Determinants of Loss Reserve Errors: Evidence from the General Insurance Market in South Africa

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Abstract

A loss reserve is the estimated liability for unpaid claims on all losses that occurred prior to the balance sheet date. The loss reserve is the most significant liability on the balance sheet of a general insurance company, often driving its overall financial performance. The loss reserve is calculated to determine the claims liability for published accounts, internal accounts, statutory accounts, business plans and budgets. It is also required for purposes of pricing and in case of a merger or acquisition. The purpose of the loss reserve can affect the methodology used as well as the extent of over-reserving or under-reserving. Additionally, under-reserving and over-reserving can be driven by the intent to smooth the inome of the general insurer, to mask financial weakness or to defer taxes.

This study examines the loss reserve errors in the South African general insurance industry. The study estimates the loss reserve errors using annual firm level data on 79 general insurance companies from 2007 to 2014. The study then proceeds to examine the hypothesised effect of firm level characteristics on the estimated loss reserve errors within a panel data framework. The panel data regression models are estimated using the ordinary least squares technique, the random effects technique and the fixed effects technique.

The findings suggest that South African general insurance industry is characterised by over-reserving. Specifcally, approximately two-thirds of the sample reported incidence of over-reserving. The results of the panel data regression analysis indicate that tax shield, financial weakness and premium growth are the significant drivers of reserve errors in the market. Tax shield was found to have a positive relationship with loss reserve errors, whereas financial weakness and growth were found to have an inverse relationship with loss reserve errors. Business line diversification and reinsurance were not found to be significant variables in the model.

The management of South African general insurers and regulation of the industry should be directed towards ensuring that general insurers do not manipulate reserves to defer taxes, fund growth through more competitive premiums, or manipulate the perceived financial strength.

Additionally, this study identified issues relating to the quality of loss reserve information supplied to the regulator. There is scope for improving the quality and consistency of the loss reserve data supplied to the regulator by the general insurers.

Dedication

I dedicate this dissertation to my grandfather, the late Sunslay Nhamoinesu Masaraure, who cultivated my love of learning at an early age; you taught me that I must never quit on myself and encouraged me to invest in my education. You were a beacon of light and a source of great love.

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And most importantly, I have the greatest gratitude to the Lord Almighty, without whom, I am nothing. His grace has truly been more than sufficient.

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List of Abbreviations

BF	Bornhuetter-Ferguson
BLDIV	Business Line Diversification
EMG	Earnings Management
FAIS	Financial Advisory and Intermediary Services
FE	Fixed Effects
FEM	Fixed Effects Model
FINWEAK	Financial Weakness
FSB	Financial Services Board
GDP	Gross Domestic Product
GROWTH	Premium Growth
IBNR	Incurred But Not Received Reserve
KFS Error	Kazenski, Feldhaus, Schneider Error
LRE	Loss Reserve Error
OCR	Outstanding Claims Reserve
OLS	Ordinary Least Squares
OLS-PCSE	Ordinary Least Squares Panel Corrected Standard Errors
RBC	Risk-Based Capital
RE	Random Effects
REINS	Reinsurance Ratio
REM	Random Effects Model
SOX Act	Sarbanes-Oxley Act
TAXS	Tax Shield
TCF	Treating Customers Fairly
UK	United Kingdom
USA	United States of America
VAT	Value Added Tax
W Error	Weiss Error

CHAPTER ONE: INTRODUCTION

1.1. Background

Insurance plays a critical role in protecting the lives and assets of individuals, corporations and governments. Insurance is used, not just as financial protection for the individual but also as an economic buffer and economic growth enabler by providing a safety net for the economy against shocks. The availability of a strong private insurance market partially relieves the government of the role of protecting the goods and lives of the citizens as far as insurable risks are concerned, for those who can afford to purchase these products. As a result of this benefit, certain insurance products are compulsory in some parts of the world. For example, third-party liability insurance is compulsory for motorists in several countries. Many banks will not issue loans via asset-based finance without the asset being insured.

The general insurance markets, characterised by the short-term duration of policies, may have claims being paid after the expiration of the contract or reporting period in which the claims are incurred. Hence, in order to develop an insurance policy or product to cover an insurable risk, an insurance company is required to hold funds aside to allow for claims that are yet to be settled for each reporting period. Some of the claims may have been lodged but not settled; or have not been lodged for the period in which they were incurred. Reserves are set aside for these two sets of claims in South Africa. These are the Incurred But Not Received Reserve (IBNR) and the Outstanding Claims Reserve (OCR) respectively. There are several other reserves which the general insurer can hold with respect to unearned premiums and unexpired risks.

The literature identifies the loss reserve as the estimated liability for unpaid claims on all losses that occurred prior to the balance sheet date (Grace & Leverty, 2012); (Quaye et al., 2014). It is often the largest liability on a general insurers balance sheet and drives the financial results on the income statement (Grace & Leverty, 2012) . The increase in the loss reserve from month to month is included in the management accounts every reporting period. At the end of the year, the closing loss reserve is included as a liability on the balance sheet.

Given the uncertainties involved in setting the reserves, errors are likely to occur, and in most cases, do occur. However, it is also possible for management to manipulate the loss reserve in order to smooth the financial results over time and to defer tax.

First, when the loss reserve is underestimated for a particular year, this can result in significant losses having to be written off in the future, and also in unqualified audits and often a restatement of past financial statements. This also increases the risk of insolvency and ultimately, bankruptcy, which exposes the shareholders, policyholders and has ripple effects on the industry and the economy. This could be done to give the impression of stronger than actual financial standing. When the reserve is significantly overstated, this could result in tied up free assets which could impede the efforts of the business to embark on other projects. However, management may also purposefully overstate reserves so as to defer taxes. Under-reserving and over-reserving could also be employed to smooth financial results.

Understanding the key drivers and trends is essential for the actuaries, the management of the insurance company and the regulators, both to manage the financial soundness of the business and to protect consumers.

1.2. Problem Statement

The general insurance market in South Africa accounts for approximately 40% of gross premiums written in Africa (Shan, 2016). However, the market is characterised by great potential for development, considering the fact that its premiums only account for less than 3% of the gross domestic product in South Africa. In order to enhance the growth of the market to strengthen its support for the South Africa economy (through the provision of risk management services to business, households and government), it is imperative to understand the factors that impact the performance of the market.

A vital component of the general insurance business relates to claims management which constitutes the major component of their liability structure. The failure to promptly pay claims made by policyholders presents great reputational risk and damages trust in the insurance mechanism which underlines the conduct of insurance business. Against this background, insurers are required to hold reserves to allow for

claims which are still to be paid for any given incurred period. However, the estimation of these reserves is subject to the manipulation of the management of the insurance company. This is beyond the more objective actuarial methodologies which have been traditionally applied for several centuries. This has the potential to understate or overstate the required reserves for the potential claims to be paid.

On the one hand, the estimation of larger than required reserves results in reduced free capital which limits the ability of the business to invest in other products and investment opportunities. On the other hand, estimating lower than required reserves results in the increased risk of insolvency and possibly, bankruptcy. Therefore, estimating accurate reserves is essential for the long-term success of the business and the financial security of the industry and economy. This necessitates the examination of the reserving nature that characterises the operation of general insurance companies for the purposes of improving claims managements, to enhance claims administration and to promote a stable insurance market which provides an effective risk management tool for various sectors of the economy.

This study seeks to provide answers to the following questions:

- Are there errors in loss reserve estimation among general insurers in South Africa?
- What factors explain the variations in the loss reserves in South Africa?

1.3. Research Objectives and Hypothesis

The main objective of this study is to examine the loss reserve errors in the South African general insurance market. The specific research objectives are as follows:

i. to estimate loss reserve errors and their variability in the general insurance market in South Africa; and
ii. to identify firm level factors that explain the variations in loss reserve errors in the general insurance market in South Africa.

Several hypotheses will be tested under objective 2. These include:

- H_1: Tax shield has a significant relationship with loss reserve variability.
- H_2: Income smoothing/Earnings management has a significant relationship with loss reserve variability.
- H_3: Financial weakness has a significant relationship with loss reserve variability.
- H_4: Premium growth has a significant relationship with loss reserve variability.
- H_5: Reinsurance ratio has a significant relationship with loss reserve variability.
- H_6: Business line diversification has a significant relationship with loss reserve variability.

1.4. Justification of the Study

The research gap identified in this investigation concerns the drivers of loss reserve errors in the South African non-life (general) insurance industry. The key driver of the financial results within insurance companies is often the loss reserves (Grace & Leverty, 2012). Therefore, being able to estimate this as accurately as possible is critical to the success of the insurance institution, and also has down-stream impacts on the economy. Several investigations reveal the role of insurance markets in supporting economic growth and stability (Alhassan & Biekpe, 2016b; Alhassan & Fiador, 2014; Ward & Zurbruegg, 2016). Therefore, the financial strength of insurers is essential for sustainable economic growth.

In other countries, professionals and academics within the insurance fields have been investigating loss reserves, their key determinants and their variability over time. The results of these investigations have provided insights to key stakeholders within the insurance management and regulatory space. These investigations have mainly been in the United Kingdom and the United States of America. One similar investigation in Africa has been done for the Ghanaian property and liability insurance industry.

The investigation of loss reserve errors is under-researched in South Africa, with no published literature in the area based on South African general insurance data. Given

the integral role of insurers in the stability of the economy, understanding the determining factors of loss reserve uncertainty is critical. And, given the size and history of the insurance industry in South Africa, it provides useful empirical evidence which will help to add to the body of knowledge.

This investigation will provide insights to the regulators, senior management, actuaries and stock analysts on how best to view the reserves and the financial results reported by general insurers in the market, aside from the risk-based view which is often the focus in setting reserves and assessing reserve movement (Panning, 2006). Understanding the differences for the South African market compared to other countries will also allow those in the South African market to understand their own drivers and any similarities or differences.

From a policy perspective, the more accurate the estimation of loss reserves, the safer the economy as a whole. Identifying the main drivers of variability in loss reserve errors may encourage more fine-tuned regulation concerning reserving protocols which exercise greater consideration of the drivers of the loss reserve errors. It will also inform and sensitise insurers concerning the impact that their reserving decisions have on the overall economy.

From the above, it is clear that there are benefits for academics, policy makers (regulators) and practitioners in understanding the key determinants of loss reserve errors in more detail for the South African insurance market.

1.5. Organisation of the Study

The study is organised into five chapters. Chapter 1 consists of the introduction and includes the background to the study, the statement of the research problem, the research hypotheses and objectives, and the justification for and limitations of the study. Chapter 2 covers the literature review and broadly presents an overview of the general insurance market in South Africa and the theoretical discussions on loss reserve errors, as well the review of empirical studies relating to the determinants of loss reserve error. Chapter 3 provides detailed discussions on the data and reserve error estimation approach, and the empirical approach employed for the analysis. Chapter 4 discusses the empirical results, while Chapter 5 concludes the study with recommendations based on the findings.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter provides a background discussion on the general insurance market in South Africa, covering the legislative framework, market products and a review of the financial statements. It then provides a comprehensive discussion on loss reserve methods and the estimation of the reserve errors; a review of theories on reserving errors and the review of empirical studies on reserving errors in insurance markets.

2.2. The General Insurance Industry in South Africa

The market is regulated by the Short-term Insurance Act 53 (1998). This is supplemented by several other pieces of legislation, which include the Policyholder Protection Rules, Micro Insurance Regulations, Binder Regulations Capital Adequacy Requirements, Demarcation Regulations, Captive Insurer Regulations, VAT Regulations, Consumer Credit Regulation, the FAIS Act and Subordinate Legislations.

The Twin Peaks approach to financial market regulation is proposed for 2017, but has not been passed by Parliament as yet. This will divide regulatory activities between Prudential and Conduct regulation. The prudential management of the financial services industry will relate to the financial management of the industry which includes the financial soundness and strength of the incomes statement and balance sheets. This function will be transferred from the Financial Services Board (FSB) to the Reserve Bank under National Treasury. Conduct refers to the relationships and communications within the industry between all stakeholders to ensure that the spirit of Treating Customers Fairly (TCF) is upheld. To support this function, an additional committee constituting of members from the FSB, Reserve Bank and National Treasury will be formed as a conflict resolution platform.

2.2.1. Stylised Facts on the Short-term Insurance Market

The South African market is the largest in Africa, in respect of the gross premiums underwritten. This is evidenced by 40% of total premiums in the non-life market in Africa having been underwritten in South Africa in 2014. However, this figure represents a decline from the 50% of gross premiums underwritten by the market in 2012 (SwissRe 2013). However, the market remains a dominant player in the African

insurance industry (Schan, 2016). The insurance penetration ratio, measured as the ratio of gross premiums to gross domestic product, captures the development of the insurance market. Table 1 presents non-life insurance penetration in a selection of African countries from 2007 to 2013.

Table 1: Non-life Insurance Penetration Ratio in Africa (2007-2013)

		2007	2008	2009	2010	2011	2012	2013
1	**South Africa**	2.742	2.625	2.704	2.557	2.517	2.594	1.885
2	**Namibia**	1.526	1.615	1.967	2.138	1.967	1.934	-
3	**Morocco**	1.554	1.557	1.581	1.626	1.658	1.706	1.713
4	**Mauritius**	1.6	1.444	1.52	1.505	1.532	1.414	1.842
5	**Cape Verde**	1.535	1.524	1.422	1.431	1.399	1.264	1.157
6	**Kenya**	1.404	1.408	1.382	1.615	1.617	1.609	1.6
7	**Tunisia**	1.3	1.289	1.252	1.261	1.256	1.397	1.531
8	**Botswana**	0.892	0.918	1.164	0.954	0.958	0.99	-
9	**Malawi**	0.86	0.984	1.041	0.949	0.966	1.102	-
10	**Zambia**	0.864	0.999	0.979	0.987	0.82	0.887	-

Source: Author's estimation based on data extracted from the Global Financial Development Database

From Table 1 above, one can see that South Africa experienced the most significant decrease in non-life insurance penetration from 2012 to 2013 (for those countries with reported values for 2013). There has been a consistently gradual increase in non-life insurance penetration for Morocco. The other countries exhibit greater volatility in their growth. Namibia, Kenya and Malawi have also experienced significant growth during the period under investigation.

Kenya has experienced a consistent decline in non-life insurance penetration from 2010 to 2013 (0.9% decrease during these three years) although there has been growth of 15% from 2007 to 2013. This is mainly due to industry growth of 16.9% from 2009 to 2010.

Tunisia exhibits the most rapid growth for the 2007 to 2013 period, at a growth rate of 18%. When one considers the growth from 2007 to 2012, Malawi and Namibia exhibit growth rates of 27% and 28% respectively.

