

**BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE AND ENGINEERING
DEPARTMENT OF STATISTICS AND MATHEMATICS**



**MODELLING THE GROWTH OF PENSION FUNDS COMPANIES IN ZIMBABWE USING
A GENERALIZED LINEAR MODEL (POISSON REGRESSION).**

A RESEARCH SUBMITTED BY:

MAKOSI YATO RIXWELL

(B193069B)

TO

THE FACULTY OF SCIENCE AND ENGINEERING

BINDURA UNIVERSITY OF SCIENCE EDUCATION

***A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE BACHELOR OF SCIENCE HONORS DEGREE IN
STATISTICS AND FINANCIAL MATHEMATICS (HBS_cSFM).***

SUPERVISOR: MS. HLUPO

JUNE 2023

APPROVAL FORM

The undersigned certify that they have read and recommended to Bindura University of Science Education for acceptance of a project entitled “**MODELLING THE GROWTH OF PENSION FUNDS COMPANIES IN ZIMBABWE USING A GENERALIZED LINEAR MODEL (POISSON REGRESSION)**”.

Submitted by **YATO RIXWELL MAKOSI** in partial fulfilment of the requirements for the Bachelor of Science Honors degree in Statistics and Financial Mathematics

MAKOSI YATO RIXWELL		09/06/2023
Name of student	Signature	Date
MS. P. HLUPO		09/06/2023
Name of Supervisor	Signature	Date
Dr. M. MAGODORA
Name of Chairman	Signature	Date

DECLARATION OF AUTHORSHIP

I declare that this research project herein is my own original work and has not be copied orextracted from previous sources without due acknowledgement of the sources.

MAKOSI YATO RIXWELL



09/06/2023

Name of student

Signature

Date

DEDICATION

I dedicate this project to Josiya Makosi, Chiedza Maswera, Last Mugariri, Kaiden Makosi, Romeo Mugariri and Elizabeth Gide whose efforts of resolute passionate and financial support made my dream a success.

ACKNOWLEDGEMENTS

First of all, I want to thank the All-Powerful God for the strength He granted me throughout my academic career.

I would like to offer my profound gratitude to Ms. Hlupo, my research supervisor, for her unwavering support, advice, and direction as I wrote my dissertation. The supervisor's insightful comments, corrections, recommendations, and remarks were of great assistance to the student. Without your direction, this project could not have been finished. I'm particularly grateful to my family for their financial and emotional support, without which I could not have completed this research project. I want to express my gratitude to Mr. Mukonoweshuro, Mr. Kanjodo, Mr. Kusotera, Mr. Basira, Mrs. Pagan'a and Dr Magodora for their support, advice, and vital assistance throughout my research work.

My sincere thanks also go to Insurance and Pensions Commission (IPEC) for taking the time to examine and approve my request for providing access to data for my dissertation. My mentor, Dr. T Mukwasi, also has my deepest gratitude for his guidance and timely input throughout the process. Many thanks to my colleagues for their assistance. Last but not least, the student wishes to express gratitude to the Department of Statistics and Mathematics for providing a supportive environment for me to complete my study. I will always be grateful to all of my fellow students for the inspiration and experiences we shared throughout this programme.

ABSTRACT

This research compares and contrasts various Zimbabwean pension plans, with a focus on the private pension plan and the increase of the pension funds over time. The current private sector workforce and anticipated future growth are both examined in this research study using generalized linear models. The researcher undertook this research to determine if the resources required to address the demands of the elderly population can be generated by pension funds at the current level of market dispersion and determine whether the current non-required contribution system for growing pension funds needs to be replaced with a system of mandatory contributions for all employed workers. The researcher uses various data for analysis, with the major sources being the Zimbabwe National Statistics Agency (ZIMSTAT), Insurance and Pensions Commission (IPEC) and World Bank. Data collected was analyzed using R-Software, E Views and Excel for descriptive statistics. The study found that population, inflation and GDP_usd were positively correlated to contribution and interest rate have negatively correlated to contribution. The study concluded that, of the four variables, inflation, population and GDP_usd have positive effects to the growth of pension and also interest rate have negative effects to the growth of defined pension schemes in Zimbabwe. The researcher made the following recommendations; a pension fund's growth should be protected from economic variables by policy makers to safeguard both pensioners and the pension fund through paying close attention to GDP_usd, population, interest rates, and inflation because these economic variables have a big impact on how well pension plans work and affects the growth of defined benefit schemes.

TABLE OF CONTENTS

APPROVAL FORM	i
DECLARATION OF AUTHORSHIP	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT.....	v
TABLE OF CONTENTS.....	vi
LIST OF FIGURES	ix
LIST OF TABLES	x
LIST OF ACRONYMS	xi
CHAPTER 1: INTRODUCTION	1
1.0 Introduction.....	1
1.1 Background.....	1
1.2 Problem statement.....	2
1.3 Research objectives.....	3
1.4 Research questions.....	3
1.5 Significant of the study	4
1.5.1 Management of pension schemes	4
1.5.2 Policy makers.....	4
1.5.3 Future scholars	4
1.6 Assumption	4
1.7 Delimitation of study	4
1.8 Limitation of the study.....	4
1.9 Definition of terms.....	5
1.10 Summary	6
CHAPTER 2: LITERATURE REVIEW	7
2.0 Introduction.....	7
2.1 Background of pension funds	7
2.1.1 Organization of pension plans	7
Defined Benefit Schemes.....	7
Defined Contribution Schemes	8
2.1.2 The population growths and life expectancy	9
2.1.3 Economic factors affecting growth of a pension plan.....	9

2.2 Theoretical framework.....	10
2.3 Empirical literature review	11
2.4 Conceptual framework.....	12
2.4.1 Critique of the existing model and research gap.....	13
2.5 Summary	13
CHAPTER 3: RESEARCH METHODOLOGY	15
3.0 Introduction.....	15
3.1 The research design.....	15
3.2 Research instruments	15
3.2.1 The internet	15
3.2.2 Journals and textbooks.....	15
3.3 Population of the study	15
3.4 Data sources.....	16
3.5 Data analysis techniques	16
3.5.1 The Generalized Linear Model.	16
3.5.2 Justification of independent variables.....	17
Long-term interest rate.....	17
GDP_usd.....	18
Population	18
Inflation.....	18
3.6 Model Stability and Diagnostic Test.....	18
3.6.1 Normality test.....	18
3.6.2 Heteroscedasticity test	18
3.6.3 Model stability	18
3.6.4 Model specification test	19
3.7 Internal and External Validity.....	19
3.7.1 Internal validity	19
3.7.2 External validity.....	19
3.7.3 Reliability.....	19
3.8 Summary	20
CHAPTER 4: DATA ANALYSIS AND PRESENTATION	21
4.0 Introduction.....	21
4.1 Data analysis and results	21
4.1.1 Contribution and GDP_usd relationship.....	21

4.1.2 Contribution and population relationship	22
4.1.3 Contribution and inflation relationship	23
4.1.4 Contribution and interest rate relationship.....	24
4.2 Analysis of parameter estimates results	25
4.3 Analysis of deviance	27
4.4 Hypothesis testing.....	28
4.5 Discussion of the findings.....	28
4.6 Summary	28
CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	30
5.0 Introduction.....	30
5.1 Summary of the findings.....	30
5.2 Conclusions.....	30
5.3 Recommendations.....	31
5.4 Areas for further research	31
5.5 Summary	31
REFERENCES	32
APPENDICES	34
APPENDIX A: Table of data used.	34
APPENDIX B: Analysis of Deviance.....	35
APPENDIX C: Interaction of the estimates variables	36
APPENDIX D: R. Code.....	37

LIST OF FIGURES

Figure 4. 1: Contribution vs GDP_usd.....	21
Figure 4. 2: Contribution vs Population	22
Figure 4. 3: Contribution vs Inflation.....	23
Figure 4. 4: Contribution vs Interest rate.....	24

LIST OF TABLES

Table 4. 1: Deviance residuals (minimum – maximum)	24
Table 4. 2: Interaction of the estimates variables	24
Table 4. 3: Analysis of deviance	26

LIST OF ACRONYMS

DC	Defined Contribution
DB	Defined Benefit
NSSA	National Social Security Authority
OASDI	Old Age Survivor and Disability Insurance
ZIMSTAT	Zimbabwe National Statistics Agency
SSA	Social Security Administration
IPEC	Insurance and Pensions Commission

CHAPTER 1: INTRODUCTION

1.0 Introduction

The generalized linear model (GLM) is used to model the growth of pension funds in this study. The difficulty that Zimbabwean pensioners faced with the introduction of the multi-currency system served as the inspiration for this study. Zimbabwe experienced economic hardships that made the Zimbabwean currency and the use of US dollars prohibited. Before the currency reform, the pension assets and arrears were invested in the local currency, and the multi-currency system had the consequence of creating a mismatch between the assets and arrears of the pension funds' fiscal situation, which resulted in meager pension benefits.

