

EFFICIENCY, COMPETITION AND RISK-TAKING BEHAVIOUR IN THE SHORT-TERM INSURANCE MARKET IN SOUTH AFRICA

Thesis presented for the **Degree of Doctor of Philosophy** in the Faculty of Commerce, Graduate School of Business at the University of Cape Town

By

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JANUARY, 2016

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Declaration

I, **Abdul Latif Alhassan**, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.



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Abdul Latif Alhassan

Abstract

In the regulation of financial services markets, policy makers have generally pursued the twin-goal of improving efficiency and competition to promote stability. This has stimulated academic inquiries into measurement and assessment of efficiency; competition and its effects on market stability in the achievement of these regulatory objectives. Despite the recognition of the role of insurance markets in complementing other financial services to promote economic growth in emerging markets; studies examining the industrial organization and microeconomics of insurance markets appear to be more focused on developed markets. Against this background, this thesis presents a collection of empirical papers on the efficiency, competition and stability of the largest short-term insurance market in Africa. Specifically, annual firm level data on 80 firms in the short-term insurance market in South Africa from 2007 to 2012 is employed to examine several industrial economics theories using a series of panel data econometric techniques.

The findings from the empirical analysis are summarized as follows: First, the results from the data envelopment analysis technique indicate that short-term insurers operate at about 50% of their productive capacity, with only 20% of insurers operating at an optimal scale. Productivity growth, which reflects efficiency changes over time, is attributable to technological changes. Firm size, product line diversification, reinsurance and leverage are identified as the significant determinants of efficiency and probability of operating at constant returns to scale. The effect of size was, however, found to be non-linear. Over the study period, the results of convergence analysis suggest a slower rate of 'catch-up' by inefficient firms.

Second, the estimates of the Panzar-Rosse H-statistic suggest that short-term insurers in South Africa earn their revenues under conditions of monopolistic competition. Further analysis also reveals that competitive pressures in the market are driven by the activities of small, foreign-owned and single-line insurers. Using the stochastic frontier analysis, average cost and profit efficiency scores of 80.08% and 45.71% respectively suggest that short-term insurers have high levels of efficiency in cost and low efficiency in profit. Competition is found to be positively related to cost and profit efficiency to validate the "Quiet-Life" hypothesis that competition improves efficiency. In examining a broader set of firm level characteristics that drive the exercise of high pricing power, proxied by the Lerner index, the thesis identifies firm size, cost efficiency, product line diversification, concentration, leverage and reinsurance contracts as significant predictors of pricing power in the market. However, the effect of cost efficiency, business line diversification and reinsurance are found to be heterogeneous across different quantiles of pricing power. Third, the thesis also documents evidence in support of the 'competition-fragility' hypothesis to indicate that competition is detrimental to the stability of the short-term insurance market. The 'competition-fragility' effect is, however, found to be stronger for weaker insurers compared with stronger insurers. Firm size, capitalization, reinsurance, business line diversification and foreign-ownership were also identified as other significant predictors of market stability.

Three main policy recommendations for the regulation of the market are derived from the findings. First, in order to improve on the high levels of inefficiency in the market, the insurance regulator is encouraged to direct efforts at improving competitive conditions since competition is found to be efficiency-enhancing. Second, the regulator is also encouraged to place restrictions on mergers that result in increased market concentration. This will reduce market power and the tendency for the exercise of high pricing power. Another way of improving competitive conditions in the market is through the increased presence of foreign-owned insurers. This could be achieved through the formulation of policies that are friendly to encourage and attract foreign-owned insurers to participate in the local market. This will help reduce the monopolistic tendencies enjoyed by domestic-owned insurers. Finally, in order to ensure a positive effect of competition on market stability, the regulator should seek to reduce information imbalances through institutionalization of a reference bureau on claims. This will be useful in collecting data to achieve actuarial fair pricing of insurance policies and reduce the incidence of adverse selection and moral hazards which are characteristic of competitive insurance markets and induces instability.

Dedication

This thesis is dedicated to my mother, Akua Badu and my father, Abdul Nassir Alhassan for their constant prayers, love and support throughout the years.

Acknowledgement

I owe a debt of gratitude to the Lord Almighty for His help in bringing me this far. I am most appreciative of His works in my life in the realization of this dream; for “He who began a good work in” me has brought it to a successful end through his everlasting grace and favour.

The writing of this dissertation was also made possible through tremendous contributions from many individuals. First, I am heavily indebted to my supervisor and promoter of this thesis, Professor Nicholas Biekpe, who was very instrumental in my decision to start the PhD programme. His guidance from the selection of my research area, detailed comments, suggestions and correction on various chapters has been very helpful in the timely completion of the thesis. As a supervisor, he also went beyond his duties as academic advisor to counsel and guide in other aspects of my life. I will forever cherish my time under his tutelage and the opportunities he presented me as his student. I am also grateful to Africagrowth Institute for providing financial support to undertake my studies. Special thanks also go to Dina Potgieter, Lydia Le Roux, Kirk de Donker and Roland Banya, all staff of Africagrowth Institute for their prayers and providing an enabling environment throughout my stay at the Institute. I extend my deepest gratitude to the Financial Services Board of South Africa, for providing the comprehensive database on the short-term insurance market in South Africa. Special thanks are reserved for Suzette Vogelsang, Head of Insurance Groups and Lesego Molawa at the Financial Services Board who facilitated my access to the data. The immense family support from my landlords, Aunty Charlotte, Donovan and Clare-Shan Medell, and their daughter, Chiara Medell during my stay in their apartment is greatly acknowledged. I also express my sincere appreciation to Dr. Mohammed Amidu (University of Ghana Business School) and Dr. John Muteba Mwamba (University of Johannesburg) for their assistance on econometrics issues pertaining to my studies.

I also extend my profound appreciation to Supt. Maame Yaa Addo Dankwa, Col. Isshaku, Bright Boateng, Ronald Kyei-Baffour, Michael Effah Asamoah, Captain Osei Kwame Bonsu, Vera Fiador and Mr Francis Tettey (Qatar Petroleum) for their kind gesture and support that facilitated my travel to South Africa to begin my studies. The help of Maame Bempomaa Akosua Addo for providing me with culinary support that helped me in surviving the unfavourable dietary conditions is most appreciated. To Sophia Ewurama Duruwaa Acquah, your love and care towards the end of my studies is graciously acknowledged. Basically, your presence provided a timely boost at the most crucial moment of my studies. I am most grateful to my late Pastor, Rev. Peter Cobinnah for his spiritual guidance and support.

I am also grateful to my relatives, friends, and colleagues, Dr. Joseph Oscar Akotey (University of Stellenbosch Business School), Amama Salifu, Freeman Owusu

Brobbey, Prince Agyekum, Lordina Amoah, Paa Akwasi Adiyiah, Abdul Jafar, Emmanuel Asante-Amoateng, Maahi Mohammed, Kwaku Frimpong, Papa Yaw Ohene-Konadu, Adusei Appau, Dr. Frank Kyei (Lister Hospital Accra) Nicholas Asare, Felix Acheampong, Gifty N. Osei, Nana Ama Akorful, Abdul Aziz Fauzia, Matthew Ntow-Gyamfi, Ofori Baah Kwaku, Kofi Boakye Afrifa, Banyen Kannyiri, Miezah Anyimiah, Deborah Akyeampong, Lydia Ashithey, Taale Dakurah and Abdul Jalil for the encouragement, guidance and prayers. Finally, to all those who spared a moment to share a thought or silent prayer for me, may the Great God bless you all.

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List of Abbreviations and Acronyms

DEA	Data Envelopment Analysis
BRIC	Brazil, Russia, India, China
CR	Concentration Ratio
CRS	Constant Returns to Scale
DFA	Distribution Free Approach
DMU	Decision Making Units
DRS	Decreasing Returns to Scale
EFFCH	Efficiency Changes
ES	Efficient Structure
FDH	Free Disposal Hull
FSAP	Financial Services Action Plan
FSB	Financial Services Board
FE	Fixed Effects
FEAR	Frontier Efficiency Analysis in R
GMM	Generalized Method of Moments
GDP	Gross Domestic Product
GP	Gross Premiums
GRMF	Governance and Risk Management Framework
GWP	Gross written Premiums
HHI	Herfindahl Hirschman Index
IAIS	International Association of Insurance Supervisors
IRS	Increasing Returns to Scale
ISUR	Iterated Seemingly Unrelated Regression
MPI	Malmquist Productivity Index
NEIO	New Empirical Industrial Organisation
NIRS	Non-Increasing Returns to Scale
OLS	Ordinary Least Squares
OLS - PCSE	Ordinary Least Squares Panel Corrected Standard Errors
P-R	Panzar Rosse

PTE	Pure Technical Efficiency
PwC	PricewaterhouseCoopers
QR	Quantile Regression
RE	Random Effects
RTS	Returns to Scale
SE	Scale Efficiency
SAM	Solvency Assessment and Management
SIM	Single Insurance Market
TFA	Thick Frontier Approach
TR	Total Revenue
ZAR	South African Rand
SFA	Stochastic Frontier Analysis
SCP	Structure-Conduct-Performance
TE	Technical Efficiency
TECHCH	Technological Changes

Chapter One

Introduction

1.1 Background to the Study

Insurance markets as a sub-sector of the financial system enhance the intermediation functions through capital accumulation and underwriting of business risk. In addition, they also have the ability to reduce capital cost to stimulate the demand for financial services. This results in increased supply of credit (Grace and Rebello, 1993 and Arena, 2008) through collateralization. These functions underline the importance of insurance business in complementing the intermediation functions of other players in the financial system to stimulate growth.

As part of the broader deregulation of financial services industries over the past two decades, insurance markets across the globe have been the subject of a wave of regulatory reforms. In Europe, the passage of Third Generation of Insurance Directives¹ in 1994 led to the creation of a Single Insurance Market (SIM) in the European Union while the US market was characterized by the demutualization policies in the early 1990s (Vaughan and Calabria, 2015). The period also coincided with the establishment of the International Association of Insurance Supervisors (IAIS) in 1994 to develop international principles, standards and related support issues for regulating² insurance business in nearly 140 countries. In Africa, reforms in insurance markets were broadly covered under financial services adjustment programmes promoted by the World Bank in the early 1990s, which led to the liberalization of the financial services industry.

At the heart of these reforms has been the drive to improve productive efficiency³ and competition to enhance market stability. These developments consequently stimulated empirical studies to assess the effect of the reforms on the efficiency, competition and stability in insurance markets in the US and Europe (See Hardwick, 1997; Noulas, 2001; Baranoff and Sager, 2003; Campbell et al., 2003; Ennsfellner et al., 2004; Cummins and Rubio-Misas, 2006; Fenn et al., 2008; Bikker and Gorter, 2008; Kasman and Turgutlu, 2011; Vencappa et al., 2013; Pasiouras and Gaganis, 2013; Cummins

¹ The provisions under the directives included single European license; Home-country control and deregulation of insurance prices.

² This culminated in the development of 26 core regulatory principles for the supervision of insurance business.

³ Productive efficiency refers to the optimal usage of resources to produce the optimal level of outputs.

et al., 2014; Shim, 2015). Unlike these developed economies, the development of insurance markets in Africa is in its early stages, as reflected by its low contribution to the gross domestic product (GDP). For instance, the gross insurance premiums underwritten by insurance companies in Africa accounted for only 3.56%⁴ of GDP in 2012, compared to 11.80%, 8.03% and 7.72% recorded for Advanced Asia, North America and Western Europe respectively (KMPG, 2014). The figure was also below the global average insurance penetration rate of 6.5% in 2012. Similar to its nascent development, academic studies on insurance markets in Africa pale in comparison with developed markets. This thesis is therefore partly motivated by the need to contribute to the scanty⁵ literature on insurance markets in Africa.

Against this background, this thesis presents a collection of related empirical research papers on the efficiency, competition and stability of an emerging insurance market in Africa, using the short-term insurance market in South Africa as a case study. First, the study estimates the level of productive efficiency and its determinants; its evolution and convergence behaviour over time. Second, the study also estimates the competitive conduct; pricing behaviour and its relationship with efficiency. The third theme of the thesis focuses on the age-old regulatory dilemma of whether competition is either good or detrimental to market stability. Specifically, it examines the effect of competition on the risk-taking behaviour of sample insurance companies employed in the empirical analysis. The analysis undertaken in this thesis provides insurance regulators with an appreciable understanding of the nature, conduct and operating environment of insurance companies in South Africa. The findings from these analyses will help provide policy directions and serve as a reference point for the organization and regulation of the insurance markets in South Africa and the rest of the continent. This will ultimately assist in the development of insurance markets and enhance its contribution to economic growth.

The thesis focuses on the short-term⁶ insurance market in South Africa, for the following reasons: First, unlike the rest of Africa, South Africa has a thriving and

⁴ This is referred to insurance penetration rate.

⁵ In relation to the themes covered in this thesis, studies on insurance markets in Africa have been biased towards efficiency analysis (See Barros et al., 2008; Ansah-Adu et al., 2012; Barros and Wanke, 2014; Barros et al., 2014 and Alhassan et al., 2015). Studies on competition and stability have rarely been examined in the context insurance markets in Africa. Theron (2001) employs concentration indicators to examine the effect of mergers on the contestability of the short term insurance market in South Africa.

⁶ The short-term insurance market is sometimes referred to as general, non-life and property-liability insurance markets in other jurisdictions.

matured insurance industry with its penetration rate among the highest in the world. This is reflected by an average insurance penetration rate⁷ of 14.16% compared with 2.65% and 6.50% for emerging and global markets respectively in 2012 (Swiss Re, 2013). However, the development of the short-term market lags behind the long-term market. For instance, the long-term insurance market accounted for 81.6% of gross insurance premiums underwritten compared with 18.4% recorded for the short-term market in 2012. In addition, the short-term insurance penetration rate of 2.60% was below the 11.56% for the long-term market in 2012 (Swiss Re, 2013). This reflects the minimal contribution of the short-term market to economic growth and offers greater scope for development. As the largest non-life insurance market in Africa, the short-term market accounts for about 50% of gross insurance premiums written in Africa (Swiss Re, 2012). Against this background, the South African economy can be described as having a high demand for insurance as a risk management tool. Second, the market comprises about 100 firms of different sizes underwriting policies in eight different business lines. Despite this large number of actors, the market appears highly concentrated among the top ten firms. In 2012, the top 10 insurers accounted for about 66 percent of gross written premiums, representing a reduction from 79 percent in 2007. Third, similar to many other African countries, the financial services industry in South Africa witnessed tremendous changes after 1994.⁸ A major development in the insurance industry was the separation of the long-term insurance businesses from the short-term businesses with the passage of different legislative Acts⁹ for both sub-markets in 1998. Another major development in the insurance market relates to the adoption of a risk-based supervisory framework in the Solvency Assessment and Management (SAM). The SAM is an adaption of the Solvency II directive¹⁰ to the South African market. The combined effect of the growth potential, market complexities, changing structure and regulatory developments provides an interesting setting to undertake this research in insurance markets from a developing country's (Africa) perspective. The analysis undertaken in this thesis will be useful to provide meaningful

⁷ According to reports by Swiss Re in 2012 and 2013, the long-term (life) insurance market has experienced strong growth in premiums compared to the short-term (non-life) insurance market. The focus on the short-term insurance market is partly influenced by the weak performance and development of the market. The stability of the market is very critical to ensure the continuity of businesses. The needed investments required to promote economic growth could be made by possible if an effective risk management system exist to provide cover for business uncertainties.

⁸ This refers to the period after the first democratic elections in South Africa after which the economy underwent some form of deregulation.

⁹ The Short-Term Insurance Act (Act 53 of 1998) regulates the activities of the short-term insurance business.

¹⁰ This is a risk-based supervisory framework that seeks to identify firm-specific solvency requirements for the management of insurance risk.

insights for policy formulation geared towards the development of the market and improve its contribution to economic growth. With an increasing presence in insurance markets in other African countries, the findings could serve as a benchmark for future studies and precursor for the regulation of insurance markets in other African countries.

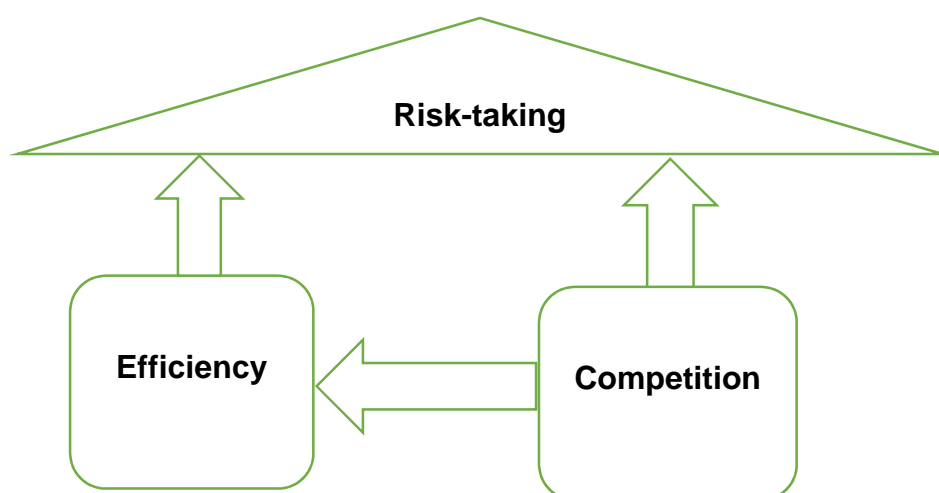
1.2 Research Problem and Motivation for the Study

The uncertainty that characterizes financial markets and institutions requires an effective risk management framework to protect households, firms and governments from the adverse effects associated with it. The role of insurance in risk indemnification is vital to support these agents in the management of the risk exposures and promote business continuity. These functions are undertaken by insurance companies through risk pooling and underwriting of insurance policies. The pre-collection of insurance premiums enables insurance companies to invest and generate returns to cover for losses from specified events. However, the ability of insurers to effectively perform these functions largely depends on productive capacity and efficient utilization of resources and internal management of risk of insurance portfolio. First, achieving efficiency in the production of insurance policies reflects the insurer's ability to operate closer to the 'best-practiced' firms. This helps to benchmark best-performing firms as role models for inefficient firms and identify the sources of resource wastage by management. Second, through efficient underwriting practices, insurers enhance their ability to underwrite more policies and provide adequate cover for losses arising out of its risk portfolio. These have formed the benchmark for the regulation of insurance markets and stimulated academic studies on efficiency (See Fecher et al., 1993; Cummins et al., 1996; Noulas et al., 2001; Worthington and Hurley, 2002; Luhnén, 2009; Cummins and Xie, 2013; Ansah-Adu et al., 2012; Barros and Wanke, 2014; Barros et al., 2014; Alhassan et al., 2015; Barros and Wanke, 2015) and stability (See Baranoff and Sager, 2003; Shiu, 2005; Ren and Schmit, 2006; Cole et al., 2011; Cheng et al., 2011; Fields et al., 2012; Cheng and Weiss, 2013; Pasiouras and Gaganis, 2013; Ho et al., 2013; Ng et al., 2013; Eling and Marek, 2014; Hu and Yu, 2014) in insurance markets.

Similar to other financial markets, theoretical evidence suggests that increasing competitive conditions is associated with both productive efficiency and market stability. First, based on the 'quiet-life' hypothesis of Hicks (1935), competitive

pressures are assumed to eliminate tendencies of managerial slack and monopoly rents to improve efficiency levels. On the other hand, competition may lead to a lax on efficiency goals in order to respond to anti-competitive practices which lead to excessive risk-taking beyond a firm's capacity. In insurance markets, increasing competitive pressures can exacerbate information asymmetry, increase information acquisition cost and reduce efficiency. Second, increasing competitive pressures in financial markets also have the potential to affect stability. In insurance markets, increasing competitive pressures can be associated with premium under-cutting as a strategy to increase market share (Ren and Schmit, 2006). This results in actuarially unfair pricing of risk and increases the probability of insolvency and translates into a negative effect of competition on stability of insurance markets. Conversely, less competition (concentration) also has the potential to increase the exercise of pricing power through the charging of higher premiums. This results in the pooling of high risk policies which increases the loss development and probability of loss occurrence. The solvency or otherwise of the industry will not only have ramifications for policy holders but also the economy as a whole, due to the high insurance consumption by both businesses and individuals.

Against this background, empirical studies have been undertaken to examine the effect of competition on efficiency (Hao and Chou, 2005; Fenn et al., 2008; Kasman and Turgutlu, 2009) and risk (Cummins et al., 2014; Shim, 2015) in developed insurance markets. Studies on insurance markets in Africa have mainly been limited to efficiency analysis (Ansah-Adu et al., 2012; Barros and Wanke, 2014; Barros et al., 2014; Alhassan et al., 2015). The need to improve on the low level of insurance penetration while enhancing the stability of insurance markets in Africa highlights the need to provide an understanding on the competitive conduct of insurers. This will provide regulators and insurance management with important tools to influence efficiency and stability. Hence, an understanding of the interrelationship among efficiency, competition and risk-taking behaviour becomes an important tool for macro-prudential regulation and management of insurance markets. For management of insurance companies, the issues addressed in this thesis will be useful in addressing questions on the areas of firms' operations that need improvements. The theoretical linkages among the three central themes of the thesis are presented in Figure 1.1.

Figure 1.1: Linkages between efficiency, competition and stability

Source: Authors design

This thesis, therefore, proposes to find answers to the questions;

1. What are the factors that drive productive efficiency in the short-term insurance market?
2. What is the nature of competitive behaviour in the market?
3. Is competition efficiency-enhancing?
4. Do short-term insurers exercise high pricing power?
5. How has competition affected risk-taking behaviour of the short-term insurers?

1.3 Research Objectives

The main objective of this thesis is to examine the efficiency, competition and risk-taking behaviour in the short-term insurance market in South Africa. The specific objectives that this study seeks to achieve include;

1. To examine the technical efficiency, returns to scale economies and productivity of the short-term insurance industry in South Africa.
2. To examine the effect of liberalization outcomes on competitive conduct in the short-term insurance market.
3. To examine the effect competition on cost and profit efficiency of short-term insurers.
4. To examine the exercise of pricing power and its determining factors in the short-term market.
5. To examine the relationship between competition and risk taking behaviour of short-term insurers in South Africa.

1.4 Hypotheses of the Study

As outlined in the objectives above, this study seeks to test the following hypotheses:

H_1 : Short-term insurers in South Africa are inefficient.

H_2 : The outcomes of financial liberalization have significant impact on the competitive behaviour in the short-term insurance market.

H_3 : Competition has significant effect on cost and profit efficiency in South Africa.

H_4 : The short-term insurance market is characterized by the exercise of exercise pricing power.

H_5 : Competition has significant effect on risk-taking behaviour of firms in the short term insurance market.

1.5 Organization of the Thesis

The thesis is structured into eight chapters, of which five are empirical papers. Chapter One provides a background to the thesis. It outlines the foundations of the thesis through the identification of research problems, objectives, hypothesis and outline for the thesis. In Chapter Two, we provide an overview of the insurance market and some stylized facts on the short-term insurance market. The section reviews historical developments in the insurance market, from regulatory changes to other structural developments. It also examines the current regulatory framework for the conduct of insurance business as well as the trends in the balance sheets and income statements of market players in the short-term market. In the first empirical section in Chapter Three, the thesis examines the efficiency, productivity and returns scale analysis using the data envelopment analysis bootstrapping approach of Simar and Wilson (2007). Through a truncated and logistic regression analysis, the chapter examines the determining factors of technical efficiency and returns to scale respectively. Finally, the chapter also examines the evolution of efficiency over time using Malmquist productivity indices and the growth convergence theory.

Chapter Four identifies three outcomes of financial liberalization and examine the impact of the outcomes on competitive conduct in the short-term insurance market. The class of new industrial empirical organization (NEIO) in the Panzar-Rosse H-statistics was employed in the analysis. The Fifth Chapter examines the so-called

'Quiet-Life' hypothesis by examining the empirical relationship between competition and efficiency in the short-term insurance market. The stochastic frontier analysis is employed to estimate both cost and profit efficiency scores of the sample firms.

Chapter Six examines the exercise of mark-up pricing power and identify the sources for the exercise of high pricing power. The chapter employs the Lerner index as the proxy for pricing power and several panel data econometric techniques to examine the effect of firm level characteristics on pricing power. The final empirical section (Chapter Seven) examines the effect of competition on risk-taking behaviour and stability in the short-term insurance market. Chapter Eight summarizes and draws conclusions from the empirical findings and discusses policy recommendations and avenues for future research.

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Chapter Two

Overview of Short-term Insurance Market in South Africa

2.1 Introduction

This section provides a comprehensive review of the historic, regulatory and financial environment of the insurance market in South Africa. It starts with the historical overview, the regulatory and supervision framework of insurance business, and insurance penetration rate. The section concludes with stylized facts on the short-term insurance market and the challenges faced by players in the short-term market.

2.2 Insurance Business in South Africa

2.2.1 Historical Overview¹¹

Insurance business in South Africa dates back to the establishment of British rule in the Cape Colony in early 1800s. The British rule facilitated the entry of British citizens and businesses, which stimulated the need for financial services like insurance. The participation of British insurance companies in the Cape Colony was partly attributable to the lack of a local insurance market. On August 6th 1806, Phoenix Assurance Company of London appointed Alexander Macdonald and John Houghton as insurance agents by a power of attorney in the Cape of Good Hope to underwrite fire insurance policies. The period from 1826 and 1844 also witnessed the entrance of five more British insurers into the Colony. The first indigenous insurance company, Zuid-Afrikaansche Brand en Levensversekering Maatschappij was established in 1935 in the Cape Colony, followed by Mutual Life Assurance Society (currently known as Old Mutual) in 1945. Equitable Marine also became the first local insurance business to underwrite marine policies in 1849, followed by the establishment of Colonial Assurance Company in 1874.

By 1861, more than twenty insurance companies had been registered to operate in the Cape Colony, reflecting the growth of the industry. The minerals discovery in the 1860s led to the establishment of insurance businesses in Johannesburg by companies from America, Britain, Australia and New Zealand. The number of foreign-owned insurance companies operating in the Cape Colony had increased to more than fifty by then. The British dominance of the market led to the set-up of the Council of

¹¹ This section is adapted from the book chapter by Verhoef (2013) titled "South Africa: Leading African Insurance"

Fire Insurance Companies, similar to the Fire Offices Committee of London to standardize the operations of fire offices. Subsequently, the Cape Town Fire Tariff Committee and Johannesburg Fire Tariff Assurance Association were established in 1894 and 1898 respectively. Life insurance businesses in the form of long-term policies were also introduced into the market with the arrival British settlers into the Colony.

Beginning from 1929, insurers were required to submit their returns to the Registrar of Insurance. This provided the opportunity for the compilation of statistics on insurance businesses. The contribution of both the short-term insurance and long-term insurance premiums to gross insurance premiums from 1929 to 2012 are presented in Table 2.1. The Table shows that the South African insurance market has historically been dominated by the long-term sub-market, accounting for 80.50% of insurance premiums in 2012. The development could be attributed to the historical absence of a government sponsored social security programmes, stimulating the demand for self-financed financial products in the form of long-term insurance policies.

Table 2.1: Premium composition in the insurance market

Years	Short-term		Long-term	
	Premiums (R'mn)	(% of TP)	Premiums (R'mn)	(% of TP)
1929*	1,541	23.70	4,960	76.30
1950	19	27.14	51	72.86
1960	75	35.71	135	64.29
1970	160	24.62	490	75.38
1990	7,580	25.79	21,807	74.21
2000	17,310	10.49	147,747	89.51
2012**	n/a	19.50	n/a	80.50

*Note: TP= Total premiums made up of the sum of the short-term and long-term premiums. * Premium values for 1929 are in Thousands of British Pounds. ** break down of figures not available from source. Source: Estimates computed based on data extracted from Verhoef (2013)¹² and A.M. Best Special Report (2014).*

Over the period from 1910 to 1955, the number of insurance companies operating in South Africa rose from 23 to 176 (Verhoef, 2013). Table 2.2 presents a historical development of firms in the insurance industry. The 1950s also witnessed an increased presence of foreign companies in the short-term insurance market

¹² The figures presented in Verhoef (2013) included reinsurance premiums. Figures in Table 2.1 exclude premiums generated from reinsurance contacts.

compared with the long-term market. However, a recommendation by the Fiscal and Monetary Policy commission in 1973 required all foreign companies to hold no more than 10% ownership. This greatly affected foreign participation in the local insurance market.

Table 2.2: Players in the insurance markets

Years	Short-term insurers		Long-term insurers		Total Number of insurers
	Primary insurers	Reinsurers	Primary insurers	Reinsurers	
1955	-	-	-	-	176
1975	-	-	-	-	99
1980	27	8	49	6	90
2000	86	7	62	3	158
2012	100	8	79	7	194

Source: Information extracted from Verhoef (2013) and Financial Services Board Annual report (2012)

The short-term market was mainly dominated by fire policies followed by workmen's compensation. Following the increases in automobile ownership, insurers began underwriting motor insurance policies in the 1930s. Effective from 1946, the Motor Vehicle Insurance Act of 1942 introduced mandatory insurance for vehicle drivers, owners and third parties. Reinsurance business was introduced into the market in 1950, with the incorporation of South African Reinsurance Corporation Limited to cater for insurance demand that exceeded the capacity of the primary insurance market (Verhoef, 2013). The number of reinsurers had increased to eight by the end of 1985.

2.2.2 Supervision and Regulation

• Regulation Before 2000

Before the 1900s, regulation of insurance business in South Africa was governed under the general laws on mercantile (Verhoef, 2013). The first legislative law passed to regulate insurance business in South Africa was the First Union Insurance Act 1923. The Act, which combined aspects of the regulatory framework for insurance markets in UK, US and Canada allowed foreign firms operating in South Africa the freedom to provide cover for policies from their investments in their home countries (Verhoef, 2013). The passage of the Insurance Act No 27 (1943) ushered in a wave of reforms in the insurance markets. The regulatory provisions during these periods were more focused on the activities of life insurance companies. They required life insurance

companies to comply with statutory provisions on compulsory and discretionary investments.

Following the liquidation of AA Mutual in 1986, the insurance market was ushered into the 1990s with the passage of the Financial Services Act No 97 (1990). This led to the creation of the Insurance Department under the newly formed the Financial Services Board (FSB) to regulate insurance businesses. The Insurance Act No 27 (1943) was replaced by the Long-Term Act 52 (1998) and Short-Term Insurance Act 53 (1998) to separate the businesses of the long-term and short-term companies. This led to the abolishing of operation of composite insurance businesses. The functions of the Insurance Division extend to licensing, promoting financial soundness, improving compliance and legal regulation of insurance companies. These functions are undertaken within the following departments;

- Registration Department
- Prudential Department
- Compliance Department
- Regulatory Department

Specific to the short-term market, a significant development was the increase in the number of business lines underwritten from six to eight, with the inclusion of engineering and liability product lines (Vivian, 2003).

Like the banking industry, the Insurance Acts only permit the operation of foreign insurers in South Africa through the setup of a wholly owned subsidiary (Butterworth and Malherbe, 1999). The aftermath of 1994 resulted in an increased presence of foreign firms in the financial services industry.¹³ The report attributes price competition, improved product offering and service quality and product development to the presence of foreign firms into the market. However, the tight exchange controls has become a barrier to increased participation of foreign firms in the financial services industry. In the insurance markets, prudential regulations governing local capitalisation, investments by foreign firms and foreign ownership creates further impediments to the increased foreign presence in the insurance markets.

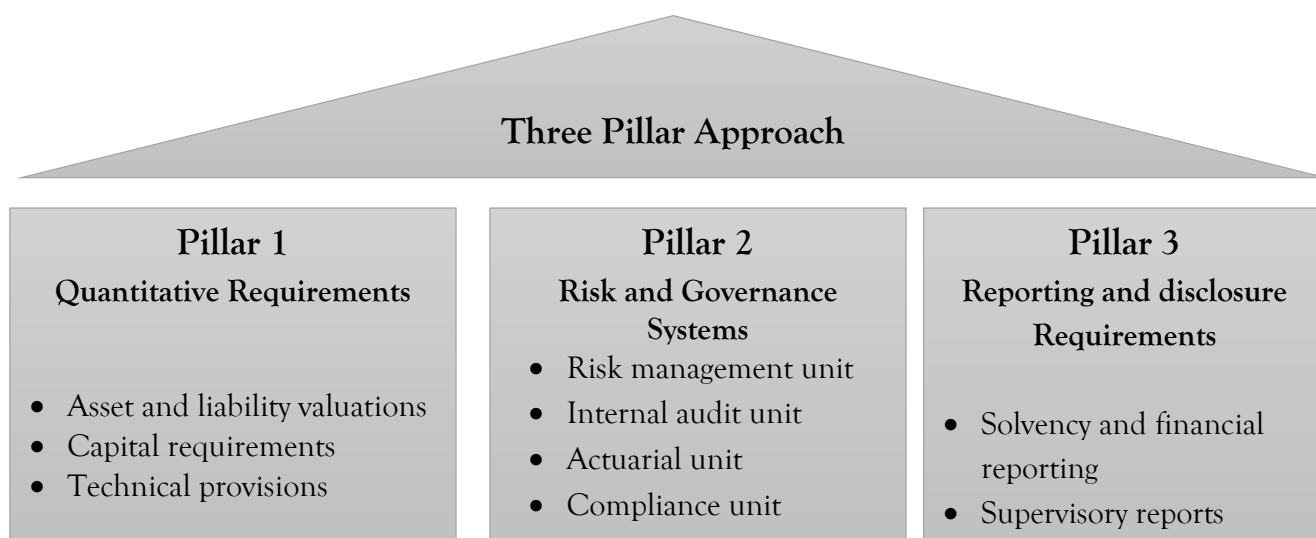
¹³ Report by Butterworth and Malherbe (1999) for the Trade and Industrial Policy Secretariat.

- **Regulation After 2000**

The millennium witnessed increased focus on prudential regulation in the market. This was evidenced by the adaption of the Solvency II¹⁴ to the South African market through the design and implementation of the Solvency Assessment and Management (SAM) regulatory framework. The SAM seeks to bring regulation of the local insurance market to the level of international standards and promote a stable market to protect policy holders. This is to be achieved by equipping the insurance regulator with both qualitative and quantitative tools to track and minimize risks inherent in underwriting insurance policies. Under the SAM, the regulator seeks to provide a regulatory framework for risk-based and group-wide supervision of the South African insurance market under three pillars.

The provisions under Pillar 1 relate to the quantitative requirements on the financial soundness of insurers. They involve the assessment of minimum capital and solvency requirements for insurers. Pillar 2 covers the risk management and governance framework of insurers. It entails the setting up of risk management, internal audit and actuarial and compliance units within a firm. Pillar 3 relates to the reporting requirements in relation to the risk management functions of insurers to the regulatory authority. In summary, a pillar 3 is relevant for the promotion of transparency of activities undertaken under Pillars 1 and 2 and enhances market discipline.

Figure 2.1: Solvency and Assessment Management Framework



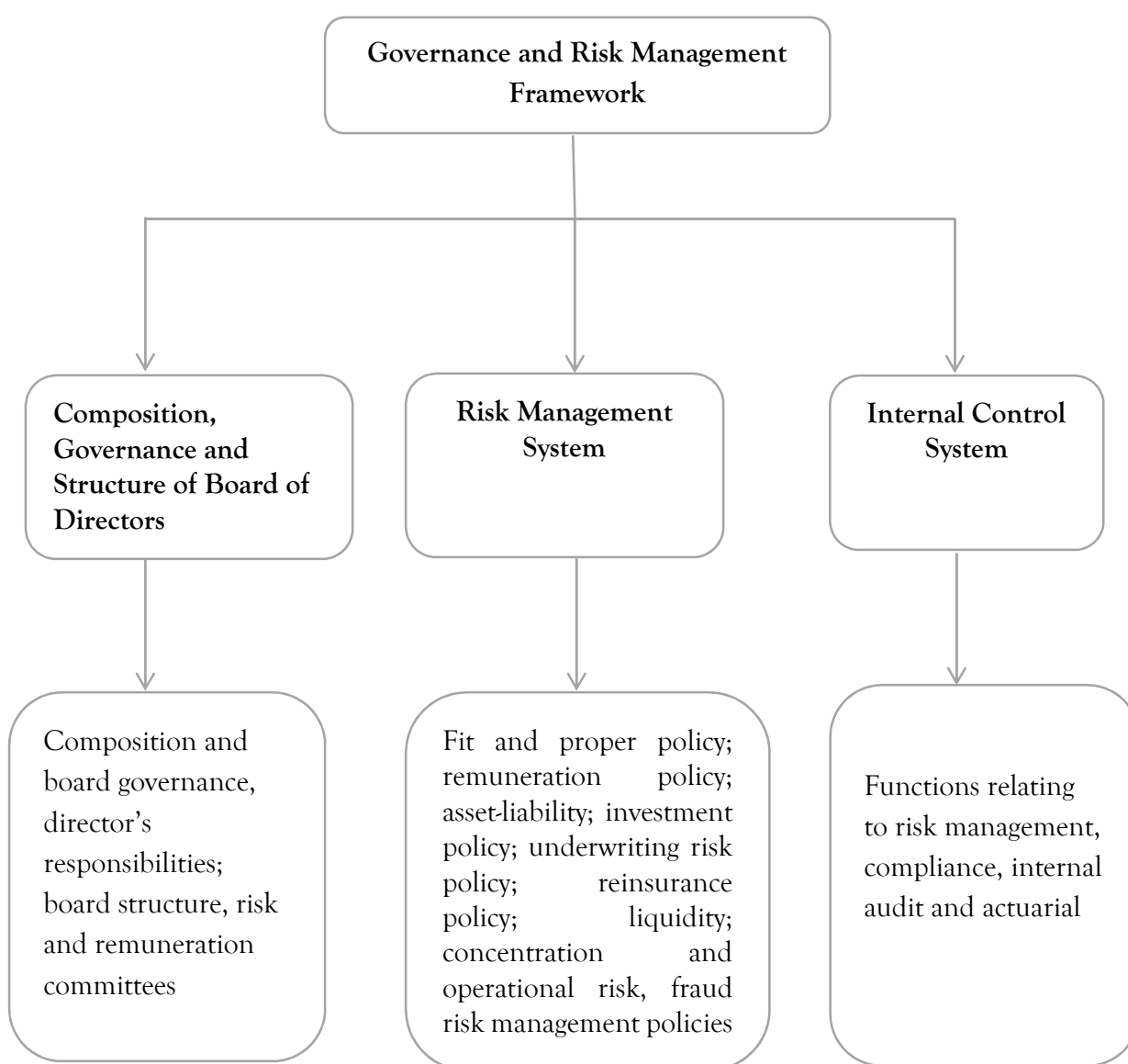
Source: Financial Services Board (2010)

¹⁴ This is a regulatory framework for insurance companies in Europe that seeks promote a risk-based approach for regulating a single European Union insurance market.

2.2.3 Governance Framework

The Governance and Risk Management Framework (GRMF) bill under Pillar 1 of the SAM was passed in December 2014 for implementation in April 2015. The framework requires insurers to 'adopt, implement and document effective mechanisms for the prudent management of insurance for the protection of policyholder interests. The framework consists of the composition and governance of board of directors; risk management system and internal control system. The structure of the governance framework is presented in Figure 2.2.

Figure 2.2: Governance and Risk Management Framework



Source: Author's design

2.2.3.1 Composition, Governance and Structure of Board

This section of the framework provides guidance to insurers on the composition of a board of directors, board governance, responsibilities of directors; risk and remuneration committee. It stipulates the appointment of both independent and non-executive directors to the board in a manner to promote diversity in knowledge and skills that enhances the direction of the operations of the insurance company. The Chairman of the board, an independent member, is responsible for providing leadership and presides over board meetings. Among the operational responsibilities of the board, the members are required to set up risk and remuneration committees. The minimum number of members for each of the sub-committees is three, made up of both independent and executive directors. Both committees should be chaired by independent directors. However, the majority of the remuneration committee members are required to be non-executive directors.

2.2.3.2 Risk Management System

The main objective of the risk management system is to promote the establishment and institutionalization of a system equipped with the strategies, policies and procedures to identify, assess, monitor, manage and track existing and potential risks faced by the insurer. The main components of the risk management include policies on fit and proper; remunerations; asset-liability management; investment; reinsurance activities and policies on risks associated with underwriting; liquidity; concentration, operations and fraud management

2.2.3.3 Internal Control System

The internal control system is responsible for providing guide lines that direct the activities of the board of directors and managing executives of an insurer to ensure a high level of consistency in the operations of an insurer. The system is centred on the policies relating to risk management, compliance, internal audits and actuarial functions.

The historical developments in the regulation of the short-term insurance market are presented in Table 2.3.

Table 2.3: Historical developments in the insurance market

Years	Milestone
1806	Appointment of first insurance agent in the Cape Colony
1835	Establishment of first indigenous insurance company
1923	Passage of the First Union Insurance Act, the first legislative law passed to regulate insurance business in South Africa.
1929	Mandatory submission of returns to the Registrar of Insurance
1942	Enactment of Motor Vehicle Act for mandatory vehicle insurance
1943	The passage of the Insurance Act No 27 (1943) ushered in a wave of reforms in the insurance markets
1950	Introduction of reinsurance
1986	liquidation of AA Mutual in 1986, the insurance market
1990	The passage of the Financial Services Act No 97 (1990) and establishment of the insurance department under the Financial Services Board (FSB).
1998	Passage of the Long-Term Act 52 (1998) and Short-Term Insurance Act 53 (1998)
1998	Increasing number of business lines from six to eight
2009	Solvency assessment and management (SAM) regulatory framework
2014	Governance and Risk Management Framework (GRMF)

2.3 Insurance Penetration

Insurance penetration, which is the ratio of gross insurance premiums to gross domestic product measures the contribution of insurance activities to economic growth and serves as an indicator of market maturity. In comparison to the rest of Africa, the South African insurance market is the largest in terms of its contribution to GDP. Table 2.4 shows that in 2012, the gross insurance premiums underwritten in South Africa amounted to US\$54.4 billion compared to US\$2.8 billion generated in the Moroccan insurance market. In South Africa, it counted for 14.1% of GDP compared to 2.9% in Morocco. The penetration rate places South Africa 17th on the global insurance penetration rankings, the only African country in the top 20 (A.M. Best, 2014) in 2012.¹⁵ Insurance penetration among the top 7 insurance consuming African countries was mainly driven by the short-term sector, with the exception of South Africa. The short-term sector accounted for only 19.5% of gross insurance premiums compared with 80.5% for the long-term sector in 2012. However, the South African market accounts for about 50% short-term insurance premiums underwritten in Africa. This indicates

¹⁵ Statistics obtained from KMPG (2014) report indicates that the average penetration rate for Africa in 2012 of 3.56% relatively higher than Emerging Asia (2.56%), Middle East (1.35%), Central and Eastern Europe (2.01%) and South and Central America (3.00%).

that while short-term market is dominant in Africa, it is less-developed and matured in relation to the long-term market in South Africa.

Table 2.4: Insurance penetration in Africa (2012)

	Gross written premiums (USD)	Short-term premiums (% of GWP)	Long-term premiums (% of GWP)	Gross written premiums (% of GDP)
South Africa	54.4	19.5	80.5	14.1
Morocco	2.8	67.4	32.6	2.9
Egypt	1.8	56.8	43.2	0.7
Nigeria	1.6	75.5	24.5	0.6
Algeria	1.4	93.2	6.8	0.7
Kenya	1.3	65.8	34.2	3.2
Angola	1.0	95.0	5.0	0.9

Note: GWP=Gross written premiums; GDP=Gross domestic product; All monetary values in Billions of US dollars. Source: A.M. Best Special Report (2014)

2.4 The Short-Term Insurance Market

The Short-Term Insurance Act 53 (1998) defines a short-term insurance business as the underwriting of insurance policies that provide benefits to those insured on a short term basis. The minimum capital requirement of short-term insurers is R5 million. This figure is, however, subject to the five year projections of insurers. The policies underwritten by registered short term insurers under the Act include:

- i. Property policy: This class of insurance policies provides cover for losses suffered by the insured in relation to the ownership, usage and damages to movable or immovable properties.
- ii. Transportation policy: This policy provides indemnity to insureds for losses arising out of the usage, possession or ownership of a vessel, aircraft, or any other craft for the transportation of persons or goods by water, air, space or land and treatment or handling of goods in transit.
- iii. Motor policy: This refers policies where insurers undertake to indemnify a policyholder if a risk relating to the possession, use and ownership of automobile vehicles occurs in return for a premium.
- iv. Accident and Health policy: This class of insurance policies provides benefits to insureds on the occurrence of an event that results in disability; health or death.
- v. Guarantee policy: This policy undertakes to indemnify policyholders for the failure of an individual to honour an obligation.

- vi. Liability policy: This relates to premiums collected by insurers with the undertaken to provide cover in the event that results in the incurring of a stipulated liability.
- vii. Engineering policy: This policy provides indemnity coverage for risk relating to the possession, usage and ownership of machinery or equipment but not motor vehicle for purpose of carrying out business; construction of buildings and other structures or the installation of machinery or equipment.
- viii. Miscellaneous policy: This relates indemnification provided by insurers in respect of risks not defined outside the seven other policies.

2.4.1 Market Players

An overview of market players in the short-term insurance market is presented in Table 2.5. As at 2012, there were 100 primary insurers underwriting various business lines in the short-term market. This represented a marginal increase from 96 insurers as at the end of 2007. The number of reinsurers however remained unchanged between 2007 and 2012. Firms are registered to underwrite policies in at least one out of the eight business lines. As shown in Table 2.5, more insurers underwrite policies in at least two business lines to reflect a high incidence of premium diversification across multiple business lines.

Table 2.5: Market characteristics

	2007	2008	2009	2010	2011	2012
Number of Insurers	96	94	100	99	97	100
Number of Reinsurers	8	8	10	9	8	8
Single-Line Insurers	15	17	16	16	17	16
Multi-Line Insurers	42	58	59	62	62	60

Source: Number of single-line and multi-line insurers is authors' estimation limited to research data. Number of insurers and reinsurers which represents the whole market was extracted from annual reports on the short-term insurance market from Financial Services Board, 2007 to 2012.

2.4.2 Market Structure

The market shares of the ten top insurers in terms of gross written premiums from 2007 to 2012 are presented in Table 2.6. It is observed that the market share of the dominant insurer, Santam declined from 24.1 percent in 2007 to 19.8 percent in 2012. The other category of insurers outside the top 10 insurers experienced increases in their market share from 21.6 percent in 2007 to 34.4 percent in 2012.

Table 2.6: Market Shares of Top 10 Insurers (% of gross premiums)

	2012	2011	2010	2009	2008	2007
Santam	19.8	19.3	19.5	20.6	19.6	24.1
Mutual & Federal	9.0	8.7	9.1	10.4	11.9	16.7
Hollard	6.7	7.4	7.3	7.5	6.9	9.7
Guardrisk	6.6	5.5	5.3	5.0	4.9	5.9
Outsurance	6.4	6.5	6.3	6.3	5.6	-
Absa	4.1	4.2	4.4	4.5	4.4	5.0
Zurich	4.1	4.4	5.9	7.9	7.8	-
Auto & General	3.8	4.1	4.4	4.6	4.2	-
Centriq	2.6	2.8	3.3	3.5	3.0	3.0
Chartis	2.4	2.5	2.7	2.8	2.8	2.8
Others	34.4	34.7	31.8	26.9	29.2	21.6

Source: Authors Computation from FSB Data, 2007 to 2012

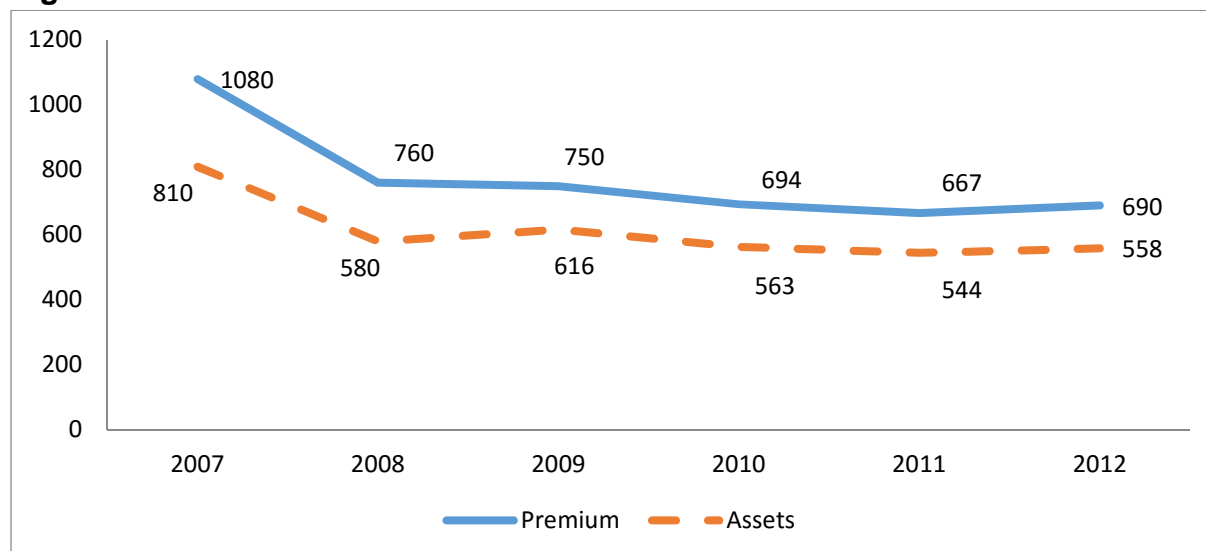
The industry concentration ratios (CR3, CR5, CR8 and CR10) for the periods from 2007 to 2012 are presented in Table 2.7. In 2007, the top 3, 5, 8 and 10 insurers accounted for approximately 51 percent, 62 percent, 73 percent and 78 percent of the market's gross premiums respectively. However, a reduction in concentration levels was observed for the top 3, 5, 8 and 10 insurers to 36 percent, 49 percent, 61 percent and 66 percent respectively in 2012. This reflects a declining market concentration and possible increase in competitive conditions.

Table 2.7: Market concentration

	CR3	CR5	CR8	CR10
2007	51%	62%	73%	78%
2008	39%	52%	65%	71%
2009	39%	53%	67%	73%
2010	36%	48%	62%	68%
2011	35%	47%	60%	65%
2012	36%	49%	61%	66%

Note: CR3=3-firm Concentration Ratio; CR5=5-firm Concentration Ratio; CR8=8-firm Concentration Ratio; CR10=10-firm Concentration Ratio. Source: Authors Estimates from FSB Data (2007-2012)

The Herfindahl Hirschman index (HHI) of gross premiums and total assets is presented in Figure 2.2. Unlike the concentration ratios, the HHI reflects the general level concentration in a market with values greater than 1800, indicating higher concentration. Consistent with the concentration ratios, a general reduction in levels of concentrations is observed from 2007 to 2012. However, Figure 2.3 shows high levels of concentrations in premiums markets compared to assets market to reflect the greater concentration of premium revenue among the few insurers.

Figure 2.3: Herfindahl Hirschman Index

Source: Authors Computation from FSB Data, 2007 to 2012

2.4.3 Income Composition

Table 2.8 presents the structure of income stream of the short-term insurance market. The two main sources of insurance revenue are premium income from policy holders and investment income generated from investing the premiums., Revenues from both sources increased throughout the period from 2007 to 2012 (FSB, 2007; 2008; 2009; 2010; 2011; 2012). Table 2.8 shows that the premium share of the total insurance revenue grew higher compared to revenue from investment activities, averaging at about 90 percent of total revenue. Investment income share declined throughout the period except for an increase to 5.9 percent in 2012 from 5.3 percent in 2011. It is also observed that majority of premium incomes are generated from underwriting insurance policies in the domestic market compared those generated from outside South Africa. However, marginal increases in foreign premiums generation are observed throughout the period. The reinsurance ratio, which reflects the amount premiums ceded by primary insurers to reinsurers as a risk diversification strategy suggest that short-term insurers generally retain about 70 percent generated premiums in 2007 and 2012 compared to an average of about 90 percent from 2008 to 2011. However, the unusual increase in the ratio to 28.2% could be influenced by the need for diversify risk in the insurance pool.

Table 2.8: Income structure

	2007	2008	2009	2010	2011	2012
Investment income (% TR)	12.1%	9.4%	7.6%	6.3%	5.3%	5.9%
Gross premiums (% TR)	87.9%	90.6%	92.4%	93.7%	94.7%	94.1%
Domestic premiums (% GP)	99.1%	99.0%	99.0%	98.8%	98.5%	98.3%
Foreign premiums (% GP)	0.9%	1.0%	1.0%	1.2%	1.5%	1.7%
Reinsurance ratio (% GP)	27.0%	10.7%	10.7%	9.3%	8.9%	28.2%

Note: TR=Total revenue; GP= Gross premium; Source: Authors Computation from FSB Data, 2007 to 2012

Short-term insurers underwrite policies in eight business lines. Table 2.9 presents the premium distribution across the eight business lines from 2007 to 2012. Across all periods, it is observed that the combined market shares of the motor and property business lines account for about 75 percent of the gross written premiums in the short-term market. The motor business line is, however, the dominant of the two, accounting for 41 percent of industry premiums compared to 35 percent for the property business line in 2012. All other business lines individually account for less than 10 percent of the premiums. This suggests that insurance premiums are mostly generated by the motor and property business lines.

