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Risk Management and Performance in Insurance Companies

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Summary

A study in the Netherlands by Laeven & Perotti (2010) has shown that the financial crisis has had a dramatic effect on the insurance industry. The impact of the crisis caused various insurance firms to fail to fulfil financial requirements as stated by the Dutch Central Bank.

Willaims et al. (2006) defined risk management in the following way: “Risk management aims to provide decision makers with a systematic approach to coping with risk and uncertainty.” First, there is traditional risk management which focuses on financial risk and manages risks in individual cases. Next, there is enterprise risk management (ERM) which manages the risks as a package. ERM focussus not only on financial risks, but also on non-financial risks.

Multiple researches have shown that the implementation of ERM has positive effects on both the performance and the value of a firm (McShane et al., 2011; Hoyt & Liebenberg, 2011; Baxter et al., 2013).
The question now rises, whether the effects of the 2007 and 2008 financial crisis could have been alleviated by having implemented enterprise risk management (ERM). This has led to the formulation of the following research question:

Does ERM implementation mitigate the effect of the crisis on performance of insurance companies?

For this study, the data from annual reports has been collected from 39 Dutch insurance firms, resulting in a sample of 156 firm year observations. The years 2005 – 2008 have been taken into account, 2005 and 2006 are regarded pre-crisis years and the years 2007 and 2008 are the years during the crisis.

To find an answer on the research question, both t-tests and regression analysis have been used. The results confirm the decrease in performance during the crisis years. This drop in performance is crucial for investigating the mitigating effect of ERM on performance.

No statistically significant evidence has been found to support the positive effects of ERM on performance, both before and during the crisis years. However, results have been found

supporting the exact opposite. Statistically significant results also show that firms with a higher ERM implementation level have a lower ROA than firms with a lower ERM implementation level in the pre-crisis period.

The combination of these findings results in the following conclusion based on the research question:

Very little evidence has been found to support a mitigating effect of ERM implementation on the negative effects on insurance company performance of the crisis.

Foreword

This thesis has been written as a final assignment of my MSc Business Administration (Financial Management track) program at the University of Twente. The subject of this thesis is enterprise risk management (ERM) and its effect on performance, before and during the financial crisis of 2007 and 2008.

Now that I have finished writing my thesis, I would like to thank several people for their help and support. First I would like to thank Dr. Xiaohong Huang and Prof. Kabir for their guidance and knowledge on the subject of my thesis.

Also I would like to thank my family and friends for their support in some hard times I had while writing this thesis. Special thanks go out to Liselotte for helping out with SPSS, Suzanne for support and motivation and last but not least to my girlfriend Marije for her personal support and understanding.

Enschede, January 27th, 2015.

Table of contents

1. Introduction

A study in the Netherlands by Laeven & Perotti (2010) has shown that the last financial crisis has had dramatic impact on the solvency level of insurance companies. The actual solvency capital was on a level above 300% of the required solvency level before the crisis and dropped dramatically in the years 2007 and 2008. Various individual insurance companies dropped to the level, or below, of the bare minimum requirements of solvency capital as stated by the Dutch Central Bank.

In the insurance business, capital is referred to as surplus. Surplus is required for insurance companies to have collateral for outstanding policies. Without it, insurance companies cannot fulfil their obligations towards the customers. Legislation requires insurance companies to hold certain levels of surplus to cover default risks (Myers & Read, 2001).

Surplus is costly for several reasons. First there are agency and information costs attached to invested capital (Merton & Perold, 1993). Second, some tax systems subject investment income to double taxation, both at corporate level and later when it is realised on shareholder level. Because of the costliness of surplus, insurance companies want to minimize their surplus amounts (Myers & Read, 2001).

Evidence found in earlier studies show that insurance companies have suffered in different extends during the recent crisis. Some insurance companies had some setbacks and decreasing surplus, while other companies had to be bailed out by the government to prevent default (example: AIG (Eling & Schmeiser, 2010); Laeven & Perotti, 2010)).

This shows the impact of the crisis on insurance companies. The question now rises whether or not the effects of the crisis could have been diminished by having an Enterprise Risk Management (ERM) system in place during the crisis.

Academics and industry experts argue that ERM is beneficial for insurance companies for several reasons. ERM helps by decreasing earnings and stock price volatility, increasing capital efficiency, reducing external capital costs, and creating synergies between different risk management activities (Cumming & Hirtle, 2001; Lam, 2001; Meulbroek, 2002; Beasley, Pagach & Warr, 2008; Hoyt & Liebenberg, 2011).

The implementation of ERM is not something that happens overnight. It is a timely and costly process. The ERM theory suggests that "firms with better ERM should be able to manage

their risks more effectively and, therefore, minimize the impact of a crisis on the firm's performance. For instance, firms that possess superior ERM capability should experience less panic sale of their stocks because of analysts' and investors' confidence in such firms" (Nair, Rustambekov, McShane & Fainshmidt, 2013, p.4).
The implementation of ERM programs is held back due to insufficient empirical evidence on the value of these programs (Hoyt & Liebenberg, 2011).

A recent study has shown the value relevance of ERM. Hoyt & Liebenberg (2011) have found evidence for a positive relation between ERM and firm value, calculating firm value by using Tobin's Q. They found statistically significant evidence that firms engaged in ERM have higher firm value than firms not engaged in ERM. Even though proving the value of ERM in insurance companies, the relative small sample size reduces the extend of the generalisation of this study.

1.1 Problem statement.

Over the past decades, more regulations for insurance companies have been created. The Solvency II Directive has been worked on for the past several years and will come into effect in 2016. The question now rises whether regulations concerning risk management are enough to prevent problems from occurring as we saw in the last crisis. There is still no proof that the implementation of Enterprise Risk Management (ERM) leads to better performance. Therefore more research is required to examine the relationship between ERM implementation and performance during a financial crisis.
The ERM framework, created by COSO, does include the components 'Reporting' and 'compliance.' When implementing this framework, firms will have to think about objectives for reporting and compliance. Reporting and compliance is the third pillar in the Solvency II directive. This shows the compatibility of ERM with the Directive.

1.2 Research Question

Based on the problem statement, the following research question can be formulated:
Does ERM implementation mitigate the effect of the crisis on performance of insurance companies?

To answer this research question, several sub questions need to be answered. The first set of sub questions will be theoretical to give a better understanding of the topic at hand.
First of all risk needs to be defined to see what risks financial firms encounter. When understanding the risks the need for risk management will become clearer. This will also give a better understanding of risk management and the benefits of risk management. Next the difference between traditional risk management and enterprise risk management (ERM) needs to be discussed. This leads to the first set of theoretical sub questions:
What is risk?
How can risk be managed?
What are the benefits of enterprise risk management and how does it differ from traditional risk management?

To answer the main research question, some additional sub questions need to be answered. Earlier studies have shown the negative effects of the crisis on performance. The difference in performance before and during the crisis needs to be researched to make sure the same is true for the sample in this study.
Also the question whether ERM implementation affects performance needs to be investigated. This will be done by dividing the sample into groups based on their level of ERM implementation. After dividing the sample, analysis on the difference in performance can be performed. Not only will the performance before and during the crisis be compared, also the effect of the crisis will be investigated for both samples.
The ERM implementation level per insurance firm will be taken into account to see if firms with a higher ERM implementation level have performed better overall, before and during the crisis. This leads to the second set of sub questions.
Is there a difference in performance before and during the crisis?
Does the implementation of ERM lead to better performance?
Do insurance firms with a higher level of ERM implementation perform better than insurance firms with a lower level of ERM implementation?