Given the nature of pension funds, the parties involved in managing these programs have a duty to see that beneficiaries' reasonable expectations are met. In Zimbabwe, withdrawal pension plans can be classified as either defined contribution (DC) plans or defined benefit (DB) plans. Defining defined benefit and defined contribution, as well as providing background information and term definitions, are all covered in this chapter. While the limitations and delimitation of the study are described, its significance is also described.

1.1 Background

A Pension funds can be thought of as types of institutional investors because, they pool and invest money from guarantors and heirs to provide for their future pension rights (Thussen 2009). In contrast to defined benefit plans, where the employer is the only one who sets aside money for the plan, participants in defined contribution plans make regular payments into a pension plan that is designed to provide funding when they decide to withdraw. There are several threats, with inflation being the most important one at the moment. Simply put, during the extensive time span, the average value of contributions decreased.

However, cautious investment is required to cover these risks and find solutions to these issues. Pension fund investments have contributed significantly to the expansion of the Zimbabwean economy. The government's decision to reinvest the money in Zimbabwe's economy provides a variety of advantages that also ensure bigger than necessary returns to balance this risk in real life. Frugality is a term used to describe the socioeconomic structure of a country or other place for the production, distribution, trading, and consumption of goods and services.

A condition known as frugality can have an impact on how goods and services are produced and delivered in a particular region. Every country in the world, notably Zimbabwe, has its own distinctive brand of frugality. The conditioning that leads to profitability may involve financial conditioning. The performance of these fiscal conditions is a responsibility of the financial sector. Similar conditioning is used when investing pension funds in order to generate a profit that profit that is sufficient to meet pension obligations. A registered scheme currently has less than 150 000 members and less than members that are actively contributing, while NSSA has less than members (source: IPEC).

However, the overall private labor force is staggeringly large, and it doesn't have any established savings or retirement plans. The government will require additional financial resources to finance the majority of the nation's infrastructure projects with the addition of county governments. If the non-contributor population in the private sector is reached, there will be enough money to invest in infrastructure bonds, resulting in double-edged gains for the expansion of the economy and the pension fund for retirees.

A supportive environment must be created for the private sector in order to fully unleash its potential and become fiercely competitive in line with vision 2030, which calls for establishing the groundwork for the profitable pillar of the Vision. If pension fund regulations were to be loosened to permit investments in private infrastructure projects and, in turn, these systems adapted their financial instruments to those pension funds' requirements, both parties would be suitable to benefit significantly from both tangible and intangible benefits, according to one of the key components of the medium-term plan for this strategy.

Financial markets aren't ethereal beings ruled by their own logic; rather, they are practical bodies acting on the various actions and viewpoints of many participants in the market. Innovative financial strategies can also be used to promote ethical, profitable growth with positive results. These cutting-edge techniques are more prevalent in wealthy economies; however, they are slowly gaining ground in emerging economies, with Zimbabwe as a leading example.

1.2 Problem statement

Socioeconomic conditions in developing nations Zimbabwe demonstrates the growing need for social security as a result of the nation's rising population. The concept of using social protection systems as mutually beneficial tools to alleviate old age poverty has received universal recognition

around the world. Pension fund arrears investments frequently last a long time. This is because participants of the fund submit claims following their retirement, which, in Zimbabwe, typically occurs at age 65.

Pension funds invest in a range of assets, such as stocks, infrastructure bonds, and other financial market securities, to generate the necessary income for businesses to fulfil their pension obligations. The pension funds are distributed evenly throughout the various economic sectors in order to maintain the program. The building of hospitals, homes, roads, and other infrastructure for the expansion of the economy are some examples of how pension funds have been used.

As a result of the current trend in the global demographic shift toward population aging, many countries have altered their pension systems from unfunded plans to funded schemes and introduced required payments. Given the current demographic trend and the design of financing systems, it is inevitable that pension funds would increase significantly over the coming few decades. Consequently, it is essential to model Zimbabwe's pension fund growth.

1.3 Research objectives

The research intends:

1. To determine if the resources required to address the demands of the elderly population can be generated by pension funds at the current level of market dispersion.
2. To determine whether the current non-required contribution system for growing pension funds needs to be replaced with a system of mandatory contributions for all employed workers.
3. Assess whether there is a rise in the proportion of retired persons who are excessively reliant on the working population and government assistance.

1.4 Research questions

The following research questions serve as the study's guiding principles:

1. Which is the best method to be use for pension contribution for all the employed labor force?
What is the ratio of over-dependent retirees to the working population and recipients of government grants?

1.5 Significant of the study

The study has a wide implication for management of pension schemes, policy makers and future scholar.

1.5.1 Management of pension schemes

The findings are important for managing pension plans because they provide the best pension growth model that the government and its parastatals may employ to make sure they can sustain themselves and fulfill their responsibilities.

1.5.2 Policy makers

Policymakers should pay attention to the study's conclusions because they provide details about the linear model that was utilized and how it applies to expanding pension funds. It offers legislators guidance on how to draft legislation that ensure the longevity of the pension system.

1.5.3 Future scholars

The study is significant to future researchers since it offers a body of material that academics interested in the same topic or other connected subjects can consult. Additionally, the work adds to our understanding of linear models for the expansion of pension funds and the operation of pension systems.

1.6 Assumption

Before beginning the research, the researcher developed the following assumptions:

The respondents gave truthful responses.

1.7 Delimitation of study

The study sought to model the expansion of pension funds nationwide. The study specifically examined profitable factors influencing the expansion of pension plans, an appropriate system for pension contributions for all employed workers, and ways to demonstrate the efficacy of pension plans as well as to perform stochastic simulations of economic factors affecting specific pensions. The study took place over a four-month period. The National Service Security Authority, PSI, and IPEC in Harare are the only sources the researcher consults for respondents.

1.8 Limitation of the study

The following restrictions could have reduced the scope of the study:

1. **Financial constraints** - The researcher's financial resources are insufficient for him to complete the desired investigation which includes collecting data, printing, and other charges. Despite having a small budget, the researcher work hard to conduct a comprehensive inquiry. The researcher make advantage of free resources, such as emails and corporate websites.

2. **Time constraints** - There may be some ambiguity due to the short amount of time available for doing the research. The researcher won't be able to perform a census of the targeted demographic due to time constraints. Nevertheless, the researcher carry out the study using a random sample of the intended population.

3. **Access to information** - Some of the information that respondents may consider sensitive and private may not be accessible to the researcher. The respondent be assured by the researcher that the data is only be used for academic purposes.

1.9 Definition of terms

'Approved Issuer' - a registered insurer under the Insurance Act's requirements, as well as any other issuer that has been approved in writing under the Capital Markets Authority Act's provisions or under any other written law;

'Defined Benefit Scheme'- is a type of retirement benefit where your payout is based on your income at the time of your departure or retirement as well as the length of time you've been enrolled in the employer's plan;

'Defined Contribution Scheme'- is an occupational pension plan where both your contributions and your employer's contributions are invested. The money from these investments is then used to purchase a pension and/or additional benefits when you reach retirement age;

'Manager' – an individual responsible for controlling an organization;

'Provident Fund'- a plan for the distribution of lump payments and other such rewards to workers upon their departure from employment or to their families upon their passing;

'Scheme' - an occupational retirement benefits scheme;

1.10 Summary

This chapter describes the study's background, problem statement, aims, research questions, and importance in addition to its boundaries, presumptions, and restrictions. Key terms are also defined. The chapter also provides an overview of modelling growth of pension funds. (DB) and (DC) pension scheme types are discussed in the chapter, along with economic factors that affect the growth of pension funds. Next is chapter two, which presents the literature review.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter gives a discussion of pertinent literature reviews. The factors that influence pension fund growth, relevant theoretical literature reviews of pension fund explanations, an empirical review that offers evidence from actual studies that have been conducted, a conceptual framework, as well as a summary of the literature, are some of the topics covered in this chapter.