Table 2.9: Premium distribution by business lines

Business Lines	2007	2008	2009	2010	2011	2012
Motor	34.50%	39.80%	39.30%	42.10%	41.20%	41.00%
Property	35.20%	33.30%	34.40%	34.60%	34.20%	34.60%
Transportation	3.10%	3.00%	2.80%	2.90%	2.80%	2.70%
Accident and Health	5.20%	6.00%	5.80%	6.00%	6.00%	6.00%
Guarantee	2.70%	2.70%	2.40%	2.50%	2.70%	2.50%
Liability	4.90%	4.60%	4.60%	4.50%	4.50%	4.60%
Engineering	3.90%	4.80%	5.00%	3.10%	3.70%	3.80%
Miscellaneous	10.40%	5.70%	5.80%	4.90%	3.80%	3.80%

Source: Authors Computation from FSB Data, 2007 to 2012

2.4.4 Invested Assets Structure and yields

The composition of the assets base of short-term insurers is presented in Table 2.10. The industry's total invested assets increased from R69, 376 million in 2007 to R101, 547 million in 2012 (FSB, 2007; 2012). The proportion of investments in shares to total assets decreased to 23.9 percent in 2012 from 35.1 percent in 2007 while mortgage investment share increased from 5.5 percent in 2007 to 6.5 percent in 2012. Table 2.10 shows that majority of the industry's assets are held in cash and deposits. The

share of cash and deposits increased from 30.4 percent in 2007 to 36.4 percent in 2012. This suggests that the short-term insurers have access to liquid assets to meet the high frequency claims made by policyholder.

Table 2.10: Industry asset structure (% of total investments in assets)

	2007	2008	2009	2010	2011	2012
Shares	35.1%	29.6%	26.6%	26.1%	26.8%	23.9%
Stocks	9.5%	9.1%	10.3%	9.3%	7.9%	8.2%
Debentures and mortgage	5.5%	5.6%	5.1%	5.4%	5.1%	6.5%
Cash and deposits	30.4%	34.5%	38.3%	33.5%	35.3%	36.4%
Fixed Assets	1.0%	1.0%	1.1%	1.0%	0.8%	0.8%
Outstanding premiums	8.1%	8.5%	7.5%	6.1%	6.6%	7.0%
Debtors	10.3%	11.6%	11.1%	18.7%	17.5%	17.1%

Source: Authors Computation from FSB Data, 2007 to 2012

Table 2.11 shows that by the end of 2012, the total invested assets of short-term insurers was R106, 491 million, generating an income of R5, 499 million. Over the period, the investment yields of the short-term market experienced continuous decline from 2007, before recording a marginal increase in 2012 to 5.2 percent from 4.5 percent in 2011. The high volatility in security prices and low interest rates partly explains low returns on investments.

Table 2.11: Investments income and yields

	2007	2008	2009	2010	2011	2012
Investment income	8,012	6,550	5,660	4,889	4,417	5,499
Total invested assets	69,376	73,997	79,019	90,481	98,437	106,491
Yield on invested assets	11.5%	8.9%	7.2%	5.4%	4.5%	5.2%

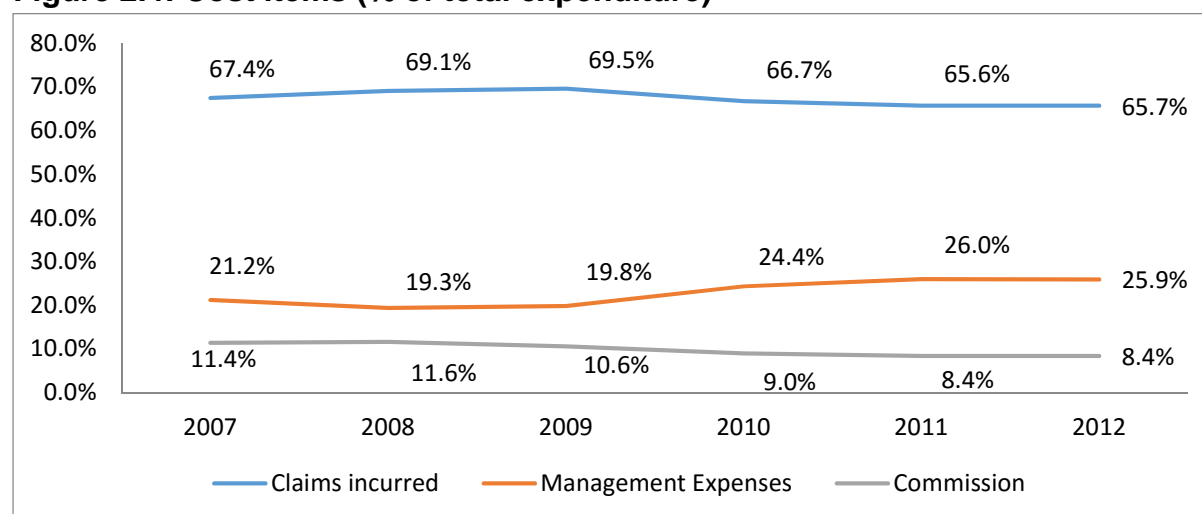
Source: All monetary values in Millions of South African Rand. Authors Computation from FSB Data 2007 and 2012

2.4.5 Cost Structure and Profitability

The main cost items on the books of insurance companies are claims paid to policy holders on the occurrence of losses, management expenses in salaries and commission expenses paid to insurance brokers for generating policies. The total operating expenditure of R5, 4991 million in 2012 represented a 53 percent increase on R 3, 5943 million in 2007 (FSB, 2007; 2012). Figure 2.4 shows that claim payments account for about two-thirds of short term insurance operating expenditure, averaging at about 60 percent from 2007 to 2012. It increased from 67.4 percent in 2007 to 69.5 percent in 2009 before declining to 66.7 percent in 2010. The next major cost item on

insurer's expenditure relates to expenses on personnel, averaging about 20 percent of total insurance expenditure.

Figure 2.4: Cost items (% of total expenditure)



Source: Authors Computation from FSB Data, 2007 to 2012

Another indicator of underwriting performance is the combined ratio, which is the sum of the expense and loss ratios. The ratio reflects the ability of premium income to cover operational expenses and policyholder claims. Table 2.12 presents the expense, loss and combined ratios from 2007 to 2012. It is observed that combined ratio is below 100 across all periods, suggesting a strong underwriting performance. The underwriting costs are mainly driven by incurred losses, with the highest the loss ratio of 63.4% in 2009. This resulted in the period high combined ratio of 83.8%, before falling to 81.7% in 2012.

Table 2.12: Underwriting expenses

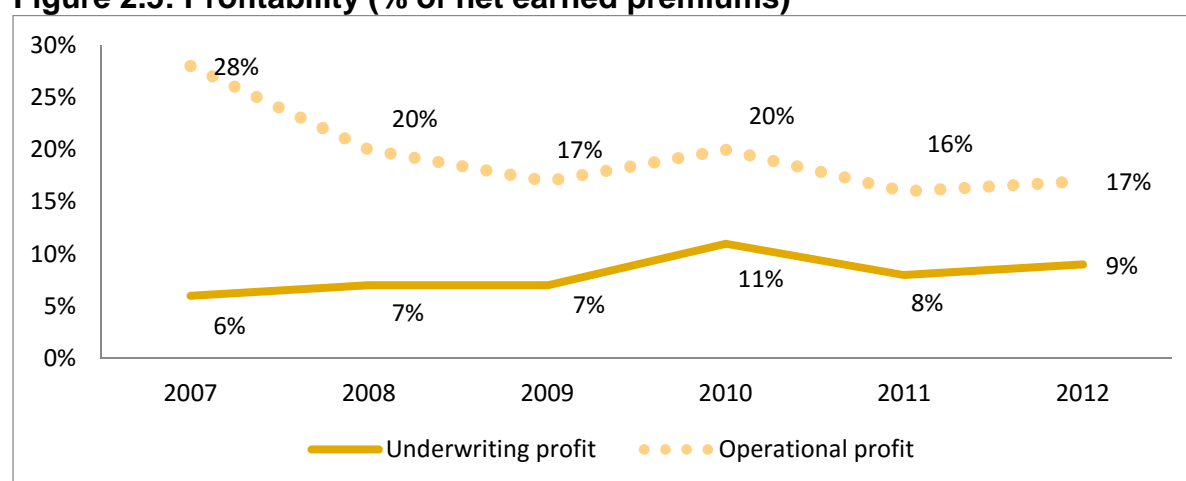
	2007	2008	2009	2010	2011	2012
Expense ratio	20.1%	20.7%	20.3%	21.4%	22.6%	21.7%
Loss ratio	57.2%	62.4%	63.4%	58.4%	58.6%	60.0%
Combined ratio	77.3%	83.1%	83.8%	79.8%	81.2%	81.7%

Note: Expense ratio=incurred expenses to gross premiums); loss ratio=incurred losses to net written premiums. Source: Authors Computation from FSB Data, 2007 to 2012

Two main indicators capture the financial performance of insurance companies. The first, underwriting profits, reflects the excess of earned premiums over the operating cost in claims, management and claims expenses. Over the period from 2007 to 2012, the highest underwriting profit as percentage of net earned premiums was observed

in 2010 at 11 percent compared to the lowest figure of 6 percent in 2007. However, underwriting profits declined after 2010 to 8 percent in 2011 and 9 percent in 2012. This is attributed to increases in claims cost arising out of high repair costs for motor claims and floods (FSB, 2011). The second profitability indicator, operating profits includes income from investment of premiums generated from policy holders. While operating profits were consistently higher compared with underwriting profits across all periods, it exhibited wider variations. It fell from 28 percent in 2007 to 20 percent in 2008. The decrease in investment yield from 11.5 percent in 2007 to 8.9 percent observed in Table 2.11 partly explains this drastic decline.

Figure 2.5: Profitability (% of net earned premiums)



Source: Extracted from Annual Reports of FSB, 2007 to 2012

2.4.6 Financial condition

The financial strength of an insurer is captured by the surplus of the insurer's assets over liabilities. This reflects insurance companies' ability to cover their liabilities and underwrite more policies. The surplus assets increased from R24, 709 million in 2007 to R42, 457 million, an increase of 71.8 percent compared 46.4 percent increase in total liabilities over the same period. The surplus ratio, measured as the ratio of earned premiums¹⁶ to surplus assets measures an insurers ability to absorb losses and shocks. Across all periods, the relatively higher ratios suggest a stronger financial health and underlines good risk management practices in the short-term insurance market. However, the observed decline in the surplus ratio between 2011 and 2012 suggest weakening financial strength of the market in the most recent years.

¹⁶ Net premium is defined gross premiums written minus reinsurance ceded.

Table 2.13: Financial health indicators

	2007	2008	2009	2010	2011	2012
Total Assets	65,155	68,789	73,477	86,532	94,447	101,657
Total Liabilities	40,446	43,055	45,990	54,740	60,406	59,200
Surplus Assets	24,709	25,734	27,487	31,792	34,041	42,457
Net Premiums written	42,411	47,125	50,503	53,283	58,520	60,153
Surplus ratio	1.72	1.83	1.84	1.68	1.72	1.42

Note: All monetary values in Millions of South African Rand. Source: Extracted from Annual Reports of FSB, 2007 to 2012.

2.5 Challenges in the Short-term market¹⁷

The challenges facing the players in the short insurance market can be categorized into internal, external, regulatory and transformational. Internally, short-term insurers are faced with continuous increases in operational costs items, primarily from worsening claims experience (PwC, 2014). The claims costs relate to catastrophic events such as floods and hail storms.¹⁸ This requires the need for an updated information and administrative system for capturing the relevant data to improve on risk modelling and reduce loss experience from such events.

From the external environment, the fluctuations in security prices and low interest rates affect returns generated from investment activities. General economic conditions and underwriting cycle also affects the premium revenues of the insurers. In addition, the depreciation of foreign exchange also adds substantial claim costs to motor business insurers, where a significant portion of costs relates to imported spare parts (PwC, 2014). Also, another cost item of short-term insurance operations emanates from global catastrophes and the high cost of using reinsurance contracts. Finally, the entrance of new firms into the market also affects the conditions and pricing of insurance policies in the market.

In respect of the regulatory challenges, insurers are faced with serious obstacles with the compliance with regulatory requirements. For instance, the preparation towards the implementation of the Solvency and Assessment Management (SAM) and compliance with International Financial Reporting Standard (IFRS), which requires investments in system and processes have added additional cost burden to insurance operations. Finally, the transformational challenges faced by the industry relate to the

¹⁷ These challenges have been highlighted by the FSB in its annual reports on the short term market from 2007 to 2012.

¹⁸ According to PwC (2014), the market leader, Santam reported losses of R630 million arising out of catastrophic events in 2012. This represented an increase from the 2013 value of R500 million.

adherence to Broad-based Black Economic Empowerment targets. In order to widen the coverage of insurance to cover the low-income citizens, market participants should design affordable products.

2.6 Conclusion

This chapter discussed the historical development of the insurance market in South Africa and some stylized facts about the short-term insurance market. From the review, it can be concluded that the regulation of the insurance market modelled on the Solvency II Directive will go a long way to enhance the soundness of the market players and protect policy holders. Unlike the long-term insurance market, the short-term insurance market is observed to be less developed and matured in terms of its contribution to gross domestic product. This presents opportunities for further growth of the sub-market to improve its contribution to economic growth.

From the review of the stylized facts of the short-term insurance market, firms in the short-term insurance market can generally be described as diversified in terms of the number of business lines underwritten. However, premium revenues are mostly concentrated in the motor and property business lines. The over-concentration in those business lines exposes the market to huge losses arising out catastrophic events like hails and floods which are becoming common occurrence in South Africa. The market is also highly concentrated among the top ten insurers, although the levels of have declined over period from 2007 to 2012 arising out competitive pressures from new entrants into the market.

Over the period 2007 to 2012, the short-term insurance market was observed to exhibit strong financial performance and a sound financial condition. The record level of net premiums underwritten in 2012 was reflected in increases in both operating and underwriting profits. However, yields on investments only increased from period low in 2011 in 2012. While the industry loss ratio increased in 2014, the markets combined ratio remained below 100% across all period to indicate a strong underwriting performance. Generally, the short-term insurers remained active in securities market with greater investments in shares and stocks. However, the ability to meet the short-term nature of their liabilities in incurred claims is greatly covered by greater reserves cash and deposits. Overall, the short-term market could be described to be financially sound and well positioned to meet the needs of its policy holders.

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Chapter Three

Efficiency, Productivity and Returns to Scale Economies in the Short-term Insurance Market in South Africa¹⁹

3.1 Introduction

There is a view that the growth in emerging economies is dependent on to the development of the financial services industry through the provision of financing opportunities for businesses and households and employment creation. Business environments in these economies are characterized by, among other things, uncertain macroeconomic conditions and unexpected losses arising from environmental factors such as fire, hailstorms, storms, fraud, accidents and thefts (Sarker and Sarke, 2000; Freeman and Kunreuther, 2002; Sinha, 2004). The occurrence of unexpected losses also results in external costly financing or reallocation of internal resources for asset replacement (Sinha, 2004). These exposures underline the need for risk management services like insurance to ensure that businesses and households are provided with the needed cover to mitigate the negative effects of these uncertain events. The short-term insurance sector is of great importance to firms, individuals and governments in emerging economies such as South Africa through the provision of cover for such unexpected losses. As Africa's largest short-term insurance market (Swiss Re, 2011) and constantly under-going regulatory reforms to improve performance of industry players, efficiency studies are relevant to highlight areas of concern that needs addressing by both regulatory policy and managerial actions. This would better position the industry to play its risk management functions effectively and promote consumer welfare. Industry best practices could be benchmarked from the results of efficiency studies.

The main objective of this chapter is to undertake a comprehensive analysis of efficiency, productivity and returns to scale economies is examined in a three-stage analysis. In the first stage, efficiency and returns to scale economies are estimated using the DEA technique. The Malmquist index is also applied to examine productivity changes over the study period. The truncated bootstrapped regression procedure of Simar and Wilson (2007) is employed to identify the determinants of efficiency while a

¹⁹ This chapter has been published in the *Special Issue on Insurance and Finance; The Geneva Papers on Risk and Insurance-Issues and Practice* (2015), 40(3): 493-515; <http://dx.doi.org/10.1057/gpp.2014.37>

logistic model is used to examine the factors that affect the probability of operating at optimal capacity of constant returns to scale in the second stage. Finally, this study examines the rate of efficiency convergence in the industry by applying the growth concepts of β -convergence and α -convergence of Barro and Sala-i-Martin (1991) applied to the banking markets by authors such Weill (2009), Casu and Giarardone (2010) and Zhang and Matthews (2012).

This chapter contributes to the literature in three ways. First, the study expands on earlier work by Eling and Luhnen (2010a) on the short-term insurance market in South Africa. In their study of 6,462 insurance companies in 36 countries, they analysed efficiency of the short-term industry in South Africa from 2002 to 2006 using 72 firm-year observations. This study expands on their sample by covering 418 firm-year observations for a current dataset from 2007 to 2012. This period has been characterized by regulatory reforms towards the adoption of the solvency assessment and management (SAM),²⁰ an adaptation of the Solvency II risk management framework to the South African context. Second, the study also examines a broad set of insurer characteristics to explain the determinants of efficiency and returns to scale²¹ which, to the authors' best knowledge, has not be explored in the South African context. This analysis is very important for regulatory policies on mergers and consolidation that affect industry structure and antitrust enforcements (Cummins and Xie, 2013). We also provide first empirical evidence on productivity growth in the South African insurance market.

Finally, the study extends the vast efficiency literature in insurance markets by applying the growth theory of convergence to analyse the evolution of efficiency scores from 2007 to 2012. Evidence of efficiency convergence reflects technology diffusion among firms in an industry. Unlike productivity analysis, analysing the evolution of efficiency using the growth convergence theory helps to determine the rate at which efficiency changes over time. Since effective regulation seeks to enhance general industry performance, convergence analysis helps in the evaluation of the effectiveness of regulatory policies in improving general levels of efficiency in an industry. To the best of the authors' knowledge, this is the first study to test for

²⁰ The SAM seeks to establish a framework that protects both policyholders and insurers and enhance the stability of the insurance industry.

²¹ Hanweck and Hogan (1996) and Cummins and Xie (2013) are among the very few studies that have specifically focused returns to scale economies in insurance markets.

efficiency convergence in insurance markets. As the first study to exclusively examine the insurance market in South Africa, the findings of the study will serve as a useful reference point for both academics and practitioners.

The rest of the chapter is structured as follows: Section 3.2 presents a review of literature on efficiency studies; Section 3.3 outlines the research methodology. Section 3.4 discusses the findings from the analysis while Section 3.5 concludes the study.

3.2 Literature Review

Efficiency, as an economic concept, refers to the transformation of inputs variables through a production process into a set of outputs (Greene, 2008). It is a comparison between observed and optimal inputs and observed and optimal outputs (Fried et al., 2008). The most widely used, technical efficiency refers to the reduction in wastages in the production process either through output maximization with a given level of inputs or input minimization with a given level of output. Hence, firms are described to be efficient if they achieve the optimal outputs from a given level of inputs or minimizes input usage to obtain a given level of outputs. In the financial services, regulators have generally sought to improve the level of industry performance in effective usage of resource to enhance financial intermediation. Traditionally, the estimation of efficiency has mainly been undertaken with both parametric and non-parametric techniques. The class of parametric techniques specify an efficient frontier in the translog function but differ in the distributional assumptions of the inefficiency and random components (Eling and Luhn, 2010a). The most widely applied techniques under the parametric approach include the stochastic frontier analysis (SFA), distribution-free approach (DFA) and thick frontier approach (TFA). On the other hand, the non-parametric approaches are mainly based on mathematical linear programming techniques, with no assumptions on the error terms. The data envelopment analysis (DEA) and free-disposal hull (FDH) are the most common non-parametric techniques for estimating efficiency.

The empirical application of efficiency techniques in the financial services has mainly been concentrated in banking markets. However, in recent years, there has been an increase in empirical studies on efficiency and productivity changes in insurance

markets. The majority of these studies²² have, however, focused mainly on the developed economies of America, Europe and Asia while empirical evidence from insurance markets in Africa appears very scanty. A recent survey of 95 efficiency studies by Eling and Luhnen (2010b) reported only two empirical evidences from Africa.²³ In addition, very few of the studies surveyed examined the issue of scale economies (Cummins and Xie, 2013).²⁴ This section provides a brief overview of empirical studies on efficiency in insurance markets using the DEA.

Fecher et al. (1993) employ a sample of 243 non-life insurers between 1984 and 1989 to conclude that the non-life insurers operate at 50% of their capacity in France. The authors also identify size as the major determinant of insurance efficiency. In examining efficiency and productivity changes in the Italian insurance industry, Cummins et al. (1996) employ a sample of 94 insurance firms (including 58 short-term firms) from 1985 to 1993 using the data envelopment analysis (DEA) and the Malmquist index. They find average technical efficiency to range between 70% and 78%.

By employing a panel data of 12 firms from 1991 to 1996, Noulas et al. (2001) empirically examine the efficiency of the non-life insurance market in Greece. Using premium revenue and investment income as outputs variables, the authors find an inefficient insurance market operating at 35% below its optimum capacity. In Australia, Worthington and Hurley (2002) also employ the two-stage DEA to analyse efficiency determinants in the general insurance market. They find the average technical efficiency of a cross-section of 46 insurers in 1998 to be 55.55%. A "U" shaped relationship is found between pure technical efficiency and size. Yao et al. (2007) examine the drivers of efficiency in the insurance industry in China from 1999 and 2004 using the two-stage DEA procedure. They identify size, ownership structure, mode of business and human capital as significant determinants of efficiency. Luhnen (2009) also analysed the efficiency and productivity in the German property-liability insurance market. The author identified distribution channels, product specialization,

²² See Eling and Luhnen (2010b) for comprehensive review on the insurance efficiency literature.

²³ Both were working papers. Since then, Ansah-Adu et al. (2012) have examined the cost efficiency of Ghanaian insurance companies. Recently, Barros and Wanke (2014) examine the efficiency of the Mozambique insurance market while Barros et al. (2014) also analysis the Angolan insurance market.

²⁴ Cummins and Xie (2013) contend that studies few studies have specifically set out to examine economies of scale characteristics in insurance markets.

size, ownership forms, leverage and premium growth as explanatory variables for efficiency.

In a comparative study on the BRIC²⁵ economies, Huang and Eling (2013) employed the Simar and Wilson (2007) two-stage DEA approach to examine the determinants of efficiency. They find profitability, size, equity and ownership form as the determinants of efficiency. In the US property and liability insurance market, Cummins and Xie (2013) find improvements in productivity and document evidence that product diversification, organizational form, equity and distribution system accounts for the probability of an insurer to operate with constant returns to scale.

Efficiency studies in insurance markets in Africa are limited to Barros et al. (2008), Ansah-Adu et al. (2012), Barros and Wanke (2014), Barros et al. (2014) and Alhassan et al. (2015). For instance, Ansah-Adu et al. (2012) employ premium income as output variable to examine the cost efficiency of life and non-life insurance companies in Ghana from 2006 to 2008. They find average cost efficiency of 30% using the DEA in the first stage analysis. The authors identify market share, size and equity as the significant determinants of cost efficiency. Barros and Wanke (2014) also analyse the technical efficiency and capacity issues of a sample of insurance firms in Mozambique, using the DEA bootstrapped technique. The authors predict the effect of market share, ownership type and firm origin, using neural network in the second stage analysis. Barros et al. (2014) also assess the technical efficiency of insurance companies in Angola from 2003 to 2012 in a two-stage analysis. The authors employ the bootstrapping technique in the first to estimate technical efficiency scores to allow for the correction of the biases associated with parametric efficiency estimates. Using artificial neural network technique, the authors predict that older insurers that originated from Portugal were more efficient. In examining the effect of market structure and efficiency on the profitability of both life and short-term insurance companies in Ghana, Alhassan et al. (2015) find evidence in support of the efficient structure hypothesis that efficiency drives profitability in both markets.

This brief review points out the scarcity of efficiency studies in insurance market in South Africa and many other African countries. As a developing financial services industry with market imperfections, this study seeks to enhance the managerial control

²⁵ Brazil, Russia, India and China

of insurance companies in Africa by providing a reference point for effective utilization of resources.

3.3 Methodology

3.3.1 Estimating Efficiency Scores

The objective of efficiency analysis is the identification of best performing decision making units to serve as role models for the inefficient ones. By estimating a production frontier, firms operating on the frontier achieve efficient utilization of resources; hence the most efficient with efficiency score of 1. The output-oriented DEA technique under assumptions of constant returns to scale (Charnes et al., 1978)²⁶ and variable returns to scale (Banker et al., 1984)²⁷ was employed to estimate efficiency. The preference of the DEA over the stochastic frontier analysis (SFA) technique is influenced by its simplistic nature. Additionally, efficiency scores obtained are individual firm observations, compared to the central tendency averages derived from parametric approaches, which are vulnerable to specification errors.²⁸ The DEA uses a linear programming technique to estimate the Farrel (1957) efficiency score for each unit relative to the best practice firms on the frontier. In estimating efficiency in this study, the study considers n insurers with m different outputs y produced from k different inputs, x . In line with Charnes et al. (1978), the insurer specific output-oriented technical efficiency assuming constant returns to scale is modelled into a linear programming and solved n times for each firm in the sample;

$$\hat{\theta}_i = \max \left\{ \theta_i > 0 \mid \theta_i y_i \leq \sum_{i=1}^n y_i \lambda_i; x_i \geq \sum_{i=1}^n x_i \lambda_i; \lambda_i \geq 0 \right\}, \quad i = 1, \dots, n \quad (1)$$

where y_i and x_i are vectors of output and inputs respectively; λ is a non-negative vector of constants specifying the optimal weights of inputs/outputs. $\hat{\theta}_i$ is the efficiency score for the i th firm. Technically efficient (TE) insurers will have $\hat{\theta} = 1$ while those with $\hat{\theta} < 1$ operate below the efficient frontier, and hence are inefficient. In order to estimate scale efficiency (SE), pure technical efficiency (PTE) under variable returns to scale has to be computed by imposing convexity constraints; $\sum_{i=1}^N \lambda_i = 1$. This

²⁶ This gives the estimates of technical efficiency

²⁷ This gives the estimates pure technical efficiency

²⁸ Refer to Cummins and Weiss (2000) for detailed discussion on the merits and demerits of non-parametric efficiency estimations.

constraint ensures that firms similar in size are compared to each other to generate efficiency scores greater than or equal to the TE scores. The difference between TE and PTE reflects scale inefficiency. The scale efficiency (SE) scores are estimated by;

$$SE(x, y) = \frac{TE(x, y)}{PTE(x, y)} \quad (2)$$

For non-increasing returns to scale (NIRS), the constraint for PTE is changed to $\sum_{i=1}^N \lambda_i \leq 1$. Based on the TE, PTE, SE and NIRS, three returns to scale (RTS) categories for each insurer are identified. Following Aly et al. (1990) and Cummins and Xie (2013), we identify the returns to scale economies of the insurers as follows; If $SE < 1$ and $PTE \neq NIRS$, the firm operate with increasing returns to scale (IRS). However, if $SE < 1$ and $PTE = NIRS$, the firm operate with decreasing returns to scale (DRS). IRS represents inefficiencies from underutilization of resources while DRS explain inefficiencies resulting from overutilization of firms' scale of operations. Insurers with $SE = 1$ operate with constant returns to scale (CRS). This represents the optimum scale of production of a firm.

The DEA, as a deterministic method, has some shortfalls. By assigning all deviations from the frontier to inefficiency, errors in the data and stochastic noises are not accounted for. There is a possibility of lower scores if such shortfalls are addressed. Simar and Wilson (1998, 2000b) introduced a bootstrapping procedure for the DEA efficiency scores to address these shortfalls by estimating confidence intervals for a generated bias corrected efficiency scores. This study adopts the bootstrap algorithm of Simar and Wilson (1998) to generate the bias corrected efficiency of the original DEA estimates. The procedure was implemented using Frontier Efficiency Analysis with R (FEAR) 1.0 of Wilson (2008).

3.3.2 Productivity Changes

Consistent with the studies by Malhberg and Url (2003), Luhnén (2009), Cummins and Xie (2013) among several others, the study favours the use of the Malmquist productivity index (MPI) over the Fischer (1922) and the Törnqvist (1936) indices to examine productivity changes in the short-term insurance market. The MPI estimates the changes in output arising out of input changes over different time periods to identify the sources of productivity growth. The MPI of Fare et al. (1994) between period $t-1$ (base technology period) and period $t+1$ (reference technology period) is denoted by;

$$M(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{d^t(x^{t+1}, y^{t+1})}{d^t(x^t, y^t)} \quad (3)$$

Under the assumptions of a constant returns to scale (Grifell-Tatjé and Lovell, 1995) output-oriented total productivity change is denoted below as;

$$MPI(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{d^t(x^{t+1}, y^{t+1})}{d^t(x^t, y^t)} \times \frac{d^{t+1}(x^{t+1}, y^{t+1})}{d^{t+1}(x^t, y^t)} \right]^{1/2} \quad (4)$$

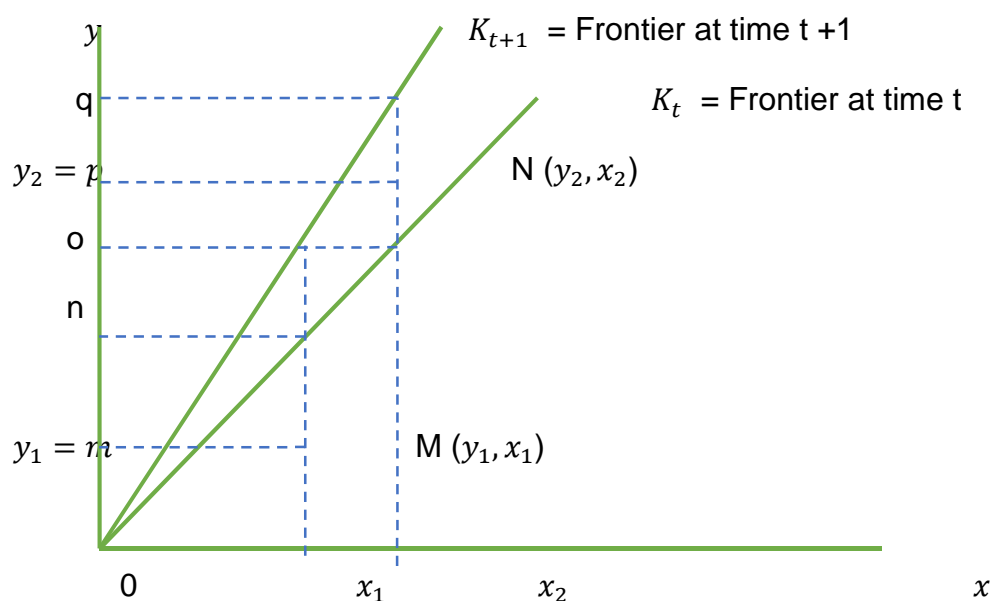
Where x^t and y^t are the input and output vectors respectively, $d^t(x^t, y^t)$ refers to the distance between period t and $t + 1$. If the value of the MPI is greater than 1 ($TFP > 1$), then a positive total factor productivity change occurred between periods t and $t + 1$ whereas $MPI < 1$ denotes a decline in productivity between the periods. The MPI can be further decomposed into productivity growth arising from efficiency changes (EFFCH) and technological changes (TECHCH). This represented in equation 3 as;

$$MPI(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{d^{t+1}(x^{t+1}, y^{t+1})}{d^t(x^t, y^t)} \left[\frac{d^t(x^{t+1}, y^{t+1})}{d^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d^t(x^t, y^t)}{d^{t+1}(x^t, y^t)} \right]^{1/2} \quad (5)$$

where the ratio inside the squared brackets measures shifts in frontier technology (TECHCH). The frontier shifts arise from innovations in production techniques and new product developments. The ratio outside the squared brackets is the EFFCH, which measures changes in efficiency between the base period t and reference period $t+1$, referred to as the 'catch-up' effect.

In a case of one input and output under constant returns to scale, the distance function of the index is graphically presented in Figure 3.1. It shows observations for period t (M) and $t + 1$ (N). In respect of output y_1 , the input x_1 in t (M) is employed while input x_2 is used to produce output y_2 . The frontiers of K_{t+1} and K_t the feasible sets for a given technology levels for t and $t + 1$. The frontier in combination with the x-axis bounds the feasible sets of outputs y in t and $t + 1$ (Neal, 2004). The Malmquist index are captured by the geometric mean of the indices from relative efficiency of production at (t) M and N ($t + 1$).

Figure 3.1: Malmquist distance function



Source: Adapted from Neal (2004)

3.3.3 Input and Output Variables

In line with the functions of insurance of; i) risk pooling and bearing ii) financial services provision intermediation activities, this study employs labour (agent and home office labour), business services (travel, communication and advertising) and capital as our input variables. For the purposes of this study, both labour and business services are employed as one input. Following the common practice in efficiency studies, capital inputs are distinguished into equity and debt capital.²⁹ In line with Cummins and Rubio-Misas (2006),³⁰ debt capital is proxied as borrowed funds, while equity capital is measured as year-end book value of equity.

Similar to other financial services industry, the choice of output variables is based on three main approaches³¹, namely; intermediation approach, user-cost method approach and value-added approach. Following the convention in efficiency studies on insurance markets, this chapter adopts the value-added approach in choosing the output variables for estimating efficiency scores. Under this approach, numerous arguments have been advanced for the use of premium income as the proxy for risk pooling and bearing of insurers by authors such as Rai (1996), Diacon et al. (2002),

²⁹ Cummins and Weiss (2000) argue for the relevance of debt and equity capital as important inputs for which adequate cost measures have to be found.

³⁰ The study does not include deposits from reinsurers due data limitations.

³¹ Refer Eling and Luhn (2010b) for a discussion on the three approaches in insurance markets.

Yao et al. (2007), Cooper et al. (2000), Kader et al. (2010) and Huang and Eling (2013). However, Yuengert (1993) cautions against this proxy because premiums represent output quantity times price and not output. Following from this, Luhnén (2009) and Eling and Luhnén (2010a) have specified the outputs for risk pooling and bearing and financial services as real incurred losses. Subsequently, Leverty and Grace (2010) find evidence to invalidate the use of present value of incurred losses as an output variable. They find evidence to rather validate forecast of expected losses as outputs.

In a survey by Eling and Luhnén (2010a) incurred claims and premiums were used as output variables in 32 and 35 studies respectively. With inconclusive evidence on the best proxy for risk pooling and bearing, this study estimates two efficiency models with premiums earned and incurred losses as output variables. Due to data limitations, this study is unable to employ forecast of expected losses. In line with Diacon (2001) and Klumpes (2007), investment income is employed as output for intermediation activities. This study is unable to employ invested assets as employed in numerous efficiency studies due to data limitations. The output variables in Model 1 are net premiums earned and investment income while Model 2 has incurred losses and investment income as outputs. All input and output variables are deflated by the consumer price index. Summary statistics of the input and output variables are presented in Table 3.1.

Table 3.1: Summary Statistics of Input and Output Variables

	Mean	Median	Std. Dev	Min	Max	N
Outputs						
Net Premium Earned	693,893	111,857	1,804,202	3,285	14,600,000	441
Claims incurred	399,242	284,823	1,162,991	463	9,962,146	441
Investment income	73,506	12,705	191,044	1,261	2,613,809	441
Inputs						
Management Expenses	136,011	24,250	292,898	2,014	1,881,896	441
Total Equity	461,476	115,518	931,181	2,833	5,886,037	441
Total Liabilities	804,561	212,660	1,614,745	507	11,300,000	441

Note: All monetary values in South African (R'000). Source: Authors Estimations from Research Data.

3.3.4 Empirical Model

This study models the determinants of efficiency in the short-term insurance industry by adapting the empirical models of Worthington and Hurley (2002), Luhnén (2009) and Huang and Eling (2013) as presented in equation 6;

$$\hat{\theta}_{i,t} = \beta_0 + \beta_1 size_{i,t} + \beta_2 size_{i,t}^2 + \beta_3 div_{i,t} + \beta_4 age_{i,t} + \beta_5 reins_{i,t} + \beta_6 lev_{i,t} + \varepsilon_{i,t} \dots \dots \dots 6$$

where the subscripts i and t represents insurers and years respectively. $\hat{\theta}$ represents the bias corrected efficiency scores (TE and PTE) from the DEA; $size$ is measured as the natural logarithm of total assets; $size^2$ is the square of size; div represents 1-Herfindahl Hirschman index (HHI)³² for product line concentration; age is the natural logarithm of the number of years since an insurer was registered; $reins$ is the ratio of reinsurance ceded to gross premiums and lev is the ratio of total liabilities to total assets. The one-way error terms, $\varepsilon_{i,t}$ is made of μ_i , the unobservable firm-specific effects and $v_{i,t}$ is the time-varying error term.

3.3.5 Variable description

Based on Coelli et al. (1999) and numerous efficiency studies,³³ this study examines the effect of insurer-specific variables on estimated efficiency scores in the second stage analysis. First, in line with studies by Malhberg and Url (2003), Luhnén (2009) among several others, this study examines the relationship between insurer size and efficiency. Large insurers are expected to benefit from economies of scale and scope in the form of lower per unit cost of production derived from large scale production. This draws them closer to the efficient frontier. On the other hand, the inability of larger firms to monitor and control activities of large scale of operation results in diseconomies of scale, hence a negative relationship. In the long run, firms may be able to adjust their scale of operations. However, difficulties in managing large scale of operations could result in a non-linear relationship between size and efficiency. While some small firms may have to reach certain size threshold to become efficient, other large firms may also become inefficient after certain size threshold. Empirical studies such as Worthington and Hurley (2002) and Eling and Luhnén (2010a) find evidence in support of a curve-linear relationship between size and efficiency in

³² The HHI is computed as the sum of the square of the market share of premiums from each business line to gross premiums for all business lines for each insurer.

³³ Noulas et al. (2001), Worthington and Hurley (2002), Cummins and Rubio-Misas (2006), Yao et al. (2007), Barros et al. (2010)

insurance market. This study thus tests for the non-linearity of the size-efficiency relationship by including a quadratic term of size.

The conglomeration and strategic-focus hypotheses explain the relationship between product diversification and efficiency. According to the conglomeration hypothesis, diversification of business operations comes with the benefits of economies of scope from complementarities in production and cost sharing. Hence, diversified insurers are expected to be more efficient. On the other hand, the strategic focus hypothesis documents a negative diversification-efficiency relationship. Inefficient internal capital markets lead to cross-subsidization of inefficient business lines by efficient ones. The inefficiencies of diversified insurers are further compounded by issues of monitoring and control in large diversified organisation. With more insurers operating multiple business lines, this study favours the conglomeration hypothesis. Malhberg and Url (2003) and Cummins and Xie (2013) find evidence in support of the conglomeration hypothesis in the Austrian and US property and liability insurance markets.

The study also examines the relationship between insurers' age and efficiency, which has rarely been analysed in empirical literature. Older firms are expected to become more efficient from 'learning-by-doing' (Arrow, 1962). Jovanovic (1982) also argue in favour of positive age-efficiency relationship because of selection effects which ensures that older firms obtain the necessary experience to survive through improved efficiency. However, Barron et al. (1994) argue that aging firms tend to employ obsolete technology and are more likely to be inefficient. Similar to other financial markets, trust is fundamental to the operations of insurers. Older insurers are seen to have 'passed' a test of confidence required by policyholder and have the ability to provide adequate cover for their client base. The study therefore expects older insurers to have the ability to provide better risk pooling and bearing services to policyholders, hence a positive age-efficiency relationship.

According to the concept of risk diversification, firms reduce their exposure to uncertain events through risk sharing and hedging decisions. Applied to the insurance market, insurers diversify their loss exposure through reinsurance policies. Through the ceding of reinsurance premiums to reinsurers, primary insurers reduce their exposure to their risk portfolio. This enhances their capacity to underwrite more risk to benefit from the principle of large numbers in insurance markets (Malhberg and Url,

2003). Hence, a positive effect of reinsurance activities on technical efficiency is expected.

Insurance leverage consists of pre-collected premiums and reserves funds to provide cover for incurred losses and unreported claims. The cash flow hypothesis of Jensen (1986) argues that leverage places financial cost on firms and increases the probability of financial distress. This binding role of leverage puts pressure on management to generate high cash flows to meet their interest obligations. Therefore, management of highly levered firms can also become efficient. Conflict between debt holders and shareholders implies that higher leverage leads to a negative leverage-performance relationship (Jensen and Meckling, 1976). Hence, the leverage-efficiency relationship is indeterminate.

3.3.6 Model Estimation

The regression estimation in the second stage DEA analysis has normally favoured the use of the Tobit and ordinary least squares (OLS) techniques. However, Simar and Wilson (2007) argue that the Tobit estimation is biased due to unknown serial correlation among the efficiency scores whereas the assumptions for the use of OLS are unattainable (Simar and Wilson, 2011). Hence, in the estimation of the empirical model, this study employs the Simar and Wilson (2007) truncated bootstrapping regression. This involves a seven step procedure in which the bias-corrected efficiency scores in the first stage DEA estimation are employed as the dependent variable in a truncated bootstrapped regression analysis. The procedure is described in Simar and Wilson (2007).³⁴

3.3.7 Modelling Determinants of Returns to Scale

Unlike technical and pure technical efficiency, scale efficiency is categorized into constant returns to scale (CRS), increasing returns to scale (IRS) or decreasing returns to scale (DRS). The efficient scale of operations of CRS is the most preferred choice for every firm. Both IRS and DRS are undesirable (Cummins and Xie, 2013) and reflect scale inefficiencies; hence the long-term objective of firms should be focused on operating at the minimum efficient scale of production at CRS. This study therefore proceeds to examine the factors that increases the probability of an insurer

³⁴ Refer to Simar and Wilson (2007) for the detailed procedure of the seven-step bootstrapping procedure and truncated bootstrapped regression

to either operate at their optimum capacity (CRS) or not (IRS and DRS). The only empirical analysis of the determinants of RTS categories by Cummins and Xie (2013) employed all three categories as the dependent variable in a multinomial logistic model. This study deviates by employing a binary-coded dependent variable. Based on the argument of Cummins and Xie (2013) that both IRS and DRS are undesirable scales of production, the sample is categorized into insurers operating at their optimum capacity (CRS=1) and those with scale inefficiencies (IRS=DRS=0). This allows the study to employ a logistic regression technique to determine the probability of an insurer to either operate with CRS or not (IRS or DRS). The model for the logistic regression as employed is expressed below as:

$$P_{i,t}(Y = 1|X_{i,t}) = \frac{\exp(\alpha + \beta X_{i,t})}{1 + \exp(\alpha + \beta X_{i,t})}$$

where *i* and *t* represents insurers and years respectively; $P(Y = 1|X)$ is the probability of an insurers to operate with CRS; *X* represents the explanatory factors that explain the probability of an insurer to operate with a returns to scale category, β is the corresponding coefficient of *X*, α is the intercept. The logistic model is expanded to form equation 7 below;

$$RTS_{i,t} = \ln\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \alpha + \beta X_{i,t} + \varepsilon_{i,t} \dots\dots\dots 7$$

Where RTS is the dummy variable coded as 1 if insurer operate under CRS and 0 otherwise. The explanatory factors (*X*) in equation 7 is the same as those specified in equation 6. The marginal effects of the independent variables on the returns to scale categories are estimated to allow for meaningful interpretations of the coefficients. Following Cummins and Xie (2013), the marginal effect at the mean level of coefficient β_k is estimated as;

$$\frac{\partial P_{k,i}}{\partial X_{j,i}} = P_{k,i}(\beta_{kj} - \sum_{k=0}^K P_{ki}\beta_j) \text{ for } k=1$$

where β_j is the coefficient of the independent variable x_j for returns to scale category *k*. The marginal effect of *X* on the RTS is interpreted as the probability of an insurer operating in a returns to scale category arising from mean changes in the independent variable. The model is estimated using the maximum likelihood estimation.

3.3.8 Estimating Efficiency Convergence

In examining the rate of efficiency convergence in the short-term insurance market, this study employs the growth theory of convergence by Barro and Sala-i-Martin (1991). When applied to efficiency, convergence refers to the tendency for firms to achieve an equal level of efficiency over time. The two widely used convergence concepts are the β -convergence and α -convergence. β -convergence refers to the ability of inefficient decision making units (DMUs) to 'catch-up' with efficient ones and become efficient over time. If inefficient DMUs are able to improve their efficiency levels more rapidly than efficient one's, β -convergence is assumed to have occurred. β -convergence is examined empirically by estimating regressions of initial levels of efficiency on the growth rate in efficiency scores. In modelling efficiency convergence in the short-term insurance industry, the study employs the dynamic model of Casu and Giarardone (2010) in equation 8;

$$\Delta y_{i,t} = \alpha + \delta \Delta y_{i,t-1} + \beta \ln y_{i,t-1} + \varepsilon_{i,t} \dots \dots \dots 8$$

Where $y_{i,t}$ is the bias corrected efficiency score for insurer i at time t ; $y_{i,t-1}$ is the bias corrected efficiency score for insurer i at time $t-1$; $\Delta y_{i,t} = \ln y_{i,t} - \ln y_{i,t-1}$, β is the coefficient that measures the rate of efficiency convergence. α is the constant term and δ is the coefficient of the lagged the dependent variable. A negative value for β indicates convergence or 'catch-up' of technically inefficient insurers while a higher absolute β implies faster rate of efficiency convergence. Evidence of β -convergence is a necessary but not sufficient for α -convergence (Sala-i-Martin, 1996), which refers to the reduction in the dispersion of efficiency over the period. Following from the β -convergence model, the model for α -convergence is also specified below as;

$$\Delta E_{i,t} = \alpha + \varphi \Delta E_{i,t-1} + \sigma E_{i,t-1} + \varepsilon_{i,t} \dots \dots \dots 9$$

where $E_{i,t} = \ln(y_{i,t}) - \ln(\bar{y}_t)$; $E_{i,t-1} = \ln(y_{i,t-1}) - \ln(\bar{y}_{t-1})$; $y_{i,t}$ and $\Delta E_{i,t} = E_{i,t} - E_{i,t-1}$. $y_{i,t-1}$ remains as defined before, \bar{y}_t is the mean efficiency score for the industry in period t , \bar{y}_{t-1} is also the mean efficiency score for the industry in period $t - 1$. $\varepsilon_{i,t}$ is the time-varying error term. α is the constant term and φ is the coefficient of the dynamic term. σ is the parameter of interest which captures the rate of convergence from $y_{i,t}$ to \bar{y}_t . Based on the dynamic panel modelling of convergence, equations 8

and 9 are estimated using the system generalized method of moments of Arellano and Bover (1995) with forward orthogonal deviations.

3.3.9 Data

Detailed dataset comprising of annual returns of all short-term insurers covering the period 2007-2012³⁵ were obtained from the prudential regulator of insurance firms in South Africa, the Financial Services Board (FSB). Specifically, income and balance sheet data were extracted from schedule returns submitted by the insurers to the Insurance Department of the FSB. Out of the initial dataset of 100 short-term insurers, 20 insurers were excluded due to large number of missing data, negative and zero premium and incurred claims cost³⁶. The total sample of seventy-six (76) satisfies the DEA convention that the number of decision making units (DMU's) should be three times greater than the number of inputs plus outputs.

3.4 Results

The results of bias-corrected efficiency scores from the bootstrapping procedure of Simar and Wilson (2007) based on equation 1 are presented in Table 3.2. In Model 1, the mean technical efficiency (TE)³⁷, pure technical efficiency (PTE) and scale efficiency (SE) scores are 52.15%, 59.25% and 87.80% respectively while in Model 2, the mean TE, PTE and SE scores are 57.25%, 67.19% and 87.34% respectively. In both models, we observe lower PTE scores compared to SE scores to indicate that technical inefficiency is attributable to pure technical inefficiency. PTE reflects the ability of firms to fully utilize state-of-the-art technology to operate on the efficient frontier. Hence, short-term insurers can improve efficiency through the adoption of technology enhancing systems for premium pricing and claims management. Table 3.2 also presents a trend analysis of the returns to scale economies to identify the sources of scale inefficiency. Over the period, 18% and 22% of the insurers operate with constant returns to scale in Models 1 and 2 respectively. This indicates that the

³⁵ This period is mostly influenced by data availability.

³⁶ They are insurers in the process being liquidated (run-off) who are winding-up their businesses and don't receive any more premiums but paying out for their existing policies.

³⁷ Barros et al (2014) report an average technical efficiency and pure technical efficiency scores of 51% and 77% respectively for the insurance market in Angola while Barros and Wanke (2014) also report 67% and 94% for technical efficiency and pure technical efficiency respectively in Mozambique. The average figures for Angola and Mozambique were estimated from the firm level results reported in both studies. In Ghana, Alhassan et al. (2015) also report an average of 65.1% and 78.2% for technical efficiency and pure technical efficiency in the non-life insurance market.

majority of the insurers operate with scale inefficiencies in the form of either increasing returns to scale or decreasing returns to scale.

Table 3.2: Efficiency Scores and Returns to Scale

	2007	2008	2009	2010	2011	2012	Average
MODEL 1							
Bias-Corrected DEA Scores							
TE	0.5474	0.4083	0.5097	0.5612	0.5518	0.5531	0.5215
PTE	0.622	0.4771	0.5349	0.6359	0.6618	0.6243	0.5925
SE	0.8679	0.8668	0.9404	0.8809	0.8283	0.8837	0.8780
Returns to Scale (% of Insurers)							
CRS	32%	9%	15%	18%	20%	17%	18%
IRS	39%	43%	51%	47%	41%	51%	45%
DRS	30%	48%	35%	35%	39%	32%	37%
MODEL 2							
Bias-Corrected DEA Scores							
TE	0.5318	0.5924	0.6759	0.4262	0.5765	0.6268	0.5725
PTE	0.6958	0.6620	0.7894	0.4532	0.7059	0.7362	0.6719
SE	0.7755	0.9029	0.8566	1.0063	0.8215	0.8522	0.8734
Returns to Scale (% of Insurers)							
CRS	23%	19%	23%	21%	23%	26%	22%
IRS	42%	47%	48%	55%	29%	32%	42%
DRS	35%	35%	29%	24%	48%	42%	36%

Note: TE= Technical Efficiency; PTE= Pure Technical Efficiency; SE=Scale Efficiency; CRS=Constant returns to scale; IRS=Increasing returns to scale; DRS=Diminishing returns to scale; Models are defined by the output variables. Model 1= Premiums and Investment Income, Model 2=Net claims incurred and Investment Income. Source: Authors Estimations from Research Data.

Table 3.3 presents the efficiency scores and returns to scale characteristics of insurers in different size categories (small, medium, big and large). In Model 1, it is observed that both small and large insurers have high TE scores compared to medium and big insurers. The same trend is also observed for the PTE but not the SE.³⁸ This implies that medium and big insurers are less efficient compared to smaller and large insurers. This gives an indication of a non-linear relationship between size and efficiency. In Model 2, a linear trend is observed for TE where the scores increase with size. An inverted 'U' relationship is however observed for SE and size categories while a 'U-shaped' relationship is found for PTE.

Analysis of returns to scale by size categories is also presented in Table 3.3. It is also observed in both models that majority of small, medium and big insurers mostly

³⁸ For Scale efficiency, medium and big insurers have higher efficiency scores compared to small and large insurers.

operate with IRS while large insurers are characterized by DRS. The under-utilization of scale for small, medium and big insurers suggests that mergers and consolidation would be beneficial in terms of efficiency improvement. This result is consistent with the findings of Luhnén (2009) and Cummins and Xie (2013) in the property and liability insurance markets in Germany and USA. For large insurers, any efficiency gains from scale reduction may be limited due to already high scale efficiency scores. The most beneficial way of improving efficiency would involve the adoption best industry practices and investment in technology.

Table 3.3: Efficiency and Returns to Scale by Insurer Size

	Small (R 64,432)	Medium (R 215,659.2)	Big (R 672,089.8)	Large (R 4,130,588)
MODEL 1:	Bias-Corrected DEA Scores			
TE	0.5061	0.4835	0.4845	0.6118
PTE	0.6383	0.5389	0.5238	0.6688
SE	0.7852	0.8867	0.922	0.9189
	Returns to Scale (% of firms)			
CRS	24%	10%	14%	24%
IRS	65%	64%	45%	7%
DRS	11%	26%	41%	69%
MODEL 2:	Bias-Corrected DEA Scores			
TE	0.4831	0.5738	0.5917	0.6422
PTE	0.6507	0.6156	0.6555	0.7662
SE	0.7844	0.9480	0.9048	0.8574
	Returns to Scale (% of firms)			
CRS	15%	15%	28%	23%
IRS	84%	74%	38%	7%
DRS	1%	11%	34%	70%

Note: Asset Class values represent the average of the lower and upper bounds for total asset values in category. Models are defined by the output variables. Model 1= Premiums and Investment Income, Model 2=Net claims incurred and Investment Income. TE= Technical Efficiency; PTE= Pure Technical Efficiency; SE=Scale Efficiency; CRS=Constant returns to scale; IRS=Increasing returns to scale; DRS=Diminishing returns to scale; Monetary values in thousands of South African Rand (R' 000) Source: Authors Estimations from Research Data

3.4.1 Productivity Analysis

The Malmquist total factor productivity change (MPI) and its components of efficiency change (EFFCH) and technology changes (TECHCH) at the geometric means are presented in Table 3.4. The results reveal improvements in MPI in both models. However, higher improvements in productivity are observed in Model 2 compared to Model 1. Except for TECHCH, both MPI and EFFCH are higher in Model 2 compared

to Model 1. For instance, over the period from 2007 to 2012, the MPI, EFFCH and TECHCH improved by 10.92%, 2.64% and 9.18% respectively in Model 1 compared to growth of 11.74%, 4.30% and 8.20% for MPI, EFFCH and TECHCH respectively in Model 2. The observed productivity growth indicates that with any given level of input over the period, short-term insurers maximized their output production in 2012 than they did in 2007. The productivity growth was attributable to TECHCH, with higher growth rates compared to EFFCH in both models. This implies that productivity growth in the short-term insurance market is largely attributable to 'frontier shifts'. This 'frontier shifts' could be attributed to the adoption of best technology through innovations. The EFFCH represents the ability of inefficient insurers to 'catch-up' with efficient. This arises due to the diffusion of the best management practices, which results from investment planning and technical experience. From the year-to-year analysis, productivity growth was also experienced in all sub-periods, with the highest growth rate of 20.05% recorded in 2009/2010 in Model 1, except a decline of 0.94, percent while the lowest growth rate of 1.37% was recorded in 2007/2008 (Model 2).

