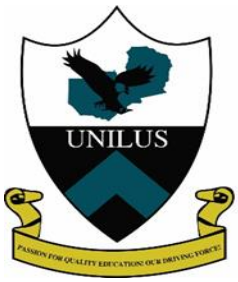

UNIVERSITY OF LUSAKA

SCHOOL OF POSTGRADUATE STUDIES

ANALYSIS OF ASSESSMENT RATES BY BUSINESS NATURE AND REPORTED ACCIDENTS IN ZAMBIA: A COMPREHENSIVE STUDY OF THE WORKERS' COMPENSATION FUND CONTROL BOARD.

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, UNIVERSITY OF LUSAKA IN PARTIAL FULFILLMENT OF THE AWARD OF THE MASTER OF SCIENCE IN ACTUARIAL SCIENCE.

BY

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DECLARATION

I **ANNA CHIKOPELA**, affirm that this study is entirely my original work to the best of my understanding. It has not been previously created or presented for any academic qualification at this university or elsewhere. Furthermore, I have properly credited and acknowledged the contributions of others in this work.

Signature: **Date:15.04.2024**

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Signature: .....

Date: 18/04/2024

To David Andrew Yasa Luo.
May this be an inspiration for higher achievements.

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To lean not on my own understanding is a lesson I have taken away from this program and therefore would love to acknowledge the presence of God through this journey and His grace throughout this research.

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ACRONYMS

ILO	International Labour Office
ISSA	International Social Security Association
OHS	Occupational, Health and Safety
PAS	Pension Administration Systems
SDGs	Sustainable Development Goals
SMEs	Small Medium Enterprises
WCB	Workers Compensation Board of Manitoba
WCFCB	Workers' Compensation Fund Control Board

ABSTRACT

This research explores into the relationship between assessment rates, business nature and reported accidents within the context of the Workers' Compensation Fund Control Board in Zambia. The study aims to provide an understanding of the assessment rates imposed on businesses and how these rates correlate with the nature of businesses and reported workplace accidents. Employing a comprehensive analytical approach, the research examines data sets encompassing diverse business sectors to determine patterns, trends, and potential gaps in assessment rates. The methodology used integrates quantitative analysis, utilizing statistical models to identify significant associations between assessment rates and reported accidents by business nature, while qualitative insights are gathered through reports and records by the Board. Results indicate a high correlation but only at 10.5% goodness of fit between assessment rates and reported accidents by nature of business. This means that assessments rates are reflective of claims experience amongst other factors. It is therefore established that considering growth rates of assessed businesses and accidents in different natures of businesses, can provide some guidance in the evaluation of risk rates after a specified interval. Recommendation is made among others that a deliberate policy be implemented by the Workers' Compensation Fund Control Board to continuously monitor and adjust assessment rates at after a specified period. This can be part of actuarial reviews conducted by the Board to be up to date with evolution of risks in different business natures.

Chapter One
INTRODUCTION

1.1. Background

Assessment rates are the premiums or contributions that businesses pay to the Workers' Compensation Fund Control Board (herein termed “the Board” or WCFCB) in Zambia. These are typically based on factors such as earnings estimates, the nature of the business, and the level of occupational risk (ILO, 2016). They play a crucial role in several aspects such as financial stability, equity and fairness, and cost containment. With Financial Sustainability, assessments are the primary source of funding for workers' compensation scheme. They ensure that there are sufficient financial resources to provide compensation to injured workers. Without proper assessments, the scheme's financial sustainability could be compromised. International labour Organisation (2016) notes that “under-declaration of the number of workers does not affect coverage of workers though since workers’ names are not recorded by the WCFCB – but it does affect WCFCB financial sustainability”. Setting rates that reflect equity and fairness in the actual risk associated with different types of businesses is crucial. High-risk industries should pay higher rates, while low-risk industries should pay lower rates. This ensures that the financial burden is distributed equitably among businesses. Furthermore, properly calibrated assessment rates can serve as incentives for businesses to prioritize workplace safety. Well-managed assessment rates can help control costs within the workers' compensation system. By charging rates that accurately reflect risk, the scheme can avoid over-compensation or under-compensation, leading to more efficient use of resources.

To finance the Workers' Compensation Scheme, employers in Zambia are mandated by law to contribute to the fund, which is managed and administered by the Board. It enforces compliance with mandatory contributions, ensuring that sufficient resources are available to provide compensation to injured workers. Therefore, the Board plays a crucial role in providing benefits to workers who are injured or contract diseases in the course of their employment and collecting revenue from employers through assessments to fulfil this mandate (Government Actuary’s Department, 2021).

This research therefore aims to analyse Workers' Compensation Fund Control Board assessment rates by business nature and reported accidents in Zambia by analysing historical assessment rate data to identify trends and patterns in rate adjustments over time. Understanding these trends can shed light on the evolution of the assessment rate structure. The research further investigates the relationship among reported accidents, business nature and assessment rates. It seeks to marry businesses with higher accident frequencies, their nature of business and if they face higher rates.

1.2. Statement of the problem

Assessment rates are primarily based on business nature, neglecting individual employer safety records and accident histories. This unfairly penalizes safe employers in high-risk industries while rewarding unsafe employers in low-risk industries. Factors such as safety measures and technology play a crucial role in minimizing workplace injuries and accidents, protecting workers, and improving overall safety culture and therefore affect the risk that is associated with the assessments. Over the years, there have been significant improvements in the areas of safety in most businesses and thus it is expected that accidents in some natures of businesses have reduced significantly. Therefore, it is important to establish if the risk associated with the nature of business should be the same or adjusted accordingly over the years. Some businesses may feel that the assessments rates are high especially for Small-Medium Enterprises (SMEs) in comparison to other bigger businesses in their classes.

It has been noted that most businesses do not feel the need to contribute to the Board as they have not incurred any accidents in the past and therefore, compliance is an expense to their business. Billima-Mulenga (2015) state that contributions towards Workers’ Compensation are identified by employers as a labour cost among others that they could not afford. The Board (WCFCB) therefore faces a challenge with business owners regarding the assessments rates contributed. This is mostly due to the knowledge and information gaps existing surrounding how the rates are determined. This is supported by a study done by Sakala (2012) in which it is concluded that employers fail to pay the revised fees into the Workers' Compensation Fund Control Board as they feel that they (assessment rates) have been imposed on them. Masumbu & Mwenge (2017) also note that firms had no clear understanding of how the rates were determined among other observations of the Board. This problem

stems from several interconnected factors, including awareness, sensitisation, availability, and access to information.

The aim of this study is to resolve the knowledge gap that exists concerning the concept of assessment rates and how they are influenced by business nature and reported accidents. The analysis also helps to establish if the assessment rates in relation to business nature and reported accidents are indeed a true reflection of the status quo and thereafter, giving recommendations from the findings. It should also be noted that the WCFCB conducts a comprehensive actuarial review every three (3) years to consider policy adjustments ensuring that assessment rates charged are appropriate for the scheme to remain sustainable (Government Actuary's Department, 2021).

1.3. Research Objectives

1.3.1 Main Research Objectives

The study seeks to examine assessment rates from the Workers' Compensation Fund Control Board in Zambia based on the nature of businesses and reported accidents. This will be accomplished by analysing historical data on assessment rates to detect trends and patterns in adjustments over time.

1.3.2 Specific Research Objectives

The following were the specific objectives of the research study.

1. To analyse trends and patterns of assessment rates using historical data.
2. To investigate assessments rates using business nature and reported accidents.
3. To evaluate if hierarchy of assessments rates in the various business natures mirrored the rate of reported accidents.

1.4. Research Questions

The following were the research questions that were used.

1. What changes have occurred in assessment rates within the Board over time?
2. What is the impact of business nature and reported accidents on the assessment rates?
3. Is the order of assessments rates in business natures reflective of the reported accidents?

1.5. Significance of the study

The significance of this research topic extends beyond the academic realm. It implies that the study will cover various aspects related to the WCFCB, including its policies, practices, and the data it collects. The research aims to provide a holistic view of how assessment rates are determined and how they relate to reported accidents and business nature. It also directly affects the attitude of businesses towards compliance and informs policy decisions in Zambia. Policies such as how frequently assessment rates should be revised and what factors should be considered. This will directly feed into the behaviour of employers' compliance levels because firms, as alluded by Masumbu & Mwenge (2017), wondered whether the Workers Compensation exists for purely revenue purposes for the Government. Additionally, the study has broader implications for the field of actuarial science and the global discourse on income protection of occupational accidents and diseases.

1.6 Scope of the study

The study focused specifically on the Workers' Compensation Fund Control Board (WCFCB) in Zambia. It examined the assessment rates of businesses, analysing data over a period of 10 years from 2012 to 2021, including historical data and recent developments. This included analysis of assessment rates, natures of business and frequency of reported accidents in the Board.

1.7. Definition of key terms and concepts

Assessment Rates: premiums or contributions that businesses pay to the WCFCB are typically based on factors such as the nature of the business, its size, and the level of occupational risk (ILO, 2016).

Business Nature: "business" means any industry, undertaking, trade occupation or other activity in which any worker is employed (Workers' Compensation Act, 1999). Different types of businesses or industries create Business Natures and different industries may have different levels of occupational risk and, therefore, different assessment rates.

Income Protection: Insurance that protects against a financial loss if a person finds they are unable to work for health or disability reasons (Moorhouse, 2021)

Reported Accidents: An accident according to the Workers' Compensation Act (1999) means an accident resulting in injury to a worker or in damage to, or destruction of, any artificial aid used by a worker in the course of employment. These incidents or injuries that occur in the workplace and are reported to the WCFCB are called Reported Accidents. The presence and frequency of reported accidents may influence assessment rates and are important to understanding the overall picture.

1.8. Organisation of the study

This study is structured across six chapters. In the initial chapter, the research sets the stage by introducing the background, articulating the problem statement, outlining research objectives and questions, underscoring the significance of the study, delineating the study's scope, and providing clear definitions of key terms and concepts.

Moving on to the second chapter, a comprehensive review of relevant literature is presented, encompassing both empirical and theoretical perspectives on the chosen topic. Additionally, this chapter incorporates a conceptual framework that holds relevance to the study.

Chapter three is dedicated to outlining the research methodology, including details on the research approach, design, study population, census size, census techniques, data collection instruments, data analysis methods, and ethical considerations.

The subsequent chapter, chapter four, systematically presents the study's findings, guided by the pre-established research questions, whilst chapter five engages in a thorough discussion of the findings, relating them to the predetermined objectives of the study.

The final chapter, chapter six, serves as a conclusion to the study, encapsulating a summary of key points, providing conclusive remarks, offering recommendations to the Board, and suggesting avenues for future research.

Chapter Two
LITERATURE REVIEW

2.1. Introduction

Workers' compensation schemes are an integral part of labour and social security policies in most countries around the world. This is a part of what is termed as “income protection”. Income protection aims to provide financial support to individuals unable to work due to injury, ensuring they receive a steady income during their recovery period. Boden (1995) suggests that while it may not necessarily reduce injury rates, it can provide benefits to workers and reduce the need for litigation. This chapter of a study will involve an analysis of academic articles, books, journals, and other authoritative sources that contribute to the understanding of the topic at hand. It will give an empirical review of various studies and thereafter give an overview of the Workers’ Compensation Fund Control Board in Zambia. Further review of Assessment rates will be done by delving into the relationship with business natures and reported accidents. A theoretical framework will then be done based on the compliance and risk-based supervision approach and lastly, a conceptual framework of the variables.

2.2. Empirical Review

Employers often provide coverage for work-related injuries through workers' compensation insurance, which includes medical care, disability benefits, and wage replacement. Coverage varies based on the insurance policy or the legal framework of the country. Typically, the injury must be work-related for workers' compensation and employers usually contribute funds to insurance schemes, compensation boards, or social security systems. It is often mandatory for employers to make these contributions, ensuring coverage for employees' income protection needs. Komamura & Yamada (2004) and Nielsen & Smyth (2008) found evidence that the burden of these contributions can be shifted back onto employees, either through wage reductions or increased compliance costs. Employers may pay insurance premiums to private insurers to cover income protection benefits for employees or contributions might go directly into designated compensation funds managed by government bodies or specialized boards. Employer contributions are crucial for the sustainability of income protection schemes, ensuring adequate funding to support compensation for injured

workers and striking a balance between adequately funding the system and managing operational costs (Spieler & Shor, 2000). Employer contributions to income protection schemes factor into the overall operational costs for businesses. It also encourages employers to maintain safer work environments to reduce the risk of workplace injuries or accidents.