2.1 Background of pension funds

Wyatt (2006) agreed with (Brown, 2002) when they stated that social security "arguably supports underwriting human dignity and strengthening family life" by "precluding reliance patterns and giving benefits as an earned right while contemporaneously guarding individuals and families against economic insecurity." This line of study was supported by Zwecher (2010) observation that as people get older, they work fewer hours and make less money, which makes it necessary for us to have a stable income to live on.

In Schultz's opinion (2012), pension plans are a financial service through which employees can contribute to their own and their elderly relatives' retirement expenses in exchange for benefits received over time. Furthermore, Schulz agreed with Ganguly (2012) that the challenge is how to accommodate the aging population, maintain and improve elderly citizens' quality of life, and strengthen their contribution to social and economic progress. In order to address the issues associated with active aging, it is necessary to abandon the notion that dependency comes with aging.

Retirement plans are intended to provide a significant financial incentive for employees, increasing performance results that help the company reach its objectives. As a result, standardized financial incentive programs were created based on work measurement and the supposition that people are motivated primarily by rewards, since providing an additional financial incentive for each adjustment in pay at work would maximize workers' output (Gore, 2014).

2.1.1 Organization of pension plans

Defined Benefit Schemes

A formula is used to calculate this benefit in a defined-benefit plan, which bases participants' benefits on both work history and salary. The employer, who sponsors the scheme, is responsible for carrying the risk of investing. A variety of terms and conditions are also included with the benefits, some of which may relate to the position and length of employment. Indeed, a number of empirical research (Chang, (2013)) suggest a link between pension payments and faster economic growth which increased saving rates should lead to fewer labor demand deformations, and the expansion of the capital market.

Thussen, (2009) claims that employees who participate in defined benefit plan acquire the promise to receive a predetermined monthly payment from the moment they retire til their death or until their spouse dies. The sponsors of these benefit plans face less risk from the financial market because the rewards depend on the period and the payment. Despite the fact that DB plan benefit accrual is back-loaded, this means that retirees collect very little in terms of significant pension wealth before retirement. According to this theory, workers who quit their employers in the early or even middle phases of their careers receive a variety of rewards, whereas those who leave their jobs before vesting, typically at 5 years, receive nothing. For each year of service that is credited, the member is given a unit of pension, which is commonly expressed as a percentage of nominal wages.

Defined Contribution Schemes

According to Ganguly (2012), capital market risk and investment options are subsequently transferred from the employer to the employee under DC plan, which is based on a menu requested by the guarantor. Due to the fact that their actions may materially affect their ability to remove wealth, it is crucial to comprehend how investors form their investment ideas. DB plans have a history of growing more slowly than DC plans, while employers have moved to save costs recently of their responsibilities and employees look for money that is easily transferrable between workplaces.

Participants in defined contribution plans are primarily responsible for making retirement savings, according to Xianyu, (2013). The employee typically has access to a variety of mutual funds through their workplace to use as a withdrawal savings vehicle. Before taxes are deducted from wages, the government permits employees to put money into mutual funds of their choice, and employers also contribute in part to the fund.

A predetermined percentage of the employee's earnings is deducted immediately from their salary as contributions. In order to prevent back loading of accumulated benefits, the defined contribution

assets accumulate at a fixed rate over a specific length of time. Due to the fact that with a DC plan, the employee is in charge of keeping track of the assets, the employee has the option of leaving the assets in the care of their former company, moving them to their new workplace, or transferring them to an individual withdrawal savings account. According to Murphy, Zorn, and Sonnastine (2007), only the employee's contributions and interest are returned if a plan is terminated before the date of vesting; benefits must still be awarded.

2.1.2 The population growths and life expectancy

Little methodological literature is available that tackles the common practical challenge of integrating estimates and targets in a population projection, aside from the desire to create harmonious sub-regional and regional predictions (Smith et al., 2001). The following steps are part of a three stage strategy offered by Keilman (2006) that is subsequently applied to the overall problem. "(1) formulate original values of model parameters; (2) check and adjust for thickness; (3) restate harmonious model variables into acclimated parameter values." Researcher makes a significant difference between internal and external constraints, and researcher look at this distinction when determining the future size of the private sector labor force in a specific nation, $P(t)$, at a specific point in time t years in the future.

Keilman (2006), claims that lower death rates around the world have led to an increase in life expectancy at birth, signaling success in the fight against mortality and morbidity. The average number of years a newborn would survive if present patterns of mortality at the time of birth remained throughout the child's life is called life expectancy at birth. Because it is anticipated that future population live longer than past and present populations, it is important to plan for an appropriate pension structure as a basis for future income.

Life Expectancy is given by
$$e_x = \frac{T_x}{l_x}$$

Where T_x is the total years lived after age x

l_x is number of person living at age x

Because pensions have locking in policies that prevent members from accessing the benefit while employed by the employer and because pension funds are heavily invested for the long term, pensions have a negative impact on the growth of the economy that has positive impacts.

2.1.3 Economic factors affecting growth of a pension plan

To analyze part of the future financial capacity of the pension plan generally, predictions are made for retirement scheme indicators (Vaughan, 2000). These forecasts take into account demographics, macroeconomic variables, and pension scheme indicators. Actuaries in Canada must identify the standards for the economic and demographic variables when estimating defined benefit pension plans. Future salary increases and returns on investment are necessary, and typically, a building block approach is employed to calculate future wage increases.

The future increase in wages is calculated as the total of three factors, including future general productivity growth and future predicted inflation. According to (Brown, 2002), in DC pension plans, it is assumed that employee retirement accounts should be made up of the same types of assets as those used to fund DB pensions. This is due to the fact that a pension plan's projections are a collection of valuations at various future time points, and the same economic considerations needed for pension valuation are also important for predicting retirement plans.

2.2 Theoretical framework

According to Emmett, (2010), a pension fund is an organization set up by a government agency, a labor union, or a business to pay for the pension benefits of employees upon retirement. It also serves as an investment plan for retirement planning that generates income for retirees. For workers, it is typically developed by government or businesses (Brown, 2002). A pension scheme is innovated on the remitted income conception claim, Viswanathan & Arunajatesan, (2009). Pension is regarded as a component of an income package that has been remitted and taken into account for withdrawal. The company builds it up as a fund and gives it to the employee as a withdrawal or retirement benefit, as an immediate and necessary payment of income.

According to data from the OECD (2005), the pension plans are created to play a genuinely useful role in financially motivating workers and ultimately resolving performance concerns that assist the fulfillment of corporate objectives. In general, a pension is a scheme that gives retirees a source of income. It is a tax-remitted savings vehicle that enables benefits to be accumulated for use as retirement income later. Insurance firms, the government, and other organizations like worker groups or trade unions create retirement pension programs (Vaughan, 2000). Superannuation plans and pension schemes are other names for retirement plans.

Saunders (2009) further noted that most pensions have additional insurance components since they frequently provide retirement benefits to survivors who are unable to care for themselves. The

fundamental idea underlying pension provision appears to be beyond debate, according to Exley, Mehta, and Smith (2003). Among the key findings is whether or not a defined benefit pension plan is financed at all, the cost of delivering one is unaffected by either option. Second-order consequences can include the scheme's credit risk as well as the potential for surplus to leak to members in the form of improved benefits. The consequences, however, are all zero-sum, meaning that a gain for members is a loss for shareholders, and the reverse is true.

Again, choosing one investment mix over another does not result in any overall gains for shareholders or members. The majority of these indicate that investing a pension plan in governmental or corporate debt instruments would result in a very significant joint gain for members and shareholders for a variety of reasons. The major investment conclusion is that holding debt securities often benefits both members and shareholders equally. This conclusion, however, is obviously at odds with present practice, at least in UK where the majority of pension schemes maintain a sizable portion of their assets in stocks (Mehta, Smith & Exley, 2003).

