this model. The Lee-Carter model assumes that the errors are homoscedastic,

which is quite unrealistic because the variance of the logarithm of the observed force of mortality is much greater at older ages than at younger ages, pointed out by the paper Brouhns et al. (2002). Furthermore, the Lee-Carter model assumes that the sensitivity of log mortality rates at each age (β_t) remains constant, while the paper by Booth, Main Donald & Smith (2002) shows that age-time interaction is highly likely in Australian data. In addition, the paper by Renshaw & Haberman (2006) claims that incorporation of cohort (age-time interaction) effects improves the performance of the Lee-Carter model. Recently, the paper by Leng & Peng (2016) points out that the two-step procedure may lead to inconsistent estimators. Moreover, the paper by Beutner, Reese & Urbain (2017) states that the identification constraint $\sum_{t=1}^T \kappa_t = 0$ becomes a constraint on the possible realization of the stochastic process $\{\kappa_t\}$, therefore, it proposes a so-called plug-in Lee-Carter model where the time-varying variable κ_t is replaced by time series models from the beginning.

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, AND INTERPRETATION

4.1 Introduction.

This chapter presents the data collected secondarily from the United Nation, World Prospect Population 2019 (WPP) and analyses it through various statistical tools to be able to answer the research questions. Graphs, tables and figures have been used to display the data.

The data was based on the case study of the Kenyan population in relation to the mortality rate and longevity risk and lack thereof of proper mortality tables and efficient longevity risk insurance. The data that was gotten in relation to the projection of Kenya is compared to that of the United Kingdom.

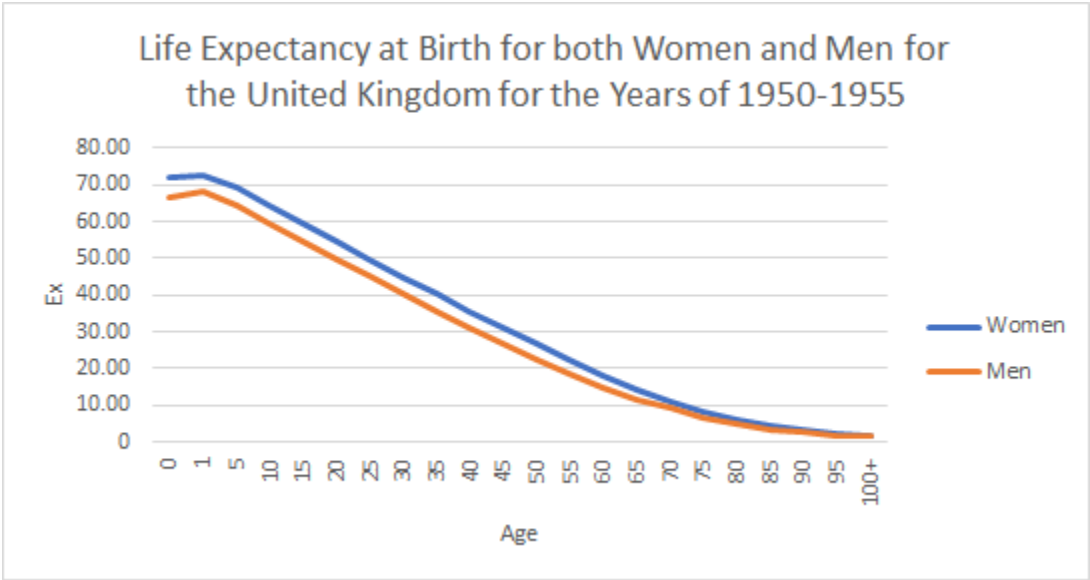
4.2 Projection information.

4.2.1 Projection using the Limit Board method.

As previously mentioned, population projections are critical to analyze behaviors of different segments of the population considering the age group and sex. It is a profile of what the future of a contingent population will look like in a certain location and in this case, it is that of Kenya as seen in the eyes of the past population in the United Kingdom.

The design borrowed considered the sex and a quinquennial age group in Kenya for the years of 2015-2050. Given a base population and following the cohort over time while considering the fertility and mortality limits for the United Kingdom. This mortality limit table that is seen in graph 4 was obtained from the World Population Prospects and has a life expectancy at birth of 66.7 and 71.94 for men and women respectively in the years of 1950 to 1955 .

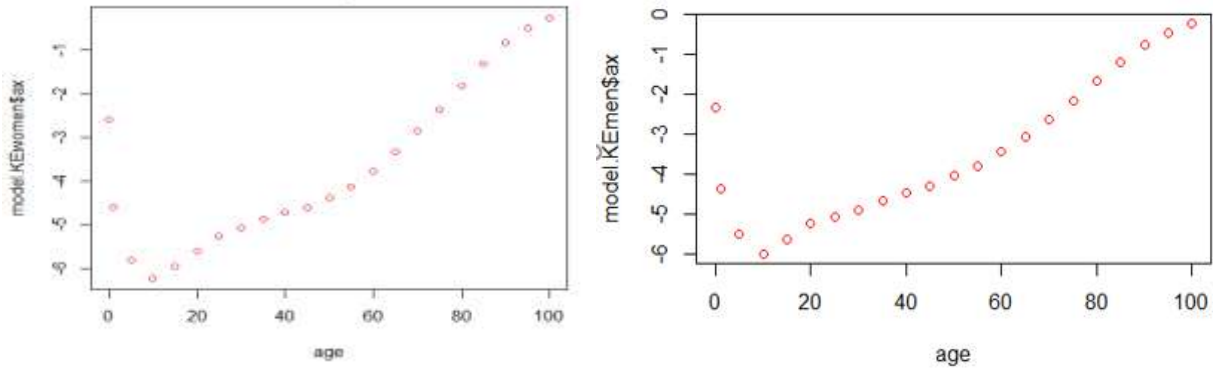
Graph 4: Projected life expectancy at birth for women and men in the United Kingdom from 1950 to 1955



Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

4.2.2 Lee Carter model projection in Kenya.

Figure 1: Estimate of ax for women and men by age in Kenya

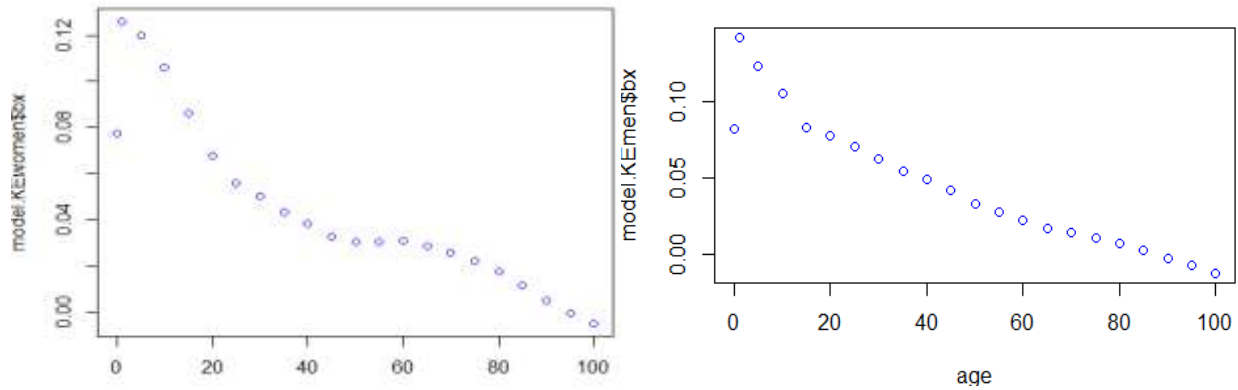


Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

In figure 1 we see the estimated values of ax for women and men in Kenya for the years of 1950 up until 2015. We realize that there is no difference in trends and that the patterns are almost

similar for both sexes. The estimated mean age-specific mortality is initially at a high of about -2.5 for the women and -2.8 for the men. Between the ages of 15 to 20, the ax drops to -6.5 for women and to -6.1 for men. From there the values rise in the following years and reach -0.3 for women and -0.1 for men at the age of 100+. This is a clear indication that the average mortality level increases as the population ages.

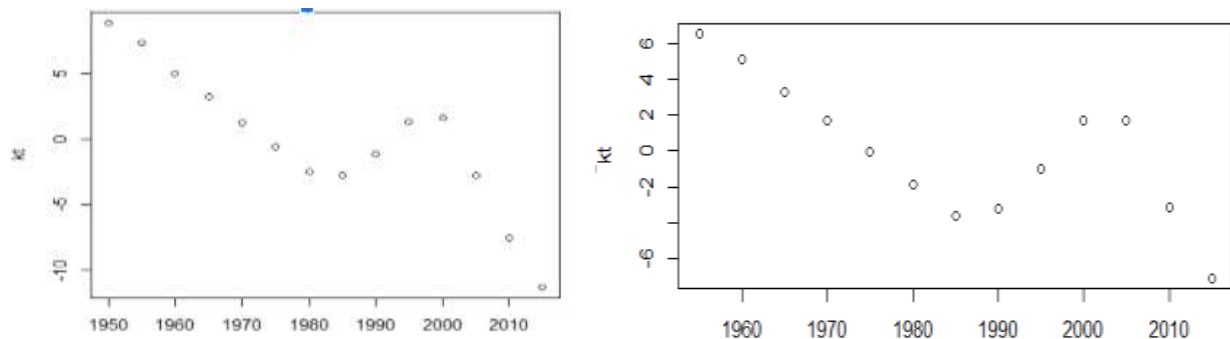
Figure 2: Estimate of bx for women and men by age in Kenya



Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

Figure 2 above shows the trend of the general bx mortality pattern estimated for both sexes for the period of 1950 to 2050. On one hand we have a general drop in the pattern of mortality in all years for both men and women. On the other hand, higher rates are found for women between 15-30 years old, which points to a high death rate in this age group possibly due to pregnancy mostly. Already, between 30-60 years, more exposed to external causes in these ranges, men suffer from higher mortality rates.

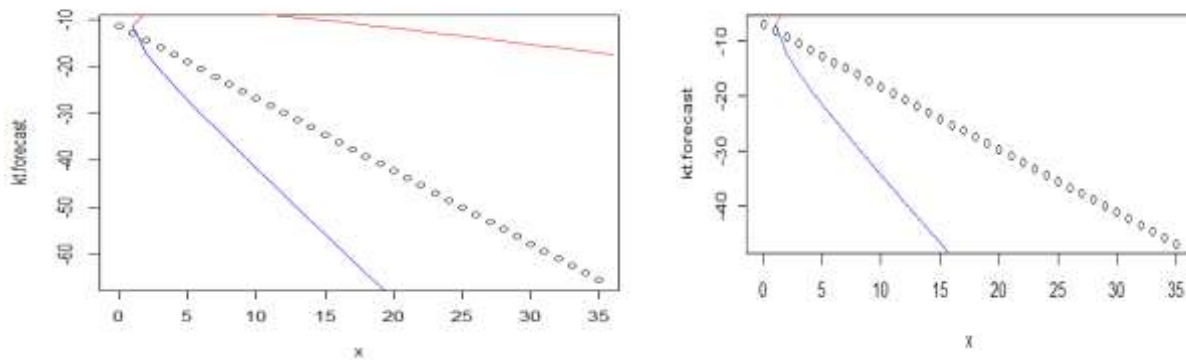
Figure 3: Estimate of kt for women and men by age in Kenya



Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

The kt , which represents the main time trend of mortality, shows a consistent drop between the years of 1950 up until 1985 and is then followed by a certain rise from the years of 1985 up to 2000 which can be mostly explained by the contraction of HIV/AIDS in many African countries, Kenya included. Kenya was one of the country's worst affected by the HIV/AIDS pandemic and data from the National AIDS Control Council indicated that by December 2000, about 2.2 million people in Kenya were living with HIV/AIDS and 13.5 percent of all adults were infected with HIV (NACC, 2001). The data also indicated that by June 2000, about 1.5 million people in Kenya had died of AIDS since the pandemic started in the 1980s. In the adult age bracket of 15-49 years, one in every 8 and one in every 5 were infected with HIV in the urban and rural areas, respectively. In the year 2000, the number of new HIV cases was estimated at 300,000 and about 180,000 people died of AIDS. Each year, about 200,000 people developed AIDS. Most of the people with AIDS do not have access to combination drugs hence live for only a few months to 2 years (Boniface O. K'Oyugi and Jane Muita). From the year 2000 up until 2010 there is a continuous drop as seen in figure 3 above. The continuous drop in mortality as of 2000 means that mortality is decreasing with every passing year and is attributed to the improvement of the quality of life and the use of advanced technology in the medical field.