Answering all of the sub questions will help to answer the main research question, which is the main goal of this thesis.

2. Literature review

In this literature review several aspects concerning risk management and performance are discussed. First risk will be defined, followed by the discussion of two methods of risk management, traditional risk management and enterprise risk management and the difference between these methods. The focus will lie on ERM and the benefits of engaging in ERM. Next, the main European regulations for insurance companies are discussed, the Solvency directive. The chapter will be concluded by the hypotheses.

2.1 Crisis

During the recent credit crisis, insurance companies were less affected than banks (Eling & Schmeiser, 2010). This is because of the difference in business models. Insurance companies are funded in advance and the payments are linked to claims. Also, according to Elling & Schmeiser (2010), many insurers "do not have significant exposure to mortgage–backed securities (MBS) and other forms of securitization and thus have not been directly affected by the credit crunch that was at the root of the current financial crisis."

However, insurance companies have suffered substantially during the recent crisis, on both the asset and liability side. The liability side of the industry can be affected through insurances in the credit market, errors in omissions insurance, or by reinsurers' default.

The negative development of the asset value is unavoidable since insurers are amongst the largest institutional investors on the capital market. Most insurers felt an indirect impact from the losses in investments during plunge in the credit market.

Evidence found in earlier studies show that insurance companies have suffered in different extends during the recent crisis. Some insurance companies had some setbacks and decreasing surplus, while other companies had to be bailed out by the government to prevent default to prevent disastrous repercussions (example: AIG (Eling & Schmeiser, 2010; Laeven & Perotti, 2010)).

2.2 What is risk?

The Oxford dictionary gives multiple definitions of the term 'risk': "The possibility that something unpleasant or unwelcome will happen" and also "The possibility of financial loss". Horcher (2005) states that risk and exposure are closely linked and often used interchangeable. Risk is defined as the probability of loss, while exposure is defined as the possibility of loss. Risk arises as a result of exposure.

Financial market exposure can lead to losses but also to opportunities for gain or profit. Risk is the likelihood of losses occurring from the exposure to the market and changes within the market. Since every organisation exists to provide value for its stakeholders, every organisation needs to have a level of exposure to create opportunities for gain and profit.

Insurance companies face two types of risk: financial risk and non-financial risk (Ai & Brockett, 2008). Over the past years the financial risks have become more important. New types of risks are created due to the changing business environment (Casualty Actuarial Society [CAS], 2003). The foreign exchange risk for instance companies occurred due to growing globalisation.

Financial risk refers to risks involved with capital and financial market risk (Ai & Brockett, 2008). The market risk is associated with fluctuations in value of traded assets (McNeil, Frey & Embrechts , 2005) and consists of interest rate, commodity risk, foreign exchange risk. The credit risk is “the risk of not receiving the promised repayments on outstanding investments, because of default of the borrower” (McNeil et al., 2005), or in short default risk (Ai & Brockett, 2008).

There are multiple types of non-financial risks: Hazard risk, operational risk and strategic risk (Ai & Brockett, 2008). Hazard risk refers to physical risks like theft, fire, liability claims, business interruptions, etc. Operational risk is a broad concept and is defined by the Basel Committee on Banking Supervision (2004) as “the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.” This can include internal and external fraud, products and business practices, damage to physical assets, business disruption and system failures, and execution, delivery and process management. Strategic risk is closely related to the firm’s overall strategies. Reputation risk, competition risk and regulatory risk are included in the strategic risk.

To prevent losses to occur from these risks, multiple forms of risk management can be implemented. The next paragraph will explain more about risk management.

2.3 Risk management.

Risk management has been around for ages. Risk management has been managed by experience, intuition and gut feeling. Being pushed by the financial problems arising from the dot-com boom and bust at the end of the last century, things began to change. This crisis led to specific sets of regulations for specific sectors. For the banking sector Basel and for the insurance industry the Solvency Directive was created. Each of these sets contains regulations concerning the amount of risk companies are allowed to take and financial buffers firms need to have to ensure their continuity. Solvency will be discussed in more detail in chapter 2.5.
With these systematic approaches into place, a new definition by Williams, Bertsch, Dale, Iwaarden, Smith & Visser (2006, p68) was created: “Risk management aims to provide decision makers with a systematic approach to coping with risk and uncertainty.”

According to Williams et al. (2006) there are three types of risk, overlapping the earlier mentioned risk types. First, there are the risks firms are obliged to manage. Often this comes through regulations of regulatory bodies and/ or governments. Also the quality of management and many environmental risks come into this category. Second, there are the classic risks of internal and external theft and fraud inherent to a business dealing with money. These risks are different because they are not regulated externally. Firms create special systems to manage these kinds of risk. Thirdly, there are the risks managed by risk management models. The integrated enterprise risk management (ERM) framework created by the Commission of Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2004) is an example of such a model.

There are two main approaches for risk management in a firm: traditional risk management and ERM which will now be discussed.

2.3.1 Traditional risk management and enterprise risk management.

Traditional risk management separates risk categories into so called risk-silos (Liebenberg & Hoyt, 2003). This means that different risk types; market, credit, liquidity and operational risk are managed separately. The downside of this method is that because of the splitting up of the risks, every risk needs to be managed individually, leading to inefficiencies in risk management.

Enterprise risk management approaches risk management in a different way. Risks are combined into a portfolio leading to a residual risk. This residual risk is smaller than all the risks combined, making it cheaper for hedging and insuring. The risk decrease of the portfolio is explained by the modern portfolio theory. This theory assumes that different assets in a portfolio work in opposite directions on a certain event, causing the negative movement to be cancelled out or minimised by the impact of the positive movement. This decreases the total risk of the portfolio.

Another difference between traditional risk management and enterprise risk management is the focus. Where traditional risk management mainly focuses on financial risks, ERM incorporates strategic and operational risk together with the financial risk into one complete risk management framework.

Enterprise risk management (ERM) was developed because the traditional form of risk management did not produce effective results (Lam, 2000). COSO (2004) developed an ERM – Integrated framework to help organisations evaluate and improve their ERM. COSO defines ERM with the following definition (COSO, 2004, p. 2):

"Enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives".

The main objective of ERM is to help management to deal with uncertainties and the associated risks and opportunities in the process of creating value. The next paragraph will go into more detail about the COSO ERM – Integrated Framework.

2.3.2 The Enterprise Risk Management - integrated framework by COSO.

Prior to the introduction of the ERM – integrated framework, COSO had successfully introduced the Internal Control – Integrated Framework in 1992. After observations on the need for a framework to effectively identify, assess and manage risk, COSO initiated a project in 2001 to develop a framework for evaluating and improving ERM. In cooperation with PricewaterhouseCoopers, the framework was finished in 2004.

To maximise value, management needs to set strategy and objectives to optimally balance growth and return goals and related risks. The following 6 capabilities inherent to ERM will help management to achieve firm's performance targets while preventing loss of resources.

Management needs to *align risk appetite and strategy* by considering the firm's willingness to take risks in evaluating different strategic situations. Related objectives need to be set and mechanisms need to be developed to manage related risks.

ERM will *enhance risk response decisions* by assisting in identifying and selecting alternative risk responses such as risk avoidance, reduction, sharing, and acceptance.

By implementing ERM, firms gain an enhanced capability to identify potential events and establish responses, *reducing operational surprises and losses*.

Firms face risks in different parts of the organisation. ERM helps *identifying and managing multiple and cross-enterprise risks* by facilitating effective response to the interrelated impacts of these risks.

By considering a full range of potential events, management is positioned to identify and proactively *realize opportunities*.