2.3 Empirical literature review

Ganguly, (2012) examined the views of business managers towards pension plans. The paper's major argument was that close asset and obligation matching, rather than the widely recognized portfolio selection theory used by practitioners, provides a normative prescription for asset allocation in pension funds. According to the study, company managers could provide a variety of secondary justifications to third parties for their continued support of pension funds' equity investments, in contrast to normative neoclassical theory. But one of the primary explanations, combined with an insider effect, appears to be the management's wish to keep the substantial power to manipulate the returns of equity-invested pension funds.

A comparison study on the effectiveness of pension systems was also conducted by Antoine (2010). The primary objective was to examine the investment results of privately managed pension funds across a number of Central and Eastern European, Latin American and OECD. The study initially presented an analysis of global risk-adjusted investment performance by country using comparatively common investment performance indicators. In the study's second phase, it was determined whether there might be any connections between the characteristics of each pension system, the regulatory settings in each, and the success of the investments. The study found that, for those nations with sufficient knowledge and statistics to adjust returns correctly, the Sharpe ratio and attribution analysis demonstrate that privately managed pension funds have benefited from a risk

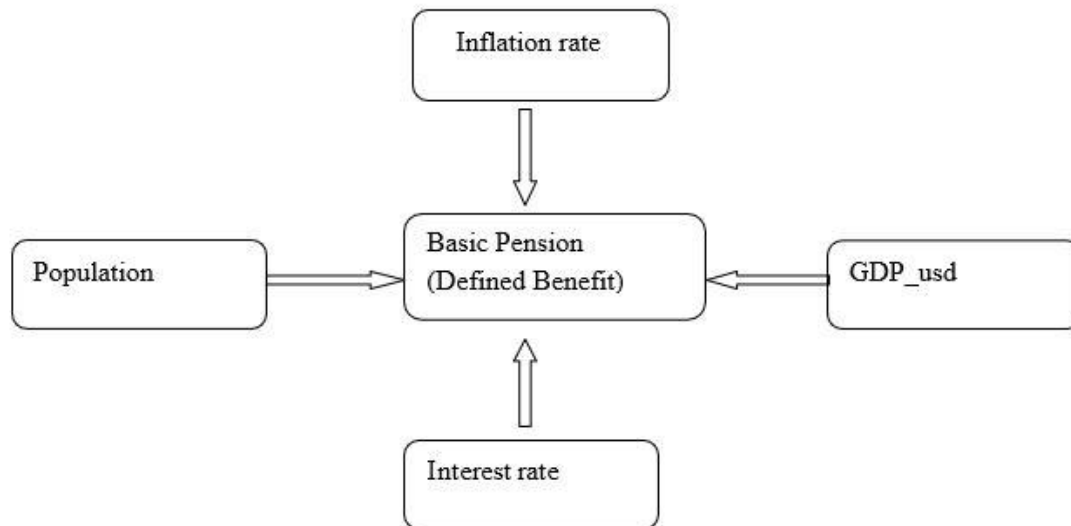
premium compared to short-term investment alternatives. The results also demonstrated that, when compared to the hypothetical portfolio with the highest mean return for a particular level of risk, pension funds have generally underperformed.

Thussen (2009), studied how pension funds are run and how they perform. These investment returns are based on the portfolio and asset allocation choices made by fund managers. Small changes in investment returns can result in significant changes in the value of your pension fund when you retire. The information about the performance of fund managers shows that, on average, they do not significantly enhance a passive approach to investing in the market index. Finding and examining the reasons behind some fund managers' persistently low growth is a crucial issue in the pensions business, and it is one that would benefit from more research.

According to Haberman (2001), a pension funds must comprehend the fundamentals of risk management because it is crucial to increasing the organizational effectiveness of various risk management functions through the creation of a central coordinating function with clear ownership and accountability for all risk management. Research into the connection between Swiss pension fund governance and investment performance was conducted by Xianyu, (2013). Using a sample of 96 pension plans with assets totaling more than usd \$ 190 million, the analysis was conducted. According to the study's findings, objective formulation and investment strategy seem to be areas where strong governance is particularly crucial.

2.4 Conceptual framework

The relationship between the fundamental pension and the response variables is illustrated using a simplified conceptual framework. Many relevant macroeconomic variables need to be considered in the long-term financial planning of the pension scheme. In this study the random variables are inflation, interest rates, GDP_usd, and population. Profits are indexed to inflation and earn inflation-adjusted profits through the following expenses: Adjustment of cost of living, benefits also adjusted to long-term interest rates and GDP_usd determines the contribution rate paid in usd and the population determines number of contributors. These probabilistic variables are assumed to be independent, but the basic pension depends on them.



Source: Researcher's design

2.4.1 Critique of the existing model and research gap

Studies conducted on growth modelling have been neglecting economic factors since there are using deterministic models. Mukwasi, (2015) and others carried out research on deterministic modelling of a pension plan. The actuarial valuation of defined-benefit schemes continues to be based on the deterministic approach. The relevant international guidelines ignore, the application of stochastic methods in this area (International Actuarial Association, 2013).

The present study explains this model further because the scholar was interested in factors such as the age-specific cohort survival, the time-specific intake of new entrants (i.e. the interest net of salary escalation). This causes a low growth of pension since the benefits are not indexed to economic factors which include inflation changes, GDP_usd growth through cost of living adjustment and long-term interest rates. The research therefore works on examining economic factors that affect the growth of pension funds that are neglected by other scholars in growth valuations of a defined benefit scheme using a (GLM) in data analysis, using R and while previous studies used E Views 10 SV for data analysis.

2.5 Summary

The study looked at the literature regarding pension funds. While conducting this analysis, the researcher discovered that the assets of pension funds differ significantly from those of other types of

collective investments. But the methods used to gauge the expansion of pension funds remain the same. On the empirical literature the researcher provided studies that were done by different researchers which also included the methodology they employed. Also, the chapter presented the economic factors affecting growth of pensions, suitable models that can be used to measure the growth rate. It also gives a brief background of Pension funds and the part of pension funds. Next is chapter three, which presents the methodology of the research.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

This chapter make known to the logical structure to be tagged to meet the objectives specified in the opening chapter of this study. The research design, data instruments and also how the data was collected and anatomized to decide findings, clarifications and conclusions which are conferred below.

3.1 The research design

Russek, (2016) explain research design as a coordination and planning of the parameters for data gathering and analysis with the goal of balancing procedure economy and relevance to the research goal. The main purpose of a research design is to make sure that the data collected allows the researcher to provide an unambiguous response to the original question. The study used a quantitative research methodology to assess how economic factors affected the growth of pension funds plan in Zimbabwe between 2012 and 2022.

3.2 Research instruments

The researcher considered the tools that are highly improved on accurate and efficiency of the collection procedure. The researcher makes sure that the reliability and validity of the statistics were unaffected. For the literature study, theories, and foundational knowledge, the researcher used a variety of textbooks, journals and internet

3.2.1 The internet

The most trustworthy library ever is the internet. The researcher used the internet to access e-journals, e-books, and works by other academics and organizations. The researcher could examine online for developments relating to the expansion of pension funds in Zimbabwe. This gives the researcher access to the most recent information and covers a broad range of population.

3.2.2 Journals and textbooks

In this study on the expansion of pension funds businesses in Zimbabwe, the researcher cited a wide range of textbooks and publications.

3.3 Population of the study

The entire spectrum of an interest system or process is referred to as the complete population. In Zimbabwe, there are 974 registered pension funds, and all registered pension schemes are included

in the target population, according to IPEC (2021). However, the contribution rates used in this research were annual. This is due to the fact that annual contributions to rate indices such as return on equity, long-term interest rates, inflation, and wage rate increases are made.

3.4 Data sources

The study used secondary data, which is information from sources other than the primary source. This strategy was found to be the most successful, and as a result, it supplied the majority of the data used in this study, notably in the analytical and literature review sections. It includes data for independent variables from 2012 to 2022 on which the researcher is going to focus on. According to (Ganguly, 2012), secondary data refers to information that has already been gathered and used by another scholar. The researcher used data from ZIMSTAT, IPEC website and World Bank website. Justification: Secondary data is timely accessible and offers insightful information on how researchers have solved problems similar to the one under consideration.