Table 3.4: Malmquist Productivity Indices

	MODEL 1			MODEL 2		
	MPI	EFFCH	TECHCH	MPI	EFFCH	TECHCH
2007/2008	1.0137***	0.9157***	1.0963***	0.9906***	1.0070***	1.0004***
2008/2009	1.0711***	1.2042***	0.8966***	1.0849***	1.1079***	0.9861***
2009/2010	1.2005***	1.0148***	1.1745***	1.2117***	1.0010***	1.1991***
2010/2011	1.1280***	0.9394***	1.2171***	1.1262***	0.9850***	1.1647***
2011/2012	1.1334***	1.0585***	1.0742***	1.1751***	1.1160***	1.0597***
2007-2012	1.1092	1.0264	1.0918	1.11749	1.04307	1.08209

Note: MPI=Malmquist Productivity Change (MPI), EFFCH=Efficiency Change, TECHCH=Technology Change; *** denotes the rejection of the null hypothesis the means are equal to 1 at 1%. Model 1= Premiums and Investment Income, Model 2=Net Claims incurred and Investment Income. Source: Authors Estimations from Research Data

On the firm specific characteristics hypothesized to explain efficiency variations, the average growth in the size of an insurer's assets (*size*) is 12.8652% while the mean of the product line diversification (*pdiv*) of 0.379 indicates that premiums are less diversified (concentrated) across business lines. The reinsurance ratio (*reins*) of 0.443 implies a retention rate of 55.7% of any business written.³⁹ The leverage ratio (*lev*) of 0.5774 also indicates insurers finance their operations with 57.74% leverage. These summary statistics are attached as Appendix 3C. Before estimating the regression

³⁹ This also indicates that 44.3% of insurance premiums generated are ceded to reinsurers. This proxy for risk diversification.

model, correlation coefficients of the independent variables are estimated to test for the presence of multicollinearity. According to Kennedy (2008), the correlation coefficients of less than 0.70 reflect the absence of multicollinearity. From the correlation matrix (in Appendix 3C), all the correlation coefficients are less than 0.70.

3.4.2 Determinants of Efficiency

The results of the bootstrapped truncated regression procedure of Simar and Wilson (2007) to identify the determinants of efficiency are presented in Table 3.5. The Wald χ^2 ($P > \chi^2$ of less than 0.05) indicates the fit of the regression models.

In Model 1, the linear term of size has a negative relationship with both TE and PTE but the quadratic term is positive. The negative effect of size on efficiency may be explained by difficulties in monitoring and control as firms grow larger. However, the positive coefficient of the squared term implies that, as firms continue to grow, they are able to adjust to their increased scale of operations and maximize the use of their investments in systems. This reflects the existence of a convex,⁴⁰ non-linear 'U-shaped' relationship between insurer size and efficiency and confirms the observations in Table 3.3. The relationships are significant at 1%. Worthington and Hurley (2002) found similar results in Australian general insurance industry.

In line with expectation, the coefficient of product line diversification has a positive relationship with all forms of efficiency but it is only significant with TE in Model 1 at 1%. This implies that insurers' diversification across multiple product lines are efficiency-enhancing and supports the conglomeration hypothesis. This arises out of the potential benefits from risk reduction by smoothing revenue flows to an insurer. Reinsurance coefficient is negatively related to both TE and PTE in Models 1 and 2 at significance levels of between 10% and 5%. This indicates that primary insurers who cede more premiums to diversify their risk portfolio become inefficient. This is expected because such insurers are denied of the funds for investment activities, hence reduced productive capacity (Shui, 2009 and Choi, 2010). The relationship between reinsurance activities and efficiency was also negative and significant in Model 2.

The coefficient of age is negatively related to TE and PTE but the relationship is only significant with TE in Model 1. This is inconsistent with the positive age-efficiency

⁴⁰ The convex relationship arises because the quadratic term of size is positive. The relationship is concave if the linear term is positive and quadratic term is negative as found in Model 2 with TE.

hypothesis of Jovanovic (1982) and Arrow (1962). We attribute this to what Barron et al. (1994) refers to as the 'liability of obsolescence'. Older firms are characterized by accumulated bureaucratic processes, hence their inability to employ the best available technology to be productive and efficient. We find leverage to exhibit significant negative relationship with TE and PTE in both models. Hence, high leverage results in efficiency declines. This is inconsistent with the free-cash flow hypothesis of Jensen (1986) that high leverage induces better management efficiency. Cummins and Nini (2002) and Luhnén (2009) also found a positive effect of leverage on efficiency.

Table 3.5: Bootstrapped Truncated Regression Results

	MODEL 1				MODEL 2			
	TE		PTE		TE		PTE	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Constant	1.933** (0.765)	2.53	3.267*** (0.418)	7.82	-1.518** (0.749)	-2.03	4.692*** (0.448)	10.47
size	-0.210* (0.121)	-1.74	-0.400*** (0.065)	-6.13	0.302** (0.119)	2.54	-0.602*** (0.069)	-8.74
size ²	0.010** (0.005)	2.04	0.016*** (0.003)	6.23	-0.010** (0.005)	-2.11	0.023*** (0.003)	8.79
div	0.112** (0.051)	2.2	-0.003 (0.036)	-0.08	0.095 (0.600)	1.59	0.032 (0.033)	0.99
reins	-0.150* (0.079)	-1.88	-0.121** (0.05)	-2.42	-0.114* (0.066)	-1.74	-0.058* (0.033)	-1.76
age	-0.031* (0.018)	-1.74	-0.016 (0.014)	-1.16	0.006 (0.021)	0.3	-0.011 (0.015)	-0.73
lev	-0.356*** (0.074)	-4.78	-0.194*** (0.047)	-4.13	-0.202** (0.083)	-2.43	-0.172*** (0.042)	-4.1
Wald χ^2 (6)	117.34		151.15		58.43		128.37	
Prob > χ^2	0.0000		0.0000		0.0000		0.0000	
Log likelihood	138.3		121.07		80.8915		122.132	
Variance	0.212***		0.1832***		0.258***		0.18204***	
Observations	418		418		418		418	

Note: Bootstrapped standard errors in parentheses. TE= Technical Efficiency; PTE= Pure Technical Efficiency; SIZE=ln (Total Assets), size²= the quadratic term of size; div= 1- Herfindahl index for product line diversification; reins= reinsurance ceded to gross premiums ratio; age=ln (The number of years in operation); lev= Total Liabilities to Assets ratio. Models are defined by the output variables. Model 1= Premiums and Investment Income, Model 2=Net claims incurred and Investment Income. *** p<0.01, ** p<0.05; * p<0.10. Number of Iterations for Bootstrapping=2,000. Source: Authors Estimations from Research Data.

3.4.3 Determinants of Returns of Scale

The results of the maximum likelihood estimation⁴¹ of the determinants of returns to scale are presented in Table 3.6. Based on the estimated marginal effects at their means, the study finds the effect of size on the probability of operating with CRS to be non-linear in both models. While the linear term of size is inversely related to the probability of operating with CRS, the quadratic term ($size^2$) is positively related to probability of operating with CRS in Model 1. This implies insurers move away from the CRS frontier with initial size increases but at certain growth thresholds, they move onto the CRS frontier. In Model 2 however, the study finds a concave relationship as the linear term of size becomes positive and the quadratic term is negative. These results are consistent with the findings of Cummins and Xie (2013) in the property and liability industry in USA.

The positive marginal effect of product line diversification on CRS indicates that diversification across multiple business lines increases the probability of operating with CRS. Hence more diversified insurers are more likely to operate at their optimal scale compared to less diversified insurers. The relationship is only significant in model 1 at 1%. The reinsurance ratio is negatively related to the probability of operating with CRS in both models. Thus insurers who retain majority of premiums have a higher probability of operating with CRS. Through high premium retention, insurers are able to increase their productive capacity through investment income. The marginal effect of leverage also exhibits significant negative relationship with CRS at significance levels of 10% and 5% in models 1 and 2 respectively. This indicates that highly levered insurers have low probability of operating with CRS.

⁴¹ The results presented is marginal effects of the independent variables which measures the probability of an insurer operating with a returns to scale category arising from deviations in the sample mean of an independent variable.

Table 3.6: Logistic Regression

	Model 1		Model 2	
	dy/dx	z	dy/dx	z
<i>size</i>	-0.451*** (0.136)	-3.33	0.882*** (0.232)	3.81
<i>size</i> ²	0.017*** (0.005)	3.13	-0.033*** (0.009)	-3.68
<i>div</i>	0.219*** (0.072)	3.07	0.126 (0.083)	1.52
<i>reins</i>	-0.124* (0.068)	-1.82	-0.030 (0.083)	-0.36
<i>age</i>	0.031 (0.026)	1.18	0.006 (0.029)	0.22
<i>lev</i>	-0.146* (0.088)	-1.65	-0.283** (0.122)	-2.32
LR χ^2 (6)	37.61		21.74	
Prob > χ^2	0.000		0.0028	
Pseudo R-squared	0.0935		0.0292	
Log likelihood	-182.36		-211.381	
Observations	418		418	

Note: Dependent Variable is RTS which equals 1 if CRS and 0 otherwise. *size*=ln (Total Assets); *size*²= the quadratic term of *size* *div*=1-Herfindahl index for product line diversification; *reins*= reinsurance ceded to gross premiums ratio; *age*=ln (The number of years in operation); *lev*= Total Liabilities to Assets ratio. Model 1= Premiums and Investment Income, Model 2=Net claims incurred and Investment Income. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$. Heteroskedastic standard errors values parentheses. Source: Authors Estimations from Research Data.

3.4.4 Efficiency Convergence

The results of efficiency convergence are presented in Table 3.7. The models were estimated using the system generalized method of moments.⁴² In the test for unconditional β -convergence, the study finds β to be negative and statistically significant at 1% in all specifications of the dependent variables. The coefficient ranges between 0.266 and 0.381. This indicates the existence of unconditional β -convergence in the short-term insurance market. Hence, inefficient insurers were able to 'catch-up' with best-practiced insurers over the study period. This results from the imitation of best industry practices by inefficient firms. We also find evidence for α -convergence, which explains the convergence towards the industry average efficiency score. This also indicates a reduction in the variability of efficiency and conversion towards a common level over the study period. The low values for β and α reflects a slower rate of convergence. This reflects the need for enhanced regulatory attention in promoting best practices among insurers and improved on the low levels of efficiency in resource utilization.

⁴² The assumptions of no second order autocorrelation and over-identifying restriction were satisfied in all the estimations.

Table 3.7: System GMM estimations of efficiency convergence

	MODEL 1				MODEL 2			
	TE		PTE		TE		PTE	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Unconditional β-Convergence								
Constant	-0.172***	-3.4	-0.137***	-3.73	-0.205***	-4.73	-0.078**	-2.45
$\delta (\Delta \ln y_{i,t-1})$	-0.166**	-2.38	-0.046	-0.43	0.017	0.17	0.180	1.24
$\beta (\ln y_{i,t-1})$	-0.339***	-4.55	-0.381***	-5.32	-0.266***	-3.99	-0.358***	-5.88
m_1 : p-values	0.04		0.018		0.041		0.145	
m_2 : p-values	0.303		0.506		0.773		0.787	
Hansen-J: p-values	0.276		0.264		0.386		0.471	
σ-convergence								
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Constant	-0.019	-0.95	0.0034	0.21	-0.002	-0.14	0.0004	0.03
$\varphi(\Delta E_{i,t-1})$	-0.177***	-2.34	-0.2734**	-2.43	-0.261***	-6.47	-0.2272***	-6.03
$\sigma(E_{i,t-1})$	-0.269***	-3.41	-0.2833***	-4.44	-0.314***	-4.00	-0.4662***	-6.02
m_1 : p-values	0.03		0.067		0.000		0.000	
m_2 : p-values	0.441		0.874		0.139		0.281	
Hansen-J: p-values	0.55		0.168		0.182		0.146	

Note: Model 1= Premiums and Investment Income, Model 2=Claims incurred and Investment Income; β = rate of β -convergence rate; σ = rate of σ -convergence; m_1 = First order autocorrelation, m_2 = Second order autocorrelation. Hansen J is the test for overidentifying restrictions*** $p < 0.01$, ** $p < 0.05$. Sources: Authors Estimation from Research Data.

3.5 Conclusions and Policy Implications

This chapter examined the efficiency, productivity and returns to scale economies of 76 short-term insurance companies from 2007 to 2012 in South Africa, using the Simar and Wilson (2007) three-stage DEA technique. Based on bootstrapped efficiency scores, the study finds that short-term insurers operate at about 50% of their potential capacity attributable to their inability to adopt the best available technology in their operational activities. The returns to scale analysis indicate that about 20% of the short-term insurers operate at their optimum capacity. While majority of large insurers are found to operate with decreasing returns to scale, small, medium and big insurers largely operate with increasing returns to scale. The existence of scale inefficiencies requires regulatory action in the form of mergers and consolidation policies. This study recommends that large insurers downsize to improve efficiency because of overutilization of existing scale while for small, medium and big insurers, regulatory policies that encourage mergers and consolidation should be promoted to improve efficiency. However, the adoption of new technologies in insurance operations would be most beneficial in terms of efficiency improvement for the industry because of the already high scale efficiency. In examining efficiency changes over the study period, improvements in productivity of about 10% was observed to be mostly attributable to innovations in production of insurance outputs that results in outward shifts of the production frontier.

In the second stage analysis, the study finds a curvilinear 'U' shaped relationship between size and efficiency to indicate the existence of a threshold effect of size on efficiency. Reinsurance, age and leverage were found to have a negative impact on efficiency while product line diversification was positively related to efficiency. On the returns to scale determinants, the study also finds a non-linear relationship between size and the probability of an insurer operating with constant returns to scale. While product line diversification was found to increase the probability of insurers to operate with constant returns to scale, reinsurance and leverage had negative effect of the probability of operating with constant returns to scale. Finally, the result from the convergence analysis in the third stage provides evidence of slower 'catch-up' effect in the short-term insurance market. This implies that over time, less efficient insurers are able to catch with efficient insurers, albeit at a slower rate.

The results of this study provide useful insights for the regulation and management of short-term insurance companies in South Africa. Through the identification of the significant determinants of efficiency in the short-term insurance market in South Africa, this study provides insurance management with relevant indicators that would guide them to make efficient use of their resource base. Finally, since the market is characterized by low diversification across product lines, regulatory policies that encourage product line diversification would also be beneficial in terms of operating at an optimal scale. This study recommends that similar analysis to be replicated to the long-term insurance market in South Africa.

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Appendices

Appendix 3A: Efficiency scores from Model 1

Insurers	2007			2008			2009		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 1	0.7173	0.7685	0.9334	0.7839	0.7778	1.0078	0.5774	0.58	0.9954
Insurer 2	0.5371	0.6598	0.814	0.7772	0.6864	1.1322	0.8508	0.719	1.1833
Insurer 3	0.6759	0.7763	0.8707	0.1894	0.2476	0.7648	0.1828	0.2951	0.6193
Insurer 4	0.105	0.1539	0.6823	0.1359	0.1631	0.8331	0.1484	0.1905	0.7789
Insurer 5	0.3124	0.3519	0.8876	0.3619	0.3689	0.981	0.8426	0.8185	1.0294
Insurer 6	0.3221	0.3421	0.9414	0.2415	0.2618	0.9226	0.2577	0.2556	1.0083
Insurer 7	0.7469	0.7828	0.9541	0.325	0.3639	0.8932	0.4591	0.4512	1.0174
Insurer 8	0.2367	0.2835	0.8351	0.1604	0.2004	0.8007	0.0414	0.0731	0.5667
Insurer 9	-	-	-	0.3274	0.3304	0.991	0.3516	0.3496	1.0057
Insurer 10	-	-	-	-	-	-	0.2491	0.3356	0.7425
Insurer 11	-	-	-	0.563	0.7633	0.7375	0.6159	0.6059	1.0165
Insurer 12	0.8024	0.7974	1.0062	0.3131	0.737	0.4248	-	-	-
Insurer 13	0.759	0.7906	0.96	0.5887	0.5986	0.9835	0.5604	0.5748	0.9751
Insurer 14	-	-	-	0.146	0.1858	0.7854	0.2551	0.299	0.8533
Insurer 15	-	-	-	-	-	-	0.5939	0.7404	0.8021
Insurer 16	0.5448	0.598	0.9111	0.4011	0.4222	0.95	0.2761	0.3142	0.8789
Insurer 17	0.4022	0.4078	0.9862	0.3233	0.3506	0.9222	0.3243	0.3239	1.0012
Insurer 18	0.5321	0.5392	0.9868	0.659	0.6904	0.9546	0.6971	0.7165	0.9729
Insurer 19	0.2152	0.5801	0.3709	0.3321	0.5392	0.6159	.	.	.
Insurer 20	0.7851	0.7973	0.9846	0.3904	0.4446	0.8781	0.4308	0.4235	1.0172
Insurer 21	0.3084	0.4182	0.7373	0.2917	0.2939	0.9924	0.7897	0.7898	0.9998
Insurer 22	0.4866	0.5629	0.8644	0.387	0.5017	0.7713	0.5627	0.5544	1.0151
Insurer 23	0.3004	0.3198	0.9394	0.253	0.257	0.9842	0.3243	0.3247	0.9989
Insurer 24	0.4761	0.5091	0.9352	0.3951	0.3997	0.9885	0.6881	0.6955	0.9895
Insurer 25	0.6384	0.8597	0.7426	0.2825	0.2716	1.0401	0.2787	0.2655	1.0497
Insurer 26	-	-	-	0.1742	0.1866	0.9335	0.2984	0.2996	0.9961
Insurer 27	0.5042	0.6496	0.7762	0.2065	0.2023	1.0208	0.4406	0.4669	0.9437
Insurer 28	-	-	-	0.1052	0.2209	0.476	0.1929	0.2729	0.7068
Insurer 29	0.777	0.7909	0.9824	0.1329	0.162	0.8203	0.3863	0.4007	0.9641
Insurer 30	0.8593	0.8637	0.9948	0.5198	0.541	0.9608	0.7509	0.7174	1.0468
Insurer 31	0.8256	0.8118	1.0169	0.5422	0.5389	1.0061	0.7880	0.7656	1.0292
Insurer 32	0.7155	0.7653	0.935	0.6612	0.693	0.9541	0.6970	0.7247	0.9617
Insurer 33	0.1632	0.3097	0.5268	0.1472	0.219	0.6723	0.2005	0.2709	0.7400
Insurer 34	0.4555	0.5587	0.8152	0.4627	0.543	0.8522	-	-	-
Insurer 35	0.7379	0.7691	0.9595	0.2126	0.2174	0.9782	0.8059	0.7893	1.0210
Insurer 36	0.7195	0.7637	0.9422	0.1619	0.7111	0.2276	0.1821	0.7373	0.2469
Insurer 37	0.7847	0.8212	0.9555	0.6655	0.6934	0.9598	0.7163	0.7192	0.9959
Insurer 38	0.4659	0.6507	0.7161	0.3822	0.4075	0.938	0.6263	0.6309	0.9928
Insurer 39	-	-	-	-	-	-	0.5122	0.5054	1.0134
Insurer 40	0.2759	0.3222	0.8564	0.259	0.3158	0.8202	0.5853	0.6289	0.9306

Insurers	2007			2008			2009		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 41	0.5847	0.6181	0.9459	0.4669	0.4687	0.9962	0.7569	0.8081	0.9366
Insurer 42	0.5582	0.7297	0.7649	0.5213	0.7268	0.7172	0.736	0.708	1.0396
Insurer 43	0.5486	0.6003	0.9139	0.3499	0.3823	0.9152	0.4402	0.4365	1.0085
Insurer 44	0.2788	0.2897	0.9623	0.1514	0.207	0.7315	0.4239	0.4111	1.0312
Insurer 45	0.6752	0.69	0.9785	0.2352	0.3184	0.7389	0.5705	0.5622	1.0147
Insurer 46	-	-	-	-	-	-	-	-	-
Insurer 47	0.5980	0.7632	0.7835	0.4738	0.7631	0.6209	0.6586	0.6361	1.0354
Insurer 48	0.2875	0.3029	0.9491	0.3684	0.3844	0.9583	0.4872	0.4843	1.0061
Insurer 49	0.8212	0.7841	1.0473	0.5756	0.7293	0.7892	0.4536	0.7783	0.5829
Insurer 50	0.4750	0.759	0.6259	0.1839	0.1899	0.9685	0.1446	0.1517	0.9533
Insurer 51	0.5271	0.5504	0.9576	0.3015	0.2887	1.0444	0.4445	0.4341	1.0238
Insurer 52	0.7496	0.7806	0.9602	0.5572	0.8228	0.6771	0.522	0.5021	1.0397
Insurer 53	-	-	-	0.465	0.5202	0.8938	0.6713	0.6973	0.9628
Insurer 54	-	-	-	0.6864	0.7037	0.9754	0.6379	0.6409	0.9953
Insurer 55	-	-	-	0.5506	0.6173	0.8919	0.6349	0.6862	0.9252
Insurer 56	-	-	-	-	-	-	-	-	-
Insurer 57	-	-	-	0.3995	0.6974	0.5728	0.7511	0.7173	1.0472
Insurer 58	-	-	-	0.6912	0.7594	0.9102	0.8709	0.7614	1.1438
Insurer 59	0.8054	0.7729	1.0421	0.353	0.3523	1.002	0.4908	0.4643	1.0572
Insurer 60	0.8644	0.8444	1.0237	0.6407	0.7647	0.8378	0.6449	0.5952	1.0834
Insurer 61	0.3490	0.3779	0.9235	0.5491	0.7698	0.7133	0.7317	0.7273	1.006
Insurer 62	0.4311	0.4950	0.8710	0.2621	0.2677	0.9793	0.3698	0.3647	1.014
Insurer 63	0.2504	0.7256	0.3451	0.5464	0.6393	0.8547	0.2793	0.4468	0.625
Insurer 64	0.8273	0.8334	0.9927	0.309	0.3226	0.9579	0.642	0.6093	1.0537
Insurer 65	0.3222	0.354	0.9101	0.2015	0.2159	0.9335	0.4792	0.5189	0.9236
Insurer 66	-	-	-	0.33	0.3772	0.8749	0.3892	0.3778	1.0301
Insurer 67	0.6222	0.6849	0.9085	0.4359	0.4763	0.9152	0.6112	0.6071	1.0068
Insurer 68	0.8074	0.7630	1.0581	0.651	0.6907	0.9425	0.6639	0.7192	0.9231
Insurer 69	-	-	-	0.6763	0.6925	0.9766	0.4758	0.48	0.9913
Insurer 70	-	-	-	0.4449	0.4523	0.9837	0.3508	0.3807	0.9214
Insurer 71	0.6252	0.7851	0.7964	0.3455	0.4609	0.7498	0.7671	0.724	1.0595
Insurer 72	0.1989	0.4794	0.4148	0.5372	0.6259	0.8582	0.5715	0.5902	0.9682
Insurer 73	0.7548	0.7698	0.9805	0.4083	0.5241	0.7791	0.7503	0.7334	1.023
Insurer 74	0.7827	0.7737	1.0117	0.7493	0.6916	1.0836	0.6610	0.7563	0.874
Insurer 75	0.2660	0.5533	0.4808	0.313	0.4838	0.6471	0.4929	0.6172	0.7986
Insurer 76	-	-	-	0.3812	0.3981	0.9577	0.5378	0.5708	0.9421
Insurer 77	-	-	-	0.6878	0.7869	0.8741	0.3700	0.3535	1.0469
Insurer 78	-	-	-	0.6827	0.6909	0.9881	0.2702	0.5409	0.4995
Insurer 79	-	-	-	0.6836	0.779	0.8775	0.8282	0.7637	1.0845
Insurer 80	-	-	-	0.1966	0.2311	0.8508	0.1028	0.1383	0.7431

Insurers	2010			2011			2012		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 1	0.5538	0.6359	0.8709	0.4556	0.4643	0.9815	0.3548	0.3632	0.977
Insurer 2	0.7789	0.8775	0.8877	0.7046	0.7403	0.9517	0.6961	0.7932	0.8776
Insurer 3	0.2363	0.2961	0.798	0.5471	0.6505	0.8411	0.2774	0.2921	0.9495
Insurer 4	0.1375	0.1593	0.8632	0.3357	0.3348	1.0027	0.2664	0.3031	0.8788
Insurer 5	0.3382	0.3955	0.8552	0.5691	0.8353	0.6813	0.7457	0.7718	0.9661
Insurer 6	0.3714	0.3875	0.9584	0.2301	0.2664	0.8639	0.2445	0.2494	0.9803
Insurer 7	0.3788	0.3924	0.9653	0.3505	0.3932	0.8914	0.4412	0.4603	0.9585
Insurer 8	0.7206	0.7761	0.9285	0.2261	0.2526	0.8951	-	-	-
Insurer 9	0.2793	0.2996	0.9323	0.3788	0.4157	0.9111	0.6197	0.7858	0.7886
Insurer 10	0.5922	0.6590	0.8987	0.6260	0.8738	0.7164	0.5599	0.6167	0.9079
Insurer 11	0.5289	0.7688	0.6880	0.6030	0.6896	0.8744	0.8904	0.8445	1.0543
Insurer 12	0.5470	0.8391	0.6519	0.7590	0.7808	0.9721	0.8233	0.7701	1.0692
Insurer 13	0.7652	0.8057	0.9497	0.7280	0.787	0.9249	0.7415	0.7666	0.9672
Insurer 14	0.7854	0.8247	0.9524	0.2501	0.496	0.5043	0.2682	0.4082	0.6569
Insurer 15	0.6054	0.6981	0.8673	0.8017	0.8624	0.9296	0.7661	0.7779	0.9848
Insurer 16	0.3190	0.3401	0.9382	0.3058	0.3854	0.7933	0.3734	0.3981	0.9382
Insurer 17	0.2824	0.2920	0.9673	0.2690	0.2817	0.9547	0.2334	0.2619	0.8914
Insurer 18	0.5869	0.5887	0.9969	0.4640	0.4808	0.9650	0.4529	0.4925	0.9196
Insurer 19	0.8850	0.8824	1.0029	0.8122	0.8256	0.9838	0.6438	0.6389	1.0077
Insurer 20	0.5899	0.5896	1.0005	0.5102	0.5509	0.9261	0.4169	0.5099	0.8177
Insurer 21	0.3694	0.4285	0.8621	0.3407	0.5195	0.6559	0.2477	0.2756	0.8989
Insurer 22	0.8209	0.8255	0.9944	0.5777	0.6249	0.9245	0.8905	0.8721	1.0211
Insurer 23	0.5151	0.5123	1.0056	0.5694	0.5904	0.9645	0.1530	0.192	0.7971
Insurer 24	-	-	-	0.7561	0.7748	0.9759	0.5871	0.5768	1.018
Insurer 25	0.5900	0.8283	0.7123	0.5708	0.8004	0.7131	0.6164	0.7995	0.7711
Insurer 26	0.4285	0.4456	0.9616	0.3701	0.384	0.9639	0.6332	0.6182	1.0242
Insurer 27	0.6302	0.7704	0.8179	0.5368	0.8506	0.6311	0.6202	0.8372	0.7408
Insurer 28	0.213	0.2761	0.7717	0.1698	0.4833	0.3513	0.3764	0.4041	0.9316
Insurer 29	0.8006	0.7803	1.0261	0.3275	0.4885	0.6705	0.4228	0.4907	0.8617
Insurer 30	0.5539	0.8564	0.6467	0.5119	0.5132	0.9975	0.4263	0.8399	0.5075
Insurer 31	0.6014	0.8467	0.7102	0.4476	0.8817	0.5077	0.5310	0.5617	0.9454
Insurer 32	0.7381	0.7709	0.9574	0.7346	0.7837	0.9374	0.7294	0.7638	0.9551
Insurer 33	0.2363	0.3093	0.7642	0.1904	0.4191	0.4543	0.0867	0.1613	0.5374
Insurer 34	0.7105	0.7393	0.961	0.7149	0.7836	0.9124	0.8395	0.7655	1.0967
Insurer 35	0.8279	0.8335	0.9932	0.7639	0.7996	0.9554	0.7564	0.7774	0.973
Insurer 36	0.2258	0.7733	0.2919	0.1184	0.8258	0.1433	0.0981	0.8041	0.1221
Insurer 37	0.7547	0.783	0.9638	0.7754	0.8072	0.9606	0.7368	0.8302	0.8874
Insurer 38	0.7528	0.7718	0.9754	0.7370	0.8019	0.9191	0.6656	0.7141	0.932
Insurer 39	0.8797	0.8469	1.0388	0.7763	0.8405	0.9237	0.7506	0.7916	0.9483
Insurer 40	0.6871	0.7731	0.8888	-	-	-	0.3572	0.469	0.7616

Insurers	2010			2011			2012		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 41	0.5490	0.6194	0.8864	0.5222	0.5933	0.8803	0.6286	0.6331	0.993
Insurer 42	0.7435	0.8301	0.8958	0.6153	0.6696	0.9189	0.8229	0.8041	1.0234
Insurer 43	0.6583	0.6729	0.9784	0.7069	0.7612	0.9287	0.5949	0.6178	0.9629
Insurer 44	0.4367	0.4491	0.9724	0.4473	0.5174	0.8645	0.5443	0.5362	1.0152
Insurer 45	0.4172	0.4396	0.9489	0.7870	0.7952	0.9897	-	-	-
Insurer 46	0.0940	0.1312	0.7162	0.1151	0.1195	0.9632	0.1789	0.1896	0.9435
Insurer 47	0.7149	0.8203	0.8716	0.8663	0.8973	0.9653	0.8662	0.8546	1.0136
Insurer 48	0.6396	0.6490	0.9855	0.5766	0.5886	0.9796	0.4856	0.4733	1.026
Insurer 49	0.5713	0.8415	0.6789	0.6456	0.8289	0.7788	0.6547	0.7696	0.8507
Insurer 50	0.2357	0.2699	0.8731	0.7257	0.782	0.9279	0.7300	0.7682	0.9503
Insurer 51	0.3377	0.4326	0.7807	-	0.7835	0.0000	-	-	-
Insurer 52	0.8802	0.8846	0.9950	0.7849	0.7962	0.9857	0.7466	0.8426	0.8861
Insurer 53	0.4659	0.4627	1.0068	0.8551	0.8777	0.9743	0.6405	0.6400	1.0006
Insurer 54	0.8020	0.879	0.9123	0.8489	0.8756	0.9695	0.7319	0.7673	0.9538
Insurer 55	0.7306	0.7818	0.9345	0.7361	0.7864	0.9360	0.7346	0.7718	0.9517
Insurer 56	-	-	-	0.7880	0.8148	0.9671	0.8272	0.8311	0.9953
Insurer 57	0.7161	0.7769	0.9218	0.2592	0.8027	0.3229	0.3545	0.8015	0.4423
Insurer 58	0.7699	0.8218	0.9369	0.7658	0.8111	0.9441	0.7588	0.7721	0.9828
Insurer 59	0.2549	0.6823	0.3736	0.4083	0.649	0.6292	0.2558	0.6091	0.4200
Insurer 60	0.6850	0.8199	0.8355	0.7215	0.7754	0.9304	0.8377	0.8282	1.0114
Insurer 61	0.7666	0.7899	0.9705	0.8171	0.8373	0.9758	0.7220	0.8465	0.8529
Insurer 62	0.4299	0.4393	0.9785	0.3512	0.3964	0.8861	0.4019	0.4475	0.898
Insurer 63	0.1822	0.4751	0.3836	0.1580	0.4362	0.3623	0.3348	0.5906	0.5669
Insurer 64	0.4296	0.7174	0.5988	0.3561	0.3702	0.9618	0.2381	0.2446	0.9736
Insurer 65	0.4860	0.5503	0.8832	0.5724	0.7561	0.7570	0.6200	0.6259	0.9907
Insurer 66	0.4418	0.4511	0.9794	0.4781	0.5162	0.9264	0.4851	0.5416	0.8958
Insurer 67	0.5648	0.6272	0.9005	0.5490	0.5941	0.9241	0.4317	0.4406	0.9799
Insurer 68	0.8873	0.7714	1.1502	0.8482	0.7899	1.0738	0.8691	0.7656	1.1352
Insurer 69	0.7609	0.7886	0.9648	0.7305	0.7865	0.9288	0.7308	0.7698	0.9494
Insurer 70	0.6190	0.7000	0.8843	0.5163	0.7762	0.6652	0.5609	0.6469	0.867
Insurer 71	0.7508	0.7895	0.9510	0.7194	0.779	0.9235	0.7828	0.7692	1.0178
Insurer 72	0.8020	0.8375	0.9577	0.4948	0.767	0.6450	0.4467	0.8509	0.5249
Insurer 73	0.7783	0.8095	0.9615	0.7341	0.7788	0.9427	0.7314	0.7672	0.9533
Insurer 74	0.8133	0.7813	1.0410	0.7745	0.7919	0.9780	0.7293	0.788	0.9256
Insurer 75	0.3918	0.6287	0.6233	0.3220	0.7761	0.4149	0.2492	0.5126	0.4863
Insurer 76	0.2907	0.3029	0.9596	0.2867	0.2953	0.9709	0.1136	0.1323	0.8584
Insurer 77	0.3296	0.3481	0.9470	0.5377	0.5420	0.9919	0.8374	0.8611	0.9725
Insurer 78	0.7648	0.8521	0.8976	0.6192	0.7194	0.8606	0.6296	0.7490	0.8407
Insurer 79	0.7867	0.8012	0.9818	0.7287	0.8630	0.8444	0.5948	0.5860	1.0150
Insurer 80	0.1732	0.1982	0.8741	0.3583	0.8458	0.4237	0.3430	0.5741	0.5975

Appendix 3B: Efficiency scores from Model 2

Insurers	2007			2008			2009		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 1	0.4986	0.6857	0.7271	0.5905	0.6357	0.9289	0.8298	0.8639	0.9605
Insurer 2	0.6386	0.9315	0.6856	0.7082	0.8468	0.8363	0.7773	0.9345	0.8318
Insurer 3	0.2172	0.7021	0.3094	0.4442	0.4904	0.9058	0.2946	0.3947	0.7464
Insurer 4	0.3454	0.3477	0.9934	0.4507	0.4484	1.0051	0.4566	0.4678	0.9761
Insurer 5	0.3691	0.3926	0.9401	0.8726	0.884	0.9871	0.7535	0.8206	0.9182
Insurer 6	0.5610	0.6777	0.8278	0.6194	0.6121	1.0119	0.6718	0.7255	0.926
Insurer 7	0.6467	0.7154	0.904	0.5093	0.5222	0.9753	0.6235	0.6509	0.9579
Insurer 8	0.3671	0.449	0.8176	0.4541	0.4952	0.917	0.6362	0.7615	0.8355
Insurer 9	-	-	-	0.8195	0.8017	1.0222	0.7587	0.7846	0.967
Insurer 10	-	-	-	-	-	-	0.4812	0.8843	0.5442
Insurer 11	-	-	-	0.8125	0.8296	0.9794	0.8710	0.8531	1.021
Insurer 12	0.2407	0.9159	0.2628	0.3272	0.3698	0.8848	-	-	-
Insurer 13	0.6360	0.837	0.7599	0.7114	0.7875	0.9034	0.7861	0.8691	0.9045
Insurer 14	-	-	-	0.8586	0.839	1.0234	0.8761	0.8967	0.977
Insurer 15	-	-	-	-	-	-	0.2765	0.5763	0.4798
Insurer 16	0.3632	0.4255	0.8536	0.4614	0.5026	0.918	0.6098	0.8348	0.7305
Insurer 17	0.5969	0.6701	0.8908	0.6036	0.632	0.9551	0.7529	0.7644	0.985
Insurer 18	0.6140	0.8564	0.7170	0.4682	0.622	0.7527	0.5972	0.8009	0.7457
Insurer 19	0.5424	0.6767	0.8015	0.5666	0.6119	0.926	-	-	-
Insurer 20	0.5856	0.7123	0.8221	0.6209	0.7272	0.8538	0.8716	0.92	0.9474
Insurer 21	0.3499	0.4703	0.7440	0.4546	0.529	0.8594	0.7874	0.8219	0.958
Insurer 22	0.7690	0.8420	0.9133	0.7286	0.8236	0.8847	0.8243	0.8677	0.95
Insurer 23	0.5219	0.5574	0.9363	0.6106	0.6132	0.9958	0.7215	0.7499	0.9621
Insurer 24	0.6724	0.6827	0.9849	0.7694	0.7967	0.9657	0.7494	0.8173	0.9169
Insurer 25	0.7163	0.8066	0.888	0.8164	0.6801	1.2004	0.785	0.8398	0.9347
Insurer 26	-	-	-	0.5222	0.6048	0.8634	0.5866	0.6075	0.9656
Insurer 27	0.716	0.7499	0.9548	0.7142	0.6917	1.0325	0.7921	0.8007	0.9893
Insurer 28	-	-	-	0.6037	0.7373	0.8188	0.6924	0.8535	0.8112
Insurer 29	0.7593	0.7797	0.9738	0.5138	0.6418	0.8006	0.6516	0.723	0.9012
Insurer 30	0.5993	0.7761	0.7722	0.6573	0.6957	0.9448	0.6705	0.8101	0.8277
Insurer 31	0.6923	0.6773	1.0221	0.8225	0.6552	1.2553	0.8642	0.8041	1.0747
Insurer 32	0.274	0.6692	0.4094	0.4743	0.6174	0.7682	0.5674	0.7911	0.7172
Insurer 33	0.3565	0.3799	0.9384	0.4018	0.4287	0.9373	0.4783	0.6361	0.7519
Insurer 34	0.6644	0.9218	0.7208	0.6514	0.9464	0.6883	-	-	-
Insurer 35	0.4535	0.6808	0.6661	0.283	0.328	0.8628	0.8724	0.8175	1.0672
Insurer 36	0.2772	0.6741	0.4112	0.3867	0.7847	0.4928	0.3784	0.794	0.4766
Insurer 37	0.3448	0.7272	0.4741	0.7491	0.7876	0.9511	0.6153	0.8035	0.7658
Insurer 38	0.6121	0.7537	0.8121	0.4087	0.4151	0.9846	0.6002	0.6383	0.9403
Insurer 39	-	-	-	-	-	-	0.3714	0.5716	0.6498
Insurer 40	0.6284	0.6915	0.9087	0.6955	0.7312	0.9512	0.8078	0.8433	0.9579
Insurer 41	0.5651	0.6745	0.8378	0.6583	0.6991	0.9416	0.7867	0.8374	0.9395

Insurers	2007			2008			2009		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 42	0.5787	0.6695	0.8644	0.5541	0.5458	1.0152	0.6477	0.6878	0.9417
Insurer 43	0.6006	0.7056	0.8512	0.5775	0.5898	0.9791	0.7228	0.7324	0.9869
Insurer 44	0.6558	0.7355	0.8916	0.3274	0.3263	1.0034	0.5892	0.5967	0.9874
Insurer 45	0.7445	0.8054	0.9244	0.7243	0.7219	1.0033	0.9067	0.9224	0.983
Insurer 46	-	-	-	-	-	-	-	-	-
Insurer 47	0.6057	0.6883	0.88	0.6381	0.6871	0.9287	0.8237	0.8647	0.9526
Insurer 48	0.4522	0.5458	0.8285	0.4155	0.4354	0.9543	0.5343	0.5625	0.9499
Insurer 49	0.6644	0.9218	0.7208	0.7080	0.9329	0.7589	0.7694	0.9637	0.7984
Insurer 50	0.3238	0.6744	0.4801	0.4773	0.6147	0.7765	0.7384	0.8535	0.8651
Insurer 51	0.4760	0.528	0.9015	0.4302	0.4507	0.9545	0.6351	0.8079	0.7861
Insurer 52	0.6510	0.7644	0.8516	0.7664	0.7564	1.0132	0.8439	0.8734	0.9662
Insurer 53	-	-	-	0.7487	0.7763	0.9644	0.8894	0.9218	0.9649
Insurer 54	-	-	-	0.4886	0.6894	0.7087	0.8836	0.8765	1.0081
Insurer 55	-	-	-	0.7412	0.7353	1.008	0.828	0.7991	1.0362
Insurer 56	-	-	-	-	-	-	-	-	-
Insurer 57	-	-	-	0.2771	0.6556	0.4227	0.3636	0.9056	0.4015
Insurer 58	-	-	-	0.6276	0.9507	0.6601	0.673	0.9727	0.6919
Insurer 59	0.5315	0.892	0.5959	0.7729	0.8025	0.9631	0.4574	0.8274	0.5528
Insurer 60	0.6785	0.7981	0.8501	0.8602	0.7867	1.0934	0.8159	0.9108	0.8958
Insurer 61	0.6155	0.7105	0.8663	0.5218	0.5164	1.0105	0.6758	0.7296	0.9263
Insurer 62	0.6409	0.74	0.8661	0.5387	0.5716	0.9424	0.6029	0.6318	0.9543
Insurer 63	0.1542	0.8503	0.1813	0.3763	0.4721	0.7971	0.3582	0.7136	0.502
Insurer 64	0.7006	0.753	0.9304	0.5193	0.6229	0.8337	0.7195	0.834	0.8627
Insurer 65	0.2565	0.3383	0.7582	0.4883	0.5014	0.9739	0.4858	0.6372	0.7624
Insurer 66	-	-	-	0.5028	0.5596	0.8985	0.6542	0.7381	0.8863
Insurer 67	0.4584	0.5403	0.8484	0.5824	0.5982	0.9736	0.6024	0.6683	0.9014
Insurer 68	0.6644	0.9218	0.7208	0.7080	0.9329	0.7589	0.7694	0.9637	0.7984
Insurer 69	-	-	-	0.5379	0.7731	0.6958	0.8670	0.8000	1.0838
Insurer 70	-	-	-	0.7454	0.7504	0.9933	0.7723	0.8986	0.8594
Insurer 71	0.6426	0.7254	0.8859	0.6506	0.6877	0.9461	0.7159	0.8100	0.8838
Insurer 72	0.4879	0.8043	0.6066	0.7634	0.6562	1.1634	0.7867	0.8322	0.9453
Insurer 73	0.5319	0.706	0.7534	0.5543	0.6596	0.8404	0.8015	0.8710	0.9202
Insurer 74	0.7619	0.7014	1.0863	0.5636	0.6360	0.8862	0.6669	0.8078	0.8256
Insurer 75	0.2377	0.6277	0.3787	0.5682	0.8612	0.6598	0.4522	0.8015	0.5642
Insurer 76	-	-	-	0.5838	0.5982	0.9759	0.546	0.5824	0.9375
Insurer 77	-	-	-	0.8057	0.7761	1.0381	0.7823	0.8571	0.9127
Insurer 78	-	-	-	0.3804	0.8048	0.4727	0.2831	0.8514	0.3325
Insurer 79	-	-	-	0.7080	0.9329	0.7589	0.7694	0.9637	0.7984
Insurer 80	-	-	-	0.3756	0.4139	0.9075	0.7296	0.9003	0.8104

Insurers	2010			2011			2012		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 1	0.3949	0.4119	0.9587	0.5279	0.564	0.936	0.5339	0.5639	0.9468
Insurer 2	0.561	0.8597	0.6526	0.6841	0.8853	0.7727	0.7538	0.9128	0.8258
Insurer 3	0.2621	0.276	0.9496	0.7546	0.866	0.8714	0.8046	0.7796	1.0321
Insurer 4	0.1902	0.2286	0.832	0.6839	0.702	0.9742	0.6104	0.643	0.9493
Insurer 5	0.6584	0.4847	1.3584	0.7251	0.6938	1.0451	0.6872	0.7543	0.911
Insurer 6	0.3777	0.3774	1.0008	0.7636	0.8102	0.9425	0.6608	0.7112	0.9291
Insurer 7	0.3003	0.3407	0.8814	0.7269	0.752	0.9666	0.8175	0.8369	0.9768
Insurer 8	0.1846	0.3261	0.5661	0.7561	0.8173	0.9251	-	-	-
Insurer 9	0.4332	0.444	0.9757	0.678	0.7312	0.9272	0.7989	0.8734	0.9147
Insurer 10	0.2803	0.3967	0.7066	0.3949	0.4522	0.8733	0.3983	0.4939	0.8064
Insurer 11	0.3487	0.3151	1.1066	0.6494	0.9043	0.7181	0.8553	0.8412	1.0168
Insurer 12	0.3096	0.7486	0.4136	0.2695	0.7196	0.3745	0.3503	0.7296	0.4801
Insurer 13	0.3987	0.5459	0.7304	0.4242	0.6925	0.6126	0.4885	0.7301	0.6691
Insurer 14	0.6681	0.4185	1.5964	0.5514	0.5694	0.9684	0.8165	0.8214	0.994
Insurer 15	0.2723	0.7008	0.3886	0.2785	0.3598	0.774	0.2467	0.6851	0.3601
Insurer 16	0.2491	0.2524	0.9869	0.4369	0.4715	0.9266	0.4862	0.5027	0.9672
Insurer 17	0.2829	0.3313	0.8539	0.6811	0.7417	0.9183	0.7116	0.741	0.9603
Insurer 18	0.2526	0.2645	0.955	0.7553	0.7584	0.9959	0.7520	0.7737	0.972
Insurer 19	0.6128	0.2771	2.2115	0.6177	0.6964	0.887	0.7470	0.7400	1.0095
Insurer 20	0.3524	0.3493	1.0089	0.6200	0.7375	0.8407	0.7202	0.7884	0.9135
Insurer 21	0.4250	0.4011	1.0596	0.5936	0.7756	0.7653	0.2463	0.6739	0.3655
Insurer 22	0.6125	0.5783	1.0591	0.6285	0.8823	0.7123	0.9172	0.9181	0.999
Insurer 23	0.5001	0.4946	1.0111	0.6685	0.7434	0.8992	0.5725	0.5599	1.0225
Insurer 24	-	-	-	0.7788	0.7249	1.0744	0.8502	0.9015	0.9431
Insurer 25	0.7689	0.5309	1.4483	0.7905	0.6898	1.1460	0.7347	0.7605	0.9661
Insurer 26	0.3227	0.3226	1.0003	0.5710	0.6616	0.8631	0.7982	0.7887	1.012
Insurer 27	0.4895	0.3986	1.2280	0.6124	0.7664	0.7991	0.8159	0.7818	1.0436
Insurer 28	0.4870	0.6487	0.7507	0.6106	0.6867	0.8892	0.5712	0.6551	0.8719
Insurer 29	0.7296	0.6215	1.1739	0.5469	0.8531	0.6411	0.6749	0.8303	0.8128
Insurer 30	0.5392	0.5214	1.0341	0.7565	0.8034	0.9416	0.5824	0.7333	0.7942
Insurer 31	0.5295	0.2078	2.5481	0.6842	0.6987	0.9792	0.2955	0.6378	0.4633
Insurer 32	0.3309	0.5107	0.6479	0.6764	0.8312	0.8138	0.7019	0.8242	0.8516
Insurer 33	0.3222	0.3681	0.8753	0.6032	0.7512	0.803	0.7276	0.7879	0.9235
Insurer 34	0.5546	0.8802	0.6301	0.5959	0.9457	0.6301	0.6584	0.9473	0.6950
Insurer 35	0.6459	0.3448	1.8733	0.5940	0.6848	0.8674	0.5061	0.7249	0.6982
Insurer 36	0.3717	0.1995	1.8632	0.2638	0.7146	0.3692	0.2558	0.6936	0.3688
Insurer 37	0.3549	0.3258	1.0893	0.4018	0.7352	0.5465	0.4337	0.7849	0.5526
Insurer 38	0.2738	0.3376	0.8110	0.7070	0.9234	0.7656	0.7191	0.7759	0.9268
Insurer 39	0.2789	0.2740	1.0179	0.3134	0.3403	0.9210	0.4510	0.5192	0.8686
Insurer 40	0.8123	0.7984	1.0174	-	-	-	0.5425	0.6420	0.8450
Insurer 41	0.6018	0.6497	0.9263	0.5891	0.7572	0.7780	0.8007	0.8056	0.9939

Insurers	2010			2011			2012		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Insurer 42	0.5156	0.4936	1.0446	0.4588	0.4689	0.9785	0.4634	0.8973	0.5164
Insurer 43	0.2968	0.3014	0.9847	0.9154	0.8921	1.0261	0.8719	0.8991	0.9697
Insurer 44	0.2729	0.2600	1.0496	0.4554	0.5829	0.7813	0.7714	0.8168	0.9444
Insurer 45	0.5318	0.5589	0.9515	0.5340	0.7078	0.7545	-	-	-
Insurer 46	0.1236	0.1261	0.9802	0.2336	0.3526	0.6625	0.3746	0.3879	0.9657
Insurer 47	0.5556	0.5631	0.9867	0.8577	0.9015	0.9514	0.8350	0.8654	0.9649
Insurer 48	0.4565	0.494	0.9241	0.6370	0.7606	0.8375	0.6281	0.6203	1.0126
Insurer 49	0.5613	0.8487	0.6614	0.5959	0.9457	0.6301	0.6584	0.9473	0.695
Insurer 50	0.3098	0.4617	0.6710	0.3798	0.6963	0.5455	0.5327	0.7293	0.7304
Insurer 51	0.2363	0.2503	0.9441	0.1917	0.6726	0.285	-	-	-
Insurer 52	0.5492	0.5311	1.0341	0.7332	0.7478	0.9805	0.9012	0.8751	1.0298
Insurer 53	0.4050	0.4617	0.8772	0.7899	0.8567	-	-	0.8653	0.9253
Insurer 54	0.3596	0.3566	1.0084	0.5298	0.5626	0.9417	0.5461	0.6066	0.9003
Insurer 55	0.3130	0.1666	1.8788	0.7785	0.6719	1.1587	0.7273	0.7237	1.005
Insurer 56	-	-	-	0.7357	0.7592	0.9690	0.6873	0.7319	0.9391
Insurer 57	0.1278	0.1364	0.937	0.2079	0.782	0.2659	0.2524	0.7383	0.3419
Insurer 58	0.5599	0.8896	0.6294	0.7511	0.8578	0.8756	0.7056	0.8484	0.8317
Insurer 59	0.6606	0.6824	0.9681	0.3244	0.6997	0.4636	0.7736	0.8462	0.9142
Insurer 60	0.6156	0.6246	0.9856	0.7380	0.8798	0.8388	0.8926	0.837	1.0664
Insurer 61	0.6442	0.617	1.0441	0.6502	0.6932	0.9380	0.8053	0.8374	0.9617
Insurer 62	0.2050	0.312	0.6571	0.6202	0.6214	0.9981	0.6172	0.6593	0.9361
Insurer 63	0.2182	0.4411	0.4947	0.2370	0.3961	0.5983	0.3251	0.4492	0.7237
Insurer 64	0.3961	0.7176	0.5520	0.3954	0.4668	0.8470	0.3847	0.4013	0.9586
Insurer 65	0.4939	0.693	0.7127	0.5022	0.6514	0.7710	0.5229	0.8045	0.65
Insurer 66	0.2820	0.2941	0.9589	0.5438	0.5414	1.0044	0.4143	0.4351	0.9522
Insurer 67	0.3809	0.3815	0.9984	0.4594	0.4937	0.9305	0.6872	0.6824	1.007
Insurer 68	0.5122	0.5881	0.8709	0.5959	0.9457	0.6301	0.6584	0.9473	0.695
Insurer 69	0.5148	0.2768	1.8598	0.7392	0.6861	1.0774	0.7615	0.7379	1.032
Insurer 70	0.6986	0.6809	1.0260	0.5252	0.6984	0.7520	0.701	0.8476	0.827
Insurer 71	0.6310	0.3588	1.7586	0.7453	0.7167	1.0399	0.8225	0.7329	1.1223
Insurer 72	0.2342	0.5305	0.4415	0.5004	0.7674	0.6521	0.4181	0.5793	0.7217
Insurer 73	0.4064	0.4736	0.8581	0.6179	0.7547	0.8187	0.5404	0.7339	0.7363
Insurer 74	0.7577	0.6996	1.0830	0.6544	0.7436	0.8800	0.7869	0.7762	1.0138
Insurer 75	0.3955	0.5486	0.7209	0.3416	0.7345	0.4651	0.4512	0.7897	0.5714
Insurer 76	0.3018	0.2988	1.0100	0.3313	0.3768	0.8792	0.3483	0.3488	0.9986
Insurer 77	0.3062	0.3078	0.9948	0.5700	0.5918	0.9632	0.7508	0.7624	0.9848
Insurer 78	0.5246	0.5667	0.9257	0.5384	0.6134	0.8777	0.6520	0.7508	0.8684
Insurer 79	0.1716	0.2020	0.8495	0.6873	0.9036	0.7606	0.6848	0.9273	0.7385
Insurer 80	0.3732	0.3897	0.9577	0.4728	0.6797	0.6956	0.4152	0.5826	0.7127

Table 3C: Summary Statistics

	<i>size</i>	<i>div</i>	<i>reins</i>	<i>age</i>	<i>lev</i>
Mean	12.8652	0.3756	0.4426	18.3977	0.5774
Std. Dev.	1.6039	0.2751	0.4448	15.5512	0.2434
Minimum	8.902	0.0000	0.0000	1.0000	0.0071
Maximum	16.6153	0.7256	4.6516	68	0.9928
N	441	439	441	440	441

Correlation Matrix

<i>size</i>	1				
<i>div</i>	0.2839***	1			
<i>reins</i>	-0.1133**	0.1800***	1		
<i>age</i>	0.5123***	0.2611***	0.0793	1	
<i>lev</i>	0.2961***	0.3606***	0.3338***	0.1013**	1

Note: *size*=ln (Total Assets), *div*= 1- Herfindahl index for product line diversification; *reins*=Ratio of reinsurance ceded to gross premiums; *age*= ln (The number of years in operation), *lev*= Total Liabilities to Total Assets ratio. *** and ** denotes significance at 1% and 5%.