ERM also assists in *improving the deployment of capital*. By obtaining robust risk information, management can effectively assess the overall capital need and enhance capital allocation.

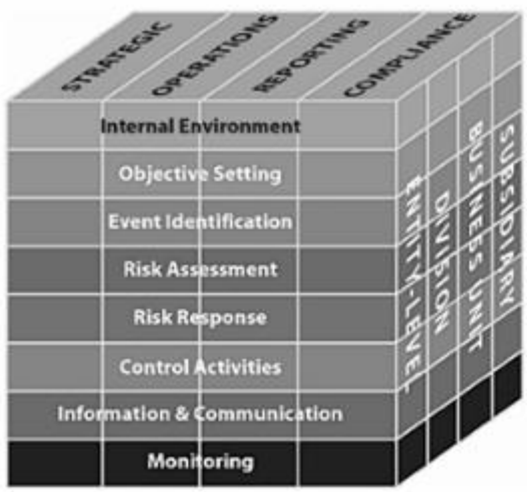

Figure 2.1: COSO ERM - Integrated Framework.

Figure 2.1 is a depiction of the three dimensions of the COSO ERM model. The first dimension is the *achievement of objectives*. The four categories in which objectives will be achieved are shown on the top of the cube. The categorisation of objectives allows a focus on separate aspects of ERM. Objectives relating to reporting and compliance are within the entity’s control, while strategic and operation objectives are subject to external events not always under the entity’s control.

The second dimension consists of the eight interrelated *components of ERM* and is shown on the front of cube. These components are derived from the way management runs an enterprise and integrated within the management process.

The *entity’s units* are depicted in the third dimension on the right side. The three dimensional depiction of the ERM model portrays the ability to focus on the entirety on an entity’s ERM, on all three dimensions, or by objectives category, component, entity unit, or any subset thereof (COSO, 2004).

2.3.3 The benefits of risk management.

Corporate insurance and hedging are two popular types of risk management. Corporate insurance protects against financial consequences of actions by representative of the firm, malfunctioning products or faulty services and contains several types of insurance. One type is ‘general liability insurance,’ which protects against claims against employees, products or services. A second type is the ‘professional liability insurance,’ which protects against claims from clients of malpractice, negligence or errors. A third type is the ‘directors and officers insurance,’ which protects against claims of mismanagement. The second and third examples are often excluded from the general liability insurance (Kumaraswamy, 2005).

Both these methods cost money but when viewed as part of the firm’s financing policy, may increase firm value (Liebenberg & Hoyt, 2003). Mayers & Smith (1982) stated that corporate insurance affects firm value through its effects on investment policy, contracting costs and the tax liabilities.

Theory suggests that corporate insurance helps to reduce expected bankruptcy costs, the tax burden and the cost of regulatory scrutiny. These theories are supported by several studies (Mayers & Smith, 1990; Ashby & Diacon, 1998; Hoyt & Khang, 2000).

Just as corporate insurance, corporate hedging also reduces expected bankruptcy costs. This is done by reducing the probability of financial distress (Smith & Stulz, 1985). The hedging literature (see Smith & Stulz, 1985; MacMinn, 1987; Campbell & Kracaw, 1990; Bessembinder, 1991; Froot, Scharfstein & Stein, 1993; Nance, Smith & Smithson, 1993) also suggests that hedging reduces expected taxes and improves the firm’s ability to take advantage of attractive investment opportunities (Liebenberg & Hoyt, 2003).

2.4 The benefits of ERM.

The main advantage of ERM over traditional risk management is the management of all risk types together instead of using the older 'silo' approach. By integrating decision making across all risk types, firms can exploit natural hedges, thus avoiding the costs of the duplication of risk management. Firms engaged in ERM should have a better understanding of the aggregated risk of different business activities, providing them with a more objective basis for resource allocation. This will improve return on equity (ROE) and capital efficiency (Meulbroek, 2002).

When having a wide range of investment opportunities, ERM is likely to be more beneficial in selecting investments based on a more accurate risk-adjusted rate than was possible whilst using traditional risk management.

ERM provides a framework which combines all risk management activities, facilitating the identification of interdependencies between risks. Thus an ERM strategy aims to reduce volatility by preventing aggregation of risk across different sources (Hoyt & Liebenberg, 2011).

The improvement on the information of the organisation's risk profile is another potential source of value created by ERM. Assessing the financial strength and risk profiles for highly financially and operationally complex organisations is difficult for outsiders. ERM might enable these organisations to be more transparent about their risk profile and serve as a signal of their commitment to risk management. By being more transparent about risk management, expected external capital and regulatory scrutiny costs are likely to decrease (Meulbroek, 2002). Standard & Poor's, a major rating agency, has increased the focus on risk management in the insurance industry and has taken ERM as assessment criteria. This will likely be an incentive for insurance companies to implement ERM, leading to a higher rating. Since ratings by rating agencies are often used as a performance indicator, a higher rating will be deemed a safer investment, thus reducing the costs of external capital.

Research on ERM has proven that ERM-adopting firms are able to produce a greater reduction of risk per dollar spent on risk management. Firms adopting ERM also experience a reduction in stock volatility. Due to the costliness and complexity of ERM implementation, the reduction in stock volatility is gradual and grows over time (Eckles, Hoyt & Miller, 2014).

2.4.1 Evidence of the benefits of ERM

To study the value implications of ERM in insurance companies, Hoyt & Liebenberg (2011) created two main variables; Tobin's Q and ERM. Tobin's Q is the most often used proxy for firm value (Smithson & Simkins, 2005).

The study has shown that firm engagement in ERM has positive outcomes. The announcement of a chief risk officer (CRO) is used as one of the indicators for ERM implementation. The mean and median Tobin's Q observations are significantly higher in the group with an identifiable ERM program, meaning a higher firm value for the ERM users.

Baxter, Bedard, Hoitash & Yezegel (2013) have investigated whether firms with high-quality ERM systems in place, perform better and are higher valued than firms with lower quality ERM systems in place. Their findings show that a higher level of ERM implementation "assists performance by helping to mitigate losses and/or to take advantage of opportunities." Also evidence is found for a positive and significant market effect to high levels of ERM implementation. Positive market responses to high levels of ERM implementation imply anticipation for better future performance. The positive market responses occur prior to the announcement of a CRO, which is often used as an indicator of ERM implementation. This is evidence of the usefulness of accounting information such as annual reports.

Also evidence has been found of quicker rebounds after the crisis period for firms with higher levels of ERM implementation. This is further proof of the confidence investors have in high level ERM implementation and the ability of these firms to address future risk in a more systematic manner.

2.5 The Solvency Directive: European regulations for insurance companies.

Different sectors have different regulations. In this chapter the European regulations will be described as put down in the Solvency Directive. The Oxford Dictionary defines solvent as: "Having assets in excess of liabilities; able to pay one's debts." The solvency ratio in insurance companies refers to the amount of capital available compared to the premium written. After the description of the Solvency Directive, the link between ERM and the Directive will be made.

In the European Union (EU) there are centralized regulations for the solvency of the insurance industry. These regulations have been put in place to protect the consumers against the risk of insolvency of insurance companies (Solvency II Directive, 2009). The EU's solvency regime was created in the 1970's and contained a specific set of outlined solvency requirements. In 2004 the Solvency I project came into effect. The Solvency I regulations did not differ very much from the earlier regulations, focussing on calculations of the solvency margins. Solvency I can be seen as a robust and easy to understand system which is inexpensive to monitor. The downside of this system is that it is mainly volume based and not explicitly risk based (McNeil et al., 2005).