3.5 Data analysis techniques

The data collected from secondary source was presented in graphical and tableau form. Descriptive and inferential statistics were used by the researcher to evaluate, interpret, and summarize the data. The dependent and independent variables were described using descriptive statistics. The inferential statistics were used to make inferences of the economic factors that affect the growth of pension schemes and the researcher used GLM to analyze the data.

3.5.1 The Generalized Linear Model.

Generalized linear models is a development of "simple" linear regression models, which forecast the response variable as a function of numerous predictor variables. A straight line can be used to characterize the relationship between the predictor variables and response variable, which is one of the assumptions that underlies the operation of linear regression models. This suggests that a predictor's constant shift causes the response variable to also change continuously. Since ecological data frequently violates this presumption, these models are expanded into generalized linear models to be able to handle non-normally distributed data. GLMs identify the equation that, best give the values of the environmental variables, most accurately forecasts the occurrence of a species. The model has three crucial components:

1. The link function $g(\cdot)$, it connects the distribution of the target outcome to the input variables..

$$E(Y) = g^{-1}(X\beta) \tag{3.1}$$

2. Part of the exponential family of distribution

$$f(y, \theta, \phi) = e^{\frac{y\theta - b(\theta)}{a(\phi)}} + c(y, \phi) \tag{3.2}$$

3. The linear predictor (LP) – it shows independent variables and their unknown coefficient β , which equal to the expected output of the target data, $E(Y)$.

$$E(Y) = X\beta \tag{3.3}$$

The following regression model was used to test the growth of pension fund in this study;

$$\ln(E(Y)) = X_1\beta_1 + X_2\beta_2 + \dots X_n\beta_n \tag{3.4}$$

where

Y=Defined Benefit

β = Beta (Regression coefficients)

X1= Population

X2= Inflation

X3= GDP_usd

X4= Interest rate

ε = Stochastic/ Error Term

As a result, although the relationship between the predictors and the response is not linear, the link function offers a change of the response such that the transformed response has a linear relationship with the predictors.

3.5.2 Justification of independent variables

Long-term interest rate

Over the past few years, long-term interest rates have fluctuated, with the effects of those fluctuations unknown to insurance firms that value pension plans. Long-term interest rates and basic pensions must be linearly correlated, with rising interest rates resulting in equitable basic pensions.

(Carter, 2013).

GDP_usd

Larger financial markets are found in nations with high GDP ratios of pension funds. Qualitatively, pension fund managers are institutional investors who have an impact on corporate governance and information disclosure, helping to create financial markets and enhance the effectiveness and depth of information.

Population

Pension funds will need to work harder than in past generations due to the extended lifespan of more people. The altered context and potential social, economic, and financial effects are currently being considered by retirement income systems around the world.

Inflation

Inflation is the continuous increase in general price levels that reduces the buying power of retirement income. According to (Mazviona, 2010), a basic pension performs poorly when there is inflation, so it must be indexed to have an inflation-adjusted basic pension.

3.6 Model Stability and Diagnostic Test

3.6.1 Normality test

The normality assumption is crucial for enabling the derivation of the estimates' probability distributions, which makes the work of calculating confidence intervals and conducting hypothesis tests easier, (Mukwasi 2015). Also, it was tested using the Jacque-Berra (JB) formal test, in the event that the probability value above the significance level, the null hypothesis for normality is adopted.

3.6.2 Heteroscedasticity test

Following estimations, the Breusch-Pagan Godfrey test was used to look for heteroscedasticity. This is when the error term's variance varies with time. Due of its inefficiency, the Ordinary Least Square estimator is no longer the Best Linear Unbiased Estimator (BLUE). As a result of the exaggerated standard error, its existence will lead to inaccurate findings for significance tests and confidence intervals.

3.6.3 Model stability

This concerned with the sensitivity of the model to change in the modelling data and assume past experience is a good predictor of future events. The changes in the past that was observed should not lead to large changes in the future predictions. The researcher test stability through cross-validation, this gives an assessing of the performance of model on unseen data through multiple splits of train and test. Since all of the data was being utilized to test out-of-sample model performance rather than just a small subset.

3.6.4 Model specification test

To check for model specification mistake, Ramsey's Regression Specification mistake Test (RESET) was applied and it also checks for measurement error, omitted variables, irrelevant variables, and model suitability. The researcher would encounter the issue of model specification bias if the model was improperly specified. (Greene, 2003). For the purpose of determining the model's validity, the R^2 and the modified R^2 were taken into consideration; the model can be valid if and only if both are more than 0.5.

3.7 Internal and External Validity

Validity this concerned with a measure of how well a measuring tools fulfills its purpose and relates to whether it assesses the behavior. Validity is determined by a pertinent and appropriate interpretation of the data collected from the measuring equipment as a result of the analysis. The measuring tool must measure what it intended to, in order to have useful results.

3.7.1 Internal validity

Internal validity this concerned with the ability of the study's design, conduct and analysis to produce reliable answers to its research question. It also used to investigate the level of systematic mistakes for instance, the selection bias. Selection bias this concerned when the researcher can use inappropriate tools for data collection. Moreover there is performance bias, this concerned when model used for data analysis is not of standard.

3.7.2 External validity

External validity this concerned when the researcher determines whether the findings maybe applied to different situations. Short-term research of pension funds which require a long period of time can have also low degree of external validity.

3.7.3 Reliability

Reliability measurement was considered to be reliable if it can be applied by numerous researches with consistent results and under stable circumstances. More so, reliability measures the extent to which the same measurement would provide the same outcomes and this enables the researcher to establish trustworthy comparisons.

3.8 Summary

The research design, population of the study, data sources and data analysis techniques were highlighted in this chapter. The following chapter focuses on data analysis and data resenation.

CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.0 Introduction

The research approach for the study was described in the previous chapter. The presentation, analysis, and discussion of study findings are the main topics of the current chapter. This chapter analyses data from secondary data sources in an effort to understand the data analysis and provide answers to the research questions. The strategies covered in the previous chapter are to be used in this chapter to accomplish the goals outlined in chapter 1.

4.1 Data analysis and results

The data analysis and outcome are based on equation (3.4), which takes into account the following significant variables: the private sector population, interest rate, GDP_usd and inflation. The objective is to model the growth of pension funds in Zimbabwe and to determine if the resources required to address the demands of the elderly population can be generated by pension funds at the current level of market dispersion.

4.1.1 Contribution and GDP_usd relationship

Figure 4.1 below shows correlation between contributions and GDP_usd is displaying a strong positive correlation between these two variables. This result implies that the growth of pension fund contributions is positively influenced by the growth of the economy, as measured by GDP. A growing economy creates employment opportunities, increases wages, and leads to higher disposable incomes, all of which contribute to the growth of pension fund contributions. In comparing the findings with the past research by (Akwimbi 2014), it can be noted that results are similar. This finding is consistent with the research by Akwimbi (2014) that economic growth leads to an increase in savings and investments, including pension fund contributions. Therefore, it is crucial for the Zimbabwean government to implement policies that promote economic growth to enhance the growth of pension funds.

