UNIVERSITY OF GHANA

ASSESSING THE IMPACT OF RISK BASED INSURANCE SUPERVISION METHODOLOGY ON NON-LIFE INSURANCE COMPANIES IN GHANA

BY

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DECLARATION

I, Abdul-Rashid Abdul-Rahaman, do hereby declare that, except for references to other Authors, which I have duly acknowledged, the study herein presented is the first of its kind to be submitted to the University of Ghana College of Basic and Applied Science under the supervision of Dr. Anani Lotsi and Dr. Ezekiel. N. Nortey

I am wholly responsible for any mistakes encountered in the course of writing this thesis.

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CERTIFICATION

I hereby certify that this dissertation was supervised in accordance with procedures laid down by the University of Ghana.

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ABSTRACT

The purpose of this research is to evaluate how the inception of risk based supervisory approach has influenced the solvency positions of insurers in Ghana. The study considered 20 General Insurance Companies from 2008 – 2018. The main objectives of the study were to generate credibility risk premium values for individual claim experience to be used as an average premium regulator and develop Performance ratio thresholds for the Insurance Industry in Ghana using credibility theories and lastly determine whether the introduction of RBS approach has caused a shift in the solvency position of Non – Life Insurance. Credibility models such as the Buhlmann Straub's Credibility theory and its components were used to test the researcher's objectives and the results showed that, Claim Counts for General Insurers reveals that, Ghana Union Assurance recorded the highest average of 76.3 claim count and a maximum of 154 claim count. Prime Insurance Company Limited recorded as low as 3.0 average claim count. Ghana Union Assurance recorded the highest average of 937.36 policy count and a maximum of 1896 policy count. Priority Insurance Company Limited recorded as low as 25.00 average policy count. The results showed that expected process variance (EPV) was **0.049064** whiles the variance of the hypothetical mean (VHM) was **0.000000226.** It was also realized that the expected process variance (EPV) was **901967.62** whiles the variance of the hypothetical mean (VHM) was **11489323773** and the variance of the hypothetical means (VHP) was .**22** . It is recommended that Gross Written Premium is the only performance ratio that recorded a significance credibility weight (54%) on the Ghanaian industry average.

DEDICATION

I dedicate this work to my Head of Supervision at National Insurance Commission Ghana (NIC) Mr. Seth Kwesi Eshun-FIA.

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LIST OF ABBREVIATIOS

RBS	Risk Based Supervision
EPV	Expected Process Variances
VHM	Variance of the Hypothetical Means
GI	General Insurance
NIC	National Insurance Commission
GIA	Ghana Insurers Association
IUMI	International Union of Marine Insurers
GIBA	Ghana Insurance Brokers Association
FPSO	Floating Production Storage and Offloading
IIM	Insurance Institute of Michigan

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Insurance plays a very important role in the development of every country's economy, as the sector contributes greatly to every nation's GDP (Chien-Chiang & Chi-Hung, 2016). The insurance sector employs citizens and also helps create confidence in an economy. It provides the requisite protection to investors and entrepreneurs to take on risk with the hope that if the insured event occurs, insurers will indemnify them properly. The insurance industry in Ghana however has not really contributed so much to GDP of the Ghanaian economy over the years. As at end of year 2018, the average insurance penetration rate was about 1% (NIC, 2018). This rate is considered to be very low and conscious efforts are being made by the NIC to improve the penetration rate through the implementation of compulsory fire insurance for commercial buildings as well as micro-insurance. The first established insurance company in Ghana was in 1962, the State Insurance Corporation. Since then, the insurance industry has developed several entities and regulatory administrations (NIC, 2017).

The National Insurance Commission (NIC), as the insurance regulatory body in Ghana, has the core mandate of being a good custodian of public interest and ensuring sound industry practice in the insurance industry in Ghana. With reference to the last six years, two Insurance companies, Industrial and General Insurance (IGI Life) and (IGI Non-Life) have been liquidated as a result of poor performance and insolvency (NIC, 2014). Some insurance companies had to go through other forms of regulatory actions such as putting a stop to underwriting new businesses among others. The occurrence of these and other concerns necessitated the need for regulatory reforms to ensure all regulated entities are solvent at any point and the insurance industry in Ghana also practice in accordance with international best

standards. In the year 2012, the NIC initiated a new approach to insurance supervision. The purpose of this study is to determine whether the new reform actually caused any deviation in the solvency positions of regulated insurance entities (NIC, 2013).

1.1 Insurance Administration in Ghana

Insurance is a risk management mechanism aimed at preventing and minimizing loss. Growth in an economy generates several kinds of businesses. The more these businesses increase in number the more complex they become, so also are the risks associated with them. Supervision involves evaluating the safety and stability of federally regulated financial institutions, providing feedback as appropriate and using powers for timely intervention where necessary (Neuhaus, 1984) According to Rejda (2014), Insurers are regulated by the state for several reasons including, maintain insurer solvency, compensate for inadequate consumer knowledge, ensure reasonable rates and make insurance available. Under Insurance Act, 2006 (Act 724), the object of the National Insurance Commission (NIC) Ghana, is to ensure effective administration, supervision, regulation and control the business of Insurance in Ghana. The NIC is decreed to perform a wide spectrum of functions including licensing of entities, setting of standards and facilitating the setting of codes for practitioners. The Commission is also assigned to approve rates of insurance premiums and commissions, provide a bureau for the resolution of complaints and arbitrate insurance claims when disputes arise. The business of insurance certainly thrives on the earning potential of insurance companies whose activities are predicated on risk taking. Insurance regulators therefore have the onerous obligation to constantly review the activities of insurers in order that the claims of policyholders are settled and paid timely. The National Insurance Commission was formally instituted in 1989 by an Act of Parliament Insurance Law 1989 (PNDC Law 227) as the sole regulator of insurance activities in Ghana. National Insurance

Commission, as part of its mandate in the regulation of insurance, has undertaken several measures such as the introduction of micro insurance, early claim settlement, no premium no cover guidelines among others to boost the insurance penetration rate in Ghana.

Since 1989, insurance supervision has gone through significant changes with the aim of making insurance a credible and attractive service in Ghana.

1.2 The Ghanaian Insurance Industry

The Insurance market in Ghana is made up of Life insurance companies, Non-Life insurance companies, Reinsurance companies, Loss Adjuster, Brokers and Insurance Agents.

Line of Business	**Number of Companies**
Life Insurers	24
Non-Life Insurers	29
Reinsurers	05
Brokers	86
Loss adjuster	03

Source: *National Insurance Commission* 2018

Currently, the Ghanaian Insurance Industry does not have composite Insurers, as composite firms were directed by the NIC to split the operations of their Life and Non-Life business in 2006.

1.3 Supervisory administrations in Ghana

The Goal of Insurance regulation in Ghana, just like any other country is to ensure equity among all players in the industry, this includes policy holders and service providers. The progress of formal insurance regulation in Ghana started with the PNDC Law 1989 (PNDC Law 227), which now operates under Insurance Act, 2006 (Act 724). Section 2(3) of the Insurance Act, 2006 states; in performing its functions under this Act the Commission shall have regard to the protection of the public against financial loss arising out of the dishonesty, incompetence, malpractice or insolvency of insurers or insurance intermediaries. The Ghanaian insurance market has seen considerable developments over the years. These developments have resulted in changes in the legal and regulatory framework. Since the establishment of the NIC in 1989 under the Insurance Law 1989 (PNDC Law 227), the Commission has been committed to its objective of monitoring the operations of insurers to ensure their solvency requirements are met. This notwithstanding, the industry still faces solvency, liquidity and operational challenges, to help stem this tide, the NIC is shifting its supervisory focus from the Compliance approach to the Risk Based approach (NIC, 2011).

1.4 Compliance as compared to Risk Based Supervision

Prior to the year 2012, the NIC was practising a regulatory supervisory approach called compliance-based supervision. With the compliance based supervision, the method of supervision was operating directly under the Insurance Act 2006, Act 724 Section 165 (4) which states; “Without limiting the scope of subsection (1), the Commission shall ensure that an inspection is carried out in respect of an insurer or insurance intermediary not less than once in every two years”. Taking into consideration the limited nature of supervisory resources at the disposal of the Commission, it was almost impossible to comply with this legislative requirement and in rare periods where the Commission is able to inspect most of

the insurers, it could be assumed to have been done in haste and of less importance simply to fulfil statutory obligations. It is often judicious that more attention is given to companies that take on higher risks in with respect to their operations. The main attention of the Commission was then aimed at ensuring all regulated entities carry out businesses in lieu with their risk appetite and appropriate operational or oversight measures to deal with these risks in place. The risk based supervision has therefore come to fill this gap in the supervisory process of monitoring insurance companies and allocating resources to effectively supervise the industry.

The Compliance Based Supervision was the regime where solvency framework was basically preserved on the grounds of "dos and don'ts". This approach of insurance supervision has been criticised and tagged as outmoded in nature (Kalman, 2012). It has been revealed that the compliance based approach did not consider the nature, scale and complexity of a company but basically meted a whole-sale approach to all companies in order to fulfil legal requirement. The unavailability of supervisory resources limited the effectiveness of the method. Again it did not encourage supervisors to look ahead of time but rather to handle issues as and when they occur. This has therefore made way for the Risk Based Supervision (RBS) approach which is more proactive and far seeing (NIC, 2013).

Risk Based supervision (RBS) as practised in Ghana is the regime where individual insurance companies are regulated considering the peculiarities of each company. Considering the nature, scale and complexity of a company and its activities, risk ratings are applied and it defines the solvency of that company. For instance, with the risk based approach, capital is defined as the regime where insurers must have a certain amount of capital, depending on the riskiness of their investments and insurance operations (Rejda, 2011). In assessing the risk and effectiveness of risk mitigating measures adopted by the various insurance companies,

the NIC adopts some key ratio indicators to determine the risk profile of a company. One major object that underpins the practice of risk based supervision is the allocation of limited supervisory resources to riskier companies. The Risk Based Supervisory framework focuses on the understanding of the key activities and risk drivers, and the effectiveness of risk management processes and practices of an insurer. It also promotes the early identification and management of risks, and affords the NIC the opportunity to focus its supervisory attention on the nature, scale, complexity and the risk profile of insurers (Supervisory Framework, NIC). A similar approach practiced in Europe is the Solvency II.

Owing to the characteristics of the global insurance industry, and the particular complexities of marketing insurance in the single European financial market, the European Commission has adopted a proposal concerning "the taking-up and pursuit of the business of Insurance and Reinsurance." The goal of this proposal is to introduce a new framework of solvency, capital and supervision for insurers and reinsurers (EU Commission, 2007).

Solvency II is the new European Union insurance regulatory regime that sets some general principles based on the regulation of the securities markets and the European Securities Commission was created to define the technical details and set up a framework to bring about greater cooperation among the European regulators.

The capital requirements for solvency will not be the only rule that the insurers must comply with; there will be further requirements for company managers and national government bodies to prevent financial scandals like Enron, TYCO International, Peregrine Systems, and WorldCom. In addition, there will be accounting regulation to ensure greater transparency, by applying the International Financial Reporting Standards (IFRS). The Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) had an important part in the drafting of Solvency II. In particular, since the new directive does not contain technical

details on the implementation of Solvency II, CEIOPS was asked to provide further advice concerning the detailed technical aspects of possible measures for implementing it (EU Commission, 2007).

1.5 Statement of the problem

Within the past six years, two insurance companies (IGI Life and IGI General) have been liquidated as a result of insolvency (NIC, 2016). As a result, the National Insurance Commission which is the sole mandatory body to regulate insurance business in Ghana, has intensified strictness in terms of their responsibilities to keep up with economic ways of supervising insurance entities. Also, the Ghanaian Insurance industry has also experienced an invasion of several foreign investors in the last few years. As a result of these international cross boarder investment together with international standardisations have made it imperative for any regulatory body to enrol in internationally best practices. A similar approach to RBS is solvency II, which is being practiced by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) in Europe. In the year 2012, the NIC adopted a new approach of supervision called the Risk Based Supervision (RBS). Admitting that this supervisory approach is new and all insurers are required to comply, its effect on the solvency of insurance companies cannot be overestimated.