To really change the regulations, the Solvency II project was started in 2001. When Solvency II comes into effect in 2016, it will replace multiple insurance directives currently in place. The key objectives of Solvency II include an improved consumer protection, Modernised supervision, a deepened EU market integration and an increased international competitiveness of EU insurers.

Solvency II is not just about capital requirements. A lot of risk management aspects are covered in the Solvency II program. Different aspects are covered in the three different pillars; 1) Capital Requirements, 2) Governance & Supervision and 3) Enhanced Reporting and Disclosure.

2.5.1 Pillar 1: Capital Requirements.

The focus of pillar 1 is the capital requirements. The main requirements are based on the Solvency Capital Requirement (SCR) and the Minimum Capital Requirement (MCR). More detailed information can be found in the Solvency II directive (2009) Chapter VI.

There is a standardized formula designed to calculate the firm's SCR. The standardized formula shall consist of at least the following risk modules: non-life underwriting risk; life underwriting risk; health underwriting risk; market risk; counterparty default risk. Insurance firms are also allowed to use an internal model to calculate the SCR when regulatory approval is given.

Calculations regarding MCR must be clear and simple and in such a way as to ensure that the calculation can be audited. The MCR is calculated using a linear function of specified variables; the undertaking's technical provisions, written premiums, capital-at-risk, deferred tax and administrative expenses. The MCR is required to stay above 25% and below 45% of the SCR.

Pillar 1 also includes harmonized standards for the valuation of assets and liabilities (Solvency II Directive, 2009).

2.5.2 Pillar 2: Governance & Supervision.

Pillar 2 demands higher standards of risk management and governance and supervision within a firm. This can be achieved by creating a system of governance within key positions of the organization. Supervisors in this system are given more power to challenge their firms on risk management issues. The system includes the 'Own Risk and Solvency Assessment', requiring a firm to undertake its own forward-looking self-assessment of its risks, corresponding capital requirements, and adequacy of capital resources (Solvency II Directive, 2009).

2.5.3 Pillar 3: Enhanced Reporting and Disclosure.

Pillar 3 aims for greater levels of transparency for both supervisors and the public. This will be achieved by introducing the Solvency and Financial Condition Report for the public and the Regular Supervisory Report for the supervisors. Firms will have to make reports containing core information to the regulators on a quarterly and annual basis to ensure a better representation of the firm's financial position.

This increase of transparency and open information is intended to assist market forces imposing greater discipline in the insurance industry (Solvency II Directive, 2009).

2.5.4 ERM and the Solvency II Directive.

Two of the objectives of the COSO ERM framework are the improvement of reporting and of compliance (COSO, 2004), as can be seen on the top side of the COSO model in Figure 2.1. Both of these aspects of the ERM framework can be directly linked to the Solvency II Directive. The reliability of reporting is one of the main aspects of pillar 3 of the Directive. The compliance aspect of ERM strives for the compliance to rules, regulations and laws put in place by the governments.

As stated earlier, the reporting and compliance are within the entity's own control. This makes it relatively easy to fulfil European regulations by implementing these aspects of the ERM framework.

2.6 Hypotheses.

To answer the research question some hypotheses have been formulated. These hypotheses are derived from findings of earlier research and literature.

As seen in the research by Laeven & Perotti (2010), the crisis had a big impact on the solvency level of insurance companies. Before the crisis, solvency levels exceeded 300% of the required solvency capital. During the crisis this has dropped to, or even below, the bare minimum amount of solvency capital as required by the Dutch Central Bank. Decreasing performance could lead to lower solvency capital and could be the cause for this drop in solvency capital.

Erkens, Hung & Matos (2012) have shown that performance during the crisis has decreased in their global study on financial firms.

To properly answer the research question, insurance company performance of the pre-crisis years (2005, 2006) needs to be compared with performance of the crisis years (2007, 2008). This has led to the formulation of hypothesis 1.

H1: Performance in the insurance industry level has been worse during the financial crisis.

Research has shown the level of ERM implementation affects performance in a positive way (Hoyt & Liebenberg, 2011; Baxter et al., 2013). A higher level of ERM implementation could help firms to identify and address risks in an earlier stage. Early identification of risks allows time for the organisation to respond to the risks before real damage has been caused to the finances of the firm.

To answer the research question, performance of firms with a higher ERM implementation level needs to be compared to the performance of firms with a lower ERM implementation level.

H2: Insurance companies having higher levels of ERM implementation perform better than insurance companies with lower levels of ERM implementation.

A higher level of ERM implementation could help firms to identify and address risks in an earlier stage. An earlier identification of the financial crisis, could allow for reinvesting the firms' capital, steering clear of the investments highly affected by the crisis such as stocks. Early measures against the crisis should result in a smaller impact of the crisis, thus mitigating the effects of the crisis.

To study the mitigating effect of ERM implementation on performance during a crisis, the relative decrease of performance during the crisis years needs be compared between firms with high and firms with low ERM implementation levels. This has led to the formulation of hypothesis 3.
H3: A higher level of ERM implementation mitigates the effects of a financial crisis on performance of insurance companies.

To answer H2 and H3, an analysis of the ERM implementation level needs to be performed. Second, the ERM implementation levels and performance of the insurance companies need to be coupled and compared to the other insurance companies in the sample.

3. Methodology

This chapter will begin with discussing the model used in this study. This will be followed by a description of the testing methodology. This will include a description of the variables used during the study. Next the principal component analysis and regression analysis will be discussed. The chapter will conclude with a description of the measurement period and the sample selection process.

3.1 Model.

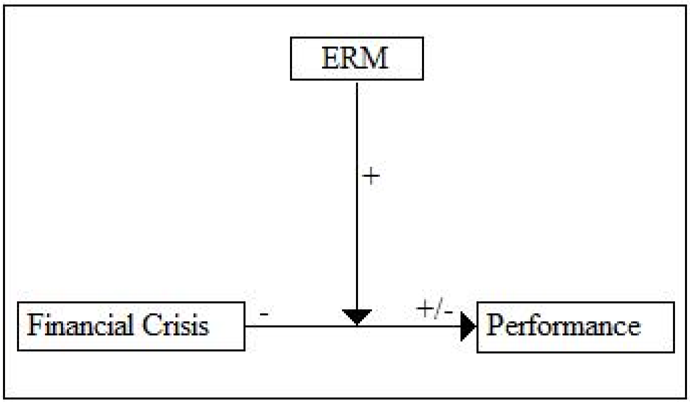

Figure 3.1: Model

This model shows the assumed negative impact of the financial crisis and the assumed positive impact of ERM on performance. Whether ERM has a significant impact on performance during a crisis will be the focus of this study.

Before investigating the impact ERM has on performance during the crisis, the crisis impact on performance needs to be investigated. This will be done by comparing the firm performance before (2005 and 2006) and during (2007 and 2008) the crisis years using paired samples t-tests (Eling & Schmeiser, 2010; Laeven & Perotti, 2010). Performance will be measured using the return on assets (ROA) and return on equity (ROE) (Clarke, Seng & Whiting, 2011; Baxter et al., 2013).
The results of the analysis on the crisis impact on performance will be used in answering hypothesis 1. Hypothesis 1 will only be supported if the results of the t-tests are statistically significant. Data within the confidence interval of 95% or a significance level of $p < 0.05$ will be regarded as statistically significant (Van Groningen & De Boer, 2010).

For the testing of the impact the ERM implementation level has on performance, the sample will be divided into two samples. The division will be based on the ERM implementation level. Again, t-tests will be used to determine whether the difference between the two samples is statistically significant.