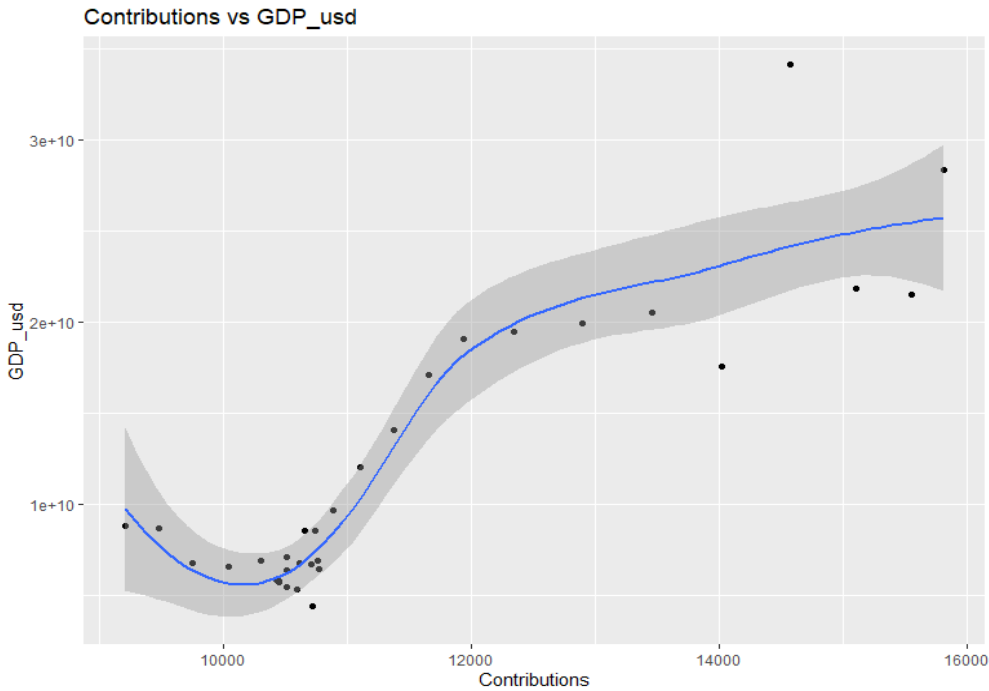


Figure 4.1: Contribution vs GDP_usd

4.1.2 Contribution and population relationship

Figure 4.2 below shows the correlation between contributions and population is showing a very strong positive correlation between these two variables. According George (2014) the strong correlation suggests that pension fund contributions grow as the population increases. This relationship is expected as a larger population means more people in employment, and thus, a larger base of pension fund contributors. Moreover, a growing population is also associated with increased demand for pension funds as the number of elderly people increases. As such, policies aimed at promoting population growth and encouraging employment can help increase pension fund contributions.

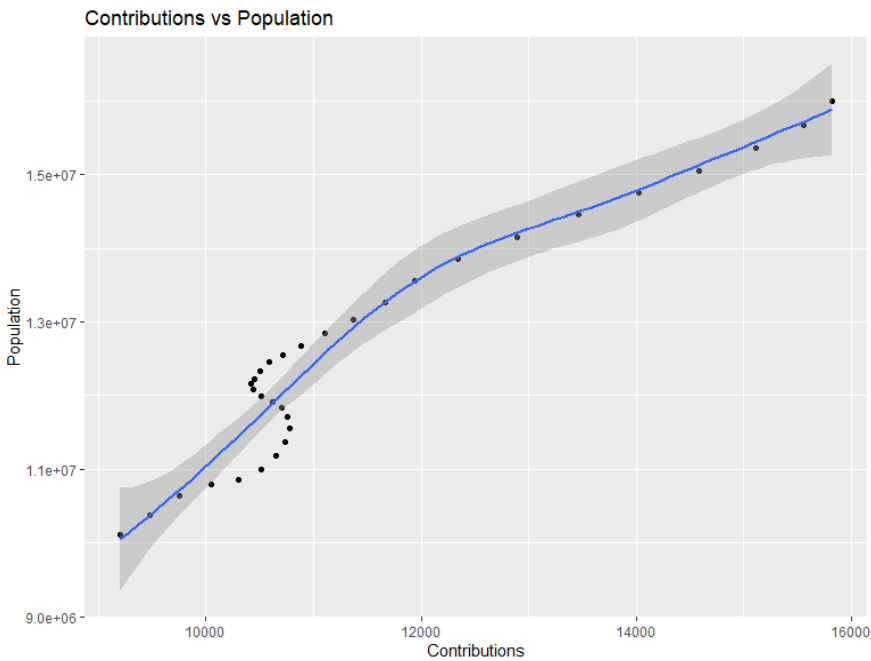


Figure 4.2: Contribution vs Population

4.1.3 Contribution and inflation relationship

Figure 4.3 below shows the correlation between contributions and inflation is showing a moderate positive correlation between these two variables. This result implies that inflation has a positive impact on pension fund contributions. According to Mukwasi (2019), high inflation leads to a higher cost of living, which creates a need for individuals to save more for retirement and also inflation increases the cost of living, which may lead to increased wages, and thus, higher disposable income that can be allocated towards pension fund contributions. According to Thomas (2012) there is a high positive relationship between contribution and inflation, the differences is that in Africa there is a high inflation as compared to America. However, it is worth noting that high inflation can also lead to reduced purchasing power and negatively affect individuals' ability to save for retirement. As such, policies that promote low inflation rates may help increase pension fund contributions in the long run.

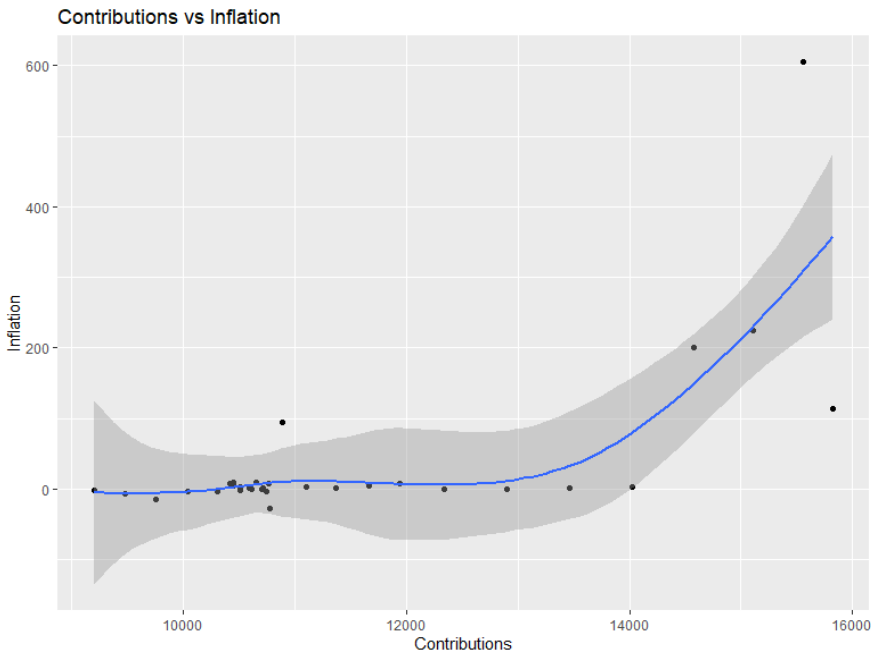


Figure 4.3: Contribution vs Inflation

4.1.4 Contribution and interest rate relationship

Figure 4.4 below shows the correlation between contributions and interest rates is showing a weak negative correlation between these two variables. This result is supported by research by Mukwasi (2019) and Pondo (2012) but differs with the research by Thomas (2012) which shows positive correlation between contribution and interest rates. The result suggests that the interest rates offered on savings and investment products do not have a significant impact on pension fund contributions. However, it's worth noting that the negative correlation implies higher interest rates that may lead to a decrease in pension fund contributions. This finding may be explained by the fact that an increase in interest rate may leads increased savings in other investment vehicles such as fixed deposits, which may compete with pension fund contributions. Nonetheless, the correlation between contributions and interest rates is not very strong, and further analysis is needed to determine the exact relationship between these variables. The results show that the growth of pension fund contributions in Zimbabwe is strongly influenced by economic growth, population growth, time, and inflation rates.