In the United States of America (USA), every state has its own scheme according to their legal framework with federal insurance playing a major role (Sorensen & Yosha, 1997). Premiums are paid to insurance companies or state-run funds whilst employers that self-insure set aside reserves for compensation costs. The pricing procedure for workers' compensation insurance in the USA follows a three-tiered approach. Firstly, an average state-wide price level is calculated. Subsequently, adjustments are made for individual industries and then for specific firms. The resulting prices are referred to as “manual rates”, reflecting the average cost of losses and expenses per unit of exposure within each classification. This is supported by Durbin & Borba, (2007) who state that “The actual premium paid by each firm is, in most cases, a weighted average of this manual rate, reflecting the average loss experience in the class, and the firm's own loss experience”. Due to variations in benefits across states and differences in the distribution of injuries among various types of employment, these rates can significantly differ (Appel & Borba, 2013). The typical structure of U.S. workers' compensation involves a board or commission establishing rules, an insurer providing coverage based on eligible workers' payroll, and cases being initially adjudicated by the insurer, with an appeals system in place for contested matters. This means that employers purchase private insurance or self-insurer to cover compensation, inclusive of medical care, rehabilitation, disability benefits and partial wage replacement. The federal government played a pivotal role in the early twentieth century with the enactment of the Federal Employers' Liability Act of 1908, providing compensation for federal employees in hazardous jobs and certain interstate commerce workers. A significant milestone occurred in 1911 when Wisconsin adopted Worker's Compensation, sparking widespread debate. Taylor & Walters (2010) summarise this as what marked a turning point, as employers successfully advocated for the "great trade off," where they agreed to furnish medical and wage benefits in exchange for employees relinquishing their right to sue.

In Canada, Gunderson & Hyatt (1998) explain that employers' payment rates encompass medical, vocational rehabilitation, and financial compensation for workplace injuries, along with administrative costs. Assessment rates vary among firms based on their claims cost experience relative to industry averages, with lower-cost firms paying below-average rates and higher-cost firms paying above-average rates. Larger employers can opt for self-insurance, where the Board covers benefits and bills the firm for compensation and administrative charges. Governed by the Workers Compensation Act and Regulations, premiums calculated by the Workers Compensation Board of Manitoba (WCB) are determined by evaluating both the likelihood of incurring claims costs and the insured value, expressed as a rate of payroll per $100.

$$rate * \frac{payroll}{\$100} = premium$$

The rate-setting model, designed for fairness and transparency, assesses the risk associated with each employer, assigning them to industry classes with corresponding base rates. Industry classes, established by the WCB, are categorized based on the risk level inherent in each business. The classification base rate, derived from the financial year average rate multiplied by the risk category, serves as the baseline for calculating premiums.

$$financial\ year\ average\ rate * risk\ category = classification\ base\ rate$$

Industry classification experience rates are monitored yearly to ensure employers are in the correct risk category. The classifications and their risk categories are based on four years of historical data that compare employers' likelihood of having claims and claims-related costs to the average of all employers. Further, to prevent smaller employers from bearing disproportionate burdens, the WCB employs a tiered rate structure, ensuring that larger employers pay higher rates than their smaller counterparts. Jurisdictions commonly adjust classification rates based on loss experience and provide incentives to participate in safety programs; for example, in Canada, the Province of Alberta adds a surcharge to class rates to fund safety association programs (Klein & Krohm, 2006). The WCB utilizes an experience factor to modify premiums based on an employer's individual claims history, comparing actual claims experience to the industry class's expected claims. Employers with

superior claims records may receive premium discounts, while those with below-average records may face premium increases. The WCB provides programs and services aimed at assisting employers in enhancing workplace safety and minimizing the risk of workplace injuries.

Forjuoh et al. (1998) highlights the need for improved coverage and preventive measures for work-related injuries in Africa emphasizing the role of African governments in injury control. In South Africa, the Compensation Fund manages the Compensation for Occupational Injuries and Diseases Act, which includes amendments from the Act of 1997. Employers contribute to the Compensation Fund through annual payments known as assessments. According to the compensation fund service booklet (1993), these assessments are calculated based on the annual earnings paid to employees, with the formula being:

$$\frac{earnings}{100} * rate = assessment\ payable$$

The booklet further states that assessment tariffs classify businesses according to their industry and associated risks, with rates determined by the nature of the business operations. The Government of South Africa (2020) in the Compensation Fund Preliminary Report state that the Compensation Fund bases its tariff calculations on past claims data and member assessments instead of actual risk ratios. It adjusts subclass tariffs to ensure a balance between expected revenue and costs, aiming for a break-even outcome. Tariffs rise when subclasses experience persistent deficits and decrease when they have continuous surpluses. The classification system helps ensure that businesses pay according to the level of risk associated with their type of work. All operations, including administrative staff, are considered part of the business unit for assessment purposes. The assessment tariffs are reviewed annually to reflect changes in risk levels for different types of work. Employers are required to share employee data with carriers and keep it up to date for the calculation of industry subclass tariffs. Each subclass has a unique tariff due to differences in accident and disease risk levels. The purpose of these tariffs is to ensure carriers have enough funds to cover workplace accidents and diseases while maintaining financial stability. The Compensation Fund calculates tariffs using historical claims cost data and expected revenue from member assessments. The Fund aims to set tariffs so that the

expected revenue matches the expected costs for each subclass, allowing for adjustments in cases of a subclass deficit or surplus.

Although the literature provides information on how these rates are calculated, it lacks details on the specific impact of two crucial factors: the nature of the business and the frequency or severity of accidents. In other words, while the literature might outline the general methodology for setting assessment rates, it doesn't delve into how much weight or influence the type of business and the occurrence of accidents have on determining the actual rates charged for each classification.

In Zambia, the Workers' Compensation Fund Control Board follows a similar pattern to the above reviewed countries basing assessment rates on nature of business and risk. There is a need to ensure that the compensation schemes are in line with international labour standards (Worugji, 2013). The following passages therefore give an overview of the Board, assessment rates and then presents the relationship between assessment rates and nature of business and that of assessment rates and reported accidents before looking at the theoretical and conceptual frameworks.

2.2.1. Overview of the Workers' Compensation Fund Control Board in Zambia

The Workers' Compensation Fund Control Board plays a pivotal role in safeguarding the welfare and rights of the nation's workforce. Established by an Act of Parliament to administer and regulate the Workers' Compensation Scheme, the WCFCB is a government agency dedicated to ensuring that workers who suffer injuries or illnesses in the workplace receive fair and timely compensation (Workers' Compensation Act No. 10 of 1999). This act was enacted to provide a comprehensive framework for addressing the needs of workers who encounter occupational accidents or contract work-related diseases. The board operates under the Ministry of Labour and Social Security and is responsible for overseeing the implementation of the Workers' Compensation Scheme. The WCFCB's work has a direct impact on the welfare of Zambia's workforce. It provides a safety net for workers who face unexpected hardships due to workplace accidents or diseases, ensuring that they receive adequate support and care. This contributes to the overall well-being of the labour force and reinforces the principle of social protection in the country. The WCFCB plays a critical role in the efficient processing of compensation claims. Workers who suffer injuries or illnesses at the workplace can file claims with the board, which then

assesses the validity of the claims and disburses compensation accordingly. This process helps injured workers and their families access the necessary financial support during challenging times.

2.2.1.1 Assessment Rates (Premiums)

Pitacco (2014), mentions that “stochastic methods, relying on Monte-Carlo simulation procedures, allow assessment of risks inherent in managing an income protection portfolio”. If a business takes up individual income protection, it offers greater customization, portability, and potential benefits for a worker, but at a higher cost and with more administrative responsibilities. In a group income protection scheme like WCFCB, it offers lowers costs, is easier to access, and has an employer-managed administration. However, businesses sacrifice some control, portability, and may be subject to premium increases based on the overall claims experience. Individual premiums would require individual risk assessments for all workers including underwriting which raises the cost of premiums. With group income protection, the premiums tend to be lower due to risk pooling with other workers in the business. However, group rates may be adjusted based on the overall claims experience.

The contributions that employers are required to pay into the workers' compensation fund are influenced by several key factors, including business nature, risk factor, earnings, number of employees, etc. The nature of the employer's business plays a crucial role in determining assessment rates. High-risk industries, such as construction or manufacturing, often have higher rates due to the elevated likelihood of workplace accidents, whilst the number of an employees’ causes larger businesses to face higher premiums due to the increased potential for reported accidents. The use of contingent workers in high-risk environments, such as independent contractors and temporals, also increases accident rates (Rousseau & Libuser, 1997). The reported accidents show high risk for accidents in a business that in turn influences the how much cover businesses should contribute to have basic cover for their employees.

To calculate the assessment rates per employer, the Board uses the formula;

*Number of Workers*Annual Gross Earnings*Risk Factor*

Where;

*Annual gross earnings are calculated at a capped ceiling determined by the Minister (K16,200 as at 2023)

*Risk factors (rates of assessments) are percentage of risk ranging between 2.05% and 14.47% published in the government gazette (last published in February 2014) varied by the Minister from the Board in accordance with actuarial guidance.

2.2.1.2 Business Nature and Assessment Rates

The relationship between business nature or industry type and assessment rates in workers' compensation systems is based on the principle of risk. High-risk industries typically face higher assessment rates due to the increased likelihood of workplace injuries or accidents. According to the Zambian Government Gazette (2014), Table 1 below gives the natures of businesses and risk rates.

This approach encourages employers to prioritize safety and invest in measures to mitigate risks, ultimately benefiting both workers and the workers' compensation system. The assessment rates are not arbitrary but are determined by evaluating the specific risk profiles of different industries, which can change over time as safety standards and practices evolve. However, the accuracy of these rates can be affected by the underestimation of industrial accidents (Akman et al, 1972).

Nature of Business	Risk Rates	Nature of Business	Risk Rates
Banking, Finance, and Insurance	2.24%	Local Authorities	5.53%
Charities, Religious, Political, Trade Unions	3.05%	Leather Industries	5.63%
Medical Services	3.34%	Printing, Publishing & Paper Industries	5.69%
Trade and Commerce	3.37%	Food, Drinks and Tobacco	5.93%
Entertainment and Sports	3.53%	Textile Industries	6.03%
Personal Services, Hotels etc.	3.72%	Chemical Industry	7.22%
Education Services	3.75%	Wood and Furniture Industry	7.63%
Glass, Brick, Tiles and Asbestos	4.04%	Building and Construction	7.63%
Professional Services	4.22%	Transport and Communication	8.90%
Agriculture and Forestry	4.62%	Mining and Quarrying	14.47%
Iron, Steel Industries etc.	4.88%		

Table 1. Annual Risk Rates Gazetted in 2014. Source: Government Gazette 97 of 2014

2.2.1.3 Reported Accidents and Assessment Rates

The significance of reported accidents in determining assessment rates in workers' compensation systems cannot be overstated. Accident data is a valuable source of information that plays a critical role in rate-setting and has several important implications. Reported accidents provide insights into the actual risk level associated with specific industries or employers. Woods (2017) implies that high incident rates indicate a greater risk of workplace injuries, while low incident rates suggest a safer working environment. Using accident data ensures that assessment rates are fair and proportionate to the level of risk. The use of accident data as a basis for rate-setting provides a powerful incentive for employers to prioritize workplace safety. Companies with high accident rates face higher assessment rates, motivating them to implement safety measures and reduce accidents. By considering accident data, workers' compensation authorities can identify industries or companies with alarming accident trends. This enables them to target these areas for additional safety inspections, education, and preventive measures.

Using accident data also helps ensure the long-term sustainability of the workers' compensation system. Adequate funding from high-risk industries and companies helps maintain the financial health of the system. Advances in data collection and analysis technologies, such as machine learning and predictive modelling, offer opportunities to better leverage accident data for rate-setting. This is particularly important considering the need for a new look at the type of data collected and analysed, with a focus on equipment and human failure rates (Kletz, 1993). These technologies can identify trends and patterns that might not be apparent through traditional methods.

2.3. Theoretical Framework

2.3.1 Compliance and Risk Based Supervision Approach

The Basel Committee on Banking Supervision (2011) defines compliance-based supervision as an approach used by regulatory authorities to ensure that individuals, businesses, and organizations adhere to applicable laws, regulations, and industry standards. The primary objective of compliance-based supervision is to maintain integrity, transparency, and fairness in various sectors, including finance, healthcare, environment, and consumer protection. A compliance-based approach is crucial for

organizations to meet regulatory requirements and maintain ethical standards (Türetken et al, 2012). The approach evaluates whether employers are meeting their legal obligations to provide workers' compensation coverage. Some challenges of compliance-based supervision are that they have a reactive nature, have limited risk assessment, are resource intensive, and have a one-size-fits-all approach. It also has innovation hindrance and is lacking in flexibility among others.

The Basel Committee on Banking Supervision (2011) defines risk-based approach as a supervisory approach that identifies, assesses, and prioritizes potential risks associated with activities, projects, or operations. Instead of applying uniform measures or controls to all aspects of operations, organizations using a risk-based approach focus resources on managing the most significant risks first. The risk-based approach promotes fairness, as it ensures that employers with a higher risk of workplace injuries pay more, while those with lower risks pay less. This can incentivize businesses to improve workplace safety. According to Deloitte (2014), the risk-based approach process is forward looking with a focus on evaluating both present and future risks, identifying incipient problems and facilitating prompt intervention or early corrective action moves.