To further analyse the impact ERM implementation has on performance, a regression analysis will be performed (Baxter et al., 2013). The regression formula is presented below in Formula 3.1.

$$Performance_i = \beta_0 + \beta_1\ ERM_i + \beta_2\ LEVERAGE_i + \beta_3\ SIZE_i + \beta_4\ LIFE_{i\ dummy} + \beta_5\ (ERM_i * DURINGCRISIS_{i\ dummy}) + \beta_6\ DURINGCRISIS_{i\ dummy} + \epsilon_i.$$

Formula 3.1: Performance regression formula

The regression formula consists of three types of variables; dependent, independent and control variables. These types of variables will be discussed in the next paragraphs. The error term, or residuals, ϵ_i is also included in the regression formula. This variable covers all other factors influencing the independent variable other than the variables already included in the model.

3.2 Variables.

Dependent variables, independent variables and control variables are multiple types of variables included in the regression formula in Chapter 3.1. The different variable types will be explained and more information on the variables will be given in this chapter.

3.2.1 Dependent variables.

To measure the performance of a company, multiple methods can be used such as the return on assets (ROA), return on equity (ROE) and Tobin's Q, these are the dependent variables. Both the ROA and the ROE are ratios used for the measurement of performance in different studies. The ROA is used by Baxter et al. (2013) as a measure of accounting performance in their study on the benefits of ERM on performance. The ROE and the ROA are both used in a performance study by Clarke et al. (2011).

Tobin's Q is often used a variable to examine firm value (Smithson & Simkins, 2005; Hoyt & Liebenberg, 2011; Quon, Zéghal & Maingot, 2012). An advantage of using Tobin's Q when measuring firm value is that it reflects market expectations and therefore is relatively free of managerial manipulations.

The ROA and the ROE will be calculated using the same formula as is used in the Orbis database and by Clarke et al. (2011).

The ROA will be calculated by dividing the profit before tax by the total assets.

The ROE will be calculated by dividing the profit before tax by the total equity.

Tobin's Q will be calculated as the market value of equity plus the book value of liabilities divided by the book value of assets. This formula is widely used for Tobin's Q as seen in multiple studies in different fields (Allen & Rai, 1996; Palia, 2001; Cummins, Lewis & Wei, 2006; Elango, Ma & Pope, 2008; Hoyt & Liebenberg, 2011).

3.2.2 Independent variables.

This study focuses on the impact of ERM implementation and of the financial crisis on the performance of insurance firms. To make a distinction between the period before and during the crisis, the dummy variable DURINGCRISIS has been included in the regression formula. DURINGCRISIS is scored 0 for the period preceding the crisis (2005 and 2006) and 1 otherwise (2007 and 2008).

The second and more complicated independent variable is ERM. The variable ERM indicates the ERM implementation level for each firm per firm year. On the next pages the measurement of ERM will be described.

There are multiple manners in measuring the implementation of ERM. Several researchers use the appointment of a Chief Risk Officer as an indicator of first ERM implementation (Hoyt & Liebenberg, 2003; 2011; Beasley, Clune & Hermanson, 2005; 2008; Eckles et al., 2014). Often this information is gathered from news databases like LexisNexis by searching articles on key words and phrases such as: 'Chief Risk Officer,' 'Enterprise Risk Management,' 'Enterprise Risk Officer,' 'Strategic Risk Management,' 'Integrated Risk Management,' 'Holistic Risk Management' and 'Consolidated Risk Management.' After a hit on an article, the article is carefully studied to determine whether an ERM adoption event is documented (Eckles et al., 2014).

Standard & Poor's is a rating agency. Only recently have they begun rating risk management in the insurance industry. Some studies base their ERM implementation level on the risk management rating provided by S&P (McShane, Nair & Rustambekov, 2011; Baxter et al., 2013). The S&P rating is qualitative, using the terms 'weak,' 'adequate,' adequate with a

positive trend,' 'strong' and 'excellent' to describe the risk management level. When comparing companies by using statistical analysis, these qualitative scores need to be changed to numerical scores.
Next to qualitative measurements of ERM implementation, quantitative measurements have been used, often in the form of an ERM index. Gordon, Loeb & Tseng (2009) created an ERM index based on the COSO Framework as described in Chapter 2.3.2. The four objectives components of the framework, 'Strategic,' 'Operations,' 'Reporting' and 'Compliance' were used for the calculation of the ERM index score. The scores on the variables were first standardized before use in the ERM index formula.
Aebi, Sabato & Schmid, (2011) used a set of ten variables for the creation of their ERM index. They based their variables on a set of best practices for risk management as defined by Mongiardino & Plath (2010). The method of an ERM index will be the method used in this paper.

To properly compare companies based on ERM, some measurements need to be performed to assess the level of ERM implementation within the firm. The presence of a chief risk officer (CRO), board independence, ERM support by the chief executive officer (CEO) and the chief financial officer (CFO), the presence of a Big Four auditor, entity size and entities in the insurance sector are all measurable factors associated with the stage of ERM implementation (Beasley et al., 2005). Other research has shown additional factors associated with the stage of ERM implementation such as the presence of a risk committee, leverage and external stakeholders (Pagach & Warr, 2010; Sabato, 2010; Aebi et al., 2011; Hoyt & Liebenberg, 2011). All of these factors are determinants of the ERM implementation level and are included in the following formula:

ERM implementation level = f [CRO, RC, BOARDINDEP, BIG4, SIZE, LEVERAGE, INSTITUTIONS]

Formula 3.2: ERM implementation level

Next the ERM determinants will be shortly discussed. For the calculations of the ERM determinants, all the information will be extracted from year reports and databases. No interviews will be conducted to gather data.

Presence of a CRO [CRO].

Multiple studies (Liebenberg & Hoyt, 2003; Beasley et al., 2005) have used the presence of a CRO as a benchmark for the implementation of ERM. These studies have proven that the presence of a CRO is positively associated with the ERM implementation level.

CRO will be scored 1 when a chief risk officer is present and 0 if not present in the firm. No mention of a chief risk officer will result in a score of 0, thus negatively impacting the score on the ERM implementation level (Hoyt & Liebenberg, 2011).

Presence of a risk committee [RC].

Similarly to the presence of a CRO, the presence of a risk committee is also a good indicator of the implementation of ERM (Sabato, 2010; Aebi et al., 2011). Since a risk committee is comparable to a CRO, the risk committee will be included in this research.

RC will be scored 1 when a risk committee is present and 0 if not present in the firm. No mention of a risk commission will result in a score of 0, thus negatively impacting the score on the ERM implementation level (Hoyt & Liebenberg, 2011).

Independence of the board of directors [BOARDINDEP].

Firms in the Netherlands have two boards, the executive board and the supervisory board. The executive board runs the day-to-day business. The supervisory board supervises the executive board. In this study the independence of the supervisory board will be measured.

The implementation of ERM is often encouraged by the board of directors (Kleffner, Lee & McGannon, 2003). This study showed that the independence of the board of directors from management is a key factor affecting the board's oversight effectiveness. A more independent board is more objective in the assessment of management actions than a less independent board. Beasley et al. (2005) have shown that a higher percentage of independent board members leads to a higher level of ERM implementation.

The presence of a CRO and the higher level of board independence are both factors showing that ERM implementation is dependent on the tone at the top towards ERM.

BOARDINDEP will be calculated to represent the percentage of independent supervisory board members present. No information on the independence of the supervisory board members will result in a score of 0 thus negatively impacting the score on the ERM implementation level.

Presence of Big Four auditor [BIG4].