To date, there exist little or no work done that assesses the impact of insurance regulatory reforms in the Ghanaian Insurance industry. So far, no scientific study has been performed to assess the impact of the solvency guidelines of 2008 on the solvency of Ghanaian insurance companies. The study therefore will investigate whether the introduction of Risk Based Supervisory approach of insurance supervision has really caused a major shift in the solvency positions of insurers in Ghana.

1.6 Objectives of the Study

The purpose of this research is to evaluate how the inception of risk based supervisory (RBS) approach has influenced the solvency positions of insurers in Ghana. The specific objectives are to;

i. generate credibility weights for policyholders of insurance companies.
ii. generate credibility risk premium for policyholders to be used as average premium by insurers.
iii. develop Performance ratio thresholds for the Insurance Industry in Ghana using credibility theories.
iv. determine whether the introduction of RBS approach has caused a shift in the solvency position of Non – Life Insurance company.

1.7 Research Questions

The research will answer the following questions in order to assess whether the insurance companies should keep to experience rating or to include class ratings or credibility risk premiums. The research questions are;

i. What credibility factors are assigned to experience ratings of the individual insurers?
ii. What balance is established between experience ratings and the class ratings of insurers in terms of claim frequencies and severities?
iii. What is the Performance ratio threshold for the Insurance Industry in Ghana?
iv. To evaluate whether the introduction of RBS has caused a shift in the solvency position of Non – Life Insurance Companies in Ghana.

1.8 Significance of the study

After the global financial crisis in the year 2011, it was realised that the significant failures in the financial services emanated out of some inherent weakness in systems of the institutions especially insurers and banks. According to IMF (2014), at the beginning of the global financial crisis, neither the Federal Reserve nor any other regulatory agency had a full overview or the tools to reach all aspects of the highly complex U.S. financial system. In order to avoid or eliminate the impact of future occurrence of such down turn in the insurance industry, the National Insurance Commission adopted the RBS approach in Ghana. This research will help supervisors to statistically assess the impact of the regulatory regimes from compliance based to a risk based methodology. Also, the level to which the various components of the RBS solvency model contribute to the solvency of a company can be confirmed. The findings from this study can help supervisors to channel their supervisory actions to specific areas of a distressed company. Insurers can equally study the outcomes of this research to know which aspects of their balance sheet needs scrutiny to remain solvent. The National Insurance Commission, which is a vibrant member of International Association of Insurance Supervisors (IAIS), can equally make use of the thresholds that are developed to equally measure performances of Insurers. Also, both foreign and domestic Investors can rely on this measure of performance to take prudent investment decisions such as mergers and acquisitions.

The findings from this study would highlight the new insurance supervisory regime called the Risk Based Supervision. It would also add to existing literature in the insurance industry especially in Ghana and other jurisdictions that are using a similar approach in their supervisory work. It would also serve as a reference point for other researchers interested in studying risk based supervision in Ghana. Again, the studies although an academic material can aid the Commission to fully employ or consider a modification to its existing key risk

based indicator ratios and solvency model. Insurers in Ghana can study the findings of this research to improve their risk management and corporate strategies in order to remain compliant with regulations in Ghana. Lastly, this thesis will make a significant accession to the related literature and improve our understanding of this regulatory approach. I expect the findings to lay foundation for future research in this area and improvement of regulatory limelight.

1.9 Scope and Limitations of the study

The study is expected to cover companies that have existed throughout the study period of 2008 to 2018, and financial burden, the study covers twenty (20) Non-Life insurers provided they have existed through the study period. In addition, the study is limited to only the financial aspects of a company's operations to measure structural break. Other corporate factors that can easily be affected by a change in regulation such as the change in board composition and risk management practices which form the heart of a company's structure are not taken into consideration. The major limitation in this research is being considered in relation to the standard explanation to which the researcher has limited the study with respect to existing theories, models and the sampling procedure. Lastly, the choice of data sets may not be comprehensive as there may be major players in the Ghanaian insurance industry whose data may be lacking due to a fall in the number of years required for the analysis or lack of past data for this purpose. However, the researcher is of strong believe that these issues will not affect the quality of the research.

1.10 Organisation of the study

The study report is organized in five main chapters as follows;

Chapter one of the studies will be made up of a brief introduction followed by research background, a statement of the research problem and research purpose. These will be followed by a concise and clear statement of the objectives of the research and the research questions and significance of the research. The challenges and or limitations that will be faced in conducting the research will be stated here. Chapter one introduces the study by describing the research gaps that the study resolves to address and the importance of the study to corporate practice, academia and policy making. Chapter Two focuses on a detailed review of the relevant theoretical and empirical literature on solvency of firms, Insurance regulations, credibility theory and material sections of the study. This section also looks at the gaps in the literature and presents some ideas for future research. Chapter Three emphasises on the research methodology and sampling technique, the research instrument and data collection procedures with data sources from annual reports, journals, articles and other related literature. The data retrieved from the study is analyzed using both qualitative and quantitative methods.

Chapter four elaborates on the results from the data analysis, interpretation and discussion of the analysis of data collected. Chapter five concludes and gives possible recommendations for policy makers.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the study reviews existing literature on risk-based supervision, its framework as well as its application and impact on various financial institutions including insurance companies. It also gives the opportunity to compare and contrast the views of other authors on the research topic.

2.1 Concept of risk-based supervision

Regulatory authorities undertake prudential supervision to promote the maintenance of efficient and fair insurance markets for the benefit and protection of policyholders and other insurance stakeholders. An efficient supervisory authority is capable of ensuring insurers take preventive and corrective measures on time. Traditionally, supervisors have applied compliance-based supervision. This type of supervision ensures that insurers comply with a set of rules provided by the law or other legislation. Recently however, supervisory trends have evolved into one that is risk based (Rejda, 2014).

There are several definitions of risk in insurance thus risk can be defined as the uncertainty concerning the occurrence of a loss. There is a degree of risk attached to every activity which people undertake (Rejda, 2008). Under the risk-based framework, supervisors assess four major factors: inherent risk, controls, residual risk and additional support. Inherent risk is the risk of an adverse event occurring. The inherent risk in a functional area can also be described as a measure of the probability of an adverse impact on an insurer's capital arising from possible future events within its usual operations. Thus, the frequency, probability and severity of the occurrence should be considered in measuring the impact of the risk. Inherent

risks can be classified as being either high, moderate or low depending on the likelihood of occurrence and the size of the potential loss (Bustic, 1994).

Controls are measures or strategies which are put in place to mitigate the frequency and severity of possible loss events or inherent risk. Controls are closely linked to risk management practices. Risk management is the process of identifying possible risks faced by an organization and selecting the most appropriate methods for dealing with these exposures (Rejda & McNamara, 2008).

Residual risk is the possibility of an adverse event occurring after risk management measures and controls have been put in place and are working appropriately. It is very difficult and possibly impossible to eliminate risks completely thus the risk that still remains after controls have been put in place is termed as the residual risk. For example, a pedestrian can minimize the risk of an accident by deciding to wait until the pedestrian green light before crossing the road. However, the residual risk will be if a driver decides to run the light. Additional support is any measure or step put in place to lessen the negative outcome or impact of a risk event occurring. For example, a vehicle owner can take preventive measures to reduce the risk of an accident however having comprehensive car insurance will serve as an additional support which will help foot the bills that will be incurred should the accident occur (Randle, 2009).

2.2 History of risk-based supervision in Ghana

The insurance in Ghana is emerging steadily and designed to manage risks thus it has to be strictly regulated to protect the interests of customers and insurers. In light of this, the National Insurance Commission has been tasked to regulate the activities of all insurance

market participants in order to ensure fairness and equity among industry players. Traditional methods of supervision which have been widely implemented in some counties over the years prescribe applying similar controls to all institutions irrespective of their business modules, operations, risk appetites etc. These methods are primarily concerned with the compliance of institutions with the rules and regulations governing them (Department of Bank Supervision, 2013). The NIC implemented these traditional methods in regulating the Ghanaian insurance market however due to an increase in insurer malpractices such as premium undercutting and other limitations inherent in the traditional methods of insurance supervision, the National Insurance commission has introduced and is implementing risked based supervision (National Insurance Commision, 2018). This step taken by the NIC was in line with the suggestion of the International Association of Insurance Supervisors (IAIS) that regulators should consider implementing alternative methods in supervising insurers such as Risk Based Supervision (RBS) in order to determine if an approach that is tailored to the business type and the risk exposure of the business (access to Insurance Initiative, 2015).

2.3 Theoretical Framework

A supervisory framework describes the principles, concepts, and core process that insurance supervisors use to guide its supervision of regulated financial institutions. These principles, concepts, and core process apply to all regulated institutions irrespective of their size and accommodates aspects of the life insurance, property and casualty insurance sectors. There are three major supervisory framework approaches that are implemented by insurance supervisors or regulators. These are: Solvency I, Solvency II, Basel I, Basel II, risk-based framework etc.

2.3.1 Solvency I

This framework is popularly referred to as the solvency margin. According to Zhang (2004), the solvency margin is a reserve over and above the amount needed to satisfy underwriting liabilities. The solvency margin is an amount set by regulators that represents the least amount an insurer must hold either as an easily convertible asset or liquid capital. In other words, it is an amount of money the insurer must hold to meet unexpected costs and events in the short term (IAIS, 2002). This methodology required the valuation of the firm's assets and liabilities to determine the optimal amount the company needs to hold in reserve to meet its unforeseen obligations.

The existing requirements of the solvency margin framework were introduced in 1973 under the initial directive for non-life firms and in 1979 under the first life directive (79/267/EEC). As time went on latter generations of life and non-life insurance directives in the 90's created a single market for insurance which resulted in a highly competitive market. Thus, insurance undertakings in the European Union were allowed to sell without price control and supervision of terms and conditions except in the case of compulsory insurance. This system recognized rules and supervisory frameworks which were harmonised at the European union level and implemented by national supervisory bodies. The important rule in line with the principle of prudence was that insurance undertakings were to establish an adequate solvency margin. The European solvency margin system was founded on the basis of the following principles (Viaene, Ayuso, Guillen, Van Gheel, & Dedene, 2007).

i. The measurements of the liability positions of insurance companies
ii. Establishment of net assets required to offset these liabilities

iii. Substantiation of amounts which are available to insurance undertakings

iv. Timely intervention of regulatory bodies if the minimum requirement falls short.

Though solvency I established a realistic minimum capital requirement there were certain problems it was unable to overcome. For instance, it did not reflect the true risk faced by insurance companies. Also, there was no harmonized method for the valuation of the assets and liabilities of the across the European Union (Zhang Z., 2004). These problems led to the introduction of the solvency II framework.

2.3.2 Solvency II

The Directive 2009/138/EC of the European Parliament shortly known as solvency II was approved on the 25 November 2009. Solvency II is a world-leading standard that requires insurers to focus on managing all the risks they face and enables them to operate much more efficiently. It is positive news for consumers and for the insurance industry(Quaye, 2014). The primary objectives of solvency II were to ensure better regulation and deeper penetration of the EU insurance market and to promote consumer protection. Solvency II also, sought to achieve certain purposes which include but are not limited to establishing an appropriate match to insurers individual risk profiles, ensuring fair valuation of assets and liabilities in a manner consistent with the IASB, harmonizing insurance standards across the European union and setting higher capital requirements (IAIS, 2002). This framework is built around three main pillars which are quantitative requirements, supervisory review and disclosure of information.