In Zambia, the Workers' Compensation Act mandates employers to provide compensation for workplace injuries. A high compliance rate is essential to ensure that workers are protected in case of injuries or accidents on the job. Low compliance could lead to workers being left without support when they need it the most. The WCFCB regularly assess compliance rates through audits and inspections. High compliance rates indicate a responsible business environment, while low compliance rates may require more enforcement and awareness efforts. Also, using a risk-based approach, WCFCB assesses and categorizes employers based on their industry, employee headcount, and the likelihood of workplace injuries. This approach tailor assessment rates to the specific risk posed by each business. Industries with higher inherent risks, such as construction, may have higher assessment rates compared to less risky industries. A compliance-focused approach alone may not adequately fund the WCFCB. It might lead to insufficient resources for compensating workers and ensuring their welfare. Combined with the risk-based approach aligns assessment rates with the actual exposure to risk, which ensures that funds are available for compensation.

This approach is more equitable and sustainable. The WCFCB can encourage employers to invest in safety measures and accident prevention, reducing workplace injuries and, in turn, claims and costs.

2.4. Conceptual Framework

The conceptual framework is based on understanding how assessment rates are determined and their variations across different business natures, how they differ based on the nature of the business, considering factors such as risk and workplace safety practices and through an investigation of the frequency, nature, and circumstances of reported accidents to assess workplace safety and identify potential correlations with assessment rates.

An assumption can be made suggesting that the nature of a business and its reported accidents are predictors or influencers of the assessment rates imposed by the Board. For example, it could be assumed that businesses with higher risk levels (dependent on business nature) may face higher assessment rates, and those with a history of more reported accidents may also experience increased rates. The objective is to uncover relationships that could provide insights into how the nature of businesses and their reported accidents in the Board are the basis to set assessment rates.

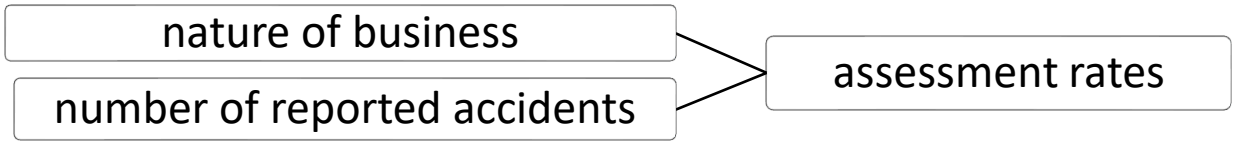

Figure 1. Graphical Conceptual Framework

2.4.1. Independent Variables

The independent variables of this research were the business nature and reported accidents.

The *nature of business* was categorised based on industry type, operational activities, and risk profiles which include industries like manufacturing, construction, service-oriented businesses, hazardous occupations, etc. This was expressed as a categorical variable representing different business types and measured using the nature of business of reported accidents as a nominal variable.

Reported Accidents included various occupational injury types (fatal, non-fatal) or occupational illnesses. It is a numeric variable, representing the number or frequency of reported accidents. This will be measured using the frequency of reported accidents in each injury type and considered a nominal variable.

2.4.2. Dependent variable

Assessment Rates are numeric variables, typically expressed as a percentage of payroll or a fixed premium per employee. This will be measured using the annual premium payable per worker as a continuous variable.

Chapter Three
METHODOLOGY

3.1. Research Approach

Goundar (2012) notes that research methodologies highlight two fundamental approaches: the quantitative approach and the qualitative approach. The quantitative approach involves generating data in numerical form, allowing for rigorous analysis in a formal and strict manner. This method is applicable to phenomena that can be expressed in terms of quantity and involves the collection and analysis of numerical data to analyse and determine the relationships between variables. This approach was useful in this research to determine the relationship between nature of business, reported accidents and assessment rates.

3.2. Research Design

Ragin & Amoroso (1994) define research design as a plan for collecting and analyzing evidence that will make it possible for the investigator to answer whatever questions he or she has posed. With the aim to provide an accurate depiction of a situation or the relationship between variables, the appropriate design will prioritize minimizing bias and maximizing the reliability of the collected and analysed data.

This research study used quantitative research design which allowed for the collection of numerical data that was analysed statistically to determine the relationship between nature of business, reported accidents and assessment rates. It further implores quasi-experimental where the independent variable is manipulated before the dependent variable is measured (Price, Jhangiani & Chiang, 2015).

3.3. Study Population

Polit and Beck (2004) define the population as an aggregate or totality of all the objects, subjects or members that conform to a set of specifications. The population for this study was all registered businesses existing between 2012 and 2021 with the Workers' Compensation Fund Control Board in Zambia. Due to the nature of the data collected in this study, no sampling was conducted. Rather, a census of the entire population for the specified period was conducted. According to Surbhi Sharma

(2016), a well-organised procedure of gathering, recording, and analysing information regarding the members of the population is called a census. It is an official and comprehensive enumeration of the entire population or universe, encompassing every unit within a defined region or group of people from which data can be gathered.

3.4. Census Size

Between the years 2012 and 2021, Workers Compensation Fund Control Board had an estimated average of 11,814 registered businesses that was used in the analysis and over 11,000 reported accidents and diseases in total.

3.5. Census Techniques

All available recorded data from the Workers' Compensation Fund Control Board for the defined period was retrieved which included assessment rates, accident reports, industry classifications, and any other relevant information. The collected data was organized systematically, ensuring categorisation based on industry types, reported accidents frequencies, and any other variables of interest.

3.6. Data Collection/Instruments

The primary sources of data collection included official records, reports, and other relevant documents which includes classification of natures of business and associated risk rates such as annual reports, actuarial reports, government statutory instruments, acts, and gazettes from the WCFCB. Internet sources, journals articles and studies by other researchers were also used.

Secondary sources of data included organisation based compiled dataset of accepted claims and assessed businesses between 2012 and 2021 from the Pension and Administrative System (PAS) that the organisation uses. No interviews or questionnaires were used in the collection of data.

With assistance from the University of Lusaka, collection of data from the Board was sought and approved.

3.7. Data Analysis

Kaul is quoted to characterize data analysis as the examination of structured information to uncover inherent truths. It involves scrutinizing data from various

perspectives to unveil new insights (Pandey & Pandey, 2021). In this research, data analysis included a review of demographics, documentation, regression, and comparison of rates.

Data Cleaning: Using Microsoft Excel from Office 16 and SPSS 16, data collected from the Board was transformed into required variables.

- Transforming the date accident reported into the year accident reported in excel. [=YEAR(date accident reported)]
- Assigning labels to **natures of business** codes in SPSS for each reported accident.
- Assigning **assessment rates** for each reported accident according to nature of business and year accident reported using formula *Annual Gross Earnings*Risk Factor.*

* Note should be taken that the assessment rates from 2012 to 2014 and those from 2015 to 2021 differ due to the adjustments of assessment rates as per 2014 gazette in Table 1.

- Automatic recode of Claim Numbers (recorded accidents) to create a measurable variable of the **reported accidents**.
    - Navigate to "Transform" and select "Automatic Recode."
    - Move the "State" variable from the left column to the "Variable -> New Name" box.
    - Input a name for the new recoded variable in the "New Name" field and click "Add New Name."
    - Ensure to check the "Treat blank string values as user-missing" box.
    - Lastly, click "OK" to complete the process.

Demographics: Using Microsoft Excel from Office 16, data of assessed businesses were manipulated to give the average total. An average was used as businesses get assessed on an annual basis and appeared recurrently.

$$Average\ Number\ of\ Business\ Assessed = \frac{Sum\ of\ Business\ Assessed\ Annually\ (2012\ to\ 2021)}{Period\ (10\ years)}$$

On the other hand, data of reported accidents was calculated at the frequency of report by each nature of business as accident reports are unique events.

$$Total\ Number\ of\ Reported\ Accidents\ by\ Nature\ of\ Business\ = Sum\ of\ Annual\ Accepted\ Claims\ by\ Nature\ of\ Business$$

Time Series Analysis: Time-series charts were also generated to identify trends and patterns overtime for different natures of businesses. This also helped in understanding which natures of businesses have consistent higher occurrences of accidents. Assuming changing rates overtime, a time series analysis was conducted which included smoothing of data generated, creating time series forecast with an accompanied trend line to establish the growth rate of the variables.

- Smoothing data: using exponential smoothing, an alpha of 0.3 was used as it provides a good balance between responsiveness to new data and stability. More weight is put to past data to create stability and less responsiveness to change. This means that the predicted data will smooth out noise and reduce volatility.
- Chart generation: Insert chart > Line graph

  X-Axis: Years

  Y-Axis: Total Number of Assessed Business/Total Number of Reported Accidents by Nature of Business
- Trend line: exponential trend line added to provide a trend equation. The trend equation is a model of the formula for calculating the forecast values. An exponential trend equation model uses an exponential curve to fit the data and predict future values and is often used when the data shows an exponential trend, either increasing or decreasing.

The equation for an exponential trend equation model is:

$$y = ce^{bx}$$

Value at time y = trend value

Initial value c = y-intercept $c = e^{\{Avg(\ln y) - (b \times \bar{x})\}}$

Growth factor b = relative rate $b = \frac{\sum\{(\ln y - Avg\ (\ln y)) \times (x - \bar{x})\}}{\sum\{(x - \bar{x})^2\}}$

e = base of the natural logarithm (2.71828…)

x = time

The exponential trend equation model is determined by fitting the model to historical data and using the initial value and growth factor to predict future values.

The *growth factor (b) is a key parameter* in the exponential trend equation model, as it determines the rate of exponential growth or decay in the data. It is a value between 0 and infinity, where a value greater than 1 indicates exponential growth and a value less than 1 indicates exponential decay. For example, a high growth factor (b) of 1.05 indicates that the data will grow at 5% at each time step whilst a low growth factor (b) of 0.95 indicates that the data will decrease by 5% at each time step. A growth factor (b) of 1 indicates a constant value, with no increase or decrease over time.
R^2 = ratio explaining changes in values in process of time.

Documentation: Reviews of annual reports, actuarial reports, government statutory instruments and gazettes was conducted to establish any changes over the years that affected the rates of assessments.

Statistical Analysis: This explored the relationships between assessment rates and reported accidents by nature of business. With data from assessment rates and reported accidents by nature of business. Data used was from 2015 to 2021 only due to the change of risk rates highlighted later in the documentation findings.

- Chi square test of independence is used to determine if two categorical variables are independent or if they are in fact related to one another. It was conducted to determine whether the differences between the conditional and marginal distributions are significant, or if they are small enough to be expected simply by random chance. The following hypothesis were established.
  - H0: "Assessment rates are independent of reported accidents by their nature of business"
  - H1: "Assessment rates are not independent of reported accidents by their nature of business"

Using SPSS, the data of assessment rates are automatically recoded into categorical variables and the chi-square test conducted.

- Transform > Automatic Recode > Assessment rates into ASSESSMENT_RATES to categorise values > Ok

Reported accidents categorised by the nature of business are renamed to ACCIDENTSBYBUSINESS. Thereafter, chi-square test is conducted.

- Analyse > Descriptive statistics > Crosstab > Assessment_rates and Accidentsbybusiness > Ok

- Regression models can help identify factors that significantly influence assessment rates. To establish the strength of the relationship between reported accidents by nature of business, simple linear regression was done.
    - Analyse > Regression > Linear > Assessmentrates (continuous variable) and accidentsbybusiness (categorical variable) > Ok

Comparison of Rates: Using Microsoft Excel 16, percentages of growth rates of assessed businesses and reported accidents were generated from the annual frequencies per nature of business. Analysing the data using growth rates of assessed businesses and reported accidents by nature of business allowed for the ranking and comparison with the risk rates which determine assessment rates payable to get a more comprehensive view.

3.8. Ethical Considerations

Ethical considerations would be paramount in this study, and the research would be conducted with respect to the privacy and confidentiality of the dataset collected. Informed consent would be obtained from the Board Management as well as University of Lusaka Research Ethics Board.

Chapter Four

PRESENTATION OF RESULTS

4.1 Introduction

This chapter will give a brief view of the demographics and then present highlights of the main findings outlined in tune with the research questions. This will be done by presenting results on the following.

1. Changes that have occurred in assessment rates within the Board over time.
2. The impact of business nature and reported accidents on the assessment rates.
3. The order of assessments rates in business natures being reflective of the reported accidents. (assuming person earns the same, use risk rate to compare with growth factor)

4.2 Demographics

Out of an average total of 11,814 assessed businesses over a period of 10 years, Figure 2 shows that Trade and Commerce had the highest business assessed at an average of 3,153 followed by Building and Construction, and Personal Services at 2,235 and 1,324 respectively. Iron and Steel, Agriculture and Forestry, and Educational Services all had above an average of 500 assessed businesses with the remaining sectors below 500 and leather industry having the lowest at an average of 10 assessed businesses.