Deloitte, PwC, Ernst & Young and KPMG are the "Big Four" auditor firms. Most of the academic literature studying audit quality, classify the Big Four as high quality auditors. Beasley et al. (2005) have shown that firms audited by one of the Big Four auditing firms are further into ERM implementation than firms audited by non-Big Four auditing firms.

BIG4, will be scored 1 if one of the Big Four auditing firms audits the firm and 0 if another auditing firms does the firms' auditing.

Firm size [SIZE].

As the size of an organisation increases, the scope of risks is likely to differ in nature, timing and extent. The need for having a more effective enterprise-wide risk management system will increase with the size of the firm. Larger firms may have greater resources allowing for greater ability to implement an ERM system. Multiple studies have shown that larger firms have a higher ERM implementation level than smaller firms (Colquitt, Hoyt & Lee, 1999; Beasley et al., 2005; Hoyt & Liebenberg, 2011)

SIZE will be calculated by using the natural log of the book value of assets (Hoyt & Liebenberg, 2011).

Leverage [LEVERAGE].

The theoretical link between leverage and ERM implementation is unclear. Firms having implemented ERM, may have lower leverage if they have decided to lower the probability of financial distress, while on the other hand, firms may decide to take greater financial risk thus increasing their leverage.

Hoyt & Liebenberg (2011) have shown that on average a firm implementing ERM has a lower leverage that a firm not implementing ERM, proving that a negative correlation exists between leverage and ERM implementation. These findings are also supported by Pagach & Warr (2010).

LEVERAGE is the only variable with a negative correlation with ERM. Firms with lower leverage have higher ERM scores (Pagach & Warr, 2010; Leach & Melicher, 2012). To incorporate this into the calculation, LEVERAGE will be calculated by dividing 1 by the total debt divided by the total assets.

External stakeholders [INSTITUTIONS].

Pressure from external stakeholders is an important force behind the implementation of ERM (Lam & Kawamoto, 1997; Lam, 2001). Where regulatory pressure will be similar across a given industry, shareholder pressure will be different per firm.

Institutions holding large quantities of shares will have more pressure than individuals holding smaller amounts of shares. This makes them more powerful in exerting pressure on the firm. The higher the percentage of institutional share ownership, the more likely it is for firms to engage in ERM. Hoyt & Liebenberg (2011) have proven that firms engaged in ERM have a higher percentage of institutional share ownership.

The INSTITUTIONS variable will be scored as the percentage of stocks held by institutions. No available stock data will result in a score of 0.

3.2.3 Control variables.

The first control variable is LEVERAGE. Leverage ratios indicate to which extend a firm has used debt to finance its business (Leach & Melicher, 2012). The relation between financial leverage and performance is unclear. Leverage reduces free cash flow that might have been invested by self-interested managers in suboptimal projects (Jensen, 1986), thus increasing performance. Excessive leverage can increase bankruptcy probability, causing additional financial distress costs (Hoyt & Liebenberg, 2011).

In earlier studies (Anderson & Reeb, 2003; Hoyt & Liebenberg, 2011; Baxter et al., 2013), leverage is used as a control variable for firm performance.

The second control variable, SIZE, will be calculated by using the natural log of the total assets (Hoyt & Liebenberg, 2011). Hoyt & Liebenberg (2011) have found a negative relation between size and performance. To control for size related variation in performance, SIZE will be included as a control variable.

The last control variable is the dummy variable LIFE. The difference between life and non-life insurance companies needs to be taken into account when looking at performance. Where life insurance pays out in case of a death, non-life insurance has much more frequent pay-out moments. This fundamental difference makes it necessary to create the dummy variable LIFE (Hoyt & Liebenberg, 2011; Cummins & Weiss, 2013). The variable LIFE takes value 1 if the insurance firm focuses primarily on life insurance, 0 otherwise.

The ORBIS database has the search criteria life insurance and non-life insurance. This has been used to make the primary division. Some firms are marked as both life and non-life insurers in the database. These firms have been divided manually based on their largest sector.

3.3 Principal component analysis to create the ERM index.

The ERM index is a composite variable, created by using different types of variables using different measurement scales. The ERM index will be determined by applying the principal component analysis (PCA) as is done by Ellul & Yerramilli (2013).

The PCA helps to reduce the number of variables in the study by combining the original variables into a smaller set of new variables. The variables of Formula 3.2 will be used as input for the PCA. The new components are called principal components. The transformation into principal components is done in such a way that the first component accounts for the maximum variance in the data as possible. Each succeeding component has the highest variance possible, under the constraint that it is uncorrelated with the preceding components.

Before any the creation of an ERM index can take place, all scores on the variables need to be standardized. At this moment the variables differ in scale and the PCA is highly sensitive to scaling of variables. The CRO is a dummy variable and can only take a score of 0 or 1. The BOARDINDEP is expressed as a percentage, allowing for scores between 0 and 1. SIZE is the natural logarithm of the total book value of the assets. By transforming all of the variables into standardized z-scores, every measure is on the same scale, allowing for computing with different variable types (Van Groningen & De Boer, 2010).

Standardized z-scores are calculated by subtracting the mean (μ) of the total sample from the score of this particular firm. This is divided by the standard deviation (σ) of the sample. This is formulated in Formula 3.3.

$$Z = \frac{X - \mu}{\sigma}$$

Formula 3.3: Standardized z-score

The new sample of standardized z-scores always has a mean of 0 and standard deviation of 1. Negative z-scores reflect scores below average on the original variable. If a firm has a z-score of 2 shows that the firm has had a score of 2 standard deviations higher than the mean of the original sample.

3.4 Regression analysis.

Regression analysis is a technique used to estimate relationships between variables. The regression analysis helps to understand how the dependent variable changes when one of the independent variables is changed, while the other independent variables stay the same (Van Groningen & De Boer, 2010). The size and direction of the change in the dependent variable is shown by β in the regression formula (McShane et al., 2011; Baxter et al., 2013).

This study will focus on the effect of ERM implementation (independent variable) on the firm performance (dependent variable). The effects of the financial crisis will also be incorporated in the regression analysis, but the crisis effect will primarily be investigated using other techniques.

The regression analysis will be performed using the statistical program SPSS. The outcomes of the regression analysis are the β's shown in the regression formula in Formula 3.1. The value of β represents the factor of the change in performance if the independent variable changes. If β has a positive value, the performance will increase by β if the independent variable increases by 1 and performance will decrease by β if the independent variable decreases by 1. The opposite is true for a negative value of β.

3.4.1 Validity.

The results of the regression analysis also have to be tested to investigate whether or not the results are valid or not. The validity will be tested using a combination of methods. First the R^2 will be investigated. The R^2 measures the amount of variation explained by the independent and control variables. The regular R^2 increases if more variables are added to the equation. To take into account the number of variables, the adjusted R^2 will be used.
The residuals (ϵ) in a regression analysis should be normally distributed for the results to be valid. Testing the normality of the residuals can be done by using a histogram or P-P plot. These are two visual tests of normality. A Shapiro-Wilk test for normality is a statistical test to investigate the normality of the residuals. A statistically significant result of this test shows that the sample in non-normally distributed (Razali & Wah, 2011).

3.5 Hypothesis testing.

Some tests on the data have to be performed to prove, or disprove, the hypotheses as stated earlier in Chapter 2.6. These tests differ between hypotheses.

Hypothesis 1 will be investigated using paired samples t-tests. These tests will show whether or not a difference in performance exists between the 2 groups. In this case the pre-crisis and the crisis years will be selected as grouping variables.