Cape Verde had the third highest non-life insurance penetration in 2007, but exhibited the lowest penetration for those reported in 2013. It has shown a 25% decrease during the six-year period. Mauritius, although having experienced a consistent decrease in the first three years, recovered in the second half of the investigation period, with a

30% increase between 2012 and 2013. It now has the second highest non-life insurance penetration after South Africa, for those with reported figures in 2013. There has been mixed reception of non-life insurance products across Africa, However, South Africa continues to be the continent leader in industry penetration and market size.

2.2.2. Product Lines

The general insurance market in South Africa generally underwrites several business classes which include Property, Transportation, Motor, Accident & Health, Guarantee, Liability, Engineering and Miscellaneous. Several of these lines are across Personal, Corporate and Commercial customer segments. Table 2 presents the distribution of gross premiums across the eight business lines from 2007 to 2014.

Table 2: Premium Distribution by Business Class (2007-2014)

	2007	2008	2009	2010	2011	2012	2013	2014
Property	34.5%	32.9%	33.3%	32.6%	35.0%	33.4%	33.5%	34.8%
Transportation	3.1%	6.0%	5.7%	2.8%	3.0%	2.8%	3.0%	3.1%
Motor	35.2%	40.1%	41.2%	44.5%	30.4%	43.1%	42.0%	41.7%
Accident & Health	5.2%	3.0%	4.6%	6.7%	6.3%	6.0%	6.7%	6.3%
Guarantee	2.7%	2.7%	2.4%	2.0%	2.8%	2.5%	3.2%	2.5%
Liability	4.9%	4.7%	4.4%	4.8%	4.7%	4.7%	4.2%	4.9%
Engineering	3.9%	5.0%	3.1%	2.6%	3.8%	3.8%	3.3%	3.3%
Miscellaneous	10.4%	5.5%	5.4%	3.9%	4.0%	3.8%	4.1%	3.3%

Source: FSB Data (2007 to 2014)

Table 3 below shows that the claims ratios for the two largest business classes, Property and Motor, have made up 77% of the industry in terms of net premium in 2014 and have consistently dominated the industry, based on Table 2 above. Additionally, they have remained fairly consistent during this period (FSB, 2014).

Table 3: Claims Ratio (2011-2014)

	2011	2012	2013	2014	2015
Property	57%	61%	62%	63%	54%
Transportation	52%	42%	51%	51%	46%
Motor	61%	66%	67%	65%	64%
Accident & Health	44%	42%	35%	6%	40%
Guarantee	15%	38%	24%	50%	20%
Liability	75%	50%	46%	60%	59%
Engineering	55%	55%	50%	50%	54%
Miscellaneous	23%	30%	38%	31%	29%

Source: FSB Data (2007 to 2014)

Table 4 below presents the net underwriting margin for the different business classes (or product types) for the period under investigation (2007-2014). The results show volatile net underwriting margins with significant decreases in the last three year (with the exception of Liability, Engineering and Miscellaneous business classes). Overall, these results are consistent with the overall performance of the industry over the duration which has been driven by mainly increased management expenses and decreased investment income.

Table 4: Net Underwriting Margin (2007-2014)

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Property	7%	3%	-4%	17%	9%	14%	5%	2%
Transportation	4%	9%	14%	10%	14%	13%	6%	9%
Motor	6%	2%	4%	7%	8%	8%	2%	5%
Accident & Health	19%	26%	29%	10%	16%	5%	3%	-9%
Guarantee	32%	44%	14%	25%	36%	48%	31%	21%
Liability	1%	15%	37%	8%	13%	2%	10%	16%
Engineering	33%	7%	0%	27%	12%	-7%	9%	8%
Miscellaneous	5%	18%	25%	16%	-37%	3%	5%	10%

Source: FSB Data (2007 to 2014)

2.2.3. Market Players

The general insurance market is dominated by primary insurers who are mainly responsible for the sale of products to policyholders. The reinsurers are responsible for supporting insurance by assuming a portion of the risk. Of the primary insurers in the industry for the investigation period, 79 will be used for the analysis. The ratio of primary insurers to reinsurers has remained fairly stable throughout the period. However, it is quite clear that the exit of a reinsurer from the market puts strain on the other reinsurers to absorb the business. Nevertheless, most primary insurers in this market do not struggle to find reinsurance arrangements.

Table 5: Number of Firms in the General Insurance Market 2007 to 2014

	PRIMARY INSURERS	**REINSURERS**	**TOTAL**
2007	96	8	104
2008	94	8	102
2009	100	10	110
2010	99	9	108
2011	97	8	105
2012	100	8	108
2013	97	7	104
2014	92	7	99

Source: FSB Data (2007 to 2014)

2.2.4. Financial Performance

Table 6 shows a summary of the financial performance of short-term primary insurers in South Africa. The table exhibits the significant growth of the market over the eight-year period. There has been a 70.3% increase in the gross premiums written from 2007 to 2014, which has translated to a 47.5% increase in the total income. The difference in these two values is mainly driven by the decreased investment income of 29.3% in the eight-year period. This is in light of the fact that there has been a 78.6% growth in assets under control and a 78.5% increase in liabilities, resulting in an insignificant net difference. This is displayed in Table 7. Notably, management expenses have increased by 133.3% during this period. Underwriting profits and operating profits have decreased by 19.8% and 26.4% respectively. The combined effect of decreased investment income and increased management expenses has driven the less than optimal increase in profits.

Table 6: Summary of South African Primary Insurance Performance (2007 – 2014) (R millions)

Primary Insurers	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Gross premium written	58 099	63 500	69 012	72 479	79 407	85 912	93 148	98 962
Income								
Net premium income	42 411	47 125	50 503	53 283	58 520	60 153	65 207	68 691
Investment income	8 012	6 550	5 660	4 889	4 417	5 233	5 025	5 665
Total	50 423	53 675	56 163	62 937	62 937	65 386	70 232	74 357
Expenditure								
Claims paid	24 239	29 392	32 035	31 110	34 299	35 914	40 722	43 679
Management expenses	7 609	8 230	9 140	11 364	13 575	14 183	15 907	17 750
Commission	4 095	4 928	4 887	4 179	4 372	4 541	4 543	4 460
Total	35 943	42 550	46 062	46 653	52 246	54 638	61 172	65 889
Underwriting profits	3 495	3 346	3 593	6 397	5 213	5 515	4 035	2 802
Operating profits	11 507	9 896	9 253	11 286	9 630	10 748	9 059	8 468

Source: FSB Data (2007 to 2014)

2.2.5. Financial Strength

As stated above, and shown in Table 7 below, the assets increased by 78.6% in the eight-year period under investigation and a 78.5% increase in liabilities, resulting in a 78.7% increase in the surplus assets. This signifies a strengthening of the overall short-term insurance industry. This has resulted in greater investment freedom (which the industry has not taken advantage of), greater scope to develop new products and improved ability to absorb shocks. However, maintaining free assets could be done as a risk management measure as the economy tightens or claims become less predictable (without having to make explicit adjustments to reserves).

Table 7: Statement of the Financial Position of the South African Primary Insurance Performance (2007 – 2014) (R millions)

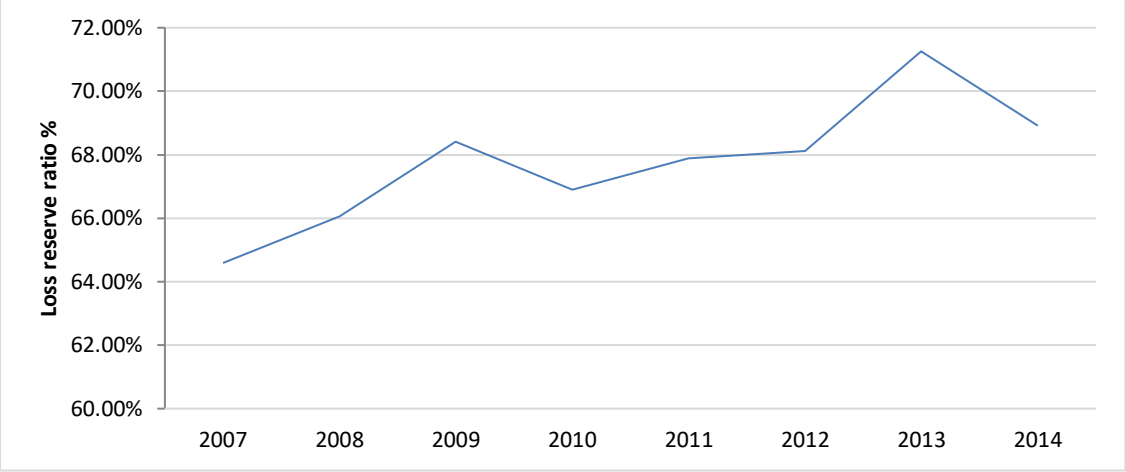
	Assets	Liabilities	Surplus Assets
2007	65 155	40 446	24 709
2008	68 789	43 055	25 734
2009	73 477	45 990	27 487
2010	86 532	54 740	31 792
2011	94 447	60 406	34 041
2012	101 657	59 200	42 457
2013	113 815	64 040	49 775
2014	116 352	72 202	44 150

Source: FSB Data (2007 to 2014)

2.2.6. Liability Structure

The graph below shows the loss reserve as a ratio of total liabilities, revealing that there has been a marked increase in the reserve contribution in the eight years under investigation. This indicates more conservative reserving protocols over time which may have been driven by the introduction of Solvency II best practices and regulation in the last four years.

Figure 1: Ratio of Loss Reserves to Total Liabilities (%)



Source: Researcher's estimations based on FSB data (2007 to 2014)

2.3. Reserving in Insurance Markets

Loss reserves are defined as amounts held to cover liabilities relating to policies already written (ActEd, 2015). The technical claims reserves are generally made up of Outstanding Claims Reserve (OCR) and the Incurred But Not Reported Reserves (IBNR). The IBNR is a reserve to provide for claims in respect of claim events that have occurred before the accounting date, but are still to be reported to the insurer by the date. The OCR is set up in respect of the liability for all reported outstanding claims,

including reserves for the future payments on claims that are currently regarded as settled, but may be reopened (ActEd, 2015).

There are several reasons for calculating reserves, which have implications for the variability and drivers for the errors that may arise, whether intentional or not. First, reserve estimations are undertaken to determine the liabilities to be shown in the insurer's published accounts. The loss reserves are also required to ascertain the tax liabilities of a general insurance provider. Reserving may be conducted, and usually on a different basis, if separate accounts have to be prepared for the purposes of supervision of solvency to determine the liabilities to be shown in those accounts, for example, Solvency II (ActEd, 2015).

Secondly, loss reserves are also calculated to determine the liabilities to be shown in internal management accounts, business plans and budgets. Occasionally, loss reserves are calculated to provide information to management as to how areas of the business are performing, and also to provide an indication as to the profitability of business currently being written.

The estimation of loss reserves is also important for pricing purposes. In such exercises, loss reserves are also calculated to estimate the claims costs incurred in recent periods as an intermediate step.

In the case of a merger or acquisition, the loss reserve needs to be calculated to value the insurer. This is in case the estimated surplus or deficit in the booked reserves (as compared to the best estimate of the reserves) will directly affect the valuation of the company (ActEd, 2015).

2.4 Theoretical Framework: Estimation of Loss Reserves

Theoretically, several approaches are employed by general insurers in the estimation of loss reserves. The key methods used are the Chain Ladder Method, the Expected Loss Ratio Method, the Bornhuetter-Ferguson (BF) Method and the Average Cost Per Claim Method.

2.4.1 Chain Ladder Method

The Chain Ladder Method is a statistical method of estimating the ultimate value of a set of development data, whereby an average of the past development is projected into the future. The projection for successive periods of future development is based on the actuary's calculation of the ratios of cumulative past development (ActEd, 2015).

The Chain Ladder Method assumes that the pattern of development derived from past experience will remain appropriate in the future (ActEd, 2015). Use of this method requires confidence that the first cohort is fully run-off, or that its development to an ultimate position can be predicted with some confidence. Where the triangle used is unadjusted for the inflation which is present in the data, the method builds in an implicit assumption that a weighted average of past inflation will be repeated in the future.

This method should ideally be applied to data that is homogeneous and consistent, for example, similar reporting, average settlement period, business line and inflationary characteristics of the claims data. The data should be consistent in timing and content and must be credible. This method can be applied to a wide variety of sets of data and can be easily modified to allow for distortions in the data. It often serves as a starting point for a number of other methods, such as the Bornhuetter-Ferguson method. However, the results can be easily distorted by unusual experience and they make limited use of the more recent periods, especially in the case of long-tail claims. Two variations of the Basic Chain Ladder Method, which are used to adjust for its limitations, are the Inflation-Adjusted Chain Ladder method and the Berquist Sherman method (the latter caters for changes in the speed of claim settlement over time) (ActEd, 2015).

2.4.2 Expected Loss Ratio Method

The loss ratio is the cost of claims per unit of exposure. The measure of exposure could be the premiums, turnover or payroll. For this method in the case of loss reserving, gross premiums can be deemed to be the measure of exposure. There may be some consistency in the loss ratios for several years allowing one to use it as a basis for estimating ultimate claims expected and therefore, the loss reserves (ActEd, 2015).

This method is based on the assumption that the loss ratio is correct (ActEd, 2015). This is a simple approach and is often used as a reference point against which one can compare the results of other methods. It can also be used in cases where the data is sparse, for example, in the case of a new product or data loss, which necessitate the use of loss ratios from the industry. These can be obtained from statutory returns or reinsurers

This method suffers from several limitations. It ignores the claims development to date and makes it difficult to adjust for large claims and past biases. It does not allow for any changes in products, claims administration or changes in product mix over time (ActEd, 2015).

2.4.3 Bornhuetter-Ferguson Method

The Bornhuetter-Ferguson (BF) Method provides a credibility estimate, based on a weighted average of an expected level of claims (estimated loss ratio method) and a projection of the ultimate claims based on experience to date (estimated by the chain ladder method) (ActEd, 2015). It provides the key benefits of the chain ladder method and the loss ratio method. For example, this method provides an element of stability, whilst still taking into account the loss development pattern to date.

The BF method is particularly useful when the available data is sparse such as new products, small books or products with long-tailed claims. The current data may not be well-developed, but the past experience data is still deemed to give an indication of the ultimate claims. It is also useful when considering a blend of experience. The key weakness of the BF method is that it can be difficult to gather the required information for the prior estimate for the claims. In the early stages of development, the prior estimate will drive the estimated reserve (ActEd, 2015).