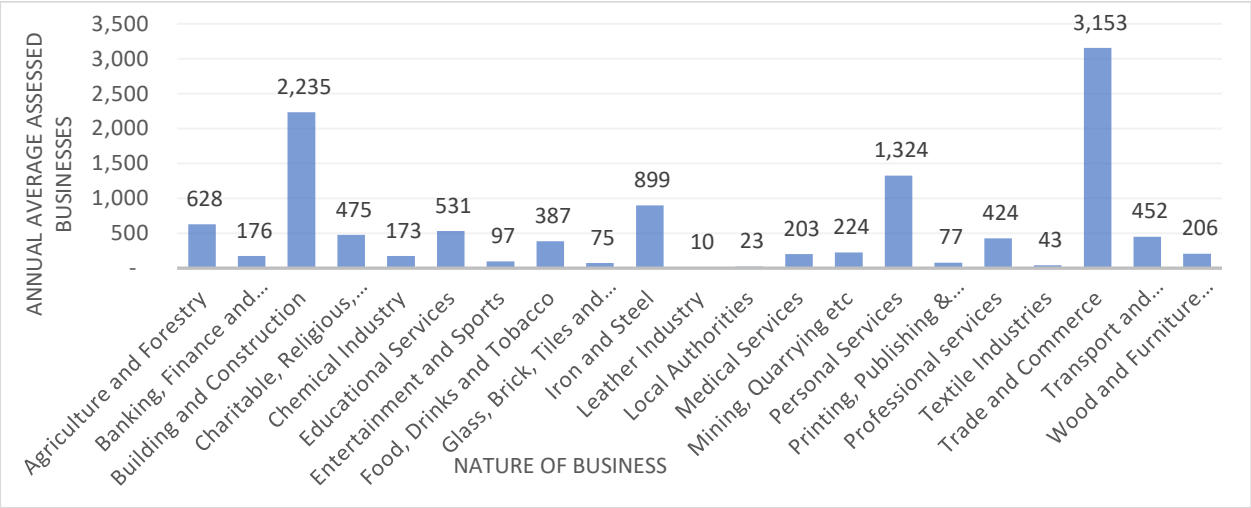

Figure 2. Average Number of Businesses Assessed by Nature of Business. *Source: Excel Output*

In Figure 3 the study revealed that Mining and Quarrying had the highest reported annual average accidents over a period of 10 years at 348, this was followed by

Building and Construction, Agriculture and Forestry at 173 and 160 respectively. Glass, Brick, Tiles and Asbestos and Food Drink and Tobacco recorded higher accidents at 137 and 125 whilst the remaining natures of businesses recorded an average of accidents below 100.

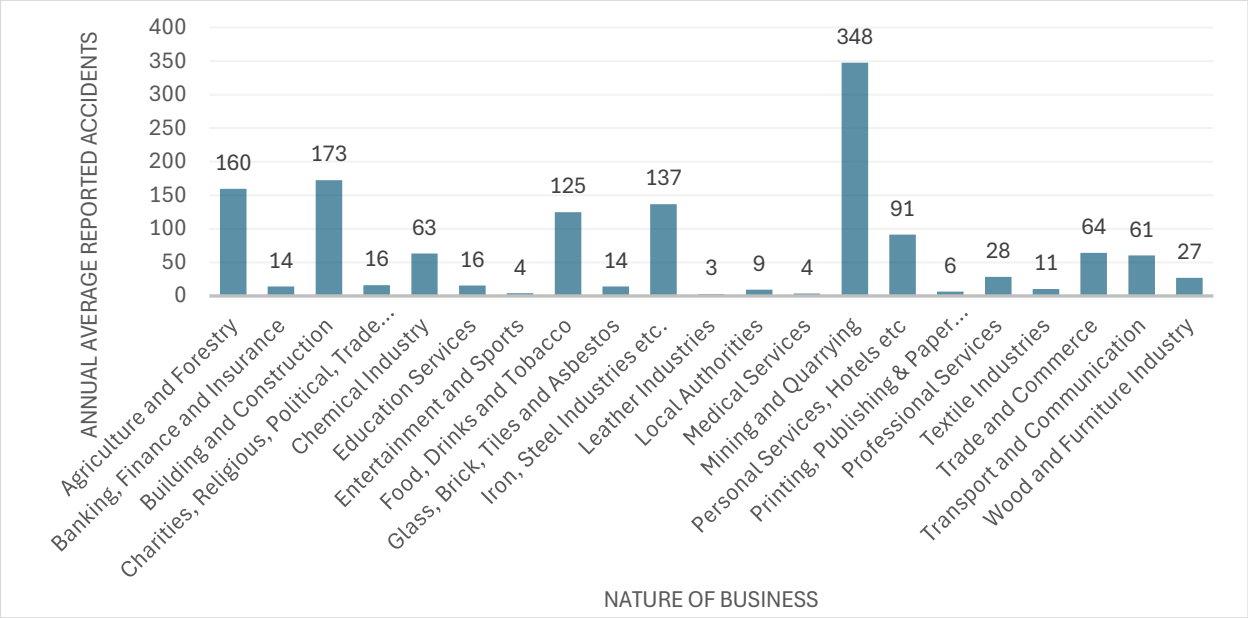

Figure 3. Frequency of Reported Accidents by Nature of Business. Source: Excel Output

4.3 Changes in assessment rates within the Board.

This section will look at documentation available for review to give a timeline of changes made over time in the Board. It will then present the findings of time series analysis conducted.

4.3.1 Documentation Findings

Data from various published documents and reports indicate the following timeline in the evolution of assessment rates with WCFCB considering that Workers' Compensation existed as far back as 1930s. The following information was retrieved from various Zambian Statutory Instruments and Government Gazettes.

YEAR		EVENT
1987	-	Adjusted risk rates by nature of business
1993	-	Annual assessable earnings at K7,200.00
1994	-	Amendment of annual assessable earnings to K600,000
1997	-	Amendment of annual assessable earnings to K1,200,000.00

1999	-	The Workers' Compensation Fund Control Board (WCFCB) was formally established under the Workers' Compensation Act No. 10 of 1999.
2000	-	Amendment of assessable earnings to K3,000,000.00
2005	-	Amendment of assessment earnings to K9,600,000.00
2014	-	Adjusted risk rates by nature of business
2022	-	Amendment of assessment earnings to K14,400.00 (rebased currency).

4.3.1 Time Series Analysis Findings

A time series analysis was conducted on annual average assessed businesses and reported accidents of the assessment businesses by nature of business shows that Glass, Brick, Tiles & Asbestos, Entertainment & Sports, Professional Services and Printing, Publishing & Paper Industries have recorded a higher increase in frequency over a period of 10 years as per growth factor calculated. This is followed by Transport & Communication, Trade & Commerce, at 8%, 7% respectively and Food, Drink & Tobacco and Chemical Industries at 6%. The remaining natures of business have maintained an increment of 5% and below with the lowest being Building and Construction at 1% and Wood & Furniture indicating no growth in the annual average assessed business

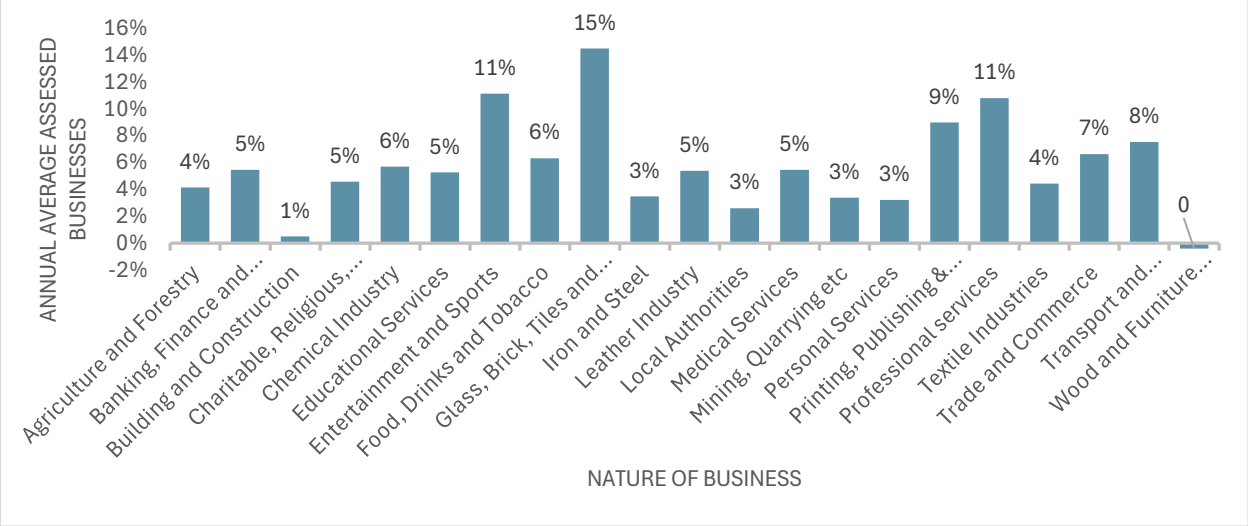

Figure 4. Time Series Analysis of Assessed Businesses by Nature of Business. Source: Excel Output

Likewise, Figure 5 below revealed that growth is observed in Glass, Brick, Tiles & Asbestos, Medical Services at 30% and 14% respectively and in Trade & Commerce and Professional Services at 10% and Entertainment & Sports at 9%. Lower growth records are further observed in Agriculture and Forestry, Chemical Industries, Wood and Furniture, Transport and Communication and Personal Services, Hotels, etc. with Educational services showing no increase. However, Iron & Steel, Leather Industry, Local Authorities, Printing, Publishing & Paper Industries and Textile Industries all observed a decay in growth rates to -8%.

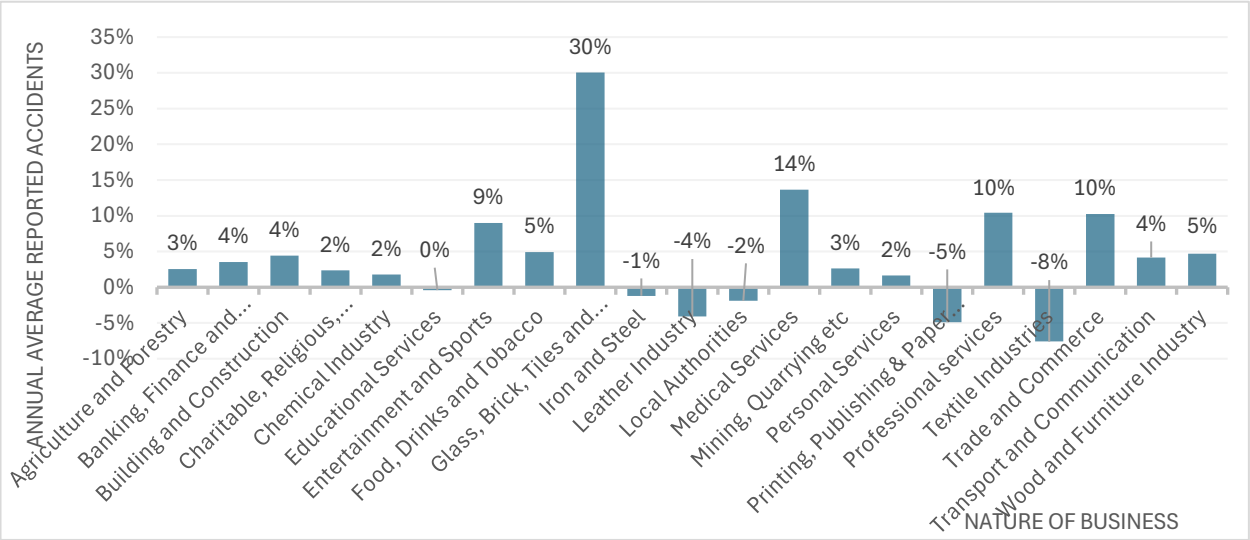

Figure 5. Time Series Analysis of Reported Accidents by Nature of Business Source: Excel Output

4.4 Impact of business nature and reported accidents on assessment rates.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
PearsonChi-Square	1.886E5[a]	380	.000
Likelihood Ratio	4.670E4	380	.000
Linear-by-Linear Association	97.857	1	.000
N of Valid Cases	9927		

a. 218 cells (51.9%) have expected count less than 5. The minimum expected count is .03.

Table 2. Relationship Test between Assessment Rates and Reported Accidents by Nature of Business

The random sampling assumptions are important to ensure the validity and reliability of statistical tests. In this case, the fact that 51.9% of the expected counts for the data are less than 5, raises concerns about the assumption of independence. Moving on to the Chi-Squared statistic, the value obtained is X2 (df=380) =1.886E5, with a p-value greater than 0.05.