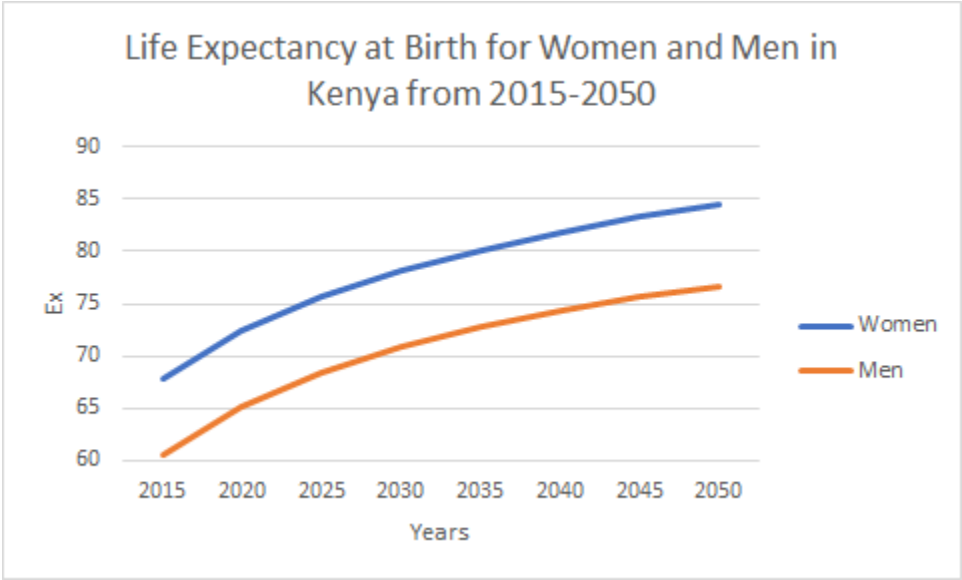
Figure 4: Kt mortality rate model with confidence interval predictions for women and men in Kenya



Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

For the projection by the Lee-Carter method, there are predictions with confidence intervals and that can be seen in figure 4. Following the trend that started in 1950, we see that the general pattern of mortality is expected to continue declining until 2050 for both men and women. It is also expected that in 2050 the mortality rate for women will be lower than that for the men. The variation in the estimates for the men and women can be attributed to the better health care that women procure all throughout their lives as compared to the men who procure health care services mostly when a health issue arises. In conclusion we can say that the model has a negative slope over the years for both the women and men.

Graph 5: Projected life expectancy at birth for women and men in Kenya from 2015 to 2050

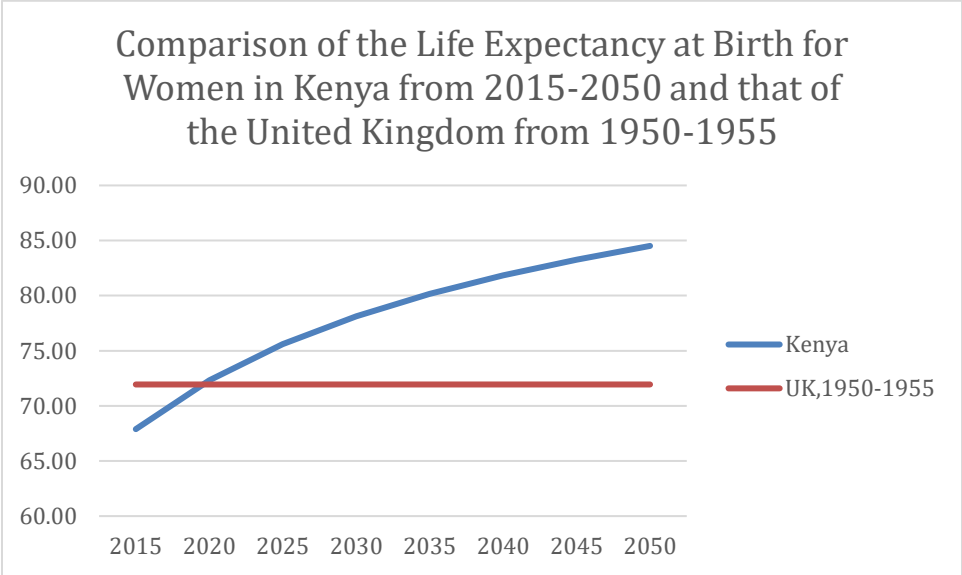


Font: elaborated by the researcher.

Looking at the comparison for the projected life expectancy at birth for both men and women, it is evident that the women have a higher life expectancy as compared to the men. But it is still important to note that as much as the life expectancy at birth for men is slightly lower, it is still one that is rising over the years as is expected considering the conditions that in the latter years caused the life expectancy to be lower have now been taken care of or are still being catered for thus allowing the possibility of higher life expectancy in the Kenyan population as time goes by. The life expectancy for the women rises from 67.89 years in 2015 to that of 84.51 years in the year 2050 and for the men it rises from 60.62 years in the year 2015 to that of 76.64 years in the year

2050. It is equally important to note that for both sexes the life expectancy is increasing approximately with two years for every five years.

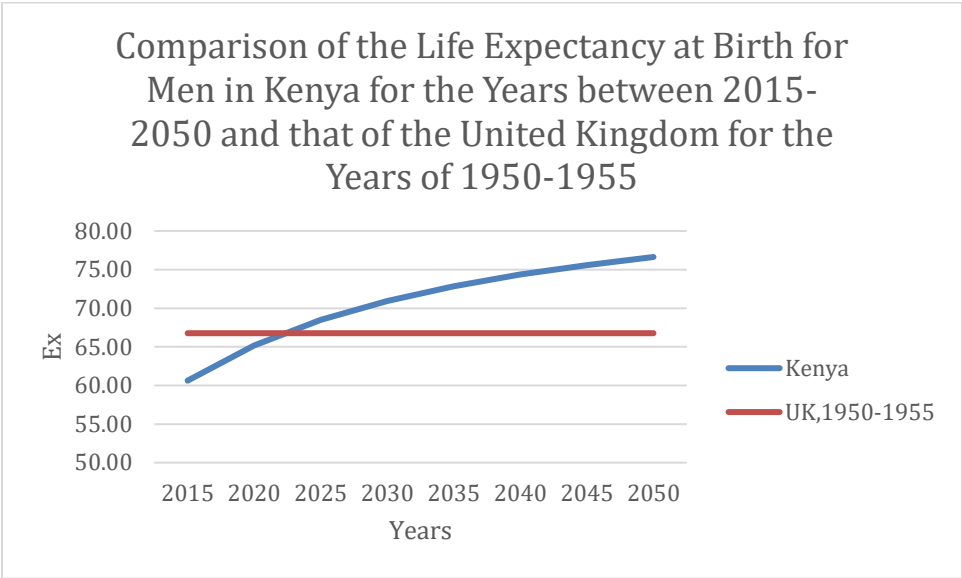
Graph 6: Comparison of the life expectancy at birth for women in Kenya from 2015-2050 and that of the United Kingdom from 1950-1955



Font: elaborated by the researcher.

Looking at the comparison for the life expectancy at birth for women for both Kenya in the years of 2015 to 2050 and the United Kingdom for the years of 1950 to 1955 we see that the life expectancies are quite different. For the years of 1950-1955 we note that the life expectancy in the United Kingdom was at 71.94 years and that of Kenya stands at 67.89 years in the year 2015 and increases to 84.51 years in the year 2050. It is very clear that the life expectancy used for the United Kingdom and compared to that of Kenya will definitely yield different results when used to calculate the mortality trends.