Chapter Four

Liberalization, Consolidation and Competitive Behaviour in an Emerging Insurance Market

4.1 Introduction

Over the past two decades, the liberalization of the financial services industry in Africa has been promoted to stimulate economic growth and improve consumer welfare. The outcomes of these liberalization policies are broadly classified into i.) the creation of large firms through consolidation; ii.) increased foreign presence in local markets iii) freedom of diversifying into wider scope of activities, among several others. Despite the belief that these outcomes have the potential to improve efficiency from operating synergies, innovation, economies of scope and scale and enhanced competition,⁴³ there is also a contrary view that they may result in tacit collusion. This occurs through market power gains resulting in collusive behaviour, which inhibits competition (Stigler, 1964). While these opposing views on the impact of liberalization on the competitiveness of the financial services industry have stimulated numerous empirical studies in the banking literature,⁴⁴ it has received little attention in insurance markets.⁴⁵

The relevance of competition in insurance markets cannot be overemphasized. For instance, similar to other financial institutions, competitive insurance markets have the ability to promote economic growth. The risk indemnification function of insurance activities promotes business continuity and reduces the cost of acquiring funds from financial institutions. This improves firms' ability to access funding for capital investment to promote growth (Grace and Rebello, 1993 in Arena, 2008). Also, increasing competition is necessary to improve managerial efficiency (Hick, 1935) in the production and delivery of insurance services leading to lower cost and welfare gains. On the other hand, competition may also have the potential to result in market failures by exacerbating information problems in adverse selection and moral hazard. This results in the shortening of relationships between policyholders and insurers.

⁴³ Refer to Claessens (2009), Keeley et al. (1990) in Lee and Hsieh (2014)

⁴⁴ Refer to Claessens and Laeven (2004), Demirguc-Kunt et al. (2004), Levy-Yeyati and Micco (2007), Yildirim and Philippatos (2007), Claessens (2009), Wu et al. (2010), Jeon et al. (2011)

⁴⁵ Studies on deregulation effects in insurance markets have been limited to the effect of consolidation on efficiency in insurance markets (See Hardwick, 1997; Noulas, 2001; Ennsfellner et al., 2007; Cummins and Rubio-Misas, 2006).

Against this background, the objective of this study is to examine the effect of three outcomes of liberalization on the competitiveness of the short-term insurance market in South Africa. Specifically, the study seeks to answer the following questions: what has been the effect of consolidation, foreign presence and business line diversification on competitive behaviour in the South African short-term insurance market? To answer these questions, the Panzar-Rosse (1987) reduced revenue model is employed on a sample of 80 short-term insurers in South Africa from 2007 to 2012 to estimate the H -statistics competitive index. The H -statistics allows for the identification of three forms of competitive conduct in monopolistic, competitive and monopolistic competitive markets through firm's pricing behaviour. The effect of the outcomes of liberalization on competitive conduct is examined by estimating H -statistics for sub-samples of the study population. The estimation is done for categories of size (small versus large insurers), ownership-type (domestic-owned versus foreign-owned insurers) and number of business line underwritten (single-line versus multi-line insurers). This analysis helps regulatory authorities to identify potential sources of barriers to competition and inform antitrust policies.

This chapter makes four significant contributions to the insurance literature. The analysis presents the first empirical evidence on the application of the Panzar-Rosse (P-R) revenue model to assess the competitiveness of insurance markets within the context of a developing economy in Africa. All prior application of the model to insurance markets by Murat et al. (2002), Kasman and Turgutlu (2008) and Coccorese (2010 and 2012) focused on developed economies of Australia, Turkey and Italy respectively. The use of this non-structural measure⁴⁶ of competition represents an improvement in relation to studies on the insurance market in South Africa. The second contribution relates to the specification of the P-R revenue model. Bikker, Shaffer and Spierdijk (2012) provide evidence that the inclusion of total assets in the P-R model amounts to misspecification and invalid inferences on competitive behaviour. This study employs the unscaled specification of the P-R model to provide consistent, unbiased and efficient inference of the structure of the insurance market.

Third, a dynamic panel framework is employed to estimate the Panzar-Rosse model. As discussed by Goddard and Wilson (2009), static specification of the revenue model

⁴⁶ This also presents the first empirical evidence on the application of New Empirical Industrial Organisation (NEIO) approach to examine the competitiveness of an insurance market in Africa.

biases the H -statistics towards zero. Adjustments to long-run equilibriums are assumed to be partial and better captured by dynamic modelling of the revenue elasticities to changes in input price. This approach appears to be non-existent in the application of the Panzar-Rosse model to insurance data. The final contribution of this paper relates to the assessment of the effect of the three outcomes of liberalization on competition. The findings from such analysis are important to inform policies on mergers and consolidation, entry restrictions on foreign firms and activity restrictions, which have implications on competitive conduct and antitrust policies. To the best of the author's knowledge, this is the first study to examine the effect of foreign presence and business line diversification on competitive behaviour in insurance markets.

The rest of the chapter is structured as follows: Section 4.2 reviews empirical literature on the competitiveness of financial institutions. Section 4.3 outlines the Panzar-Rosse methodology used to assess the degree of competition and the hypotheses to be tested; Section 4.4 interprets the estimates of the Panzar-Rose model. Section 4.5 provides a summary of the findings and draws conclusions and policy implications of the findings.

4.2 Literature review

Studies on the competitiveness of financial services industry have focused on banking markets in both developed and developing economies. The competitiveness of insurance markets appears to be heavily under-researched in both developed and developing economies. In this section, a brief review of approaches employed in examining the competitiveness of financial institutions as well as empirical application of the methodologies in both banking and insurance markets is presented.

4.2.1 Approaches to Measuring Competition

The measures of competition are traditionally classified under structural and non-structural approaches. The structural approaches infer competition from the structural features of a market. The theoretical bases for these measures are derived from the structure-conduct-performance (SCP) hypothesis of Mason (1939) and Bain (1951) and the Efficient-Structure (ES) hypothesis of Demsetz (1973). The SCP assumes that market concentration leads to higher pricing from collusion among firms with market power, hence higher profitability. These arguments have, however, been contradicted

by empirical evidence which suggest that collusive behaviour could still be present in less concentrated markets. The ES hypothesis,⁴⁷ which is an improvement over SCP, argues that concentration does not necessarily imply lack of competition. According to Demsetz (1973), concentration could result from competitive market whereby efficient firms are able to increase their market share through low production cost. This would result in exit of inefficient firms to increase market concentration.

The non-structural measures are based on new empirical industrial organisation (NEIO) theory and consist of the conjectural variation of Bresnahan-Lau approach (Bresnahan, 1982 and Lau, 1982), the Panzar-Rosse (1987) model, Lerner Index (1934) and the Boone (2008) indicator. Using a short-run model, Bresnahan (1982) and Lau (1982) provides empirical determination of the market power of a firm using aggregate industry data. It involves the simultaneous estimation of a demand and supply functions to generate a parameter, which is interpreted as a conjectural variation coefficient or the perceived marginal revenue.

The *H*-statistic of Panzar and Rosse (1987) and the Lerner index (Lerner, 1934) are the most widely used non-structural measures of competition in financial services industries. These measures are premised on the basis that firms pricing behaviour in relation to the changes in their input prices are dependent on the structure of the market. While the Panzar-Rosse *H*-statistics capture the competitiveness at the industry level and measures the extent to which a change in a vector of input prices is reflected in gross revenue,⁴⁸ the Lerner index identifies market power at the firm level through the ability of firms with market power to charge prices above their marginal cost. A recent proxy for assessing industry competitiveness, which is also based on the NEIO theory, is the Boone indicator (BI).⁴⁹ The BI is premised on the efficient structure hypothesis of Demsetz (1973) that efficient firms (firms with lower marginal costs) gain higher market shares through lower pricing. Unlike the Panzar-Rosse model, the Boone indicator and Lerner index make no assumption of long-run equilibrium.

⁴⁷ Choi and Weiss (2005) employ a formalised test of the SCP and ES hypotheses in the US insurance market.

⁴⁸ If a market is perfectly competitive, change in input prices will be fully reflected in revenue

⁴⁹ Boone (2008)

4.2.2 Empirical Literature

The early literature on the competitiveness in the financial services industry focused on the use of the Panzar-Rosse model in the banking industry. Most of these studies applied the model to cross-sectional data. For instance, Schaffer (1982) finds evidence to suggest that a sample of US banks earned revenues under monopolistic competitive conditions in 1979, using the model. Subsequently, Nathan and Neave (1989) also examine the competitiveness of the Canadian financial system using cross-sectional data on Canadian banks, trust and mortgage companies in operation from 1982 to 1984 by employing the P-R model. The authors conclude that while the banking sector exhibited perfect competition in 1982, the periods of 1983 and 1984 were characterized by monopoly. Molyneux et al. (1994) also employ the model in assessing the competitive conditions of major banking markets within the European Commission between 1986 and 1989. The authors conclude that the banking systems in Germany, the United Kingdom, France and Spain operated under monopolistic competition while banks in Italy were characterized by monopoly and conjectural variation oligopoly. Using data on the Finnish banking system from 1985 to 1992, Vesala (1995) finds monopolistic competitive conditions for all years except 1989 and 1990, where the conditions were found to be consistent with perfect competition. However, Molyneux et al. (1996) examine competition within the Japanese banking and find evidence of conjectural variation short-run oligopoly in 1986 while banks operated under conditions of monopolistic competition in 1988.

Later applications of the model have employed cross-sectional time series data. For example, De Bandt and Davis (2000) examine competitive behaviour among small and large banks in France, Germany and Italy between 1992 and 1996 using the Panzar-Rosse model. The authors find evidence to suggest that large banks in all the countries earned revenue under monopolistic competitive conditions while small banks in France and Germany operated under conditions of monopoly. Claessens and Laeven (2004) apply the model⁵⁰ to examine the degree and determinants of banking systems competition in 50 countries from 1994 to 2001. The authors identify foreign bank entry as an explanatory factor of the estimate *H*-statistics.

⁵⁰ Recent applications of the Panzar-Rosse models include Yildirim and Philippatos (2007), Al-Muharrami (2009), Biekpe (2011), Daley and Matthews (2012), Park (2013), Simpasa (2013), Fosu (2013)

Unlike the banking industry, literature on the competitiveness of the insurance market⁵¹ appears scant. The few studies have mostly been concentrated on developed insurance markets. For instance, Murat et al. (2002) provide the first application of the model to an insurance market using a cross-sectional data on the Australian general insurance market. From the estimated H -statistics, the authors conclude that general insurers operate under imperfect competitive conditions. Kasman and Turgutlu (2008) examine the evolution of competitive behaviour of short-term insurers in Turkey from 1996 to 2004. Through the estimation of the H -statistics over three sub-periods, the authors find evidence to suggest that the periods from 1996 to 1998 and 1999 to 2001 were characterized by monopolistic pricing. The H -statistics for the third sub-period from 2002 to 2004 reflected a monopolistic competitive behaviour. In Italy, Coccorese (2010) also employs the model to examine competitive behaviour in the car insurance market between 1998 and 2003. From the estimated H -statistics, the author finds evidence to suggest a monopolistic car insurance market. The findings lent support to antitrust regulations by the insurance regulator. Subsequently, Coccorese (2012) evaluated the decision by the regulatory authority to impose fines on 39 insurers in Italy for anti-competitive behaviour. The author applies the model to estimate H -statistics for both fined and non-fined insurers. The findings suggest that the fined insurers operated under conditions ranging from monopoly and monopolistic competition to validate the decision of the regulator. Jeng (2015) examined the changing competitiveness of the Chinese life and short-term insurance market from 2001 to 2009. The author finds evidence to indicate that non-life insurance companies earned revenues under monopolistic conditions while the revenue for life insurance firms were earned under monopolistic competitive conditions for the majority of the period.

Two major themes are identified from the reviewed studies on the application of the P-R model to insurance markets. First, all prior studies employ a scaling variable⁵²

⁵¹ Bikker (2012) examines the competitiveness of the Dutch Life insurance market using the recently developed Boone Indicator. The only exception is a study by Theron (2001), which analysed the merger between Santam and Guardian National Insurance and its impact on the structure of the short-term insurance industry in South Africa. The author employs the structural indicators in the HHI to conclude that market contestability exists despite the high levels of concentration. This review is restricted to only applications of the P-R model.

⁵² Kasman and Turgutlu (2008) and Coccorese (2010, 2012) include the natural logarithm of size as an explanatory variable while Murat et al. (2002) and Jeng (2015) employ a scaled revenue (ratio of insurance revenue to total assets) as the dependent variable. Jeng (2015) further includes size also as an explanatory variable. The scaling of the revenue model biases the H -statistics upwards ($H=1$), making it highly unlikely to identify monopolistic conduct (Bikker et al., 2012)

(either the use of revenue to assets as the dependent variable or the inclusion of size as an explanatory variable). Bikker et al. (2012) describe this as a misspecification of the model and provide evidence that such misspecification results in invalid inferences on competitive behaviour. They further claim that a valid estimate of competitive behaviour can only be inferred from unscaled specification of the revenue model. Second, the static modelling of the reduced-form revenue models, Goddard and Wilson (2009) suggest that the partial adjustments to long-run equilibriums are better captured by dynamic modelling of the revenue elasticities to changes in input price. The use of static models does not account for such a dynamic process. The summary of studies using the Panzar-Rose model in insurance markets is presented in Appendix A1.

4.3 Methodology

This section discusses the empirical strategy employed in achieving the objectives of this study. The Panzar and Rosse (1987) model for H -statistics competitive index as well as the equilibrium conditions for testing the validity of the estimated H -statistics are first discussed. It then proceeds to discuss the variables used in the model and hypotheses to be tested. Finally, the technique for estimating the models is briefly discussed.

4.3.1 Measuring competition: Panzar-Rosse H -Statistics

The Panzar and Rosse (1987) reduced form revenue model is used to compute the sum of the elasticities of the revenue with respect to input prices to define the H -statistics. The model is based on the assumption that firms vary their pricing strategies in response to changes in input prices, depending on the structure of the market. The reduced form revenue equation, R is defined as a function of input prices, w and exogenous factors z ;

$$R = f(w, z)$$

From the above, H -statistics is defined as;

$$H = \sum \frac{\partial R}{\partial w} * \frac{w}{R}$$

The estimated H -statistic identifies three major market structures in monopoly, monopolistic competition and perfect competition. The type of market structure is determined by the value of the estimated H -statistic. Following the application of the model to the banking sector by De Bandt and Davis (2000), this study also assumes that the short-term insurance industry is also single-product market. In line with Murat et al. (2002), Kasman and Turgutlu (2008), Coccorese (2010, 2012) and Jeng (2015), the study specifies the reduced-form revenue equation for short-term insurance market in South Africa as follows;

$$\ln pr_{i,t} = \beta_0 + \beta_1 \ln pl_{i,t} + \beta_2 \ln pk_{i,t} + \beta_3 \ln pd_{i,t} + \beta_4 \ln eqt_{i,t} + \beta_5 \ln cr_{i,t} + \beta_6 \ln reins_{i,t} + \varepsilon_{i,t} \dots \dots \dots 10$$

$$\ln trev_{i,t} = \beta_0 + \beta_1 \ln pl_{i,t} + \beta_2 \ln pk_{i,t} + \beta_3 \ln pd_{i,t} + \beta_4 \ln eqt_{i,t} + \beta_5 \ln cr_{i,t} + \beta_6 \ln reins_{i,t} + \varepsilon_{i,t} \dots \dots \dots 11$$

where i represent an insurer, t denotes time in years and \ln is the natural logarithm. pr and $trev$ represent premium income and total revenue respectively. pr reflects the core intermediation activity of insurers while $trev$ is made up of premium income and investment income. pl is the input price of labour, pk is the input price of capital, pd is the input price for debt. For the purpose of this study, equity, claims ratio and reinsurance ratio are used as control variables. The summation of the coefficients β_1 to β_3 ($H = \beta_1 + \beta_2 + \beta_3$) becomes the computed H -statistics.⁵³

The static specification of the revenue has been found to generate estimates of the H -statistics, which are biased towards zero (Goddard and Wilson, 2009).⁵⁴ This study therefore models the revenue functions in a dynamic panel framework by including a lagged term of the dependent variable as described in equations 12 and 13;

$$\ln pr_{i,t} = \beta_0 + \beta_1 \ln pr_{i,t-1} + \beta_2 \ln pl_{i,t} + \beta_3 \ln pk_{i,t} + \beta_4 \ln pd_{i,t} + \beta_5 \ln eqt_{i,t} + \beta_6 \ln cr_{i,t} + \beta_7 \ln reins_{i,t} + \varepsilon_{i,t} \dots \dots \dots 12$$

⁵³ In an alternative specification, the H -statistics in the premium equation (equation 10) is computed by excluding the coefficient of pd (β_3). This is based on the assumption that insurance debt decreases premiums due to the revenue from the investments of the debt. However, in order to ensure consistency across both equations, the study employs all input prices in the estimation of the H -statistics.

⁵⁴ Refer to Goddard and Wilson (2009) for theoretical arguments on the dynamic modelling of the Panzar-Rosse equation.

$$\ln trev_{i,t} = \beta_0 + \beta_1 \ln trev_{i,t-1} + \beta_2 \ln pl_{i,t} + \beta_3 \ln pk_{i,t} + \beta_4 \ln pd_{i,t} + \beta_5 \ln eqt_{i,t} + \beta_6 \ln cr_{i,t} + \beta_7 \ln reins_{i,t} + \varepsilon_{i,t} \dots \dots \dots 13$$

where $\ln pr_{i,t-1}$ and $\ln trev_{i,t-1}$ are the lags of premium revenue and total revenue respectively. The H -statistics for the dynamic model is computed as;

$$H = \left(\sum_{i=2}^4 \beta_i \right) / (1 - \beta_1)$$

The estimated H -statistics describes three forms of competitive behaviour. A market is described as monopolistic if the H -statistics is less than or equal to zero ($H \leq 0$). This is based on the economic theory of negative relationship between monopolist's⁵⁵ price and revenue. Hence, an increase in the input prices of monopolists increases marginal cost, which reduces equilibrium output and revenue. A negative H -statistics reflects short run conjectural variation oligopoly. An estimated H -statistics equal to one ($H = 1$) reflects a perfect competitive market. In such markets, changes in inputs prices results in proportional changes in production cost without affecting output levels. Firm survival depends on their ability to charge prices that covers average production cost. The third market structure defined by the H -statistics is monopolistic competition. Firms in this market are characterized by both features of monopolistic and perfect competitive markets. In this market, changes in input prices induce more than proportionate change in revenue. Hence, the estimated H -statistics becomes greater than zero but less than 1 ($0 < H \leq 1$). While firms exhibit monopoly power, there is also evidence of contestability through the ease of entry and exit into the market.

4.3.2 Equilibrium condition

The conclusions from the estimation of the Panzar-Rosse model are only valid under assumptions of long-run equilibrium. In the long-run equilibrium, input prices are not expected to be correlated with the rate of returns in the model. In line with empirical applications⁵⁶ of model in both banking and insurance markets, we test for the long-run equilibrium condition by replacing the dependent variables in equations 10 and 11 with return on assets (ROA) to form equation 14;

⁵⁵ This reflects the description of a monopolist as a price taker or quantity adjuster but not both.

⁵⁶ Refer to Nathan and Neave (1989), Molyneux et al. (1994), Murat et al. (2002), Kasman and Turgutlu (2008), Coccoresse (2010, 2012), Park (2013) and Fosu (2013).

$$\ln roa_{i,t} = \alpha_0 + \alpha_1 \ln pl_{i,t} + \alpha_2 \ln pk_{i,t} + \alpha_3 \ln pd_{i,t} + \alpha_4 \ln eqt_{i,t} + \alpha_5 \ln cr_{i,t} + \alpha_6 \ln reins_{i,t} + \varepsilon_{i,t} \dots \dots \dots 14$$

where $\ln roa_{i,t}$ is the natural logarithm of return on assets for insurer i in time t . Similar to equations 10 and 11, long-run equilibrium test measures the degree of sensitivity of return on assets to changes in input prices. If the sum of the estimated coefficients for the input prices is equal to zero, $E = \alpha_1 + \alpha_2 + \alpha_3 = 0$, the industry is said to be in long-run equilibrium. However, If $E = 0$ is rejected, the industry is classified to be in long-run disequilibrium (Shaffer, 1982 and Claessens and Leaven, 2004). Due to the possibility of negative profits and in line with Daley and Matthews (2012) and Andries and Capraru (2014), ROA is transformed by $(1+ROA)$ to enable for log transformation of negative values. The equilibrium test for the dynamic model specified is estimated by equation 15;

$$\ln roa_{i,t} = \alpha_0 + \alpha_1 \ln roa_{i,t-1} + \alpha_2 \ln pl_{i,t} + \alpha_3 \ln pk_{i,t} + \alpha_4 \ln pd_{i,t} + \alpha_5 \ln eqt_{i,t} + \alpha_6 \ln cr_{i,t} + \alpha_7 \ln reins_{i,t} \dots \dots \dots 15$$

Table 4.1 presents a summary of interpretation of the estimated H -statistics and equilibrium conditions.

Table 4.1: Interpretation of H-Statistics

Competitive Conditions	
$H \leq 0$	Monopoly or Conjectural Variations
$H = 1$	Perfect Competition
$0 < H < 1$	Monopolistic Competition
Equilibrium Test	
$E^{ROA} = 0$	Equilibrium
$E^{ROA} < 0$	Disequilibrium

Source: Panzar and Rosse (1987) and Nathan and Neave (1989).

4.3.3 Variables description

4.3.3.1 Dependent variable: Insurance revenue

In this study, two specifications of the dependent variable, insurance revenue are employed. The first dependent variable, premium revenue reflects the core functions of insurance business. The second dependent variable is the total revenue, which is made up of premium and investment income. The inclusion of investment income

enables the study to capture the comprehensive revenue⁵⁷ from insurance activities. As explained earlier, the study refrains from the use of scaled⁵⁸ specification of the dependent variable, which results in misspecification of the revenue model (Bikker et al., 2012). The misspecification, according to Bikker et al., (2012), results in price equation, which leads to over-estimation of H-statistics. This makes it impossible to identify monopolistic conduct ($H < 0$) and invalid inferences on competitive behaviour.

4.3.3.2 Independent variables: Inputs prices

In line with insurance literature, the study assumes that insurers employ labour, equity capital and debt capital as inputs in generating their revenues. Labour expenses are made up of management and commission expenses. Equity is measured as the total book value of policyholder's surplus, while debt capital is the addition to technical reserves (incurred but unreported claims and unearned premiums). The price of labour input is measured as the ratio of management and commission expenses to total assets.⁵⁹ Due to data limitations, the study is unable to follow convention in empirical literature and employ the number of employed staff as the denominator. The ratio of net income to equity capital is employed as the price of equity capital, PK . Due to the possibility of negative profits; a constant is added to price of equity to allow for logarithmic transformation. The price of debt capital, PD ⁶⁰ is proxied as the ratio of investment income to total reserves, made up of provisions for unearned premiums and outstanding claims.

4.3.3.3 Control variables

Following prior empirical applications of the model in insurance markets,⁶¹ the study controls for equity, claims ratio and reinsurance. Equity and claims ratio proxies for the risk level of insurers. The expected sign of the coefficient of equity depends on whether having high level of risk capital results in lower or high revenues. For claims ratio, the study expects a positive effect since high values reflect high risk and, therefore, a high

⁵⁷ Insurance premiums pre-collected at the beginning of an insurance contract are invested to generate investment income to adequately cover for future expected losses. Kasman and Turgutlu (2008) and Coccoresse (2010) employ total insurance revenue as the dependent variable in the Panzar-Rosse model.

⁵⁸ An alternative scaling approach (which has been applied in all prior estimates of the H-statistics in insurance markets) is the inclusion of the size (natural logarithm of total assets) as an explanatory variable in the revenue equation. This also yields wrong inferences on competitive conduct as the scaled dependent variable. Following the arguments of Bikker et al. (2012), this paper desists from the including a scale variable in revenue model.

⁵⁹ Murat et al. (2002) applies a similar measure for price of labour.

⁶⁰ The convention in literature is the use of expected investment income which excludes those attributable to equity capital as the numerator. The data does not allow for the separation of investment income into its main sources. Hardwick et al. (2011) employs similar proxy for price of debt capital.

⁶¹ Murat et al. (2002); Kasman and Turgutlu (2008) and Coccoresse (2010)

expected return. Reinsurance usage is measured as the ratio of reinsurance premiums ceded to gross written premiums as a proxy for risk diversification. The summary statistics of the variables of the model are presented in Table 4.2.

Table 4.2: Summary Statistics of Panzar-Rose Model Variables

	Mean	Median	Std Dev	Minimum	Maximum	N
<i>pl</i>	0.1456	0.1993	0.2138	0.2129	1.8817	441
<i>pd</i>	0.3295	0.1340	1.2163	0.0962	19.5421	441
<i>pk</i>	0.1738	0.1973	0.3350	-3.2481	1.2446	441
<i>eqt</i>	0.4220	0.3974	0.2434	0.0072	0.9929	441
<i>cr</i>	0.5814	0.5578	0.7006	0.0012	9.9047	441
<i>reins</i>	0.4540	0.3695	0.4345	0.0011	4.6515	441
<i>pr</i>	594,060	241,015	730,749	15,787	2,301,008	441
<i>trev</i>	641,212	259,110	782,046	17,048	2,505,290	441
<i>roa</i>	0.1471	0.0861	0.1734	0.0000	1.1813	441

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; *pr* =Gross Premium in thousands of Rands; *trev*=Total Insurance Revenue in Thousands of Rands; *roa*=Return on assets.

4.3.4 Data

Annual data on 80 short-term insurers from 2007 to 2012 were sourced from the Insurance Supervision Department of the Financial Services Board (FSB). The financial data used in this study was extracted from the returns containing the income and balance sheet statements submitted by all insurers to the FSB. Out of the 100 insurers as of 2012, firms with negative and zero premiums were excluded from the sample since they were in run-off mode and thus were not competing for premiums. The study period is limited by data unavailability.

4.3.5 Hypotheses development

In order to test the hypotheses that the three outcomes of liberalization (large firms, increased foreign presence and increased business line diversification) improve competitive behaviour in insurance markets, the study classifies the sample based on size, ownership-type and number of business lines underwritten. For the size sub-sample, the study categorizes the data into small and large insurers while for ownership-type sub-sample; the study defines the sample into domestic-owned and foreign-owned markets. Finally, the study also categorizes the sample by business lines into single-line insurers and multi-line insurers. It then proceeds to estimate the *H*-statistics for the categories under each sub-sample. By interpreting the *H*-statistic

as a continuous measure of competition, higher values reflect strong competitive behaviour and vice versa (Shaffer, 1982; Vesala, 1995 and Bikker and Haaf 2002a, b). Hence, for each sub-sample, the category with higher *H*-statistic is described to operate under more competitive conditions than those with lower *H*-statistic. The theoretical justifications explaining competitive behaviours within the three broad sub-samples are discussed in the preceding sections;

4.3.5.1 Size and Competitive Behaviour

A common feature of liberalization is the consolidation of financial services through mergers and acquisition, which results in the creation of financial conglomerates. From industrial organization theory, large firms are expected to exercise market power and exhibit monopolistic tendencies. Hence, they are less competitive compared with small firms. On the other hand, empirical evidence from banking markets suggests that the international operations of large banks expose them to outside competition compared to small banks who are only exposed to local markets (Bandt and Davis, 2000 and Bikker and Haaf, 2002a). In the Italian insurance market, Coccorese (2010) provides evidence of strong competitive behaviour among large firms compared to small firms. This study therefore expects large insurers to earn revenue under more competitive pressures compared with small insurers. In this study, small insurers are described as firms with assets value of less than R 1,267,471⁶² while large insurers have assets value greater than R 1,267,471.

H₁: Large insurers have higher H-statistics compared to small insurers.

4.3.5.2 Ownership and Competitive Behaviour

It has long been argued that the lack of competition among domestic firms results in higher transaction cost and reduced access to financial services in emerging markets. Through the process of liberalization, emerging economies have opened up their markets and reduced the barriers to the entry of foreign firms⁶³ into insurance markets. This was meant to address these imperfections (Puri, 2007; Dorfman, 2008). Theoretically, the presence of foreign firms has been hypothesized to affect competitive behaviour through the 'spill-over' and 'direct-effect' channels. Through the 'spill-over' channel, foreign presence in local markets brings sophistication and

⁶² This is the mean value of total assets.

⁶³ The effect of foreign presence on competition also depends on the mode entry into the local market. This occurs through either 'greenfield' investments or cross-border acquisition. This study is unable to distinguish between these two forms of foreign-ownership due to data limitations.

technological innovation in the intermediation functions of financial institutions to improve production efficiency (Lensink and Hermes, 2004; Rajan and Gopalan, 2010 in Mulyaningsih et al. 2015). Under the 'direct-effect' channel, foreign firms offer competitive pricing in an aggressive manner to overcome their information challenges in local markets. This enables them to gain market share and challenge the monopolistic tendencies of domestic firms (Goldberg, 2004 in Chelo and Manlagñit, 2011). This study therefore expects foreign-owned insurers to earn revenues under more competitive pressures compared with domestic-owned insurers. In this study, domestic-owned insurers are defined as firms with majority ownership (more than 50%) in the hands of the South African nationals while foreign-owned insurers have more than 50% of ownership in the hands of foreign nationals.

H₂: Foreign-owned insurers have higher H-statistics compared with domestic-owned insurers

4.3.5.3 Diversification and Competitive Behaviour

The nature of firms' diversification decisions impacts on their competitiveness. The relatedness of a firms' diversification strategy enables the firm to benefit from the economics of scale and scope. In insurance markets, the underwriting of multiple business lines gives insurers the advantage of reduced operating cost through cost sharing and operating synergies. This study therefore expects multi-line insurers to earn their revenues under more competitive⁶⁴ conditions compared with single-line insurers. This translates into a higher *H*-statistic for multi-line insurers compared with single-line insurers. In this paper, single-line insurers are classified as insurers who generate revenue from only one business line while multi-line insurers generate revenues from more than one business line.

H₃: Multi-line insurers have higher H-statistics compared with single-line insurers

4.3.6 Estimation techniques

The static panel data models (Equations 10 and 11) are estimated using the fixed effect (FE) and random effect (RE) techniques while the dynamic Panzar-Rosse model (Equations 12 and 13) are estimated with the system generalized method of moments (GMM) of Arellano and Bover (1995). For both RE and FE techniques, this study follows the convention in panel data studies and use the Hausman (1978) specification

⁶⁴ Barbosa et al. (2015) however find banks operating across multiple products to exhibit high monopolistic tendencies compared to specialised banks.

to identify the appropriate distribution of the error term. The GMM is suitable for dynamic panel data models because of its advantage in addressing the simultaneity and endogeneity biases associated with the inclusion of the lagged dependent variables as an explanatory variable. It uses the lagged differences of the explanatory variables as instruments. The validity of the GMM estimates is examined by the test of over-identifying restriction and no second order autocorrelation. In this study, the Hansen (1982) test is employed to test the validity of the over-identifying restrictions while the Arellano-Bond (1991) test is used to examine the absence of second order autocorrelation.

4.4 Empirical Results

This section⁶⁵ presents the results of both the static and dynamic estimates of the H -statistics. It first discusses the results of the static specifications in equations 10 and 11 using the fixed and random effects techniques. Although the fixed effects results is the preferred over random effects based on the Hausman specification test results, both results are reported as a form of robustness check. The results of system Generalized method of moments (GMM) estimation of the dynamic models in equations 12 and 13 are then discussed. The section ends with the discussion of the estimated H -statistics for the sub-samples of large versus small insurers, domestic-owned versus foreign-owned insurers and single-line versus multi-line insurers.

4.4.1 Static and Dynamic Panel estimations

Table 4.3 presents the estimated H -statistics from equations 10 and 11 using the fixed and random effects techniques. The H -statistics range between a minimum of 0.3841 and a maximum of 0.5780. The results of the Wald test indicate the H -statistics is significantly different from 0 and 1 at 1%. This suggests that short-term insurers in South Africa earn revenues under monopolistic competitive conditions. This reflects the existence of some form of market contestability despite the monopolistic tendencies from high levels of concentration. However, the H -statistics⁶⁶ is considerably higher than what was found in the short-term insurance markets in Turkey and Italy. From the coefficients of the input prices, it is observed that the prices of labour, PL and equity capital, PK are positive and statically significant at levels of

⁶⁵ The correlation matrix to test for the presence of multicollinearity is attached as Appendix 4B. Since all the coefficients are below the threshold of 0.7, the empirical estimations are free from multicollinearity biases.

⁶⁶ Kasman and Turgutlu (2008) find H -statistics of 0.205 and 0.165 for the short-term insurance market in Turkey.

between 5% and 1% while the price of debt capital, PK is negatively related to the two proxies of insurance revenue. The main driver of the H -statistics is the PL as reflected by the higher coefficient compared to the two other input prices.

The results of the dynamic panel estimations of equations 12 and 13 are also presented in Table 4.3. The Hansen J test of over-identifying restrictions is not rejected at significance level of 10% to indicate a correct specification of the instruments. The assumption of no second order autocorrelations is also not rejected as indicated by the p-values of m_2 being greater than 10%. The lagged dependent variables are positive and significant. This reflects the persistence of earned revenue. Delis et al. (2008) explains the persistence to reflect barriers to competition, resulting in uncompetitive markets.

Consistent with the static estimations, the estimated H -statistics of 0.6721 and 0.7577 are significantly different from 0 and 1 at 1%. This confirms our conclusions from the static estimations that short-term insurers earn their revenue under conditions of a monopolistic competition. Comparing the estimated H -statistics under the static (RE and FE) and dynamic (GMM) estimations, higher values are observed for the dynamic estimations. This is consistent with the arguments of Goddard and Wilson (2009) that static estimations of the model are bias towards zero. Consistent with the static results, the PL is also found to be the main driver of the H -statistics with higher coefficients compared with unit prices of debt (PD) and equity (PK).

On the control variables, the coefficient of equity is negative and significant across all estimations and consistent with Kasman and Turgutlu (2008). This suggests that higher equity capital reduces the financial cost that is associated with leverage usage, hence higher revenue. A significant positive coefficient is also observed for underwriting risk (CR) at 5% across all the estimations. This suggests that insurers with high underwriting risk earn more revenues. Finally, a negative coefficient is for reinsurance variable across both static and dynamic estimations. This indicates that the usage of reinsurance contracts reduces insurance revenue.

Table 4.3: Static and dynamic estimates of H-statistics

Equations	ln (Premium)						ln (Total Revenue)					
	10		10		12		11		11		13	
	FE		RE		GMM		FE		RE		GMM	
	Coef.	t	Coef.	z	Coef.	z	Coef.	t	Coef.	z	Coef.	z
Constant	11.600***	35.5	10.934***	32.12	7.076***	5.10	11.806***	42.35	11.146**	36.71	6.972***	6.28
L1.					0.282**	2.22					0.329***	3.39
pl	0.186***	4.36	0.225***	5.55	0.225**	2.37	0.159***	4.37	0.191***	5.28	0.194***	2.62
pk	0.125***	6.30	0.147***	7.13	0.080	1.02	0.109***	6.48	0.128***	7.07	0.065	1.08
pd	0.133***	5.91	0.206***	9.19	0.239	1.62	0.116***	6.03	0.184***	9.27	0.192*	1.80
eqt	-0.374***	-6.13	-0.346***	-6.48	-0.160**	-1.98	-0.332***	-6.38	-0.317***	-6.59	-0.162***	-2.63
cr	0.166**	2.43	0.219***	3.12	0.247***	2.65	0.108*	1.86	0.155**	2.51	0.184**	2.53
reins	-0.082**	-2.03	-0.087**	-2.16	-0.100**	-2.21	-0.062*	-1.82	-0.072**	-2.02	-0.089**	-2.48
H-statistics	0.4440		0.5780		0.7577		0.3841		0.5029		0.6721	
H=0: F/Wald χ^2	38.06***		58.24***		4.33**		71.73***		122.74***		13.33***	
H=1: F/Wald χ^2	187.6***		167.17***		22.6***		184.44***		119.89***		19.66***	
Market Structure	MC		MC		MC		MC		MC		MC	
Wald χ^2 /F(6)	27.61***		303.16***				28.17***		293.51***			
R-Squared	0.3257		0.6092				0.3301		0.6053			
m_1 : p-value					0.165						0.100	
m_2 : p-value					0.304						0.365	
Hansen J: p-value					0.352						0.226	
Instruments					13						13	
Year Dummies	YES		YES		YES		YES		YES		YES	
Insurers	79		79		79		79		79		79	
Observations	428		428		345		428		428		345	

Note: Note: L1=Lag of dependent variable; pl=Price of Labour; pk=Price of equity capital; pd=Price of Debt; eqt=Ratio of total equity to total assets; cr=Ratio of claims incurred to net earned premiums; reins= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; MC denotes a monopolistic competition. m_1 = First order autocorrelation, m_2 = Second order autocorrelation, Hansen J is the test of over-identifying restrictions. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

4.4.2 Long-run equilibrium condition

The reliability of the estimated H -statistics is based on the assumption of long-run equilibrium, E . In long-run equilibrium, input prices are expected to be unrelated to revenue. The results of the long-run equilibrium estimations from both the static and dynamic models are presented in Table 4.4. The results indicate that long-run equilibrium ($E^{ROA}=0$) cannot be rejected in all our preferred models. Hence, the conclusions drawn from the estimated H -statistics are valid.

Table 4.4: Long-run equilibrium conditions

Equations	Dependent Variable: $\ln(1+ROA)$					
	14			15		
	FE		RE		GMM	
	Coef.	t	Coef.	z	Coef.	z
Constant	0.02	0.12	0.316***	5.12	0.363***	9.31
L1.					0.163***	3.57
pl	-0.021***	-3.1	-0.014***	-2.6	-0.005*	-1.66
pk	0.038***	4.81	0.049***	5.76	0.061***	12.02
pd	0.039**	2.2	0.032***	2.95	0.013*	1.87
eqr	0.083***	3.92	0.071***	6.51	0.057***	12.11
cr	-0.055***	-2.7	-0.056***	-3.4	-0.040***	-3.79
$reins$	0.019	1.41	-0.003	-0.7	-0.008***	-2.73
E^{ROA} - Statistics	0.056		0.068		0.0825	
$E^{ROA}=0$: F/Wald χ^2	1.08		1.56		1.88	
Equilibrium condition	Long-run		Long-run		Long-run	
Wald χ^2 (6)	10.64***		70.69***			
R-squared	0.4975		0.7018			
Hausman	89.97***					
m_1 : p-value					0.094	
m_2 : p-value					0.313	
Hansen J: p-value					0.477	
Instruments					13	
Insurers	79		79		79	
Observations	428		428		345	

Note: L1=Lag of dependent variable; pl =Price of Labour; pk =Price of equity capital; pd =Price of Debt; eqr =Ratio of total equity to total assets; cr = Ratio of claims incurred to net earned premiums; $reins$ = reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; m_1 = First order autocorrelation, m_2 = Second order autocorrelation, Hansen J is the test of over-identifying restrictions; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$.

4.4.3 Liberalization outcomes and competitive behaviour

This section presents the discussion of the results of the effect of the three outcomes of liberalization (large firms, foreign presence and business line diversification) on

competitive behaviour. In line with the full sample estimations, all the models are estimated with fixed effect, random effect and system GMM estimation techniques. For the sake of brevity, this section reports only the H -statistics and the test results. The full parameter estimates are attached as appendices.

4.4.3.1 Size and Competitive Behaviour

The estimated H -statistics for small and large insurers are presented in Table 4.5. The H -statistics for both small and large insurers are significantly different from 0 and 1 to indicate monopolistic competitive markets. The higher H -statistics for small insurers compared with large insurer suggests that small insurers earn their revenues under relatively higher competitive conditions compared with large insurers. This is inconsistent with evidence⁶⁷ from banking markets, which suggests that large banks are more competitive compared with small banks. The high premium concentration among the top 10 insurers reflects the high incidence of market power and explains the less competitive conditions for large insurers in the market.

Table 4.5: H-Statistics: By insurer size

In (Premium)	Small Insurers (N=216)			Large Insurers (212)		
	FE	RE	GMM	FE	FE	GMM
H -statistics	0.5080	0.5330	0.5678	0.1820	0.2960	0.4108
$H=0$: F/Wald χ^2	48.10***	62.03***	6.87***	11.21***	32.65***	3.14*
$H=1$: F/Wald χ^2	45.49***	47.58***	27.85***	226.89***	184.13***	36.24***
In (Total Revenue)						
H -statistics	0.2600	0.2750	0.5576	0.1545	0.2454	0.4593
$H=0$: F/Wald χ^2	43.15***	61.02***	11.01***	13.61***	33.43***	2.84*
$H=1$: F/Wald χ^2	68.94***	75.58***	52.95***	266.69***	219.81***	41.97***

Note: FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; a is the F statistic for testing the null hypothesis that $H=0$ and $H=1$. ***, ** and * denotes H -statistics is significantly different from 0 and 1 at 1%, 5% and 10% respectively.

4.4.3.2 Ownership and Competitive Behaviour

Table 4.6 presents the results of the estimated H -statistics for domestic-owned and foreign-owned insurers. We also observe that the H -statistics for domestic-owned insurers ranges between a minimum of 0.3540 and a maximum of 0.4460 while for foreign-owned insurers, the H -statistics are from 0.4651 and 0.9870. In all cases, the test results of the hypotheses that $H=0$ and $H=1$ are rejected to indicate a monopolistic competitive market for both domestic-owned and foreign-owned insurers. However,

⁶⁷ See De Bandt and Davis (2000), Bikker and Haaf (2002a) and Staikouras and Koutsomanoli-Fillipaki (2006)

the higher H -statistics for foreign-owned insurers suggests that foreign-owned insurers operate under more competitive conditions than domestic-owned insurers. This confirms the hypothesis that foreign presence improves the competitiveness of the insurance market and is also consistent with evidence from banking markets (See Claessens and Laeven, 2004 and Yildirim and Philippatos, 2007). The high regulatory restrictions governing foreign participation in the financial services industry partly explain the high monopolistic tendencies among domestic-owned insurers.

Table 4.6: H-Statistics: By ownership type

In (Premium)	Domestic-owned (N=300)			Foreign-owned (N=135)		
	FE	RE	GMM	FE	RE	GMM
H -statistics	0.3840	0.4460	0.3691	0.8900	0.9870	0.4651
$H=0$: F/Wald	47.38***	65.76***	2.79*	153.5***	352.1***	3.19*
$H=1$: F/Wald	122.1***	101.5***	33.07***	2.34	0.06	54.97***
In (Total Revenue)						
H -statistics	0.3540	0.4070	0.3831	0.777	0.952	0.6039
$H=0$: F/Wald	48.06***	63.02***	4.35**	124.7***	211.7***	2.8*
$H=1$: F/Wald	160.53***	133.9***	38.12***	10.33***	0.55	51.79***

Note: FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; a is the F statistic for testing the null hypothesis that $H=0$ and $H=1$. ***, ** and * denotes H -statistics is significantly different from 0 and 1 at 1%, 5% and 10% respectively.

4.4.3.3 Number of Business Lines Underwritten and Competitive Behaviour

From the estimates of the H -statistics for single-line and multi-line insurers in Table 4.7, we reject the hypotheses of perfect competition and monopoly at significance levels of between 10% and 1%. Hence, it can be concluded that the markets for single-line and multi-line insurers are characterized by monopolistic competitive behaviour. However, the observed high H -statistics for single-line insurers compared with multi-line insurers in all the estimations suggests that single-line insurers operate under more competitive pressures than multi-line insurers.⁶⁸ The limited market scope for single-line insurers necessitates the need for competitive pricing to survive in their niche markets where they also face competition from some multi-line insurers.

⁶⁸ This is consistent with Barbosa et al. (2015) who find Brazilian banks operating multiple products line to exhibit high market power, hence less competitive.

Table 4.7: H-Statistics: By business line diversification

In (Premium)	Single Line (N=85)			Multi-Line(N=341)		
	FE	RE	GMM	FE	RE	GMM
<i>H</i> -statistics	0.236	0.347	0.6801	0.185	0.249	0.4962
<i>H</i> =0: F/Wald χ^2	3.48*	12.86***	3.98**	13.45***	25.16***	4.92**
<i>H</i> =1: F/Wald χ^2	36.62***	45.61***	24.53***	262.4***	230***	87.04***
In (Total Revenue)						
<i>H</i> -statistics	0.6360	0.8100	0.4316	0.2670	0.3460	0.4950
<i>H</i> =0: F/Wald χ^2	26.56***	67.82***	11.99***	34.25***	58.65***	9.57**
<i>H</i> =1: F/Wald χ^2	8.70***	3.72*	24.15***	258.6***	209.3***	19.62***

Note: FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; *a* is the F statistic for testing the null hypothesis that *H*=0 and *H*=1. ***, ** and * denotes *H*-statistics is significantly different from 0 and 1 at 1%, 5% and 10% respectively.

The results of the test of the long-run equilibrium for the sub-markets are presented in Table 4.8. The null hypothesis ($E^{ROA} = 0$) is not rejected in all the regression estimations. Although the hypothesis is not rejected for large, domestic-owned and multi-line insurers under the RE Models, the Hausman test favours the FE Models in all the specifications. Hence, the conclusions of Long-run equilibrium are based on the FE results. This indicates that all the sub-markets are in long-run equilibrium and confirms the reliability of the estimated *H*-statistics in all the sub-markets.

Table 4.8: Test for sub-market long-run equilibrium conditions

		FE		RE		GMM	
		Decision		Decision		Decision	
Small Insurers	E^{ROA} - Statistics	-0.0076		0.0143		0.0155	
	$E^{ROA}=0$: Wald χ^2	0.2	Accept	1.28	Accept	1.01	Accept
	Prob > χ^2	0.6592		0.258		0.3139	
Large Insurers	E^{ROA} - Statistics	0.0104		0.0261		0.0558	
	$E^{ROA}=0$: Wald χ^2	0.92	Accept	10.75	Reject	0.25	Accept
	Prob > χ^2	0.3402		0.001		0.6193	
Domestic Owned	E^{ROA} - Statistics	0.01559		0.02181		-0.017	
	$E^{ROA}=0$: Wald χ^2	2.51	Accept	7.18	Reject	0.2	Accept
	Prob > χ^2	0.1147		0.0074		0.6539	
Foreign-owned	E^{ROA} - Statistics	-0.0128		0.01914		0.0198	
	$E^{ROA}=0$: Wald χ^2	0.44	Accept	2.03	Accept	0.05	Accept
	Prob > χ^2	0.5109		0.1543		0.8214	
Single Line	E^{ROA} - Statistics	0.02729		0.02901		-0.0239	
	$E^{ROA}=0$: Wald χ^2	0.43	Accept	2.45	Accept	0.27	Accept
	Prob > χ^2	0.5159		0.1177		0.6003	
Multi-Line	E^{ROA} - Statistics	0.0082		0.021		-0.0082	
	$E^{ROA}=0$: Wald χ^2	0.62	Accept	7.02	Reject	0.06	Accept
	Prob > χ^2	0.4321		0.0081		0.8134	

Note: FE=Fixed Effects; RE=Random Effects; GMM=Generalized Method of Moments; Figures in parenthesis are the t -values for FE Models and z -statistics for RE and GMM Models.

4.5 Conclusion and policy recommendations

The competitiveness of the financial services industry has long been recognised to have an impact on financial stability and consumer welfare. While this has stimulated academic discourse on the competitiveness of banking markets, little appears to have been done on insurance markets. Taking motivation from the liberalization of the financial services industry in African countries over the past two decades, this chapter sought to examine the effect of three outcomes of liberalization on competitiveness of the largest short-term insurance market in Africa. The study identifies these three outcomes of liberalization as the creation of large firms through consolidation; increased foreign presence in local markets and freedom of diversifying into a wider scope of activities. To achieve the objectives of the study, the Panzar-Rosse reduced revenue model is employed on a panel data of 80 insurers in South Africa from 2007 to 2012 to estimate the H -statistics competitive index. The sample is then classified into large versus small insurers; domestic-owned versus foreign-owned insurers and single-line versus multi-line insurers and estimate the H -statistics for the categories of each of the sub-samples. This helps in assessing the effect of liberalization outcomes on competition.

The H -statistics for the full sample range between 0.3841 and 0.5780 from the estimations of the static model, while the dynamic estimations produced H -statistics of 0.6721 and 0.7577 over the study period. This is consistent with other empirical evidence that H -statistics estimated from static models are downwards biased. All the H -statistics are significantly different from zero and one and suggest that short-term insurers in South Africa earn revenues under monopolistic competitive conditions. Consistent with the full sample estimations, the study finds all sub-sample estimates of the H -statistics to be significantly different from 0 and 1. Hence, the conclusion of monopolistic competitive market holds.

From the sub-sample estimations to examine the effect of liberalization outcomes on competition behaviour and identify possible explanatory factors of competitive behaviour, the study concludes that the creation of large insurers reduces competitive pressures in the market. In terms of competitive behaviour of foreign-owned and domestic-owned insurers, the study documents evidence to confirm evidence from

prior literature that the presence of foreign firms into domestic markets improves industry competitiveness. The monopolistic tendencies of domestic insurers are explained by the tight exchange controls and regulatory restrictions on foreign participation in the insurance markets. Finally, the results also suggest that single-line insurers earn revenues under more competitive conditions compared to multi-line insurers.

The general conclusion from this study is that despite high levels of industry concentration, the activities of small, foreign-owned and single-line insurers improve the competitiveness of the short-term insurance market. These firm characteristics provide pointers to inform regulatory policies that seek to improve the competitiveness of the short-term insurance market. For instance, policies on reducing barriers that impede the participation of foreign firms would be beneficial in curtailing the monopolistic tendencies of domestic-owned insurers and increase the competitiveness of the market.

A limitation of this study is the inability to distinguish between 'greenfield' foreign presence and cross-border acquisition of domestic firms. This presents an opportunity for researchers to extend this study by examining the effect of entry mode by foreign insurers on competition. Researchers could also examine the effect other firm and industry factors on competitive behaviour in the insurance market. The H-statistics, which is an industry level (firm invariant) proxy for market competition does not permit for a regression of time-varying firm variant variables. Finally, this study recommends the applications of the methods employed in this paper to the more developed long-term insurance market.

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Appendices

Appendix 4A: Empirical applications of Panzar-Rosse model in Insurance Markets

Authors	Country	Sample	Scaling	Model	N	H	Decision
Murat et al. (2002)	Australia	1998	Yes	Static	68	0.75	MC
Kasman and Turgutlu (2008) 1996-2004	Turkey	1996-1998	Yes	Static	66	0.03	M
		1999-2001	Yes	Static	77	0.09	M
		2002-2004	Yes	Static	47	0.8	MC
		1996-2004	Yes	Static	190	0.21	MC
Coccoresse (2010) 1998-2003	Italy	Small	Yes	Static	106	0.27	MC
		Large	Yes	Static	33	0.02	M
		All firms	Yes	Static	136	0.34	MC
Coccoresse (2012) 1998-2003	Italy	Fined	Yes	Static	80	0.31	MC
		Non-fined	Yes	Static	44	0.67	C
Jeng (2015)*	China-Life	2001-2009	Yes	Static	267	-	MC
	China-No-Life	2001-2009	Yes	Static	226	-	M

Note: N=Number of observations; H=the estimated H-statistics from static specifications of the Panzar-Rose Model; MC=Monopolistic competition; M=Monopoly market, C=Competitive market; Static=static modelling of the P-R framework. *The decisions on the market structure are inferred from the annual estimates of the H-statistics.