Further, the regression analysis conducted in this study shows that the value of r^2 is 0.105, indicating that 10.5% of the variation in assessment rates can be explained by the business nature of reported accidents.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.325[a]	.105	.105	422.48901

a. Predictors: (Constant), ACCIDENTSBYBUSINESS

b. Dependent Variable: AssessmentRates

Table 3. Regression Analysis of Assessment Rates by Reported Accidents of Nature of Business

4.5 Evaluation of Status Quo Rates Hierarchy.

The study first compares the annual average frequency of reported accidents for each nature of business to the growth factor to establish if an increase of the frequency of reported accidents indicates an increase in the growth rate of reported accidents. Table 4 below shows the annual average frequency of reported accidents and the growth rate of reported accidents for each nature of business.

Nature of Business	Risk Rates	Annual Average Reported Accidents	Growth in Reported Accidents
Banking, Finance and Insurance	2.24%	14	4%
Charities, Religious, Political, Trade Unions	3.05%	16	2%
Medical Services	3.34%	4	14%
Trade and Commerce	3.37%	64	10%
Entertainment and Sports	3.53%	4	9%
Personal Services, Hotels etc.	3.72%	91	2%
Education Services	3.75%	16	0%
Glass, Brick, Tiles and Asbestos	4.04%	14	30%
Professional Services	4.22%	28	10%
Agriculture and Forestry	4.62%	160	3%
Iron, Steel Industries etc.	4.88%	137	-1%
Local Authorities	5.53%	9	-2%
Leather Industries	5.63%	3	-4%
Printing, Publishing & Paper Industries	5.69%	6	-5%
Food, Drinks and Tobacco	5.93%	125	5%
Textile Industries	6.03%	11	-8%
Chemical Industry	7.22%	63	2%
Building and Construction	7.63%	173	4%
Wood and Furniture Industry	7.63%	27	5%
Transport and Communication	8.90%	61	4%
Mining and Quarrying	14.47%	348	3%

Table 4. Comparison of annual average frequency of reported accidents and growth rate of reported accidents

The table shows that whilst mining and quarrying has the highest number of reported accidents as per Figure 3, the rate of reported accidents has only experienced a 3% increment. On the other hand, whilst Glass, Brick, Tiles & Asbestos shows an average of 14 annual reported accidents, it has the highest increment rate of 30% in the 10 years period. Similarly, medical, and professional services also have the same observed pattern with low average frequency of reported accidents at 4 and 28 but growing factor of 14% and 10% respectively. It is also observed that Iron and Steel Industries which has a higher frequency of reported accidents shows a decrease in growth at -1%. Other natures of businesses having lower frequencies of reported accidents annually also show a decline in the rate of reported accidents. These include the textile industry, local authorities, printing, publishing & paper industries and leather industries at -8%, -2%, -5% and -4% respectively.

Nature of Business	Risk Rates	Growth in Assessed Business	Growth in Reported Accidents
Banking, Finance, and Insurance	2.24%	5%	4%
Charities, Religious, Political, Trade Unions	3.05%	5%	2%
Medical Services	3.34%	5%	14%
Trade and Commerce	3.37%	7%	10%
Entertainment and Sports	3.53%	11%	9%
Personal Services, Hotels etc.	3.72%	3%	2%
Education Services	3.75%	5%	0%
Glass, Brick, Tiles and Asbestos	4.04%	15%	30%
Professional Services	4.22%	11%	10%
Agriculture and Forestry	4.62%	4%	3%
Iron, Steel Industries etc.	4.88%	3%	-1%
Local Authorities	5.53%	3%	-2%
Leather Industries	5.63%	5%	-4%
Printing, Publishing & Paper Industries	5.69%	9%	-5%
Food, Drinks and Tobacco	5.93%	6%	5%
Textile Industries	6.03%	4%	-8%
Chemical Industry	7.22%	6%	2%
Building and Construction	7.63%	1%	4%
Wood and Furniture Industry	7.63%	0%	5%
Transport and Communication	8.90%	8%	4%
Mining and Quarrying	14.47%	3%	3%

Table 5. Comparison of Assessment Rates by Growth in Nature of Business and Reported Accidents

Comparing growth factor rates with actual risk rates for different types of businesses can indicate if the hierarchy of assessment rates accurately reflects the current status of reported accidents. If a business type has a high growth rate in reported accidents,

it suggests a high-risk nature, and consequently, should have higher assessment rates. Table 5 below gives values allowing for the comparison of these variables. Results of this comparison indicate that despite having lower assessments rates (determined by risk rates, average = 5.50%), Entertainment & Sports, Glass, Brick, Tiles & asbestos and Professional Services are seen to have a higher rate of growth in terms of assessed business over the decade at 11%, 15% and 11% respectively with growth in reported accidents observed at 9%, 30% and 10%. On the higher end of assessment rates of 8.9%, 7.22%, 5.93%, Transport & Communication, Chemical Industry and Food, Drink & Tobacco are observed to have a growth in the number of assessed businesses. However, they recorded lower or declining reported accidents. Further, it can also be observed that Printing, Publishing & Paper Industries which has a risk rate just above average at 5.69% indicated a growth in number of assessed businesses at 9% but indicated a decline in the number of reported accidents at -5%.

Chapter Five
DISCUSSION OF FINDINGS

5.1 Introduction

This chapter will summarise the demographics found and then give a discussion of the findings using the objectives of the study.

1. Analysing trends and patterns of assessment rates using historical data.
2. Investigating the relationship of assessments rates using business nature and reported accidents.
3. Evaluating if hierarchy of assessments rates in the various business natures mirrored the rate of reported accidents.

5.2 Demographics

The results of the analysis of demographics of the study population indicate that majority of registered businesses with the Board are in Trade & Commerce, Building & Construction and Personal services with over a thousand registered and assessed businesses a year in the period studied. However, these businesses with the exemption of building & construction are seen to have lower accidents reported. This can be indicated to the assumption by Mock, et al, (2017) that high-hazard sectors include agriculture, construction, and mining for occupational injuries and fatalities especially in low and middle-income countries. Analysis of data supports this statement by high average number of accidents reported in agriculture & forestry, building & construction and mining & quarrying. It can therefore be proposed that businesses that are physically demanding will have higher numbers of reported accidents. Some limitations to this information however are that the data obtained may not be a complete picture of what is happening in the country due to apathy to reporting accidents, wrong classification of businesses and non-compliance of businesses to register with the Board.

5.3 Analysing trends and patterns of assessment rates using historical data.

This section will look at the findings of the documentation available for review to give a timeline of changes made over time in the Board and discuss the findings of time series results.

5.3.1 Documentation Findings

Over time, historical modifications in risk rates and assessable earnings have resulted in two primary forms of adjustments for the assessment rates paid by employers. These adjustments can manifest as either an augmentation in assessable earnings or an elevation in risk rates. The alterations in these factors impact the overall assessment rates that employers are obligated to pay. The dynamics of these changes reflect the evolving landscape of risk assessment and financial considerations in the context of employer obligations. Increase in assessable earnings affects all natures of businesses irrespective of risk associated with that business. This is mainly done to ensure that the Board has sufficient funds to carry out its mandate. Increase in risk rates affects the businesses according to their nature and the risk associated with. This is the determining factor of which nature of business are classified as high risk and those that are low risk. As mentioned earlier in the theory of risk-based supervision, it promotes fairness as it ensures that those with higher risk pay accordingly.

Literature on the methodology of how risk adjustments are calculated are not readily available and it therefore becomes difficult to establish the exact factors involved in the risk adjustments implemented. A leaf out of the Compensation Fund in South Africa clearly state that it calculates tariffs using historical claims cost data and expected revenue from member assessments. Understanding how historical changes influence assessment rates helps employers anticipate potential adjustments and proactively implement safety measures to control their risk factors. In Zambia, the Occupational Health and Safety (OHS) department offers a platform outlined in Part III Section 3(a) and (b) of the Workers' Compensation Act No. 10 of 1999 to prevent accidents or diseases and enhance the health and safety of workers. Additionally, in collaboration with the International Social Security Association (ISSA) and the International Labour Organisation (ILO), the department has enacted the Vision Zero 2030 Global Campaign. This initiative aims to establish a worldwide platform and strategy for preventing accidents and fostering the safety, health, and well-being of workers (ISSA, 2017). Therefore, a reduction in reported accidents indicates good safety measures and less hazardous environment which eventually may factor into reduction of assessment rates.

5.3.2 Time Series Analysis

Time series analysis plays a crucial role in understanding and predicting patterns in data over time. One of the key components of time series analysis is identifying trends and seasonality in the data. By examining the annual average of assessed businesses and reported accidents over several years, we can gain deeper insights into the underlying patterns and potential relationships between these two variables. Additionally, time series analysis allows for the detection of anomalies and unusual fluctuations, which can provide valuable information for decision-making and risk assessment. From the results generated, four main categories have been observed worth highlighting.

Business Natures with Rising Growth Rate of Assessed Businesses and Falling Rate of Reported Accidents: This category includes industries like Printing, Publishing & Paper Industries, Leather Industry, Textile Industries, Iron and Steel, and Local Authorities. The observation here is that while the number of businesses being assessed is increasing (indicating growth in these sectors), the rate of reported accidents is decreasing. This trend suggests that despite business expansion, safety measures or risk management practices might have improved, leading to a decline in accidents over time.

Business Natures with Rising Assessed Businesses and Slight Increase in Reported Accidents: This category covers industries such as Transport and Communication, Chemical Industry, Educational Services, Charitable, Religious, Political, and Trade Unions. Here, the number of assessed businesses is growing, but the increase in reported accidents is relatively small. This could imply that as more businesses are evaluated, the overall accident frequency remains manageable or does not rise significantly.

Business Natures with Rising Growth Rate of Assessed Businesses and Equal Rise in Reported Accidents: Industries like Entertainment and Sports, Professional Services, Food, Drinks and Tobacco, Banking, Finance and Insurance, Agriculture and Forestry, Mining, Quarrying, and Personal Services fall into this category. In these sectors, the growth in assessed businesses corresponds to an equal increase in reported accidents. This suggests that as the business landscape expands, so does the frequency of reported accidents, maintaining a proportional relationship.

Business Natures with Rising Rate of Reported Accidents Compared to Growth in Assessed Businesses: This category includes industries like Glass, Brick, Tiles and Asbestos, Trade and Commerce, Medical Services, Building and Construction, and Wood and Furniture Industry. Here, the rate of reported accidents is increasing at a higher pace than the growth in assessed businesses. This indicates a potential issue with safety or risk management within these industries, as the rise in accidents outpaces the growth in business activities.

5.3 Investigating the assessment rates relationships.

The Chi-square test of independence is a statistical test used to determine whether there is a significant association between two categorical variables. It is commonly used in research to examine the relationship between two variables and to determine if they are independent or dependent. The test works by comparing the observed frequencies of the variables to the expected frequencies, assuming that the variables are independent. The test statistic is calculated as the sum of the squared difference between the observed and expected frequencies, divided by the expected frequency. The resulting value is then compared to a critical value from the Chi-square distribution to determine the p-value. The null hypothesis of the Chi-square test of independence is that the variables are independent, while the alternative hypothesis is that they are dependent. If the p-value is less than the chosen level of significance (commonly 0.05), the null hypothesis is rejected, and there is evidence of a significant association between the variables. According to a study published in the Journal of the American Statistical Association, the Chi-square test of independence is a widely used and powerful tool for analysing the relationship between categorical variables (Agresti, 2012). It is a simple and flexible test that can be used in a variety of research contexts.

The 51.9% of the expected counts for the data being less than 5 in this study indicated a violated assumption which is crucial for the Chi-Square test to be valid. This violation assumes that the variables are independent and that the observations are not influenced by other factors. If this assumption is violated, the test results may not be accurate or reliable. Further, the study also indicates that the chi-square test is statistically significant with a $p>0.05$, and the null hypothesis can be rejected. The null hypothesis in this case was that assessment rates and reported accidents by business nature are independent. Therefore, the results indicate that there is evidence that

these variables are not independent, and that the value of reported accidents by business nature changes the probability distribution of assessment rates. The findings suggest that there is a relationship between assessment rates and reported accidents by business nature. However, due to the potential violation of the assumption of independence, the results are interpreted with caution and further analysis was done to confirm the relationship and to ensure the validity and reliability of the results using simple linear regression analysis.

A linear regression model is used to determine the relationship the independent variable is thought to explain or predict the dependent variable. James, Witten, et al, (2023) state that “it is a very straightforward simple linear regression approach for predicting a quantitative response Y on the basis of a single predictor variable X”. In this study the independent variables included the reported accidents in each business nature and the dependent variable were the assessment rates. Logically, assuming that the range of possible values for the independent variable is not limited to just the specific data points, the values between the observed points are also considered possible. The core assumption of linear regression is that the average (mean) of the dependent variable depends linearly on the independent variable. This means an increase (or decrease) in the independent variable leads to a proportional increase (or decrease) in the average outcome. This implies that the assumptions are crucial for the validity and accuracy of linear regression models. If they are not met, the model may not effectively capture the true relationship between the variables, leading to misleading predictions.