A combination of regression analysis and t-tests will be used to test hypotheses 2 and 3. The firms will be divided into 2 groups based on the ERM implementation level. The performance of these groups will be compared to investigate whether ERM implementation leads to a difference in performance. Also these 2 groups will be used when measuring the difference in the effects of the crisis years and to see whether or not ERM implementation mitigates the effects of the crisis.

Both hypotheses will also be tested using a regression analysis. The effect of the independent variable ERM_i on the dependent variable $PERFORMANCE_i$ will be investigated. The effects of ERM implementation during the crisis years will be investigated using an interaction dummy variable.

A hypothesis will only be supported when sufficient statistically significant data has been found to support the hypothesis. Data within the confidence interval of 95% or a significance level of $p < 0.05$ will be regarded as statistically significant (Van Groningen & De Boer, 2010).

3.6 Measurement period.

A measurement period for this study needs to be defined. To study the performance before and during the financial crisis, first the ‘crisis years’ need to be defined. Following earlier studies, 2007 and 2008 have been labelled as the ‘crisis years’ (Eling & Schmeiser, 2010; Laeven & Perotti, 2010). To study the difference between crisis and pre-crisis years, also the performance in pre-crisis years need to be taken into account. Because the crisis is affecting regular performance, the two years preceding the crisis, 2005 and 2006, will be regarded as the pre-crisis years.

3.7 Sample selection.

For this study, insurance companies in the Netherlands will be studied. To select these companies to be included, some criteria need to be established. The first criterion is that the insurance company must be located in the Netherlands. Second, the financial data required for this study needs to be available.

ORBIS allows for a great variety of search criteria. The firm location (Netherlands) is the first criterion used in the selection. The second selection criterion is the industry the firm is active in. Only insurance firms are included in the search. Lastly, only firms with available financial data in the entire 2005 – 2008 period are included in the search. This has led to 48 insurance companies in the Netherlands, both parent and subsidiary firms, with available financial data from the year 2005 to 2008 available in the Orbis database. 8 firms have been excluded for being the parent company of one or more subsidiary firms in the same dataset. The financial data of the subsidiary firm are included in the consolidated year report of the parent firm, which would lead to a double counting. 1 Firm has been excluded from the study due to insufficient available annual reports, or data required for the calculation of the ERM implementation level, leaving a total sample of 39 firms. A sample of 39 firms results in a total sample of 156 firm years.

4. Data

Now that the methodology is determined, the data collection will take place. The data will be collected from various sources; annual reports provided by insurance companies websites, the REACH database and the ORBIS database. The ORBIS database will also be used to collect key financial data. An overview of the insurance companies can be found in Appendix I.
When information has been gathered, it is put into an excel file per company for later use in SPSS. An example of the data collected and entered into a table for overview can be found in Table II.1 in the appendix. Next a table showing the descriptive statistics of the total sample will be shown.

Variable	Mean	Median	1st Quartile	3rd Quartile	Min	Max	Std Dev
ROA	2,587	2,165	0,138	5,985	-19,190	16,960	5,686
ROE	7,978	15,070	1,065	25,533	-438,970	575,620	71,882
CRO	0,103	0	0	0	0	1	0,304
RC	0,282	0	0	1	0	1	0,451
BOARDINDEP	0,162	0,000	0,000	0,000	0,000	1,000	0,345
BIG4	0,949	1	1	1	0	1	0,221
SIZE	14,082	13,900	12,725	15,075	9,400	19,900	2,130
LEVERAGE	0,767	0,800	0,690	0,930	0,030	1,000	0,206
1/LEVERAGE	2,033	1,125	1,075	1,449	1,000	33,330	4,204
INSTITUTIONS	0,904	1,000	1,000	1,000	0,000	1,000	0,279
LIFE	0,333	0	0	1	0	1	0,473
NONLIFE	0,667	1	0	1	0	1	0,473
TOTAL ASSETS (Mil $)	$17.938	$1.088	$336	$3.527	$12	$438.996	65727

Table 4.1: Descriptive statistics (N = 156)

As visible in the table above, the performance measurement Tobin's Q has been excluded. This is caused by the fact that this variable is based on the market value of equity. The market value of equity is calculated by multiplying the number of stocks with the stock price (Hoyt & Liebenberg, 2011). Since most firms in the sample are not publicly traded, stock data are not available. This makes it impossible to calculate the market value of equity.

For the dummy variables, the mean can be interpreted as the percentage of firms scoring a 1 on the variable. The closer the mean is to 0.5, a fifty-fifty distribution, the higher the standard deviation. Of the dummy variables, BIG4 has a mean furthest from 0.5 of all the dummy variables and thus has the smallest standard deviation. Only 2 out of the 39 firms are not audited by a Big Four auditing firm, resulting in 8 non-BIG4 observations out of 156 observations in total.

Even though BOARDINDEP and INSTITUTIONS are measured as a percentage, the median values and quartiles are scored 0 and 1. This is because 80% of the firms score 0 on BOARDINDEP and 87% of the firms score 1 on INSTITUTIONS.

Table II.2 in the Appendix shows the descriptive statistics of the firm averages of all the years. The only variables that stand out in that table are the performance measures ROA and ROE. The minimum and maximum values are less extreme and also the standard deviation has decreased a lot.

The extreme values found for ROA and ROE could be explained by outliers in the sample. This will be explored and dealt with in Chapter 5.1 before continuing to the analysis. The original descriptive statistics of the performance measures per firm year are visible in Table II.3 in the Appendix

For future use, 1/LEVERAGE will be used for the variable LEVERAGE as is explained earlier in Chapter 3.2.2.

4.1 ERM index.

Because of the different measures included in the index, it is necessary to develop the index before any analysis can take place. As mentioned before, the construction of the index will take place using the PCA method in SPSS.

The preliminary analysis of the PCA consists of two parts before continuing. First we need to look at the correlation matrix in Table III.1 for any variables being too correlated with others. Too high correlation would mean very similar impact on the result. The correlation between BOARDINDEP and INSTITUTIONS is -0.836 and highly statistically significant. This means that these variables mirror each other which results in loss of statistical power. To handle this problem, there are two options. First, one variable could be deleted. The downside of this option is that some firms score 100% on BOARDINDEP and 0% on INSTITUTIONS, while other firms score exactly opposite. This option would negatively affect one of these groups. The second option is to combine the two variables into a new variable. This could be achieved by adding the variables and dividing this by 2, thus taking the average score. This new variable will be called BOARDINST and will be used in further analysis. A new correlation matrix is presented in Table III.2

Step two of the preliminary analysis is the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The KMO measure tests how small the partial correlations, relative to the original correlations, between the variables are. If the variables share common factors, the partial correlation is smaller and the KMO score is closer to 1. The KMO measure can vary from 0 to 1 and should be greater than 0.5 to show that the sample is adequate and usable for further analysis (Parinet, Lhote & Legube, 2004; Field, 2005). The sample has a KMO score of 0.616, this is sufficient to continue the analysis.

The Bartlett's test tests for equal variances in the samples. The test has the null hypothesis that the original correlation matrix is an identity matrix. For factor analysis to work we want this test to be significant (Parinet et al., 2004; Field, 2005). The dataset used in the Bartlett's test is highly significant ($p < 0.01$), therefore analysis can continue. The results of the KMO and Bartlett's Test can be found in Table III.3.

Now that the preliminary analysis is completed, we can continue with the PCA. This is done using the standardized variables as described in Formula 3.3. The eigenvalues are shown below in Table 4.2. On the left is the number of components. This equals the number of variables used. The initial eigenvalues represent the variance explained by each component. Component 1 explains 35.083% of the variance in the total sample and component 2 explains 19.896% of the variance. Together these two components explain 55.069% of the variance in the sample.