Appendix 4B: Correlation Matrix

	<i>trev</i>	<i>pr</i>	<i>pl</i>	<i>pk</i>	<i>pd</i>	<i>eqt</i>	<i>cr</i>	<i>reins</i>
<i>trev</i>	1.000							
<i>pr</i>	0.992***	1.000						
<i>pl</i>	0.311***	0.319***	1.000					
<i>pk</i>	0.316***	0.328	-0.045	1.000				
<i>pd</i>	0.757***	0.734***	0.147***	0.168***	1.000			
<i>eqt</i>	-0.394***	-0.408***	-0.008	-0.012	-0.455***	1.000		
<i>cr</i>	0.179***	0.184***	-0.053	-0.238***	0.146***	-0.199**	1.000	
<i>reins</i>	-0.193***	-0.194***	-0.337***	-0.172***	-0.014	-0.190***	-0.064	1.000

Note: *pl*=Price of Labour, *pd*=Price of debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio of claims incurred to net earned premiums; *reins*= reinsurance to gross premiums. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4C: Estimates of H-statistics for small versus large insurers – Premium Income

ln (Premium)	Small Insurers				Large Insure			
	FE		RE		FE		FE	
	Coef.	t	Coef.	z	Coef.	t	Coef.	z
Constant	10.096***	24.01	10.159***	23.76	13.204***	42.04	13.373***	39.53
<i>pl</i>	0.201***	3.68	0.189***	3.88	0.076	1.44	0.182***	3.7
<i>pk</i>	0.108***	3.91	0.140***	5.22	0.056***	3.24	0.061***	3.36
<i>pd</i>	0.199***	6.18	0.204***	6.55	0.050***	2.85	0.053***	2.83
<i>eqt</i>	-0.395***	-5.28	-0.342***	-5.39	-0.094	-1.35	-0.125*	-1.94
<i>cr</i>	0.085	0.94	0.196**	2.25	-0.096	-1.45	-0.026	-0.37
<i>reins</i>	-0.010	-0.2	-0.027	-0.55	-0.038	-1.01	-0.046	-1.18
<i>H</i> -statistics	0.5080		0.5330		0.1820		0.2960	
<i>H</i> =0: F/Wald χ^2	48.1		62.03		11.21		32.65	
Prob > χ^2	0.000		0.000		0.001		0.000	
<i>H</i> =1: F/Wald χ^2	45.49		47.58		226.89		184.13	
Prob > χ^2	0.000		0.000		0.000		0.000	
Wald F(6)/ χ^2	21.35		161.08		5.22		48.31	
Prob > χ^2	0.000		0.000		0.0001		0.000	
R-Squared	0.4461		0.4452		0.1611		0.418	
Insurers	43		43		36		36	
Observations	216		216		212		212	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4D: Estimates of H-statistics for small versus large insurers – Total Revenue

In (Total Revenue)	Small Insurers				Large Insurers			
	FE		RE		FE			
	Coef.	t	Coef.	z	Coef.	t	Coef.	z
Constant	10.231***	26.46	10.200***	26.7	13.703***	47.44	13.773***	43.51
<i>pl</i>	0.161***	3.21	0.148***	3.42	0.099**	2.03	0.184***	3.98
<i>pk</i>	0.099***	3.9	0.127***	5.24	0.056***	3.53	0.062***	3.61
<i>pd</i>	0.182***	6.16	0.198***	7.05	0.030*	1.85	0.035**	2.02
<i>eqt</i>	-0.350***	-5.1	-0.297***	-5.32	-0.088	-1.37	-0.105*	-1.74
<i>cr</i>	0.070	0.84	0.1688**	2.15	-0.054	-0.88	0.010	0.16
<i>reins</i>	-0.022	-0.47	-0.0303	-0.69	-0.020	-0.59	-0.032	-0.88
<i>H-statistics</i>	0.25959		0.2749		0.1545		0.2454	
<i>H=0: F/Wald χ^2</i>	43.15		61.02		13.61		33.43	
<i>Prob > χ^2</i>	0.000		0.000		0.0003		0.000	
<i>H=1: F/Wald χ^2</i>	68.94		75.58		266.69		219.81	
<i>Prob > χ^2</i>	0.000		0.000		0.000		0.000	
<i>Wald F(6)/ χ^2</i>	20.15		169.88		4.53		44.15	
<i>Prob > χ^2</i>	0.000		0.000		0.0003		0.000	
<i>R-Squared</i>	0.4319		0.4791		0.143		0.3848	
<i>Insurers</i>	43		43		36		36	
<i>Observations</i>	216		216		212		212	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4E: GMM estimates of H-statistics for small versus large insurers

	Small insurers				Large insurers			
	ln (Premium)		ln (Total Revenue)		ln (Premium)		ln (Total Revenue)	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Constant	11.992	0.34	11.348	0.4	79.925	1.22	75.878	1.32
L1.	0.416***	2.99	0.438***	3.75	0.621***	5.24	0.551***	4.44
<i>pl</i>	0.393***	3.09	0.340***	3.61	0.324***	3.1	0.334***	3.13
<i>pk</i>	0.019	1.56	0.019	1.61	0.032*	1.79	0.038**	2.4
<i>pd</i>	-0.081***	-2.64	-0.045*	-1.71	-0.201***	-4.2	-0.166***	-3.6
<i>eqt</i>	-0.025	-0.5	-0.021	-0.57	0.076	0.76	0.043	0.4
<i>cr</i>	0.021	0.88	0.016	0.83	0.005	0.1	0.037	0.77
<i>reins</i>	0.541***	3.4	0.501***	3.88	0.571***	3.47	0.643***	3.72
<i>H</i> -statistics	0.5678		0.5576		0.4108		0.4593	
<i>H</i> =0: Wald χ^2	6.87		11.01		3.14		2.84	
Prob > χ^2	0.0088		0.0009		0.0764		0.0922	
<i>H</i> =1: Wald χ^2	27.85		52.95		36.24		41.97	
Prob > χ^2	0.000		0.000		0.000		0.000	
AR(1): <i>p</i> -values	0.046		0.067		0.16		0.012	
AR(2): <i>p</i> -values	0.343		0.389		0.866		0.491	
Hansen J: <i>p</i> -values	0.609		0.299		0.517		0.419	
Insurers	43		43		36		36	
Observations	181		181		175		175	

Note: L1=Lag of dependent variable; *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$.

Appendix 4F: Estimates of H-statistics for domestic-owned versus foreign-owned insurers – Premium Income

In (Premium)	Domestic-owned				Foreign-owned			
	FE		RE		FE		RE	
	Coef.	t	Coef.	z	Coef.	t	Coef.	z
Constant	11.576***	35.98	11.186***	32.13	5.218***	7.44	4.249***	8.28
<i>pl</i>	0.185***	4.09	0.195***	4.45	0.139***	3.04	0.156***	3.93
<i>pk</i>	0.096***	4.31	0.112***	4.83	0.047**	2.28	0.042**	2.23
<i>pd</i>	0.103***	4.89	0.139***	6.55	0.704***	12.48	0.789***	20.23
<i>eqt</i>	-0.351***	-5.38	-0.351***	-5.69	0.061	0.79	0.154***	2.85
<i>cr</i>	0.003	0.03	0.023	0.3	0.231***	3.32	0.207***	3.2
<i>reins</i>	-0.067*	-1.66	-0.077*	-1.89	0.096*	1.77	0.073	1.49
<i>H</i> -statistics	0.3840		0.4460		0.89002		0.98683	
<i>H</i> =0: F/Wald χ^2	47.38		65.76		153.47		352.09	
Prob > χ^2	0.000		0.000		0.000		0.000	
<i>H</i> =1: F/Wald χ^2	122.08		101.46		2.34		0.06	
Prob > χ^2	0.000		0.000		0.1289		0.8023	
Wald F(6)/ χ^2	17.9		154.5		44.73		704.99	
Prob > χ^2	0.000		0.000		0.000		0.000	
R-Squared	0.3192		0.4974		0.7227		0.9388	
Insurers	55		55		24		24	
Observations	300		300		135		135	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4G: Estimates of H-statistics for domestic-owned versus foreign-owned insurers – Total Revenue

In (Total Revenue)	Domestic-owned				Foreign-owned			
	FE		RE		FE		RE	
	Coef.	t	Coef.	z	Coef.	t	Coef.	t
Constant	11.858***	40.29	11.426***	35.11	6.137***	9.04	-65.613	-1.44
<i>pl</i>	0.170***	4.12	0.173***	4.24	0.111**	2.5	0.141***	3.2
<i>pk</i>	0.096***	4.68	0.108***	5.04	0.037*	1.88	0.051*	1.67
<i>pd</i>	0.088***	4.57	0.125***	6.34	0.629***	11.5	0.759***	11.38
<i>eqt</i>	-0.318***	-5.33	-0.320***	-5.56	0.087	1.17	0.183**	2.5
<i>cr</i>	0.021	0.29	0.038	0.51	0.1781**	2.64	0.261***	2.65
<i>reins</i>	-0.070*	-1.88	-0.080**	-2.11	0.1213**	2.32	0.097**	2.11
<i>H</i> -statistics	0.3536		0.4069		0.7765		0.9515	
<i>H</i> =0: F/Wald χ^2	48.06		63.02		124.65		211.72	
Prob > χ^2	0.000		0.000		0.000		0.000	
<i>H</i> =1: F/Wald χ^2	160.53		133.87		10.33		0.55	
Prob > χ^2	0.000		0.0000		0.0017		0.4583	
Wald F(6)/ χ^2	17.85		150.17		36.96		301.54	
Prob > χ^2	0.000		0.000		0.000		0.000	
R-Squared	0.3187		0.489		0.6829		0.9417	
Insurers	55		55		24		24	
Observations	300		300		135		135	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4H: GMM estimates of H-statistics for domestic-owned versus foreign-owned insurers

	Domestic-owned insurers				Foreign-owned insurers			
	ln (Premium)		ln (Total Revenue)		ln (Premium)		ln (Total Revenue)	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Constant	38.174	1.00	46.615	1.3	31.821	0.17	40.244	0.59
<i>L1</i>	0.390***	2.68	0.347**	2.32	0.786***	4.33	0.834***	5.28
<i>pl</i>	0.393***	2.96	0.376***	3.24	0.124*	1.96	0.154*	1.76
<i>pk</i>	0.022*	1.88	0.024*	1.95	0.003	0.18	0.001	0.04
<i>pd</i>	-0.190***	-3.53	-0.150***	-2.94	-0.027	-0.63	-0.054**	-2.01
<i>eqt</i>	0.007	0.08	-0.006	-0.08	-0.074	-0.79	0.005	0.09
<i>cr</i>	0.000	-0.02	0.005	0.2	0.077	1.47	0.024	0.28
<i>reins</i>	0.695***	3.7	0.726***	3.89	0.162	1.03	0.154	0.91
<i>H</i> -statistics	0.3691		0.3831		0.4651		0.6039	
<i>H</i> =0: Wald χ^2	2.79		4.33		3.19		2.8	
Prob > χ^2	0.0949		0.0374		0.074		0.0941	
<i>H</i> =1: Wald χ^2	33.07		38.92		54.97		51.79	
Prob > χ^2	0.000		0.000		0.000		0.000	
AR(1): <i>p</i> -value	0.019		0.019		0.145		0.08	
AR(2): <i>p</i> -value	0.985		0.747		0.477		0.839	
Hansen J: <i>p</i> -value	0.156		0.273		0.305		0.254	
Insurers	55		55		24		24	
Observations	241		241		110		110	

Note: *L1*=Lag of dependent variable; *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4I: Estimates of H-statistics for single-line versus multi-line insurers – Premium Income

ln (Premium)	Single Line				Multi-Line			
	FE		RE		FE		RE	
	Coef.	t	Coef.	z	Coef.	t	Coef.	z
Constant	6.057***	7.2	5.932***	8.52	11.643***	32.8	11.365***	30.58
<i>pl</i>	0.170	1.42	0.265***	2.94	0.087**	2.05	0.138***	3.34
<i>pk</i>	0.065**	2.33	0.082***	2.96	0.098***	5.03	0.111***	5.52
<i>pd</i>	0.529***	8.12	0.565***	10.41	0.123***	5.14	0.163***	7.05
<i>eqt</i>	0.177**	2.19	0.103	1.36	-0.309***	-4.84	-0.284***	-4.82
<i>cr</i>	-0.169*	-1.73	-0.173*	-1.86	0.091	1.29	0.139*	1.95
<i>reins</i>	0.073	1.43	0.065	1.34	0.003	0.06	-0.013	-0.27
<i>H-statistics</i>	0.7640		0.9120		0.3080		0.4120	
<i>H=0: F/Wald χ^2</i>	3.48		12.86		13.45		25.16	
<i>Prob > χ^2</i>	0.0674		0.0003		0.0003		0.0000	
<i>H=1: F/Wald χ^2</i>	36.62		45.61		262.43		229.95	
<i>Prob > χ^2</i>	0.0000		0.0000		0.0000		0.0000	
<i>Wald F(6)/ χ^2</i>	16.44		161.75		14.93		139.05	
<i>Prob > χ^2</i>	0.0000		0.0000		0.0000		0.0000	
<i>R-Squared</i>	0.642		0.8086		0.2491		0.5246	
<i>Insurers</i>	24		24		55		55	
<i>Observations</i>	85		85		341		341	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4J: Estimates of H-statistics for single-line versus multi-line insurers – Total Revenue

In (Total Revenue)	Single Line				Multi-Line			
	FE		RE		FE		RE	
	Coef.	t	Coef.	z	Coef.	t	Coef.	z
Constant	6.889***	9.34	6.358***	10.24	11.686***	38.05	11.483***	34.41
<i>pl</i>	0.107	1.02	0.199**	2.49	0.067*	1.82	0.106***	2.91
<i>pk</i>	0.062**	2.54	0.075***	2.99	0.084***	5.00	0.094***	5.38
<i>pd</i>	0.467***	8.16	0.536***	11.05	0.116***	5.63	0.146***	7.15
<i>eqt</i>	0.214***	3.01	0.128*	1.89	-0.295***	-5.35	-0.277***	-5.24
<i>cr</i>	-0.076	-0.89	-0.101	-1.2	0.028	0.46	0.068	1.09
<i>reins</i>	0.101**	2.23	0.091**	2.09	0.002	0.05	-0.011	-0.27
<i>H</i> -statistics	0.6360		0.8102		0.2668		0.3462	
<i>H</i> =0: F/Wald χ^2	26.56		67.82		34.25		58.65	
Prob > χ^2	0.0000		0.0000		0.0000		0.0000	
<i>H</i> =1: F/Wald χ^2	8.7		3.72		258.56		209.25	
Prob > χ^2	0.0047		0.0537		0.0000		0.0000	
Wald F(6)/ χ^2	17.37		174.75		16.63		137.76	
Prob > χ^2	0.0000		0.0000		0.0000		0.0000	
R-Squared	0.6546		0.8453		0.4175		0.4919	
Insurers	24		24		55		55	
Observations	85		85		341		341	

Note: *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; FE=Fixed Effects; RE=Random Effects. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 4K: GMM estimates of H-statistics for single versus multi-line insurers

	Single Line				Multi Line			
	ln (Premium)		ln (Total Revenue)		ln (Premium)		ln (Total Revenue)	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Constant	-12.225	-0.27	655.042***	2.77	368.732*	1.85	357.379***	2.59
L1	0.647**	2.29	0.723***	4.52	0.613***	5.11	0.555***	5.05
<i>pl</i>	0.208**	2.08	0.132	1.47	0.203	2.54	0.209***	2.99
<i>pk</i>	0.036**	1.80	0.026	1.30	0.021	1.05	0.022	1.57
<i>pd</i>	-0.004	-0.03	-0.038	-0.95	-0.032	-0.64	-0.011	-0.24
<i>eqt</i>	-0.095	-0.68	-0.053	-0.91	-0.075	-1.25	-0.084	-1.40
<i>cr</i>	-0.033	-0.70	0.018	0.60	0.015	0.50	0.025	0.68
<i>reins</i>	0.412	1.65	0.27	1.59	0.378***	2.70	0.433***	3.36
<i>H</i> -statistics	0.6801		0.4316		0.4962		0.495	
<i>H</i> =0: Wald χ^2	3.98		11.99		4.90		9.57	
Prob > χ^2	0.0462		0.0005		0.0268		0.002	
<i>H</i> =1: Wald χ^2	24.53		24.15		87.04		19.62	
Prob > χ^2	0.000		0.000		0.000		0.000	
AR(1): <i>p</i> -values	0.227		0.108		0.014		0.006	
AR(2): <i>p</i> -values	0.277		0.471		0.537		0.727	
Hansen J: <i>p</i> -values	0.572		0.453		0.45		0.683	
Insurers	24		24		63		63	
Observations	69		69		258		258	

Note: L1=Lag of dependent variable; *pl*=Price of Labour, *pd*=Price of Debt, *pk*=Price of equity capital; *eqt*=Ratio of total equity to total assets; *cr*=Ratio claims incurred to net earned premiums; *reins*= reinsurance to gross premiums; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Chapter Five

Competition and Efficiency in the short-term insurance market in South Africa⁶⁹

5.1 Introduction

This chapter examines the empirical relationship between competition and efficiency in the short-term insurance market in South Africa. The reference literature that examines the competition-efficiency nexus is the 'quiet-Life' hypothesis of Hicks (1935), which posits that managers of firms with market power enjoy a 'quiet-life' free from competition. The lack of competition results in reduced managerial effort leading to inefficiency. Leibenstein (1966) further argues in his 'liquidation hypothesis' that intense competition increases the pressure on management to reduce slack and improve efficiency. From these hypotheses, competition is expected to improve efficiency in two ways. First, in the absence of competition, firms do not have the incentives to control cost since they can price their products above competitive levels. In addition, the goal of managers to maintain market power in less competitive markets raises cost and decreases efficiency. Second, due to pressure to meet financial obligations and avoid financial distress, firms are forced to improve their work efforts and control cost.

Similar to other financial services industries, competition also has the potential to exacerbate the information asymmetry⁷⁰ in insurance markets and can result in market failures (Arrow, 1963; Akerlof, 1970 and Rothschild and Stiglitz, 1976) and reduced efficiency (De Feo and Hindriks, 2014). For instance, competitive financial services industry has the tendency to shorten long-term relationships (Petersen and Rajan, 1995) between insurers and policy holders and widen the information gap. This increases the cost of acquiring new information and results in declining efficiency. Additionally, the profits enjoyed by firms with market power serves as incentives for prudent selection of less risky insurance portfolios leading to reduced screening and

⁶⁹ This chapter has been accepted for publication in a forthcoming issue of the *Journal of Economics Studies*, Volume 43 Issue 6. An earlier draft of the Chapter was presented at the 11th African Finance Journal Conference, 14th-15th May, 2014 in Durban, South Africa titled "Cost and Profit Efficiency in Insurance Markets: Evidence on Competition Effects in South Africa".

⁷⁰ Through adverse selection, high risk individuals are more likely to be selected into insurance pool, hence increasing the probability of expected losses.

monitoring costs. Hence, the effect of competition on efficiency in insurance markets remains an empirical enquiry.

Although the relationship has received considerable attention from researchers in banking markets in both developed and developing countries (Berger, 1995; Goldberg and Rai, 1996; Berger and Hannan, 1998), empirical evidence appears to be scanty in insurance markets. The few recent studies have been restricted to data from Europe and Asia (See Hao and Chou, 2005; Fenn et al., 2008 and Kasman and Turgutlu, 2009). As evidenced from the conflicting theories, empirical studies on the effect of competition on efficiency remain inconclusive. To the best of the author's knowledge, the evidence from insurance markets in Africa and other emerging markets appears non-existent.

In order to achieve the objectives of this study, the stochastic frontier analysis (SFA) technique is employed to estimate both cost and profit efficiency of 80 short-term insurers in South Africa from 2007 to 2012. The competitiveness of the short-term insurance market is also analysed by undertaking cross-sectional estimations of the Panzar-Rosse (1987) reduced revenue model to generate annual industry H-statistics. This allows the study to distinguish among three forms of market structures in monopolistic, competitive and monopolistic competitive markets. Finally, the effect of competition on estimated efficiency scores is analysed using fixed-effects techniques that accounts for heteroscedasticity. Product line diversification, size, age, underwriting risk, reinsurance usage and leverage are employed as control variables.

This chapter contributes to the empirical literature in several ways. First, a major contribution of this paper is the analysis of profit efficiency in the South African insurance market. To the best of the author's knowledge, this is the first study to examine profit efficiency in an African insurance market.⁷¹ The relevance of estimating profit efficiency is premised on the assumption that cost efficiency only captures efficiency from the input side (through cost minimization). Managerial ability to concurrently maximize revenue and minimize cost is only captured through the estimation of profit efficiency (De Guevara and Maudos, 2002). This study is also the

⁷¹ From a survey of 95 efficiency studies by Luhn and Eling (2010a) in insurance markets, very few studies evaluated profit efficiency in developed insurance markets.

first to apply the SFA technique⁷² to analyse efficiency in an insurance market in Africa. Unlike the deterministic data envelopment analysis (DEA) which attributes all deviations (errors) from the frontier to inefficiency (Coelli et al., 1998), the SFA accounts for measurement errors and statistical noise, and represents a more robust assessment of firm efficiency. All prior efficiency studies in insurance markets in Africa have used the DEA technique (See Ansah-Adu et al., 2012; Barros and Wanke, 2014; Barros et al., 2014)

The study also provides the first empirical evidence on the competitiveness of insurance markets in Africa using non-structural measure of market structure. The use of the Panzar-Rosse *H*-statistics improves on the limitations of the structural measures of competition employed by prior studies to examine the direct effect of competition on efficiency in insurance markets. The structural measures, which are based on the assumption that concentration reflects lack of competition, have been contradicted by both theoretical and empirical evidence (See Demsetz, 1973; De Guevara et al., 2005). This is supported by the efficient structure hypothesis of Demsetz (1973), which argues that competitive markets could still be characterized by high levels of concentration through the exit of inefficient firms. Through cross-sectional estimations of the *H*-statistics, this study outlines the evolution of competition over time. This analysis is useful to regulators in assessing the progress towards improving industry competitiveness.

The rest of the chapter is structured as follows: Section 5.2 reviews the empirical literature on cost and profit efficiency in insurance markets; Section 5.3 details the empirical strategy employed for the analysis and testing the research hypotheses; Section 5.4 discusses the results and Section 5.5 concludes the study.

5.2 Literature Review

This section discusses the theoretical linkages between competition and efficiency. Due to the paucity of studies on the relationship in insurance markets, empirical discussions are extended to cover studies on determinants of cost and profit efficiency.

⁷² The only exception was Eling and Luhn (2010b) which covered a small sample of insurance companies in South Africa.

5.2.1 Competition and Efficiency

The 'quiet-life' hypothesis of Hicks (1935)⁷³ provides the theoretical basis for the relationship between competition and efficiency. Hicks (1935) posits that market power (less competition) results in less managerial efforts to control cost. In concentrated markets, Hicks (1935) contends that firms with market power maximize profits by setting prices above their marginal cost. The monopoly rents enjoyed by such firms allows for inefficient allocation of resources. This is supported by the arguments of Hart (1983) that competitive pressures motivate management to become efficient. From these arguments, we expect competition to be efficiency-enhancing, hence a positive relationship between H-statistics and efficiency. However, due to information asymmetry (adverse selection and moral hazards) in insurance markets, competition may have a negative effect on firm efficiency. De Feo and Hindriks (2014) show that adverse selection worsens in competitive insurance markets and that concentrated market⁷⁴ enables the monopolist to improve efficiency. Hence, a negative relationship between competition and efficiency would also suggest the existence of information asymmetry⁷⁵ in insurance markets.

5.2.2 Empirical literature: Determinants of Cost and Profit Efficiency

In a survey of efficiency studies in insurance markets by Cummins and Weiss (2000) and Eling and Luhn (2010a), it is observed that majority of the studies were concentrated on developed markets in US, Europe and developing Asian markets. In the most recent review by Eling and Luhn (2010a), only two non-peer reviewed papers examine efficiency in African insurance markets. Similar to the majority of studies in developed markets, the two studies focused on technical efficiency. The analysis of cost and profit efficiency has mainly been limited to developed markets. This study provides a brief review of empirical studies on efficiency in insurance markets.

Fecher et al. (1993) employ both the data envelopment analysis (DEA) and stochastic frontier analysis (SFA) to estimate cost efficiency of 243 non-life insurers in France.

⁷³ The efficient-structure hypothesis of Demsetz (1973) however proposes a reverse causality between efficiency and competition. The central theme behind ES is that concentration does not imply less competition. The argument is that efficient firms will produce at lower cost and increase market share at the expense of inefficient. For the purposes of this study, the discussions in this study are limited to the testing the Hicks (1935) 'quiet-life' theory.

⁷⁴ The market power hypothesis of Bain (1951) and Baumol (1982) also supports a negative relationship between competition and efficiency. Choi and Weiss (2005) developed a formal test for the Market Power Hypothesis.

⁷⁵ It should however be noted that formal tests have been developed and employed to examine the existence of information asymmetry in insurance markets.

The authors find an average industry operating cost of 50% above the efficient frontier. In examining the determinants of efficiency in a cross-section of 46 insurers in Australia, Worthington and Hurley (2002) find the average cost efficiency of 29.6%. Kader et al. (2010) examine the cost of efficiency of 26 non-life Takaful insurance firms from 2004 to 2006 across 10 countries to find an average cost efficiency of 0.70. Board size, ownership concentration, product diversity and firm size were identified as the drivers of cost efficiency in the second stage analysis.

In the US, Cummins and Xie (2013) find average cost efficiency of 51% for 781 property and liability insurance companies from 1993 to 2009. Choi and Elyasiani (2011) employ the SFA to identify cost efficiency of 79.8% in US property and liability insurance while Luhn (2009) uses the DEA to find cost efficiency of 48% for the German property and liability insurance market. In a cross-country study, Eling and Luhn (2010b)⁷⁶ find average cost efficiency of 58% for the short-term insurance market in South Africa from 2002 to 2006. From the UK life insurance industry, Hardwick et al. (2011) examine effect of board characteristics on profit efficiency in the UK life insurance market. The authors find that life insurers earn 69.1% of their potential earnings using the SFA technique. Following the liberalization towards the establishment of a single European insurance market, Kasman and Turgutlu (2011) analyse the behaviour of cost efficiency in the increased competitive environment between 1995 and 2005. The authors report an average cost efficiency of 88.2% to be mainly driven by smaller insurers compared with large insurers. In assessing the relationship between stock returns and efficiency of 399 listed insurance firms in 52 countries between 2002 and 2008, Gaganis et al. (2013) find an average cost and profit efficiency of 88.15% and 44.61% respectively using the SFA.

In relation to this study, authors such as Hardwick (1997), Noulas (2001), Cummins and Rubio-Misas (2006) and Ennsfellner et al. (2004) have also analysed efficiency during periods of deregulation and consolidation in European insurance markets. However, unlike the banking sector (Berger, 1995; Hannan, 1995; Goldberg and Rai, 1996; Berger and Hannan, 1997), very few studies have empirically examined the direct effect of competition on efficiency in insurance markets. For instance, Hao and Chou (2005) provide the first empirical evidence on the effect of competition on

⁷⁶ The estimations included a total of 72 observations for the short-term insurance market in South Africa.

efficiency in insurance markets. The authors employ the stochastic frontier and distribution free analysis techniques on 26 Taiwanese life insurers between 1997 and 1999 to estimate cost efficiency. The results of the random effects estimations suggest that competition (market power) resulted in the decline (improvement) in cost efficiency of life insurers in Taiwan. Fenn et al. (2008) also employ data on life and non-life firms in 14 European insurance markets from 1995 to 2001 to estimate cost efficiency using the SFA. Their results revealed that non-life insurers in Europe operate at only 7% above the cost efficient frontier. From the regression analysis, the authors conclude that competition improves cost efficiency in both the life and non-life markets. Both Hao and Chou (2005) and Fenn et al. (2008) employ market share as their proxies for market structure. Kasman and Turgutlu (2009) also examined the cost efficiency in the Turkish insurance industry from 1990 to 2004. Using the SFA technique, the authors identify average cost efficiency to range between 63.1% and 81.7%. The authors find evidence to suggest market concentration improves cost efficiency.

In Africa, Munro and Snyman (1995), Theron (2001), Liebenberg and Kamerschen (2008), Olaosebikan (2013) and Akotey et al. (2013) have examined various characteristics of insurance markets in different countries.⁷⁷ Efficiency related studies appear to have rarely been examined. Since the review by Eling and Luhnen (2010a), efficiency studies on insurance markets in Africa have begun to gain prominence among academics. For instance, Ansah-Adu et al. (2012) employ premium income as output variable to examine the cost efficiency of life and short-term insurers in Ghana from 2006 to 2008. They find an average cost efficiency of 30%, using the DEA in the first stage analysis. The authors identify market share, size and equity as the significant determinants of cost efficiency. Barros and Wanke (2014)⁷⁸ also analyse the technical efficiency and capacity issues of Mozambique insurance firms using the DEA bootstrapped technique. The authors predict the effect of market share, ownership type and firm origin using neural network. In examining the effect of market structure and efficiency on the profitability of both life and non-life insurance companies in Ghana, Alhassan et al. (2015) find evidence in support of the efficient

⁷⁷ Barros et al. (2008) provide the first reported evidence efficiency on insurance market in Africa. The authors analyzed the productivity changes in the insurance market in Nigeria.

⁷⁸ Similar analysis was conducted by Barros et al. (2014) in the Angolan insurance market.

structure hypothesis that efficiency drives profitability in both markets. The authors also employ the DEA technique in the estimation of efficiency scores.

From this overview, this study identifies the following gaps in the empirical literature on insurance markets. First, there is no evidence on profit efficiency estimates for insurance markets in Africa. Second, it appears there is no study that applies the new empirical industrial organisation (NEIO)⁷⁹ theory to assess competition in insurance markets in Africa and other emerging markets. This chapter addresses this research gaps by providing the first evidence on the empirical link between competition and efficiency using the Panzar-Rosse (1987) model, which is based on the NEIO as the proxy for competition.

5.3 Methodology

The empirical investigations are carried out in three stages. The first stage involves the estimation of cost and profit efficiency scores using the Stochastic Frontier Analysis (SFA). In the second stage, the Panzar-Rosse (P-R) model for estimating competitive behaviour is discussed. The final stage involves the description of the empirical model and theoretical justifications of the model variables.

5.3.1. Stage 1: Cost and Profit Efficiency

The concepts of cost and profit efficiency refer to the economic objectives of a firm in cost minimization and profit maximization. Cost efficiency examines the extent of deviation from the 'best-practice' firm while profit efficiency represents a much broader concept which examines the ability of firms to achieve the maximum profits given a set of outputs, inputs and their prices. In this chapter, the parametric SFA technique is favoured over the non-parametric DEA technique to estimate cost and profit efficiency. The SFA technique accounts for measurement errors and statistical noise, unlike the DEA technique, which attributes all deviations (errors) from the frontier to inefficiency (Coelli et al., 1998). The SFA involves the maximum likelihood estimation of a Translog cost and profit functions based on distributional assumptions of the error terms. From the comparison between optimum costs or profits and those realised, any deviation from the optimum levels are attributed to inefficiency and random noise (Aigner et al., 1977; Meeusen and van der Broeck, 1977)

⁷⁹ The NEIO infers competition from firm pricing behaviour

To estimate cost efficiency, the total cost of an insurer, C (consists of labour and business services expenses and capital expenses) is defined as a function of output vector y , input prices, w and the error term ε . The error term is decomposed into the inefficiency term, u and random factors, v which account for measurement errors and statistical noise. Based on Aigner et al. (1977) specification, the cost function is expressed below as;

$$C_{i,t} = f(y_{i,t}, w_{i,t}) + \varepsilon_{i,t} \dots \dots \dots 16$$

where i and t refers to insurance firm and time period respectively. The two-sided error term, ε is also defined as;

$$\varepsilon_{i,t} = u_{i,t} + v_{i,t} \dots \dots \dots 17$$

$u_{i,t}$ = inefficiency component

$v_{i,t}$ = measurement errors and other random factors

The inefficient component, $u_{i,t}$ is a one-sided non-negative random variable independently distributed with zero truncation while the two-sided random factors $v_{i,t}$ are assumed to have independent and identical distribution with a zero mean and constant variance, σ_v^2 .

In line with SFA convention, equation 16 is log transformed into equation 18 below;

$$\ln(C_{i,t}) = f(\ln y_{i,t}; \ln w_{i,t}) + u_{i,t} + v_{i,t} \dots \dots \dots 18$$

In the case of profit efficiency, this study follows Berger and Mester (1997) and Hardwick et al. (2011) and estimates the alternative profit frontier, which assumes⁸⁰ uncompetitive inputs markets as opposed to the standard profit frontier. The cost in equations 16 and 18 are replaced by profit after tax (π) in estimating the alternative profit efficiency in equations 19 and 20 below;

$$\pi_{i,t} = f(y_{i,t}, w_{i,t}) + \varepsilon_{i,t} \dots \dots \dots 19$$

$$\ln(\pi_{i,t} + \theta) = f(\ln y_{i,t}; \ln w_{i,t}) - u_{i,t} + v_{i,t} \dots \dots \dots 20$$

where θ is a constant added to the profit of each insurer. The constant is defined as the addition of the minimum absolute value of profits to one (1). Hence the dependent variable is defined by $\ln(\pi + \min|\pi| + 1)$. This is done to obtain positive values to allow

⁸⁰Hardwick et al. (2011) also make similar assumptions for the life insurance market in UK.

for logarithmic transformation of negative profits (Maudos et al., 2002 and Hardwick et al., 2011).

Following Hao and Chou (2005) and Fenn et al. (2008), this study employs the multiproduct Translog⁸¹ cost and profit functions based on value added approach and identify the output variables (y) as net incurred claims and investment income. The input variables (w) considered includes labour and business services cost, debt and equity capital. The Translog cost function for short-term insurers in South Africa is modelled on the works of Christensen et al. (1973) and Hao and Chou (2005) is presented in equation 21. Following Mester (1996) and Maudos et al. (2002), the study includes equity and time trend to capture risk differentials across the sample and the technological changes respectively over time. The multi-product translog cost function is presented in equation 21 as;

$$\begin{aligned} \ln\left(\frac{tc}{w_3}\right)_{i,t} &= \alpha_0 + \alpha_1 \ln y_{1i,t} + \alpha_2 \ln y_{2i,t} + 0.5\alpha_3 \ln y_{1i,t}^2 + 0.5\alpha_4 \ln y_{2i,t}^2 + \alpha_5 \ln y_{1i,t} \ln y_{2i,t} \\ &+ \beta_1 \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \beta_2 \ln\left(\frac{w_2}{w_3}\right)_{i,t} + 0.5\beta_3 \ln\left(\frac{w_1}{w_3}\right)_{i,t}^2 + 0.5\beta_4 \ln\left(\frac{w_2}{w_3}\right)_{i,t}^2 \\ &+ \beta_5 \ln\left(\frac{w_1}{w_3}\right)_{i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \gamma_1 \ln y_{1i,t} \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \gamma_2 \ln y_{1i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t} \\ &+ \gamma_3 \ln y_{2i,t} \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \gamma_4 \ln y_{2i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \delta_1 \ln e_{i,t} + \delta_2 \ln e_{i,t}^2 \\ &+ \delta_3 \ln e_{i,t} \ln y_{1i,t} + \delta_4 \ln e_{i,t} \ln y_{2i,t} + \delta_5 \ln e_{i,t} \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \delta_6 \ln e_{i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t} \\ &+ \tau_1 \text{trend}_t + v_{i,t} + u_{i,t} \dots \dots 21 \end{aligned}$$

where \ln is the natural logarithm; tc is insurers total cost (made up of incurred claims and other operational expenses). In the profit model, we replace tc by net profit after tax,⁸² y_1 = claims incurred; y_2 = investment income; w_1 = prices of labour and business services, w_2 = price of debt capital, w_3 = price of equity capital; e is equity capital. α , β , δ and τ are parameters to be estimated. In line with SFA convention, the study imposes homogeneity restrictions⁸³ by normalising tc , $(\pi_{s,t} + \theta)$, w_1 and w_2 by w_3 .

⁸¹ The use of the Translog function instead of the Cobb-Douglas function is supported by the test of functional form. The result is presented in the parameter estimates of both the cost and profit functions

⁸² For profit efficiency, the inefficiency term u changes to $-u$.

⁸³ The input share equations based on Shepherd's Lemma restrictions are omitted in line with the arguments of Rai (1996), Berger and Mester (1997) and Beccalli et al. (2006).

In estimating the translog cost and profit functions, the Battese and Coelli (1995)⁸⁴ specification, which assumes that the residuals follow truncated normal distributions and a time-varying efficiency term (Battese and Coelli, 1993 and Coelli et al., 1998) is employed. The maximum likelihood estimation technique is used to estimate the parameters of the translog functions in equation 21. The existence of inefficiency in the model is defined by the variance ratio,⁸⁵ $\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$ (See Battese and Corra, 1977). γ explains the proportion of error term attributable to the inefficiency term, u other than the random error term, v . The value of γ lies between 0 and 1 with values closer to 1 indicating most of the deviations from the efficient frontier is due to managerial inefficiency. The efficiency scores are predicted using Jondrow et al. (1982) estimation. The predicted scores for each firm lies between 0 and 1 with values closer 1 reflecting higher efficiency.

5.3.1.1 Output Variables

In determining the choice of output variables, the study follows the convention in efficiency literature and employs the value-added approach. In line with Yuengert (1993), Luhnén (2009), Hardwick et al. (2011), incurred claims are employed as proxy for risk-pooling and bearing and financial services function of short-term insurers. This represents the amounts given to policyholders to compensate for losses arising out of specified events. This study refrains from the use of earned premiums income since it captures both output quantity and price and not just output (Yuengert, 1993). Due to data unavailability, investment income instead of invested assets is used as the output for intermediation activities. This is consistent with Diacon (2001) and Klumpes (2007).

5.3.1.2 Inputs Prices

Following the convention in the insurance efficiency literature,⁸⁶ short-term insurers are assumed to employ inputs in labour and business services, debt and equity capital to generate their outputs. This study proxies labour and business services input price, PL as the ratio of management expenses and commissions paid to total assets.⁸⁷ The

⁸⁴ While the two-step procedure is heavily biased by presence of heteroskedasticity (Wang and Schmidt, 2002), attempts to employ the single-step estimation of Battese and Coelli (1995) in which the inefficiency effects in the composed error term are expressed as an explicit function of the firm-specific variables produced erratic results. In all instances, the standard errors of the explanatory variables are not generated by system. However, the use of the two stage procedure is consistent with studies by Liadaki and Gaganis (2010) and Gaganis et al. (2013).

⁸⁵ Based on the Battese and Corra (1977) parameterization, the variance is given by $\sigma^2 = \sigma_u^2 + \sigma_v^2$

⁸⁶ Jeng et al. (2007) and Huang et al. (2007)

⁸⁷ The number of employees has normally been used as the denominator. This study is unable to employ this approach due to data limitations.

price of debt capital, PD^{88} is proxied as the ratio of investment income to total reserves (unearned premiums and outstanding claims). The ratio of net income to equity capital is employed as the price of equity capital, PK . Due to the possibility of negative profits; a constant is added to price of equity to allow for logarithmic transformation. All monetary values are deflated by the consumer price index. Table 5.1 presents the summary statistics of variables used in the Translog function models.

Table 5.1: Summary of Profit, Cost, Output and Input Prices

	Mean	Std. Dev	Min	Max	N
Cost	550,791	452,077	264,868	1,683,939	436
Profit	94,812.15	217,428.5	-100,271	1,500,000	436
Outputs					
Y1	429,843	296,473	240,066	1,136,771	436
Y2	72,913	68,762	265,59	229,580	436
Input Prices					
PL	0.1456	0.2138	0.2129	1.8817	441
PK	0.1738	0.3350	-3.2481	1.2446	441
PD	0.3295	1.2163	0.0962	19.5421	434
Risk					
Equity	461,476	931,181	2,833	5,886,037	441

Note: Cost=Operating expenditure; Profit=Net Profit after Tax; Y1=Incurred Claims, Y2=Investment Income, PL= Price of Labour, PK=price of equity capital, PD=Price of debt. All Monetary values are in Thousands of South African Rand

5.3.2 Stage 2: Measuring Competition

In this study, the Panzar and Rosse (1987) H -statistics is employed to examine the pricing behaviour of short-term insurers in South Africa. The P-R model is a reduced form revenue equation, which examines the elasticity of firm revenue to changes in input prices depending on the market structure. The H -statistics is defined as the sum of the elasticities of revenue with respect to input prices and valid under the assumption of long run market equilibrium (Nathan and Neave, 1989). The estimated H -statistic identifies three major market structures in monopolistic, monopolistic competition and perfect competitive markets. Following Murat et al. (2002), Kasman and Turgutlu (2008) and Coccoresse (2010), the reduced-form revenue equation for the annual estimates of H -statistics for the short-term insurance market is specified in equations 22 and 23 as;

⁸⁸ The convention in the literature is the use of expected investment income which excludes those attributable to equity capital as the numerator. The data does not allow for the separation of investment income into its main sources. Hardwick et al. (2011) employ similar proxy for price of debt capital.

$$\ln pr_i = \beta_0 + \beta_1 \ln pl_i + \beta_2 \ln pk_i + \beta_3 \ln pd_i + \beta_4 \ln ta_i + \beta_5 \ln eqr_i + \beta_6 \ln risk_i + \varepsilon_i \dots \dots \dots 22$$

$$\ln tr_i = \lambda_0 + \lambda_1 \ln pl_i + \lambda_2 \ln pk_i + \lambda_3 \ln pd_i + \lambda_4 \ln ta_i + \lambda_5 \ln eqr_i + \lambda_6 \ln risk_i + \xi_i \dots \dots \dots 23$$

where i represent an insurer; \ln is the natural logarithm. pr and tr represent insurer's revenue⁸⁹ proxied as premium and total revenues⁹⁰ respectively. The use of pr is to capture the sensitivity of premium income to changes in the prices of insurance inputs. The input prices, pl , pk and pd are defined as in the translog functions. For the purpose of this study, size, equity and underwriting risk are used as control variables. Size is measured as the natural logarithm of total assets, equity is the ratio is equity capital to total assets and underwriting risk is the ratio of incurred claims to net premiums. The summation of β_1 (λ_1) to β_3 (λ_3) ($\beta_1 + \beta_2 + \beta_3 = H$ and $\lambda_1 + \lambda_2 + \lambda_3 = H$) becomes the computed H -statistics, together with the standard error, are used to test the significance of the coefficient. A computed H -statistics which is less than or equal to zero ($H \leq 0$) implies a monopolistic market, where firms experiences reduction in equilibrium output and revenue with increases in input prices. For competitive markets, the H -statistics is greater or equal to one ($H = 1$). This suggests that changes in production cost are proportional to changes in inputs prices. A monopolistic competitive market is captured by the H -statistics between zero and one ($0 < H < 1$). The validity of the H -statistics depends on the existence of long-run market equilibrium. In testing for the equilibrium condition, the dependent variables in equations 22 and 23 are replaced by return on assets.

5.3.3 Stage 3: Empirical Model

To test the Quite Life hypothesis of Hicks (1935), the study models the relationship between competition and efficiency on the works of Hao and Chou (2005) and Fenn et al (2008) by regressing the estimated H -statistics on the predicted cost and profit efficiency scores, as shown in equation 24;

$$u_{i,t} = \phi_0 + \phi_1 hs_t + \sum_{j=2}^K \beta_{j,it} x_{j,it} + \varpi_{s,t} \dots \dots \dots 24$$

⁸⁹ Several arguments have been exposed on the use of scale revenue as the dependent variable. This study follows Bikker et al. (2006) and use an unscaled specification of the revenue term

⁹⁰ This is made up of premium income and investment income.

where subscripts i and t denotes firm and year respectively. u represents the estimated cost and profit efficiency scores from the SFA. hs is the H -statistics estimated in equations 22 and 23. Following Shaffer (1983), Vesala (1995) and Bikker and Haaf (2002a, b), the study interprets the estimated H -statistics as a continuous measure of competition in the regression model, with high values reflecting strong competitive behaviour and vice versa. Hence, a positive coefficient for estimated H -statistic would indicate that competition improves efficiency while a negative coefficient would suggest that competition is detrimental to efficiency. Equation 24 is expanded to include the control variables to form equation 25;

$$u_{i,t} = \phi_0 + \phi_1 hs_t + \phi_2 pdiv_{i,t} + \phi_3 size_{i,t} + \phi_4 age_{i,t} + \phi_5 cr_{i,t} + \phi_6 reins_{i,t} + \phi_7 lev_{i,t} + \varepsilon_{i,t} \dots \dots \dots 25$$

where $pdiv$ represents 1-Herfindahl Hirschman index (HHI)⁹¹ for product line concentration, $size$ is measured as the natural logarithm of total assets, age is the natural logarithm of years since a firm was registered as a short-term insurer, cr is the ratio of incurred claims to earned premiums, $reins$ is the ratio of reinsurance ceded to gross premiums and lev is the ratio of debt to equity. The error terms, ε , is decomposed into the unobservable firm-specific effects μ and v , are the time-varying error terms, which are independently and identically distributed.

The choice of control variables is motivated by the empirical studies of Hao and Chou (2005), Fenn et al. (2008), Hardwick et al. (2011), Ansah-Adu et al. (2012), among several others. Through the underwriting of multiple business lines, insurers are able to hedge against the fluctuations in revenues. In addition, they are able to maximize the use of fixed capital through input sharing in labour and technology (Huberman et al., 1983). Hence, diversified insurers are expected to be more efficient. On the other hand, inefficient internal capital markets lead to cross-subsidization of inefficient business lines by efficient ones. In such situations, firms with focused operations are more likely to be more efficient compared to diversified firms. In line with the findings of Khaled et al. (2001) and Luhn (2009), a positive relationship is expected between product line diversification and efficiency.

⁹¹ The HHI is computed as the sum of the square of the market share of premium from each business line to gross premiums for all business lines for each insurer.

Firm growth is more likely to result in economies of scale advantages (Berger et al., 1993; Yuengert, 1993 and Hao and Chou, 2005). Hence, cost and profit efficiency are more likely to improve in large firms because of reduced per unit production cost and increased market share. However, difficulties in monitoring and control of large scale of operations (Fama and Jensen, 1983) could result in wastage and increased cost. The empirical evidence on the size-efficiency relationship in insurance markets remains inconclusive.

It has been argued that the survival of older firms is influenced by their ability to adjust to their operating environment with time through "learning-by-doing". This suggests that the older firms are more likely to be efficient than new insurers (Arrow, 1962 and Jovanovic, 1982). On the other hand, older firms may also be constrained by their inability to adopt modern technology. This has a negative impact on productive capacity (Barron et al., 1994). However, insurance businesses rely on reputation and trusts which are built from long-term relationships. Hence, this study expects a positive age-efficiency relationship.

The study also controls for the effect of risk, measured as the ratio of claims incurred to premiums earned on efficiency. This variable reflects the quality of insurers underwriting policies. Insurers that underwrite risky policies have uncertain cash flow (Fama and Jensen, 1983) resulting from the high variations from their claims. Risky insurers are expected to have high underwriting losses, hence less efficient. However, the underwriting of less risky portfolio may add to the cost structure of insurers through investments in underwriting processes and monitoring activities. This would explain any positive effect of risk on efficiency.

Reinsurance activities measure the extent of risk management activities of an insurer. Through the ceding of reinsurance premiums to reinsurers, primary insurers enhance their underwriting capacity (Malhberg and Url, 2003) and reduce the risk of insolvency (Kader et al., 2010). This study therefore expects reinsurance to be efficiency-enhancing. Financial risk, proxied as leverage imposes financial cost on firms and increases the probability of financial distress and insolvency. A high insolvency risk, according to Berger et al. (2000), is less likely to attract risk-sensitive policy holders, hence decline in revenues. This results in negative leverage-efficiency relationship. However, the binding role of leverage puts pressure on management to perform and

reduces managerial slack (Jensen, 1986), hence a positive effect of leverage on efficiency. Following Luhnén (2009) and Kasman and Turgutlu (2009), a positive effect of leverage on efficiency is therefore expected. The descriptive statistics of the variables in equation 25 are presented in Appendix 5A.

5.3.4 Data

Annual income and balance sheet data on 100 short-term insurers were obtained from audited financial statements submitted to the insurance department of the Financial Services Board (FSB). The sample is made up of insurance companies of different sizes and business complexities covering the period⁹² from 2007 to 2012. Insurers with negative values for assets and equity capital and missing data for more than three years of the study period were excluded from the final sample employed in the estimations. The final number of insurers employed in the analysis of 80 covers about 80% of firms in the short-term insurance market. Hence, the results of the analysis are fairly representative of the short-term insurance market. Although 80 firms were employed for the estimation of cost and profit efficiency scores, due to data unavailability for the age variable for firms, the final sample for the panel data estimations dropped to 75 firms.

5.4 Empirical Results

This section presents the results of analysis undertaken in stages 1 and 2. The parameter estimates of the translog cost and profit functions variables in equation 21 estimated using STATA 12 is reported in Appendix 5B. The value of variance parameter⁹³ γ (0.997 and 0.998 for cost and profit functions respectively) indicates that the one-sided inefficiency term dominates the error structure of our models. Hence, the SFA technique better captures the inefficiency of the sample compared with deterministic models. The log likelihood ratio test also supports the use of the translog function over the Cobb-Douglas function.

⁹² The period is constrained by data availability. The inclusion of data prior to 2007 will reduce the sample from 80 to less than 30 and have an adverse effect on the statistical power.

⁹³ The study refrains from discussing the parameters of the translog functions for brevity. From the variance parameters, the study finds the coefficients of γ of 0.997 and 0.998 for cost and profit efficiency respectively. This indicates that inefficiency accounts for greater deviations from the efficient frontier at 1%. The test that $\lambda=0$ is rejected at 1% in both the cost and profit equations.

The results of predicted cost and profit efficiency scores are reported in Table 5.2. The cost efficiency⁹⁴ score of 0.8008 suggests that an average short-term insurer in South Africa spends 19.92% more on costs relative to the best-practice insurers. This represents an improvement on the 58% cost efficiency⁹⁵ estimated by Eling and Luhnen (2010b) between 2002 and 2006. For profit efficiency,⁹⁶ the score of 0.4175 also indicates that short-term insurers earn only 41.75% of their earnings potential compared with best-practiced insurers. The high profit inefficiency could be attributable to output side inefficiencies from mispricing of insurance products (Berger and Hannan, 1998) and reflects inefficiency on the revenue side of short-term insurers. In South Africa, high volatility in security prices and low interest rates accounts for the low yields on investments.⁹⁷ This partly explains the high levels of profit inefficiency.

The high levels of cost efficiency compared with profit efficiency is consistent with empirical evidence in the insurance (Gaganis et al., 2013) and banking (Berger and Mester, 1997; Maudos et al. 2002; Pasiouras et al., 2009) literature. The observed differences between cost and profit efficiency scores also suggest an imperfect competitive market (Boss and Kool, 2006). Over the study period, we observe relatively higher variations in profit efficiency compared with efficiency as indicated the standard deviations. Finally, a weak correlation⁹⁸ is observed for the estimated cost and profit efficiency scores. This suggests that cost efficient insurers are not necessarily profit efficient and consistent with the findings of Gaganis et al. (2013). According to Rodgers (1998), the greater effect of revenues compared to cost on profit efficiency scores explains the differences.

⁹⁴ Kader et al. (2010) find CE of 0.70 for Takaful non-life insurers; Hardwick et al. (2007) find CE of 0.66 for UK non-life insurance market while Wang et al. (2007) find 0.72 CE by for the non-life insurance market in Taiwan.

⁹⁵ The differences could be attributed to differences in sample period and sample size.

⁹⁶ This is lower than the 0.691 found by Hardwick et al. (2011) in the UK Life insurance market but similar to the 39.62% found by Gaganis et al. (2013) for 399 listed insurance firms in 52 countries.

⁹⁷ As at the end of 2012, approximately 33% of investments of short-term insurers were in Shares and stocks.

⁹⁸ This was obtained from a correlation analysis. A correlation coefficient of 0.2654 was insignificant.

Table 5.2: Evolution of Efficiency

Years	Cost Efficiency		Profit Efficiency	
	Mean	Std. Dev	Mean	Std. Dev
2007	0.8241	0.074	0.5847	0.223
2008	0.8194	0.079	0.5432	0.207
2009	0.8095	0.084	0.494	0.209
2010	0.7969	0.09	0.4324	0.207
2011	0.7884	0.094	0.3935	0.187
2012	0.7749	0.099	0.3365	0.178
Average	0.8008	0.089	0.4571	0.217

Note: Estimations from Research Data; See Appendix 5B for the parameter estimates of the SFA model

Due to the high variations in the size of the sample, efficiency differences between large and small insurers are also analysed. The results of the profit and cost efficiency scores across small and large insurers are presented in Table 5.3. A high cost and profit efficiency scores are observed for small insurers compared with large insurers. The t-test of mean differences suggests significant differences in cost efficiency of small and large insurers at 1%. The relatively high cost inefficiency for large insurers reflects the over-utilization of their scale of operations, which results in increased cost and low profits. The relative high cost efficiency among small insurers could be attributed to the ease of monitoring and controlling small business operation which maximizes resources usage. This suggests that mergers and consolidation which results in the increases in firm size may not be efficiency-enhancing.