The result from the regression means that the model has a relatively low accuracy in predicting assessment rates based on the business nature of reported accidents. The r^2 value is a statistical measure that represents the proportion of variance in the dependent variable (assessment rates) that can be explained by the independent variable (business nature of reported accidents). In this case, the r^2 value of 0.105 suggests that the model has a weak fit, and that other factors not included in the model may also influence assessment rates. Therefore, while the study finds evidence of a relationship between assessment rates and reported accidents by business nature, the regression analysis suggests that this relationship only explains a small proportion of the variation in assessment rates. Further research or actuarial review may be

necessary to identify other factors that contribute to assessment rates and to improve the accuracy of the model.

5.4 Evaluation of assessments rates hierarchy

It is noted in the literature review, that for most employers, the WCFCB assessment rates are a form of basic cover for the group income insurance. Group income insurance is a cost-effective insurance option due to its straightforward data requirements, which do not include cash values per employee or the need for individual employee details, distinguishing it from individual life insurance (Bastien, 2003). It is further established that assessed businesses and reported accidents only have limited influence on assessment rates, and therefore can be concluded that there may be other factors that determine assessment rates and a more comprehensive actuarial investigation may be done.

Having determined an existence of a relationship, whilst minor, the study proceeds to evaluate whether the rates currently in use are reflective of the reported accidents in businesses. This will be done by comparing two ideas. First will be if businesses with higher assessment rates experience a high number of reported accidents. Second will be to analyse growth rate factor of reported accidents and assessed businesses by assessment rates. From the results, the study establishes the following outcomes.

5.4.1 Assessment Rates and Frequency of Reported Accidents

The study highlights that the relationship between assessment rates and reported accidents is complex and not always straightforward. Factors such as the rate of growth of accidents over time and industry-specific trends can play a role in understanding this relationship. Analysing the relationship between assessment rates and reported accidents across various industries, the following key points are considered.

In terms of high assessment rates and frequency of reported accidents, the study finds that industries like agriculture & forestry and iron and steel have assessment rates below average but still experience a high frequency of reported accidents annually. This suggests that a higher assessment rate doesn't always translate to a higher frequency of reported accidents. With regards to the rate of growth of reported accidents, despite the high frequency of reported accidents in certain industries with

lower assessment rates, the rate of growth of reported accidents in these industries is low or decreasing over time. This indicates that while accidents may occur frequently, they are not increasing at a significant rate. Further, some businesses have above average assessment rates e.g. local authorities, leather, and printing, paper & publishing. However, whilst they have assessment rates above average, they experience a low frequency of reported accidents. This suggests that a higher assessment rate does not necessarily correlate with a higher frequency of accidents. Another notable feature is that of the declining rates of growth in reported accidents. Similar to the first point, industries with above-average assessment rates also show declining rates of growth in reported accidents over time indicating that despite having higher assessment rates, the number of reported accidents is decreasing. And lastly, some businesses with the high assessment rates such as mining & quarrying and building & construction also have among the highest reported accidents. However, the time series analysis reveals a low growth rate in reported accidents annually for these industries. This suggests that although these industries have a high frequency of accidents, the rate of increase in accidents is not significant.

In broader context, the findings of the study leads to a re-evaluation of how assessment rates impact safety outcomes across industries and the need for industry-specific risk assessments prompting further investigation into the factors contributing to the stability or decline in accident rates despite high frequencies. Furthermore, this could lead to inquiries into the effectiveness of safety measures and risk management strategies in these industries sparking discussions on the impact of regulatory frameworks, safety initiatives, and technological advancements on accident reduction. The findings can also lead to investigations into the effectiveness of risk mitigation strategies in the high-risk industries.

With this information, it can be prudent to review industry-specific trends by continuously monitoring industry-specific trends in reported accidents and assessment rates to identify any anomalies or areas of improvement. This includes analysing the rate of growth of reported accidents over time and its correlation with assessment rates. Implementing targeted interventions based on the analysis of declining rates of growth in reported accidents in certain industries and considering implementing targeted interventions or policies aimed at sustaining or accelerating this decline will

be necessary. This could involve industry-wide safety campaigns, enhanced training programs, or regulatory adjustments. Facilitating knowledge by sharing and collaboration among industries to exchange best practices and lessons learned in accident prevention and risk management can help improve overall safety performance across different sectors. Consideration of regulatory adjustments by assessing the effectiveness of existing regulatory frameworks related to assessment rates and workplace safety can be done. This will be by considering making adjustments or enhancements to regulations based on industry-specific insights and emerging trends in reported accidents.

5.4.2 Assessment Rates and Rates of Growth

Similar to assessment rates and frequency of reported accidents, it can be noted that high assessment rates do not equate high rates of grow in both assessed businesses and reported accidents. This implies that there can be discrepancies between the assessment rate's impact on business growth and its impact on accident rates. In educational services, despite showing an increase in the growth rate of assessed businesses, the education services industry does not exhibit a corresponding growth rate in reported accidents. This suggests that while the industry is expanding, it is maintaining a relatively stable safety record. In contrast, the wood and furniture industry demonstrates zero growth in assessed businesses but experiences a rise in the growth rate of reported accidents over time. This indicates a potential mismatch between business growth and safety performance in this industry. Industries like iron & steel, local authorities, and leather industries show slow-growing assessed businesses with a decline in accident reports. This suggests that despite the reduction in businesses has also reduced the number of accidents reported. It can also be noted that industries where growth rates diverge between assessed businesses and reported accidents such as medical services and trade & commerce which exhibit a slow increase in assessed businesses but a high growth rate of reported accidents could indicate a potential safety challenge despite business expansion. On the other hand, industries like glass, brick, etc., and professional services show a higher growth rate in both assessed businesses and reported accidents suggesting a parallel growth trajectory in business activities and risk incidents.

This underscores the importance of not only considering assessment rates but also analysing the growth rates of businesses and reported accidents to gain a comprehensive understanding of risk performance across industries taking into account the following scenarios.

Rise in the rate of growth in assessed businesses can have the same reaction in the growth rate of reported accidents: This point suggests that when there is an increase in the growth rate of businesses registering with the board, there might also be a corresponding increase in the growth rate of reported accidents. One reason for this could be that newly registered businesses tend to choose business natures with lower risk levels to minimize their assessment rates. However, despite the lower risk classification, these businesses might still experience accidents at a relatively high frequency. This observation is supported by the distribution of growth rates, which shows that businesses with lower risk rates tend to have higher rates of growth in both assessed businesses and reported accidents compared to businesses with higher risk rates. An example as earlier seen in the results being trade & commerce with a low risk rate of 3.37% of premiums payable showing an increase in assessed businesses at 7% and an increase in reported accidents at 10% whilst transport & communication with a risk rate of 8.9% of premiums payable showing a similar increase in assessed businesses at 8% only has a 4% increase in reported accidents.

Rise in the growth rate of assessed businesses can have the opposite effect in the growth rate of reported accidents (decline will be observed): This point highlights a potential opposite effect where an increase in the growth rate of assessed businesses leads to a decline in the growth rate of reported accidents. One possible explanation is that businesses may experience accidents but fail to report them to the board. This lack of reporting can be attributed to factors such as a lack of awareness about reporting procedures, concerns about legal consequences or job security, and complex bureaucratic processes. ILO (2002) noted that fatal occupational accidents are more reliably recorded than non-fatal accidents due to legal requirements, leading to potential under-reporting of non-fatal incidents.

Natures of Businesses with higher assessment rates but with a declining rate of reported accidents may indicate that businesses are practicing safe measures: This point suggests that industries with higher assessment rates but a declining rate of

reported accidents may indicate improved safety measures, working conditions, or reporting standards. It acknowledges that certain industries may inherently have a higher frequency of accidents due to the nature of the work. However, the reduction in the rate of growth in reported accidents over time reflects positive changes in safety practices. A study in Spain indicated that the adoption of new occupational safety and health legislation reduced the number of injuries in advanced manufacturing sectors (Arocena, 2009) whilst another study in the United States (US) indicated that the introduction of a 12-hour shift system in a company led to a reduction in overall accident rates (Laundry, 1991).

These points collectively emphasize the complex interplay between business growth, risk assessment, accident reporting behaviors, safety practices, and regulatory influences in shaping the patterns of reported accidents across industries.

5.4.3 Comparison with status quo

Having evaluated the findings of this study, comparison of the growth rates of assessed businesses and reported accident to that of risk rates of premiums payable as per table 5 will be used to scrutinise the status quo and its implications.

Firstly, businesses that demonstrate high growth rates in reported accidents while maintaining steady growth in assessed businesses can have an increase in assessment rates. This implies that the increase in reported accidents despite steady growth in assessed businesses suggests potential safety issues or risk factors within these industries. It indicates that although the number of businesses being assessed is growing steadily, the rate of reported accidents is outpacing this growth, signifying a higher risk or incidence of accidents per business.

Secondly, businesses showing similar growth patterns in both assessed businesses and reported accidents can maintain the assessment rates. This implies that the stability or consistency in growth rates for both assessed businesses and reported accidents suggests a relative balance between assessment rates and risk. This indicates that the rate of reported accidents is proportional to the growth in assessed businesses, reflecting a consistent level of risk over time.

Also, businesses that exhibit an increase or maintenance of growth rates in assessed businesses but experience a decline in reported accidents can be considered for a

reduction in assessment rates. The decline in reported accidents despite growth or maintenance of assessed businesses indicates improved safety measures or risk management practices within these industries. This also suggests that although the number of businesses being assessed is growing or stable, the rate of reported accidents is decreasing, highlighting successful safety initiatives or interventions.

This comparison shows the importance of conducting industry-specific risk assessments to identify and address potential safety hazards or risk factors that contribute to the high growth rates in reported accidents. It highlights the need for enhanced regulatory oversight and enforcement to ensure that businesses with increasing assessment rates also maintain adequate safety standards to prevent a disproportionate rise in reported accidents. In addition, while maintaining assessment rates is positive, there is room for continuous improvement through ongoing safety training, risk assessments, and the adoption of innovative safety technologies. Further, industries experiencing a reduction in assessment rates coupled with declining reported accidents can serve as benchmarks for sharing best practices and lessons learned in effective safety management. In a broader context, these outlooks can inform policy-making, regulatory frameworks, and industry practices aimed at enhancing workplace safety and reducing accidents.

Chapter Six

CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The purpose of the research was to analyse assessment rates by business nature and reported accidents in Zambia. This was done by doing a study of the WCFCB by answering questions on what the frequencies of reported accidents in the different business natures are, how the assessments rates evolved over time in the Board, how the business nature and reported accidents influence the assessment rates of businesses, and establish if the hierarchy of business natures, according to reported accidents, correspond with the currently used hierarchy of risk rates.

To establish viable information, quantitative and quasi experimental research designs were used that allowed statistical analysis of variables with minimal manipulation. Primary and secondary data were collected from the Board that included official records, reports, and a compiled dataset of accepted claims and assessed businesses between 2012 and 2021 from the Pension and Administrative System (PAS) that the organisation uses.

After an analysis of data collected was done, it was observed that Trade & Commerce and Building & Construction were the most assessed business natures. On the other hand, Agriculture & Forestry, Building & Construction, and Mining & Quarrying reported the most accidents. However, Glass, Brick, Tiles & Asbestos was observed to show a steep increase in reported accidents which could be because of the increased assessed businesses.

A peruse through the history of assessment rates showed that adjustments of the same were done by increasing the risk rate in the business nature or upward adjustments of assessable earnings. It is also established that reported accidents by business nature do influence assessment rates with a strength of 10.5% indicating that other factors are considered to determine assessment rates.

It was then noted that the frequency and growth rates of each industry in assessed businesses and reported accidents gave an indication of businesses that pose as

higher risk than others and could be considered for adjustment in terms of assessment rates payable.

6.2 Conclusion

There is a noticeable trend towards adjusting risk rates or assessable earnings. This adjustment is often driven by factors such as changes in market conditions, advancements in risk assessment methodologies, regulatory requirements, and shifts in business activities. The Board needs to regularly review and update risk assessment models to ensure they accurately reflect the current risk landscape faced by businesses. As businesses expand or undergo changes in their operations, there can be fluctuations in the frequency and severity of accidents reported. This relationship is important for the Board to analyse assessment rates as it helps in assessing the evolving risk profiles of entities.

While there is a relationship between assessment rates and reported accidents based on the nature of business, this impact is often minimal. Various factors, such as actuarial factors, demographics, average cost of losses, expenses per unit of exposure within each classification, historical claims cost data and expected revenue from member assessments, can mitigate the direct correlation between assessment rates and accident frequency. The Board may consider these nuances when setting assessment rates for different business categories as per guidance of the actuaries. Based on research findings and analysis, it is advisable to periodically review and potentially adjust the assessment rates in different categories due to the dynamic nature of businesses and the continuous evolution of risk factors. The Board may need to realign their assessment rate structures to better reflect current risk exposures and ensure fairness in premium calculations across various business segments. Understanding the correlation between assessment rates and the reported accidents by nature of business, it enables businesses to proactively address potential risk factors specific to their industry.