2.3.3 Risk Based Supervision

Access to Insurance Initiative (2015) defines risk-based supervision framework as "a structured process aimed at identifying the most critical risks that face each insurance company and through focused review by the regulator, assessing the company's risk management practices and the institution's financial vulnerability to potential adverse experience". There can be a large number of different firms of various sizes undertaking a range of activities. Supervisors on the other hand are few and constrained on resources thus they need to prioritize effectively. Risk-based supervision (RBS) increases the efficacy of supervision through improved resource allocation and processes. This is because resources are allocated to areas facing the greatest risk. Although risks are not completely eliminated under this framework, regulators are able to put in place risk management measures which mitigate these risks in the most efficient and effective way (Toronto centre, 2018).

Characteristics of Risk Based Supervision

The risk-based supervision framework differs from others due to its unique characteristics which will be discussed in this section(Toronto centre, 2018).

i. Priority is given to the greatest risk. RBS focuses on the most important risks. These are risks which will have colossal negative impacts on the operations of the firm in terms of the regulator's objectives. This type of supervision considers the impact of the risk should it occur as well as the probability of the occurrence.
ii. Risk based supervision requires continuous valuation and classifying or grading of institutions and the risks they are exposed to usually on a specialised sheet. This enables supervisors to compare institutions and to assess comparative risks and prioritize.
iii. Risk based supervision accounts for risks arising from other sources such as macroeconomic risks as well as firm specific risks.

iv. There is a greater degree of flexibility generally in RBS. Under compliance-based supervision had to strictly follow rules and legislation however under RBS the regulators are more attentive to prudential principles (Randle, 2009).
v. Risk based supervision is forward looking thus it enables risks to be easily identified and addressed in a timely manner.
vi. It allows for improved decision making and allows scarce supervisory resources to be put to good use (Toronto centre, 2018).

Principles of Risk Based Supervision

The risk-based supervision framework varies slightly depending on the supervisory body being considered nevertheless, it works based on the same principles which will be mentioned in this section (Randle, 2009).

i. Where RBS is applied, it needs to be consistent in its application. Although each firm will be dealt with in a unique manner depending on their risk exposure and possible outcomes of adverse events, decisions must be taken in a consistent manner.
ii. RBS needs to take into account of pertinent information both from internal and external sources of the supervisory body.
iii. RBS should depend on an applicable framework supported by the necessary infrastructure.
iv. RBS should be forward looking and actions taken by supervisors to remedy risks should be proportional to the risk events.
v. Risks should be accessed in a broad context and RBS should be concerned with all outcomes (Toronto centre, 2018).

Preconditions of Risk Based Supervision

In order to apply RBS effectively, authoritative agencies accept some preconditions that have to be met. There are 5 elements that need to be considered: The state of the law, the anatomy of the supervisory agency, advice and training for supervisors, a risk rating model and a measurement tool. One of the aims of the RBS is to ensure that insurers have sufficient capital to offset their obligations. The state of the law implies that where a supervisor is dissatisfied with the capital level proportional to an insurer's risk, it must oblige the insurer to increase its set aside funds using authority derived from the law. Moreover, the authority vested in supervisors by the law must range over different sections in order to enable them react appropriately (Randle, 2009).

The classification of adverse events and the eminence of controls are both subjective. The differences in opinions are influenced by the supervisor's degree of risk aversion. More risk averse individuals will use harsh methods to deal with risks whereas risk loving supervisors might use lenient methods of treating adverse outcomes. This can interfere with the process of comparing risk profiles of insurers and assessing the efficiency of their controls in light of these authoritative agencies need to be structured in a way that will not exploit the level of consistency in RBS. A structure that has been fruitful in some agencies is to allot the duty regarding the supervision of singular safety net providers to singular bosses under the administration of an individual who directs every one of the safety net providers and approves each hazard and control appraisal. This has the extra preferred standpoint of enabling regulators to procure a more top to bottom learning of the firms for which they are answerable (Randle, 2009).

To manage the likelihood of irregularity further, experts will need to give careful consideration to the training of supervisors. The guidance needs to be in the form of formal training sessions to enable regulators to transition from compliance-based supervision to subjective risk supervisions (Židuļina, 2006).

A risk model is designed to summarize risk and control event into an overall risk assessment. The complexity of the model depends on the judgement of the supervisory agency. These models use qualitative terms to express individual adverse events and the probabilities however, more advanced models express the outcomes in quantitative terms (Randle, 2009).

Classification of Inherent Risks

Inherent risk refers to the chance of loss arising from an adverse event in a particular environment. In insurance nonetheless, inherent risks can be categorized under some broad definitions and contexts.

i. Insurance Risk

This refers to the possibility of all adverse events arising from the insurance process and operations. It covers risks associated with underwriting and product design and pricing. Thus, the risk that the insurer will suffer loss resulting from selecting and retaining risk prone individuals is considered here. Furthermore, the risk of making losses due to inability of set premiums to meet expected liabilities is factored here.

ii. Market Risk

This risk occurs due to changes in asset level, asset and liability mismatch, reinvestment and unpredictability in the financial securities market. Stated differently, it arises due to changes in market prices and conditions. It includes the possibility of loss occurring as a result of changes in interest rates, foreign exchange rates.

iii. Credit Risk

Risk of debtors defaulting or the possibility of a change in the creditworthiness of a borrower, counterparty or intermediaries where institutions have legitimate claims to settle. This risk can greatly impact the output of a firm and thus needs to be closely regulated by supervisory bodies.

iv. Liquidity Risk

This is a risk that occurs due to the unavailability of easily tradable securities or short-term assets to meet cash flows arising from an institution's liabilities. This can happen if a firm has to sell its securities at an unexpected low price. A firm's liquidity position is largely determined both by its assets as well as its liabilities.

v. Operational Risk

Operational risk is the risk of an adverse outcome due to failure of internal systems, personnel and procedures. These kinds of risks are hard to quantify because they arise from dishonesty, human error, breakdown of internal processes and many more. It is believed that these risks can be quantified if there is appropriate empirical data from insurers and other financial institutions. The availability of said data will go a long way to measure and more conveniently assess this risk.

vi. Concentration risk

This is the probability of an adverse outcome resulting from the placing of a large proportion of investment funds into one sector, market, geographical area etc. This type of rick can be minimized by prudential diversification of funds.

vii. Strategic Risk

This arises when an institution is unable to adequately execute its business plan, procedures, available resources and so on.

viii. Supervisory Process

Although the risk based supervisory framework is dynamic and intuitive, there need to be a laid down set of steps that should be followed to ensure consistency in decision making and assessment of institutions. To begin this process, the regulatory agency assigns a supervisor known as the regulation manager to a firm. This supervisor becomes responsible for all on-going supervision of the firm and also ensures that the supervisory process is applied on a timely basis. The process includes planning, monitoring, on site reviews, reporting and intervention or follow-up(CARTAC, 2013).

i. Planning

The development of a strategy for supervising an institution is known as planning. This strategy can be for an annum or plan covering several years. In proposing an efficient strategy, supervisors must take into account existing documentation, the type of institution, the nature of its operations, the risk profile and appetite of the firm. The document produced after planning outlines steps to be taken by supervisors over a number of years and the objectives of these processes. Planning is not limited to putting in place measures for each institution; it also includes a strategy on how to allocate supervisory resources between

different firms depending on their risk profiles. This is because resources are not infinite and each firm does not require the same amount of supervision (CARTAC, 2013).

ii. Monitoring

Under this process, regulators appraise the data gathered from a specific institution and compare the firm's current standing to historical ones and the standing of its peers. This allows the easy recognition of changes in the institutions risk profile. Monitoring can also be done by engaging institutions under the process in discussions of new trends in the market. The depth and rate of monitoring of a firm is proportional to the firm's risk characteristics. It is however recommended that each organization should be monitored at least every quarter. In cases where monitoring reveals a change in the risk profile of an organization, plans should be updated in accordance (CARTAC, 2013).

iii. On site review

Aside from knowledge gleaned by regulatory authorities from information presented by the insurer, it is imperative that the relationship manager for each institution interacts personally with the employees, processes and operations of the insurer. This will go a long way to bolster the regulators understanding of the insurer's risk identity.

iv. Reporting

Supervisors must document their findings on a firm as well as its initial risk profile and measures put in place. After personally appraising a firm, any recognizable change in the organizations risk profile should be recorded to ensure the continuity of information and to allow other supervising officers to correctly track the insurer's progress (CARTAC, 2013). The information gathered can then be passed on to the stakeholders of the insurer to facilitate the implementation of required actions.

v. Intervention and follow up

Once information is made available to the management of a firm (thus may include internal and external audit, the actuarial function etc), authoritative bodies should put in place measures to ensure that the right processes are implemented by the organization to deal with concerns and new risk events in a timely fashion (CARTAC, 2013).

2.4 Credibility Theory

"Credibility theory is a technique that can be used to determine premiums or claim frequencies (number of claims) in general insurance. This technique uses historical data related to the actual risk and data from other related but relevant sources commonly referred to as collateral data. The credibility premium formula as derived by Waters (1994) is of the form; $m_{T+1} = Z\bar{X} + (1-\mathrm{Z})\mu$. Where; m_{n+1} is the premium z is the weight or credibility factor and is usually between zero and one. The credibility factor here is an increasing function for large value of *n* claims. The mean parameter x is the observed mean claim amounts per unit risk exposed for individual contract/risk itself. μ is the parametric estimate of the proposed data in the case than an assumption of the underlying distribution is made. For a series of risks, μ is the corresponding portfolio (set of risks) mean."

2.5. Features of Credibility formula

"The formula is made up of a linear combination of estimates and a pure premium policy based on observed data from the risk itself and the other based on projected risks. The credibility factor z, shows the degree of reliability of the observed risk data in the sense that high values of z implies high reliability. The credibility z is a dependent function of the

number of claims. This implies, the higher the claim number the larger the credibility factor and finally, the value of credibility factor lies between zero and one."

"Credibility theory was originally developed for a long time by actuaries from North America in the early 20th century. Mowbray (1914) put it into practical solution to premium calculation and it came to be called the American credibility theory. It is sometimes referred to as limited credibility theory or the fixed effect credibility. In this work' it was assumed that the annual claims $X_{1,}\ X_{2...}X_T$ are independently and identically distributed random variables from a probabilistic model with means m(α) and variance s^2 (α). The assumption is that the data follows a normal distribution."

2.5.1 Buhlmann - Straub credibility model

This is more of generalization of the credibility premium of (Buhlmann (1969). The risk here is just one risk in a collective of *n* similar risks. Each has unobserved random risk parameter θ_i. Let $Y_{1,}Y_2,.....,Y_T$ be successive values of random variables representing the quantity in which we are interested in (aggregate claims) for risk *i.* Each year, t, there is some non-random quantity m_t which measures risk volume at period *t*. We define $X_t = \frac{Y_t}{m_t}$ which imply that m_tY_t is the aggregate claims in year t for risk *i*. Distribution of X_t depend on parameter θ whose value is fixed but unknown. X_1/θ, X_2/θ,....., X_T/θ are independent and identically distributed. It is assumed that; $E[X_{it}/\theta]$ don't depend on *t* and denote $m(\theta_i)$ and m_{it} var$[X_{it}/\theta]$ don't depend on *t* and denote $E[s^2(\theta)]$. Without depending on any risk, the best estimate is $E[m(\theta)]$ as collective risk mean and $E[s^2(\theta)]$ expected variance. The task here is to produce an estimator that uses data from the risk itself and collateral information.