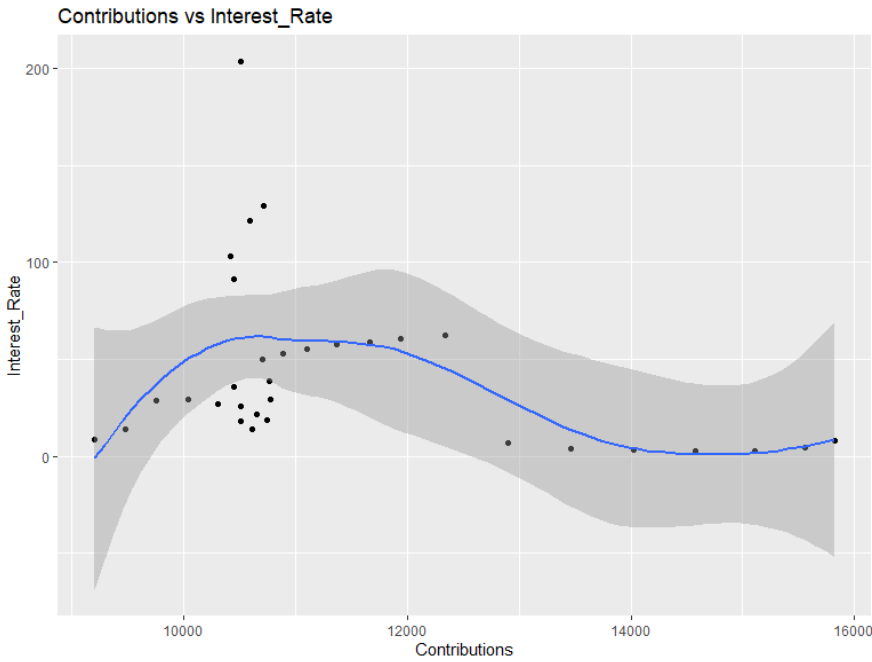


Figure 4.4: Contribution vs Interest rate

4.2 Analysis of parameter estimates results

Call:

```
glm (formula = Contribution ~ GDP_usd + population + Inflation + interest_rate, family = poisson,
data = data)
```

Table 4.1. Deviance residuals (Minimum – Maximum)

Deviance Residuals				
Min	1Q	Median	3Q	Max
-4.8676	-2.1544	-0.4476	2.6652	4.4516

Table 4.2: Interaction of the estimates variables

Coefficients:				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	8.388e+00	2.387e-02	351.462	< 2e-16 ***
GDP_usd	1.351e-12	4.786e-13	2.823	0.00476 **
Population	7.567e-08	2.322e-09	32.588	< 2e-16 ***
Inflation	9.451e-05	1.600e-05	5.907	3.48e-16 ***
Interest rate	-5.395e-04	4.744e-05	-11.373	< 2e-16 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for poisson family taken to be 1)

Null deviance: 8165.52 on 31 degrees of freedom

Residual deviance: 229.54 on 27 degrees of freedom

AIC: 597.21

Number of Fisher Scoring iterations: 3

The explanation of parameter estimates analysis

The Poisson Family of distributions served as the foundation for the generalized linear model (GLM) that was fitted to the data in findings. Given a collection of covariates, Poisson regression is unique in that it models the continuous response variables. The constant coefficient is undoubtedly (with a value $8.388e+00$) that is significant to the model.

The researcher also noticed that the lagged values of independent variables have negative impact to the contribution. The GDP_usd and Inflation have significant contribution to the model for its p-value that is less than 0.05 (level of significance) with the value ($9.451e-05$) and ($1.351e-12$). Population is also a significant factor having coefficient value ($7.567e-08$), which implies a decrease in contribution as interest increases. Lastly population under cover have also positive effects to the growth of contribution.

The intercept has a large positive estimate, indicating that, on average, there is a high level of pension fund contributions in Zimbabwe. GDP_usd has a positive estimate, suggesting that as the GDP increases, there is a tendency for pension fund contributions to increase. Population also has a positive estimate, indicating that as the population increases, there is an increase in pension fund contributions. This may be due to a higher demand for pension funds as the population ages. Inflation has a positive estimate, suggesting that as inflation increases, so do contributions to pension funds. This may be due to a higher need for individuals to save and invest in order to protect their future purchasing power. This result is supported by research by Akwimbi (2013) and Mukwasi (2019) this is because inflation rate in Africa are too high and they cause positive relationship with contribution.

Lastly, interest rate has a negative estimate, indicating that as the interest rate increases, contributions to pension funds decrease. This may be due to higher returns in other investment vehicles that divert potential pension fund contributions elsewhere. However, this result is differing

from research by Akwimbi (2013) which shows positive relationship between interest rate and contribution, because there is low return in other investments vehicles.

4.3 Analysis of deviance

anova(model, test = "Chi")

Model: poisson, link: log

Table 4.3: Analysis of deviance

	Response: Contribution				
	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)
NULL			31	8165.5	
GDP_usd	1	6408.5	30	1757.1	< 2.2e-16 ***
Population	1	1318.6	29	438.5	< 2.2e-16 ***
Inflation	1	78.6	28	359.9	< 2.2e-16 ***
Interest_rate	1	130.4	27	229.5	< 2.2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The explanation of deviance

Based on the outcomes above, shows the ANOVA for the covariates; shows the interaction of the lagged contribution amount with population size, GDP_usd and inflation. The deviance represents the difference between the residual deviance of the current model and the residual deviance of the previous model. In this case, the residual deviance decreases substantially with the addition of each variable, indicating that the model with all four variables is a better fit than the model with only one variable.

The p-values for all four variables are highly significant ($p < 0.001$), indicating that each variable has a significant impact on Contributions. The variable with the largest impact is Population, followed by GDP_usd, Inflation, and interest rate.

The results of the Poisson regression model suggest that GDP_usd, Population, Inflation, and interest rate are all important predictors of Contributions in Zimbabwe's pension fund market. The model can be used to evaluate the current level of market dispersion and the resources needed to meet the needs of the elderly population, as well as to determine whether a mandatory contribution system is necessary for all employed labor force to support pension fund growth. The model can

also be used to monitor the dependency ratio and whether there is an increase in the number of retired persons who are too dependent on the working population and grants from government.

4.4 Hypothesis testing

The Population, GDP_usd and inflation have a positive effect on the growth of pension funds.

`pchisq(deviance(model), df.residual(model), lower.tail = FALSE)` 5.251587e-34

H0: (p value < 0.05)

H1: (p value > 0.05)

Using table (4.2), the interaction of the variables and fund value is significant since ($P < 0.05$) hence null hypothesis cannot be rejected.

4.5 Discussion of the findings

The correlation results of economic factors which affect the growth of pension funds indicate that there is a strong positive relationship between contribution and population, strong positive relationship between contribution GDP_usd and a moderate relationship between contribution and inflation. Also there is negative relationship between contribution and interest rate.

In comparing findings with past research by Thomas (2012), it can be noted that produce similar results where by economic factors (inflation, population and GDP_usd) in determining the growth of pension. Inflation, population and GDP_usd are significant factors in determining the growth of defined benefit pension schemes in agreement with earlier findings by Thomas (2012)

There is a negative relationship between contribution and interest rate in line with research conducted by Pondo (2012) whose stochastic model for pension benefit in Kenya found the same but differs with research done by Thussen (2013) which shows the positive relationship between defined benefit and long term interest rate. Population have a positive relationship with defined benefit in line with study by Akwimbi (2014) but conflict with Thomas (2012) which shows a negative relationship this is due to different data used.

However, the current results revealed that these economic factors have a significant impact to the growth of defined benefit pension schemes. This means that the growth of pension schemes is affected by inflation, GDP_usd and population.

4.6 Summary

The chapter covers data presentation, interpretation and discussion of the research findings. The

researcher presented data using graphs, tables and charts. Also, the researcher used Chi-Square test to test the efficiency of the model stated in the previous chapter. The next chapter considers conclusion and policy recommendations.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The study's overview, findings, and suggestions are presented in this chapter.

5.1 Summary of the findings

The results show that there was a strong positive correlation relationship between inflation and contribution, also there was a strong positive correlation between population and contribution. There was a moderate positive correlation between GDP_usd and contribution. Lastly there was a negative correlation relationship between interest rate and contribution.

The coefficient value (8.388e+00) of contribution indicates that there was a significant relationship with independent variables. Population was significant factor having coefficient value (7.567e-08), inflation was significant factor having coefficient value (9.451e-05), GDP_usd was significant factor having a coefficient value (1.351e-12) and interest rate having a value of (-5.395e-04). These findings suggest that, with the exception of interest rate, which was adversely connected, all economic factors that influence the growth of pension funds are positively correlated to contributions.

These economic aspects also significantly influence how well the suggested generalized linear model performed in this study. The residual deviance in this case decreases gradually with the addition of each variable, showing that the model with four variables is better fitted than the model with just one variable. Additionally, the deviance represents the difference between the residual deviance of the current model and the residual deviance of the previous model.