Table 5.3: Efficiency scores and insurer size

	Small (N=214)	Large (N= 215)	Mead Diff	t-test	p-value
Cost Efficiency	0.8252	0.7765	0.0486	5.8757	0.0000***
Profit Efficiency	0.4681	0.4462	0.0219	1.0424	0.2978

Note: Small=Small Short-term insurers, Large=Large Short-term insurers; the t-test was conducted under an unequal variance assumption. $H_0 = \text{Mean (small)} - \text{Mean (large)} = 0$, $H_1 = \text{Mean (small)} - \text{Mean (large)} \neq 0$. The number of observations small insurers profit efficiency is 211. *** denotes significant differences at 1%

The annual estimates of the H -statistics⁹⁹ over the study period are also presented in Table 5.4. Across all periods,¹⁰⁰ the H -statistics (under the two specifications of the insurance revenue in premium revenue, $hs-pr$ and total revenue, $hs-tr$) lies between 0 and 1 and significantly different from 0 and 1. This indicates that short-term insurers

⁹⁹ The estimation results are attached as Appendix 5E.

¹⁰⁰ The only exception was in 2011 were the hypothesis of monopoly was not rejected under the premium income.

earn revenues under conditions of monopolistic competition. As a continuous measure of competition, the smaller values estimated H -statistics (closer to 0 than 1) suggest that the competitive pressures in the market are not very strong. On the evolution of competition, a relatively stronger competitive pressure is observed in 2008 under both forms of insurance revenue. A decline in competitive pressures is also observed after 2008 till 2011, after which competitive conditions increases in 2012.

Table 5.4: Evolution of Competitive Behaviour

years	Premium Revenue ($hs-pr$)			Total Revenue ($hs-tr$)			N
	H-stat	H=0:	H=1:	H-stat	H=0:	H=1:	
2007	0.3548	3.16*	10.45***	0.2907	3.08*	18.31*	57
2008	0.4753	9.17***	11.18***	0.4586	10.81***	15.06***	75
2009	0.4349	7.8***	13.17***	0.4052	8.86***	19.10****	75
2010	0.3538	6.67**	22.27***	0.3436	7.67***	27.97***	78
2011	0.2480	2.67	24.58***	0.2551	3.39*	28394***	79
2012	0.4285	7.47***	13.3***	0.4189	8.70***	16.75***	77

Note: MC and MP denotes monopolistic competitive and monopolistic markets respectively; H=0 and H=1 tests the null hypothesis that H-statistics is significant different from 0 and 1 respectively; N=number of cross-sectional observations; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$. Refer to Appendix 5C for parameter estimates of the Panzar-Rosse (1987) model estimations;

Before examining the effect of competition on efficiency, a test for the presence of strong collinearity among the independent variables using the Pearson correlation matrix is undertaken. From the estimated correlation coefficients, all the correlation coefficients are found to be lower than the threshold of 0.70 which reflects the presence of multicollinearity (Kennedy, 2008). However, the two proxies of competition, $hs-pr$ and $hs-tr$, have a correlation coefficient of 0.944. Hence, the two proxies of competition are introduced into the regression model in a stepwise manner to avoid the possibility of multicollinearity biases. The Pearson correlations matrix is presented in Table 5.5.

Table 5.5: Correlation Matrix

	<i>hs-pr</i>	<i>hs-tr</i>	<i>pdiv</i>	<i>size</i>	<i>age</i>	<i>cr</i>	<i>rein</i>	<i>lev</i>
<i>hs-pr</i>	1.000							
<i>hs-tr</i>	0.944***	1.000						
<i>pdiv</i>	0.016	0.013	1.000					
<i>size</i>	-0.043	-0.030	0.283***	1.000				
<i>age</i>	-0.013	-0.012	0.264***	0.513***	1.000			
<i>cr</i>	0.012	0.005	-0.021	0.040	0.030	1.000		
<i>rein</i>	-0.025	-0.009	0.178***	-0.114**	0.080	-0.065	1.000	
<i>lev</i>	0.004	-0.013	0.292***	0.222***	0.056	-0.028	0.091*	1.000

Note: *hs-pr* is the H statistics based on premium revenue as dependent variable, *hs-tr* is the H statistics based on Total revenue as dependent variable, *size*=ln (Total Assets), *pdiv*= 1- Herfindahl index for product line diversification; *age*= ln (The number of years in operation), *cr*= incurred claims to premiums ratio; *reins*=ratio of reinsurance ceded to gross premiums, *lev*=ratio of liabilities to equity. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

5.4.1 Regression Results

Presented in Table 5.6 are the panel regression results on the relationship between efficiency and competition. The proxies for insurance market competition are the Panzar and Rosse (1987) H-statistics for premium revenue (*hs-pr*) and total revenue (*hs-tr*). Based on the Hausman (1978) specification test, the models were estimated using the fixed effects technique. The dependent variable in Models 1 and 2 is cost efficiency while Models 3 and 4 have profit efficiency as the dependent variable. All estimations are heteroskedastic and autocorrelated consistent.

In Models 1 and 2, the coefficients of competition, *hs-pr* and *hs-tr* are positive and significant at 1%. This indicates that competition leads to improvements in cost efficiency. This supports the 'quiet-life' hypothesis which suggests that competitive pressures motivate managers to perform closer to the efficient frontier and consistent with the findings of Fenn et al. (2008). The relationship between profit efficiency and competition is also positive and significant at 1% in Models 3 and 4. This indicates that competitive pressures improve profit earning potential of short-term insurers in South Africa. Hence, the market power hypothesis, which posits that concentration improves profit efficiency is rejected.¹⁰¹ In a comparison of the coefficients of the competition under the cost and profit efficiency Models, higher coefficients are observed in the profit models compared with the cost models. This suggests that improving industry

¹⁰¹ The improved cost efficiency in competitive markets leads to increased market share for efficient firms. Hence, high sales revenue results in increased profit efficiency. This is in line with the efficient structure hypothesis of Demsetz (1973).

competitiveness would be more beneficial in improving on the high profit inefficiencies in the market.

On the control variables, firm size is negatively related to cost efficiency at 1% across all estimations. This suggests that large insurers have high cost inefficiency and reflects the monitoring difficulties and resources duplication which characterizes large operations. A negative relationship between size and profit efficiency at 1% in Models 3 and 4 also reflects the existence of diseconomies of scale for large insurers in the short-term insurance market. These findings support the earlier observations in Table 5.3.

Age of insurers is also negatively related to both cost and profit efficiency at 1%. This implies older insurers have high cost and profit inefficiency. Underwriting risk proxied as the claims ratio (CR) is positively related to cost and profit efficiency at significance levels of 1%. This indicates that high risk insurers are more cost and profit efficient. This result from additional cost incurred to underwrite low risk insurance pools (low claims ratio). The cost involves investments to improve underwriting practices and monitoring activities, resulting in increased production cost and lower profit margin.

Leverage is also positively related to both cost and profit efficiency. The relationship is only significant with profit efficiency at 10% in Model 4. This indicates that high leverage leads to higher profit efficiency, *ceteris paribus*. This result confirms the over-utilization of equity capital as an input by insurers (Cummins and Nini, 2002). Luhn (2009) and Kasman and Turgutlu (2009) find similar results in the German property and liability and Turkish insurance market respectively. However, no evidence is found in support of either the conglomeration or the strategic focus hypotheses in respect of the short-term insurance market. The relationship between reinsurance usage and efficiency was also found to be insignificant.

Table 5.6: Fixed Effects Results

	Cost Efficiency				Profit Efficiency			
	Model 1		Model 2		Model 3		Model 4	
	Coef.	<i>t</i>	Coef.	<i>t</i>	Coef.	<i>t</i>	Coef.	<i>t</i>
Constant	1.051*** (0.063)	16.61	1.080*** (0.065)	16.51	1.873*** (0.237)	7.9	2.011*** (0.244)	8.25
<i>hs-pr</i>	0.040*** (0.005)	8.02			0.190*** (0.025)	7.68		
<i>hs-tr</i>			0.014*** (0.003)	4.76			0.064*** (0.015)	4.29
<i>pdiv</i>	0.005 (0.014)	0.38	0.006 (0.015)	0.44	0.048 (0.059)	0.81	0.053 (0.060)	0.89
<i>size</i>	-0.016*** (0.006)	-2.73	-0.016*** (-2.73)	-2.73	-0.087*** (0.02)	-4.31	-0.090*** (0.021)	-4.24
<i>age</i>	-0.030*** (0.008)	-3.94	-0.031*** (0.008)	-4.01	-0.168*** (0.028)	-5.96	-0.176*** (0.03)	-5.92
<i>cr</i>	0.0002*** (1E-04)	4.49	0.00024*** (6E-05)	4.25	0.002*** (2E-04)	6.81	0.0016*** (3E-04)	6.28
<i>reins</i>	-0.006 (0.004)	-1.28	-0.00606 (0.004)	-1.38	0.004 (0.018)	0.22	0.0014 (0.019)	0.08
<i>lev</i>	0.0002 (0.0002)	1.02	0.00026 (0.00026)	0.99	0.003* (0.001)	1.94	0.0026* (0.0015)	1.78
F(7,74)	31.13***		21.85***		48.89***		32.26***	
R-squared	0.4277		0.4068		0.5592		0.5375	
Hausman χ^2	437***		513***		287.67***		380.67***	
Insurers	75		75		74		74	
Observations	394		394		392		392	

Note: *hs-pr* is the H statistics based on premium revenue as dependent variable, *hs-tr* is the H statistics based on Total revenue as dependent variable, *pdiv*= 1- Herfindahl index for product line diversification; *size*=ln (Total Assets); *age*= ln (The number of years in operation); *cr*= incurred claims to earned premiums ratio; *reins*=ratio of reinsurance ceded to gross premiums, *lev*=ratio of liabilities to equity. Figures in parentheses are heteroskedastic and autocorrelated consistent standard errors. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

5.5 Conclusions and Policy Recommendations

Empirical studies on the efficiency of financial institutions in Africa have mainly been limited to banking markets. In this chapter, the thesis extends the existing literature by empirically examining the effect of competition on cost and profit efficiency in the short-term insurance market in South Africa. The stochastic frontier analysis is employed to estimate cost and profit efficiency of 75 short-term insurers from 2007 to 2012. Insurance market competition is analyzed by cross sectional estimations of the Panzar-Rose (1987) revenue model. The findings indicate high levels of efficiency in cost and low levels in profit. On the average, costs are about 20% over the estimated cost frontier while insurers earn 45.71% of their optimum profits. The results of ordinary least square estimations of the P-R models indicate a monopolistic competitive short-term insurance industry.

In the third stage analysis, fixed effects multiple regression analysis to examine the effect of competition and other contextual variables on cost and profit efficiency is employed. A positive effect of competition on cost efficiency is found to support the 'quiet-life' hypothesis of Hicks (1935) which suggests that competitive insurance markets leads to improvements in cost efficiency. The positive relationship between competition and profit efficiency also indicates that competition improves profit efficiency to invalidate the market power hypothesis. The findings also suggest that small insurers are more efficient in controlling cost and maximizing profits compared to large insurers. This reflects the monitoring and control difficulties associated with the management of large scale operations. Older insurers were also found to be less cost and profit efficient. Against expectation, the study finds increasing underwriting risk improves cost and profit efficiency. This result from cost incurred by insurers in reducing the risk associated with insurance pool. Short-term insurers were also found to over-utilize their equity from the positive effect of leverage on profit efficiency.

The findings of this study have implications for the regulation and management of insurance companies. To help reduce the high profit inefficiencies and maximize the earning potential of short-term insurers, regulatory authorities should seek to improve on the competitive conditions as a means of strengthening managerial efforts to

reduce wastages. For management of insurance companies, the effect of firm level characteristics on efficiency provides insights on the focal areas of their insurance operation that need improvements.

Future studies could also examine the reverse causality between competition and efficiency. From a methodological perspective, the one-step estimation of the inefficiency effects as proposed by Wang and Schmidt (2002) could be employed in future studies. As described earlier in this chapter, the attempts to employ the approach produced erratic results. The differences in the nature of business in both long-term and short-term markets imply that the findings of this study may not be applicable to the life market. Hence, similar analysis could also be undertaken for the long-term insurance market.

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Appendices

Appendix 5A: Summary Statistics of Control Variables of efficiency

Variables	Hypotheses	Measurement	Symbol	Mean	Std. dev
Diversification	Conglomeration	1- Herfindahl Index	<i>pdiv</i>	0.3756	0.2751
Size	Economies of Scale	Ln (Total Assets)	<i>size</i>	12.8652	1.60387
Age	Learning By Doing	Ln (Age)	<i>age</i>	2.5381	0.9391
Claims Ratio	Bad Luck	Claims/Premiums	<i>cr</i>	0.6692	2.7851
Reinsurance	Risk Diversification	Reinsurance/Premiums	<i>reins</i>	0.4426	0.4448
Leverage	Cash flow	Debt/Equity	<i>lev</i>	2.1518	4.4684

Source: Authors estimation from Research Data

Appendix 5B: Cost and Profit Efficiency Frontier Estimates

	<i>Parameters</i>	Cost Efficiency		Profit Efficiency	
		<i>Coef.</i>	<i>z</i>	<i>Coef.</i>	<i>z</i>
Constant	α_0	-17.701	-4.36***	135.433	6.1***
y1	α_1	0.011	0.07	-4.474	-5.09***
y2	α_2	1.719	10.15***	-0.376	-0.46
0.5y1y1	α_3	0.004	3.84***	0.034	5.62***
0.5y2y2	α_4	0.024	12.96***	-0.006	-0.73
y1y2	α_5	-0.040	-4.23***	-0.030	-0.57
wl	β_1	-0.389	-0.47	34.504	6.69***
wd	β_2	3.656	5.31***	3.788	1.32
0.5wlwl	β_3	-0.006	-0.07	0.078	0.14
0.5wdwd	β_4	0.039	2.83***	0.002	0.06
wlwd	β_5	0.381	3.47***	0.676	0.84
y1wl	γ_1	-0.882	-10.56***	-2.433	-5.25***
y1wd	γ_2	-0.293	-4.78***	-0.069	-0.33
y2wl	γ_3	1.002	12.92***	-0.480	-1.41
y2wd	γ_4	-0.009	-0.24	-0.218	-1.47
e	δ_1	0.633	9.01***	-1.864	-4.28***
e2	δ_2	0.008	2.96***	0.057	4.21***
y1e	δ_3	-0.008	-0.94	0.081	2.28**
y2e	δ_4	-0.035	-4.58***	0.000	0.00
wle	δ_5	0.204	8.14***	0.197	1.69*
wde	δ_6	0.050	2.55**	0.008	0.160
years	τ	0.006	3.13***	-0.031	-3.64***
Variance Parameters					
μ		-4.653	-	-23.227	-7.05***
σ_u		0.563	23.37***	2.606	99.05***
σ_v		0.030	6.64***	0.120	10.45***
λ		19.006	693.84***	21.761	752.84***
σ^2		0.318		6.807	
γ		0.997		0.998	
Test of Functional Form: H₀: Cobb-Douglas					
Wald χ^2		42.58		46.37	
Prob > χ^2		0.000		0.000	
Wald χ^2 (21)		243011.8		1633.77	
Prob > χ^2		0.000		0.000	
Log likelihood		565.128		-24.1989	
Insurers		80		80	
Observations		434		434	

*** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

Appendix 5C: Predicted Cost Efficiency scores using SFA Model

INSURERS	2007	2008	2009	2010	2011	2012
INSURER 1	0.8247	0.8141	0.8030	0.7913	0.7790	0.7661
INSURER 2	0.7773	0.7643	0.7507	0.7364	0.7215	0.7059
INSURER 3	0.7808	0.7680	0.7545	0.7404	0.7257	0.7103
INSURER 4	0.7553	0.7413	0.7266	0.7112	0.6952	0.6785
INSURER 5	0.8181	0.8071	0.7957	0.7836	0.7709	0.7576
INSURER 6	0.6398	0.6210	0.6014	0.5813	0.5606	0.5392
INSURER 7	0.8739	0.8661	0.8578	0.8491	0.8399	0.8301
INSURER 8	0.8176	0.8067	0.7952	0.7831	0.7704	-
INSURER 9	-	0.7629	0.7492	0.7349	0.7199	0.7042
INSURER 10	-	-	0.9435	0.9399	0.9360	0.9319
INSURER 11	-	0.8412	0.8315	0.8214	0.8106	0.7994
INSURER 12	0.9034	0.8973	-	0.8840	0.8768	0.8692
INSURER 13	0.7897	0.7773	0.7643	0.7507	0.7364	0.7215
INSURER 14	-	0.8349	0.8249	0.8144	0.8033	0.7916
INSURER 15	-	-	0.8308	0.8206	0.8099	0.7986
INSURER 16	0.8113	0.8000	0.7882	0.7757	0.7627	0.7490
INSURER 17	0.7138	0.6979	0.6812	0.6640	0.6460	0.6274
INSURER 18	0.7364	0.7214	0.7058	0.6896	0.6726	0.6550
INSURER 19	0.8326	0.8225	-	0.8006	0.7888	0.7764
INSURER 20	0.9034	0.8973	0.8908	0.8840	0.8767	0.8691
INSURER 21	0.7922	0.7799	0.7670	0.7535	0.7394	0.7246
INSURER 22	0.9157	0.9104	0.9047	0.8987	0.8923	0.8856
INSURER 23	0.7421	0.7274	0.7121	0.6961	0.6794	0.6621
INSURER 24	0.8576	0.8489	0.8397	-	0.8197	0.8089
INSURER 25	0.7690	0.7555	0.7415	0.7268	0.7115	0.6954
INSURER 26	-	0.7792	0.7663	0.7527	0.7386	0.7238
INSURER 27	0.8067	0.7952	0.7831	0.7704	0.7571	0.7431
INSURER 28	-	0.8737	0.8659	0.8576	0.8489	0.8397
INSURER 29	0.8584	0.8496	0.8404	0.8307	0.8205	0.8098
INSURER 30	0.9640	0.9616	0.9591	0.9565	0.9536	0.9506
INSURER 31	0.9193	0.9141	0.9087	0.9029	0.8968	0.8903
INSURER 32	0.8643	0.8559	0.8470	0.8377	0.8278	0.8175
INSURER 33	0.7773	0.7643	0.7507	0.7365	0.7215	0.7060
INSURER 34	0.8338	0.8237	-	0.8019	0.7902	0.7779
INSURER 35	0.8074	0.7959	0.7838	0.7712	0.7579	0.7440
INSURER 36	0.9610	0.9585	0.9558	0.9529	0.9499	0.9466
INSURER 37	0.9643	0.9620	0.9595	0.9569	0.9541	0.9511
INSURER 38	0.7740	0.7609	0.7471	0.7326	0.7176	0.7018
INSURER 39	-	-	0.7911	0.7788	0.7660	0.7524
INSURER 40	0.7872	0.7747	0.7616	0.7478	-	0.7184
INSURER 41	0.8145	0.8034	0.7917	0.7794	0.7666	0.7531
INSURER 42	0.6698	0.6521	0.6336	0.6146	0.5948	0.5745
INSURER 43	0.7177	0.7019	0.6855	0.6684	0.6506	0.6321
INSURER 44	0.7831	0.7704	0.7570	0.7431	0.7285	0.7132

INSURERS	2007	2008	2009	2010	2011	2012
INSURER 45	0.9374	0.9334	0.9291	0.9246	0.9198	-
INSURER 46	-	-	-	0.6253	0.6060	0.5860
INSURER 47	0.7716	0.7583	0.7444	0.7298	0.7146	0.6987
INSURER 48	0.9203	0.9152	0.9098	0.9041	0.8981	0.8917
INSURER 49	0.7783	0.7654	0.7518	0.7376	0.7227	0.7072
INSURER 50	0.7620	0.7483	0.7339	0.7189	0.7032	0.6868
INSURER 51	0.7836	0.7709	0.7576	0.7437	0.7291	.
INSURER 52	0.9070	0.9011	0.8949	0.8883	0.8813	0.8739
INSURER 53	-	0.7955	0.7834	0.7707	0.7574	0.7435
INSURER 54	-	0.9479	0.9445	0.9410	0.9372	0.9332
INSURER 55	-	0.8512	0.8421	0.8325	0.8224	0.8117
INSURER 56	-	-	-	-	0.9293	0.9248
INSURER 57	-	0.7202	0.7046	0.6882	0.6712	0.6536
INSURER 58	-	0.9317	0.9273	0.9227	0.9177	0.9125
INSURER 59	-	0.6568	0.6386	0.6197	0.6001	0.5800
INSURER 60	0.8310	0.8207	0.8100	0.7986	0.7867	0.7742
INSURER 61	0.9210	0.9160	0.9107	0.9050	0.8990	0.8927
INSURER 62	0.8425	0.8329	0.8228	0.8122	0.8009	0.7892
INSURER 63	-	0.9191	0.9139	0.9085	0.9027	0.8966
INSURER 64	0.7825	0.7697	0.7564	0.7424	0.7277	0.7124
INSURER 65	-	-	-	-	0.7975	0.7856
INSURER 66	-	0.7913	0.7790	0.7661	0.7526	0.7385
INSURER 67	0.9371	0.9330	0.9287	0.9242	0.9194	0.9142
INSURER 68	0.8038	0.7921	0.7799	0.7670	0.7535	0.7394
INSURER 69	-	0.7913	0.7790	0.7661	0.7526	0.7384
INSURER 70	-	0.9000	0.8937	0.8870	0.8800	0.8725
INSURER 71	0.7607	0.7469	0.7325	0.7174	0.7016	0.6851
INSURER 72	0.8417	0.8320	0.8219	0.8112	0.7999	0.7881
INSURER 73	-	0.9666	0.9645	0.9622	0.9597	0.9571
INSURER 74	0.8852	0.8781	0.8705	0.8624	0.8540	0.8450
INSURER 75	0.8558	0.8469	0.8376	0.8277	0.8173	0.8064
INSURER 76	-	0.8232	0.8125	0.8013	0.7896	0.7772
INSURER 77	-	0.9188	0.9136	0.9081	0.9023	0.8962
INSURER 78	-	0.8415	0.8319	0.8217	0.8110	0.7998
INSURER 79	-	0.7382	0.7233	0.7078	0.6917	0.6748
INSURER 80	-	-	-	-	-	-

Appendix 5D: Predicted Profit Efficiency scores using SFA Model

INSURERS	2007	2008	2009	2010	2011	2012
INSURER 1	0.6026	0.5375	0.4696	0.4013	0.3354	0.2744
INSURER 2	0.7346	0.6842	0.6285	0.5687	0.5061	0.4429
INSURER 3	0.5262	0.4554	0.3840	0.3152	0.2519	0.1964
INSURER 4	0.2861	0.2138	0.1510	0.1004	0.0630	0.0375
INSURER 5	0.3377	0.2630	0.1955	0.1384	0.0934	0.0605
INSURER 6	0.0414	0.0187	0.0070	0.0021	0.0005	0.0001
INSURER 7	0.7882	0.7455	0.6972	0.6438	0.5862	0.5258
INSURER 8	0.5870	0.5225	0.4562	0.3904	0.3276	-
INSURER 9	-	0.2370	0.1720	0.1184	0.0774	0.0485
INSURER 10	-	-	0.7311	0.6817	0.6275	0.5698
INSURER 11	-	0.6770	0.6206	0.5602	0.4974	0.4341
INSURER 12	0.7681	0.7225	-	0.6156	0.5561	0.4947
INSURER 13	0.5284	0.4577	0.3864	0.3175	0.2541	0.1985
INSURER 14	-	0.4955	0.4257	0.3570	0.2923	0.2340
INSURER 15	-	-	0.6970	0.6437	0.5863	0.5262
INSURER 16	0.6705	0.6122	0.5496	0.4844	0.4188	0.3553
INSURER 17	0.1487	0.0938	0.0536	0.0274	0.0124	0.0050
INSURER 18	0.7042	0.6498	0.5906	0.5279	0.4635	0.3998
INSURER 19	0.4842	0.4117	-	0.2732	0.2133	0.1624
INSURER 20	0.7118	0.6585	0.6001	0.5380	0.4741	0.4104
INSURER 21	0.4102	0.3349	0.2636	0.1998	0.1459	0.1032
INSURER 22	0.7526	0.7046	0.6512	0.5933	0.5322	0.4696
INSURER 23	0.1234	0.0741	0.0398	0.0188	0.0077	0.0027
INSURER 24	0.6859	0.6298	0.5692	-	0.4414	0.3784
INSURER 25	0.5806	0.5136	0.4444	0.3756	0.3102	0.2505
INSURER 26	-	0.5623	0.4961	0.4288	0.3629	0.3010
INSURER 27	0.7022	0.6476	0.5882	0.5253	0.4609	0.3971
INSURER 28	-	0.6690	0.6118	0.5507	0.4875	0.4241
INSURER 29	0.7491	0.7006	0.6468	0.5884	0.5270	0.4643
INSURER 30	0.4687	0.3949	0.3227	0.2555	0.1961	0.1464
INSURER 31	0.8020	0.7615	0.7153	0.6639	0.6080	0.5488
INSURER 32	0.5902	0.5240	0.4553	0.3867	0.3210	0.2607
INSURER 33	0.5878	0.5214	0.4527	0.3840	0.3184	0.2582
INSURER 34	0.7272	0.6760	-	0.5593	0.4967	0.4336
INSURER 35	0.0160	0.0060	0.0019	0.0005	-	-
INSURER 36	0.7594	0.7124	0.6599	0.6028	0.5422	0.4800
INSURER 37	0.7887	0.7461	0.6979	0.6445	0.5870	0.5266
INSURER 38	0.7295	0.6785	0.6222	0.5618	0.4989	0.4355
INSURER 39	-	-	0.7822	0.7394	0.6914	0.6387
INSURER 40	0.0764	0.0410	0.0192	0.0078	-	0.0008
INSURER 41	0.2294	0.1619	0.1066	0.0650	0.0367	0.0193
INSURER 42	0.7680	0.7223	0.6710	0.6149	0.5552	0.4934
INSURER 43	0.6017	0.5365	0.4686	0.4003	0.3343	0.2734
INSURER 44	0.7639	0.7175	0.6657	0.6091	0.5489	0.4869

INSURERS	2007	2008	2009	2010	2011	2012
INSURER 45	0.6782	0.6219	0.5616	0.4989	0.4357	-
INSURER 46	-	-	-	0.0035	0.0009	0.0002
INSURER 47	0.6146	0.5506	0.4834	0.4155	0.3494	0.2878
INSURER 48	0.7478	0.6992	0.6452	0.5867	0.5252	0.4624
INSURER 49	0.7222	0.6701	0.6129	0.5518	0.4885	0.4249
INSURER 50	0.5412	0.4713	0.4004	0.3314	0.2674	0.2106
INSURER 51	0.4333	0.3617	0.2935	0.2317	0.1785	-
INSURER 52	0.7858	0.7427	0.6941	0.6403	0.5824	0.5219
INSURER 53	-	0.6031	0.5399	0.4744	0.4088	0.3456
INSURER 54	-	0.8180	0.7803	0.7371	0.6888	0.6358
INSURER 55	-	0.4474	0.3761	0.3077	0.2451	0.1906
INSURER 56	-	-	-	-	0.5854	0.5259
INSURER 57	-	0.4923	0.4224	0.3537	0.2891	0.2311
INSURER 58	-	0.6740	0.6173	0.5567	0.4937	0.4304
INSURER 59	-	0.4498	0.3786	0.3101	0.2474	0.1926
INSURER 60	0.6773	0.6198	0.5578	0.4930	0.4276	0.3640
INSURER 61	0.8009	0.7602	0.7139	0.6623	0.6062	0.5470
INSURER 62	0.6909	0.6349	0.5743	0.5105	0.4456	0.3819
INSURER 63	-	0.6917	0.6370	0.5779	0.5160	0.4531
INSURER 64	0.1496	0.0945	0.0541	0.0277	0.0126	0.0051
INSURER 65	-	-	-	-	0.4807	0.4187
INSURER 66	-	0.7050	0.6517	0.5939	0.5329	0.4705
INSURER 67	0.7890	0.7464	0.6983	0.6450	0.5875	0.5271
INSURER 68	0.7541	0.7064	0.6532	0.5955	0.5345	0.4720
INSURER 69	-	0.3644	0.2927	0.2273	0.1707	0.1247
INSURER 70	-	0.7149	0.6628	0.6060	0.5457	0.4837
INSURER 71	0.6999	0.6450	0.5853	0.5223	0.4577	0.3940
INSURER 72	0.5511	0.4832	0.4143	0.3471	-	0.2284
INSURER 73	-	0.7288	0.6784	0.6231	0.5640	0.5027
INSURER 74	0.7507	0.7025	0.6489	0.5908	0.5295	0.4668
INSURER 75	0.7698	0.7243	0.6733	0.6174	0.5578	0.4962
INSURER 76	-	0.6480	0.5887	0.5260	0.4617	0.3982
INSURER 77	-	0.6761	0.6197	0.5592	0.4963	0.4331
INSURER 78	-	0.6219	0.5602	0.4957	0.4306	0.3671
INSURER 79	-	0.2892	0.2202	0.1606	0.1123	0.0758
INSURER 80	-	-	-	-	-	-

Appendix 5E: Annual Estimates of Panzar-Rosse H-Statistics

Dependent Variables	2007		2008		2009		2010		2011		2012	
	PR	TREV	PR	TREV	PR	TREV	PR	TREV	PR	TREV	PR	TREV
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Constant	-1.632 (1.300)	-0.934 (1.079)	-2.970*** (1.001)	-2.213** (0.890)	-2.074** (0.984)	-1.375 (0.860)	-1.646* (0.873)	-1.273 (0.791)	-1.457 (0.890)	-1.104 (0.813)	-1.590 (0.955)	-1.236 (0.865)
PL	0.449** (0.170)	0.339** (0.141)	0.710*** (0.130)	0.613*** (0.115)	0.627*** (0.121)	0.529*** (0.106)	0.602*** (0.105)	0.542*** (0.096)	0.536*** (0.104)	0.495*** (0.095)	0.641*** (0.114)	0.589*** (0.103)
PD	-0.144* (0.083)	-0.089 (0.069)	-0.268*** (0.096)	-0.186** (0.085)	-0.252** (0.102)	-0.181** (0.089)	-0.305*** (0.088)	-0.249*** (0.08)	-0.404*** (0.108)	-0.338*** (0.099)	-0.260** (0.105)	-0.211** (0.095)
PK	0.050 (0.031)	0.041 (0.026)	0.034 (0.026)	0.031 (0.177)	0.060** (0.023)	0.057*** (0.02)	0.057** (0.024)	0.051** (0.022)	0.117*** (0.034)	0.098*** (0.031)	0.047 (0.031)	0.040 (0.028)
SIZE	1.112*** (0.119)	1.065*** (0.099)	1.237*** (0.090)	1.188*** (0.080)	1.179*** (0.085)	1.135*** (0.075)	1.129*** (0.075)	1.110*** (0.068)	1.113*** (0.075)	1.094*** (0.068)	1.139*** (0.081)	1.116*** (0.073)
EQT	-0.181 (0.142)	-0.138 (0.118)	-0.079 (0.123)	-0.078** (0.11)	-0.019 (0.140)	-0.003 (0.122)	0.023 (0.110)	0.033 (0.100)	0.268* (0.143)	0.240* (0.130)	0.047 (0.139)	0.028 (0.126)
RISK	0.075 (0.092)	0.069 (0.076)	0.098 (0.079)	0.078 (0.070)	0.088 (0.096)	0.105 (0.084)	0.079 (0.093)	0.088 (0.084)	0.078 (0.082)	0.071 (0.075)	0.166** (0.083)	0.134* (0.075)
H-Statistics	0.3548 ^{MC}	0.2907 ^{MC}	0.4753 ^{MC}	0.4586 ^{MC}	0.4349 ^{MC}	0.4052 ^{MC}	0.3538 ^{MC}	0.3436 ^{MC}	0.2480 ^{MP}	0.2551 ^{MC}	0.4285 ^{MC}	0.4189 ^{MC}
H=0: F	3.16	3.08	9.17	10.81	7.8	8.86	6.67	7.67	2.67	3.39	7.47	8.7
Prob > F	0.0815	0.0856	0.0035	0.0016	0.0068	0.004	0.0118	0.0072	0.1063	0.0695	0.0079	0.0043
H=1: F	10.45	18.31	11.18	15.06	13.17	19.1	22.27	27.97	24.58	28.94	13.3	16.75
Prob > F	0.0022	0.0001	0.0013	0.0002	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0001
F	51.7	74.44	64.58	78.33	53.86	68.7	57	69	55.23	64.47	49.76	58.47
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.8612	0.8993	0.8507	0.8736	0.8261	0.8584	0.8281	0.8536	0.8215	0.8431	0.8101	0.8337
Adj. R-squared	0.8445	0.8872	0.8375	0.8624	0.8108	0.8459	0.8136	0.8412	0.8066	0.83	0.7938	0.8194
Root MSE	0.66789	0.55467	0.65845	0.58541	0.67178	0.5871	0.64992	0.589	0.67907	0.6199	0.72406	0.65595
Observations	57	57	75	75	75	75	78	78	79	79	77	77

Note: PR=premium revenue, TREV=Total revenue, dependent variable; PL=Price of Labour, PD=Price of Debt, PK=Price of equity capital; Size=Natural logarithm of Total Assets; EQT=Ratio of total equity to total assets; RISK=Ratio of claims incurred to net earned premiums; MC and MP denotes monopolistic competitive and monopolistic markets respectively; Robust standard errors in parenthesis. *** p<0.01, ** p<0.05; * p<0.10

Chapter 6

Explaining Pricing Power in Insurance Markets¹⁰²

6.1 Background

Conventional wisdom suggests that financial services industries in developing economies are characterized by imperfect competition, due to high concentrations and market power. The existence and exercise of market power, as evidenced from both theoretical and empirical literatures,¹⁰³ has the potential to induce losses in social welfare and efficiency. Through the ability of firms to set prices above their marginal cost (Solis and Maudos, 2008), output production within concentrated markets fall reducing the satisfaction derived by society from the consumption of less volume of goods and service, hence losses in social welfare (Berger and Hannan, 1998). In addition, the exercise of market power can also increase managerial inefficiency, as posited by the so-called 'quiet-life' hypothesis of Hicks (1935) and allows firms to charge monopoly rents. The rent-seeking behaviour is reflected in pricing power and excessive risk-taking, which affects market stability.

In insurance markets, the existence of pricing¹⁰⁴ power could affect industry stability in two ways. First, the exercise of pricing power (in the form of higher premiums) results in selection bias, a situation where high risk individuals are self-selected into an insurance pool at the expense of low risk individuals. Second, the payment of high premiums by low risk policy holders is used to subsidize the low premiums paid by high risk policy holders, resulting in financial inequity. This increases portfolio risk and probability of losses and result in market failure (Rothschild and Stiglitz, 1976). Hence, the identification of the sources of pricing power in insurance markets is relevant to improve insurance coverage, promote consumer welfare and reduce riskiness of insurance portfolio to enhance market stability. From a policy perspective, studies on

¹⁰² An earlier draft of this chapter was presented at 12th African Finance Journal Conference, 20th- 21st May, 2015, Protea President Hotel, Cape Town, South Africa. It is under review in *Applied Economics journal*.

¹⁰³ See Hicks (1935), Berger and Hannan (1998), Rothschild and Stiglitz (1976)

¹⁰⁴ In the pricing of insurance policies, insurers set premiums to cover expected claims by policy holders as well as other incidental costs (such as loss adjustment, sales underwriting, etc.) associated with the operation of an insurance business (Refer to Myers and Cohn, 1986 in Berry-Stolzle and Born, 2012). However, the ability to price above these costs could be attributable to market conditions (hard and soft markets) as well other firm-specific behaviour. For the purposes of this study, the discussions are limited to firm characteristics that influence the pricing behaviour among short-term insurers.

pricing power (competitive conduct) in insurance markets are useful reference point in the design and implementation of competition policies.

With this in mind, this chapter has two main objectives. First, the study seeks to assess the level of pricing power in the short-term insurance market in South Africa. Second, it also attempts to identify the factors that drive the exercise of pricing power in the largest short-term insurance market in Africa. In order to achieve these objectives, annual firm level data on 79 short-term insurance companies from 2007 to 2012 is employed to estimate the Lerner (1934) index as the proxy for pricing power. The Lerner index evaluates the ability of firms to set prices taking into account their marginal cost of production. Firms that are able to charge prices above their marginal cost are described to exercise pricing power, hence operate under less competitive conditions. This study favours the use of the index over other non-structural measures of pricing behaviour in the Panzar-Rosse (1987) and Boone (2008) indicators for the following reasons. First, the Lerner index allows for the estimation of firm level pricing behaviour as opposed to industry level estimates from the Panzar-Rosse (1987) and Boone (2008) models. This enables the study to use firm level data to examine the sources of pricing power. Second, estimates from the Panzar-Rosse (1987) are only valid under the assumption of long-run equilibrium, which may be difficult to achieve in emerging markets (Simpasa, 2013). Third, the empirical application of Panzar-Rose model is characterized by debate on the correct specification¹⁰⁵ of the revenue model. Hence, the validity of the estimated competitive conduct from the P-R model becomes debateable.

In the second stage, the ordinary least squares (OLS), random effects (RE) and generalized method of moment's (GMM) estimation techniques are employed to estimate both static and dynamic panel data models to identify the sources of pricing power in the market. While the OLS and RE are employed in the estimation of the static models, the GMM helps in examining the persistence of pricing power with the inclusion of the lagged values of the Lerner index in a dynamic panel framework. The paper also performs two tests of robustness for the regression coefficients. First, the

¹⁰⁵See Bikker et al. (2012) for notes on the misspecification bias in the application of the P-R Model mainly related to the inclusion of a scaling variable in size (natural logarithm of total assets) in the revenue equation. Shaffer and Spierdijk (2013) further provide theoretical and empirical evidence to suggest that the Lerner index performs better at identifying uncompetitive behaviour compared to the Panzar-Rosse approach which could predict competitive conditions for concentrated markets.

regression models are estimated for sub-samples of domestic-owned and foreign-owned insurers. This enables us to identify the determinants of pricing power in the two sub-markets. In the second sensitivity analysis, the quantile regression technique is employed to test whether the effect of the explanatory variables is heterogeneous across different distributions of pricing power.

This chapter makes three significant contributions to the literature on insurance markets. First, the study appears to pioneer the empirical application of the Lerner index to estimate pricing power in an insurance market. Prior studies on insurance markets competition have relied on the use of the Panzar-Rose¹⁰⁶ H-statistics and Boone indicator¹⁰⁷ in addition to the structural indicators in the Herfindahl Hirschman index. These measures estimate competition at industry level and fail to capture individual firm level competitive behaviour. The application of Lerner index in the estimation of competitive behaviour addresses this shortcoming. The second contribution is the analysis on the determinants of pricing power. This is relevant to assist regulatory authorities in identifying the sources of pricing power and apply the appropriate measures to control pricing conduct. As far as this study is aware, such analysis is not available in the literature on emerging insurance markets in Africa.

Finally, the study also analyses the effect of the explanatory variables on pricing power using the quantile regression (henceforth QR) technique of Koenker and Bassett (1978). The technique is based on the assumption that a non-uniform relationship may exist between a set of independent variables and a dependent variable. This allows for an analysis on the heterogeneous effect of the explanatory variables across different distributions of pricing power. The classical least squares estimation techniques, which assume an average behaviour for a sample, perform poorly when the sample exhibit extreme deviations from the central tendency (Lee and Li, 2012).

The rest of the chapter is organised into six sections; Section 6.2 focuses on empirical studies in insurance markets; Section 6.3 outlines the empirical strategy; Section 6.4 discusses the empirical results while Section 6.5 concludes the study.

¹⁰⁶See studies on insurance markets by Murat et al. (2002) in Australia, Kasman and Turgutlu (2008) in Turkey and Coccoresse (2010, 2012) in Italy

¹⁰⁷ Bikker and Van Leuvensteijn (2008) and Cummins et al. (2014)

6.2 Literature Review

Studies on insurance pricing have received considerable attention in both empirical and theoretical literature. However, majority of these studies have focused on the effects of regulations on pricing in insurance markets (See Harrington, 1987; Cummins and Harrington, 1987; Grabowski et al., 1989; Cummins et al., 2001; Butler, 2002; Harrington, 2002; Grace and Phillips, 2008, Berry-Stolzle and Born, 2012). Little attention has been paid to the exercise of pricing power¹⁰⁸ in insurance markets.

The estimation of competition in financial services industries has been broadly categorized into structural and non-structural approaches. The class of structural measures of competition are premised on the structure-conduct-performance hypothesis of Mason (1939) and Bain (1951). These indicators infer competition from the structure of the market and equate market concentration to less competition. Various studies¹⁰⁹ on insurance markets have applied these indicators as proxy for competition to assess the effect of market structure on performance (i.e. profitability and efficiency).

The non-structural approaches, based on new empirical industrial organisation (henceforth NEIO) theory, assess competition through direct observation of firm conduct. They are made up of the conjectural variation of Bresnahan (1982) and Lau (1982); Panzar-Rosse (1987) reduced form revenue model; Lerner (1934) index and the Boone (2008) indicator. While these approaches have severally been applied to the banking markets (Claessens and Laeven, 2004; De Guevara and Maudos, 2007; Aboagye et al., 2008; Coccorese, 2009; Jeon et al., 2011; Biekpe, 2011; Delis, 2010; Delis, 2012; Fosu, 2013; Simpasa, 2013; Efthyvoulou and Yildirim, 2014; Mirzaei and Moore, 2014), the estimation of competition in insurance markets are limited to very few studies.

Early applications of the NEIO theory to insurance markets were largely limited to the use of the Panzar-Rosse (1987) H-statistics model. For instance, Murat et al. (2002) employ the Panzar-Rosse model on a cross-section of 48 general insurance companies in Australia. The authors find evidence to suggest that the market was

¹⁰⁸ In the financial services, the exercise of pricing power, which is the ability of firms to price their products above their marginal cost production, has generally been equated less competition. Hence, this review is approached from the standpoint of competition in insurance markets.

¹⁰⁹ See Hao and Chou (2005); Fenn et al. (2008) and Kasman and Turgutlu (2009)

characterized by monopolistic competition. This was followed by Kasman and Turgutlu (2008) who evaluated the evolving nature of competition across different time periods (1996 to 2004) in the short-term insurance market in Turkey. In estimating the H-statistics over three sub-periods, the authors conclude that the market was characterized by monopolistic pricing behaviour for the first two sub-periods (1996 to 1998 and 1999 to 2001). However, industry players were found to earn revenues as if they operated under monopolistic competitive conditions in the third sub-period from 2002 to 2004. Taking motivation from the fines imposed on firms in the motor market for collusion, Coccorese (2010) estimates the H-statistics for a data set from 1998 to 2013 to empirically assess competitive behaviour in Italy. The author finds evidence to support the existence of collusive pricing in the market. Using the same data set, Coccorese (2012) further examines the pricing behaviour of both fined and non-fined firms over the period. The author finds evidence to suggest that fined insurers earned their revenues under monopolistic conditions. In China, Jeng (2015) examines the evolution of competition in both the life and short-term insurance market from 2001 to 2009. The author finds evidence to indicate that short-term insurance companies earned revenues under monopolistic conditions while the revenue for life insurance firms were earned under monopolistic competitive conditions for the majority of the period.

However, recent estimates of insurance market competition have favoured the recently developed Boone (2008) indicator which is based on the performance-conduct-structure hypothesis. Based on the NEIO theory, the indicator suggests that competition reallocates profit from inefficient firms to efficient firms (Olley and Pakes, 1996; Stiroh, 2000; Cummins et al., 2014). For example, Bikker and van Leuvensteijn (2008), Bikker (2012), Bikker and Popescu (2014) and Cummins et al. (2014) have all employed the Boone (2008) indicator to examine the effect competition on various aspects of life insurance companies. In relation to this study, Cummins et al. (2014) analyse the relationship between efficiency, competition and solvency of life insurance companies in Europe.¹¹⁰ From the estimates of the Boone indicator, the authors observed a decline in competition over the period from 1999 to 2011. The authors also

¹¹⁰The countries are made up of Austria, Belgium, Denmark, Germany, Spain, France, UK, Italy, Netherlands and Sweden.

identify market size, stock market development, bond issues and GDP growth as the significant determinants of competition across the sample.

The above review reveals the scarcity of studies on competition in insurance markets. With the exception of Cummins et al. (2014), there is no evidence on the analysis of explanatory factors of pricing power (competition) in insurance markets. The study also identifies following gaps in relation to analysis on insurance market competition. First, to the best of the author's knowledge, no study has examined the competitiveness of insurance markets in emerging countries (Africa)¹¹¹ using the NEIO approach. Second, none of the prior studies have attempted to identify the sources of pricing power in insurance markets. Majority of the studies do not go beyond the assessment of the nature of competition to identify the determining factors. The estimates of the Lerner index as a proxy for pricing power enables the study to assess the relative mark-up of output price over marginal cost of underwriting insurance policies at the firm level. As far as this study is aware, this chapter presents the first application of the Lerner index to data on insurance markets. The summary of studies analysing competitiveness of insurance markets is attached in Appendix 6A.

6.3 Methodology

This section outlines the theoretical estimation of the pricing power, as well as the empirical approach in identifying the sources of pricing power in the short-term insurance market. The measurement and hypothesized effect of explanatory variables on pricing power are also discussed.

6.3.1 Estimation of Pricing Power: Lerner Index

In the estimation of the pricing power, this study follows the new empirical industrial organisation class of non-structural measures of competition and adopts the Lerner index. The index measures market power at the firm level and captures a firm's ability to set prices above marginal costs. This indicator also captures individual firm pricing power over time. A higher value of the Lerner index (closer to 1) reflects greater pricing power (and less competition) and vice versa. By definition, the value of the index can increase either through a rise in output prices or fall in marginal cost, all other things

¹¹¹ In South Africa, Theron (2001) applied the SCP hypothesis to examine the effect of the merger between Santam and GNI on competition in the short-term insurance market.

being equal. The equation for estimating the Lerner index¹¹² as adopted from De Guevara et al. (2005), Berger et al. (2009) and Turk-Ariss (2010) is given as:

$$li_{i,t} = \frac{p_{i,t} - mc_{i,t}}{p_{i,t}} \dots \dots \dots 26$$

where $p_{i,t}$ is the output price¹¹³ set by an insurer i at time t and $mc_{i,t}$ is insurer i 's marginal cost at time t . Consistent with estimates of the index in banking markets, we employ total assets as an aggregated insurance output.¹¹⁴ In line with Turk-Ariss (2010), output price is measured as the ratio of total revenue (net earned premiums and investment income) to total assets. To obtain the $mc_{i,t}$, the translog cost function in equation 27 is estimated;

$$\begin{aligned} \ln\left(\frac{tc}{w_3}\right)_{i,t} &= \alpha_0 + \alpha_1 \ln y_{i,t} + 0.5\alpha_2 \ln y_{i,t}^2 + \beta_1 \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \beta_2 \ln\left(\frac{w_2}{w_3}\right)_{i,t} \\ &+ 0.5\beta_3 \ln\left(\frac{w_1}{w_3}\right)_{i,t}^2 + 0.5\beta_4 \ln\left(\frac{w_2}{w_3}\right)_{i,t}^2 + \gamma_1 \ln y_{i,t} \ln\left(\frac{w_1}{w_3}\right)_{i,t} \\ &+ \gamma_2 \ln y_{i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \delta_1 trend_t + \delta_2 trend_t^2 + \delta_3 trend_t \ln y_{i,t} \\ &+ \delta_4 trend_t \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \delta_5 trend_t \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \varepsilon_{i,t} \dots \dots \dots 27 \end{aligned}$$

where subscripts i and t represents insurer and time respectively, tc is insurers total cost, y represents insurance outputs in total assets, w_1 the price of labour, w_2 the price of equity capital and w_3 the price debt. The study imposes homogeneity conditions by normalizing tc , w_1 and w_2 by w_3 to correct for scale and heteroskedasticity biases (Turk-Ariss, 2010). The study follows Turk-Ariss (2010) and several others and take the first derivative of the estimated cost function in equation 27 with respect to output to generate the marginal cost as specified in equation 28:

$$mc_{i,t} = \frac{\partial tc_{i,t}}{\partial y_{i,t}} = \frac{tc_{i,t}}{y_{i,t}} \left[\alpha_1 + \alpha_2 \ln y_{i,t} + \gamma_1 \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \gamma_2 \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \gamma_3 trend_t \right] \dots \dots \dots 28$$

¹¹² The definition of the index given in equation 26 is commonly referred to as the conventional Lerner index. The efficiency-adjusted Lerner index is gaining currency in the banking market. Refer to Maudos and De Guevara (2007) for notes on the efficiency-adjusted Lerner index.

¹¹³ Traditionally, the most widely used proxy for insurance price is the inverse of the loss ratio, which is defined as the ratio of incurred losses to earned premiums. However, for the purposes of this study, we follow prior application of the Lerner index in banking markets and employ the ratio of total insurance revenue to total assets as our measure of insurance output price.

¹¹⁴ Due to data limitations, this study is unable to generate separate prices for both premiums and claims.

In convention with the insurance literature, the study defines three main inputs of short-term insurers in labour and business services, debt and equity capital to generate their outputs. The price of labour, w_1 is defined as the ratio of management expenses and commissions paid to total assets. The price of equity capital w_2 is proxied as the ratio of net income to equity capital. In order to account for the possibility of negative profits, a constant is added to price of equity to allow for logarithmic transformation. The price of debt capital (w_3) is defined as the ratio of investment income to total reserves (unearned premiums and outstanding claims). The summary statistics of the untransformed variables used in the estimation of marginal cost are presented in Table 6.1.

Table 6.1: Summary of Cost, Output and Input Prices

	Mean	Std. Dev	Min	Max	N
Cost (tc)	550,791	452,077	264,868	1,683,939	436
Output					
Total assets (y)	1,269,660	2,371,393	7,347	1.64e+07	441
Input Prices					
Price of labour (w_1)	0.1456	0.2138	0.2129	1.8817	441
Price of equity capital (w_2)	0.1738	0.335	-3.2481	1.2446	441
Price of debt capital (w_3)	0.3295	1.2163	0.0962	19.5421	434

Note: All Monetary values are in Thousands of South African Rand

6.3.2 Regression model: Determinants of pricing power

In examining the drivers of pricing power (pp), the estimated Lerner index is expressed as a function of firm and industry level variables in a panel regression model. The model on the determinants of pricing power in the short-term insurance market as adapted from De Guevara et al. (2005) and Cummins et al. (2014) is expressed in equations 29 and 30 as;

$$pp_{i,t} = \alpha_i + \beta_1 size_{i,t} + \beta_2 cef_{i,t} + \beta_3 bldiv_{i,t} + \beta_4 mc_t + \beta_5 lev_{i,t} + \beta_6 reins_{i,t} + \beta_7 fown_t + \mu_t + \epsilon_{i,t} \dots \dots \dots 29$$

$$pp_{i,t} = \alpha_i + \beta_1 pp_{i,t-1} + \beta_2 size_{i,t} + \beta_3 cef_{i,t} + \beta_4 bldiv_{i,t} + \beta_5 mc_t + \beta_6 lev_{i,t} + \beta_7 reins_{i,t} + \beta_8 fown_t + \mu_t + \epsilon_{i,t} \dots \dots \dots 30$$

where $pp_{i,t}$ is pricing power proxied by the estimated Lerner Index for insurer i in period t ; $pp_{i,t-1}$ is the pricing power for firm i in period $t - 1$; $size_{i,t}$ is the natural logarithm of total assets. Firm size affects pricing behaviour in two ways. First, large

firms are expected to benefit of economies of scale in cost reductions. This cost savings could be passed onto consumers in the form of lower prices, hence large insurers may exercise low pricing power. On the other hand, the monitoring difficulties associated with large scale operations may result in resource duplication and increased cost of production. Such firms may tend to exercise pricing power by passing on increased production cost to consumers. Hence the effect of size on pricing power is ambiguous. $ceff_{i,t}$ is cost efficiency of estimated from translog cost function in equation 28. Through managerial efficiency, firms will still be able to maximize profit by producing at low cost and reduce prices to generate higher sales margin. This underpins the efficient structure hypothesis of Demsetz (1973). Hence, efficiency is expected to result in reduced pricing power. $bldiv_{i,t}$ is the diversification of income across business lines. As insurers diversify across multiple business lines, they are able to benefit from economies of scope in lower per unit cost of production and prices. Hence, the study expects highly diversified insurers to exercise lower mark-up prices and pricing power. As a concentration measure, a higher value of the index reflects premium concentration in few business lines and vice versa. By Taking index value from 1, the index is transformed into a diversification measure. Hence, higher values would reflect a higher level of business line diversification¹¹⁵ which indicates that premiums are generated across a wider range of business lines. Fully specialized and focused insurers have a value of zero. mc_t is the market concentration indicators made up of hhi_t , the Herfindahl Hirschman index for premium concentration and $cr5_t$ which represents the five-firm concentration index. The effect of this variable on pricing power is explained by the structure-conduct-performance hypothesis of Mason (1939) and Bain (1951). The theory argues that market concentration induces collusive behaviour among firms with market power to charge high prices. Hence, the study expects a positive effect of this variable on pricing power. $lev_{i,t}$ is insurance leverage, measured as the ratio of insurers liabilities made up of unearned premiums and provisions of incurred losses to total assets, increases the cost of financial distress due to default risk. The resulting high cost of funding could be transferred to policy holders in the form of high pricing. Leverage is therefore expected to increase the

¹¹⁵ This study measures business line diversification using the Herfindahl Hirschman index of premium concentration in business lines described below; $bldiv = \sum_{i=1}^8 \left(\frac{GWP_{i,t}}{GIWP_t} \right)^2$; where GWP_i is the premium written in business line i at time t and $GIWP_t$ is the gross premiums written for insurer at time t .

exercise of pricing power. $reins_{i,t}$ is the ratio of reinsurance premiums ceded to gross premiums written, enhances underwriting capacity, stabilizes loss experience and limits the effect of catastrophic events on primary insurers. This suggests that reinsurance affects the cost structure of insurers by altering the claim distribution. As a risk management tool for primary insurers, the usage of reinsurance reduces the cost in claims payable to policyholders. Hence, the study expects insurers that have high usage of reinsurance contracts to exercise less pricing power due to lower potential claim cost. $fown_t$ is a dummy for ownership type, defined as one (1) for foreign-owned insurers and zero (0) otherwise. The study defines domestic-owned insurers as firms with majority ownership (more than 50%) in the hands of the South African nationals while foreign-owned insurers have more than 50% of ownership in the hands of foreign nationals. In theory, the presence of foreign firms in local markets affects competitive conduct through the 'direct-effect' channel. In terms of pricing, foreign firms are known to offer competitive pricing in an aggressive manner to overcome their information challenges in local markets and increase market share (Goldberg, 2004 in Chelo and Manlagñit, 2011). Hence, it is expected that foreign-owned insurers will exercise less pricing power compared with domestic-owned insurers. $\varepsilon_{i,t}$ is the two-sided error terms. The summary statistics of the independent variables¹¹⁶ are presented in Table 6.2.