2.6 Review of Empirical Studies

According to Abdallah (2015) the growth and development of the financial sector in a given country is largely dependent on the supervisory framework implemented. In light of this, many authors and researcher have delved into and expressed varied opinions on the existing supervisory frameworks and their impact on the economy. These writings will be discussed in this section and will seek to summarize the findings of the publications. In a study titled solvency II assumptions for increasing the international competitiveness of EU insurance industry, Peleckienėa and Peleckisa (2014) sought to present new requirement of insurers under solvency II and ways of successfully implementing them to increase the credibility and competition in the European union insurance market. They applied quantitative impact assessments in their analysis of the supervisory framework which showed that capital requirements under solvency II were sufficiently lower than under solvency I throughout the EU insurance market. This implies that firms did not need to raise additional capital to remain solvent. They also gleaned that the application of internal models for underwriting life insurance risks resulted in higher risk charges as compared to the SCR's risk model whereas for non-life risks the opposite was true.

Abdallah (2015) in a study, examined the supervisory frameworks implemented in the ghanaian financial industry. After reviewing several regulations implemented in the ghanaian finaancial industry particularly in the banking sector, he concluded that frontier markets in africa and depreciation of exchange rates are examples of market imbalances that cause a decline in the growth of the financial market. He emphasises that these instabilities can be managed with appropriate regulatory supervisory regimes. Also, he stated that although the banking and non- bank institutions as well as the structure of financial industry have evolved over the years, the supervisory structure is changing to meet the risks introduced by the

market changes. He reccommended that the Bank of Ghana should ensure that financial institutions use the most productive regulatory scheme to ensure the continued growth of the industry. He also encouraged other researchers to investigate how the bank of Ghana uses the recommendations in the Basel accords to supervise institutions.

In a study aimed at determining the role of banking reforms on the perforance of banks, it was recorded that due to a series of problems facing the ghanaian financial industry, the government of Ghana in collaboration with the world bank introduced and implemented some financial reforms. Although the reforms resulted in an increase in bank performance, some weaknesses were noted by banks and other banking market participants. Inability to control inflation rates, high minimum capital requirements and ineffective enforcement of banking regulations were among the problems cited. It was recommended that the requirements for minimum capital should be indexed to exchange rate to avoid the influence of inflation. Also, internal bank supervision unit should be set up to monitor controls and other bank operations. Furthermore, a collaboration between the bank of Ghana and other supervisoryy bodies such as the National Insurance Commission should be encouraged (Lartey, Antwi S., Boadi, 2013).

The functions or activities of supervisory bodies can be classified into two broad categories which are supervision and regulation. Though there are several supervisory frameworks, the risk based supervisory framework stands out for various reasons. To begin with, RBS focuses on prompt and timely identification of evolving risks so they can be properly tackled. In addition, it allows risks and their controls to be adequately evaluated resulting in the acquisition of an in-depth understanding of the organization's structure and risk profile.

Moreover, the RBS allows efficient utilization and allocation of supervisory resources among firms using the method of prioritization. Also, this framework inculcates the culture of risk management into the day to day running of institutions and offers flexibility to regulators to rely on their intuition while still following a well-defined structure (CARTAC, 2013).

Nather (1984) conducted a study using questionnaires issued to 47 respondents who were experts such as compliance and risk managers, auditors and so on. The purpose of this study was to measure the impact of risk based supervision on the Kenyan insurance industry. To perform this analysis, descriptive statistics, statistical tests and some models such as frequency tables, pie charts, mean, correlation and so on were used. The results of these tests established that there is a positive relationship between return on insurance assets and risk based supervison factors influencing the market. The risk based supervision standards that were statistically significant were risk management, standards of RBS and RBS caapacity. The study recommended that risk based supervision models shoould be further enhanced and implemented in the insurance market. Furthermore, insurance companies should include effective risk management techniques in their day to day operations. Staff and employees of insurers should be trained and retrained on risks and their controls as and when necessary to further inculcate risk management practices into their operations.

Twumbarima (2015) undertook a study to explore the discrepancies between inherent risk exposures of insurance companies and their risk control measures. He proposed that the main aim of RBS is to prioritise scarce resources and implement controls which will improve the overall health of a financial institution. The data used for the study was collected through a survey in which 200 employees of insurers from the ghanaian insurance market were

sampled. The study revealed that respondents from the life insurance sector were more abreast with informatiion on risk based supervision than those from the non-life sector. It was also revealed that most insurer insolvencies were caused by inherent risks particularly liquidity risk. The study also showed that the inherent risk activities of insurers were proportinally twice as much as the controls they had in place. The recommendations made were similar to those proposed by (Nather, 1984). Whitney (1918)and other researchers criticized a lot this theory. Whitney proposed "that claims are random in nature and hence assumption of fixed effects model was invalid. In addition, the theory also faced the problem of partial credibility since it was difficult to determine the value of the credibility factor. After the World War II revolution, Whitney's random effect model came into place.

Later on, Nelder and Verall derived credibility functions by the generalized linear model approach and consequently included the random effects model. This has provided a wide range of actuarial application among them is premium rating and reserving. Though a lot of research was done that yield several findings, it was found that the fixed effect credibility was not able to solve the problem of credibility. It is said that part of it was due to undeveloped or poor statistical background.

In 1967 and 1970, a robust methodology came when Bulhmann derived the credibility premium formula in a distribution free-way such that there was no assumption of prior distribution of claims. Bulhmann later clarified in this work the several assumptions of using the credibility premium formula (Bühlmann, 1971). This major breakthrough has seen much of the research tilting to the development of Bayesian estimation techniques by Jewell (1975) Jewell, Hachemeister (1975) and DeVylder (1976). Jewell (1975) showed that for exponential family distribution, the best linear approximation to Bayesian estimate is

obtained using quadratic loss functions". Hachemeister (1975) extended the Bulhmann Straub model by use of matrix methods.

2.7 Definition of related concepts

Related concepts in TailVaR estimations and also general time series properties are defined in the following sub-sections.

2.7.1 Coherent risk measure.

The risk measure ρ is a coherent risk measure if the four conditions are satisfied;

i. Monotonicity

If portfolio Y always has lower returns than another portfolio X, for every state of the world, then its risk measure of X should always be greater than risk of Y.

$\rho(X) \leq \rho(Y)$ *if* $X \leq Y$ with probability 1

ii. Homogeneity

Changing the size of a portfolio by a factor t while keeping the relative amounts of different items in the portfolio the same should result in the risk measure being multiplied by the factor

$\rho(tX) = t\,\rho(X)$

iii. Subadditivity.

The risk measure (ρ) of two portfolio say X *and* Y after they have been merge should be no greater than the sum of the sum of their risk measures before they were merged.

$\rho(X + Y) \leq \rho(X) + \rho(Y)$

iv. Translation Invariance

If we add an amount of cash N to a portfolio, where $N > 0$, its risk measure should go down

by N

$$\rho(X+N) = \rho(X) - N$$

2.8 Conceptual Framework

A conceptual framework is a narrative or visual summary of the salient points and concepts in a study and the relationship between them (Miles & Huberman, 1994). As a result, this section will highlight the relationship between the major players in risk-based supervision and the RBS framework.

Solvency is a very important concept which plays a critical role in the insurance industry and in the management of risks associated with insurance. Solvency is influenced by risks inherent in insurance and the control measures implemented to minimize risk.

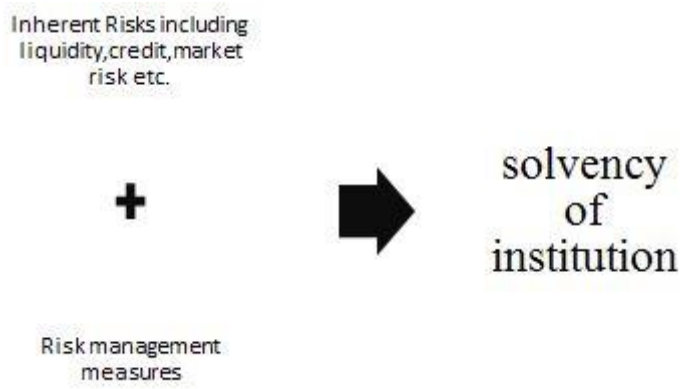

Figure 2.1: Conceptual Framework

The key players in any insurance market are the insurer, the insured and the supervisory authority of regulator. The insurer just like any business entity seeks to make profit whereas the insured seeks peace of mind and value for money. The regulator acts as the referee who seeks to ensure that every player in the market is treated fairly particularly the insured(Rejda, 2014).

In order for supervisors to effectively regulate the market they need to follow a laid down set of principles or rules which will ensure consistency and equity in the supervisory process. Thus, set of principles or rules are known as the supervisory framework (CARTAC, 2013). Several supervisory frameworks have been implemented over the years in various parts of the world typical examples are the Basel framework, Solvency I and II and so on. This study will focus on the risk based supervisory framework. The risk-based framework differs from other compliance-based ones because it is forward looking and enables early identification of risks and the controls to deal with them. Another unique characteristic of the RBS is that it allows for some level of intuition from the supervisor and deals with each individual firm according to its risk profile, size, type of operation and other characteristics. The RBS follows a simple supervisory process which is outlined in figure 2.1 (Department of Bank Supervision, 2013).

Band (2019) in his work concluded that, the classical Bühlmann premium are considered in case it is used in the more general Bühlmann-Straub model. Reasons for not applying the Bühlmann-Straub premiums may be to establish more solidarity among the insured or the fact that no proper measures for the weights in the Bühlmann-Straub model are available. The optimal 'classical-Bühlmann like' premium is derived if the parameters in the Bühlmann-Straub model arc known. For cases in which these parameters are not known, some estimators are examined if they are based on the incorrect assumptions of the classical Bühlmann model. It turns out that substitution of these estimators into the classical Bühlmann premium approximately leads to the optimal classical-Bühlmann-like premium in the Bühlmann-Straub model with known parameters.

Martin. L (2017), investigated a concept of multivariate pricing, which included claim history for more than one line of business and is a generalization of the Buhlmann-Straub model. The model was extended to allow for age of the claims to influence the estimation of future claims

and the results showed that, the model performs slightly better than the one-dimensional Buhlmann-Struab credibility model in terms of predicting error in a testing sample

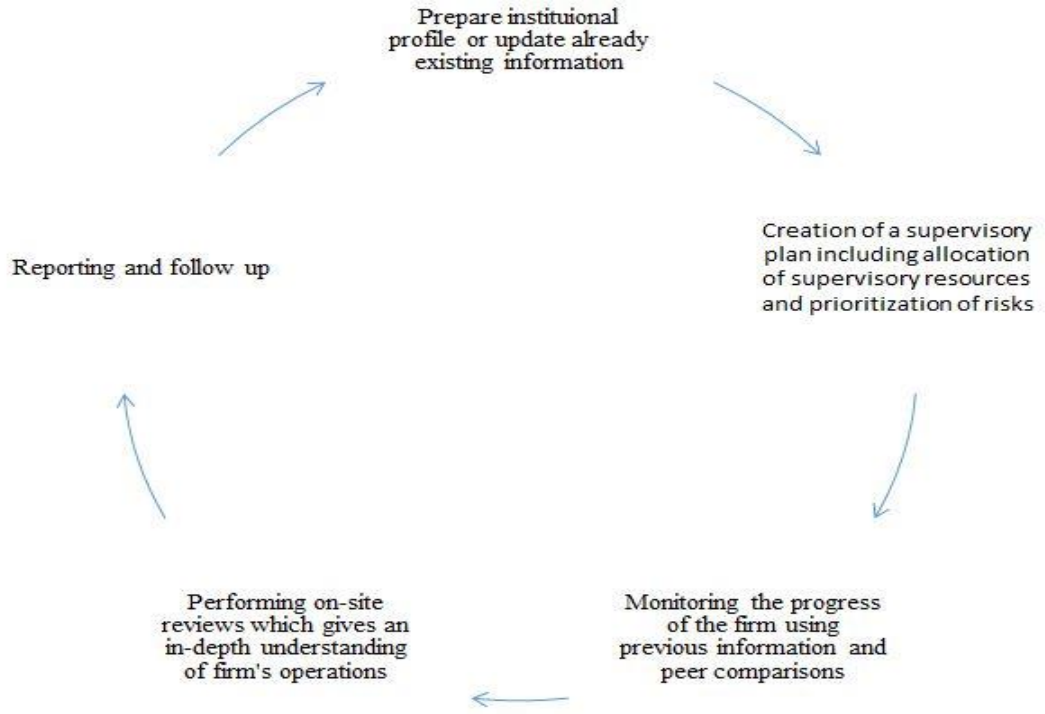

Figure 2.2: The Risk-Based Supervisory Process

(Park & Lemaire, 2012) applied regression methodology to an unstable panel data which comprised of 68 countries. This data was obtained for a ten-year period to determine the factors that affect non-life insurance demand with the stipulated 68 countries. This research found out that most cultural beliefs negatively impacted on non-life insurance and this was affirmed by the R-squared coefficient which gave a margin of 11.7% between developed and developing countries. The margin was mainly purported to be as a result of cultural differences. The above conclusion simply stipulates that risk in insurance should commence by having knowledge about cultural difference of the particular country of interest.