Key points to consider when determining assessment rates include emphasizing the importance of data-driven decision-making processes that incorporate both quantitative (growth rates of assessed businesses and reported accidents) and qualitative (safety measures, risk assessments) aspects to evaluate safety performance comprehensively. Encouraging continuous monitoring and evaluation of

safety performance metrics to track trends, identify emerging risks, and implement timely interventions to prevent accidents. Fostering collaboration among industries, regulatory agencies, and safety experts to exchange knowledge, share best practices, and collectively work towards improving safety outcomes on a broader scale. By tailoring safety protocols and training programs to address these specific risks, businesses can strive to create a safer working environment for employees while also mitigating financial implications associated with high assessment rates. The interplay of assessment rates, nature of business, and reported accidents underscores the significance of a proactive and industry-specific approach to accidents. The implementation of a risk-based approach, particularly in high-risk industries such as transportation and construction, can further enhance workplace safety (Pykhtin, et al, 2017).

Grounded on the idea that regulatory bodies typically rely on empirical evidence and data trends to make informed decisions, the Board should use data on reported accidents and assessed businesses to inform decision-making regarding adjustment of assessment rates. Monitoring the performance of reported accidents and assessed businesses allows for evidence-based adjustments to assessment rates. And lastly, it is assumed that the Board has a commitment to continuous improvement and refinement of workers' compensation policies based on observed trends and outcomes. Orlikoff and Totten (2009) notes that the commitment of a Board to continuous improvement is crucial for effective governance. With a dynamic regulatory framework, adjustments to assessment rates can be made in response to changes in reported accidents and assessed businesses among other factors, ensuring that the system remains responsive to evolving workplace safety conditions.

6.3 Recommendations

Adjustments of Assessment Rates

Based on the history of adjustments in the risk rates and assessable earnings, there is no set period of analysis for adjustments. The Board should therefore implement a monitoring policy of all the factors that influence adjustments for a deliberate set period. Further, a standard formula should be created to calculate adjustments periodically.

Actuarial Reports

Actuarial reports which are done every three years should also give an analysis on all actuarial factors that affect assessment rates for a comprehensive reflection of risk in each business nature.

6.4 Limitations of the Study

The conducting of the study was well carried out with minimal setbacks which included accessibility of old records in the Board that have not been properly preserved. This led to limited acquisition of information that may have been necessary for the study. Examples of records not available were copies of tangible gazettes and Statutory Instruments. However, in due course, with unlimited time, this information is traceable through the Zambia Government Printers.

Another limitation was the unavailability of similar research studies globally. Not many research studies have been conducted in this specific topic and therefore, it was difficult to establish comparable literature. The calculation of premiums under income protection therefore assisted in establishing literature for the study.

6.5 Areas of Further Research

After establishing that growth rates of assessed businesses and reported accidents for each nature of business differ over the studied period, it will be imperative to break down the study to note how change in risk rates as seen in 2014 affects the behaviour of assessed businesses and reported accidents. This will give a clear picture of prior change and after the change to compare if the change in assessment rates has an effect on the growth rates of assessed businesses and reported accidents. This will help to establish predictive behavioural patterns of businesses in relation to assessment rates and how they can be adjusted in terms of contributing factors.

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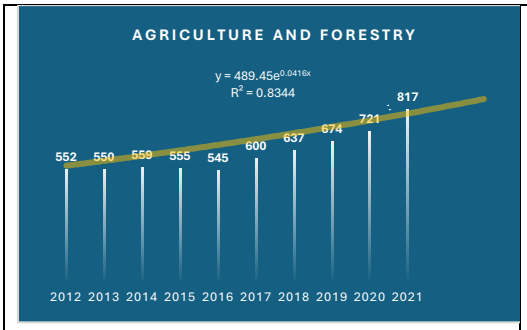
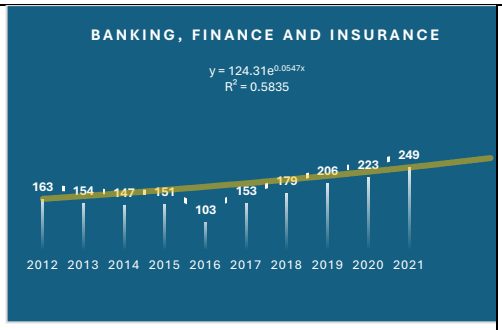
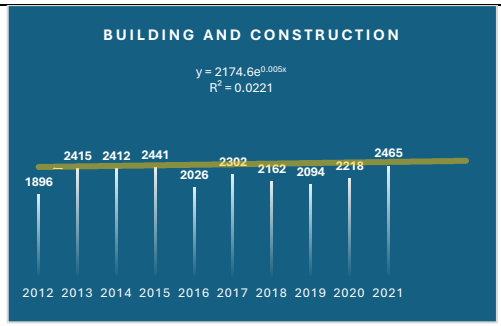
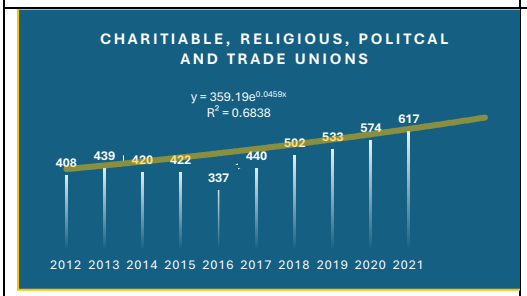
APPENDIX

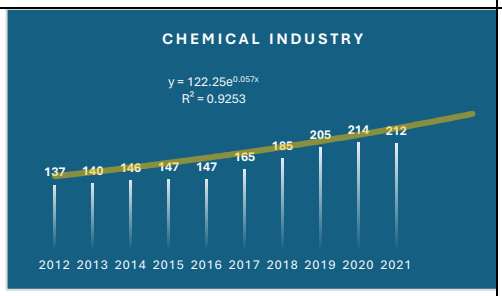
A. Time Series Analysis of Assessed Businesses