Table 6.2: Correlates of pricing power

Variables	Mean	Median	Std. Dev.	Min	Max	N
<i>size</i>	12.8652	12.7654	1.6039	8.9020	16.6153	441
<i>ceff</i>	0.6202	0.6100	0.1155	0.3424	0.9609	439
<i>bldiv</i>	0.3756	0.4602	0.2751	0.0000	0.7256	439
<i>hhi</i>	0.0774	0.0722	0.0141	0.0667	0.1080	480
<i>cr5</i>	0.5163	0.5009	0.0483	0.4738	0.6154	480
<i>lev</i>	0.5774	0.6003	0.2434	0.0071	0.9928	441
<i>reins</i>	0.4426	0.3695	0.4448	0.0000	4.6516	441
<i>fown</i>	0.3038	0.0000	0.4604	0.0000	1.0000	474

Note: *size*=natural logarithm of total assets; *ceff*=cost efficiency; *bldiv*=business line diversification; *hhi*=Herfindahl Hirschman index; *cr5*=five firm concentration ratio; *lev*=leverage; *reins*=reinsurance ceded; *fown*=coded 1 if foreign-owned and zero otherwise. Source: Authors estimations from Research data.

¹¹⁶ A summarized description of the variables is presented in Appendix 6B.

6.3.3 Estimation Techniques

Three different estimation techniques are employed to estimate the regression models on the determinants of pricing power in equations 29 and 30. The ordinary least squares and random effects estimations are employed to estimate the static model in equation 29. First, the panel-corrected ordinary least squares (OLS-PCSE) estimation technique of Beck and Katz (1995), which corrects for the non-spherical error term¹¹⁷ normally associated with panel data models is used to estimate the regression models. Second, the choice of the random effects (RE) over the fixed effects (FE) was determined by the results of the Hausman (1978) specification test.¹¹⁸ In respect of the dynamic panel model in equation 30, the system generalized method of moments (GMM) of Arellano and Bover (1995) was used. The use of the dynamic model enables the study to assess the persistence of pricing power in the market. By definition, the introduction of the lagged term of the dependent variable in the model may result in simultaneity and endogeneity biases and lead to inconsistent estimates of the regression coefficients. This problem is overcome in the GMM with the use of the lagged differences of the explanatory variables as instruments. The estimates from the GMM technique are required to satisfy two main assumptions in over-identifying restrictions and no second order autocorrelation. In assessing the validity of the GMM estimates, the study employs the Hansen (1982) *J* test to assumption of over-identifying restrictions. The Arellano-Bond (1991) test is also used to examine the absence of second order autocorrelation.

6.3.4 Data

The annual data on 79 short-term insurance companies from 2007 to 2012 were sourced from the Insurance Supervision Department under Insurance section of the Financial Services Board (FSB). The income and balance sheet statements were obtained from returns submitted by all insurers to the FSB. Out of the 100 insurers as of 2012, firms with negative and zero premiums were excluded from the sample since they were in run-off mode and thus were not competing for premiums.

¹¹⁷ This indicates the presence of heteroscedasticity and autocorrelation. The test of autocorrelation was examined using the Wooldridge (2002) test of serial correlation while the Breusch-Pagan/Cook-Weisberg test was used to examine the presence of heteroscedasticity in the regression models. The OLS-PCSE estimation was done taking into account the results from the two tests, which are unreported but available on request.

¹¹⁸ The test results are unreported by available on request from the authors.

6.4 Results and Discussions

6.4.1 Summary statistics

The evolution of marginal costs, output price and pricing power (Lerner index) in the short-term insurance market from 2007 to 2012 is presented in Table 6.3. The average marginal cost increased by 1.54% between 2007 and 2012 while average output price of insurance policies also increased by 1.02% over the same period. This indicates that increases in production cost were higher than increases in output price over the period. This is reflected in the average Lerner index falling by 5.02% between 2007 and 2012.

Overall, the average Lerner index of 0.6989 indicates that insurers set prices of insurance policies at 69.89% above their marginal cost of production and suggests the existence of high pricing power, hence less competitive pressures in the market. Consistent with evidence from the South African banking market,¹¹⁹ this paper attributes the exercise of high level of pricing power in the market to the dominance by few (top ten) insurers.

Table 6.3: Marginal Cost, Output Prices and Pricing Power (Lerner Index)

years	Marginal Cost (MC)		Output Price (P)		Lerner Index [(P-MC)/P]	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
2007	0.1113	0.088	0.3969	0.2696	0.7241	0.0896
2008	0.117	0.0929	0.4094	0.2962	0.7204	0.0802
2009	0.1277	0.1006	0.4312	0.3074	0.7120	0.0985
2010	0.1296	0.1021	0.4199	0.3314	0.6733	0.1994
2011	0.129	0.1055	0.4176	0.331	0.6897	0.1036
2012	0.1267	0.1038	0.4071	0.3313	0.6740	0.1771
Mean	0.1236	0.0988	0.4137	0.3112	0.6989	0.1247

Note: Lerner Index=pricing power (pp). Source: Authors estimations from Research data

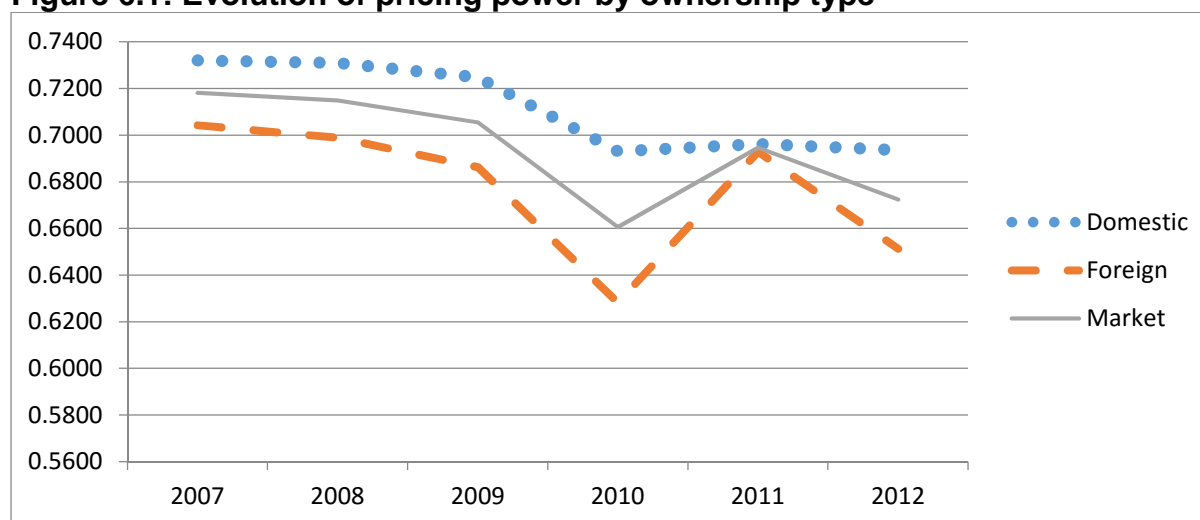
6.4.2 Pricing Power by Ownership

The evolution of the Lerner index across the two forms of ownership is presented in Figure 3. First, a downward trend is observed for the index for both types of ownership. Second, a higher Lerner index is also observed for domestic-owned insurers compared with foreign-owned insurer across all the periods. This suggests that domestic-owned insurers exercise high pricing power in comparison with foreign-

¹¹⁹ This is similar to the findings of Kouki and Al-Nasser (2014) in the South African banking market. The authors estimated a Lerner index of 0.6523 over the period from 2005 to 2010

owned insurers and confirms the hypothesis that the presence of foreign-owned firms improves the competitiveness of financial services markets.

Figure 6.1: Evolution of pricing power by ownership type



Source: Authors estimations from Research data

The average Lerner index, marginal cost and output prices for domestic and foreign-owned insurers are presented in Table 6.4. While insignificant differences are observed between the marginal cost of domestic and foreign-owned insurers, the output price for domestic-owned insurers is significantly higher than that of foreign-owned insurers. This is reflected in significant higher Lerner index (pricing power) in favour of domestic-owned insurers. This suggests both domestic and foreign-owned insurers operate with a similar cost structure. However, the dominance¹²⁰ and operational advantages enjoyed by domestic-owned insurers enables them to set higher prices compared with foreign-owned insurers. Theoretically, domestic firms are assumed to hold information advantages in local markets and this could explain this result. In South Africa, the prohibitive regulations¹²¹ governing the participation of foreign firms in the insurance markets could also account for the uncompetitive behaviour of the domestic-owned insurers.

Table 6.4: Ownership type and Pricing power

	Domestic	Foreign	Mean Diff.	t	p-value
Marginal cost (MC)	0.1256	0.1210	0.0046	0.512	0.609
Output price (P)	0.4313	0.3839	0.0474	2.190	0.029**
Pricing power (PP)	0.7118	0.6770	0.0348	2.554	0.011**

Note: Pricing power is the estimated Lerner index; ** $p < 0.05$

¹²⁰ The sample used for this study included 55 domestic-owned insurers compared to 24 foreign-owned.

¹²¹ It includes local capitalisation, investments and ownership by foreign firms.

Before proceeding with the regression analysis, the presence of strong collinearity among the independent variables is first examined. From the estimated Pearson correlation coefficients in Table 6.5, with the exception of the correlation between *hhi* and *cr5*, it is observed that all correlation coefficients are below the threshold of 0.70 that reflects the presence of multicollinearity (Kennedy, 2008). Hence, *hhi* and *cr5* are introduced separately into the regression models.

Table 6.5: Pearson Correlation Matrix

	<i>pp</i>	<i>size</i>	<i>ceff</i>	<i>bldiv</i>	<i>hhi</i>	<i>cr5</i>	<i>lev</i>	<i>reins</i>	<i>fown</i>
<i>pp</i>	1.000								
<i>size</i>	-0.027	1.000							
<i>ceff</i>	-0.168***	0.418***	1.000						
<i>bldiv</i>	-0.167***	0.284***	0.268***	1.000					
<i>hhi</i>	0.096**	-0.068	0.381***	0.003	1.000				
<i>cr5</i>	0.108**	-0.075	0.400***	0.006	0.982***	1.000			
<i>lev</i>	-0.240***	0.296***	0.298***	0.361***	0.036	0.043	1.000		
<i>reins</i>	-0.071	-0.113**	-0.015	0.180***	-0.053	-0.055	0.334***	1.000	
<i>fown</i>	-0.198***	0.242***	0.169***	0.185***	0.000	0.000	0.250***	0.195***	1

Note: *pp*=Lerner index; *size*=natural logarithm of total assets; *ceff*=cost efficiency; *bldiv*=business line diversification; *hhi*=Herfindahl Hirschman index; *cr5*=five firm concentration ratio; *lev*=leverage; *reins*=reinsurance ceded; *own*=coded 1 if foreign-owned and zero otherwise. *** $p < 0.01$, ** $p < 0.05$;

6.4.3 Determinants of Pricing Power

The hypothesized determinants of pricing power are first examined using the panel corrected ordinary least squares (OLS-PCSE), random effects (RE) and the system generalized method of moments (GMM) of Arellano and Bover (1995). The estimated coefficients are presented in Table 6.6. The diagnostics of all the estimators suggests that regression models employed to explain the exercise of pricing power in the short-term insurance market are well fitted. The study employs the *hhi* and *cr5* as the two proxies for market concentration indicator. Due to high correlations between two variables, they enter the regression equations in a step-wise manner. Column 1 represents the Model with *hhi* as the proxy for market concentration while column 2 uses *cr5* as the proxy for market concentration.

The lagged term for pricing power (*lag.dep*) is positive and significant in the GMM estimation. This suggests that pricing power is persistent in the short-term insurance market and reflects high uncompetitive pressures. From Table 6.6, the coefficient of firm size is found to be positively related to pricing power across all the estimations.

This suggests that increasing bank size results in high pricing power. Due to their dominant position in the market, large banks have the tendency to pass on their operating inefficiencies to policyholders in the form of higher premiums. This explains the positive effect of size on pricing power in the market.

The coefficient of cost efficiency is negative and significantly related to pricing power in the OLS-PCSE and GMM estimation at 1%. This indicates that the cost efficient insurers have lower Lerner index hence exercise low pricing power. In line with the efficient structure hypothesis of Demsetz (1973), this result suggests that cost-savings by efficient insurers are reflected in the reduction in insurance premiums. Another plausible explanation for the negative effect could be the use efficiency as a barrier to entry into the market. The lower pricing of efficient insurers enable them to increase sales and gain market share. This makes it unsustainable for new entrants to cover initial high levels of operational cost by charging actuarial fair premiums for policies.

The results also show a negative and significant relationship between business line diversification and pricing power in both the OLS-PCSE and GMM estimations. This indicates that highly diversified insurers exercise lower pricing power compared to specialized insurers. Through the benefits of economies of scope enjoyed by diversified insurers, they enjoy lower per unit cost of production, hence the exercise of less pricing power. The coefficients of market structure (*hhi* and *cr5*) are observed to be positively related to pricing power. The relationship is significant in all three estimations at 1% and indicates that increasing market concentration increases the exercise of pricing power. This is consistent with evidence from banking markets and supports the structure-conduct-performance hypothesis. In concentrated markets, firms with market power are more likely to collude in setting prices to earn high profits.

The results also indicate that leverage is negatively related to pricing power at 1% in the OLS and RE estimations. This suggests that increasing leverage results in lower pricing power. According to the agency theory of Jensen (1986) the binding effect of leverage on management reduces the incidence of managerial slack which translates into increased efficiency. This efficiency gains could be reflected in low output prices, hence low pricing power. The positive coefficient for reinsurance suggests that insurers that use more reinsurance contracts exercise high pricing power. As noted by Froot (2001) and Cummins et al. (2014), the price of reinsurance contracts is

sometimes above the actuarial price of the original policy underwritten. Hence, primary insurers that cede premiums in reinsurance contracts are more likely to pass on the cost to policy holders in the form of high output pricing. This could explain the positive effect of reinsurance usage on the exercise of pricing power. The coefficient of the ownership dummy is negative and significant across all estimations. This indicates that foreign-owned insurer's exhibit lower pricing power compared to domestic-owned insurers and supports the view that presence of foreign firms in local financial markets improves competition, hence low pricing power. Similar results have been found in banking markets by Martinez-Peria and Mody (2004), Claessens and Laeven (2004) and Yildirim and Philippatos (2007b).

Table 6.6: Determinants of Pricing Power

Dependent Variable: Pricing Power (Lerner Index)						
Equations:	29				30	
	OLS-PCSE		RE		GMM	
Columns	(1)	(2)	(1)	(2)	(1)	(2)
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Constant	0.604*** (0.035)	0.496*** (0.051)	0.625*** (0.053)	0.544*** (0.061)	0.284*** (0.079)	0.235*** (0.079)
<i>lag.dep</i>					0.228** (0.106)	0.302*** (0.101)
<i>size</i>	0.011*** (0.002)	0.012*** (0.002)	0.007* (0.004)	0.008** (0.004)	0.008*** (0.003)	0.007*** (0.002)
<i>ceff</i>	-0.136*** (0.033)	-0.149*** (0.034)	-0.025 (0.047)	-0.056 (0.049)	-0.144*** (0.036)	-0.122*** (0.031)
<i>bldiv</i>	-0.028* (0.014)	-0.027* (0.014)	-0.020 (0.019)	-0.020 (0.019)	-0.040** (0.015)	-0.036*** (0.013)
<i>hhi</i>	1.141*** (0.284)		0.771*** (0.253)		3.707*** (0.755)	
<i>cr5</i>		0.381*** (0.082)		0.281*** (0.076)		0.531*** (0.125)
<i>lev</i>	-0.077*** (0.017)	-0.078*** (0.083)	-0.083*** (0.023)	-0.084*** (0.023)	-0.026 (0.020)	-0.024 (0.019)
<i>reins</i>	0.043*** (0.011)	0.044*** (0.011)	0.020 (0.016)	0.021 (0.016)	0.028** (0.012)	0.025** (0.011)
<i>fown</i>	-0.028*** (0.007)	-0.028*** (0.007)	-0.025* (0.014)	-0.024* (0.014)	-0.019** (0.009)	-0.017** (0.007)
Wald χ^2	111.18	119.7	32.1	36.66	96.69	116.2
Prob > χ^2	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.1565	0.1657	0.1267	0.142		
m_1 :p-value					0.002	0.003
m_2 :p-value					0.683	0.585
Hansen J: χ^2					19.17	22.57
Prob > χ^2					0.635	0.426
Instruments					31	31
Insurers	79	79	79	79	79	79
Observations	432	432	432	432	349	349

Note: *lag.dep*= lag of pricing power; *size*=natural logarithm of total assets; *ceff*=cost efficiency; *bldiv*=business line diversification; *hhi*=Herfindahl Hirschman index; *cr5*=five firm concentration ratio; *lev*=leverage; *reins*=reinsurance ceded; *fown*=coded 1 if foreign-owned and zero otherwise. Heteroscedasticity and auto correlated standard error in parentheses; m_1 = first order autocorrelation; m_2 = second order autocorrelation; Hansen J= test of over-identifying restrictions; OLS-PCSE=ordinary least squares panel-corrected standard errors; RE=random effects; GMM=generalized method of moments. *** p < 0.01; ** p < 0.05; *p < 0.10

6.4.4 Robustness Check

The study also performs two different tests of robustness for the explanatory variables in the basic estimations (Table 6.6). First, the determinants of pricing power are re-estimated for samples of domestic-owned and foreign-owned insurers. This is due to the significant differences in pricing power of domestic-owned and foreign-owned insurers observed in Table 6.4. Second, the quantile regression (QR) technique of Koenker and Bassett (1978) which is robust to the presence of outliers¹²² is also employed in the estimation of the regression model. The QR technique is based on the assumption that the effect of the explanatory factors may vary across the distributions of the dependent variable. The use of least squares regression techniques, which assume the mean coefficient to be constant across all distributions of the dependent variable is unable to capture such dynamics. This technique helps to examine the effect of the explanatory variables at different quantiles (10th to 90th percentiles) of pricing power. The QR coefficients are estimated using a bootstrapping approach with 1,000 replications to produce heteroscedasticity consistent parameters. The test of quantile coefficient equality is performed to assess the appropriateness of applying the QR technique to the dataset. The test is performed under the null hypothesis of equal coefficients across the quantiles. The rejection of the null hypothesis at significance of 5% validates the use of the QR.

6.4.4.1 Ownership type and determinants of pricing power

Table 6.7 presents the results of the determinants of pricing power among domestic-owned and foreign-owned insurers. All the estimations are undertaken with the OLS-PCSE, RE and system GMM techniques. The study employs the *hhi* as our indicator for market structure since the *cr5* captures only the market power for only 5 top insurers. From Table 6.7, slight differences are observed in the patterns for the two ownership-types categories. The results for the domestic-owned insurers are similar to the results from the full sample across all the three estimation techniques. This could be attributed to the domination of domestic-owned insurers in the short-term market. The positive coefficient of the lagged Lerner index for domestic-owned insurers indicates that pricing power persists among domestic-owned insurers. For the foreign-

¹²² From the estimated Lerner index, wide variations are observed between the mean value and the minimum and maximum values. This is confirmed by a high standard deviation of 0.4408 with a minimum and maximum values of -7.55 respectively

owned sample, the results vary across the three estimation techniques. All the coefficients have the same signs as those obtained in the full sample estimations.

Table 6.7: Determinants of pricing power by Ownership Type

Dependent Variable: Pricing Power (Lerner Index)						
Equations:	Domestic			Foreign		
	29		30	29		30
	OLS-PCSE	RE	GMM	OLS-PCSE	RE	GMM
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Constant	0.602*** (0.041)	0.606*** (0.063)	0.129 (0.118)	0.601*** (0.076)	0.671*** (0.105)	0.578*** (0.116)
<i>lag.dep</i>			0.353** (0.142)			-0.006 (0.072)
<i>size</i>	0.012*** (0.003)	0.008* (0.004)	0.011*** (0.004)	0.010* (0.005)	0.004 (0.009)	0.005 (0.006)
<i>ceff</i>	-0.144*** (0.049)	-0.022 (0.060)	-0.217*** (0.044)	-0.139** (0.057)	-0.013 (0.069)	-0.078 (0.068)
<i>bldiv</i>	-0.026 (0.016)	-0.013 (0.021)	-0.044** (0.021)	-0.044 (0.042)	-0.008 (0.060)	-0.018 (0.036)
<i>hhi</i>	1.109*** (0.370)	0.710*** (0.259)	4.831*** (1.002)	1.215*** (0.447)	0.679** (0.334)	2.035* (1.207)
<i>lev</i>	-0.076*** (0.019)	-0.055** (0.022)	-0.022 (0.030)	-0.040 (0.040)	-0.161*** (0.061)	-0.085** (0.042)
<i>reins</i>	0.053*** (0.013)	0.016 (0.021)	0.036** (0.017)	0.003 (0.028)	0.042 (0.030)	0.011 (0.013)
Wald χ^2	48.97	22.28	86.75	42.1	29.44	57.18
Prob > χ^2	0.000	0.0011	0.0000	0.0000	0.0001	0.0000
R-squared	0.1146	0.0797		0.1809	0.1104	
m_1 :p-value			0.0080			0.086
m_2 :p-value			0.537			0.804
Hansen J: χ^2			13.77			15.58
Prob > χ^2			0.842			0.272
Instruments			28			21
Insurers	55	55	55	24	24	24
Observations	297	297	239	135	135	110

Note: *lag.dep*= lag of pricing power; *size*=natural logarithm of total assets; *ceff*=cost efficiency; *bldiv*=business line diversification; *hhi*=Herfindahl Hirschman index; *lev*=leverage; *reins*=reinsurance ceded; Heteroskedastic and autocorrelated standard error in parentheses; m_1 =first order autocorrelation; m_2 = second order autocorrelation; Hansen J= test of over-identifying restrictions; OLS-PCSE=ordinary least squares panel-corrected standard errors; RE=random effects; GMM=generalized method of moments;*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

6.4.4.2 Quantile Regression

The coefficients of the explanatory variables at the 10th, 25th, 50th, 75th and 90th percentile distribution of pricing power are presented in Table 6.8. The magnitude, sign and significance of the estimated coefficients reflects the heterogeneous effect of

the explanatory variables on the conditional distributions of pricing power. The test for equality of coefficients across the quantiles is also reported in Table 6.8 while the graphical representation of the quantile slopes¹²³ is presented in Appendix 6C.

From Table 6.8, the coefficient of size is found to be positive and significant across all quantiles of pricing power. This indicates that across all distributions of pricing power, increasing firm size is associated with high pricing power. However, the magnitude of the size coefficient is observed to be greater at lower percentiles (Q10th and Q25th) compared to higher percentiles (75th and 90th) of pricing power. This suggests that an initial increase in firm size has a stronger effect on increasing pricing power. After the median value of Lerner index, further increases in firm size have lesser effect on pricing power.

The coefficient of cost efficiency is consistently negative across all quantiles of pricing power. The negative effect increases monotonically from the median quantile. This suggests that improving cost efficiency has greater effect on pricing power at higher quantiles. A negative coefficient for business line diversification is observed after the 10th percentile. However, significance is only observed in the 25th and 50th percentiles. This indicates that diversification across multiple business lines only reduces pricing power at specific thresholds, beyond which the impact diminishes.

The effect of market concentration (*hhi*) on all distributions of pricing power is found to be positive. However, the coefficient only becomes significant at the 50th, 75th and 90th percentiles and decreases monotonically in magnitude from the median quantile. This indicates market concentration only increases pricing power at higher quantiles and suggests that reducing pricing power to levels below the median value will diminish any effect of market concentration. This implies that merger decisions should only be approved if it does not increase pricing power beyond median level.

The negative effect of leverage on pricing power is only significant at the 25th, 50th and 75th percentiles of pricing power. This also suggests the existence of a threshold levels at which leverage usage controls pricing power. The positive coefficients of

¹²³ The straight broken lines capture the OLS slopes of the effect of the explanatory variables on pricing power while the moving lines represents the slopes of the Quantile estimates at 95% confidence interval.

reinsurance contracts are observed from the 25th percentile with monotonic increases. However, the magnitude of the coefficient reduces after the 50th percentile.

The foreign-ownership (*fown*) coefficient is negative and significantly related to pricing power at the 50th, 75th and 90th percentiles. This indicates that foreign-owned insurers have greater effect on reducing pricing power at higher percentiles. This result highlights the importance of foreign-owned firms in reducing the high levels of pricing power and intensifies market competition.

The efficiency of the QR estimates lies in the non-equality of coefficients across the quantiles. Hence, this study performs the test of equality of coefficients across all quantiles of each of the explanatory variables under the null hypothesis of equality of coefficients ($\alpha_{Q10} = \alpha_{Q25} = \alpha_{Q50} = \alpha_{Q75} = \alpha_{Q90} = 0$). A rejection of the null hypothesis for a variable will indicate that the existence of heterogeneous effect on the dependent variable. From the test of equality of the coefficients, it is observed that the coefficients of cost efficiency, product line diversification and reinsurance are significantly from one another at different quantiles of pricing power. This suggest that effect of cost efficiency, product line diversification and reinsurance are heterogeneous across different quantile distributions of pricing power.

Table 6.8: Quantile regression estimates of pricing power determinants

Equation 29:		Dependent Variable: Pricing Power (Lerner Index)					
Percentiles	Q10	Q25	Q50	Q75	Q90	Equality of Coefficients	
	Coef.	Coef.	Coef.	Coef.	Coef.	F(4, 424)	Prob > F
Constant	0.511*** (0.040)	0.545*** (0.043)	0.570*** (0.072)	0.701*** (0.068)	0.746*** (0.047)	2.01*	0.092
size	0.013*** (0.003)	0.013*** (0.004)	0.010* (0.005)	0.008** (0.004)	0.009** (0.004)	1.69	0.152
ceff	-0.097** (0.043)	-0.054 (0.044)	-0.099* (0.059)	-0.159*** (0.058)	-0.205*** (0.049)	2.80**	0.026
bldiv	0.0001 (0.016)	-0.042* (0.022)	-0.047* (0.024)	-0.017 (0.018)	-0.020 (0.015)	2.80**	0.026
hhi	0.400 (0.0346)	0.579 (0.457)	1.474*** (0.462)	1.361*** (0.475)	1.232*** (0.327)	0.89	0.473
lev	-0.040 (0.028)	-0.107*** (0.027)	-0.079*** (0.027)	-0.073*** (0.021)	-0.030 (0.021)	0.33	0.856
reins	-0.026 (0.017)	0.050** (0.022)	0.061*** (0.019)	0.034** (0.017)	0.035** (0.014)	2.7**	0.030
fown	0.007 (0.008)	-0.013 (0.008)	-0.027** (0.012)	-0.036** (0.015)	-0.038*** (0.013)	1.71	0.146
Pseudo R-squared	0.0912	0.0565	0.1173	0.1306	0.0849		
F-test	5.16						
Prob> F	0.000						
Observations	432						

Note: size=natural logarithm of total assets; ceff=cost efficiency; bldiv=business line diversification; hhi=Herfindahl Hirschman index; lev=leverage; reins=reinsurance ceded; fown=coded 1 if foreign-owned and zero otherwise. Bootstrapped standard errors in parentheses; F is the test of equality of coefficients across the quantiles;

*** $p < 0.01$

** $p < 0.05$

* $p < 0.10$

6.5 Conclusion and policy recommendations

The existence of pricing power in insurance markets has the tendency to induce social welfare losses, managerial inefficiency and excessive risk-taking and increase the probability of insurance insolvency. In this chapter, the study provides the first empirical evidence on the determinants of pricing power in an emerging insurance market. The identified predictors of pricing power are important to assist regulatory authorities in the formulation of policies to control the exercise of pricing power and its effect on social welfare and inefficiency. To achieve the objectives of this study, annual firm level data on 79 insurance companies from 2007 to 2012 is employed to estimate the Lerner competitive index as a proxy for pricing power. Panel regression models are estimated using the OLS-PCSE, RE and GMM estimation techniques to examine the effect of firm level characteristics in explaining pricing power in the short-term insurance market.

The results suggest that the short-term insurance market is characterised by the existence of high pricing power. The pricing behaviour of domestic-owned insurers is identified as one of the sources of the high pricing power in the market. This confirms the hypothesis that foreign presence improves the competitiveness (lower pricing power) of local financial markets. From the panel regression analysis, firm size, cost efficiency, business line diversification, market concentration, leverage and reinsurance contracts are identified as the significant explanatory factors for pricing power in the market. Specifically, large and specialized insurers and reinsurance contracts are observed to result in exercise of high pricing power while cost efficiency and leverage reduces pricing power. The results also confirm the hypothesis that increases in market concentration increases pricing power. Finally, through a quantile regression analysis, the results show that the effects of cost efficiency, business line diversification and reinsurance contracts are not homogeneous across different distributions of pricing power.

The findings of this study present numerous implications for the regulation of the insurance market. From a policy perspective, competition policy should place great importance on mergers that increases market concentration. If unchecked, mergers involving insurers with large market share could increase market concentration; with the potential to increase the exercise of pricing power. In addition, the barriers that

limit the participation of foreign insurers in the market should be re-examined as a means to curtailing the pricing power of domestic-owned insurers. The identified firm specific drivers of pricing power are relevant for the regulatory authority to formulate policies that have direct impact on firm behaviour. Specifically, efficiency enhancing policies in the form of product development and new delivery channels should be encouraged to reduce the high level of pricing power. In respect of business line diversification, insurers should be assisted to identify efficiency-enhancing levels of diversification. Policies that also seek to increase leverage usage by insurers could also be beneficial to lower the exercise of pricing power and improve the competitiveness of the market.

The study could be improved in several ways. First, it is recommended that further analysis be carried out to assess the effect of pricing power on social welfare and efficiency in the market. This will help quantify the losses in social welfare associated with pricing power and efficiency losses from the 'quiet-life' enjoyed by management. Second, the analysis employed in this paper could also be replicated for the long-term insurance market in South Africa and other emerging insurance markets. Finally, the effect of corporate governance on pricing power in insurance markets could also be examined.

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Appendices

Appendix 6A: Summary of studies on competition in insurance markets

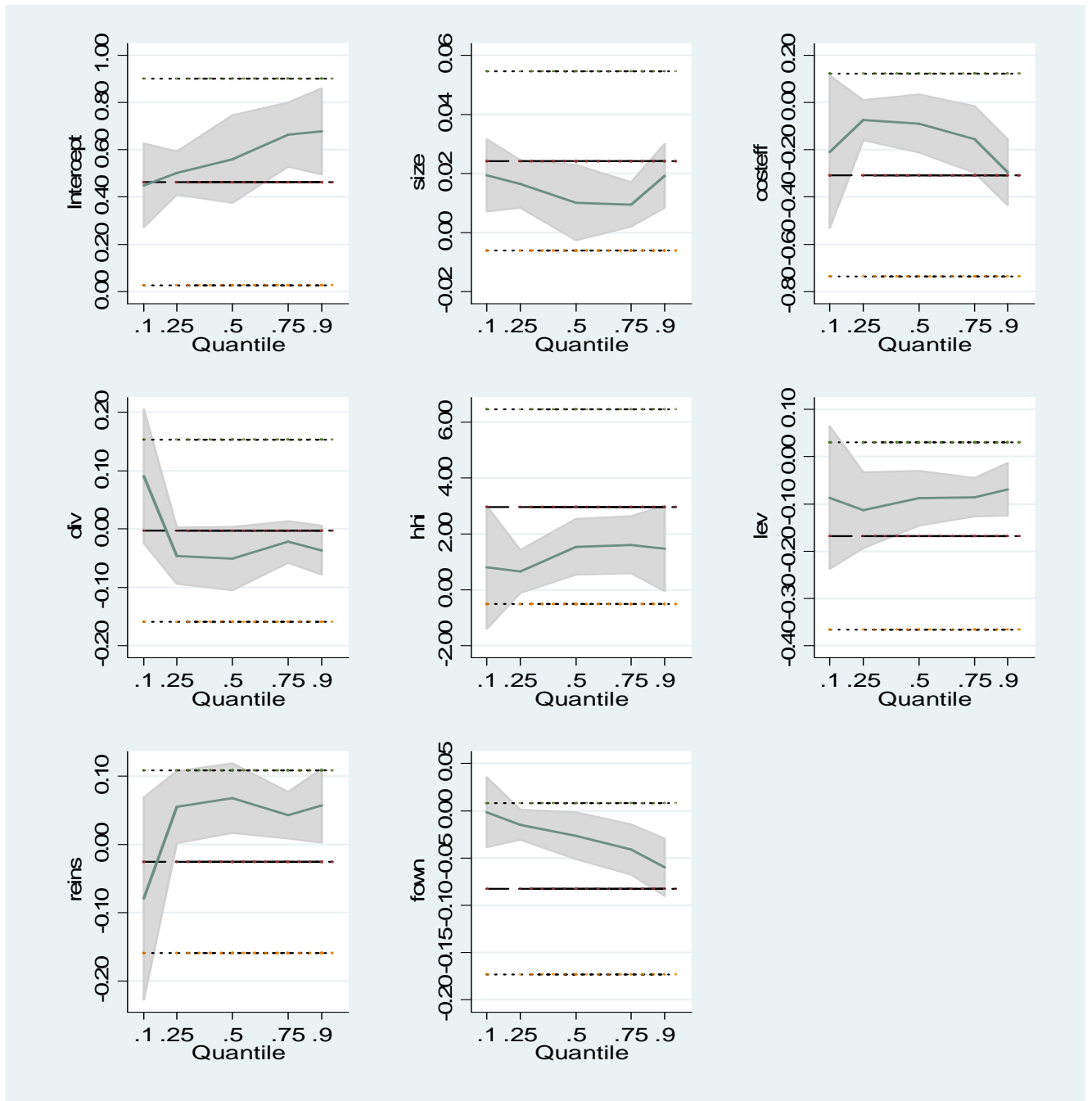
Authors	Country	Period	Measure of Competition
Murat et al. (2002)	Australia	1998	H-statistics
Kasman and Turgutlu (2008)	Turkey	1996-2004	H-statistics
Coccoresse (2010)	Italy	1998-2003	H-statistics
Coccoresse (2012)	Italy	1998-2003	H-statistics
Bikker and van Leuvensteijn (2008)	Netherlands	1995-2003	Boone indicator
Bikker (2012)	Netherlands	1995-2010	Boone indicator
Bikker and Popescu (2014)	Netherlands	1992-2012	Boone indicator
Cummins et al (2014)	10 EU	1999-2011	Boone indicator
Jeng (2015)	China	2001-2009	H-statistics

Source: Various sources

Appendix 6B: Measurement of variables

Variable names	Symbols	Measurement
Dependent variable		
Pricing power	<i>pp</i>	Lerner index
Independent variables		
Firm Size	<i>size</i>	Natural logarithm of total assets
Cost efficiency	<i>ceff</i>	Stochastic frontier estimation of the Translog cost function
Business line Diversification	<i>bldiv</i>	Herfindahl index of premiums across business lines
Market concentration (mc)	<i>hhi</i>	Herfindahl index of gross written premiums
	<i>cr5</i>	Five-firm concentration ratio
Leverage	<i>lev</i>	Ratio of total liabilities to total assets
Reinsurance	<i>reins</i>	Ratio of reinsurance ceded to gross written premiums
Foreign ownership	<i>fown</i>	Dummy variable; Equals 1 if foreign-owned and 0 otherwise

Appendix 6C: Quantile plots



Chapter Seven

Competition and risk-taking behaviour in the short-term insurance market in South Africa¹²⁴

7.1 Introduction

The regulation of financial services industries has generally favoured the promotion of competition to improve efficiency in financial intermediation and enhance market stability. In the formulation of regulatory policies, regulators are confronted with the age-old dilemma of whether competition is good or bad for market stability. Traditionally, two schools of thought have been advanced to explain the relationship between competition and stability. The first, referred to as 'competition-fragility' hypothesis suggests that competition is detrimental to stability. This is based on the assumption that competition erodes profitability, which increases the incentives for excessive risk-taking by management and erodes buffers for potential losses (Keeley, 1990 in Fungacova and Weill, 2013). The second school of thought, as advanced by Boyd and De Nicolo (2005) argue in favour of 'competition-stability' hypothesis which suggests that improving market competitiveness enhances stability. In recent years, a third view has been promoted by Martínez-Miera and Repullo (2010) which suggests a non-monotonic relationship between competition and stability. Specifically, the authors argue that lower levels of competition are assumed to be stability-enhancing while higher levels of competition results in market instability. This result in a 'U'-shaped competition-stability relationship.¹²⁵

Applied to insurance markets, traditional industrial economics theory suggests that increasing competition has the potential to exacerbate information asymmetry problems in adverse selection and moral hazard as well as shortening insurer-client relationship. This increases the cost of acquiring information and monitoring client behaviour over time. In addition, firms in competitive insurance markets are more likely adopt low-pricing and premium under-cutting as growth and expansion strategy.¹²⁶ Such strategies make it difficult to achieve actuarially fair pricing of risk (Ren and

¹²⁴ An earlier draft of this chapter was presented at the 2015 Global Development Finance Conference, 29th-30th October, 2015, Spier Hotel, Cape Town, South Africa

¹²⁵ A fourth theory also suggests a dual relationship between competition and stability (Refer to Shaeck et al. 2009 and Turk-Ariss, 2010). For the purposes of this study, we restrict our arguments to the first three views.

¹²⁶ Ren and Schmit (2006) refer to this as an attractive risk-shifting strategy since it accords insurers the opportunity to generate income before the settlement of claims in the future.

Schmit, 2006) and increase the risk of insurers having insufficient funds to cover expected claims and insolvency risk. In applying the framework of Boyd and De Nicolo (2005) to insurance markets, less competitive insurance markets are expected to be characterized by the exercise of pricing power and the charging of actuarially unfair premiums. This could attract high risk clients into an insurance pool to increase loss development and probability of loss occurrence. Unlike the banking markets (See studies by Salas and Saurina, 2003; Beck et al., 2006; Boyd et al., 2006; Yeyati and Micco, 2007; Berger et al., 2009; Jimenez et al., 2013; Liu and Wilson, 2013; Fungacova and Weill, 2013; Kouki and Al-Nasser, 2014; Schaeck and Cihák, 2014), these theoretical expositions have rarely been examined empirically in insurance markets.

Against this background, this chapter empirically contributes to the debate and examines both the linear and non-linear effect of competition on risk-taking behaviour and solvency in the short-term insurance market in South Africa between 2007 and 2012. The objectives of this study are achieved in a three-stage analysis. First, in line with the prior studies (Cheng et al., 2011; Ng et al., 2013; Pasiouras and Gaganis, 2013; Cummins et al., 2014; Shim, 2015), this study measures risk-taking behaviour¹²⁷ of insurers using the z-score solvency ratio and underwriting risk. Firm level estimates of the Lerner index is employed as proxy for insurance market competition in the second stage. The index captures the mark-up power of firms over marginal cost and represents the pricing power of firms in a market. The choice of the Lerner index over the market level approaches in the Panzar-Rosse (1987)¹²⁸ and Boone (2008)¹²⁹ models is motivated by its ability to allow for the estimation of firm level pricing behaviour. To the best of the author's knowledge, this approach has been rarely used in the estimation of insurance market competition. In the third stage analysis, series of panel model regression techniques are employed to examine the effect of the competition (Lerner index) on the two proxies of insurance risk. First, the iterated seemingly unrelated regression (ISUR) is used to account for correlation among the error terms of the two systems of equation.¹³⁰ This approach enhances efficiency of

¹²⁷ In this paper, (in) solvency and stability are used interchangeably to denote risk-taking behaviour.

¹²⁸ Refer to studies by Murat et al. (2002), Kasman and Turgutlu (2008), Coccoresse (2010, 2012) and Jeng (2015) on the application of the Panzar-Rosse H-statistics to estimate insurance market competition.

¹²⁹ Refer to studies by Bikker and van Leuvensteijn (2008), Bikker (2012), Bikker and Popescu (2014) and Cummins et al. (2014) for applications of Boone indicator to measure competitiveness of insurance markets

¹³⁰ This refers to two equations with the same set of independent variables but different dependent variables.

the parameter estimates compared to the step-by-step estimation of the system of equations (Zellner, 1962). Second, a sensitivity analysis of the ISUR estimates is undertaken by employing the ordinary least squares, random effects and quantile regression techniques to estimate the static models while the system generalized method of moments (GMM) of Arellano and Bover (1995) is also employed to estimate dynamic models. The quantile regression helps to examine the varying effect of competition on varying financial health of insurers and assess the reaction of insurers of varying risk levels to competitive pressures. The GMM helps to address potential endogeneity issues in the regression models. Annual firm level data on 79 short-term firms from 2007 to 2012 is employed in the empirical analysis.

This chapter makes two significant contributions to the literature on competition in insurance markets. The first contribution relates to the evidence on the potential non-linear relationship between competition and solvency in insurance markets. To the best of the author's knowledge, the examination of the non-linear¹³¹ relationship between competition and risk is limited to banking markets. The analysis also presents the first empirical examination on the potential determinants of insurance solvency in an emerging insurance market in Africa. This is useful for insurance regulators for policy formulation to protect policy holders, insurance management and shareholders.

The rest of the paper is organised into; Section 7.2 focuses on the theoretical explanations on the competition-stability relationship and empirical studies on the risk determinants in insurance markets; Section 7.3 outlines the empirical strategy while Section 7.4 discusses the empirical findings; Section 7.5 concludes the study and discusses the regulatory implications of the findings.

7.2 Literature Review

This section first discusses the theoretical underpinnings of the competition and risk relationship in the financial services industry. Due to the scarcity of empirical studies on the relationship in insurance markets, the empirical discussions are extended to cover studies on risk determinants in insurance markets.

¹³¹ The two papers on the linear relationship between competition and stability are by Cummins et al. (2014) and Shim (2015).

7.2.1 Theoretical literature

7.2.1.1 Competition-Fragility Hypothesis

The Competition-Fragility hypothesis (CFH) advocates for a negative effect of competition on risk-taking behaviour and stability to suggest that competition is detrimental to market stability. This school of thought advances three main transmission mechanisms for this relationship. First, increasing market competition has the ability to exacerbate the information asymmetry problem. As argued by Petersen and Rajan (1995), competition shortens relationships between firms and their clients which increase the cost of acquiring information and monitoring customer behaviour. This increases the risk of insurance pools and the probability of policy holder claims. Second, increasing competition also affects the quality of supervision by regulatory authorities in checking excessive risk-taking (Allen and Gale, 2004). The third mechanism as explained by Keeley (1990) suggests that the competition for profits increases the incentives for excessive risk-taking. This also reduces the capital buffers and exposes firms to adverse economic conditions. The under-cutting of insurance premiums to generate higher sales of insurance policies which characterizes competitive insurance markets supports this hypothesis. This has the tendency to increase loss distribution of insurance pools, hence high probability market insolvency.

7.2.1.2 Competition-Stability Hypothesis

A positive effect of competition on stability is explained by the Competition-Stability hypothesis (CSH). According to this school of thought, competition reduces the risk-taking incentives of firm management (Boyd and de Nicolo, 2005). This flows from the rent-seeking behaviour of firms in concentrated markets that increases the cost of financial intermediation and the resultant information asymmetry problems in adverse selection and moral hazard. Applied to insurance markets, the reduction in competitive conduct (increasing concentration) has the potential to increase the price of insurance policies in premiums through the exercise of market power by dominant firms. This could lead to the adverse selection of high risk policy holders into an insurance pool, increasing the probability of loss occurrence and market stability.

7.2.1.3 Martinez-Miera-Repullo (MMR) Hypothesis

Based on the assumption of a non-monotonic relationship between competition and risk, Martinez-Miera and Repullo (2010) show that increasing competition induces a risk-shifting effect. On one hand, the authors suggest that intense competition reduces interest revenue as buffer for losses by increasing non-performing loans. It can also reduce the chances of loan defaults. The net margin effect results in 'U'-shaped relationship between competition and risk. This study makes similar assumptions for the short-term insurance market and examines the potential for a non-linear effect of competition on insurance solvency.

7.2.2 Empirical Literature

Empirical studies on the competition-risk relationship have been severally tested in banking markets (See Demsetz et al., 1996; Saunders and Wilson, 2001; Salas and Saurina, 2003; Beck et al., 2006; Boyd et al., 2006; Yeyati and Micco, 2007; Berger et al., 2009; Jimenez et al., 2013; Liu and Wilson, 2013, Kouki and Al-Nasser, 2014). To date, only Cummins et al. (2014) and Shim (2015) have examined the relationship in insurance markets in Europe and US respectively. In this review, the study extends the discussion to studies on the determinants of risk in insurance markets to identify the research gap.

Baranoff and Sager (2003) examines the interrelationships among asset risk, capital structure, distribution and organizational forms of a sample of life insurance companies in the US from 1993 to 1999. The authors find evidence of a positive relationship between regulatory asset risk and capital ratio. Cheng and Wong (2004) employ 16 financial ratios to examine the predictors of financial health of both life and non-life insurance companies in Japan, Singapore, Malaysia and Taiwan from 1994 to 1999. Using a logit regression model, the authors identify investment returns, liquidity, combined ratio, operating margin, insurance surplus and size as the significant predictors of financial health of non-life insurers while asset mix, investment returns, size and product mix significantly influence the financial health of life insurers in the sample countries. In the UK, Shiu (2005) also analysed the solvency determinants of life insurance companies from 1986 to 1999. The author finds reserves and inflation to negatively impacts on solvency of life insurers while bond issues, equity and new businesses improve insurance solvency. Cole et al. (2011) undertake an analysis of ownership and management separation on the risk-taking behaviour of US non-life

insurance companies from 1996 to 2004. Using Best's capital adequacy ratio, the authors find evidence to suggest that the risk-taking behaviour of the sample firms is heterogeneous across different forms of ownership structure.

In the USA, Cheng et al. (2011) analyse the effect of stable institutional ownership on the risk-taking behaviour of Life-Health insurers. By employing a simultaneously modelling approach, the authors find evidence to support the prudent-man law hypothesis that stable institutional ownership is associated with low risk-taking behaviour. The authors employed surplus to assets ratio, underwriting and investment risk as the proxies for risk-taking behaviour. Ho et al. (2013) examine the effect of organizational form and board composition of US non-life insurers on risk. Across three risk proxies in leverage, investment and underwriting risks, the authors show that stock insurers are characterized by high risk-taking behaviour compared to mutual insurers. They also conclude that the effect of board composition varies across the three risk proxies. Cheng and Weiss (2013) also investigate the relationship between capital and risk among a sample of property and liability insurers from 1993 to 2007 in US. The authors employ a three-stage least squares technique to provide evidence which suggests that increases in capital result in increased investment and underwriting risk. Using data on a sample of insurance companies across a wide range of sample, Pasiouras and Gaganis (2013) explore the relationship between the soundness and regulatory policies. The findings from empirical analysis lend support to the relevance of supervisory power and technical provisions and investments regulations on solvency. However, the authors do not find evidence in favour of corporate governance indicators and capital requirements to have any impact on insurance solvency.

From a governance perspective, Eling and Marek (2014) examine the effect of corporate governance variables on the risk-taking in two large European insurance markets¹³². The authors employ asset, product and financial risks in a structural equation model using corporate governance indicators as the latent variables. The empirical results suggest that increased executive compensation, monitoring and blockholder participation reduce risk-taking. In Malaysia, Ng et al. (2013) evaluate the relationship between size and risk-taking in a sample of insurance companies from 2000 to 2010. The results from fixed effects, random effects and system GMM

¹³² United Kingdom and German insurance markets

estimations suggest a positive effect of insurer size on underwriting risk. Using a sample of life insurance companies in Taiwan, Hu and Yu (2014) analyse the interrelationships among investment risk, underwriting risks and capital ratio between 2004 and 2009. Using both the two-stage least squares and quantile regression approaches, the authors find a positive relationship between underwriting risk and capital while a negative relationship is found between capital and investments risk.

Closely related to this study are studies by Cummins et al. (2014) and Shim (2015). Cummins et al. (2014) examine the effect of competition on the stability in selected life insurance markets in the European Union. The authors estimated Boone indicator for insurance markets in 10 European countries using annual data from 1999 and 2011. The authors find evidence in favour of the competition-stability hypothesis that competition enhances the soundness of insurance companies. Through the use of the Boone indicator as the proxy for competition, their finding suggests that efficiency acts as the transmission in enhancing insurance solvency in competitive markets. The authors also show that the positive effect of competition on solvency is stronger for less solvent insurers compared highly solvent ones. In the US, Shim (2015) also examines the empirical relationship between market concentration and the stability of the property-liability market. The author find evidence to suggest that market concentration increases financial instability.

The review undertaken in this chapter identifies the following research gaps. First, there is a dearth of studies on the competition-risk relationship in insurance markets. Second, empirical evidence on the determinants of risk-taking behaviour in insurance markets in Africa appears non-existent. Finally, as far as this study is aware, the non-linear relationship between competition and risk has not been examined in the insurance literature. This study goes a long way in addressing these research gaps. A summary of literature is presented in Table 7.1.

Table 7.1: Summary of studies on risk-taking behaviour in insurance markets

Authors	Period	Sample	Sub-Market	Risk Measures	Focus (Relationship with)
Baranoff and Sager (2003)	1993 to 1999	US	Life	Regulatory asset risk	Capital, distribution and organizational forms
Shiu (2005)	1986-1999	UK	Life	Free asset ratio	Firm-level and economic factors
Ren and Schmit (2006)	1994-2003	US	Short-term	Leverage, RBC	Competition and Franchise value
Cole et al. (2011)	1996-2004	US	Short-term	BCAR	Ownership and Management Separation
Cheng et al. (2011)	1993-2008	US	Life-Health	Surplus ratio, underwriting and investment risk	Stability of institutional ownership
Fields et al. (2012)	1992-2006	66 countries	Life, Short-term, composite	Solvency ratio (z-score); underwriting leverage	investor protection, governance quality and contract enforcement
Cheng and Weiss (2013)	1993-2007	US	Short-term	Underwriting and asset risks	Capital
Pasiouras and Gaganis (2013)	2005-2007	46 countries	Life and Short-term	Solvency ratio (z-score)	Regulatory policies
Ho et al. (2013)	1996-2007	US	Short-term	Underwriting and investment risk, loss ratio, leverage	Organizational structure and board composition
Ng et al. (2013)	2000-2010	Malaysia	Life, Short-term, composite	Underwriting risk	Firm size
Eling and Marek (2014)	1997-2010	UK, German	Life and Short-term	Asset, product and financial (leverage) risks	Corporate governance
Hu and Yu (2014)	2004 and 2009	Taiwan	Life	Underwriting and investment risks	Capital Ratio
Cummins et al. (2014)	1999-2011	EU	Life	Solvency ratio (z-score)	Competition (Boone)
Shim (2015)	1996-2010	US	Short-term	Solvency ratio (z-score)	Concentration (HHI, C4)

Note: UK-United Kingdom, US-United States of America, EU-European Union, BCAR-Best's Capital Adequacy Ratio, HHI= Herfindahl Hirschman Index, C4=4-firm concentration ratio

7.3 Empirical Strategy

7.3.1 Measuring of Risk-taking behaviour

This study employs two proxies for insurance of risk-taking behaviour. First, in line with the convention in both the banking (See Laeven and Levine, 2009) and insurance (See Fields et al., 2012; Pasiouras and Gaganis, 2013; Cummins et al., 2014; Shim, 2015) literatures, this study employs the solvency ratio in the z-score¹³³ as a proxy for insurance risk. The index reflects firm's buffer in equity and profits with the standard deviations of profits. As a solvency indicator, the z-score measures the distance to default and represents the number of standard deviations firms' income must fall to erode equity capital. Hence, a higher value indicates a high distance to default, hence high solvency and stability and vice versa. Following Fields et al. (2012), Pasiouras and Gaganis (2013), Cummins et al. (2014) and Shim (2015), the equation for estimating the z-score is given as;

$$Z_{score_{i,t}} = \frac{roa_{i,t} + eqr_{i,t}}{\sigma roa_i} \dots \dots \dots 31$$

where subscripts i and t represents insurer and year respectively; roa is return on assets measured as the ratio of profit before tax to total assets, eqr is the equity ratio measured as the ratio of book value of equity to total assets, σroa is the standard deviation of return on assets. In order to address the extreme variations in the variable, the estimated values are transformed by taking the natural logarithm as employed by Laeven and Levine (2009) and Shim (2015).¹³⁴

The second proxy for insurance risk-taking behaviour is underwriting risk (see Adams and Buckle, 2003; Ng et al., 2013). The underwriting risk ($urisk$) represents the risk associated with the insurance portfolio. It is measured as the ratio of incurred losses to net earned premiums and captures the proportion of claims paid out of every earned premium. Higher values of this proxy reflects high underwriting risk, hence high risk-taking behaviour and vice versa.