Furthermore, (Hössjer, Eriksson, Järnmalm, & Ohlsson, 2009) opined that insurance risk-based supervision of claim frequency in nonlife insurance can be modeled by Poison regression to find the extent of risk the particular insurance company is facing. This method is somewhat different from the Buhlmann-straub credibility model. Even though the Buhlmann's method is far robust than the poison regression careful consideration must to fish out the particular risk an insurance firm is likely to face.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter describes the various methods and techniques used to collect and analyse the data gathered for the study to gain a deeper understanding of the topic under consideration. The chapter discusses among other issues, the research design, data source and structure, model specification, and finally method of data analysis.

3.1 Target Population

The population of this study consists of Non- life insurance companies with licenses form National Insurance Commission (NIC). However, the companies need to have been listed for the entire period of January 2008 to December 2018.

3.2 Data Source and Structure

Data that was used for the study was secondary and was sourced from the Annual financial reports of the National Insurance Commission (NIC). The study sampled twenty (20) non-life insurers out of the 29 companies. These non-life companies had their financial reports fully prepared for the period under study (2008-2018). Data were produced basically from the Balance Sheet, Income Statements, Financial ratios and other relevant information from the annual reports for all the selected companies. Sampling was strictly based on the availability of full data and did not consider any other factor such as the nationality. The data was available at the actuarial and data management unit of the supervisory department of NIC and on the company's websites as well as other reports relevant to addressing the research questions.

3.3 Method of Data Analysis

We employed credibility models in our analysis, more precisely, the credibility premium model and Buhlmann – Straub Credibility model was fitted as a special case of linear mixed models (LMMs) with the underlying assumption of normality. The analysis is extended to capture the Poisson distribution as it is more appropriate in describing the distribution of claims. Data mining software used in this analysis is SAS.

3.4 Credibility Theory

Let $X_{i1,}X_{i2},.....,X_{iT}$ be the claims date for insureds of an insurance company where ($i=1,2,3,.....,n$) denotes the insurance companies and ($t=1,2,3,...,T$) representing the years in which aggregate claims of a company occurred. The credibility predictor has the following for;

$$\hat{X}_{T+1}=Z_i\bar{X}_i+(1-Z)\mu$$
$$0\le Z_i\le 1 \qquad (1)$$

Where the average, $\bar{X}_i$ is historical claim for company i and μ is the overall mean in the insurance portfolio. The credibility factor Z_i is a weight assigned to the individual company owns claims experience, in other words, is the amount of credibility placed to a certain data set created out of the past experience data.

3.4.1 Credibility Premium Model

It is clear from equation (1), that a systematic approach for the treatment of past data of a particular company is a weighted linear balance between $\bar{X}_i$ and u. Ideally, rather than the pure premium $\bar{X}_i=E(X_{it})$, one would like to charge individual policyholders

$\mu_{T+1}(\theta) = E[X_{T+1} / \theta]$, where θ is the risk parameter associated with the policyholders. Because θ is unknown, it become difficult, however, when we condition on x the past data from the policyholder instead, we are able to use the Bayesian premium $E(\mathrm{X}_{T+1} | x)$. We use the conditional distribution or hypothetical mean $\mu_{n+1}(\theta)$ for estimation of the next year's claims. Because we have observed x, one suggestion is to approximate $\mu_{T+1}(\theta)$ by a linear function of the past data. Specifically for company *i*, the predictor is given by;

$$\hat{X}_{T+1} = \alpha_0 + \alpha_1 X_1 + ... + \alpha_T X_T \qquad (2)$$

We restrict ourselves to estimators of the form $\alpha_0 + \sum_{t=1}^{T} \alpha_t X_t$ where $\alpha_0, \alpha_1, \alpha_2, ..., \alpha_T$ need to be estimated. At this point, we will estimate the αs to minimize the mean squared error (MSE) loss, that is,

$$Q = E\left\{ \left[\mu_{T+1}(\theta) - \alpha_0 - \sum_{t=1}^{T} \alpha_t X_t \right]^2 \right\} \qquad (3)$$

Where the expectation is over the joint distribution of $X_1, ..., X_T$ and θ. The mean squared error (Q) is averaged over all possible values of θ and all possible observations. To minimize Q equation (3), we take derivatives of Q. We first rewrite equation (3) as,

$$\frac{\partial Q}{\partial \alpha_j} = -2E\left\{ X_j \left[\mu_{T+1}(\theta) - \alpha_0 - \alpha_j X_j - \sum_{t \neq j}^{T} \alpha_t X_t \right] \right\} \qquad (4)$$

We shall denote $\tilde{\alpha}_0, \tilde{\alpha}_1, \tilde{\alpha}_2, ..., \tilde{\alpha}_T$ as estimates for $\alpha_0, \alpha_1, \alpha_2, ..., \alpha_T$ which minimizes equation (3).

NB $E[\mu_{T+1}(\theta)] = \mathrm{E}[\mathrm{X}_{T+1}]$ and $E[\mu_{T+1}(\theta)\,\mathrm{X}_j] = \mathrm{E}[\mathrm{X}_{T+1}\mathrm{X}_j]$

Equating $\frac{\partial Q}{\partial \alpha_0}$ to zero yields

$$E[\mathrm{X}_{T+1}] = \tilde{\alpha}_0 + \sum_{t=0}^{T} \tilde{\alpha}_t E[X_t] \tag{5}$$

Equating $\frac{\partial Q}{\partial \alpha_j}$ to zero yields

$$E[\mu_{T+1}(\theta) X_j] = \mathrm{E}[\tilde{\alpha}_0 X_j] + \sum_{t=0}^{T} \tilde{\alpha}_t E[X_t X_j] \tag{6}$$

$$E[\mathrm{X}_{T+1} X_j] = \tilde{\alpha}_0 \, \mathrm{E}[X_j] + \sum_{t=0}^{T} \tilde{\alpha}_t E[X_t X_j] \tag{7}$$

The final step is to multiply equation (5) by $E(X_j)$ and subtract from equation (7) to obtain the covariance matrix. Thus,

$$\mathrm{Cov}(X_j, X_{T+1}) = \sum_{i=1}^{n} \tilde{\alpha}_i \, \mathrm{Cov}(X_i, \mathrm{X}_j) \quad i = 1, \ldots, n \tag{8}$$

Equation (6) and equations (8) are the normal equations. We solve these equations for $\tilde{\alpha}_0, \tilde{\alpha}_1, \tilde{\alpha}_2, \ldots, \tilde{\alpha}_n$ to yield the credibility premium.

3.4.2 Buhlmann - Straub Credibility Model

The Buhlmann - Straub credibility model extends the Buhlmann theory to cases where the loss data X are not identically distributed. In particular, the process variance of the loss measure is assumed to depend on the exposure. Let m_{it} denote the exposure and X_{it} the loss per unit of exposure for company *i* at time *t*. The exposure may not be the number of insureds although it may often be the case. Assume that $X_{i1}, \ldots, X_{iT}$ are independent, the conditional on θ with common mean. The conditional variance of X_i for company *i* is

$$Var(X_{it} | \theta) = \frac{\sigma_X^2(\theta)}{m_{it}} \tag{9}$$

Where $\sigma_X^2(\theta)$ is the variance of the claim frequency of an insured and the exposure m_{it} is the number of insureds in company *i* covered by period *t*, ($t = 1, 2, 3, ..., T$) and ($i = 1, 2, 3, ..., n$)

Given θ, the conditional mean and variance of X_{it} are

$$E(X_{it}|\theta) = \mu_X(\theta) \tag{10}$$

$$Var(X_{it}|\theta) = \frac{\sigma_X^2(\theta)}{m_{it}} \tag{11}$$

The unconditional mean of X_{it} is

$$E(X_{it}) = E\left[E(X_{it}|\theta)\right]$$

$$= E\left[\mu_X(\theta)\right]$$

$$= \mu$$

The mean of the conditional variance of X_{it} is calculated as

$$E\left[\text{var}(X_{it}|\Theta)\right] = E\left[\frac{\sigma_X^2(\theta)}{m_i}\right]$$

$$= \frac{EPV}{m_i}$$

For $i \in \{1, \ldots, n\}$, where EPV is the Expected Value of process mean, and the variance of its conditional mean is

$$Var\left[E(X_i|\theta)\right] = Var\left[\mu_X(\theta)\right]$$

$$= \sigma_{HP}^2$$

$$= VHM$$

The ratio $k = \frac{EPV}{VHM}$ gives the Buhlmann credibility factor for company *i* as, $Z_i = \frac{m_i}{m_i + k}$.

Hence the estimate of the credibility premium for company *i* is

$$\hat{X}_{T+1} = Z_i \bar{X}_i + (1 - Z_i)\mu . \qquad (12)$$

where

$$\bar{X}_i = \frac{1}{m_i} \sum_{t=1}^{T} m_{it} X_{it}$$

$$\mu = \frac{1}{m} \sum_{i=1}^{n} m_i \bar{X}_i$$

whilst

$$m_i = \sum_{t=1}^{T} m_{it}$$

$$m = \sum_{i=1}^{n} m_i$$

3.4.3 Extended Poisson Credibility Model

Let $X_1, X_2, ..., X_T$ be the number of claim counts and follows a Poisson distribution, that is $X_{it} \sim Pois(\lambda_0 \theta_i)$, and the probability density function is given by

$$\Pr(X_{it} = x_{it} | \theta) = \frac{e^{-\lambda_0 \theta_i} (\lambda_0 \theta_i)^{x_{it}}}{x_{it}!} \qquad (13)$$

In each event, the mean and variance are equal and given by $Var(\mu_{it}) = \mu_{it}(\theta_i)$.

Lemma: *Let the random variable X_{it} denote the number of claims. In the framework of generalized linear mixed models, its expectation and variance are given by*

$$E(X_{it} | \theta_i) = \mu(\theta_i) = \exp(\beta_0 + \mu_i) \qquad (14)$$

$$\text{Var}(X_{it} | \theta_i) = Var[\mu(\theta_i)] \qquad (15)$$

The credibility estimator for individual independent and identically distributed, the period $T + 1$ is given by

$$\hat{X}_{i,T+1} = \lambda_0 + \frac{v\lambda_0^2}{E\left[Var\left[\mu(\theta_i)\right]\right] + vT\lambda_0^2}\left(\sum_{i=1}^{T} X_{it} - \sum_{i=1}^{T}\lambda_0\right) \qquad (16)$$

Where v *denotes the variance of exponential transformation of random effect* $v = Var\left(e^{\mu_i}\right)$ *and* λ_0 *denotes the overall mean of the insurance contracts* $\lambda_0 = e^{\beta_0}$.