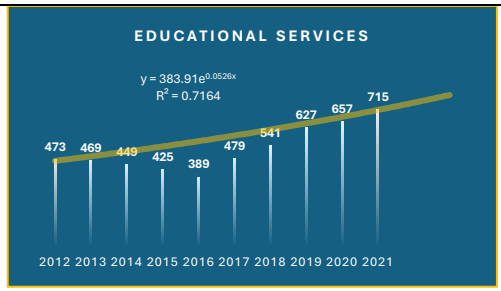


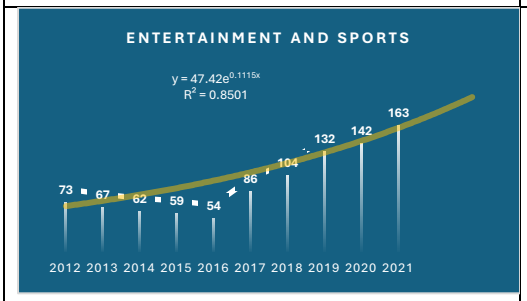


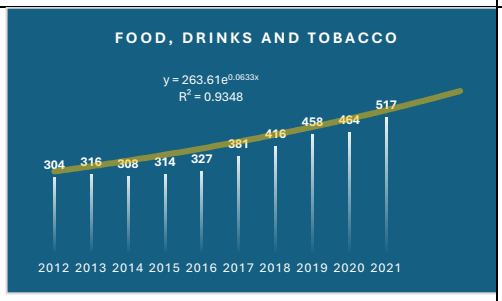


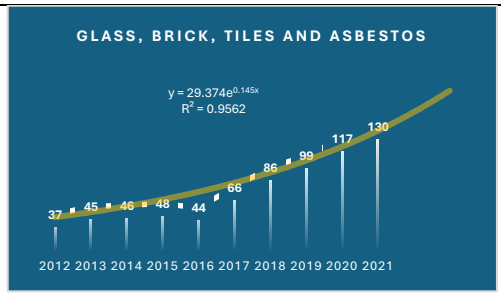


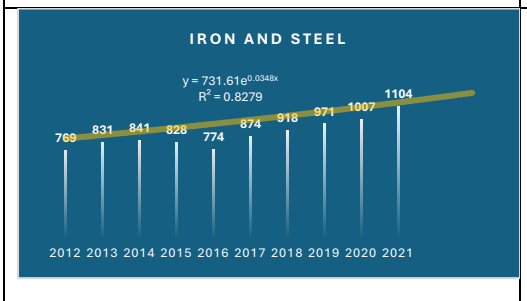


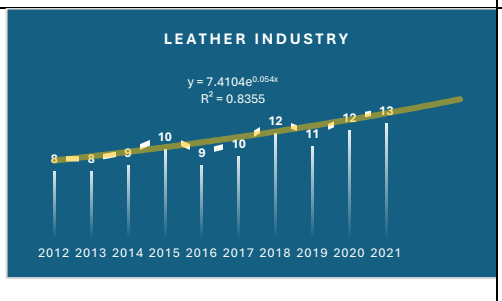


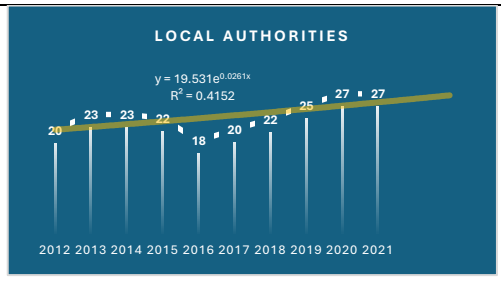


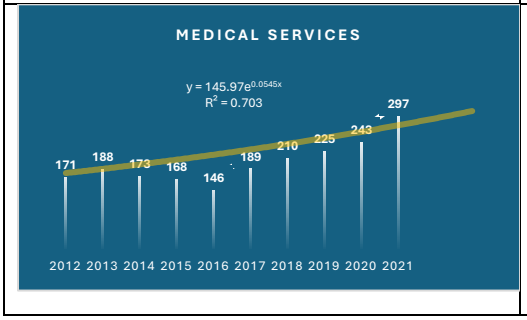


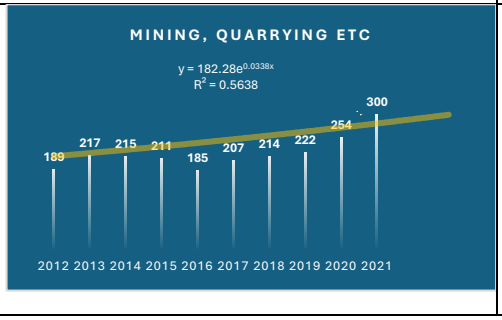


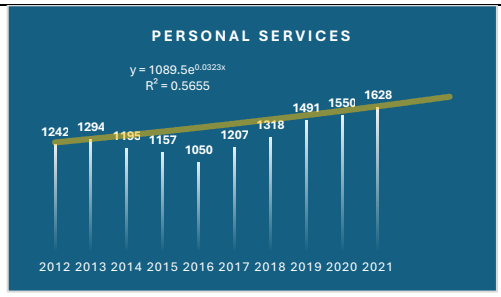


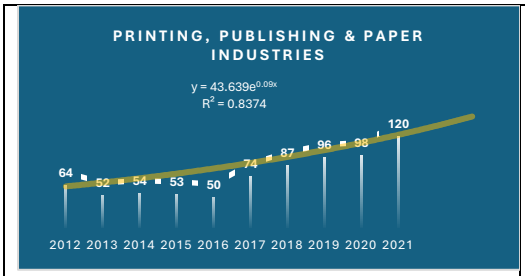


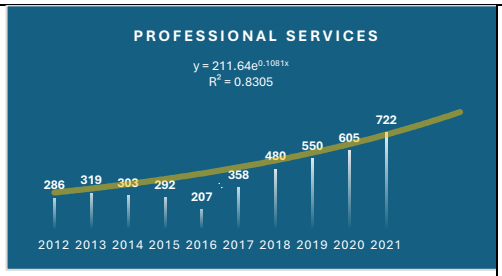


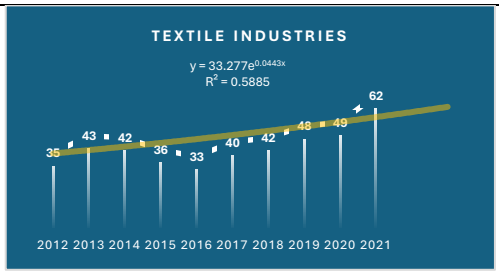


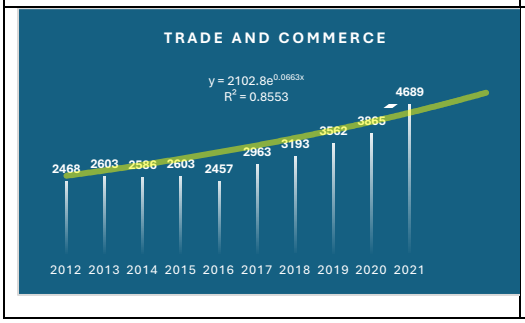


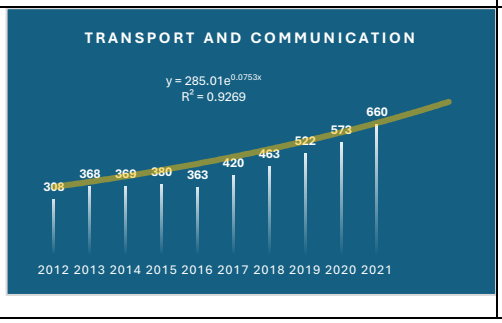


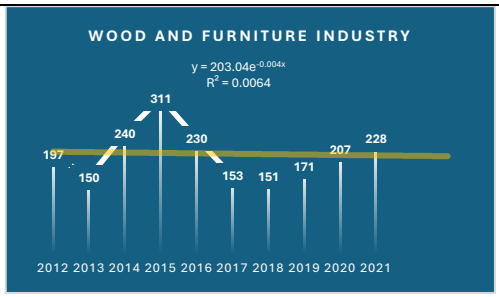




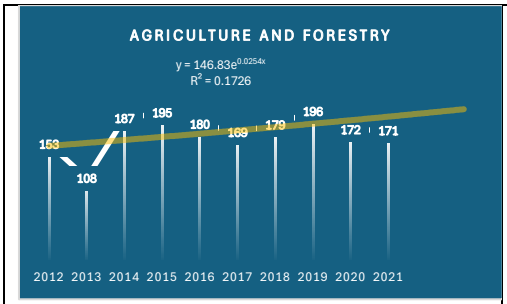


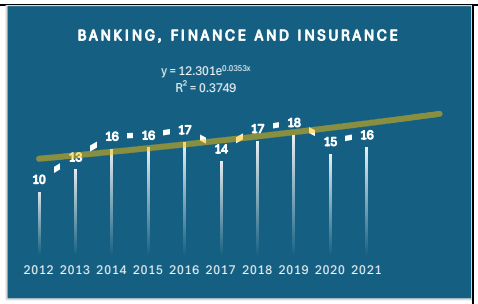


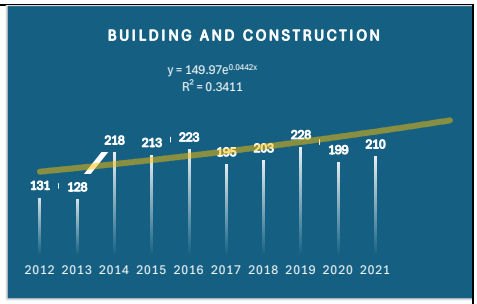


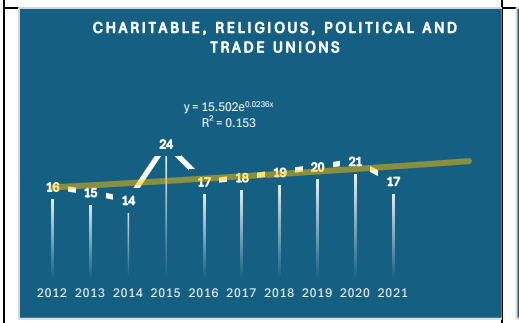


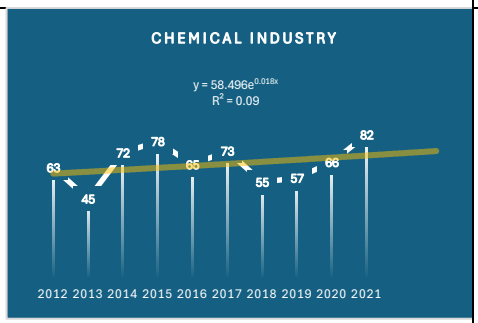
B. Time Series Analysis of Annual Reported Accidents

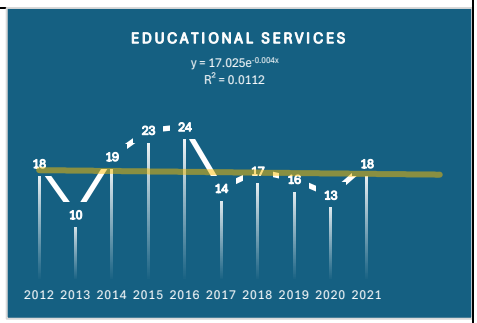


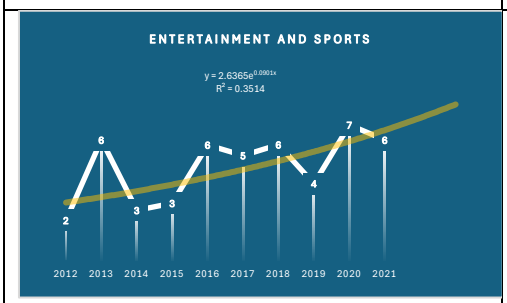


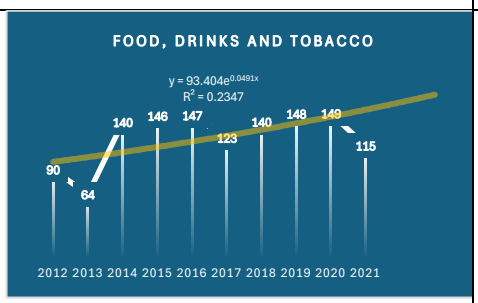


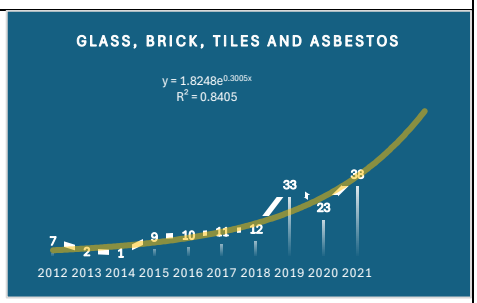


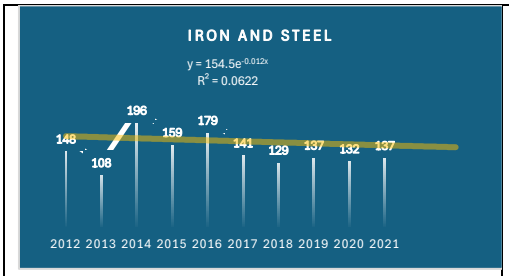




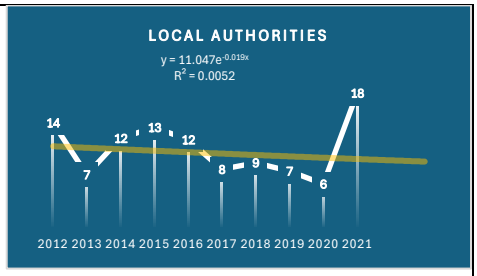


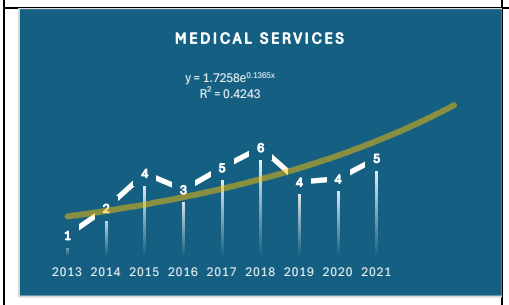


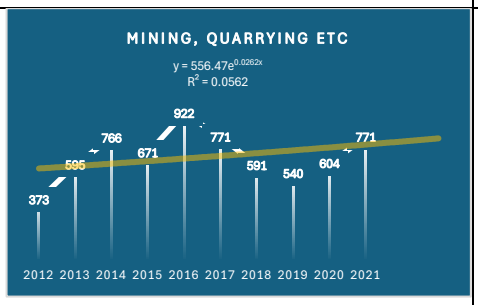


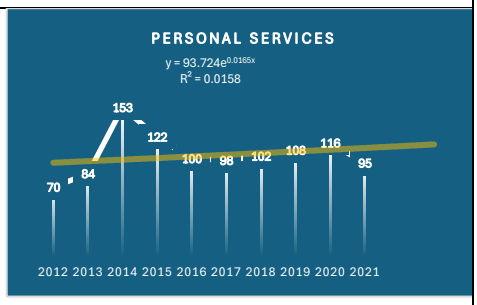

IRON AND STEEL
y = 154.5e-0.012x
R2 = 0.0622
148 108 196 159 179 141 129 137 132 137
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

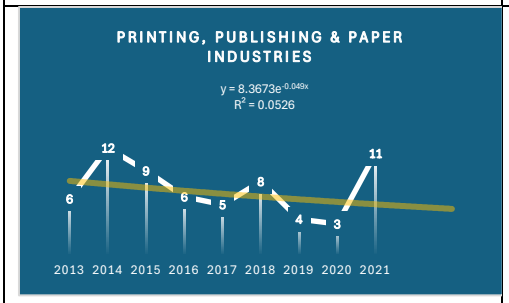

LEATHER INDUSTRY
y = 3.0659e-0.041x
R2 = 0.1295
5 2 3 4 2 1 2 3 2 3
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

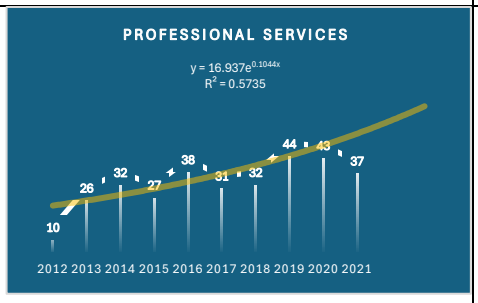

LOCAL AUTHORITIES
y = 11.047e-0.019x
R2 = 0.0052
14 7 12 13 12 8 9 7 6 18
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

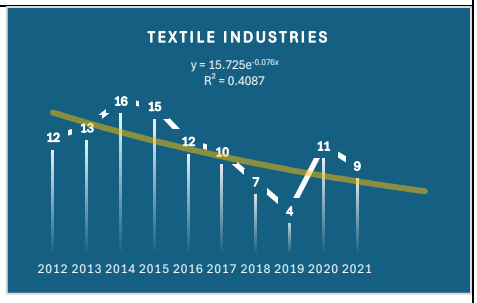

MEDICAL SERVICES
y = 1.7258e0.1365x
R2 = 0.4243
1 2 4 3 5 6 4 4 5
2013 2014 2015 2016 2017 2018 2019 2020 2021

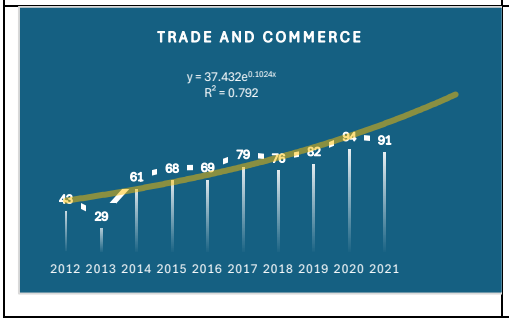

MINING, QUARRYING ETC
y = 556.47e0.0262x
R2 = 0.0562
373 595 766 671 922 771 591 540 604 771
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

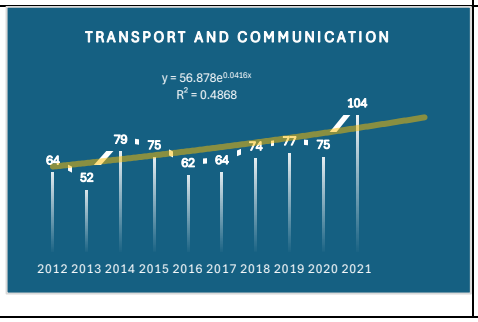

PERSONAL SERVICES
y = 93.724e0.0165x
R2 = 0.0158
70 84 153 122 100 98 102 108 116 95
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


PRINTING, PUBLISHING & PAPER INDUSTRIES
y = 8.3673e-0.049x
R2 = 0.0526
6 12 9 6 5 8 4 3 11
2013 2014 2015 2016 2017 2018 2019 2020 2021


PROFESSIONAL SERVICES
y = 16.937e0.1044x
R2 = 0.5735
10 26 32 27 38 31 32 44 43 37
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


TEXTILE INDUSTRIES
y = 15.725e-0.076x
R2 = 0.4087
12 13 16 15 12 10 7 4 11 9
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


TRADE AND COMMERCE
y = 37.432e0.1024x
R2 = 0.792
43 29 61 68 69 79 76 82 94 91
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


TRANSPORT AND COMMUNICATION
y = 56.878e0.0416x
R2 = 0.4868
64 52 79 75 62 64 74 77 75 104
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


WOOD AND FURNITURE INDUSTRY
y = 19.847e0.0468x
R2 = 0.3399
29 20 27 24 21 15 21 32 37 42
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021