5.2 Conclusions

The study's conclusion about the economic factors that influence the growth of pension funds are positively correlated to contribution except interest rate and significantly affect the efficiency of defined benefit schemes. These factors consist of population, GDP_usd and inflation.

The study came to the additional conclusion that inflation had the greatest impact on the growth of pension schemes among the four variables. This is due to high inflation, which raises the cost of living and makes it necessary for people to save more money for retirement. Inflation also raises the cost of living, which may result in higher wages and more disposable income that can be used to

contribute to pension funds. The study came to the conclusion that the proposed GLM model is effective and should to be used by pension funds companies.

5.3 Recommendations

The study made the following recommendations.

1. The growth of pension plans is significantly influenced by the population, GDP_usd, inflation, and interest rate, hence policymakers should use a proposed generalized linear model that pays close attention to these economic variables.
2. Also, policy makers should make sensible investments to guarantee good returns because their success is essential to meeting the needs of their retirees.

5.4 Areas for further research

According to the research findings, it would be beneficial to repeat the study in a new environment, with a focus on different pension funds. This could further clarify the discriminatory effects that these economic factors have on various pension fund companies. Other factors influencing pension scheme growth should also be taken into account, in addition to population, GDP_usd, inflation, and interest rates.

5.5 Summary

The research findings on the economic variables influencing the growth of pension funds in Zimbabwe were summarized in this chapter. Additionally, recommendations and ideas for additional research were provided.

REFERENCES

- Schultz, E., (2012) Retirement Heist: How Company Plunder and Profit from the Nest Eggs of American Workers, Penguin, New York City
- Saunders et.al., (2007) Research Methods for Business Students, Prentice Hall, New York
- OECD., (2005). Pensions at a Glance: Public Policies Across OECD Countries
- Moyo, I., (2010) Employee Benefits Strategy: Sustainable Benefits Institute of Personnel Management Lecture, Specis College, Harare
- Ganguly, A., (2012) Group Discussion for Admissions and Jobs, Pustak, Mahal
- Emmett, R.B., (2010) The Elgar Companion to the Chicago School of Economics: Michigan State University, USA
- Dorfman, et.al., (2013) China's Pension System: A Vision, World Bank, Washington D.C
- Dorfman, M.S., (2003) Introduction to Risk Management and Insurance, 6 th edition, Prentice Hall International, Upper Saddle River
- Brown, R., (2002) Your Retirement: How to make the most of it, 8 th edition, Clays Ltd, Great Britain
- Arunajatesan, S. and Viswanathan, T.R., (2009) Risk Management and Insurance: Concepts and Practices of Life and General Insurance, McMillan India Ltd, India
- Vaughan, W.R., (2000) Vaughan's "Freedman's Pension Bill, Books for Libraries Press, USA
- Ward, D. and Zurbruegg, R., (2000) Does Insurance Promote Economic Growth: Evidence from OECD Countries, The Journal of Risk and Insurance, 67(4): 484-506
- Wyatt, W., (2006) Canadian Pensions and Retirement Income Planning, 3 rd. edition, CCH Canadian Ltd, USA
- Zwecher, M.J., (2010) Retirement Portfolios: Theory, Construction and Management, John Wiley and Sons, New Jersey
- Greene., (2003) Model stability and diagnostics tests. Statistical modeling, 195-197.
- Mazviona., (2010) Inflation and the purchasing power of retirement income. Insurance and Investments, 61-63.

Thussen., (2009) Growth of a basic pension. Pensions and Insurance Mathematics, 199-2010.

Xianyu., (2013) Stochastic modeling of Defined Benefit. Insurance and Financial Mathematics, 4-7.

(Thomas, 2014) (Xianyu, 2013) (Greene, 2003) (Carter, 2013) (Hakim, 2007) (Saunders,2009) (Lee R. D., 2002) (Lee R. D., 2014)(Mukwasi., 2015) (Pondo 2014) (Akwimbi 2014) (Russek, 2016) (Wilkie, A stochastic investment model for actuarial use, 2006) (Wilkie, More on a stochastic asset model for actuarial use,2006) (Zhang C. B., 2011) (Dufresne, 2014) (Huang, 2016)

Steven Haberman and Iqbal Owadally., (2001) Modeling Defined Benefits Pension Scheme: Funding and Asset Valuation; 6-7 Page 1-4

Davies, G., (2002) A History of Money, University of Wales Press, Cardiff

Chang, S. C., (2013) Pension valuation under uncertainties: The Journal of, 171-192.

Antoine Bozio, Rowena Grawford and Gemma., (2010) The History of State Pensions in the UK: Tetlow page 4-12

The Pension and Provident Fund Act (Chapter 24: 07)

OECD Report (2021) IPEC Reports (2012 -2022)

APPENDICES

APPENDIX A: Table of data used.

Year	Contribution	GDP_usd	Population	Inflation	Interest rate
2012	11372	14101920310	13025785	2.171761274	57.55194951
2013	11662	17114849880	13265331	4.855945322	59.07442053
2014	11939	19091019990	13555422	8.091140320	60.63381986
2015	12341	19495519630	13855753	0.624974693	62.41713494
2016	12896	19963120610	14154937	0.367419549	6.704529648
2017	13464	20548678070	14452704	2.014094534	4.090833333
2018	14027	17584890937	14751101	3.056905217	3.274166667
2019	14580	34156069918	15052184	200.7695776	2.532500000
2020	15110	21832234926	15354608	225.3946482	2.975000000
2021	15560	21509698406	15669666	604.9458642	4.518333333
2022	15821	28371238666	15993524	113.2949806	8.059166667

APPENDIX B: Analysis of Deviance

	Response: Contribution				
	Df	Deviance Resid	Df	Resid. Dev	Pr(>Chi)
NULL			31	8165.5	
GDP_usd	1	6408.5	30	1757.1	< 2.2e-16 ***
Population	1	1318.6	29	438.5	< 2.2e-16 ***
Inflation	1	78.6	28	359.9	< 2.2e-16 ***
Interest rate	1	130.4	27	229.5	< 2.2e-16 ***

APPENDIX C: Interaction of the estimates variables

Coefficients:			
	Estimate	Std. Error	z value Pr(> z)
(Intercept)	8.388e+00	2.387e-02	351.462 < 2e-16 ***
GDP_usd	1.351e-12	4.786e-13	2.823 0.00476 **
Population	7.567e-08	2.322e-09	32.588 < 2e-16 ***
Inflation	9.451e-05	1.600e-05	5.907 3.48e-16 ***
Interest rate	-5.395e-04	4.744e-05	-11.373 < 2e-16 ***

APPENDIX D: R. Code

```
# Load the data
data <- read.csv("Contributions.csv", header = T, sep = ';')
View(data)
# Basic summary of the data
summary(data)
str(data)
# Visualize the data using ggplot2
install.packages('ggplot2')
library(ggplot2)
ggplot(data, aes(x = Contributions, y = GDP_usd)) +
  geom_point() +
  ggtitle("Contributions vs GDP_usd") +
  xlab("Contributions") +
  ylab("GDP_usd")
ggplot(data, aes(x = Contributions, y = Population)) +
  geom_point() +
  ggtitle("Contributions vs Population") +
  xlab("Contributions") +
  ylab("Population")
ggplot(data, aes(x = Contributions, y = interest_rate)) +
  geom_point() +
  ggtitle("Contributions vs Interest_Rate") +
  xlab("Contributions") +
  ylab("Interest_Rate")
#Build a GLM and perform Analysis of Parameter Estimates
# Build GLM
model <- glm(Contributions ~ GDP_usd + Population + Inflation + interest_rate, data = data, family = poisson)
# Analysis of Parameter Estimates
summary(model)
# Analysis of Deviance
anova(model, test = "Chi")
# Wald Test
install.packages('aod')
library(aod)
wald.test(b = coef(model), Sigma = vcov(model), Terms = 2:5)
# Hypothesis Testing
install.packages('lmtest')
library(lmtest)
pchisq(deviance(model), df.residual(model), lower.tail = FALSE)
# Null hypothesis: The coefficients of predictors are equal to zero
# Alternative hypothesis: The coefficients of predictors are not equal to zero
# Significance level: 0.05
```