Substituting equation (14) and (15) of X_{it} into equation (16) and simplifying the credibility predictor;

$$\hat{X}_{i,T+1} = \lambda_0 + \frac{v\lambda_0^2}{E\left[Var\left[\mu(\theta_i)\right]\right] + vT\lambda_0^2}\left(\sum_{i=1}^{T} X_{it} - \sum_{i=1}^{T}\lambda_0\right)$$

$$= \lambda_0 + \frac{v\lambda_0^2}{E\left[\exp(\beta_0 + \mu_i)\right] + vT\lambda_0^2}\left(\sum_{i=1}^{T} X_{it} - \sum_{i=1}^{T}\lambda_0\right)$$

$$= \lambda_0 + \frac{v\lambda_0^2}{\lambda_0 + vT\lambda_0^2}\left(\sum_{i=1}^{T} X_{it} - \sum_{i=1}^{T}\lambda_0\right)$$

$$= \lambda_0 + \frac{v\lambda_0^2}{1 + vT\lambda_0}\left(\sum_{i=1}^{T} X_{it} - \lambda_0 T\right)$$

$$= \lambda_0\left(\frac{1 + v\sum_{i=1}^{T} X_{it}}{1 + vT\lambda_0}\right)$$

This credibility predictor can be decomposed into the Buhlmann credibility predictor in equation (1), where λ_0 the overall mean of the Poisson distribution is over the collection of insurance claims and averaged experience loss of the individual contract is

$$\hat{X}_i = (1/T)\sum_{t=1}^{T} X_{it}$$

$$\hat{X}_{i,T+1} = \lambda_0 \frac{v\sum_{i=1}^{T} X_{it}}{1+vT\lambda_0} + \frac{1}{1+vT\lambda_0}\lambda_0$$

$$= z\bar{X}_i + (1-z)\lambda_0$$

where the credibility factor, z is

$$z = \frac{vT\lambda_0}{1+vT\lambda_0}$$

$$z = \frac{T}{\frac{1}{(v\lambda_0)} + T}$$

3.5 Value – at – Risk (VaR) and Tail Value – at – Risk (TVaR)

3.5.1 Value – at – Risk (VaR)

Value at Risk (VaR) calculates the maximum loss expected (i.e. the worst case scenario) on an investment over a defined period given a specified degree of confidence (Harper, 2004).

In essence, VaR is the maximum financial loss that cannot be exceeded over a defined period based on a given $\alpha[0 \le \alpha \le 1]$ confidence level. VaR can also be defined as the minimum amount of loss that would be suffered with a given probability (α) within a defined period of time. The VaR is derived from a percentile principle, that is, what capital is needed to safeguard the insurance company against a certain ruin or loss probability. Mathematically,

$$VaR_\alpha(X) = \inf\{\ell \in \mathbb{R} : p(X > \ell) \le 1-\alpha\}$$

$$= \pi_\alpha \qquad (17)$$

$$= F_X^{-1}(\alpha)$$

Where X denote a random variable, α is selected to be close to 1: 95% *or* 99% *or* 99.5%. Claim size is the random variable and is assume to follow a lognormal distribution.

3.5.2 Tail - Value – at – Risk (TVaR)

The quantile risk measure $VaR_\alpha(X)$ provides us only with the probability that a loss random variable X will exceed the $VaR_\alpha(X)$ for a certain confidence level. It does not provide any information about how large the losses (claim size) are beyond a particular percentile. The Tail-Value-at-Risk (TVaR) in other words Conditional Tail Expectation (CTE), Expected Shortfall (ES) and Tail Conditional Expectation (TCE) measure does consider losses above a percentile. Mathematically,

$$TVaR_\alpha(X) = \frac{\int_{VaR_\alpha(X)}^{\infty} xf(x)dx}{1-F\left(VaR_\alpha(X)\right)} \qquad (18)$$

$$= \frac{\int_{F_X^{-1}(\alpha)}^{\infty} xf(x)dx}{1-\alpha}$$

Substituting into equation (16) $y = F(x)$ then

$$x = F^{-1}(\mathrm{y})$$

$$= VaR_y(X)dy$$

.

$$= F^1(x)$$

$$= f(x)dx$$

The lower limit of the integral becomes $F\left[F^{-1}(\alpha)\right] = \alpha$, and the upper limit becomes $F(\infty) = 1$, yields the following result;

$$TVaR_{\alpha}(X) = \frac{\int_{\alpha}^{1} VaR_{y}(X)\,dy}{1-p}$$

In essence, the TVaR of the claim amount (2008 – 2018) in the insurance companies is calculated by integrating the percentiles.

3.6 Chapter Summary

In this chapter, we discussed the methodological framework employed to achieve our research objectives. In the first place, we presented our research design, population of study and sampling techniques. We stated that our research strategy was to construct a social index and use that as a benchmark to evaluate solvency of Nonlife insurance companies over the period of 2008-2018. Secondly, we submitted a sound methodology for determining credibility risk premium values for individual claim experience to be used as an average premium regulator. For such purpose, credibility premium model was fitted with regards to the data available. To develop Performance ratio thresholds for the insurance industry in Ghana, Buhlmann- Staub credibility model was extended to include Poisson distribution as it is more appropriate for describing the distribution of a number of claims.

Next, we submitted our method of data analysis. We mentioned that, data analysis would be carried out using Statistical Application Software (SAS) and STATA.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.0 Introduction

This chapter presents analysis and findings derived from the study and interpretation of the results. The data were collated over an extensive period 2008 to 2018. The analysis was done in phases. First, descriptive analysis of claim size, policy counts and claim counts were carried out. Secondly, the study estimate credibility weights and premiums, including credibility frequencies and severities and by extension credibility frequency-severity premiums for policyholders of each non-life insurance company. Again the study will provide more scientific thresholds for assessing ratio performances of short term insurers. The study will again show bar chats of estimated premiums incorporating detail variation of the individual risk premium class, thus credibility risk premiums. Solvency position of these Non-life companies would be projected). Interpretation of the results ends the analysis and a chapter summary ends the entire chapter.

4.2 Preliminary Test

4.2.1 Descriptive Statistics on Claim Count for General Insurers

The descriptive statistics of each general insurer is presented in Table 4.1. The table describes the mean, median, maximum and minimum counts, the standard deviation. We again looked at the measures of spread such as skewness and kurtosis of the distributions of the claim count within the study period. The descriptive statistics of the claim counts for the companies gives a brief summary of the claim count data and gives us a fair idea about the distribution of the claim counts of each company.

Table 4.1: Descriptive Statistics of Claim Counts for General Insurers

Company	Mean ($\overline{x}$)	Max	Med	Min	S^2	sk'nes	Kurt (g_2)
Activa Int.Insurance	8.45	25	7	1	6.77	1.10	0.51
Donewell insurance	2.09	5	2	1	1.38	0.90	-0.64
EIC	1.91	4	2	1	1.14	0.90	-0.73
Ghana Union Assurance	76.27	154	121	1	71.55	-0.11	-2.10
Glico General Insurance	7.18	12	8	1	4.35	-0.38	-1.74
Imperial General	2.82	4	3	1	1.17	-0.37	-1.51
Hollard Insurance	3.64	8	4	1	2.46	0.38	-1.37
NSIA Ghana Insurance	2.09	4	2	1	0.94	0.49	-0.84
Phoenix Insurance	4.45	10	4	1	3.30	0.43	-1.46
Prime Insurance	1.45	3	1	1	0.69	0.98	-0.45
Priority Insurance	1.82	4	2	1	0.98	0.90	-0.37
Provident Insurance	5.18	18	2	1	5.95	1.05	-0.59
Quality insurance	18.18	117	7	3	33.84	2.23	3.63
RegencyNem Insurance	2.91	4	3	1	1.22	-0.45	-1.57
Saham Insurance	1.55	4	1	1	0.93	1.55	1.42
SIC Insurance	2.55	5	2	1	1.37	0.34	-1.37
Star Assurance	4.27	11	2	1	4.00	0.76	-1.36
Unique Insurance	3.55	12	3	1	3.05	1.80	2.51
Vanguard Assurance	1.91	4	2	1	1.14	0.90	-0.73
Wapic Insurance	5.18	14	4	1	4.00	0.86	-0.43

Source: Computations from Researcher's Findings (2019)

Inferring from table 4.1, Ghana Union Assurance recorded the highest average of 76.3 claim count and a maximum of 154 claim count. Prime Insurance Company Limited recorded as low as 3.0 average claim counts. Positive and negative values of the skewness describe the tail behavior of the risk classes. With a negative coefficient of skewness, the observations are skewed to the left whilst those risk classes with a positive coefficient of skewness are

positively skewed. The negative kurtosis of the claim counts of the risk classes depicted a platykurtic distribution for the claim counts of the general insurance firms.

4.2.2 Descriptive Statistics on Policy Count for General Insurers

The descriptive statistics of each of the general insurers is presented in Table 4.2. The table describe the mean, median, maximum and minimum counts, the standard deviation, it again looked at the measures of spread such as skewness and kurtosis of the distributions of the policy count within the study period 2008 – 2018.

Table 4.2: Descriptive Statistics on Policy Count for General Insurers

Company	Mean ($\overline{x}$)	Max	Med	Min	S^2	sk'nes	Kurt. (g_2)
Activa Int.Insurance	87.18	158	85	48	31.41	0.89	-0.12
Donewell insurance	41.45	61	45	16	16.48	-0.24	-1.70
EIC	26.91	48	30	11	13.35	0.31	-1.39
Ghana Union Assurance	937.36	2702	1163	60	911.84	0.40	-1.28
Glico General Insurance	149.27	225	190	44	78.49	-0.33	-1.89
Imperial General	124.27	163	140	63	37.63	-0.19	-1.77
Hollard Insurance	79.18	207	54	23	63.61	1.28	-0.13
NSIA Ghana Insurance	30.09	54	32	13	13.90	0.55	-1.00
Phoenix Insurance	98.18	202	78	54	50.69	0.93	-0.86
Prime Insurance	39.73	82	34	24	21.49	1.25	-0.18
Priority Insurance	25.00	47	30	3	14.12	0.21	-1.27
Provident Insurance	37.36	70	20	11	26.74	0.26	-1.97
Quality insurance	843.36	1896	902	60	568.59	0.26	-0.98
Regency Nem Insurance	128.55	222	140	19	70.46	-0.26	-1.48
Saham Insurance	84.91	114	91	24	26.06	-0.92	0.08
SIC Insurance	220.64	1645	54	32	475.79	2.41	4.31
Star Assurance	68.18	221	54	16	60.54	1.48	0.97
Unique Insurance	66.64	190	54	20	46.40	1.54	1.71
Vanguard Assurance	60.09	104	56	15	26.29	0.00	-1.18
Wapic Insurance	60.82	98	58	31	21.42	0.17	-1.37

Source: Computations from Researcher's Findings (2019)

Inferring from table 4.2, Ghana Union Assurance recorded the highest average of 937.36 policy counts and a maximum of 1896 policy count. Priority Insurance Company Limited recorded as low as 25.00 average policy counts. Positive and negative values of the skewness describe the tail behaviour of the risk classes/insurer. With a negative coefficient of skewness, the observations are skewed to the left whilst those risk classes with a positive

coefficient of skewness are positively skewed. The negative peakness or kurtosis of the policy counts of the risk classes depicted a platykurtic distribution for the policy counts of the general insurance firms. The the platykurtic and the high peak nature of the distributions of the data of most of these companies shows that the normality assumption is not achieved. However, the Buhlmann-Straub credibility model is non-parametric distribution and makes no use of normality or distributional assumptions.

4.2.3 Descriptive Statistics on claim severity for General Insurers

Table 4.3 displays the mean, median, maximum and minimum counts, the standard deviation, it again looked at the measures of spread such as skewness and kurtosis of the distributions of the claim size within the study period 2008 – 2018. It can be seen from the table that, Phoenix Insurance Company Limited recorded the highest average claim size of GHC8, 297,281.00 and a maximum claim size of GHC 4, 276,032.90.