Graph 7: Comparison of the life expectancy at birth for men in Kenya from 2015-2050 and that of the United Kingdom from 1950-1955



Font: elaborated by the researcher.

Looking at the comparison for the life expectancy at birth for men both in Kenya in the years of 2015 to 2050 and the United Kingdom for the years of 1950 to 1955 we see that the life expectancies are quite different. For the years of 1950-1955 we note that the life expectancy in the United Kingdom was at 66.77 years and that of Kenya stands at 60.62 years in the year 2015 and increases to 76.64 years in the year 2050. It is very clear that the life expectancy used for the United Kingdom and compared to that of Kenya will definitely yield different results when used to calculate the mortality trends. In the case of men, it is evident that the life expectancy of the United Kingdom in the years 1950-1955 is higher than that of Kenya in 2015 up until and that of Kenya only exceeds that of the United Kingdom as of 2025.

Table 1: Projected mortality rates for women in Kenya from 2015 to 2050

Age	2015	2020	2025	2030	2035	2040	2045	2050
0	0.031251	0.017175	0.009439	0.005187327	0.002851	0.00157	0.0008610	0.0004732
1	0.002446	0.000921	0.000347	0.000130448	0.000049	0.00002	0.0000070	0.0000026
5	0.00077	0.000304	0.00012	0.000047482	0.000019	0.00001	0.0000029	0.0000012
10	0.000591	0.00026	0.000114	0.000050267	0.000022	0.00001	0.0000043	0.0000019
15	0.000976	0.0005	0.000256	0.000131140	0.000067	0.00003	0.0000176	0.0000090
20	0.001737	0.001029	0.000609	0.000360621	0.000214	0.00013	0.0000749	0.0000443
25	0.002724	0.001766	0.001145	0.000742253	0.000481	0.00031	0.0002022	0.0001311
30	0.00358	0.002427	0.001646	0.001116049	0.000757	0.00051	0.0003479	0.0002359
35	0.004719	0.003371	0.002408	0.001720342	0.001229	0.00088	0.0006271	0.0004480
40	0.005752	0.004274	0.003176	0.002360053	0.001754	0.00130	0.0009683	0.0007195
45	0.00688	0.005339	0.004142	0.003214152	0.002494	0.00194	0.0015015	0.0011651
50	0.008879	0.007012	0.005538	0.004374098	0.003455	0.00273	0.0021549	0.0017019
55	0.011336	0.00894	0.00705	0.005559766	0.004385	0.00346	0.0027269	0.0021505
60	0.016403	0.012909	0.01016	0.007996099	0.006293	0.00495	0.0038980	0.0030678
65	0.026052	0.020892	0.016755	0.013436660	0.010776	0.00864	0.0069302	0.0055578
70	0.043394	0.035495	0.029035	0.023750320	0.019428	0.01589	0.0129991	0.0106332
75	0.073707	0.062128	0.052368	0.044141080	0.037207	0.03136	0.0264350	0.0222822
80	0.133079	0.116355	0.101733	0.088947940	0.077770	0.06800	0.0594514	0.0519802
85	0.23981	0.219383	0.200697	0.183601800	0.167963	0.15366	0.1405683	0.1285951
90	0.419275	0.403378	0.388083	0.373369100	0.359213	0.34559	0.3324898	0.3198834
95	0.617651	0.620343	0.623046	0.625760500	0.628487	0.63123	0.6339762	0.6367387
100	0.828867	0.862895	0.89832	0.935199300	0.973593	1.01356	1.0551720	1.0984910

Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

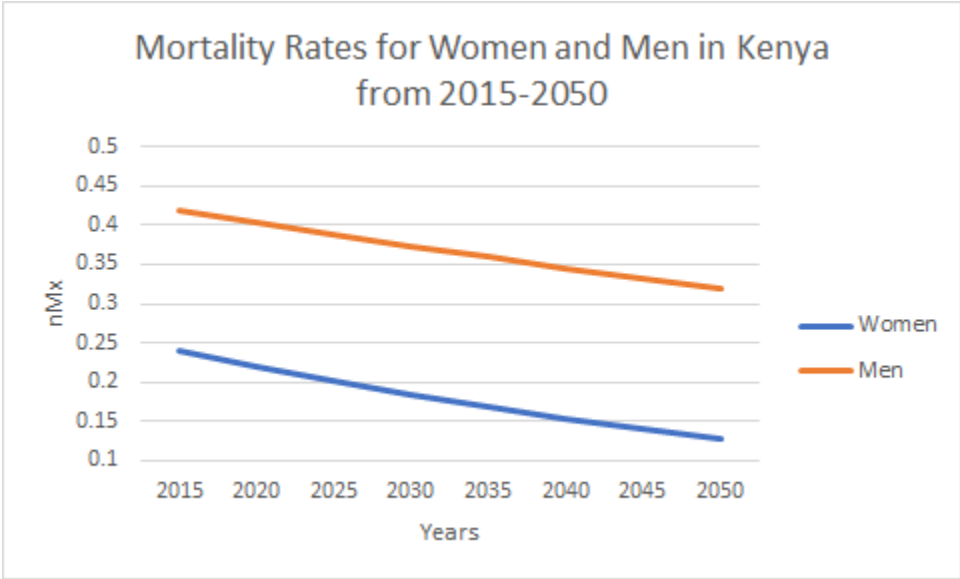
Table 2: Projected mortality rates for men in Kenya from 2015 to 2050