2.4.4 Average Cost Per Claim Method

This method requires that one calculates the claim frequency and the claims severity for each origin year. If the frequency calculated in the method is proxied by the number of claims, the ultimate claims can be estimated by multiplying together the estimated ultimate number of claims and the estimated average size of the claims. The loss reserve is then the difference between the estimated ultimate claims and the paid claims (ActEd, 2015).

This method requires considerably more data than other methods and can only be used when the appropriate data is available. This method can only be used when the claim count and average claim size are meaningful (consistent and easily predictable according to the nature of the business. It is easy to understand and communicate and provides more information than other methods. This method also allows adjustments to be made, either to the frequency or severity separately (ActEd, 2015).

However, this method can be easily distorted in the case of reopened claims, nil claims and partial payments. It also assumes that the distribution of claims is the same for each origin or settlement year (ActEd, 2015).

2.5 Choice of Reserving Method

The choice of which method one uses depends on several factors, in addition to the purpose of the reserving exercise. The extent and quality of the available data, the age of the business, the cohort of claims and historical claim development information available, are the main drivers of the reserving method to use.

The class of business, (in particular, the length of the tail of the run-off of the liabilities) and the exposure of the insurance/reinsurance contracts are strong drivers of which method to use. The types of claims that have been incurred, or may be expected to occur, will affect the method chosen as well (ActEd, 2015).

2.6 Loss Reserve Errors

Loss reserve errors occur when differences are observed from reserves in the contract period and the reserves at the end of the development period. There are several reasons for reserve errors which are not easily identifiable from the publicly available data.

Any changes to the mix in the business will affect the claims development, and therefore the reserves required for those claims. Changes to policy conditions will impact either the pricing or the claims experience or both. This will impact the mix of claims (ActEd, 2015).

Changes in reporting or settlement delays due to changes in processing protocols or systems will result in changes in the development of claims. Shocks which result in large claim distortions will impact estimations of future claims and result in over-estimation or under-estimation of future claims (ActEd, 2015).

Incorrect past and future inflation assumptions will be reflected in future expectations of claims growth, as they have been allowed for in the development triangles. Further claims outstanding from earlier origin years may have been under-estimated and may manifest in later years when claims have been assumed to be completely run-off (ActEd, 2015).

Social trends which are not projected properly can have an impact on reserving errors. Examples of this are an increasingly litigious society or increased fraud by policyholders. These will have an impact on future claims. Loss reserving methods which make use of development triangles are likely to magnify claims paid most recently which may not be representative of the future loss development. Incorrect assumptions of run-off patterns (and ultimate loss ratios for the Bornhuetter-Ferguson method) also result in increased loss reserve errors (ActEd, 2015).

There are additional reasons, driven by management and/or regulation to explain why a loss reserve error could arise. Given that the loss reserve is a key driver of the financial results of an insurance company, and it is an estimated amount, it is exposed to potential manipulation to smooth income, to give the impression of stronger financial results and to defer taxes. These are detailed in Section 2.8. below, with supporting literature.

2.7 Calculating Loss Reserve Errors

The estimation of loss reserves errors has been undertaken in different ways, with several authors proposing several measures in the past three decades. In practice, the estimation of the reserve errors in the empirical studies has focused on two main approaches by Weiss (1985) and Kazenski et al. (1992).

Weiss (1985) had earlier defined the loss reserve error as the difference between the originally reported incurred losses and the actual liability loss (ultimate loss development), as a proportion of the originally reported incurred losses.

Equation 1: Loss Reserve Error by Weiss (1985)

$$Loss\ reserve\ error_t = \frac{Originally\ reported\ incurred\ losses_t - Ultimate\ loss\ development_{t,n}}{Originally\ reported\ incurred\ losses_t}$$

Kazenski et al. (1992) took a similar approach, but used re-estimated reserves as opposed to actual claims as the basis of estimating loss reserve errors.

Equation 2: Loss Reserve Error by Kazenski et al. (1992)

$$Loss\ reserve\ error_t = \frac{Initial\ estimated\ reserve_t - Revised\ estimated\ reserve_{t,n}}{Initial\ estimated\ reserve_t}$$

2.8 Determinants of Reserve Errors: Review of Theories

2.8.1 Income Smoothing

As stated above, the loss reserves are the most significant items on an insurer's financial statement. Managers have several motivations for displaying stable results and are therefore driven to smooth the income distribution to achieve this. One of the simplest ways to do this is to manipulate the loss reserve. Given that most items on the income statement and the balance sheet are based on actuals, the loss reserve, due to its estimated nature and the impact it has on the financials, is a direct way to shift the income in the direction and to the magnitude required to exhibit a smoother income distribution.

Lambert (1984) found that income smoothing, through the use of reserves, acted as optimal equilibrium behaviour (to achieve Pareto-optimality). This was investigated in light of the impact of compensation schemes to drive managerial behaviour towards desired results. The manner in which compensation schemes are structured drives the extent to which managers behave. Therefore, developing a structure that encourages more stable returns (which are likely to be more desirable among shareholders) may encourage managers to manipulate the loss reserves to a greater extent, in order to achieve this goal.

This was further supported by Grace (1990), who identified a negative relationship between average net income in the past three years and loss reserve errors. There

was sufficient evidence to support the hypothesis that insurers maximised their discounted cash flows, subject to estimation errors and income smoothing constraints. For a portion of the period under consideration, reserving practices aided in smoothing of earnings volatility. This investigation essentially proved that managers managed the volatility in the financial performance by increasing or reducing the reserves, depending on the performance of the previous three years. This was to give the impression of more smoother income movements, instead of shocks.

Graham et al. (2005) found that an insurance company with more stable earnings gives the impression of potentially more predictable and credible returns. Missing an earnings target, or reporting volatile earnings, was considered to reduce the predictability of earnings. This supports the findings of Lambert (1984), that the mandate of managers can be used to drive the loss reserving behaviour. Predictability is attractive to investors, especially those of an institutional nature. The strengthened perception of the company's ability also to perform consistently may have the impact of driving up the share price of the insurance company, if it is listed. The ultimate goal of a private company is to maximise shareholder value. If smoother earnings are required to drive up or maintain shareholder value, there is a great incentive for them to do so, and to do so using the loss reserves. This was supported by Anderson (1971), who identified that changes in loss reserve margins tend to stabilise underwriting results.

Titman (1984) identified that there was a lower perceived probability of bankruptcy for firms that had stable earnings. The manipulation of loss reserves is therefore not only tied to the actual impact on shareholder value, but also to the perceptions of the company, which may have more significant long-run effects beyond the current year's balance sheet. This could potentially impact sales and third-party negotiations (e.g. terms of borrowing).

Smith (1980) provided evidence that the loss reserves were not random in nature, but indeed had a relationship with the underwriting results in the property-liability insurance in the auto industry. Insurers were found to intentionally manage loss reserve estimates in order to smooth reported underwriting results. Being able to smooth earnings also allows the insurance company to pursue a consistent investment strategy which could strengthen investment returns and also to pursue additional

product and business opportunities (Minton & Schrand, 1999). The funds which have to be set aside for the technical reserves cannot be used for aggressive investments or the development of new products. Under-reserving could be used to increase the portion of free assets (the assets over the total liabilities) which, in turn, allows greater investment freedom. However, under-reserving means that there will be better financial results for the period and could result in a higher tax bill, which may not be desirable. This is discussed further in 2.8.3.

2.8.2 Financial Weakness

Financially weak organisations have a greater incentive to mask weakness. This can be done by under-reserving. By under-reserving, the insurer decreases the increase in reserves which must be passed on in the management accounts and total reserves to the balance sheet. This, therefore, results in a higher profit for the period.

Petroni (1992) noted that managers of financially weak insurers consistently underestimate reserves. This is heightened when the insurers are close to receiving regulatory attention due to their financial weakness. Under-reserving at this time could give the regulator the impression of (temporary) financial recovery.

Gaver and Paterson (2004) supported this by showing that the level of under-reserving was to the extent of just avoiding regulatory intervention based on the Insurance Regulatory Information System ratios used for solvency assessment by the regulators in the USA. Reserve manipulation was found to postpone regulatory intervention for extended periods of time. However, due to the fact that reserve manipulation is only temporary, and only a deferral of the actual claims scenarios, a financially weak firm is likely to receive regulatory attention if the business does not begin to experience organic growth (loss reserve manipulation can be perceived to be inorganic growth).

Browne et al. (2012) showed that there was an inverse relationship between the risk based capital (RBC) and the size of under-reserving errors. The risk-based capital is the minimum amount of capital that an insurance company is required to hold to support its overall business, based on the size and degree of risks on the books of the insurer (ActEd, 2015). In their investigation, they defined RBC as being the ratio of total adjusted capital to authorised control level risk-based capital. This is consistent

with the results of Petroni (1992), who identified that insurers with weaker ratings made greater reserving errors.

Essentially, a company with a higher risk based capital is likely to be one with a greater proportion of risk associated with its book of business. It has to hold this risk-based capital to be allowed to continue operating. This places constraints on its ability to invest and expand its business. In a financially weak company, it might place constraints on day-to-day operations. To improve the financial state of the company and free up assets and cashflow for the business (in the short to medium term), management may decide to do so by reducing the loss reserves. Again, this is an inorganic way of improving the financial standing of the business. Without genuine business improvement, it is likely to breach the regulatory capital requirements and face regulatory attention, to the extent of being closed to new business and being told to wind down by the regulator.

It is worth noting that an insurer could under-state its financial strength to avoid a possible acquisition attempt or to defer taxes. This could be done by over-reserving. The manipulation of loss reserves to defer taxes is detailed further below in section 2.8.3.

2.8.3 Tax Shield

The managing individuals of an insurance company could manipulate the tax bill by over-reserving. Over-reserving results in an increase in the change in reserves which must be passed on to the management accounts. This ultimately reduces the earnings for the period, and therefore, the tax charged in that reporting period. This also results in a higher liability being passed onto the balance sheet.

However, this manipulation results in a delay of the tax bill only, and not an elimination of any part of it. This is due to the fact that the actual claims for the period will still materialise and have to be accounted for in the management accounts in future reporting periods. This delay acts as an interest-free borrowing and could provide opportunities for further investments and compensation. For this reason, it is in the interest of the government revenue collection services to achieve more accurate reserving.

Bradford and Logue (1999) showed that changes in tax rule changes were associated with over-reserving in the following period. This could also be associated with a desire to smooth earnings after step changes in the tax bill. They, however, stressed the fact that the reserves are inevitably subject to correction over time (for the reason stated above).

2.9 Empirical Literature on Determinants of Loss Reserve Errors

The studies on loss reserve errors estimation and their determining factors have largely focused on developed markets in Europe and America. One of the earliest studies on loss reserve errors was by Weiss (1985) on the property-liability market in the U.S. using data from sixteen large automobile liability insurers from 1955 to 1975. The results of this investigation indicated that the loss reserve errors helped to stabilise the reported underwriting results. Significant relationships were found between interest rates, unanticipated inflation and loss reserve errors.

Grace (1990) investigated the reserving practices of property-liability insurers in the US from 1966 to 1979 and found that the insurers manipulated reserves to aid in the reduction of tax bills as well as income smoothing. The reasons for loss reserve errors differed for different periods.

Kazenski et al. (1992) identified that no single development horizon was adequate for all circumstances, in contradiction with the methodologies adopted by several other authors. Shorter development horizons (two or three years) were found to be adequate when the industry was being examined as a whole (or several insurers), whilst longer development horizons were necessary for more precise measurement error on individual insurers.

Petroni (1992) conducted a study which found that managers of financially weak insurers under-reserved more frequently compared to other financially stronger insurers, ceteris paribus. This same investigation found that the extent of under-reserving was greater in cases where the insurer was close to receiving regulatory attention, as a result of failing to satisfy the regulatory requirements of financial soundness. This investigation was also done on property-casualty insurers.

Beaver et al. (2003) analysed loss reserve errors to identify the use of earning distribution and loss avoidance as the motivation to manipulate reserves across public, private and mutual companies in the United States of America. Using a five-year loss development period and W-error equation on annual data from 1988 to 1998, the authors aimed to provide evidence of over-reserving in the US market. This was found to be more pronounced for public companies and mutual in order to manage losses. Private companies were not found to do the same. This behaviour was, however, consistent across financially healthy and distressed companies.

Diacon et al. (2003) found that the typical United Kingdom general insurance companies had a tendency to over-reserve by a substantial margin. However, the empirical evidence showed that the insurance companies with high net profitability and stronger solvency margins were found to under-estimate the liabilities.

Gaver and Paterson (2004) investigated the relationship between external monitoring and earning management within the property-casualty insurance industry. This required assessing whether certain auditor-actuary pairs were closely associated with loss reserve errors. This investigation showed that under-reserving by weak insurers is eliminated by using auditors and actuaries from the 'Big Six' audit firms in the United States of America. This may be related to the fact that the actuaries from the 'Big Six' audit firms are more attuned to the liability exposure of the auditors.

Browne et al. (2006) also investigated the impact of executive stock options on the accuracy of reserving estimates in the United States of America. This investigation revealed that there was sufficient empirical evidence to support that the perceived accuracy of financial disclosures was directly related to market valuations. Therefore, executives with options were driven to report loss reserves as accurately as possible.

Both Beaver et al. (2003) and Browne et al. (2006) used the ordinary least squares method to regress the absolute value of the reserve error against independent variables. D'Arcy and Au (2008) identified that in a non-stable inflation environment, loss reserve variability tends to be higher. This emphasised that it is important to include inflation in any analysis of loss reserve.

Grace and Leverty (2010) found that insurers would over-reserve in the presence of stringent rate regulation. Regulatory rates would result in pricing below the competitive level – effectively a wealth transfer from the insurer to the consumer. To avoid this, insurers would report loss inflating discretionary reserves (over-reserve) in an attempt to reduce the impact of the rate suppression imposed by the regulator.

Kelly et al. (2012) conducted an investigation on Canadian property and casualty insurers to understand the key drivers of loss reserve errors. They found that the employment status of the actuaries employed (in-house versus consultants) did not have an impact on the reserve errors. Their investigation also revealed that larger firms and firms that were writing larger proportions of short-tailed business had smaller reserve errors. However, consulting actuaries were found to over-reserve as the amount of short-tailed business increases. They found no evidence to support the manipulation of reserves to smooth income, avoid regulatory attention, or appear financially stronger. However, their results indicated the use of over-estimation to defer taxes. Market cycles were found to explain reserve errors for internal actuaries as opposed to consulting actuaries. This may be due to the fact that consulting actuaries are likely to have a broader industry perspective and have a greater ability to anticipate market movements and identify cycles (therefore, they are likely to have allowed for these cycles in advance, as opposed to reacting to cyclical changes in the short term).