Positive and negative values of the skewness describe the tail behavior of the risk classes/insurer. With a negative coefficient of skewness, the observations are skewed to the left whilst those risk classes with a positive coefficient of skewness are positively skewed. The negative peakness/kurtosis of the claim severity of the risk classes depicted a platykurtic distribution for the policy counts of the general insurance firms.

Table 4.3: Descriptive Statistics on claim severity for General Insurers

Company	Mean	Max	Med	Min	S^2	sk'nes	Kurt
Activa Int.Ins.	13963746	80057936	9136249	410270	22391469	2.28	3.93
Donewell ins.	3823051	7636117	3300694	74846	2811774	0.02	-1.68
EIC	21266187	107092789	9893000	32002	30952723	1.86	2.44
Ghana Union Ass.	4981687	23629298	2710113	221100	6666965	1.91	2.64
Glico General Ins.	7119859	23299112	5184792	386347	7735854	0.90	-0.65
Imperial General	686382	2016184	543892	70380	675141	1.09	-0.42
Hollard Insurance	14512448	40516249	10310779	84419	13653628	0.82	-0.79
NSIA Ghana Ins.	2319937	6411406	1890477	250405	1902493	0.74	-0.63
Phoenix Ins.	8297281	42760329	2887530	29126	13528586	1.60	1.12
Prime Insurance	2296692	8646252	727341	63872	2877480	1.03	-0.39
Priority Insurance	1074548	5184792	670732	6972	1388347	2.30	4.02
Provident Ins.	2667691	7935863	2586432	9220	2493105	0.81	-0.56
Quality insurance	4027020	9017348	2885167	10053	3501809	0.28	-1.74
RegencyNem Ins.	2552026	11160382	952503	17915	3856924	1.28	-0.02
Saham Insurance	2533905	14465834	1086299	29786	4083497	2.21	3.66
SIC Insurance	20797161	80273841	13310549	767119	21924386	1.67	2.07
Star Assurance	10173561	31832006	4984987	2116773	10869033	1.06	-0.54
Unique Insurance	1778008	5433325	1154008	423596	1641418	1.07	-0.39
Vanguard Assu	12633455	46595904	6363382	79917	15752297	1.12	-0.33
Wapic Insurance	4514258	13819866	3442728	1180239	3919447	1.28	0.33

Source: Computations from Researcher's Findings (2019).

4.3 Credibility Risk Premium under Claim Severity and Frequency for General Insurers

In the Bühlmann credibility model, we focus on one policyholder. We know that this policyholder has incurred claim amounts $X_1, X_2, ..., X_T$ in Year ($t = 1, 2, \ldots, T$) respectively.

We want to estimate the conditional mean of the claim amount in Year T +1. That is how much renewal premium each of the policyholders should pay in 2019. Any marginal change in frequency and severity of losses has impacted on volume and sizes of claims of these general insurance companies and must subsequently be translated into the determination of premiums. The product of claim frequency and severity represents pure premium, thus the amount of money that the insurer will need to pay as an estimated loss over the life of the policy. Claim frequencies and severities are affected by risk profiles of each class risk which vary across risks or insurance companies coupled with limited claim history. Hence, the study employs Buhlmann-Straub Credibility Theory in estimating credibility average claim frequency and severity for the next immediate years, 2019.

4.3.1 Credibility Factors, Claim Frequencies and Estimates for Claim Cost for General Insurers

Inferring from Table 4.4, the estimated values of credibility claim frequencies, average claim frequency, the weighted average and claim counts for the following business year 2019 are obtained. It can be observed that only Ghana Union Assurance has credibility factor above 30% and the rest of the companies have their factors less than 10%. Likewise in table 4.5 the expected process variance (EPV) is $E\left[\lambda(\theta)\right] = 0.049064$ whiles the variance of the hypothetical mean (VHM) is $Var\left[\lambda(\theta)\right] = 0.000000226$. Again, it is statistically prudence to compare the collective risk frequency (λ) and the expected process variance (EPV). It can be observed that these two values are the same. This information is sufficient to conclude that, claim frequencies for class risks and risk profiles follows a poison distribution with mean equals one.

Table 4.4: Credibility Factors and Claim Frequencies Estimates for General insurers

Company	W_i	$\lambda(\theta_i)$	Z_i	$\lambda_{n+1}(\theta_i)$
Activa Int.Insurance	959	0.097	0.042	0.051
Donewell insurance	456	0.050	0.021	0.049
EIC	296	0.071	0.013	0.049
Ghana Union Assurance	10311	0.081	0.322	0.059
Glico General Insurance	1642	0.048	0.070	0.049
Imperial General	1367	0.023	0.059	0.048
Hollard Insurance	871	0.046	0.039	0.049
NSIA Ghana Insurance	331	0.069	0.015	0.049
Phoenix Insurance	1080	0.045	0.047	0.049
Prime Insurance	437	0.037	0.020	0.049
Priority Insurance	275	0.073	0.013	0.049
Provident Insurance	411	0.139	0.019	0.051
Quality insurance	9277	0.022	0.299	0.041
RegencyNem Insurance	1414	0.023	0.061	0.047
Saham Insurance	934	0.018	0.041	0.048
SIC Insurance	2427	0.012	0.101	0.045
Star Assurance	750	0.063	0.033	0.050
Unique Insurance	733	0.053	0.033	0.049
Vanguard Assurance	661	0.032	0.030	0.049
Wapic Insurance	669	0.085	0.030	0.050

Source: Computations from Researcher's Findings (2019)

Table 4.5: Parameter estimates for the Claim Frequency

Parameter	$E[\lambda(\theta)]$	$Var[\lambda(\theta)]$
Estimate	0.049064	0.000000226

Source: Computations from Researcher's Findings

4.3.2 Credibility Factors and Estimates of claim Severities for General Insurers

The Table 4.4 presents credibility severity for the year 2019, claim count, average severity, and weights for the listed general insurance companies. Table 4.6 from the research estimates of the structure parameters under claim severities. Enterprise Insurance Company recorded the highest credibility factor over 94% whiles Allianz Insurance registered the least value of 15%. It can be realized that the expected process variance (EPV) is $E\left[\mu(\theta)\right]=901967.62$ whiles the expected process variance (EPV) is $E\left[s^2(\theta)\right]=11489323773$ and the variance of the hypothetical mean (VHP), $Var\left[\mu(\theta)\right]=2739567063.22$.

Table 4.6: Credibility Factors and Estimates of claim Severities for General Insurers

Company	N_i	Z_i	$\mu(\theta_t)$	$\mu_{n+1}(\theta_t)$
Activa Int.Insurance	93	0.689	1651625.82	1392221.04
Donewell insurance	23	0.354	1828415.654	1055061.75
EIC	21	0.334	11139431.24	4221298.03
Ghana Union Assurance	839	0.952	65314.12753	93918.18
Glico General Insurance	79	0.653	991372.7722	815555.36
Imperial General	31	0.425	243554.9677	297985.33
Hollard Insurance	40	0.488	3990923.088	2220091.54
NSIA Ghana Insurance	23	0.354	1109535.157	872515.42
Phoenix Insurance	49	0.539	1862655	1236457.13
Prime Insurance	16	0.276	1578975.563	853038.55
Priority Insurance	20	0.323	591001.1471	711640.12
Provident Insurance	57	0.576	514817.5062	727371.54
Quality insurance	200	0.827	221486.125	218203.51
RegencyNem Insurance	32	0.433	877259	569034.65
Saham Insurance	17	0.288	1639585.617	731678.36
SIC Insurance	28	0.400	8170313.393	3391922.60
Star Assurance	47	0.528	2381046.277	1559332.42
Unique Insurance	39	0.482	501489.359	547313.36
Vanguard Assurance	21	0.334	6617524.048	2534898.21
Wapic Insurance	57	0.576	871172.6044	826293.21

Table 4.7: Parameter estimates for the Claim Severities

Parameter	$E[\mu(\theta)]$	$E[s^2(\theta)]$	$Var[\mu(\theta)]$
Estimate	901967.62	11489323773	2739567063.22

Source: Computations from Researcher's Findings (2019)

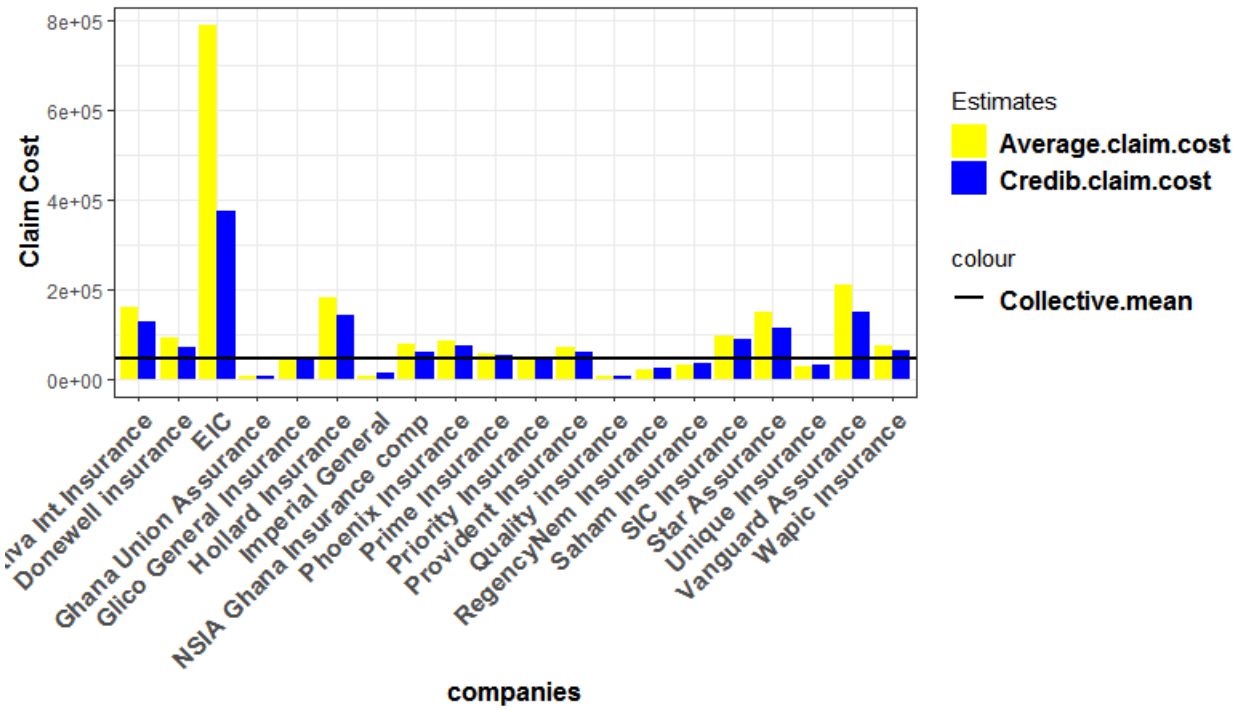

Figure 4.1: Bar Chart plot of Average Claim costs and Credibility Estimates of risks

Source: Computations from Researcher's Findings (2019)

4.4 Performance Ratio threshold using the Credibility theorem

Average Loss Ratio in the general insurance business is a ratio of losses to gains. It is the opposite of the gross profit ratio. For insurance, the loss ratio is the ratio of total losses incurred in claims plus adjustment expenses divided by the total premiums earned. According to the NIC (2018), out of the current twenty nine (29) Non-Life Insurance Companies operating in Ghana, nine (9) of them, have foreign ownership. It will be prudent that performances of Ghanaian companies that form part of the multinational group be measurable or comparable to its other subsidiaries. ICP25.1.41 (e) further suggest that, regulators should exercise the ability to perform suitability assessments at insurance legal entity and insurance group (on both a national and cross-border) level.