¹³³ The z-score was first employed by Altman (1968) to predict bankruptcy.

¹³⁴ In order to enable the logarithm transformation of the negative values of the variables, the minimum value and a constant is added.

7.3.2 Insurance market competition: Lerner Index

The approaches for the estimation of competition are classified into the structural and non-structural approaches. The class of structural measures of competition are premised on the structure-conduct-performance (SCP) hypothesis of Bain (1951) which infers competition from the structure of the market. These classes of measures have been found to have weak theoretical basis since concentrated markets could also be competitive (Demsetz, 1973). The non-structural measures are premised on the new empirical industrial organisation (NEIO) which infers competition from firm pricing behaviour.

In this study, the non-structural Lerner (1934) index is employed to estimate insurance market competition. The index infers competition from firm pricing conduct. This approach is preferred over other non-structural measure of competition (H-statistics of Panzar-Rosse, 1987; the conjectural variation of Bresnahan, 1982 and Lau, 1982 and the Boone, 2008) indicator for the following reason. The index captures a firm's ability to charge prices above their marginal costs depending on the competitiveness conditions of their market over time. This is suitable for the industry level data employed in this paper. Following prior studies,¹³⁵ this paper defines the Lerner index as;

$$li_{i,t} = \frac{p_{i,t} - mc_{i,t}}{p_{i,t}} \dots\dots\dots 32$$

where $p_{i,t}$ is the output price set by an insurer i at time t and $mc_{i,t}$ is insurer i 's marginal cost at time t . Output price is proxied as the ratio of total revenue (net earned premiums and investment income) to total assets. Higher values of the Lerner index closer to unity reflect greater market power while lower values indicate competitive market. The marginal cost, $mc_{i,t}$ of producing insurance policies is derived through estimation of a translog cost function as equation 33;

$$\ln\left(\frac{tc}{w_3}\right)_{i,t} = \alpha_0 + \alpha_1 \ln y_{i,t} + 0.5\alpha_2 \ln y_{i,t}^2 + \beta_1 \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \beta_2 \ln\left(\frac{w_2}{w_3}\right)_{i,t} + 0.5\beta_3 \ln\left(\left(\frac{w_1}{w_3}\right)_{i,t}\right)^2 + 0.5\beta_4 \ln\left(\left(\frac{w_2}{w_3}\right)_{i,t}\right)^2 + \gamma_1 \ln y_{i,t} \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \gamma_2 \ln y_{i,t} \ln\left(\frac{w_2}{w_3}\right)_{i,t}$$

¹³⁵ Refer to studies by De Guevara et al. (2005), Berger et al. (2009), Turk-Ariss (2010) among several others.

$$\delta_1 trend_t + \delta_2 trend_t^2 + \delta_3 trend_t \ln y_{i,t} + \delta_4 trend_t \ln \left(\frac{w_1}{w_3} \right)_{i,t} + \delta_5 trend_t \ln \left(\frac{w_2}{w_3} \right)_{i,t} + \varepsilon_{i,t} \dots \dots \dots 33$$

where subscripts *i* and *t* are as defined before; *tc* is insurers total cost made up of claims paid, management expenses and commission paid, *y* represents insurance outputs in total assets. In line with prior insurance literature¹³⁶, we assume that short-term insurers employ labour and business services, debt and equity capital to produce their outputs. From equation 33, *w*₁ is the price of labour; *w*₂ is the price of equity capital and *w*₃ is the price debt. The study defines the price of labour and business services as the ratio of management expenses and commissions paid to total assets (*w*₁). The price of equity capital (*w*₂) is measured as the ratio of net income to equity capital. In order to account for the possibility of negative profits; a constant is added to price of equity to allow for logarithmic transformation. The price of debt capital (*w*₃) is also measured as the ratio of investment income to total reserves (unearned premiums and outstanding claims). In line the SFA convention, the normalization of *tc*, *w*₁ and *w*₂ with *w*₃ is undertaken to impose homogeneity conditions. Taking the first derivative of the cost function in equation 33 with respect to output gives the marginal cost of production;

$$mc_{i,t} = \frac{\partial tc_{i,t}}{\partial y_{i,t}} = \frac{tc_{i,t}}{y_{i,t}} \left[\alpha_1 + \alpha_2 \ln y_{i,t} + \gamma_1 \ln \left(\frac{w_1}{w_3} \right)_{i,t} + \gamma_2 \ln \left(\frac{w_2}{w_3} \right)_{i,t} + \gamma_3 trend_t \right] \dots \dots \dots 34$$

Table 7.2 presents the summary statistics of the variables in the translog cost function in equation.

Table 7.2: Summary of Cost, Output and Input Prices

	Mean	Std. Dev.	Min	Max	N
Cost (<i>tc</i>)	550,791	452,077	264,868	1,683,939	436
Output					
Total assets (<i>y</i>)	1,269,660	2,371,393	7,347	1.64e+07	441
Input Prices					
Price of Labour (<i>w</i> ₁)	0.1456	0.2138	0.2129	1.8817	441
Price of equity capital (<i>w</i> ₂)	0.1738	0.335	-3.2481	1.2446	441
Price of debt capital (<i>w</i> ₃)	0.3295	1.2163	0.0962	19.5421	434

Note: All Monetary values are in Thousands of South African Rand

¹³⁶ Refer to Jeng et al. (2007) and Huang et al. (2007)

7.3.3 Empirical Model

This study adopts the empirical models of Salas and Saurina (2003), Cummins et al. (2014) and Shim (2015) to examine the relationship between insurance market competition and risk-taking behaviour in the short-term insurance market in South Africa. The model is defined in equation 35 as;

$$Risk_{i,t} = \theta_0 + \theta_1 comp_{i,t} + \theta_2 comp_{i,t}^2 + \sum_{j=2}^K \theta_{j,it} x_{j,it} + \varpi_{s,t} \dots \dots \dots 35$$

where $Risk_{i,t}$ refers to insurance risk-taking behaviour; $comp_{i,t}$ and $comp_{i,t}^2$ are the linear and quadratic terms of competition respectively. $x_{j,it}$ is a vector of control variables while $\varpi_{s,t}$ represents the time-varying error terms.

Equation 35 is expanded to include the proxies of insurance solvency and risk and competition to form equations 36 and 37;

$$z_{score}_{i,t} = \phi_0 + \phi_1 lerner_{i,t} + \phi_2 lerner_{i,t}^2 + \phi_3 size_{i,t} + \phi_4 npe_{i,t} + \phi_5 reins_{i,t} + \phi_6 bdiv_{i,t} + \phi_7 fown_t + \varepsilon_{i,t} \dots \dots \dots 36$$

$$urisk_{i,t} = \psi_0 + \psi_1 lerner_{i,t} + \psi_2 lerner_{i,t}^2 + \psi_3 size_{i,t} + \psi_4 npe_{i,t} + \psi_5 reins_{i,t} + \psi_6 bdiv_{i,t} + \psi_7 fown_t + \xi_{i,t} \dots \dots \dots 37$$

where i and t represent insurers and years respectively; z_{score} and $urisk$ denote solvency risk and underwriting risk respectively; $lerner$ is the proxy of competition in the Lerner index; $lerner^2$ is the quadratic term for the Lerner index. $size$ is the natural logarithm of total assets; npe is the ratio of net earned premium to equity; $reins$ is the ratio of reinsurance premiums ceded to gross premiums written; $bdiv$ is the diversification of income across business lines; $fown$ is the ownership dummy coded as 1 if the firm is majority foreign-owned and zero otherwise. ε and ξ are the two-sided error terms for equations 36 and 37 respectively.

In order to conclude on the hypothesis tested in equation 36, positive signs for both the linear (ϕ_1) and quadratic (ϕ_2) coefficients indicate that increasing competition (decreasing market power) decreases insurance solvency while negative signs for ψ_1 and ψ_2 in equation 37 are expected to arrive at the same conclusions. This supports the competition-fragility hypothesis that competition is detrimental to stability. On the other hand, evidence in favour of competition-stability can only be arrived if the

coefficients of ϕ_1 and ϕ_2 are negative and positive for ψ_1 and ψ_2 . In respect of the 'U-shaped' relationship of the MMR hypothesis, a negative (positive) coefficient is expected for ϕ_1 (ψ_1) while a positive (negative) is expected for ϕ_2 (ψ_2). Reversal of the coefficients for both the linear and quadratic terms will lead to a rejection of the MMR hypothesis.

In respect of the control variables, firm size, measured as the natural logarithm of total assets is expected to have a positive effect on insurance solvency and risk. This effect is underpinned by the 'Too-Big-to-Fail' hypothesis which assumes that large conglomerates are prone to excessive risk-taking. In insurance markets, Hardwick (1997) argues that through economies of scale, large insurers are able to have high level of performance to improve their risk absorption capacity (Cummins and Sommer 1996; Baranoff and Sager, 2002).

The study also controls for the effect of capitalization differences on insurance solvency and risk with the inclusion of equity variable. This is measured as the ratio of net earned premiums to shareholder's equity. The view is that increases in equity lowers the risk of financial distress and insolvency. Conversely, equity increases could also affect the portfolio of risky assets and overall firm risk (Koehn and Santomero, 1980). As a risk management strategy, conventional wisdom suggests that the usage of reinsurance contracts enhances the solvency of insurance companies. This occurs through a risk transfer where primary insurers pass on some premiums (and risk) to reinsurers to reduce their exposures. Hence, a positive relationship is expected between reinsurance and risk-taking. This variable is measured as the ratio of reinsurance premiums ceded to gross premiums underwritten.

Business line diversification refers to the underwriting of insurance policies across a spectrum of product lines ensuring a diversified revenue source. This reduces the risk inherent in each business line and ultimately the overall portfolio risk. Hence, the diversification of insurance premiums across multiple product lines is expected to improve insurance solvency. The Herfindahl Hirschman index of premiums concentration is used to proxy for this variable. The index is computed as the sum of the squares of percentages of net written premiums across the eight business lines. The equation for computing the index is given as;

$$bldiv = \sum_{i=1}^8 \left(\frac{PWBL_{i,t}}{GPW_{i,t}} \right)^2$$

where $PWBL_i$ is the premium written in business line i at time t and $GPW_{i,t}$ is the gross premiums written for insurer i at time t . The index is transformed into a measure of diversification by subtracting the value from unity, hence higher values will reflect diversified business lines and vice versa.

The presence of foreign-owned firms in domestic financial markets has conflicting effects on stability. On one hand, it is argued that the presence of foreign-owned firms enhances solvency through risk diversification (Berger et al., 2009) and increased efficiency (Claessens et al., 1998). These result from the enhanced intermediation functions that ensure efficient allocation of resources. Conversely, foreign-owned firms are viewed as a source of contagion risk by exposing local markets to shocks from their country of origin. The transmission of shocks to the operational activities of such firms has the potential to affect their risk appetite and solvency.

7.3.4 Estimation Strategy

In the estimation of regression models with different dependent variables and the same independent variables, there is a high possibility of correlations among the residuals. In order to account for these correlations to improve the efficiency of the predicted coefficients, a systems method of estimation is employed. This is done through the simultaneous estimation of all regression models. This study employs the seemingly unrelated regression (SUR) of Zellner (1962) to estimate the systems of equations in models 36 and 37. Theoretically, from equations 38 and 39 below;

$$y_{(i,t)1} = x_{(i,t)1} + \varepsilon_{(i,t)1} \dots \dots \dots 38$$

$$y_{(i,t)2} = x_{(i,t)2} + \varepsilon_{(i,t)2} \dots \dots \dots 39$$

where the correlation between the error terms of the two equations is given by; $E(\varepsilon_{(i,t)1}, \varepsilon_{(i,t)2}) = \sigma_{13}$. Since equations 38 and 39 will be estimated for the same sample, the equations appear to be seemingly unrelated since correlations are only captured by the unobservable error terms. Hence, the step-by-step estimation of equations 38 and 39 is less efficient compared to the application of a technique that jointly estimates the systems of equation (Zellner, 1962). According to Zellner (1962),

efficiency of the parameter estimates of the system of equations are enhanced if the set of independent variables are not highly correlated while the error terms of the different equations are highly correlated. Hence, the empirical models in equations 36 and 37 are estimated using the iterated seemingly unrelated regression (ISUR) of Zellner (1962) in STATA12. The assumptions underlying the efficiency of the coefficients are examined. First, the correlation coefficients of the independent variables are estimated to assess the correlation among the independent variables before proceeding with the regression estimation. The second test, which captures aggregation bias, is based on the assumption that the coefficients of across the systems of equation are significantly different from one another ($x_{(i,t)1} = x_{(i,t)2} = 0$). The rejection of the null hypothesis suggests that efficiency of the ISUR estimates compared to that of the ordinary least squares estimation.

7.3.5 Data

Annual data on 79 short-term insurers from 2007 to 2012 were sourced from the Insurance Supervision Department of the Financial Services Board (FSB). The financial data used in this study were extracted from the returns containing the income and balance sheet statements submitted by all insurers to the FSB. Out of the 100 insurers as of 2012, firms with negative and zero premiums were excluded from the sample since they were in run-off mode and thus were not competing for premiums. The study period is constrained by data unavailability.

7.4 Discussion of results: Univariate analysis

The summary statistics of the regression variables are presented in Table 7.3. The mean values of the risk variables in the z-score and *urisk* are 48.9995 and 0.6692 respectively. This indicates that 66.92% of insurance premiums are paid out as claims. The Lerner index averaged 0.6989 to suggest that the average insurance premiums are about 69.89% above the marginal cost incurred in the production of the insurance policy. This reflects a less competitive insurance market. The average growth in insurance assets was 12.865 percent over the study period while the reinsurance ratio (*reins*) of 0.4426 indicates that insurers retain about 56 percent of their gross premium revenues. The business line diversification (*bdiv*) of 0.3790 suggests that majority of insurance premium revenue are generated from smaller number of business lines. On the average, approximately 30% of insurers are majority foreign-owned.

Table 7.3: Descriptive statistics

	Mean	Median	Std. Dev.	Min	Max	N
<i>z_{score}</i>	48.9995	13.4307	160.6437	-0.7519	2,014.4860	441
<i>urisk</i>	0.6692	0.5577	2.7851	-24.7692	43.7914	428
<i>lerner</i>	0.6989	0.6993	0.1247	-7.5555	0.9925	441
<i>size</i>	12.8652	12.7654	1.6039	8.9020	16.6153	441
<i>npe</i>	1.6418	1.0504	4.7481	-0.4936	78.6500	441
<i>reins</i>	0.4426	0.3695	0.4448	0.0000	4.6516	441
<i>bdiv</i>	0.3790	0.4602	0.2823	-0.2321	0.8258	439
<i>fown</i>	0.3038	0.0000	0.4604	0.0000	1.0000	474

Note: z_{score} = solvency ratio; *urisk*= the ratio of net incurred claims to net earned premiums; *Lerner*=estimated Lerner index; *size*= natural logarithm of total assets; *npe*=net earned premiums to equity; *reins*=reinsurance to gross premiums; *bdiv*=business line diversification; *fown*=coded 1 if foreign-owned and zero otherwise;

7.4.1 Regression Results

The result of the iterated seemingly unrelated regression (ISUR) estimation of regression Models 36 and 37 are presented in Table 7.4. The results of the correlation among the independent variables presented in Appendix 7A suggest low correlations. In Table 7.4, columns 1 and 2 presents the results of the linear model while columns 4 and 5 displays the results of the quadratic model. Columns 3 and 6 present the test results of aggregation bias examined by the Breusch-Pagan test of independence of model parameters. In both Models, the null hypothesis of equal coefficients across equations 36 and 37 are rejected except for equity and foreign-ownership variables.

From the linear models, a positive relationship is observed between the Lerner index and the z-score. This indicates that improving competition (reducing pricing power) has the tendency to stimulate insolvency/instability in the market. The negative effect of the Lerner index on operational risks also indicates that improving competition (reducing pricing power) increases the underwriting risk of short-term insurers. This suggests that operational risk associated with insurance business increases in the presence of increasing competitive pressures. In the quadratic model, both the linear and quadratic coefficients of the Lerner index are positively related to the z-score in Model 4 while in Model 5, the coefficients of *Lerner* and *lerner*² are both negatively related to underwriting risk. This indicates that even at higher levels competition (very low levels of pricing power), insolvency and underwriting risks still increases. Hence, intense competition increases risk-taking and insolvency among short-term insurers in South Africa. These results are consistent with the competition-fragility hypothesis that

competition increases financial instability. As an indicator of pricing power, the increasing Lerner index reflects insurer's ability to set high pricing of insurance policies to generate high returns. This provides buffers against claims from policy holders and improves insurance solvency. In respect of the insurance literature, this result is at variance with the findings of Cummins et al. (2014) in the life insurance market in the European Union and Shim (2015) in the property-liability market in US. The relatively weaker regulations of the South African insurance market compared to the developed markets in EU and US could explain this negative effect of competition on risk-taking behaviour. This could also be explained by the supervision challenges faced by regulatory authorities in competitive markets, which make it difficult to monitor excessive risk by firms (Allen and Gale, 2004)

In respect of the control variables, their effect on insurance solvency appears mixed with the theoretical expositions. First, a positive coefficient is observed for firm size with the z-score and underwriting risk in both the linear and quadratic models. Consistent with Cheng and Wong (2004), the positive coefficient for the z-score indicates increasing firm size improves solvency. However, increases in firm size increases the insurer's underwriting risk.

Against expectations, the reinsurance coefficient is negatively related to the z-score but positively related underwriting risk in both the linear and quadratic Models. This indicates that increasing reinsurance usage increases insurance insolvency and underwriting risk. As a risk management tool, insurers with high risk levels in the form of leverage (Garven and Lamm-Tennant, 2003) are more likely to use reinsurance contracts to mitigate financial constraints and insolvency risk. Similar findings have been documented by Shim (2015) in the property-liability market in US. The business line diversification (*bdiv*) coefficient also exhibits significant positive relationship with the z-score at 1% level of significance in both the linear and quadratic Models. The positive effect on z-score suggests that diversification of premium income across multiple business lines improves the solvency of insurers.

Finally, a negative relationship is found between the foreign-ownership coefficient and z-score while a positive coefficient is observed for underwriting risk in both models. This indicates that foreign-owned insurers have lower solvency (high underwriting risk)

compared to domestic owned insurers. However, the relationship is only significant in underwriting risk models (Columns 2 and 5).

Table 7.4: Seeming Unrelated Regression

Columns Dep. Vars.	Linear Model						Quadratic Model					
	1		2		independence of coefficient (3)		4		5		independence of coefficient (6)	
	<i>z_{score}</i>		<i>urisk</i>		χ^2	<i>prob > χ^2</i>	<i>z_{score}</i>		<i>urisk</i>		χ^2	<i>prob > χ^2</i>
	Coef.	z	Coef.	z			Coef.	z	Coef.	z		
Constant	0.602 (0.641)	0.94	-0.682 (0.416)	-1.64	3.14	0.2076	1.913*** (0.548)	3.49	-1.591*** (0.351)	-4.54	28.41***	0.0000
<i>lerner</i>	1.888*** (0.489)	3.86	-1.289*** (0.317)	-4.07	26.94***	0.0000	2.348*** (0.663)	3.54	-2.264*** (0.425)	-5.33	35.8***	0.0000
<i>lerner</i> ²							1.202 (1.173)	1.02	-2.545*** (0.751)	-3.39	11.74***	0.0028
<i>size</i>	0.064 (0.043)	1.48	0.046 (0.028)	1.63	5.84*	0.0540	0.061 (0.043)	1.41	0.052* (0.028)	1.88	6.57**	0.0375
<i>npe</i>	-0.019 (0.013)	-1.40	-0.008 (0.009)	-0.93	3.34	0.1887	-0.017 (0.013)	-1.3	-0.011 (0.009)	-1.23	3.84	0.1469
<i>reins</i>	-0.524** (0.210)	-2.50	0.418*** (0.136)	3.07	13.46***	0.0012	-0.551*** (0.211)	-2.61	0.473*** (0.135)	3.50	16.54***	0.0003
<i>bdiv</i>	0.714*** (0.250)	2.86	0.161 (0.162)	0.99	10.40***	0.0055	0.743*** (0.251)	2.96	0.100 (0.161)	0.62	9.99***	0.0068
<i>fown</i>	-0.134 (0.146)	-0.92	0.185* (0.095)	1.95	4.17	0.1243	-0.123 (0.146)	-0.84	0.160* (0.094)	1.71	3.24	0.1977
Wald χ^2	35.55		50.19				36.69		63.13			
Prob > χ^2	0.0000		0.0000				0.0000		0.0000			
R-squared	0.0811		0.1108				0.0835		0.1354			
RMSE	1.2612		0.8176				1.2595		0.8061			
Parameters	6		6				7		7			
Observations	403		403				403		403			

Note: *Lerner*=estimated Lerner index; *size*= natural logarithm of total assets; *npe*=net earned premiums to equity; *reins*=reinsurance to gross premiums; *bdiv*=business line diversification; *fown*=coded 1 if foreign-owned and zero otherwise. Heteroscedasticity and autocorrelated standard error in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

7.4.2 Sensitivity Analysis

The robustness of the results of ISUR estimations are examined using standard static and dynamic panel data techniques. In respect of the static model, the ordinary least squares (OLS), random effects (RE)¹³⁷ and quantile regressions (QR) techniques are employed to estimate the linear model while the dynamic modelling of the quadratic equation is estimated using the system Generalized Method of Moments (GMM) estimation technique of Arellano and Bover (1995). The explanations and motivations for the use of the various techniques and the estimated results are discussed in the preceding sections.

7.4.2.1 Linear model: OLS, RE and QR estimations

Unlike the OLS and RE techniques, the QR¹³⁸ technique of Koenker and Bassett (1978) is based on the assumption that a set of independent variables has a non-uniform effect on a dependent variable. In relation to this study, it is expected that the reaction of weaker insurers (with low z-score) to competition may be different from stronger insurers (with high z-score) to reflect a varying effect of competition on insurance solvency. Hence, different coefficients should be estimated at different distributions of the dependent variable. This paper therefore attempts to estimate the coefficients of competition at different distributions of solvency to assess the effect of competition on risk-taking behaviour condition on the financial strength of insurers (Cummins et al., 2014). The QR estimates are more robust to the presence of outliers and departures from normality assumption compared to the OLS and RE. Table 7.5 presents the results of the OLS and RE estimates in Column 1 while the QR coefficients for the 10th, 25th, 50th, 75th and 90th percentiles are presented in Column 2.

The coefficient of the Lerner index is positive and significant at 1% in the OLS and RE models to support the competition-fragility hypothesis that competition is detrimental to the solvency of insurers. A positive coefficient is also observed for the Lerner index across all the quantile distribution of the z-score. The null hypothesis that the coefficient

¹³⁷ The choice of the RE was based on the results of the Hausman (1978) specification which was unreported to conserve space.

¹³⁸ The QR estimation is undertaken with 1,000 bootstrapping replications to generate heteroscedasticity consistent coefficients. The test of coefficient equality across quantiles under is performed under the null hypothesis of equal coefficients across the quantiles. The rejection of the null hypothesis at significance of 5% validates the use of the QR. From Table 7, the null hypothesis is rejected for the coefficients of the Lerner index, reinsurance, business line diversification and foreign-ownership dummy.

of the Lerner index is equal across all quantiles of the z-score is rejected at a level of 1% as indicated by the F-test in Table 7. It is also observed that lower values of the coefficient at the 50th and 75th percentiles while higher and significant coefficients are observed for the 10th, 25th and 90th percentiles. Through the classification of 10th and 25th percentile as weaker insurers, 50th and 75th percentile as moderately stronger insurers and 90th percentile as stronger insurers, the results indicate that the stability-enhancing effect of increasing pricing power (concentration) is greater for weaker and stronger insurers compared with moderately stronger insurers. Hence increasing competition has greater destabilization effect on weaker and stronger insurers. However, comparison of the coefficients at the 10th and 90th percentiles suggests that destabilizing effect of competition is greater for weaker insurers. The relationship is presented in a quantile plot in Figure 2 as appendix 7B.

In respect of the control variables, the results of the F-test indicate that the reinsurance usage, business line diversification and foreign-ownership have a heterogeneous effect on insurance solvency. This justifies the use of QR in examining the competition-stability relationship.

Table 7.5: OLS, RE and QR estimates

Columns	Dependent Variable: z-score								
	1		2						
	OLS	RE	Quantile Regression					Equality of Coefficients	
	Coef.	Coef.	Q10	Q25	Q50	Q75	Q90	F(4, 414)	Prob > F
<i>Constant</i>	1.007 (0.744)	0.741 (0.872)	-1.479** (0.708)	-1.134 (0.690)	1.209 (0.889)	2.999*** (0.909)	3.541** (1.623)	5.78***	0.0002
<i>lerner</i>	1.571*** (0.350)	1.198*** (0.390)	2.066*** (0.667)	1.969*** (0.588)	0.717 (0.679)	1.203** (0.549)	1.976*** (0.653)	6.79***	0.0000
<i>size</i>	0.056 (0.052)	0.094 (0.060)	0.112** (0.048)	0.126*** (0.046)	0.077 (0.050)	-0.027 (0.067)	-0.028 (0.115)	0.96	0.4279
<i>npe</i>	-0.016* (0.009)	-0.021*** (0.007)	-0.005 (0.023)	-0.001 (0.014)	-0.009 (0.016)	-0.021 (0.019)	-0.022 (0.033)	0.95	0.4329
<i>reins</i>	-0.364** (0.173)	-0.255 (0.241)	-0.063 (0.249)	-0.104 (0.181)	-0.213 (0.246)	-0.510* (0.288)	-0.752* (0.429)	4.85***	0.0008
<i>bdiv</i>	0.588*** (0.277)	0.484* (0.275)	0.298 (0.308)	0.315 (0.277)	0.354 (0.260)	0.887*** (0.328)	0.610 (0.680)	3.32***	0.0108
<i>fown</i>	-0.201 (0.131)	-0.243 (0.213)	-0.140 (0.149)	-0.085 (0.116)	-0.269* (0.141)	-0.206 (0.237)	-0.154 (0.314)	2.49**	0.0430
Wald χ^2	40.7	25.57							
Prob > χ^2	0.000	0.0003							
R-squared	0.571	0.0556							
Pseudo R-squared			0.0205	0.0331	0.0222	0.0158	0.0281		
Insurers	79	79					79		
Observations	431	431					431		

Note: Lerner=estimated Lerner index; size= natural logarithm of total assets; npe=net earned premiums to equity; reins=reinsurance to gross premiums; bdiv=business line diversification; fown=coded 1 if foreign-owned and zero otherwise. Heteroscedasticity and autocorrelated standard error in parentheses in OLS and RE estimates and Bootstrapped standard errors in parentheses in the QR estimates; F is the test of equality of coefficients across the quantiles. *** p<0.01, ** p<0.05; * p<0.10

7.4.2.3 Quadratic Model: System GMM estimation

An econometric issue that is not addressed by static regression models is the potential endogeneity. This arises when an independent variable is also endogenously determined. In respect of this paper, there is high potential that the set of control variables used also has the potential to influence competition. The failure to address this in the model may result in inconsistent and biased estimates of the coefficients. In order to address this flaw with the static models, this paper employs the system Generalized method of moments (GMM) estimation of Arellano and Bover (1995) in the estimation of the regression models. The dynamic modelling of the quadratic equation to test the relationship between competition and risk-taking behaviour in the short-term insurance market is specified in equations 40 and 41 as;

$$z_{score_{i,t}} = \varpi_0 + \varpi_1 z_{score_{i,t-1}} + \varpi_2 lerner_{i,t} + \varpi_3 lerner_{i,t}^2 + \varpi_4 size_{i,t} + \varpi_5 npe_{i,t} + \varpi_6 reins_{i,t} + \varpi_7 bdiv_{i,t} + \varpi_8 fown_t + \eta_{i,t} \dots \dots \dots 40$$

$$urisk_{i,t} = \varrho_0 + \varrho_1 urisk_{i,t-1} + \varrho_2 lerner_{i,t} + \varrho_3 lerner_{i,t}^2 + \varrho_4 size_{i,t} + \varrho_5 npe_{i,t} + \varrho_6 reins_{i,t} + \varrho_7 bdiv_{i,t} + \varrho_8 fown_t + \zeta_{i,t} \dots \dots \dots 41$$

where $z_{score_{i,t-1}}$ and $urisk_{i,t-1}$ are the lags of the dependent variables solvency risk and underwriting risk respectively. All the other variables are as defined before. Equations 40 and 41 are estimated with Generalized Method of Moments (GMM) of Arellano and Bover (1995) using `xtabond2` command in Stata 12. The presence of the lagged dependent variables has the potential to result in simultaneity and endogeneity biases and in inefficient coefficients. The system GMM technique uses the lagged differences of the explanatory variables as instruments. The estimated models are required to meet the assumptions of over-identifying restrictions and no-second order correlations. In respect of the test of over-identifying restrictions, the Hansen (1982) J test results is examined to validate the instruments selected. Under the null hypothesis of no over-identifying restrictions, the rejection of the alternative hypothesis confirms the validity of the instruments employed in the estimation. The Arellano-Bond (1991) test is used to examine the existence of no second order auto-correlation.

The system GMM estimates of the quadratic dynamic panel models are presented in Table 7.6. All the assumptions underlying the use of the GMM are satisfied as indicated by the insignificance of the test of no second order autocorrelation, which suggests the

absence of second order autocorrelations. In respect of the Hansen (1982) J test of over-identifying restrictions, the $\text{prob} > \chi^2$ values greater than 0.10 indicates that the null hypothesis of over-identifying restrictions cannot be rejected in all models. This confirms the validity of the instruments. In the estimation of the dynamic models, the study follows Roodman (2009) and control for the effect of instrument proliferation. The number of instruments reported in Table 7.6 is lower than number of observations. This confirms the robustness of the GMM coefficients.

The coefficients of the lagged values of the dependent variables are significant for both measures of r risk at 1 percent. This indicates that insurers underwriting losses persist over time hence controlling current levels of losses through an effective underwriting practices serves as an appropriate strategy to control the levels of solvency and operational risks. The results also show positive coefficients for both the linear and quadratic terms of competition with the z-score while negative coefficients are observed with underwriting risk (*urisk*). However, significance is observed in all but the linear term in the z-score model, with the quadratic term showing a marginal significance at 10%. This is consistent with the estimations from the ISUR and supports our earlier findings that competition is not stability-enhancing in the insurance market.

Consistent with the earlier estimates, a positive coefficient is observed for size across the two proxies of insurance risk. The coefficients are, however, not statistically significant. The coefficient for equity (*npe*) is negatively related to both the z-score and underwriting risk at 1% to indicate that increasing insurance equity reduces solvency and underwriting risk. Consistent with the ISUR estimates, reinsurance is found to increase insolvency and underwriting risk of insurers. Finally, foreign-owned insurers are characterized by high insolvency and underwriting risk compared with domestic-owned insurers.

Table 7.6: System GMM estimations

	<i>z_{score}</i>		<i>urisk</i>	
	Coef.	z	Coef.	z
Constant	1.410*** (0.430)	3.27	0.363* (0.213)	1.70
Lag	0.348*** (0.075)	4.67	-0.276*** (0.038)	-7.27
<i>lerner</i>	0.745 (0.485)	1.54	-1.490*** (0.178)	-8.39
<i>lerner</i> ²	1.035* (0.548)	1.89	-2.669*** (0.358)	-7.45
<i>size</i>	0.037 (0.034)	1.10	0.022 (0.017)	1.30
<i>npe</i>	-0.007** (0.003)	-2.23	-0.015*** (0.002)	-8.61
<i>reins</i>	-0.283* (0.159)	-1.78	0.170** (0.071)	2.39
<i>div</i>	0.200 (0.193)	1.04	0.110 (0.095)	1.15
<i>fown</i>	-0.209* (0.118)	-1.78	0.115** (0.055)	2.10
<i>m</i> ₁ : p-value	0.109		0.211	
<i>m</i> ₂ : p-value	0.442		0.296	
Hansen J: χ^2	22.58		32.44	
Prob > χ^2	0.31		0.216	
Instruments	36		36	
Insurers	79		77	
Observations	346		338	

Note: *Lerner*=estimated Lerner index; *size*= natural logarithm of total assets; *npe*=net earned premiums to equity; *reins*=reinsurance to gross premiums; *bdiv*=business line diversification; *fown*=coded 1 if foreign-owned and zero otherwise. *m*₁ = first order autocorrelation; *m*₂ = second order autocorrelation; Hansen J= test of over-identifying restrictions; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

7.5 Conclusions and policy recommendations

This chapter contributes to the on-going debate on the relationship between competition and solvency of financial services industry with specific reference to an emerging insurance market. In order to promote a stable financial services industry for efficient financial intermediation, regulatory authorities are normally confronted with the dilemma on whether competition policies are stability-enhancing or not. In this chapter, the thesis examines the effect of competitive pressures on the stability and solvency of the largest short-term insurance market in Africa. Using firm level annual data on 79 short-term insurance companies in South Africa from 2007 to 2012, the study employs two proxies of insurance risk in the solvency ratio of z-score and

operational risk while insurance market competition is analysed using the Lerner index of pricing power. The empirical relationship is examined using the seemingly unrelated regression technique of Zellner (1962) to estimate a system of equations to enhance the efficiency of regression coefficients. The OLS, RE, QR and system GMM techniques were also employed to account for modelling failures of the SUR estimates.

The empirical estimates suggest that the short-term insurance market is characterized by high underwriting risk and the exercise of high pricing power to indicate a less competitive market. From the panel regression estimates, the study provides strong evidence in support of the competition-fragility hypothesis, which suggests that competition is harmful to the stability of the short-term insurance market. This conclusion is consistent across all econometric approaches employed in the estimation of the regression models. Other firm specific factors are also identified to be significant predictors of insurance solvency. Specifically, large insurers are found to be associated with high underwriting risk but are more solvent and stable. On the other hand, increasing equity reduces underwriting risk but increases the risk of insolvency. The usage of reinsurance contracts also increases both underwriting and insolvency risks. The diversification of premiums across business line also enhances insurance solvency while foreign-insurers have high levels of underwriting and insolvency risks compared with domestic insurers. Finally, the results also indicate that effect of competition, reinsurance usage, business line diversification and foreign-ownership vary at different levels of insurance solvency. Specifically, the 'competition-fragility' effect is more pronounced among weaker insurers. This suggests that competition has greater destabilizing effect on weaker insurers.

The findings offer several policy implications for the regulation and management insurance stability. First, pro-competition prudential regulations should only be promoted if mechanisms could be implemented to maintain the franchise value and buffers of insurers against losses. In addition, information imbalances in the market could be greatly reduced through the formalization of a claims reference bureau to collate data on claims history of insurance consumers. Second, the results of the quantile regression suggest that regulatory policies consider the financial health of insurers in the design of competition policies. In addition, the regulatory authority should put in place mechanisms to curtail the negative practices of foreign-owned

insurers in the form of aggressive pricing and premium undercutting to gain market share that impact negatively on stability of the market.

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Appendices

Appendix 7A: Correlation Matrix

	z_{score}	$urisk$	$lerner$	$lerner^2$	$size$	npe	$reins$	$bdiv$	$fown$
z_{score}	1.000								
$urisk$	-0.122**	1.000							
$lerner$	0.190***	-0.056	1.000						
$lerner^2$	-0.116**	-0.019	-0.773***	1.000					
$size$	0.070	-0.006	0.023	-0.021	1.000				
npe	-0.035	-0.016	-0.037	-0.053	0.190***	1.000			
$reins$	-0.100**	-0.047	-0.315***	0.404***	-0.113**	-0.090*	1.000		
$bdiv$	0.070	-0.028	-0.071	-0.034	0.284***	0.188***	0.180***	1.000	
$fown$	-0.085*	-0.002	-0.156***	0.050	0.242***	0.159***	0.195***	0.185***	1.000

Note: z_{score} = solvency ratio; $urisk$ = the ratio of net incurred claims to net earned premiums; $Lerner$ = estimated Lerner index; $lerner^2$ = quadratic term of the lerner index; $size$ = natural logarithm of total assets; npe = net earned premiums to equity; $reins$ = reinsurance to gross premiums; $bdiv$ = business line diversification; $fown$ = coded 1 if foreign-owned and zero otherwise; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.10$

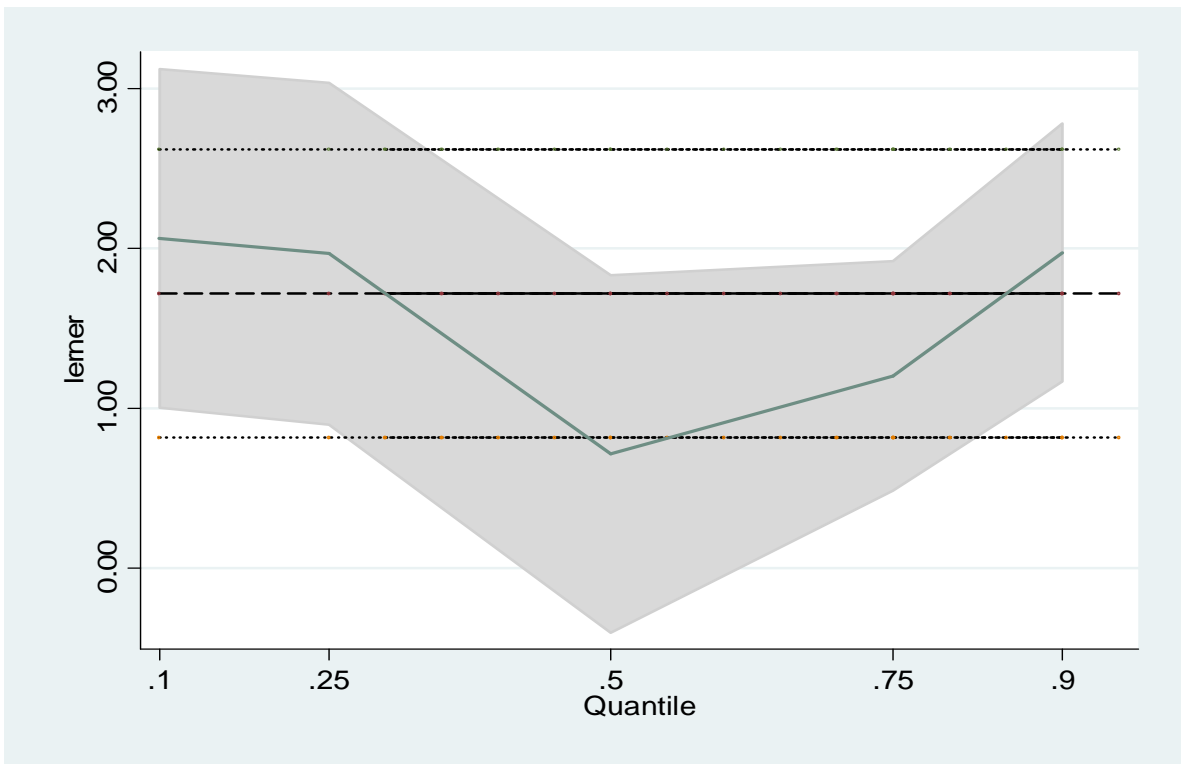
Appendix 7B: Quantile Plot

Figure 1: The quantile plot of the Lerner index on the z-score: QR and OLS estimates at 95% confidence intervals

Chapter Eight

Conclusions and Policy Recommendations

8.1 Introduction

This thesis is a collection of empirical research papers on three thematic areas in efficiency, competitiveness and risk-taking behaviour in the short-term insurance market in South Africa. Specifically, it examines the efficiency, returns to scale and productivity growth; the competitive conduct of firms and how competition influences efficiency and risk-taking behaviour in the market. The annual financial data employed in the empirical analysis, which covered 80 short-term insurance companies from 2007 to 2012, was obtained from the Insurance Department in the Financial Services Board. The thesis consists of eight chapters, of which five are empirical papers. Chapters one and two focus on the introduction and overview of the short-term insurance market respectively. The first empirical theme in Chapter three presents estimates of technical efficiency, productivity growth and returns to scale economies in the short-term insurance market in a two-stage data envelopment analysis. In Chapter four, the analysis is extended to cover the effect of three outcomes of financial liberalization on competitive conditions using the Panzar-Rosse H-statistics, while Chapter five examines the linkages between cost and profit efficiency on the one hand and competition to test the so called 'Quiet-Life' hypothesis. Cost and profit efficiency scores are estimated using the stochastic frontier analysis technique. Chapter six presents the estimates of pricing power measured using the Lerner index which reflects firms' ability to set prices above marginal cost due to their power in the market. The Chapter then proceeds to explore the effect of firm and industry level characteristics in identifying the driving factors for the exercise of pricing power. The last empirical analysis in Chapter seven examines the relationship between competition measured using the Lerner index and risk-taking behaviour, measured as the solvency ratio and underwriting risk. This final chapter of the thesis summarizes the findings from the empirical chapters and discusses the policy implications of the findings. It ends by outlining the major contributions made to the empirical literature on insurance markets and discusses the limitations and avenues for future research.

8.2 Summary of Main Findings

The findings from the empirical chapters are summarized as:

Efficiency, productivity and returns scale economies: Over the study period, the study finds an average technical efficiency of about 50% to suggest that the sample insurers operate at about half of their productive capacity. This is attributable to their inability to adopt the best available technology in their operational activities. The analysis also reveals that only 20% of the short-term insurers operate at the optimal capacity of constant returns to scale. This suggests that majority of the short-term insurers in South Africa operate at inappropriate scales where they produce at either diminishing returns to scale or increasing returns to scale. In addition, productivity growth is found to be driven by innovations in production of insurance outputs that result in outward shifts of the production frontier. From the regression analysis, the size of insurers is found to have a non-linear 'U' shaped relationship with technical efficiency. This result indicates that beyond a threshold level of firm growth, increasing the size of short-term insurers reduces efficiency. The results also suggest that firm age, reinsurance usage and leverage reduce efficiency levels while diversification of insurance premiums across business lines enhances efficiency. On the returns to scale determinants, a non-linear relationship is also found between size and the probability of an insurer operating with constant returns to scale. The findings also reveal that highly diversified insurers have a high probability of operating at optimal capacity of constant returns to scale while increasing reinsurance usage and leverage decreases the probability of operating with constant returns to scale. Finally, the chapter also documents evidence of convergence in efficiency levels in the market to indicate a 'catch-up' by inefficient insurers over the study period. However, the rate of convergence was found to be low.

Liberalization outcomes and competitive behaviour: Using different specifications of insurance revenue, the estimated H -statistics from the Panzar-Rosse revenue model was significantly different from zero and one. This suggests that revenues in the short-term insurance market are earned under monopolistic competitive conditions. This conclusion was robust across both static and dynamic specification of the revenue as well as different panel data estimation techniques. Based on three outcomes of liberalization, the H -statistics was estimated for sub-samples of large versus small, domestic-owned versus foreign-owned and single-line versus multi-line insurers to identify potential sources of competitive pressures in the market. Consistent with the

full sample estimations, we find the H -statistics for all sub-samples to be significantly different from zero and one to confirm monopolistic competitive market. From the sub-sample estimates, the activities of small, foreign-owned and single-line insurers were found to be the driving factors of competitive conditions in the market.

Competition and efficiency relationship: From the estimates of the stochastic frontier analysis reveals an average cost efficiency of 80.08% to indicate that an average insurer spends 19.92% more on actual cost over the estimated efficient cost frontier. The findings also reveal that insurers earn 45.71% of their potential profits. These suggest that the sample insurers have high levels of efficiency in cost and low levels in profit. Using annual estimates of the H -statistics as the proxy for competition, the results of fixed effects panel estimation shows a positive effect of competition on cost and profit efficiency scores. This suggests that competition is efficiency-enhancing to validate the 'quiet-life' hypothesis. In addition, insurer age, underwriting risk and leverage are also identified as the other significant determinants of cost and profit efficiency in the short-term insurance market.

Explaining pricing power: The estimate of the Lerner index indicates output prices of insurance policies are over and above the unit cost of production. This was reflected in an average index value of 0.6989 to suggest a relative mark-up of insurance premiums over cost of about 70%. This reflects the exercise of high pricing power and less competitive pressures in the market. On explanatory factors for the exercise of pricing power, the analysis reveals that firm size has a positive effect on pricing power to suggest that large insurers exercise higher mark-up power. In addition, less diversified insurers and insurers with high usage of reinsurance contracts are found to be characterized by the exercise of high pricing power. However, cost efficient and highly leveraged insurers are found to be characterized by the exercise of lower pricing power. The analysis also documents evidence that market concentration is a significant predictor of high pricing power. The presence of foreign-owned insurers' results in lower exercise of pricing power compared to domestic-owned insurers. However, the effect of cost efficiency, business line diversification and reinsurance contracts are found to be heterogeneous across distributions of pricing power.

Competition and risk-taking behaviour: In examining the empirical relationship competition and risk-taking behaviour in the short term-insurance market, two proxies

of insurance risk in the z-score and underwriting risk are employed while insurance market competition is measured by Lerner index. The results of the panel regression analysis provide strong evidence in support of the 'competition-fragility' hypothesis, which suggests that competition is harmful to the stability of the short-term insurance market. However, the destabilizing effect of competition is found to be stronger among weaker insurers compared with stronger insurers. This conclusion is consistent across several econometric approaches employed in the estimation of the regression models. Other explanatory factors for risk-taking behaviour are identified as firm size, equity, reinsurance usage, business line diversification and foreign-ownership.

8.3 Policy Implications and Recommendations

Three major policy recommendations are derived along the central themes examined in this thesis. The results of the efficiency analysis provide three major implications for the management of insurance companies. First, the high levels of technical inefficiency require greater managerial effort and attention to reduce resource wastages. This will enhance the ability of insurers to operate closer to their optimum capacity and underwrite more insurance policies. Second, the significant firm level determinants of efficiency and returns to scale also provide management of insurance company's useful insights on the focal areas of insurance operation that need improvements. For instance, management of insurance companies should also focus on the adoption of new technologies as a means of improving their operations and achieve efficiency in resource utilization. In addition, the evidence of the non-linear effect of size on efficiency suggests that insurance management should focus their efforts at identifying their most efficient scale of operation to optimize resource usage. To eliminate the incidence of resource under-utilization in the market, the regulator should encourage mergers among small, medium and big insurers while over-utilization of input resources associated with large insurers could be addressed through the placement of restrictions on mergers and acquisition involving large insurers.

The results of the estimates of competitive conduct and pricing power also provide insights for prudential regulation of the short-term insurance market. The evidence of monopolistic tendencies and the exercise of high pricing power imply that prudential policies have not been effective in improving on competitive conditions in the market. This presents an opportunity for intensifying efforts at improving competitive pressures

in the short-term market. The regulator can improve on competitive pressures in the market in two main ways. First, the regulator should place restrictions on mergers and acquisition, which results in the creation of large insurers. This will curtail high levels of market concentration, which increases the potential for the exercise of pricing power and reduces competitive pressures. Second, the restriction on the participation by foreign-owned insurers in the local insurance market should be relaxed to curtail the monopolistic tendencies of domestic-owned firms. Overall, the regulatory drive of improving competitive conditions in the insurance market will be beneficial in reducing the high resources wastages and improve on the earning potential of insurers.

The final policy recommendation relates to the stability of the market. While the findings of the study suggest that competition is detrimental to the stability of the short-term insurance market, this study argues in favour of pro-competition prudential policies. In order to mitigate the negative effect of competition on the risk profile of short-term insurers, steps should be taken by the regulator to reduce information imbalances between insurers and policyholders that characterizes competitive markets and increases the riskiness of insurance portfolio. Similar to banking markets, this could be achieved through the formalization of a claims reference bureau to collate data on claims history of insurance consumers. This will enhance insurer's ability to adequately price risk and settle claims made by policyholders. The results also imply that policies aimed at improving competitive pressures will have a greater destabilizing effect on weaker insurers. Hence, the design of competition policies should account for the varying levels of insurer's financial health. While the participation of foreign-owned insurers improves the competitive conditions, their activities should be closely monitored to control the risk appetite and the tendency to take on excessive risk. This could be achieved by the regulator by placing stringent measures in the quantitative reporting requirements under the SAM for foreign-owned insurers.

8.4 Contributions and Research Limitations

To the best of the author's knowledge, this dissertation presents the first comprehensive assessment and evaluation of the insurance market in South Africa. The analysis undertaken in this thesis makes several contributions to the empirical literature on insurance markets. First, the thesis extends on the vast efficiency literature in insurance markets by applying the growth theory of convergence to

analyse the evolution of efficiency scores from 2007 to 2012. The relevance of such analysis helps to evaluate the effectiveness of regulatory policies in improving overall industry performance and reducing the wide variations in the performance among players. As far as the author is aware, this thesis presents the first empirical assessment of efficiency convergence in an insurance market.

In the second contribution, the thesis also presents robust application of the Panzar-Rosse *H*-statistics to insurance markets. As argued by Bikker et al (2012), the conclusions from the estimations P-R model with the inclusion of total assets either as a scaling variable or explanatory variable results in wrong inferences from competitive conduct. In addition, all prior estimations of the *H*-statistics to insurance markets have employed static P-R models, which are found to be downwards biased (Goddard and Wilson, 2009). In this thesis, these issues were addressed in the application of the P-R model estimate to competitive behaviour. This is also a first in estimation of competitive conduct in insurance markets in Africa within the framework of New Empirical Industrial Organization (NEIO) theory.

The thesis also presents the first empirical assessment of profit efficiency in the South African insurance market. This is useful in assessing the ability of insurance managers to minimize cost and maximize both premiums and investment income. To the best of the author's knowledge, this is the first evidence of profit efficiency estimates in an African insurance market. Fourth, the thesis also pioneers the empirical application of the Lerner index to estimate pricing power in an insurance market. Unlike the competition estimates using the Panzar-Rosse *H*-statistics, Boone indicator and Herfindahl Hirschman index, the Lerner index has the advantage of estimating pricing behaviour at an individual firm level. This is particularly suitable for the firm level data used in this thesis. The thesis also provides the first evidence on the determining factors of pricing power in an insurance market to enhance regulatory understanding of pricing behaviour. The final contribution relates to the analysis of the determinants of risk-taking behaviour and stability of insurance markets in Africa. The analysis provides important tools for enhancing market stability.

Despite the contributions enumerated above, this study suffers from the following limitations: First, this study uses financial data to answer the research questions that

motivated the development of the thesis. Hence, the conclusions drawn from the empirical analysis are limited to the secondary data employed.

One other aspect of insurance market regulation relates to the information imbalances between policy holders and insurers. The results from one of the empirical chapter's point to the existence of information asymmetry in the short-term insurance market. The dataset employed could not allow the application of more robust and widely used techniques to test for the presence or otherwise of information asymmetry in the market. This presents the second limitation of the thesis.

The third limitation relates to sample period. Due to data limitations, comparative analysis of the period before and after 1998 regulation could not be undertaken. This would have been useful to assess the impact of the legislative act on efficiency, competition and risk-taking behaviour across both periods. Finally, the findings and recommendation from this thesis only relates the South African short-term insurance market. Hence, extrapolation of the findings for other short-term insurance markets in Africa may be limited due to differences in market conditions, development and regulatory framework.

8.5 Avenues for Future Research

The empirical analysis undertaken in thesis seeks to serves as a spring board to stimulate academic inquiry into insurance markets in Africa. As an emerging research area in Africa, further studies could be undertaken along the following research gaps, which were not addressed by this thesis.

First, in lieu of the findings on efficiency and returns to scale analysis, future studies could take a more in-depth approach to qualitatively analyse the operational environment of some selected insurance companies in South Africa. Such a case study approach will assist in identifying the major operational issues of managing insurance businesses to provide reference point for other insurance companies. The financial data analysis carried out in this thesis is limited in this aspect. Future researchers could also explore the option of testing for the presence of information asymmetry in the short-term insurance in South Africa.

On the basis of the estimated competitive conditions in the short-term insurance market, future studies could seek to estimate the actual cost of high pricing power and monopolistic tendencies (market power) on efficiency and social welfare. This will help quantify the losses in social welfare associated with pricing power and efficiency losses from the 'quiet-life' enjoyed by management. Fourth, the effect of corporate governance on pricing power in insurance markets could also be examined. Finally, the analysis employed in this paper could also be replicated for the life insurance market in South Africa, as well as other emerging insurance markets.

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