Grace and Leverty (2012) found insurers using the reserves to defer taxes and to reduce the impact of regulatory rate suppression. There was, however, limited evidence in this investigation to indicate that insurers were using loss reserves to avoid solvency monitoring. This is likely due to the standard regulatory oversight. Sun et al (2012) identified the characteristics of the audit committee as being critical to the extent of the loss reserve error. Eckles and Halek (2010) found that managers receiving bonuses which are capped, or no bonuses, tend to over-reserve, with those receiving bonuses tending to under-reserve.

Grace (2013) identified that the preference to smooth may motivate senior management to manipulate the loss reserve. The US implemented the Sarbanes-Oxley (SOX) Act in 2002 which introduced several interventions to improve accuracy and transparency amongst publicly traded companies. Brandt et al. (2013) found that

the introduction of SOX did not result in changes in the reserving behaviour (which brings into question the costs and time commitments associated with over-regulation).

Quaye et al. (2014) investigated the level and variability of Ghanaian property and liability insurers' reserve estimates to examine their source and determine if the errors were random. They used a regression model using the log transformation of the reserve error ratio against the dependent variables. They allowed for time-variability of all variables. In their investigation, they also analysed the effect of the first lag and second lag of loss reserves. The reserve errors were found to be random across firms, which is indicative of independent reserving within the industry (not manipulated between companies and influenced by competitors).

Kamiya and Milidonis (2016) found that officer actuaries (for example, statutory actuaries) and non-officer actuaries had different reserving practices with regards to tax shielding and earnings management. Officer actuaries were found to over-reserve for tax-shielding purposes, less so than non-officer actuaries overall. Officer actuaries were found to reserve in a manner that is consistent with increasing firm-value over a shorter period, in comparison to non-officer actuaries. Managerial discretion was found to dominate actuarial independence which has a significant economic impact

Table 8: Taxonomy of Loss Reserve Error Studies

	Author(s)	Year	Period	Country(ies)	LD Period (yrs)	Error
1	Anderson	1971	1954 - 1968	U.S.	4	Under-reserving
2	Smith	1980	1955 - 1974	U.S.	5	Under-reserving & Over-reserving
3	Weiss	1985	1995-1975	U.S.	4	Under-reserving & Over-reserving
4	Grace	1990	1965-1979	U.S.	4	Under-reserving & Over-reserving
5	Kazenski, Feldhaus, and Schneider	1992	1977-1988	U.S.	3 or more	Under-reserving & Over-reserving
6	Petroni	1992	1979-1983	U.S.	5	Under-reserving
7	Bradford and Logue	1999	1976 - 1994	U.S.	1 to 6	Under-reserving
8	Gaver and Paterson	2000	1990-1993	U.S.	4	Under-reserving
9	Gaver and Paterson	2001	1993-1997	U.S.	4	Over-reserving
10	Beaver, McNichols and Nelson	2003	1988-1998	U.S.	5 and 4	Over-reserving
11	Diacon, Fenn, and O'Brien	2003	1985-1996	U.K.	5	Over-reserving
12	Gaver and Paterson	2004	1988-1993	U.S.	5	Over-reserving
13	Browne, Ma and Wang	2006	1995-1998	U.S.	5	Under-reserving
14	D'Arcy and Au	2008	1974 - 1991	U.S.	**	Under-reserving & Over-reserving
15	Grace and Leverty	2010	1990-2002	U.S.	5	Under-reserving & Over-reserving
16	Eckles and Halek	2010	1992-2001	U.S.	5	Over-reserving
17	Grace and Leverty	2012	1990-1997	U.S.	5	Over-reserving
18	Brown, Ju and Lei	2012	1997-2000	U.S.	5	Under-reserving
19	Kelly, Kleffner and Li	2012	1995-2010	Canada	3	Over-reserving
20	Browne, Ma and Wang	2012	1997 - 2000	U.S.	5	Under-reserving & Over-reserving
21	Sun, Wei and Xu	2012	2003 - 2007	U.S.	4	Under-reserving & Over-reserving
22	Brandt, Ma and Pope	2013	1998-2006	U.S.	5	Under-reserving & Over-reserving
23	Quaye, Aboagye and Andoh	2014	2000-2010	Ghana	3	Under-reserving
24	Kamiya and Milidonis	2016	2007 - 2014	U.S.	5 and 3	Over-reserving

**The methodology does not explicitly provide the number of development years, but indicates that the model can allow for 18*18 run-off triangles. The examples they used in the literature allowed for three to ten years.

2.10 Summary

This section reviewed the general insurance market in South Africa as well as the empirical studies on loss reserve errors in insurance markets.

From the overview of the general insurance market, it is shown that the South African general insurance market dominates other markets in Africa. In addition, the premiums mobilised from the non-life insurance market account for about 2% of the GDP in South Africa, the highest in Africa. The South African market represents 40% of the African non-life insurance market for 2014, with the highest penetration of 1.885, followed closely by Mauritius, at 1.842, which experienced rapid growth from 2012 to 2013. Tunisia has shown the most rapid growth over this period, with Cape Verde showing the greatest decline in non-life insurance penetration.

Property and Motor insurance policies accounted for about 77% of gross premiums underwritten in the general insurance market in South Africa at the end of 2014. These business lines have provided consistent claims ratios which have supported industry claims stability due to their magnitude. However, this has not translated to financial results as the industry has experienced increased management expenses and decreased investment income. The rise in total income has only increased by 47.5% during this period, with decreases in the underwriting profits and operating profits at 19.8% and 26.4% respectively. This is in light of increasing growth in premiums of 70.3%.

Changes in risk management regulations such as Solvency II have contributed to more conservative reserving protocols. This has translated to an increase in loss reserves as a proportion of total liabilities. The regulatory landscape of non-life insurance in South Arica is broad and is currently undergoing further developments to provide greater oversight of market conduct under the Twin Peaks framework.

The key methods used are the Chain Ladder Method, the Expected Loss Ratio Method, the Bornhuetter-Ferguson (BF) Method and the Average Cost Per Claim Method. The

choice of which method to use mainly depends on the purpose of the reserving exercise, the data available and the development patterns of claims that have been considered.

The calculation of loss reserve errors could be done with the use of revised loss reserves or with ultimate claims. The main methodologies used are those of Weiss (1985) and Kazenski et al. (1992). Several reasons exist for the estimation of the loss reserves being inaccurate. These reasons could be related to the methodology used and could also relate to deliberate attempts by management in pursuit of a financial agenda. These include income smoothing, improving financial strength, and tax shielding. It is clear from the key areas of investigation that there is a strong assumption that managers exercise a significant amount of discretion in setting the final reserve for the financial statements, and that human elements such as qualifications, firm background, anticipation and interpretation of regulation, and compensation of senior management are contributing factors in setting the reserve. Therefore, operational risks may have an impact on loss reserve errors and variability.

From the application of theories to estimate and explain loss reserve error behaviour in insurance markets, the review clearly highlights the paucity of studies in developing insurance markets. All but two of the twenty-four (24) studies relate to insurance markets in North America. Closely related to this current investigation in terms of the development of the insurance market is that of Quaye et al. (2014). This current investigation seeks to contribute to the paucity of studies on reserve errors from an emerging markets perspective and extends the microeconomic analysis of the South African insurance market by Alhassan (2016) and Alhassan and Biekpe (2015; 2016; 2017).

CHAPTER THREE: DATA AND METHODOLOGY

3.1. Introduction

This chapter discusses the empirical strategy employed in testing the research hypotheses specified in Chapter 1. It covers discussions on the data used for the analysis; the reserve error estimation approach employed; the regression approach adopted; and the estimation technique used for the results.

3.2. Data

The investigation of determining factors influencing loss reserve errors requires the following data:

- run-off triangles showing the development of claims over time (gross of reinsurance); and
- financial accounts (which must display the reserves allocated each year)

The required data will be obtained from the financial submissions made from the general insurers to the Insurance Department of the Financial Services Board (FSB). The population of the study includes all registered general insurance companies at the end of 2014. However, the sample for analysis is limited to 79 general insurers whose returns were available from 2007 to 2014. The sample of 79 general insurers accounts for over 80% of gross insurance premiums written in the market, hence, it can be argued to be representative of the general insurance market in South Africa. The financial returns from 2007 to 2014 are used in this study. The key determinant for choosing an insurance company in this investigation was the availability of comprehensive information as detailed above. All general insurers with complete submissions with the FSB will be included in formulating the results. The estimations of the reserve errors are undertaken from the run-off triangles in Schedule D of the returns.

Table 8 below presents the run-off triangle of a large insurer extracted from Schedule D of their returns submitted to the Insurance Department of the FSB. Details of the calculation of the loss reserve errors are contained in Appendix A.

Figure 2: Example of Run-Off Triangle

From 2007's return
From 2008's return
From 2009's return
From 2010's return
From 2011's return
From 2012's return
From 2013's return
Insert 2014's figures

Section 1 - Payment development (Net of all Reinsurances)

INSURERS - FINANCIAL YEAR CLAIMS OCCURRED AND PREMIUMS EARNED (QUARTERLY)
REINSURERS - UNDERWRITING YEAR CLAIMS OCCURREDAND PREMIUMS EARNED (QUARTERLY)

			DEVELOPMENT QUARTER DURING WHICH CLAIMS WERE PAID																									
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
	Year	Quarter	Quarter 1 R'000	Quarter 2 R'000	Quarter 3 R'000	Quarter 4 R'000	Quarter 5 R'000	Quarter 6 R'000	Quarter 7 R'000	Quarter 8 R'000	Quarter 9 R'000	Quarter 10 R'000	Quarter 11 R'000	Quarter 12 R'000	Quarter 13 R'000	Quarter 14 R'000	Quarter 15 R'000	Quarter 16 R'000	Quarter 17 R'000	Quarter 18 R'000	Quarter 19 R'000	Quarter 20 R'000	Quarter 21 R'000	Quarter 22 R'000	Quarter 23 R'000	Quarter 24 R'000	Total paid for that quarter R'000	Net earned premium per quarter R'000
	Earlier years																										5 000	-
2 007	2007	1	582 708	613 334	125 093	48 831	90 361	28 270	25 484	2 636	2 154	12 173	1 600	691	11 190	4 406	1 781	1 619	2 466	1 555	5 528	-1 440	-2 012	4 940	15 323	585	1 579 276	2 145 320
2 008		2	584 057	682 253	122 577	47 207	23 296	9 652	5 636	927	25 643	4 465	10 245	2 238	607	1 795	3 951	3 365	377	1 760	3 136	489	930	-212	1 053	-	1 535 448	2 529 413
2 009		3	612 367	684 487	124 140	71 095	59 502	48 552	10 700	9 215	17 929	2 892	1 823	29 942	5 879	13 040	-914	1 436	-2 281	2 014	696	3 611	7 319	1 442	-	-	1 704 883	2 702 741
2 010		4	700 605	703 553	205 717	87 427	25 817	13 367	6 354	3 046	3 675	4 230	12 508	2 543	1 796	1 629	24	2 437	-727	1 019	842	658	407	-	-	-	1 776 928	2 737 961
2 011	2008	1	500 153	743 619	257 772	80 263	48 518	7 334	6 403	33 033	3 154	47 754	3 658	99 454	1 764	3 155	902	-6 393	11 307	7 121	3 448	5 733	1 262	7 687	2 123	11	1 869 233	2 342 046
2 012		2	521 899	770 681	299 797	67 144	41 548	38 865	7 675	11 869	13 041	7 941	5 079	2 312	3 189	5 721	-2 199	2 342	15 061	3 074	6 423	2 181	3 395	5 365	3 128	-	1 835 531	2 714 978
2 013		3	582 594	940 857	116 007	44 151	15 265	27 591	15 407	-2 623	17 989	1 951	484	1 290	1 785	10 141	8 787	26 160	11 768	4 894	5 838	4 919	11 909	5 507	-	-	1 852 671	2 918 992
2 014		4	647 517	871 829	145 434	59 276	21 994	53 381	17 947	7 158	5 041	-694	2 174	3 436	6	4 201	5 384	6 185	2 234	3 184	4 164	-36 453	1 788	-	-	-	1 825 185	2 918 992
	2009	1	839 676	886 681	237 759	98 150	28 621	59 778	16 993	17 664	10 375	5 567	3 423	692	2 026	11 410	4 054	5 464	1 300	1 589	5 231	13 086	2 068	1 887	11 517	4 698	2 269 710	2 628 342
		2	702 730	931 504	244 811	98 936	126 327	30 936	9 666	5 538	29 080	7 282	4 754	6 565	15 758	-1 317	14 423	5 220	4 881	4 734	3 989	750	2 235	1 655	1 488	-	2 251 946	2 835 960
		3	773 031	868 802	131 032	48 480	28 320	12 141	9 029	2 877	3 128	2 224	3 607	18 138	2 393	3 746	7 097	6 085	3 947	7 242	7 999	3 477	5 505	1 109	-	-	1 949 409	3 195 090
		4	851 446	849 413	184 133	52 092	23 857	5 895	822	14 829	32 905	4 474	5 085	1 768	5 396	3 282	4 938	2 250	2 073	1 960	2 870	1 764	1 472	-	-	-	2 052 723	3 346 720
	2010	1	797 767	828 543	187 304	66 968	38 397	18 682	19 301	12 088	3 918	6 831	10 318	4 087	1 513	10 292	3 049	6 356	5 637	1 858	9 626	12 640	-	-	-	-	2 045 176	2 812 310
		2	724 391	816 971	167 310	22 152	11 514	43 311	2 637	11 533	4 670	2 266	12 348	2 346	5 401	10 373	4 035	4 284	7 012	3 691	8 245	-	-	-	-	-	1 864 490	3 608 455
		3	725 624	793 150	95 789	39 873	8 978	6 424	6 953	7 946	7 209	5 222	980	4 966	4 968	4 306	1 786	12 047	1 562	6 731	-	-	-	-	-	-	1 734 505	3 705 892
		4	889 506	794 229	205 652	82 822	21 778	38 693	8 826	8 875	17 647	5 782	3 989	16 620	11 808	2 672	4 907	3 977	4 170	-	-	-	-	-	-	-	2 121 952	3 466 525
	2011	1	855 402	932 936	192 993	67 703	45 655	39 651	23 540	6 884	10 095	-8 065	6 859	2 411	7 906	11 001	5 839	3 041	-	-	-	-	-	-	-	-	2 203 851	3 031 492
		2	770 444	961 409	133 391	38 566	16 546	12 196	5 900	17 026	3 771	4 987	924	4 489	2 306	3 329	2 538	-	-	-	-	-	-	-	-	-	1 977 822	4 927 076
		3	1 014 013	725 920	123 628	58 753	35 994	25 606	7 015	7 771	2 136	3 608	4 607	22 526	5 255	5 205	-	-	-	-	-	-	-	-	-	-	2 042 037	3 705 892
		4	1 026 185	850 319	182 403	63 520	33 365	52 196	32 887	9 954	12 944	3 008	10 732	1 167	29 010	-	-	-	-	-	-	-	-	-	-	-	2 307 690	3 466 525
	2012	1	992 792	887 434	211 028	104 421	32 239	24 702	28 536	13 812	17 799	6 018	20 219	7 580	-	-	-	-	-	-	-	-	-	-	-	-	2 346 580	3 182 466
		2	927 635	812 798	150 268	45 562	72 464	29 560	26 188	8 197	12 317	12 498	19 824	-	-	-	-	-	-	-	-	-	-	-	-	-	2 117 311	3 644 640
		3	972 776	966 714	144 008	73 548	14 880	12 556	7 605	13 488	15 443	35 991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 257 009	3 889 438
		4	1 146 898	1 293 598	352 993	120 963	44 423	28 206	55 711	11 715	11 769	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3 066 276	3 889 496
	2013	1	984 329	1 057 928	251 669	132 529	45 266	26 094	40 552	37 374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 575 741	3 313 443
		2	1 058 152	978 918	110 578	47 506	33 731	23 262	15 276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 267 423	3 840 796
		3	1 085 033	931 484	108 505	85 972	32 581	13 283	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 256 858	4 296 258
		4	1 155 591	1 095 453	288 969	148 774	75 313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 764 090	4 057 788
	2014	1	1 002 928	990 115	221 602	80 122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 294 767	3 875 873
		2	927 637	941 424	171 379	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 040 440	3 821 979
		3	1 045 699	933 232	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 978 931	3 845 379
		4	1 035 133	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 035 133	4 110 293

3.3. Empirical Strategy

To achieve the stated objectives of the study, a two-stage approach will be used. In the first stage, the loss reserve errors will be estimated. The second stage will involve the estimation of a panel regression model to examine the effect of firm level characteristics on the reserve errors estimated in stage 1.