Age	2015	2020	2025	2030	2035	2040	2045	2050
0	0.0538803	0.0338847	0.0213097	0.0134014	0.0084280	0.0053003	0.0033333	0.0020963
1	0.0046460	0.0020759	0.0009276	0.0004144	0.0001852	0.0000827	0.0000370	0.0000165
5	0.0016971	0.0008437	0.0004195	0.0002086	0.0001037	0.0000515	0.0000256	0.0000127
10	0.0011910	0.0006558	0.0003611	0.0001989	0.0001095	0.0000603	0.0000332	0.0000183
15	0.0019691	0.0012283	0.0007661	0.0004779	0.0002981	0.0001859	0.0001160	0.0000723
20	0.0030488	0.0019628	0.0012636	0.0008135	0.0005237	0.0003372	0.0002171	0.0001397
25	0.0037931	0.0025392	0.0016998	0.0011379	0.0007618	0.0005099	0.0003414	0.0002285
30	0.0048312	0.0033883	0.0023763	0.0016666	0.0011689	0.0008198	0.0005749	0.0004032
35	0.0063886	0.0046955	0.0034510	0.0025364	0.0018642	0.0013701	0.0010070	0.0007401
40	0.0080596	0.0060977	0.0046134	0.0034904	0.0026408	0.0019979	0.0015116	0.0011436
45	0.0102502	0.0080960	0.0063945	0.0050507	0.0039892	0.0031508	0.0024887	0.0019656
50	0.0140370	0.0116337	0.0096418	0.0079910	0.0066228	0.0054889	0.0045491	0.0037702
55	0.0185799	0.0159052	0.0136155	0.0116554	0.0099775	0.0085412	0.0073116	0.0062590
60	0.0274520	0.0242691	0.0214553	0.0189677	0.0167685	0.0148243	0.0131055	0.0115860
65	0.0419259	0.0381190	0.0346577	0.0315108	0.0286496	0.0260482	0.0236830	0.0215325
70	0.0663446	0.0613372	0.0567078	0.0524278	0.0484708	0.0448125	0.0414302	0.0383033
75	0.1075962	0.1016210	0.0959777	0.0906477	0.0856138	0.0808594	0.0763690	0.0721280
80	0.1793673	0.1728324	0.1665356	0.1604682	0.1546219	0.1489886	0.1435605	0.1383301
85	0.2983374	0.2938526	0.2894351	0.2850840	0.2807984	0.2765772	0.2724194	0.2683241
90	0.4840714	0.4920549	0.5001702	0.5084193	0.5168044	0.5253278	0.5339918	0.5427987
95	0.6765281	0.7069671	0.7387757	0.7720155	0.8067508	0.8430490	0.8809803	0.9206183
100	0.8719091	0.9370555	1.0070693	1.0823144	1.1631816	1.2500910	1.3434940	1.4438760

Font: data gotten from WPP and elaborated by the researcher.

On analyzing the projected mortality tables for Kenya for the years 2015 to 2050 for both men and women, the mortality rate is seen to be decreasing across the years from the age of 0 up until the age of 85 which is expected considering there is a lot of technology being applied in the medical field and there is better access to general health care for a large part of the population currently and is expected to get better as time goes by. It is important to note that at the age of 90 up until the age of 100+ the process is inverted and the mortality rate is seen to be increasing over the years which can be attributed to diseases such as diabetes, arthritis, heart attack, kidney failure and the one that is most prevalent currently cancer.

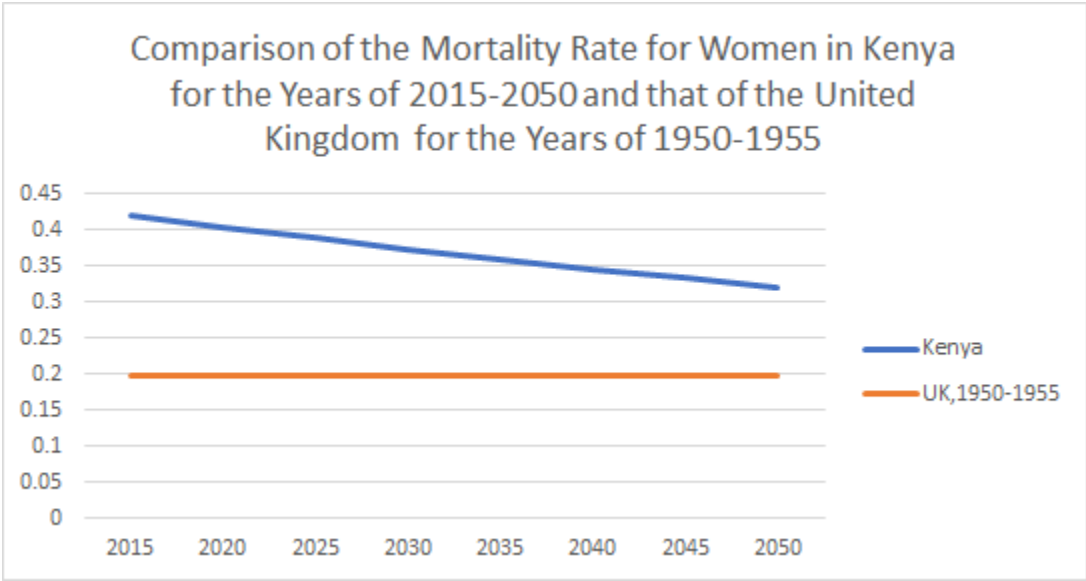
Graph 8: Mortality rates for women and men in Kenya at the age of 85 from 2015 to 2050



Font: elaborated by the researcher.

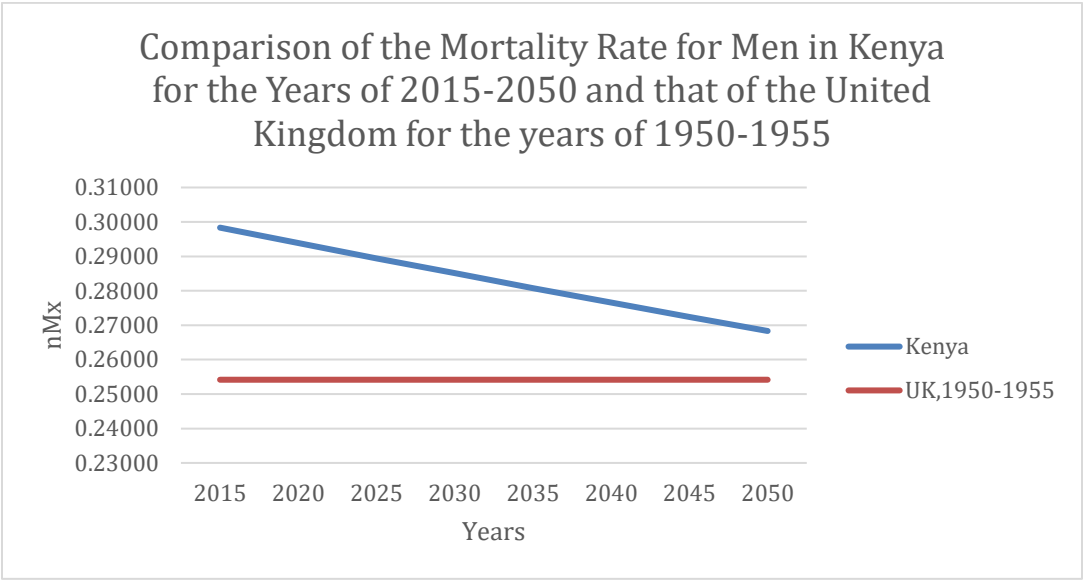
Looking at the comparison for the projected mortality rates at the age of 85 for both men and women, it is evident that the women have a higher mortality rate as compared to the men. The mortality rate of women decreases from about 0.24 in the year 2015 to that of 0.13 in the year 2050 and that of men decreases from one of 0.298 in the year 2015 to that of 0.268 in the year 2050. The decrease in mortality rate for both sexes is something that is expected to continue over the years considering the constant urge of educating the population on the importance of better lifestyles and the importance of taking one's health seriously and in turn taking care of it.