This method provides a basis for the use of a credibility approach which is a pure statistical process. The pure statistical approach to credibility theory provides a way to estimate a parameter for a subset of a population given certain probability elements. These probability elements are the observed mean and standard deviation of the data for the small data set, and the probability distribution of these parameters for subsets of the population as a whole (Behan, 2009).

This study uses the Ghanaian Industry Averages as the smaller sample whiles the international standards (which is similar and common to AM Best and OSFI thresholds) is used as the population data.

Table 4.8: Performance Ratio threshold Indicators

Ratio	$E\left[s^2(\theta)\right]$	$Var\left[m(\theta)\right]$	Z_i
Change in Gross Written Premium (%)	66620.24	8450.35	0.5433
Change in Net Written Premium (%)	14912.21	5781.46	0.5332
Gross Insurance Risk Ratio	11029.04	4291.90	0.5481
Net Insurance Risk Ratio	4025.47	4138.05	0.5385
Change in Capital and Surplus (%)	21403.10	3774.95	0.3542
Investments Yield (%)	12895.42	2145.32	0.2994

Source: Computations from Researcher's Findings (2019)

Inferring from Table 4.8 above, Change in Gross Written Premium is the only performance ratio that recorded a significance credibility weight (54%) on the Ghanaian industry average. Trying to combine this with the international standard ratio imply that much weight will be assigned to the local average. This was followed by Gross Insurance Risk Ratio which also saw a weight of 55%.

Change in Capital and Surplus ratio and Investment yield however recorded poor credibility rating of 35% and 30% respectively. Per the capital standards, it is reasonable for this low

weight to be assigned to the Ghanaian industry Capital change since the low levels of capital and regular regulatory intervention by the National Insurance Commission to inject capital makes the Ghanaian Capital base not stable hence less credible.

Again Change in Net Written Premium and Net Insurance Risk Ratio had fairly good weighting as its averages produced a credible weight of about 50%.

Table 4.9: Average Loss Ratio for the Non-Life Insurance Companies

Company	Average Loss Ratio
Activa International Insurance	0.543289
Donewell insurance	2.581731
EIC	1.529191
Ghana Union Assurance	1.254806
Glico General Insurance	2.050975
Imperial General	3.850357
Hollard Insurance	1.261487
NSIA Ghana Insurance	5.172965
Phoenix Insurance	0.833262
Prime Insurance	3.950469
Priority Insurance	0.982914
Provident Insurance	0.764255
Quality insurance	3.098441
Regency /Nem Insurance	2.994564
Saham Insurance	1.963577
SIC Insurance	2.580735
Star Assurance	2.720609
Unique Insurance	6.008971
Vanguard Assurance	2.036313
Wapic Insurance	1.463803

Source: Computations from Researcher's Findings (2019)

Table 4.9 presents the ratio of the aggregate claims to the gross premiums for each of the companies. The loss ratios then informed us about how many times the premiums collected by the companies can cater for their liabilities. Among all companies Unique Insurance has the highest potential of paying all its liabilities followed by NSIA Ghana Insurance whilst Activa International Insurance recorded the lowest.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents a summary of the findings evolving from the study. It tries to answer the research questions that aid to achieve the objective of the study. Thus, questions about credibility factors, credibility premiums, performance ratio threshold for insurance companies in Ghana as well as the determination of shift in solvency position caused by Risk Based Supervision. The chapter also provides conclusions drawn from those findings and some recommendations for further study and drawbacks of the study.

5.1 Summary of Findings

Descriptive Statistics of Claim Counts for General Insurers reveals that, Ghana Union Assurance recorded the highest average of 76.3 claim counts and a maximum of 154 claim counts. Prime Insurance Company Limited recorded as low as 3.0 average claim counts. The negative kurtosis of the claim counts of the risk classes depicted a platykurtic distribution for the claim counts of the general insurance firms. Also, descriptive Statistics on Policy Count for the twenty General Insurers indicated that, Ghana Union Assurance recorded the highest average of 937.36 policy counts and a maximum of 1896 policy count. Priority Insurance Company Limited recorded as low as 25.00 average policy counts. Lastly, descriptive Statistics on claim severity for the general insurers reported that, Phoenix Insurance Company Limited recorded the highest average claim size of GHC8, 297,281.00 and a maximum claim size of GHC 4, 276,032.90. The negative peakness/kurtosis of the claim severity of the risk classes depicted a platykurtic distribution for the policy counts of the

general insurance firms. Table 4.6 presented that, only Ghana Union Assurance has its credibility factor more than 30% and the rest of the companies less 10% in a Like manner, in table 4.5 the expected process variance (EPV) is $E\left[\lambda(\theta)\right]=0.049064$ whiles the variance of the hypothetical mean (VHM) is $Var\left[\lambda(\theta)\right]=0.000000226$. Again, it statistically prudence to compare the collective risk frequency (λ) and the expected process variance (EPV). It can be observed that these two values are the same. This information is sufficient to conclude that, claim frequencies for class risks and risk profile follows a poison distribution with mean equals one. In Table 4.7 Enterprise Insurance Company recorded the highest credibility factor over 94% whiles Allianz Insurance registered the least value of 15%. It can be realized the expected process variance (EPV); $E\left[\mu(\theta)\right]=901967.62$ whiles the variance of the hypothetical mean (VHM), $E\left[s^2(\theta)\right]=11489323773$ and the variance of the hypothetical mean (VHM), $Var\left[\mu(\theta)\right]=2739567063.22$. From tables 4.3, 4.4 and 4.6, it was observed that most of the insurers have less credibility factors both in terms of the claim costs, claim severities and claim frequencies hence; we proposed that insurers used credibility premiums instead of experience or class rating for charging risks transferred to them by policyholders.

Another and perhaps very important factor identified was that, change in Gross Written Premium is the only performance ratio that recorded a significance credibility weight (54%) on the Ghanaian industry average. Trying to combine this with the international standard ratio imply that much weight will be assigned to the local average. This was followed by Gross Insurance Risk Ratio which also saw a weight of 55%.

It was noted that, change in Capital and Surplus ratio and Investment yield however recorded poor credibility rating of 35% and 30% respectively. Per the capital standards, it is reasonable for this low weight to be assigned to the Ghanaian industry Capital change since the low

levels of capital and regular regulatory intervention by the National Insurance Commission to inject capital makes the Ghanaian Capital base not stable hence less credible.

Again Change in Net Written Premium and Net Insurance Risk Ratio had fairly good weighting as its averages produced a credible weight of about 50%.

5.2 Conclusion

With regard to the objective of the study, Solvency positions has been identified as shown by the test can also be attributed to time factor. The Risk Based Methodology can be considered to be in its early stages whilst insurers must keep familiarizing themselves with the technicalities and requisite expertise needed to effect this new regulation. Again, owners of insurance companies will need enough time to organize themselves to fully comply with such regulations which bother mainly on capital and corporate governance. The study also estimated the average risk premiums, the variability in the annual claim costs, annual claim severities and annual claim frequencies based on which the credibility factors for the claim histories of each insurance company or class risks were estimated including the credibility premium or claim cost, credibility severity and frequency using the Bühlmanns-Straub Credibility Theory.

5.3 Recommendations

From the discoveries of the study, the following suggestions are made:

i. The Regulator, National Insurance Commission (NIC) should take stringent measures to ensure that all insurance companies adhere to regulations. This can be achieved by putting in place punitive measures that will deter non-compliance with regulations.

ii. Insurers interested with limited number of claim history should perform experience rating using Extended Poisson Credibility modelling to measure the balance between their average claim cost or premium and the collective risk premium over an entire or sizable number of classes trading in similar risks.

iii. It recommended that data should be smoothened of any outliers in order to increase accuracy of the credibility premiums.

References

Abdallah, Z. T. (2015). An Evaluation of Simultaneous Openness Hypothesis in the Context of Stock Market Development. *Modern Economy*,.

Bühlmann. (1971). "Credibility Procedures." *Sixth Berkeley Symposium on Mathematical Statistics*, *11*, 515–525.

Buhlmann H. (1969). Experience rating and credibility. *ASTIN Bulletin*, 5, 157–165.

Bustic, R. (1994). 'Solvency measurement for property liability risk-based capital applications', Journal of Risk and Insurance, vol 61, pp. 1-6.

CARTAC. (2013). Financial Sector Resources.

Centre, T. (2018). Implementing Risk Based Supervision: A Guide for Senior Managers. *Practical Leadership and Techical Guidance*, 1–19.

Chien-ChiangLee, Chi-HungChang, M. & C.-C. (2016). Economic growth and insurance development: The role of institutional environments, *59*, 361–369. https://doi.org/https://doi.org/10.1016/j.econmod.2016.08.010

De Vylder, F. (1976). Geometrical credibility. *Scandinavian Actuarial Journal*, 121–149.

Hachemeister, C. (1975). Credibility for Regression Models with Application to Trend. Kahn, P. (Ed.), Credibility Theory and Applications. *Academic Press, New York.*

Hössjer, O., Eriksson, B., Järnmalm, K., & Ohlsson, E. (2009). Assessing Individual Unexplained Variation in Non-Life Insurance. *ASTIN Bulletin*, *39*(1), 249–273. https://doi.org/10.2143/ast.39.1.2038064

IAIS. (2002). Solvency and Actuarial Issues subcommittee. Principles on Capital Adequacy and Solvency. Basle, Switzerland.

IMF. (2014). International Monetary Fund Report.

Jewell, W. S. (1975). The use of collateral data in credibility theory: A hierarchical model. Giornale d e l l ' Istituto degli Attuari Italiani, *38*, 1–16. 18.

Kalman, R. (1960). A new approach to linear filtering and prediction problems. *Transactions ASME, Journal of Basic Engineering 83D*, 35–45.

Lartey, V. C., Antwi, S., Boadi, E. K. (2013). The relationship between liquidity and profitability of listed banks in Ghana. International Journal of Business and Social Science, 4(3), 48–56.

McNamara, R. &. (2008). Principles of Risk Management and Insurance [RENTAL EDITION], 14th Edition.

Mowbray, A. H. (1914). How extensive a payroll exposure is necessary to give a dependable pure premium? *Proceedings of Casualty Actuarial Society*, 1, 24–30.

Nather, W. (1984). Bayes estimation of the trend parameter in random fields Statistics, 15, 553–558.

Neuhaus, W. (1984). Inference about parameters in empirical linear Bayes estimation problems. *Scandinavian Actuarial Journal*, 131–142.

NIC. (2005). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2011). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2013). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2014). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2016). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2017). Annual Report, National Insurance Commission, available at: www.nic.gh.org.

NIC. (2018).Annual Report National Insurance Commission.

Quaye, A. (2014). "Loss Reserve Variability and Loss Reserve Errors: An Empirical Analysis of the Ghanaian Property and Liability Insurance Industry,." *Journal of Risk Finance*, *15*(3), 26–32.

Rejda. (2011). Principles of Risk Management and Insurance 11th Global Edition Pearson.

Rejda. (2014). Principles of Risk Management and Insurance. *11th Global Edition Pearson*.

Twumbarima, S. (2015). Risk Based Supervision Of Insurance In Ghana: Prospects And Challenges. *University of Ghana Http://Ugspace.Ug.Edu.Gh*.

Viaene, S., Ayuso, M., Guillen, M., Van Gheel, D., & Dedene, G. (2007). Strategies for detecting fraudulent claims in the automobile insurance industry. *European Journal of Operational Research*, *176*(1), 565–583. https://doi.org/10.1016/j.ejor.2005.08.005

Waters H. R. (1994). An Introduction to Credibility Theory, London and Edinburgh. *Institute of Actuaries and Faculty of Actuaries*.

Whitney, A. W. (1918). The Theory of Experience Rating. *Proceedings of the Casualty Actuarial Society*, *2*, 274–292.

Zhang Z. (2004). A Bayesian loss reserving model. *Alberta: The University of Calgary*.