3.3.1. Stage 1: Estimation of Loss Reserve Errors

This process will start by identifying the loss reserves. These are readily available from the management accounts in both the income statement and the balance sheet. Calculation of the loss reserve errors requires the run-off triangles from the management accounts. Incremental paid loss results will be used, and not the cumulative one. This allows the researcher to avoid the problem of correlated errors.

The loss development pattern will be identified which will assist in identifying which development years will be used for purposes of the analysis. A preliminary assessment of the data has revealed that the overall claims (across all business lines) are expected to be more than 90% run-off for the whole book after two calendar years.

The run-off triangles will be collapsed from quarterly triangles to annual triangles to obtain the development of claims, net of reinsurance.

The main run-off triangles under consideration will be those of the latest financial year as they contain the greatest amount of information for the later years. Earlier run-off triangles will be considered for the earlier years as they are not all represented in the run-off triangles of the later years.

In the empirical literature, the estimation of loss reserves errors is undertaken using either W Error (Weiss, 1985) or KFS Error (Kazenski, Feldhaus & Schneider, 1992). The names of these errors have been derived from the initials of the authors. While the W Error approach estimates the difference between the originally reported loss reserve and the claims paid after the development period, the KFS Error estimates the differences between originally reported loss reserve and a revised estimate after the

development period. The equation for estimating the W Error is defined in Equation 3 as:

Equation 3: W Error

$$Loss\ reserve\ error_t = \frac{Originally\ reported\ incurred\ losses_t - Ultimate\ loss\ development_{t,n}}{Originally\ reported\ incurred\ losses_t}$$

where i and t denote insurer and year respectively; k represents the loss development years. Consistent with the empirical literature and the initial assessment of the data, the reserve errors will be estimated for three-year; four-year and five-year loss development periods (i.e. k=3, 4 and 5).

An assessment of the variability of claims payment patterns over time by checking the proportion of ultimate claims paid in each development year. This will determine whether a time series analysis is necessary in the next step (Panning, 2006).

3.3.2. Stage 2: Regression Model

In the identification of the explanatory factors for the estimated reserve errors, this study adopts the empirical models of Grace and Leverty (2012a), Kelly et al. (2016) and Kamiya and Milidonis (2016) as shown in Equation 4 below:

Equation 4

$$LRE_{i,t} = \delta_i + \delta_1 taxs_{i,t} + \delta_2 emgt_{i,t} + \delta_3 finweak_{i,t} + \delta_4 growth_{i,t} + \delta_5 reins_{i,t} + \delta_6 bldiv_{i,t} + \varepsilon_{i,t}$$

where i and t denote insurers and years respectively; $taxs$ is the tax shield; $emgt$ denotes earnings management; $finweak$ is a proxy for financial weakness; $growth$ represent premium growth; $reins$ denotes the reinsurance ratio; $bldiv$ represent the business line diversification and ε is an error term that represents random disturbances or deviations from the predicted relationship between the loss reserve indicator and the independent variables. δ are the parameters and will be estimated in this study.

3.4. Description of Variables

This section presents the description of the variables in the regression model and theoretical linkage between each independent variable and reserve errors.

3.4.1. Tax Shield

Grace (1990) measured the tax shield to cater for the fact that some insurers would try to reduce the tax bill by over-reserving. The hypothesis related to tax shielding is that, ceteris paribus, over-reserving provides the firm an opportunity to reduce the tax bill for that year (although this is purely a deferral of the overall tax bill). Therefore, it is assumed that the greater the potential savings from over-reserving, the larger the loss reserve error. Grace (1990) measured the tax shield as below in Equation 5.

Equation 5

$$Tax\ Shield_{i,t} = \frac{Net\ Income_{i,t} + Estimated\ Reserve_{i,t}}{Total\ Asset_{i,t}}$$

This is an approximation of the taxable income before reserves as a proportion of the insurer's net assets. Grace (1990) proposed that insurers would over-estimate reserves as the taxable income increased, i.e. a direct relationship between the loss reserve errors and the tax shield potential.

3.4.2. Earnings Management

This can be regarded as being the same as income smoothing. The earnings management hypothesis is that an insurance company is going to manage earnings to keep them in line with expectations (Beaver et al., 2003; Weiss, 1985). Unexpectedly higher earnings result in over-reserving to smooth the reported earnings. Unexpectedly lower earnings result in under-reserving to smooth the reported earnings. However, it can be argued that poor past averages are not likely to motivate an insurance company to over-reserve purely for the purpose of understaing the financial performance. Beaver et al. (2003) found that the insurance companies that reported small positive earnings reported under-reserving the most frequently and the insurance companies with the strongest financial results over-reserved the most frequently.

3.4.3. Financial Weakness

Petroni (1992) found that financially weak firms manipulated the loss reserves more to give the impression of stronger financial performance, particularly in instances where there was the threat of regulatory intervention, i.e. financially weak insurers under-reserve more than financially stronger firms. This assists financially weak firms to avoid insolvency and regulatory scrutiny (Gaver & Paterson, 2004; Petroni, 1992). The hypothesis for financial weakness is that the more financially weak a firm is, the greater the under-reserving (negative loss reserves errors). The financial weakness is measured using the solvency ratio as this is the key measure of financial strength in the South African market. This is defined as being the free reserves as a proportion of the net written premiums (less reinsurance).

3.4.4. Premium Growth

Growth here is defined as the one-year percent increase in net premiums written for each insurer (net of reinsurance) (Grace & Leverty, 2012a; Harrington & Danzon, 1994; Sun et al., 2012). Harrington & Danzon (1994) stated that the moral hazard hypothesis predicts that firms which under-reserve charge lower premiums, and, as a result, experience faster growth than firms which over-reserve (i.e. have to set aside higher reserves). They assumed that insurance companies hide the insufficient premiums with initial under-reserving. However, as the claims begin to develop, the initial reserves have to be revised upwards. This is a common consequence of under-pricing. This is exacerbated by the high demand driven by the low premiums. This puts upward pressure on repricing and new product pricing to compensate for the initial under-reserving. Therefore, the hypothesis here is that premium growth is associated with increases in loss reserve errors (as the insurer finds ways to recover losses over time).

3.4.5. Reinsurance

Reinsurance here is measured as the percentage of gross premiums ceded to the reinsurer (Browne et al. 2012; Grace & Leverty, 2012). Their investigations indicated that higher reinsurance purchases were associated with more accurate reserving and hence lower reserve errors. Therefore, there is an assumed negative relationship between reinsurance and the absolute value of loss reserves.

3.4.6. Business Line Diversification

Business diversification is measured here by the Business Herfindahl index (Browne et al., 2012).

Equation 6

$$bldiv = \sum_{l} (\frac{DPW_l}{TPW})^2$$

where: $DPW_l = amount\ of\ direct\ premims\ written\ on\ a\ particular\ business\ line\ l$

$$TPW = amount\ of\ total\ premiums\ written\ acorss\ all\ states$$

This measure varies from 0 to 1. Insurance companies with higher values of $bldiv$ have greater concentration in their line of business.

There are two lines of thinking that can be followed to explain the relationship between $bldiv$ and reserving errors.

A firm that is highly concentrated may have greater experience in the fewer lines of business it concentrates on and may therefore be able to reserve more accurately within these lines of business compared to a more diversified insurance company. The hypothesis here is that an inverse relationship exists between the $bldiv$ and the absolute reserve errors.

On the other hand, greater concentration may expose an insurance company to higher catastrophe risk which may warrant over-reserving to allow for the greater uncertainty and inability to smooth experience across several business lines. (That being said, the several business lines under investigation are not likely to exhibit negative correlations.) Therefore, greater business line diversification (the opposite of concentration) is associated with over-reserving. The hypothesis here is that the there is a positive relationship between $bldiv$ and loss reserve errors as a result of over-reserving.

The definition and measurement of the variables in the Equation 4 are summarised in Table 9 below based on the previous discussion:

Table 9: Variables

SYMBOLS	VARIABLES	MEASUREMENT
taxs	tax shield	$\frac{(Net\ income - Reserve) * 100}{Total\ assets}$
emg	earnings management	Average return on assets over the previous three years
finweak	financial weakness	$\frac{Free\ reserves}{Net\ written\ premiums}$
growth	premium growth	One-year percent increase in net premiums written for each insurer
reins	reinsurance ratio	$\frac{Reinsurnce}{Gross\ written\ premiums}$
bldiv	business line diversification	$\sum_l (\frac{DPW_l}{TPW})^2$

3.5. Estimation Technique

In the estimation of the regression model in Equation 4, this study will adopt a systematic approach in deciding between the ordinary least squares estimation (OLS) technique, the random effects technique and the fixed effects technique.

The OLS technique has the possibility of resulting in biased estimates when used to estimate panel data. This is due to unobserved heterogeneity, i.e. the variation between and within cross-sections (Greene, 2000). Either the fixed or random effects models can be used to correct for unobserved heterogeneity. These methods control for omitted (unobservable) company-specific effects and period-specific effects

First, the Breusch-Pagan Lagrange Multiplier test will be employed to test between the OLS and random effects techniques. If the null hypothesis that there are no company-specific or period-specific effects is rejected, the fixed effects or random effects models are deemed to be more efficient compared to a pooled cross-sectional model (under the OLS technique). If the OLS technique is rejected, the Hausman χ^2(1978) test will be used to test for the choice between the Random Effects (RE) and the Fixed Effects (FE) technique. If the null hypothesis that random effects are appropriate is rejected, the fixed effects are deemed to be the most appropriate.

However, the residuals of fixed effect models are assumed to follow the normal distribution and to be homogeneous. On the other hand, the fixed-effects estimation procedure on loss reserve revisions tends to be positively serially correlated. Panel data has been found to be heteroskedastic in the past (Grace & Leverty, 2012b).

The Wald test will be used to test for evidence of heteroskedacity and serial correlation. If the null hypothesis of a common variance on all residuals across the panel is rejected, it is assumed that the data exhibits group-wise heteroskedacity (Grace & Leverty, 2012b). This will then require the incorporation of feasible generalised least squares to estimate Equation 5. This approach allows for the incorporation of panel-specific heteroskedastic and serial correlated error terms.

CHAPTER FOUR: DISCUSSION OF FINDINGS

4.0. Introduction

This chapter discusses the results of the data analysis approach as discussed in Chapter Three. It covers the evolution of the estimated loss reserve errors and the descriptive statistics of the variables in the regression model in equation 3. It ends with the discussion of the regression results on the determinants of loss reserve errors.

4.1. Evolution of Loss Reserve Errors

Table 4.1. below shows the development of the loss reserve errors from 2007 to 2014. The positive mean loss reserve indicates over-reserving by the firms represented in the study. This is consistent over the eight-year period. Interestingly, over-reserving can be seen to be quite significant during the global economic recession from 2008 to 2010. This may be indicative of a prudent insurance environment exacerbated by the economic uncertainty that plagued South Africa at the time. Economic downturns are often associated with an increase in claims. As indicated above, when observing the results, the greatest weight is placed on the loss reserve of earlier years in the investigation to allow for the fact that there is limited information on the development of claims from the later years.

Based on the estimated loss reserve errors, the sample is classified into insurers with negative errors (under-reserving) and positive errors (over-reserving). The distribution of the estimated loss reserve errors across the two categories of reserve errors over the sample period is also presented in Table 4.1. Consistent with the whole sample, it can be observed that the market is dominated by firms with over-reserving tendencies across the sample period. Overall, about two-thirds (2/3) of insurers in the market over-reserve. This implies a generally cautious approach to reserving in the South African general insurance industry for the period under investigation. This may be indicative of an unpredictable market, or highly variable claims experience. This is often the case in expanding markets and uncertain economic conditions for consumers.