Graph 9: Comparison of the mortality rates at the age of 85 for women in Kenya from 2015-2050 and that of the United Kingdom from 1950-1955



Font: elaborated by the researcher.

Graph 10: Comparison of the mortality rates at the age of 85 for men in Kenya from 2015-2050 and that of the United Kingdom from 1950-1955



Font: elaborated by the researcher.

Looking at the comparison for the mortality rate on graphs 9 and 10 at the age of 85 for men and women both in Kenya in the years of 2015 to 2050 and the United Kingdom for the years of 1950 to 1955 we see that the mortality birth rates for both countries and in the case of both sexes are quite different. On one hand, for the years of 1950-1955 we note that the mortality rate in the United Kingdom for men was at 0.25417 years while that of women was at 0.1985. On the other hand, in the case of Kenya the mortality rates stand at 0.2983 for men in the year 2015 and drops to 0.2683 in the year 2050 while that of women stands at 0.2983 in the year 2015 and drops to 0.1286 in the year 2050. It is very clear that the mortality rate of the men in the United Kingdom is lower than that of the men in Kenya throughout all the years while that of the women in the United Kingdom is lower than that of the women in Kenya up until the year 2025 and from there onwards it is higher up until the year 2050.

4.3 Extent of influence of mortality tables and longevity risk on the performance of pension scheme system in Kenya.

Looking at the research and results carried out using the Lee Carter method in relation to the data of Kenya from the years of 1950 to 2015 and projected up until 2050 and thereafter compared with that of the United Kingdom for the years of 1950 to 1955 we can be able to deduce a couple of things in relation to the influence of mortality tables and longevity risk on the performance of the pension scheme system in Kenya.

The use of mortality tables that are appropriate to the population in question is a major factor in the performance of the pension scheme system in use in a country. In the case of Kenya, for a very long time the mortality tables used were those of the United Kingdom from the years of 1950 to 1955 and South Africa for the years 1985 to 1990 up until the year 2010 where a mortality table for Kenya was created and is still undergoing constant changes to help it best fit the current and future population of Kenya. For this specific study we used the tables from the United Kingdom and did an analysis from the United Nation, World Population Prospect 2019 (WPP) which clearly shows us from graph 4 that the life expectancy in the United Kingdom that was at 66.77 and 71.94 for men and women respectively in the years of 1950 to 1955 is very different from that of Kenya. Through the Lee Carter method that was applied to the data gotten from the United Nations, WPP 2019 and projected into the future we can see that the life expectancy in Kenya was at 60.62 and 67.89 as seen in graph 1 for men and women respectively in the year 2015. This is a clear indication of the large disparity in the life expectancy at birth for both countries at different years. It is

important to note therefore that the usage of the mortality tables from the United Kingdom that were fully being used in Kenya before the year 2010 and are still being partially applied currently give incorrect results in relation to the calculations they are applied to by the different pension scheme companies. This is evident in the different life expectancies seen in both countries at different times. With this happening the performance of the pension scheme system in Kenya is affected where the calculation of the pensions to be given to the members in the future is either inaccurate or not as correct or as close to the right figure to be calculated and given to the beneficiaries.

The usage of the mortality tables from the United Kingdom have had effects on the pension scheme system both internally and externally. Internally it causes a problem where the pension scheme systems are not able to adequately and fully serve the clients to their full potential because the population of the mortality tables being used is not directly related to the population in which the mortality tables are applied. With this happening the pension scheme systems are not able to plan out their pension benefits in relation to the actual life span of their beneficiaries. On the other side, externally the clients who are served by the pension scheme systems end up not receiving the right amount of pension benefits they should due to miss calculations caused by the usage of improper mortality tables.

On the other hand, in relation to the longevity risk which is an issue that has been discussed over the years and is on the rise as time goes by, it is important for it to be looked into more seriously more so in developing countries and in this specific case in Kenya. As life expectancy is rising over the years for both men and women where that of women rises from 67.89 years in 2015 to that of 84.51 years in the year 2050 and for the men it rises from 60.62 years in the year 2015 to that of 76.64 years in the year 2050. The rise is of approximately two years in every five years and the trend is expected to continue in the same manner if not grow over the other years in the projected future and thus it is a clear indication in the longevity of humans increasing in Kenya over the years which means the longevity risk factor is equally on the rise. With longevity increasing it pulls in the reality of an increased aging population in the future which in simpler terms is more people living for longer and living to old ages. With this happening the need for proper longevity risk insurance is a rising major concern to many pension scheme systems in Kenya. It is important that proper longevity risk insurance is implemented so as to help better the

performance of the pension scheme system. As a result of taking into account the future improvements in mortality and life expectancy, benefit payments to a pension scheme member will increase with respect to the case where no account for improvements is taken. Therefore, pension funds with an older age-membership structure will experience an impact from longevity risk on their liabilities and may have less room to maneuver and correct the changes in longevity risk. Currently the performance of the pension scheme system in Kenya is affected by the lack of proper longevity risk insurance where the people under the pension systems outlive the amount of time, they are to be covered by the pension funds and this in turn brings a strain on the performance of the system in Kenya.

The findings of the study reveal that there is a continuous rise in the life expectancy at birth of both men and women in Kenya as projected from the years of 1950-2010 and into the years of 2015 to 2050. It is also evident that there is a drop in the mortality rates for both men and women over the projected years as of 2015 to 2050. This is well tied into the two main factors affecting the performance of the pension scheme system in Kenya that were discussed in the study which were the lack of proper mortality tables as well as lack of proper longevity risk insurance.

Firstly, the usage of mortality tables from the United Kingdom in the years of 1949 to 1952 for the population of Kenya has clearly affected how the pension scheme systems in Kenya perform, both internally and externally. Internally it causes a problem where the pension scheme systems are not able to adequately and fully serve the clients to their full potential because the population of the mortality tables being used is not directly related to the population in which the mortality tables are applied. With this happening the pension scheme systems are not able to plan out their pension benefits in relation to the actual life span of their beneficiaries. On the other side, externally the clients who are served by the pension scheme systems end up not receiving the right amount of pension benefits they should due to miss calculations caused by the usage of improper mortality tables.

Secondly the rise in the life expectancy at birth of the Kenyan population is causally related to the risk of longevity. This is of great effect to the performance of the pension scheme systems where they are not able to adequately cater for the older population and for those who outlive their expected life span properly. The need to find solutions to the issue related to longevity risk is one to be taken seriously and worked on as soon as possible in the pension scheme systems to enable

the performance to be at its best. Currently the longevity risk is not well taken care of as there is no proper longevity risk insurance being rolled out to the population at large, but more to the older and ageing population. This in return causes a tremendous strain on the performance of the pension scheme system as there is no clear working system currently functioning to help with the risk of longevity.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS.

5.1 Conclusion.

The analysis of mortality tables and life expectancy is "at the core of the pension scheme skill set." We are used to carrying out these analyses with due care." (Gavin Jones, July 2013 issue of Reinsurance News). One of the things pension scheme systems always look at is the difference between lives-based and time-based mortality experience. The research sought to determine how the use of inefficient mortality tables and the lack of proper longevity risk insurance are affecting the performance of pension scheme performance in Kenya. The information gathered would be useful pension schemes, researchers and regulators. This would help find ways to make improvements in the industry and how to safeguard members' contributions.

The usage of a descriptive analysis design that targeted the population of Kenya from the year 1950 to 2010 and thereafter projected into the years of 2015 to 2050 through the Lee Carter method and thereafter compared to the population of the United Kingdom for the years of 1950 to 1955. It purposely collected data in relation to the life tables of Kenya from the WPP 2019 so as to carry out the study on how the use of inefficient mortality tables and lack of proper longevity risk insurance affect the performance of the pension scheme system in Kenya.

The study discovered that usage of inappropriate mortality tables lead to the poor performance of pension scheme systems in Kenya and its administration is what is mostly affected, but the benefits to the pensioners are also insufficient due to this. The findings also revealed that lack of proper longevity risk insurance is one of the major challenges' affecting the performance of pension scheme systems in Kenya. The study found out that longevity risk is an issue that is not only currently on going but will continue to even become more in the years to come as seen in the projections done in the study at hand.

The research involved the usage of the Lee Carter method with limited secondary data for Kenya and the presence of a high epidemic (HIV/AIDS). Therefore, the findings may not provide a fair representation across the entire pension scheme system in Kenya but provide a generalized view of the population.

The study evaluates performance measures of the pension scheme system in Kenya tied down to only two challenges based on passed data and projected into the future, therefore, they are subject to different aspects of performance generalized for research purposes.

The study only focused on Kenya and since Kenya is a major economic player in matters finance and industry in the region, it plays a big part in unifying all east African countries in creating one economic front. The findings of this research would have been of greater use if done on a broader scale in consideration of all east African states to provide a generalized view of the sector in greater East Africa.

5.2 Recommendations.

5.2.1 Implementation of proper mortality tables.

As seen in the study carried out and passed studies such as “Modelling of Mortality and Longevity Risk Based on Insufficient Data, 2017” we deduce the usage of mortality tables borrowed from countries with a different population affect the final results obtained by the different pension scheme systems in Kenya. This in turn affects the benefits to the pensioners and puts a strain on the finances of the pension scheme system. The recently put together mortality table of Kenya for the year 2009 still needs a lot of changes in order to be viable and of great benefit in the calculations of the life expectancies of those people who in future will receive benefits as pensioners.

5.2.2 Hedging longevity risk.

Longevity risk hedging is most concerned with the financial impact of adverse developments in the long-term trend of survival probabilities. Over the last few years, hedging instruments emerged to help financial institutions e.g. pension funds to protect themselves against longevity risk. Existing literature shows that the effect of longevity risk on single life annuities can be substantial, and that there exists a natural hedge potential from combining single life annuities with death benefits or survivor swaps. They include:

Buy-ins and buy-outs.

These involve pension funds buying bulk annuities from insurance companies that then payout the pensions, therefore, taking over the longevity and investment risk. In a buy-in, the insurance company makes periodic payments like those pension plans provide to its members, at a fee. This is a way of reducing the risk associated with longevity. However, the sponsor remains responsible for the pension's benefits.

Longevity swaps.

In a longevity swap, a pension scheme transfers the risk of paying for its pensioners living longer than expected to counterparty, usually an investment bank or insurance company, in return for an agreed stream of payments from the scheme. Longevity swap reinsurance should be a standard pricing exercise for professional life reinsurers. However, there are several pitfalls along the way which we have highlighted in this article; D Portfolio-specific mortality is crucial. D Different risk classes must be projected separately, to avoid underpricing. D Mortality improvement trends come with considerable model uncertainty, longevity basis risk and lack of robustness, all of which must be priced in for the risk margin. Life reinsurers are well suited to take on longevity risk, because they have the required skill set, and because they are likely to require the least amount of additional capital to cover longevity risk. Nevertheless, their capacity to take on this risk is finite. Possibly, longevity swaps will be a tool with which the insurance market will be able to transfer this risk into the capital markets.

5.2.3 Implementation of favorable pension scheme system policies.

Government policies and restrictions that help with bettering the use of Kenyan based mortality tables and encourage the implementation of proper mortality tables have a positive significance to the performance of pension schemes. Involvement of the Revenue Benefits Authorities (RBA) in educating and providing regulation operations in relation to the two challenges in relation to the pension scheme systems to help in ensuring the overall performance of pension scheme systems in Kenya is improved.

The pension scheme systems have put in some measures to counter the challenges which implies that they are ready to take into account the need for the usage of proper mortality tables, the

implementation of proper longevity risk insurance in order to cater well for its employees, customers and stakeholders' as well as apply technological advancements when dealing with various challenges.

The study recommends that in order to enhance the performance of pension scheme systems in Kenya, there is a need for a concerted effort by both the Regulatory authority and the individual pension scheme systems in implementing strategies that will ensure that the challenges identified as hindering performance are dealt with.

The Regulator needs to implement measures to ensure that pension schemes are insulated from errors caused by the usage of improper mortality tables and the lack of longevity risk insurance to help facilitate their growth and better their performances. This will create an enabling environment for the pension industry to thrive.

REFERENCES

Adam Augustyn, (2013) Pension | **Definition of Pension Merriam dictionary pension.**

Adesodun Isaac, Adebayo. (2013). **Pension Crisis in Nigeria: Causes and Solutions. IOSR Journal of Applied Chemistry.**

Alfred Tango (2014) **The case of National Social Security Fund, Makerere University and the Ministry of Public Service. Makerere University SSS Collection**

Altman DG. (2001) **Advantages of Data analysis in Business. Descriptive analysis. 47: 931-936.**

Amy Kessler (November,2019). **New Solutions to an Age-Old Problem: Innovative Strategies for Managing Pension and Longevity Risk.**

Ashira Menashe Oren, Guy Stecklov. **Urban–rural disparities in adult mortality in sub-Saharan Africa.**

BOOTH, Heather; TICKLE, Leonie. **Mortality modelling and forecasting: A review of methods.** ADSRI - The Australian Demographic & Social Research Institute, 2008.