Table 4.1.: Loss Reserve Errors

	All Sample				Under-Reserving		Over-Reserving	
	Mean	**Median**	**Std. Dev**	**N**	**Mean**	**N ****	**Mean**	**N****
2007	1.75%	0.0084	0.107	56	-6.41%	25 (45%)	8.61%	30 (54%)
2008	4.98%	0.0107	0.1605	74	-6.47%	26 (35%)	11.42%	47 (64%)
2009	6.95%	0.0287	0.1362	74	-4.31%	20 (27%)	11.11%	54 (73%)
2010	6.41%	0.0152	0.1366	77	-3.37%	22 (29%)	10.32%	55 (71%)
2011	5.54%	0.0128	0.1389	78	-2.41%	26 (33%)	9.52%	52 (67%)
2012	2.98%	0.0025	0.1408	76	-5.22%	36 (47%)	10.37%	40 (53%)
2013	1.77%	0.0135	0.1309	71	-8.45%	25 (35%)	7.33%	46 (65%)
2014	7.71%	0.0549	0.1201	68	-5.25%	10 (15%)	9.94%	58 (85%)
Average					**-5.28%**	**190 (33%)**	**9.91%**	**382 (67%)**

*Note: UR=Under-reserving sample; OR=Over-reserving sample; ** denotes percentage of total sample across years*
Source: Author's estimates from research data

4.2. Descriptive Statistics

The descriptive statistics of the regression variables are presented in Table 4.2. The average loss reserve error indicates that, on average, South African general insurers over-reserved by 4.849% of their initial estimated reserve during the period 2007 to 2014. However, it is important to note the wide range over which the loss reserve errors are observed for these insurers, ranging from -36.227% to 69.308%, with a standard deviation of 13.653%

The average tax shield of 0.519 in the industry for the eight years shows insurers protecting a significant portion of their revenue and assets from the impact of tax using reserves. Earnings management, proxied by the return on assets, with an average of 0.092 indicates an average of 9.2% return on assets. This is three times higher the figure (3%) for the non-life insurance in Ghana by Alhassan et al. (2015) and Asare et al. (2017) .

The financial weakness average of 0.386 indicates that the general insurers are maintaining 38.6% of their net written premiums as free reserves for the period under investigation. The average annual growth in gross premiums underwritten was 12.455%. The reinsurance usage in the industry was 43.9% over the eight-year period, consistent with the findings of Alhassan and Biekpe (2015, 2016a, 2017) in the South African insurance market. This result suggests that general insurers retain 56.1% of

gross premiums underwritten in the market for these insurers. This is indicative of a high usage of reinsurance contracts as a means of insurance risk diversification.

The results show a business diversification value of 0.38 which indicates moderate concentration. This reveals that the average firm operates in approximately three business lines. This is reaffirmed by Table 2 showing a concentration of premiums within the Property and Motor lines of business. Alhassan and Biekpe (2015; 2016) also found similar results for the general insurance market in South Africa between 2007 and 2012.

Table 4.2.: Summary Statistics

	LRE	TAXS	EMG	FINWEAK	GROWTH	REINS	BLDIV
Mean	4.849%	0.519	0.092	0.386	12.455	0.439	0.380
Std. Dev	13.653%	0.650	0.649	0.200	1.872	0.424	0.280
p10	-4.908%	0.179	-0.016	0.097	9.756	0.000	0.000
p25	-0.673%	0.374	0.009	0.260	11.327	0.091	0.017
p50	1.583%	0.513	0.044	0.387	12.547	0.372	0.462
p75	7.367%	0.622	0.117	0.536	13.739	0.748	0.623
p90	20.878%	0.762	0.205	0.638	14.759	0.939	0.706
Min	-36.227%	-0.671	-3.504	0.000	5.580	-0.002	-0.232
Max	69.308%	15.145	15.003	0.914	16.805	4.652	0.826
N	574	581	582	582	579	582	585

Note: LRE= 5 Year Weiss Loss reserve error; taxs=tax shield; emg=earnings management; finweak=financial weakness; growth=premium growth; reins=reinsurance ratio; bldiv=business line diversification. Source: Author's estimates from research data

4.3. Correlation Analysis

A basic assumption for linear regression models is the independence of the explanatory variables. In order to empirically examine the assumption with the data, the correlation coefficients of pairs of the independent variables are estimated and presented in the correlation matrix in Table 4.3. Following Kennedy (2008), estimated correlation coefficients of 0.7 have the potential to result in biased estimates of the regression estimates due to the incidence of multicollinearity Table 4.3. shows a strong association between the tax shield and earnings management, with a correlation of 0.9333. The estimation of the regression equation was undertaken by considering the observed strong correlation.

Table 4.3.: Correlation Matrix

	LRE	TAXS	EMG	FINWEAK	GROWTH	REINS	BLDIV
LRE	1.0000						
TAXS	0.9300***	1.0000					
EMG	0.9474***	0.9333***	1.0000				
FINWEAK	-0.0785*	0.1586***	-0.1100***	1.0000			
GROWTH	0.0365	0.1726***	0.0673	0.3551***	1.0000		
REINS	-0.0032	-0.0209	-0.0492	0.1984***	-0.0791*	1.0000	
BLDIV	0.0375	0.0793*	0.0269	0.2708***	0.3399***	0.1820***	1.0000

*Note: LRE= 5 Year Weiss Loss reserve error; taxs=tax shield; emg=earnings management; finweak=financial weakness; growth=premium growth; reins=reinsurance ratio; bldiv=business line diversification. ***, ** and * denotes significance at 1%, 5% and 10% respectively. Source: Author's estimates from research data*

4.4. Regression Results

This section displays and discusses the results of the regression estimates on the determinants of loss reserve errors in South Africa. As discussed in the previous chapter (Chapter 3), the regression model is estimated using the ordinary least squares panel corrected standard errors (OLS-PCSE), the fixed effects model (FEM) and the random effects model (REM) The model is estimated with and without the presence of multicollinearity.

The results of the regression coefficients without accounting for multicollinearity (including both tax shield and earning management variables) are presented in Table 4.4. From the model diagnostics. The investigation commences by comparing the OLS method with the random effect method using the Breusch-Pagan Lagrange Multiplier. The results show that there is enough evidence to reject the null-hypothesis (that there is no panel effect) and the researcher proceeds to use the Hausman test to identify whether to proceed with the random effects model or the fixed effects model. The Hausman test result leads to a rejection of the the null hypothesis (that the difference in coefficients is not systematic). Therefore, the ideal model to proceed with is the fixed effects model. The Wald statistic was found to be significant for all three models. The R-squared for the fixed effects model indicates that it explains 96.58% of the total variation in the industry loss reserve error, compared to 92.75% under the random effects model.

Table 4.4.: Regression Results

Techniques	**OLS-PCSE**		**FEM**		**REM**	
	Coef.	*z*	*Coef.*	*t*	*Coef.*	*z*
Constant	0.057	0.53	0.278	1.34	0.161	1.08
	(0.107)		(0.208)		(0.149)	
TAXS	1.346	6.63***	1.764	25.64***	1.692	24.58***
	(0.203)		(0.069)		(0.069)	
EMG	0.553	2.74***	0.194	2.88***	0.256	3.79***
	(0.202)		(0.067)		(0.068)	
FINWEAK	-0.982	-4.87***	-1.157	-9.79***	-1.156	-10.66***
	(0.202)		(0.118)		(0.108)	
GROWTH	-0.036	-4.42***	-0.057	-3.29***	-0.048	-3.78***
	(0.008)		(0.017)		(0.013)	
REINS	0.177	4.74***	0.071	1.36	0.115	2.55**
	(0.037)		(0.052)		(0.045)	
BLDIV	0.112	2.08**	0.030	0.26	0.082	1.02
	(0.054)		(0.112)		(0.080)	
Wald (6)/F	1641.91		2271.35		13354.62	
Prob > χ^2	0.0000		0.0000		0.0000	
R-squared	0.9298		0.9658		0.9275	
Hausman test χ^2	32.715					
Prob > χ^2	0.0000					
BPLM Test: $\hat{\chi}$	362.36					
Prob > $\hat{\chi}$	0.0000					
Insurers	79		79		79	
Observations	568		568		568	

*Note: WLR5= Weiss Loss reserve error; taxs=tax shield; emg=earnings management; finweak=financial weakness; growth=premium growth; reins=reinsurance ratio; bldiv=business line diversification. BPLM= Breusch-Pagan Lagrange Multiplier test of random effects; ***, ** and * denotes significance at 1%, 5% and 10% respectively. Source: Author's estimates from research data*

The coefficient of tax shield is positive and significant at the 1% level in all three estimation techniques to indicate that higher shields result in higher (positive) reserve errors (over-reserving). This suggests that tax incentives play an important role in the loss reserving estimates of general insurers in South Africa and supports the assertion by Grace (1990) that insurers tend to over-estimate reserves as taxable income increases in order to reduce their current tax obligations. This finding is consistent with the findings of Grace and Leverty (2012) and Kamiya and Milidonis (2016) for the property-liability market in US.

It also emerges that the proxy for earnings management, return on assets, has a positive relationship with loss reserve errors and is significant at the 1% level across all three techniques. This suggests that return on assets is also significant to the loss reserving estimation within South African general insurers. Higher returns on assets result in

higher (positive) reserve errors (over-reserving). This finding supports the assertion by Beaver et al. (2003) that the insurance companies with the strongest financial results tend to over-reserve the most. In South Africa, this finding can be explained by a tendency to balance superior investment returns with higher reserves, in an effort to ensure smooth income results (and hence give a sense of stability and more predictability which improves investor perceptions) and not to inflate the balance sheet. This could also be in an effort not to dilute earnings or superior returns by high tax charges. This consequently explains the high correlation with the tax shield as indicated Table 4.3.

There is an inverse relationship between financial weakness, as measured by the solvency ratio, and loss reserve errors. Thus, the solvency ratio is found to move in the opposite direction of the reserve error. As a firm's finances strengthened, their loss reserve errors decreased. This is found to be significant at the 1% level across all three models, indicating that the financial strength of general insurer is significant to the loss reserve estimation of general insurers in South Africa. This is in line with the findings of Petroni (1992) and this may indicate a tendency to manipulate loss reserves to display stronger financial results, at the risk of accurate reserves.

Growth, as indicated by the growth in net written premiums, was also found to have an inverse relationship with loss reserve errors and to be significant at the 1% level across all models. Therefore, growth is also found to be a significant contributor to the loss reserve estimation in the South African general insurance market. This suggests that as the net premiums written increase over time, firms tend to under-reserve. This supports the findings of Grace and Leverty (2010). For a rapidly growing insurer, there may be greater uncertainty which may warrant higher (positive) loss reserve errors. However, the results show a tendency to under-reserve, which may point towards a tendency to portray lower liabilities to balance the capital investment locked up due to the growth or expansion. This also assists with the pricing of new products. Lower reserves may allow an insurer to set lower premiums which is largely due to the fact that larger free reserves result in greater scope for competitive pricing. Within a pricing model, typical cashflow elements which must be allowed for include contributions to the product reserves, statutory reserves and the solvency capital requirements, as well as the interest on reserves. Depending on the sign, these can be considered as income or expenses, but are usually regarded as expenses. When pricing products which have options or

guarantess, the cost of the additional reserves must be incorporated into the premium. Otherwise, some other party will be paying for the cost of guarantees (ActEd, 2015).

Reinsurance and business line diversification were found to be the least significant variables in the random effect and fixed effect models. Reinsurance was found to be significant at the 1% level for the OLS model and significant in the random effect model at the 5% level. It was not found be significant in the fixed effects model. It has a positive relationship with loss reserve errors, indicating that firms which cede a greater percentage of their gross premiums to their reinsurers are more likely to have higher absolute loss reserve errors. This is in contrast to the observations of Browne et al. (2012) and Grace and Leverty (2012b). This is likely to be due to the fact that the direct insurers are still required to be, and regarded as, the key responsible party for claims payment. In some instances, the reinsurer places its reserves for business ceded to it, with the direct insurer. Therefore, it can be concluded that South African general insurers do not place weight on the existence of reinsurance for the calculation or manipulation of reserves.

Business line diversification was only found to be significant in the OLS model at the 5% level. It is also found to have a positive relationship with the loss reserve errors, indicating that greater business line diversification is associated with over-reserving. Although this is considered not to be significant, this may be due to the compounding effect across several lines. This is primarily due to the fact that reserving for the South African general insurance market is conducted individually by business line. If there is a market tendency to over-reserve, this is likely to apply for each line and this impact accumulates further, the more business lines that are available.

4.4.1. Accounting for Multicollinearity

Due to the observed high correlation between tax shield and earnings management in Table 4.3., with a correlation coefficient of 0.9333, the regression model was re-estimated using a stepwise approach to account for multicollinearity between tax shield (TAXS) and earnings management (EMG). From Table 4.5., Model 1 has TAXS as an explanatory variable with EMG, while Model 2 has EMG as an explanatory variable without TAXS. Consistent with the first estimation in Table 4.4., the model is estimated using OLS, and the random effect techniques. The results of the Breusch-Pagan Lagrange Multiplier however show that there is enough evidence to reject the null-

hypothesis (that there is no panel effect) in both cases. Hence, the random is preferred over the OLS. The choice of random effects versus fixed effects was examined by the Hausman (1978) test. Proceeding on the null hypothesis of random effects, the result does not provide enough evidence for the researcher to reject the null hypothesis (that the difference in coefficients is not systematic) at the 1% and 5% significance levels. Hence, the results from the random effects technique are preferred in both Model 1 and 2. In both models, the significance of the Wald statistics indicates the joint significance of the independent variables in explaining variations in loss reserve errors. The R-squared of 0.9236 and 0.9012 in Models 1 and 2 respectively suggests that 92.36% and 90.12% variations in LRE are explained by firm level characteristics when accounting for multicollinearity.

From Model 1, the coefficient of tax shield is found to have a positive relationship with the loss reserve errors at 1% in all three techniques. This is consistent with the findings of Grace (1990), Grace and Leverty (2012) and Kamiya and Milidonis (2016) who find that insurers manipulated loss reserves in order to defer the tax bill. In Model 2, this coefficient of earning management is also found to have a positive relationship with loss reserve errors at 1% level across all three estimation techniques. This finding is also consistent with the assertions of Beaver et al. (2003) that insurers manipulate loss reserves to smooth earnings and avoid losses .

Insurance companies with the strong financial health results and/or higher taxable income tend to over-reserve the most. This allows these South African general insurers to protect their strong income statements and balance sheets from that eroding impact of tax (temporarily). Given the significance of premium growth among these insurers, the deferral of tax may play a role in providing interest-free capital to the business to support further growth in business in the hope that this new business will adequately cover for the tax deferral in the future when it becomes due. As noted above, this may also allow the insurer to charge lower premiums to support business growth. However, future premiums may have to increase rapidly to compensate for the under-reserving in earlier periods as the claims materialise.

Table 4.5.: Regression Results

Models	**MODEL 1**			**MODEL 2**		
Techniques	***OLS-PCSE***	***FEM***	***REM***	***OLS-PCSE***	***FEM***	***REM***
	Coef.	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**
Constant	0.024	0.347*	0.214	0.122	-1.370***	0.041
	(0.089)	(0.208)	(0.158)	(0.227)	(0.278)	(0.123)
TAXS	1.887***	1.956***	1.947***			
	(0.051)	(0.017)	(0.017)			
EMG				1.846***	1.835***	1.861***
				(0.076)	(0.030)	(0.178)
FINWEAK	-1.472***	-1.336***	-1.379***	0.192**	0.380*	0.249
	(0.087)	(0.101)	(0.091)	(0.088)	(0.205)	(0.167)
PG	-0.038***	-0.063***	-0.054***	-0.027*	0.084**	-0.020*
	(0.007)	(0.017)	(0.013)	(0.015)	(0.041)	(0.012)
REINS	0.196***	0.067	0.107**	0.127***	0.107	0.117*
	(0.039)	(0.052)	(0.046)	(0.038)	(0.094)	(0.064)
BLDIV	0.144**	0.036	0.092	0.041	0.136	0.003
	(0.058)	(0.113)	(0.084)	(0.049)	(0.231)	(0.094)
R-squared	0.9249	0.9652	0.9236	0.9014	0.9192	0.9012
Wald > χ^2/ F (5)	1405.28	2683.37	13545.69	623.35	1101.11	144.95
Prob > > χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test > χ^2	10.757			4.513		
Prob > χ^2	0.0564			0.4781		
BPLM Test: $\hat{\chi}$	439.21			60.38		
Prob > $\hat{\chi}$	0.0000			0.0000		
Insurers	79	79	79	79	79	79
Observations	568	568	568	568	568	568

*Note:Tax shield; emg=earnings management; finweak=financial weakness; growth=premium growth; reins=reinsurance ratio; bldiv=business line diversification. BPLM= Breusch-Pagan Lagrange Multiplier test of random effects; ***, ** and * denotes significance at 1%, 5% and 10% respectively. Source: Author's estimates from research data*

Across all techniques, there is a significant (at 1% significance level) inverse relationship between financial weakness and loss reserve errors. This indicates Therefore, once again, the solvency ratio is found to move in the opposite direction of the reserve error, in support of Petroni (1992). However, interestingly, the reverse is true when the model includes earnings management, instead of the tax shield. The relationship becomes direct and the variable is not found to be as significant (only at the 10% level for the fixed effects model and is not found to be significant for the random effects model).

In the models with the tax shield, growth was also found to have an inverse relationship with loss reserve errors and to be significant at the 1% level across all models. As the net premiums written increase over time, firms tend to under-reserve. This is, once again, consistent with the findings of Grace and Leverty (2010). In the models with earnings management, it was not found to be as significant (10% significance for the random effects model).

In the models with the tax shield, reinsurance was found the be significant at the 1% level for the OLS model and significant in the random effect model at the 5% level. It was not found be significant in the fixed effects model. It has a positive relationship with loss reserve errors, indicating that firms which cede a greater percentage of their gross premiums to their reinsurers are more likely to show higher absolute loss reserve errors. When earnings management is included in the model, the results are similar, with the exception that the variable is only significant at the 10% level in the random effects model.

Business line diversification was only found to be significant in the OLS model at the 5% level, when the tax shield is included in the model. It was also found to have a positive relationship with the loss reserve errors indicating that greater business line diversification is associated with over-reserving. Once again, the significance of reinsurance and business line diversification was brought into question and these were not found to be critical determinants to the loss reserve estimation within South African general insurers.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter concludes the study on the determinants of loss reserve errors in the general insurance market in South Africa. This includes the summary of the study and the conclusions drawn from the empirical discussions in Chapter Four. It also discusses the policy recommendations based on the conclusions and recommendations for future research. The chapter ends with the limitations encountered in the undertaking of the research.

5.2. Summary of the Study

This investigation examined the key determinants of loss reserves, the largest liability on the balance sheet of general insurance companies. The investigation made use of the annual financial returns of 79 general insurers in South Africa, from 2007 to 2014. The Weiss approach was adopted to calculate the loss reserves, using the run-off triangles showing the development of claims during this period, on a quarterly basis.

This particular investigation was motivated by the fact that loss reserve errors have not been investigated in South African general insurers, unlike the United States of America, Canadian, United Kingdom and Ghanaian general insurance markets. Given that the key driver of the financial results within insurance companies is often the loss reserve, the ability to estimate this as accurately as possible is critical to the financial health and sustainability of insurance business. The financial strength of insurers is essential for sustainable economic growth. Therefore, the accuracy of loss reserves is a contributing factor to economic development.

The analysis adopted the ordinary least squares estimation (OLS) technique, the random and fixed effects technique. Additionally, the models were run using the step-wise approach to allow for the multi-collinearity that existed within the data. The most accurate model was found to be the random effects model with the tax shield variable.

Overall, the findings from the empirical analysis suggest that the existence of errors in the estimation loss reserve, with the industry mostly characterised by insurers who over-reserve.

5.3. Conclusion

The random effects model with the tax shield variable provides the highest R-squared value of the random-effects models once multi-collinearity is allowed for. It explains 92.4% of the total variation in the industry loss reserve error. The most significant variables of this model were found to be tax shield, financial weakness and growth.

The relationship with tax incentives is found to be positive, showing that insurers tend to over-estimate reserves as taxable income increases, in order to reduce their current tax obligations. Therefore, there is insufficient evidence to reject H1, as described in Section 1.2.

Financial weakness, measured using the solvency margin, was found to have an inverse relationship with loss reserve errors. As a firm's finances were seen to strengthen, its reserves tended to be more accurate, as indicated by decreasing loss reserve errors. Therefore, there is insufficient evidence to reject H3.

Growth, measured using the growth of net premiums written, was seen to have an inverse relationship with loss reserve errors as well. As the net premiums written of a firm increased over time, the firm tended to produce more accurate loss reserves, as indicated by lower loss reserve errors. Therefore, there is insufficient evidence to reject H4.

The results showed that the relatively larger insurers, or those with fast growing net premiums written or lower taxable income are found to reserve more accurately compared to other insurers.

Business line diversification and reinsurance were not found to be significant variables in the models. Therefore, there is sufficient evidence to reject H5 and H6. This was in contrast to the findings of Browne et al. (2012) and Grace and Leverty (2012b).

The findings of this investigation were similar to the findings of other researchers in other jurisdictions. The above results support those of Grace (1990), Grace and Leverty (2012) and Kamiya and Milidonis (2016), Beaver et al. (2003) and also Petroni (1992)

5.4. Limitations

The main limitations related to this investigation were the quality of reserving data available. Several insurers, particularly the smaller and younger insurers rarely populated the claims run-off triangles in full, with several insurers only populating the last or first quarter of the year. Although the run-off triangles were presented in quarters, none of the other financial information available from the statutory financial returns was available for each quarter. This created challenges in estimating the W-error in some instances.

Several insurers were found not to populate Section 4 of the reserving triangles in full. This information provides the researcher with an indication of the updated reserves and the split of the total reserve by the past years. In cases where they were populated, the reserves were not updated each year. This made it difficult to estimate the KFS-error.

Additionally, in several cases, insurers did not have all eight years of financial returns. In some cases, it was because they commenced business after 2008 or closed for business, were acquired or merged with another insure before 2014. In several cases, it was possible to identify the new company name and combine the financial returns over the several years appropriately.

5.5. Recommendations

The findings of this investigation may have implications for the management and regulation of general insurance companies in South Africa, and ultimately, for more prudent oversight of the economy. There are additional measures and studies that could be pursued to ensure that the determinants of loss reserve errors are better understood in the South African general insurance industry.

The annual financial returns should be filled in completely, with appropriate updates being applied to the reserving breakdown every year. This would allow a similar investigation to be conducted using the KFS-method.

A more robust investigation could be conducted if the quarterly reports of the general insurance companies could be obtained, as this could assist in identifying any annual seasonality in the data.

Further investigation of the loss reserve errors by business line may be instrumental in identifying the areas that are more subject to manipulation and hence significant loss reserve errors. The data required for this exercise is available in the current format of annual financial returns. For further investigation, the independence of reserving actuaries should also be indicated in the data collated to understand whether the independent position of the reserving actuary is a significant variable in the control of case persistent reserving errors.

In addition, future research could also examine the role of executive compensation and corporate governance in explaining reserving errors in the South Africa. This would help in examining the role of insurance management manipulation of loss reserves, depending on the design of executive compensation packages and board structures that are present, as has been noted in the United States of America. This research would be instrumental in identifying whether executive compensation packages which are designed to align the interests of shareholders and management, have repurcussions in the exercise of discretion over accounting and actuarial practices to maximise their utility (Eckles et al., 2011).

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Appendix A: Calculation of W-error and KFS -error

Given that the financial returns are provided in the same format for the different insurers, reference will be made to the format provided in the files used.

Key Tab: D1 (the claims development for the whole general insurers for one reporting year are in this tab).

Description of D1:

- Section 1: Development quarter during which claims were paid
- Section 2: Development quarter which changes occurred in claims liability
- Section 3: Development quarter which claims were reported

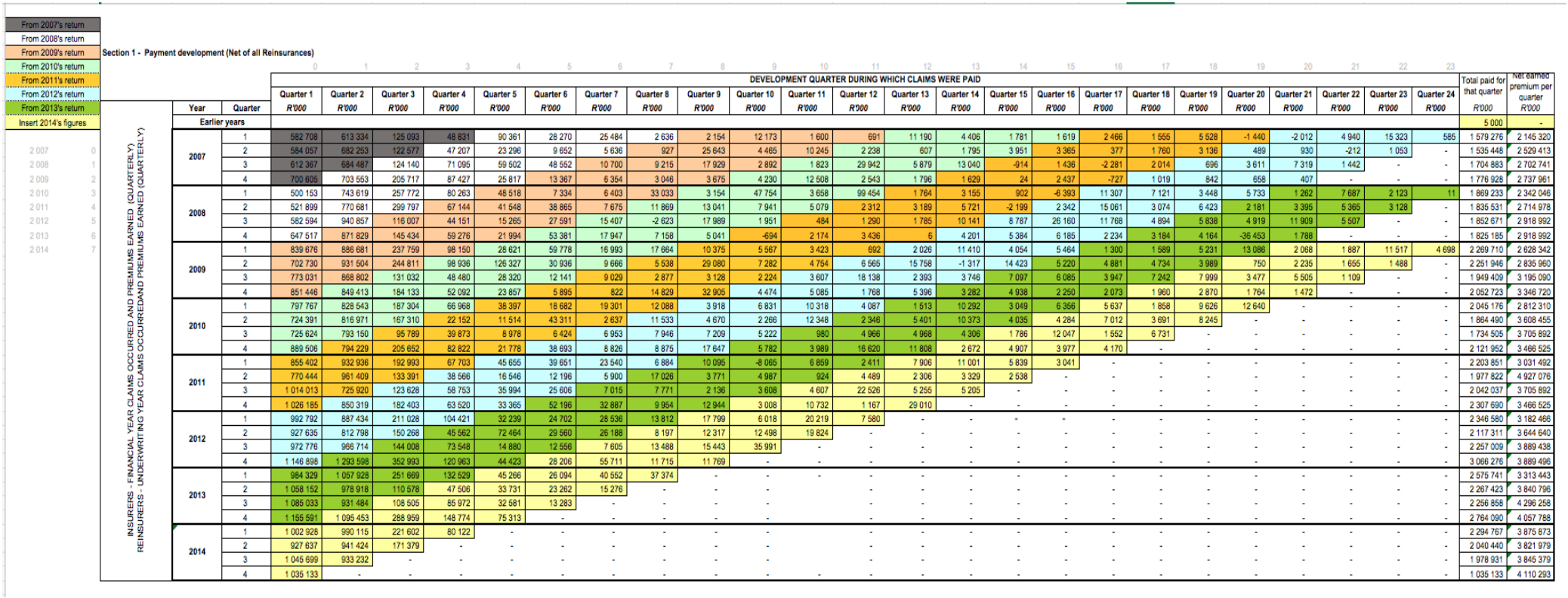
The calculation of the W-error starts by developing the complete run-off triangle. This is done by taking the most recent run-off triangles from the 2014 financial returns, which covers the latest development of claims from 2009 to 2014. The 2008 claims development is obtained from the 2013 financial returns and the 2012 claims development is obtained from the 2012 financial returns. This is done because these years' financial returns provide the latest available claims development for these earlier years.

Due to the fact that the financials are provided at an annual level, the triangles were synthesised in their quarterly format and then collapsed to annual loss reserve errors for purposes of the loss reserve error analysis.

Below is a combination of the run-off triangles to obtain eight years of the claims developed.

For example, R237 759 of the claims incurred in the first quarter of 2009 were paid in the third quarter of 2009 while R1 045 699 of the claims incurred in third quarter of 2014 were paid in the same quarter.

Figure 3: An Example of a Run-Off Triangle



From 2007's return
From 2008's return
From 2009's return
From 2010's return
From 2011's return
From 2012's return
From 2013's return
Insert 2014's figures

Section 1 - Payment development (Net of all Reinsurances)

INSURERS - FINANCIAL YEAR CLAIMS OCCURRED AND PREMIUMS EARNED (QUARTERLY)
REINSURERS - UNDERWRITING YEAR CLAIMS OCCURREDAND PREMIUMS EARNED (QUARTERLY)