Ermanno Pitacco, Michel Denuit, Steven Haberman and Annamaria Olivieri (2009). **Modelling Longevity Dynamics for Pension and Annuity Business.**

Georges Reniers, Bruno Masquelier, Patrick Garland. **Adult Mortality in Africa** (pp 151-170).

Guyen, Melis. **Extending Pension Coverage to the Informal Sector in Africa.** World Bank, 2019.

Guyen, Melis U., and Phillippe G. Leite. **Benefits and costs of social pensions in Sub-Saharan Africa.** World Bank, 2016.

Kakwani, Sun &Hinz (2006). **Risk Management strategies and returns by pension funds.**

LEE, Ronald Demos; CARTER, Lawrence R. **Modeling and Forecasting U. S. Mortality. Journal of the American Statistical Association, [s. l.], 1 Jan. 1992.**

Melis Guven (July,2019). **Extending Pension Coverage to the Informal Sector in Africa.**

Michael Sherris, Samuel Wills (July, 2007). **Financial Innovation and the Hedging of Longevity Risk.**

Mungai, L. M., & Elly, D. (2018). **The Effect of Alternative Investments on the Financial Performance of Pension Funds in Kenya.** *African Development Finance Journal (ADFJ)*, 1(2).

Muruthi, James R., and Denise C. Lewis. "FACTORS IMPACTING OLD-AGE ECONOMIC SECURITY: VIEWS OF KENYAN RURAL-DWELLING OLDER ADULTS." *Journal of Ethnographic & Qualitative Research* 11.1 (2016).

Musaali, M., Stewart, F., Bonyi, D. N., Kiryabwire, W. T., Katto, J., Kiwanuka, P., ... & Isaka, I. (2019). **Pension Systems in East Africa.**

Nanua, Kendi Gloria. **The Effect of demographic transition on the equity risk premium in Kenya.**

Ngugi, W., & Njuguna, A. (2018). **Nexus between pension fund size, design and investment strategy: a review of occupational retirement benefits schemes in Kenya.**

Nicholas Kibiwott Bett (August, 2007). **Modelling and Forecasting Mortality and Longevity Risk Based on Insufficient Data: Kenyan Population.**

Pablo Antolin. **Longevity Risk and Private Pensions.**

Ralf Stevens, Anja de Waegenare, Bertrand Melenberg (August,2009). **Longevity Risk and Hedge Effects in a Portfolio of Life Insurance Products with Investment Risk.**

Sundeeep K Raichura (September,2008). **Analytical Review of the Pension Scheme System of Kenya.**

THOVOETHIN, Paul-Sewa; EWALEFOH, Jobson O. Universal old-age pension: Can Africa overcome its challenges? **Africa's Public Service Delivery and Performance Review**, v. 6, n. 1, p. 1-7, 2018.

World Bank Group. **Pension Systems in East Africa.**

APPENDIX

Table 3: Projected life expectancy at birth for women in Kenya from 2015 to 2050

Ages	2015	2020	2025	2030	2035	2040	2045	2050
0	67.89	72.33	75.59	78.11	80.15	81.84	83.28	84.51
1	69.03	72.57	75.30	77.52	79.38	80.97	82.35	83.55
5	65.69	68.83	71.40	73.56	75.39	76.98	78.35	79.55
10	60.93	63.93	66.44	68.57	70.40	71.98	73.35	74.55
15	56.11	59.01	61.48	63.59	65.41	66.98	68.35	69.55
20	51.37	54.15	56.55	58.63	60.43	61.99	63.36	64.56
25	46.79	49.42	51.72	53.73	55.49	57.03	58.38	59.57
30	42.40	44.84	47.00	48.92	50.62	52.12	53.44	54.61
35	38.12	40.35	42.37	44.18	45.80	47.24	48.53	49.67
40	33.97	36.00	37.85	39.54	41.07	42.44	43.67	44.78
45	29.89	31.72	33.42	34.98	36.41	37.70	38.87	39.93
50	25.85	27.51	29.07	30.51	31.83	33.04	34.15	35.15
55	21.91	23.40	24.81	26.13	27.34	28.46	29.49	30.43
60	18.04	19.36	20.61	21.79	22.89	23.91	24.86	25.73
65	14.37	15.48	16.56	17.58	18.55	19.45	20.30	21.09
70	11.03	11.92	12.79	13.63	14.43	15.20	15.93	16.61
75	8.10	8.75	9.40	10.03	10.65	11.25	11.83	12.38
80	5.63	6.05	6.47	6.90	7.32	7.74	8.15	8.55
85	3.75	3.96	4.18	4.42	4.65	4.89	5.12	5.35
90	2.50	2.50	2.58	2.67	2.77	2.86	2.96	3.06
95	0.00	0.00	2.50	2.50	2.50	2.50	2.50	2.50
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.

Table 4: Projected life expectancy at birth for men in Kenya from 2015 to 2050

Age	2015	2020	2025	2030	2035	2040	2045	2050
0	60.62	65.17	68.47	70.94	72.84	74.36	75.60	76.64
1	62.95	66.40	68.94	70.89	72.46	73.75	74.85	75.80
5	60.09	62.94	65.19	67.01	68.51	69.77	70.86	71.80
10	55.58	58.19	60.32	62.07	63.54	64.79	65.87	66.80
15	50.90	53.37	55.42	57.13	58.58	59.81	60.88	61.81
20	46.38	48.69	50.62	52.26	53.66	54.86	55.91	56.83
25	42.05	44.14	45.93	47.47	48.79	49.95	50.97	51.87
30	37.81	39.68	41.30	42.72	43.97	45.07	46.05	46.93
35	33.67	35.31	36.76	38.06	39.21	40.25	41.18	42.02
40	29.69	31.09	32.36	33.51	34.56	35.51	36.37	37.16
45	25.80	26.97	28.06	29.06	29.98	30.84	31.63	32.36
50	22.03	22.99	23.89	24.74	25.54	26.29	26.99	27.66
55	18.45	19.21	19.94	20.64	21.31	21.95	22.56	23.14
60	15.01	15.60	16.17	16.73	17.27	17.80	18.30	18.79
65	11.85	12.29	12.72	13.15	13.57	13.98	14.37	14.76
70	9.04	9.35	9.66	9.97	10.28	10.57	10.87	11.16
75	6.64	6.83	7.03	7.23	7.42	7.61	7.80	7.99
80	4.68	4.79	4.89	5.00	5.10	5.20	5.31	5.41
85	3.23	3.26	3.30	3.34	3.38	3.41	3.45	3.49
90	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Font: data gotten from United Nations, WPP 2019 and elaborated by the researcher.