			DEVELOPMENT QUARTER DURING WHICH CLAIMS WERE PAID																								Total paid for that quarter	Net earned premium per quarter
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
			Quarter 1 R'000	Quarter 2 R'000	Quarter 3 R'000	Quarter 4 R'000	Quarter 5 R'000	Quarter 6 R'000	Quarter 7 R'000	Quarter 8 R'000	Quarter 9 R'000	Quarter 10 R'000	Quarter 11 R'000	Quarter 12 R'000	Quarter 13 R'000	Quarter 14 R'000	Quarter 15 R'000	Quarter 16 R'000	Quarter 17 R'000	Quarter 18 R'000	Quarter 19 R'000	Quarter 20 R'000	Quarter 21 R'000	Quarter 22 R'000	Quarter 23 R'000	Quarter 24 R'000	R'000	R'000
Year	Quarter	Earlier years																									5 000	-
2007	1		582 708	613 334	125 093	48 831	90 361	28 270	25 484	2 636	2 154	12 173	1 600	691	11 190	4 406	1 781	1 619	2 466	1 555	5 528	-1 440	-2 012	4 940	15 323	585	1 579 276	2 145 320
	2		584 057	682 253	122 577	47 207	23 296	9 652	5 636	927	25 643	4 465	10 245	2 238	607	1 795	3 951	3 365	377	1 760	3 136	489	930	-212	1 053	-	1 535 448	2 529 413
	3		612 367	684 487	124 140	71 095	59 502	48 552	10 700	9 215	17 929	2 892	1 823	29 942	5 879	13 040	-914	1 436	-2 281	2 014	696	3 611	7 319	1 442	-	-	1 704 883	2 702 741
	4		700 605	703 553	205 717	87 427	25 817	13 367	6 354	3 046	3 675	4 230	12 508	2 543	1 796	1 629	24	2 437	-727	1 019	842	658	407	-	-	-	1 776 928	2 737 961
2008	1		500 153	743 619	257 772	80 263	48 518	7 334	6 403	33 033	3 154	47 754	3 658	99 454	1 764	3 155	902	-6 393	11 307	7 121	3 448	5 733	1 262	7 687	2 123	11	1 869 233	2 342 046
	2		521 899	770 681	299 797	67 144	41 548	38 865	7 675	11 869	13 041	7 941	5 079	2 312	3 189	5 721	-2 199	2 342	15 061	3 074	6 423	2 181	3 395	5 365	3 128	-	1 835 531	2 714 978
	3		582 594	940 857	116 007	44 151	15 265	27 591	15 407	-2 623	17 989	1 951	484	1 290	1 785	10 141	8 787	26 160	11 768	4 894	5 838	4 919	11 909	5 507	-	-	1 852 671	2 918 992
	4		647 517	871 829	145 434	59 276	21 994	53 381	17 947	7 158	5 041	-694	2 174	3 436	6	4 201	5 384	6 185	2 234	3 184	4 164	-36 453	1 788	-	-	-	1 826 185	2 918 992
2009	1		839 676	886 681	237 759	98 150	28 621	59 778	16 993	17 664	10 375	5 567	3 423	692	2 026	11 410	4 054	5 464	1 300	1 589	5 231	13 086	2 068	1 887	11 517	4 698	2 269 710	2 628 342
	2		702 730	931 504	244 811	98 936	126 327	30 936	9 666	5 538	29 080	7 282	4 754	6 565	15 758	-1 317	14 423	5 220	4 881	4 734	3 989	750	2 235	1 655	1 488	-	2 251 946	2 835 960
	3		773 031	868 802	131 032	48 480	28 320	12 141	9 029	2 877	3 128	2 224	3 607	18 138	2 393	3 746	7 097	6 085	3 947	7 242	7 999	3 477	5 505	1 109	-	-	1 949 409	3 195 090
	4		851 446	849 413	184 133	52 092	23 857	5 895	822	14 829	32 905	4 474	5 085	1 768	5 396	3 282	4 938	2 250	2 073	1 960	2 870	1 764	1 472	-	-	-	2 052 723	3 346 720
2010	1		797 767	828 543	187 304	66 968	38 397	18 682	19 301	12 088	3 918	6 831	10 318	4 087	1 513	10 292	3 049	6 356	5 637	1 858	9 626	12 640	-	-	-	-	2 045 176	2 812 310
	2		724 391	816 971	167 310	22 152	11 514	43 311	2 637	11 533	4 670	2 266	12 348	2 346	5 401	10 373	4 035	4 284	7 012	3 691	8 245	-	-	-	-	-	1 864 490	3 608 455
	3		725 624	793 150	95 789	39 873	8 978	6 424	6 953	7 946	7 209	5 222	980	4 966	4 968	4 306	1 786	12 047	1 552	6 731	-	-	-	-	-	-	1 734 505	3 705 892
	4		889 506	794 229	205 652	82 822	21 778	38 693	8 826	8 875	17 647	5 782	3 989	16 620	11 808	2 672	4 907	3 977	4 170	-	-	-	-	-	-	-	2 121 952	3 466 525
2011	1		855 402	932 936	192 993	67 703	45 655	39 651	23 540	6 884	10 095	-8 065	6 859	2 411	7 906	11 001	5 839	3 041	-	-	-	-	-	-	-	-	2 203 851	3 031 492
	2		770 444	961 409	133 391	38 566	16 546	12 196	5 900	17 026	3 771	4 987	924	4 489	2 306	3 329	2 538	-	-	-	-	-	-	-	-	-	1 977 822	4 927 076
	3		1 014 013	725 920	123 628	58 753	35 994	25 606	7 015	7 771	2 136	3 608	4 607	22 526	5 255	5 205	-	-	-	-	-	-	-	-	-	-	2 042 037	3 705 892
	4		1 026 185	850 319	182 403	63 520	33 365	52 196	32 887	9 954	12 944	3 008	10 732	1 167	29 010	-	-	-	-	-	-	-	-	-	-	-	2 307 690	3 466 525
2012	1		992 792	887 434	211 028	104 421	32 239	24 702	28 536	13 812	17 799	6 018	20 219	7 580	-	-	-	-	-	-	-	-	-	-	-	-	2 346 580	3 182 466
	2		927 635	812 798	150 268	45 562	72 464	29 560	26 188	8 197	12 317	12 498	19 824	-	-	-	-	-	-	-	-	-	-	-	-	-	2 117 311	3 644 640
	3		972 776	966 714	144 008	73 548	14 880	12 556	7 605	13 488	15 443	35 991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 257 009	3 889 438
	4		1 146 898	1 293 598	352 993	120 963	44 423	28 206	55 711	11 715	11 769	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3 066 276	3 889 496
2013	1		984 329	1 057 928	251 669	132 529	45 266	26 094	40 562	37 374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 575 741	3 313 443
	2		1 058 152	978 918	110 578	47 506	33 731	23 262	15 276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 267 423	3 840 796
	3		1 085 033	931 484	108 505	85 972	32 581	13 283	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 256 858	4 296 258
	4		1 155 591	1 095 453	288 959	148 774	75 313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 764 090	4 057 788
2014	1		1 002 928	990 115	221 602	80 122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 294 767	3 875 873
	2		927 637	941 424	171 379	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 040 440	3 821 979
	3		1 045 699	933 232	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 978 931	3 845 379
	4		1 035 133	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 035 133	4 110 293

A total of R7 349 271 of claims were incurred in 2014 and paid in 2014, and R2 117 901 of claims were paid in 2014, but incurred in 2013.

A total of R9 864 112 of claims have been paid for claims which were incurred in 2013.

Figure 4: Annualised Run-Off Triangle and Claims Development

Annual transformation

INSURERS - FINANCIAL YEAR CLAIMS OCCURRED AND PREMIUMS EARNED (QUARTERLY) REINSURERS - UNDERWRITING YEAR CLAIMS OCCURREDAND	Year	DEVELOPMENT YEAR DURING WHICH CLAIMS WERE PAID						Total paid for that year	Net earned premium per year	Total paid for that year - 1 DevYrs	Total paid for that year - 2 DevYrs	Total paid for that year - 3 DevYrs	Total paid for that year - 4 DevYrs	Total paid for that year - 5 DevYrs
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5							
		R'000	*R'000*	*R'000*	*R'000*	*R'000*	*R'000*	*R'000*	*R'000*	*R'001*	*R'000*	*R'000*	*R'000*	*R'001*
	2007	4 756 312	1 558 343	125 077	99 347	20 365	37 090	6 596 535	10 115 435	6 314 655	6 439 733	6 539 080	6 559 445	6 596 535
	2008	5 345 151	1 552 064	308 202	27 073	124 122	26 008	7 382 620	10 895 008	6 897 215	7 205 417	7 232 490	7 356 612	7 382 620
	2009	6 434 591	1 718 391	138 419	102 990	76 944	52 454	8 523 789	12 006 111	8 152 982	8 291 401	8 394 391	8 471 335	8 523 789
	2010	5 997 534	1 423 629	157 342	96 784	90 835	-	7 766 123	13 593 182	7 421 162	7 578 504	7 675 288	7 766 123	7 766 123
	2011	6 680 395	1 562 526	166 519	121 959	-	-	8 531 399	15 130 985	8 242 921	8 409 440	8 531 399	8 531 399	8 531 399
	2012	7 172 764	2 330 032	284 380	-	-	-	9 787 176	14 606 039	9 502 796	9 787 176	9 787 176	9 787 176	9 787 176
	2013	7 746 211	2 117 901	-	-	-	-	9 864 112	15 508 285	9 864 112	9 864 112	9 864 112	9 864 112	9 864 112
	2014	7 349 271	-	-	-	-	-	7 349 271	15 653 524	7 349 271	7 349 271	7 349 271	7 349 271	7 349 271

The IBNR reserve of R4 522 642 declared for 2014 is distributed across six years, from 2009 to 2014. R2 941 798 of the R4 522 642 is attributable to claims that were incurred in 2014, while R486 369 of the R4 522 642 is attributable to claims that were incurred in 2013 etc.

Figure 5: Spread of Reserves

Reserving Development from D1

Split of IBNR Across the Years

Incurred Year	2007	2008	2009	2010	2011	2012	2013	2014	
2007	2 169 447								2 169 447
2008	589 466	2 127 967							2 717 432
2009	207 564	325 990	585 670						1 119 224
2010	140 832	312 468	503 755	2 236 059					3 193 113
2011	102 730	245 875	322 373	557 785	2 455 368				3 684 130
2012	95 846	174 613	245 881	362 200	622 576	3 127 017			4 628 133
2013		156 934	162 888	260 933	412 494	632 016	3 092 181		4 717 446
2014			183 114	215 666	314 938	380 757	486 369	2 941 798	4 522 642

Key Tab: B5: Net Underwriting Results

This tab sets out the net claims incurred for each financial year.

The table below shows the results of the W-error calculation errors. The loss reserve errors are calculated as being the difference between the initial estimated incurred losses and the losses as actually developed after t periods. The losses actually developed are obtained from the net underwriting results. The loss reserve error percentages are obtained by making the difference a proportion of the initial estimated loss.

Figure 6: Calculation of W-errors

		11	12	13	14	15	15							
		1 Yr Loss Development	2 Yr Loss Development	3 Yr Loss Development	4 Yr Loss Development	5 Yr Loss Development	Ultimate Loss Development	Initial Estimated Reserve	Year 1 Claims Development	Net Claims Incurred	1 Yr Loss Reserve Error	2 Yr Loss Reserve Error	3 Yr Loss Reserve Error	4 Yr Loss Reserve Error	5 Yr Loss Reserve Error
2	2007	6 314 655	6 439 733	6 539 080	6 559 445	6 596 535	6 596 535	2 169 447	4 756 312	6 821 654	506 999	381 921	282 574	262 209	225 119
3	2008	6 897 215	7 205 417	7 232 490	7 356 612	7 382 620	7 382 620	2 127 967	5 345 151	7 436 896	539 681	231 479	204 406	80 284	54 276
4	2009	8 152 982	8 291 401	8 394 391	8 471 335	8 523 789	8 523 789	585 670	6 434 591	8 614 561	461 579	323 160	220 170	143 226	90 772
5	2010	7 421 162	7 578 504	7 675 288	7 766 123	7 766 123	7 766 123	2 236 059	5 997 534	8 018 751	597 589	440 247	343 463	252 628	252 628
6	2011	8 242 921	8 409 440	8 531 399	8 531 399	8 531 399	8 531 399	2 455 368	6 680 395	8 735 759	492 838	326 319	204 360	204 360	204 360
7	2012	9 502 796	9 787 176	9 787 176	9 787 176	9 787 176	9 787 176	3 127 017	7 172 764	9 916 971	414 175	129 795	129 795	129 795	129 795
8	2013	9 864 112	9 864 112	9 864 112	9 864 112	9 864 112	9 864 112	3 092 181	7 746 211	10 961 373	1 097 261	1 097 261	1 097 261	1 097 261	1 097 261
9	2014	7 349 271	7 349 271	7 349 271	7 349 271	7 349 271	7 349 271	2 941 798	7 349 271	10 086 666	2 737 394	2 737 394	2 737 394	2 737 394	2 737 394

The original and adjusted IBNRs are available in Section 4 of D1, as shown below.

Figure 7: Section 4 of D1

Section 4 - Reserving development

		FINANCIAL YEAR DURING WHICH THE CLAIMS OCCURRED							Total for all years
		Earlier	2009	2010	2011	2012	2013	2014	
		R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
	Outstanding claims net of all reinsurances								
4	Provisions made at end of this year	163 159	181 297	180 688	260 293	293 076	377 464	2 100 701	3 556 678
5	Original provisions at year-ends at the top of each column		1 666 847	1 601 133	1 788 511	2 391 193	2 267 170	2 100 701	
	Claims incurred but not reported (IBNR) net of all reinsurances								
6	Provisions made at end of this year	0	1 817	34 978	54 645	87 681	108 905	841 097	1 129 123
7	Original provisions at year-ends at the top of each column		602 747	634 925	666 858	735 824	825 013	841 097	

8	Total claims - original estimate (1+5+7)	8 704 186	8 233 593	9 135 764	10 299 781	10 838 394
9	Total claims - adjusted estimate (1+2+4+6)	8 706 903	7 981 789	8 846 337	10 167 933	10 350 481
10	**Sufficiency of total claims provision - 9 as a percentage of 8**	100%	97%	97%	99%	95%
11	OCR + IBNR - original estimate (5+7)	2 269 595	2 236 059	2 455 368	3 127 017	3 092 183
12	OCR + IBNR - adjusted estimate (2+4+6)	2 272 312	1 984 255	2 165 942	2 995 169	2 604 270
13	**Sufficiency of OCR + IBNR reserves - 12 as a percentage of 11**	100%	89%	88%	96%	84%
14	IBNR - original estimate (7)	602 747	634 925	666 858	735 824	825 013
15	IBNR - adjusted estimate (3+6)	486 478	482 786	543 756	694 101	648 020
16	**Sufficiency of IBNR reserve - 15 as a percentage of 14**	81%	76%	82%	94%	79%

The difference between the original and adjusted estimates provides the aggregated KFS-errors (from year one to year five) for each incurred year. However, a more detailed calculation was performed to obtain the KFS-error by development year. Below is a

representation of the KFS-errors for this insurer. The KFS-error is regarded as being the difference between the initial estimated reserve and the revised estimated reserve.

Figure 8: Calculation of KFS-error

Year Claims Occurred

	2007	2008	2009	2010	2011	2012	2013	2014
Original Reserve	2 169 447	2 127 967	585 670	2 236 059	2 455 368	3 127 017	3 092 181	2 941 798
1 yr KFS Reserving Error	21 638	118 556	(1 636 476)	254 646	270 266	164 969	487 911	-
2 yr KFS Reserving Error	514 226	(44 767)	(1 593 513)	292 888	313 829	131 848	487 911	-
3 yr KFS Reserving Error	245 847	(5 246)	(1 620 011)	297 371	289 426	131 848	487 911	-
4 yr KFS Reserving Error	263 585	(58 107)	(1 613 962)	251 804	289 426	131 848	487 911	-
5 yr KFS Reserving Error	233 378	(66 436)	(1 686 642)	251 804	289 426	131 848	487 911	-
6 yr KFS Reserving Error	233 378	(66 436)	(1 613 962)	251 804	289 426	131 848	487 911	-