Next all the components with eigenvalues greater than 1 are extracted. The eigenvalues after rotation are displayed on the right side of the Table. Rotation refers to the rotation of the new components to create a clearer image of the input variables in relation to the new components. It can be seen that component 1 losses a little explaining power of the variance and components 2 becomes a little more explanatory.

A visual representation of the rotation can be seen in Figure III.2 and Figure III.3 in the Appendix.

Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,105	35,083	35,083	2,099	34,990	34,990
2	1,199	19,986	55,069	1,205	20,080	55,069
3	,972	16,208	71,277			
4	,758	12,637	83,914			
5	,544	9,061	92,975			
6	,421	7,025	100,000			

Extraction Method: Principal Component Analysis.

Table 4.2: Total Variance Explained

A scree plot is a graph of the eigenvalues and can be seen in Figure III.1 in the Appendix. The components are arranged in descending order to create a downward sloping graph. Both the scree plot and the eigenvalue can be used to determine the numbers of components to extract. Since this study uses standardized values, Kaizer's criterion can be applied. Kaizer's criterion states that because all the components have been standardized, they all add a variance of 1. All components with an eigenvalue above 1 explain more variance than they add so have explanatory power.

The next step is the rotation matrix as can be seen below in Table 4.3. The rotated component matrix shows the loads of the original variables on the two new components. The underlined scores are the biggest loads per variable.

Rotated Component Matrix[a]

	Component	
	1	2
CRO	**,670**	,030
RC	**,790**	,114
BOARDINST	,522	**-,653**
BIG4	,221	**,871**
SIZE	**,782**	-,015
LEVERAGE	**-,304**	,071

a. Rotation converged in 3 iterations.

Table 4.3: Rotated Component Matrix

One obvious observation is that all variables score high on one component and low on the other. This means that all variables can be expressed in these 2 new components.

The two new components are the results of the PCA and the six input variables. The variables CRO, RC, SIZE and LEVERAGE score high on component 1. The first two variables relate to management and the last two variables relate to the firm's total assets. Component 1 will be named MANTA. The variables BOARDINST and BIG4 score high on component 2. These variables relate to control and ownership of the firm, therefore component 2 will be named CONTROWN. Next the descriptive statistics of the principal component is displayed in Table 4.4.

Descriptive Statistics

Variable	Mean	Median	1st Quartile	3rd Quartile	Min	Max	Std Dev
MANTA	0,000	-0,373	-0,588	0,408	-2,107	3,494	1,000
CONTROWN	0,000	0,258	0,249	0,394	-4,344	0,670	1,000

Table 4.4: Descriptive statistics (N = 156)

Firms scoring high on the variables MANTA and CONTROWN will be regarded as having a higher level of ERM implementation than firms scoring low.

The descriptive statistics show most of the scores on CONTROWN are packed closely together. The middle 50% of the observations lie between 0.249 and 0.394. The MANTA scores are more evenly spread like a normal distribution.

Studying the correlation matrix in Table III.2 shows that between both variables in CONTROWN, a very significant correlation is present. This results in high scores on this component. The same is true for most of the variables in MANTA.

4.2 Differences between high and low ERM implementation levels.

To analyze differences between firms based on the ERM implementation level, first a division needs to be made based on whether a firm is regarded as having a high or low ERM implementation level. This division is made based on the yearly firm's scores on CONTROWN and MANTA. Firms with a score higher than the median score on all 4 firm years are regarded as having a high ERM implementation level on that component.

For MANTA, this method leads to similar results as when looking whether a firm has a chief risk officer (CRO) or risk committee (RC) in place, two indicators often used to identify ERM in firms (Liebenberg & Hoyt, 2003; Baxter et al., 2005; Hoyt & Liebenberg, 2011).

After dividing the firms, 15 have been labeled as MANTA high firms and11 firms have been labeled as CONTROWN high firms. The mean descriptive statistics are presented in Table 4.5. The statistical significance of the difference has been determined using t-tests.

	MANTA level			CONTROWN level		
	High	Low	Difference	High	Low	Difference
CRO	0,217	0,031	0,185*	0,205	0,063	0,142
RC	0,550	0,115	0,435**	0,500	0,196	0,303*
BOARDINST	0,557	0,519	0,037	0,500	0,547	-0,047
BIG4	1,000	0,917	0,083	1,000	0,930	0,071
SIZE	16,030	12,865	3,165**	15,327	13,593	1,734*
LEVERAGE	0,887	0,692	0,195**	0,784	0,760	0,024
LIFE	0,600	0,167	0,433**	0,583	0,222	0,361*

**. Difference is significant at the 0.01 level (2-tailed), *. Difference is significant at the 0.05 level (2-tailed).
Total observations in sample: 39, MANTA high: 15, low: 24, CONTROWN high: 11, low: 28
Table 4.5: Differences between high and low ERM implementation level

Table 4.5 shows the differences between firms with a high and with a low implementation level. For the variable LEVERAGE, the original data are used and not 1/LEVERAGE. The variable LEVERAGE has results opposite to the expectations. Firms scoring high on MANTA have 19.5% more leverage than firms scoring low on MANTA. This result is opposite to earlier research by Pagach & Warr (2010) and Hoyt & Liebenberg (2011).

The descriptive statistics show that firms scoring high on MANTA and CONTROWN, more often have a risk committee (RC) in place. Also a CRO is more frequently in place in firms scoring high on MANTA. These findings correspond with earlier studies, where RC and CRO have been used as an ERM indicator (Beasley et al., 2005; Hoyt & Liebenberg, 2011).

The statistics also show that firms with a higher ERM implementation level are larger on average. This finding is in line with earlier studies, showing that firms with higher ERM implementation levels are larger on average than firms with lower ERM implementation levels (Hoyt & Liebenberg, 2011; Baxter et al., 2013).

Lastly, the results show that life insurers employ higher levels of ERM. The results on both ERM measures are high and statistically significant. Hoyt & Liebenberg (2011) found no difference in ERM implementation between life and non-life insurers.

Next the performance between firms with high and firms with low implementation levels will be discussed.

5. Analysis

This chapter will begin by discussing the outliers present in the performance data. First the outliers in the performance measures ROA and ROE will be identified and dealt with by using multiple techniques after which one method will be chosen to continue using. Analysing the crisis effect on performance will be part of each technique. Next, the correlations between the variables included in the regression Formula 3.1 will be discussed. This will be followed by the regression analysis and validity testing. Lastly, the differences between firms with high ERM implementation and firms with low ERM implementation will be discussed.

5.1 Outliers.

Before the analysis of the results can be performed, outliers in the data need to be handled. Outliers are values at the lower or upper end that lie apart from the distribution and can have a great impact on the mean and standard deviations. SPSS will be used to locate outliers on the performance variables per year. Outliers are determined by using the interquartile range (IQR). The IRQ is defined as the distance between the first quartile observation and the third quartile observation. Outliers are observations that are located more than 1.5 IQR below the first quartile, or above the third quartile. One example of an outlier will now be discussed.

Nationale-Nederlanden schadeverzekering Maatschappij NV has a ROE of 137.6 in 2007, compared to 29.76 in 2006. This enormous increase is partially caused by a drop in equity, from $14,801,000 in 2006 to $5,352,000 in 2007. Combined with $462,993,000 unspecified gains, has led to this increase in the return on equity. It is possible that this firm has cashed a portion of its equity without reinvesting it, leading to an outlier in the dataset.

There are multiple ways for coping with outliers. The first possible option is deleting the variable altogether. This could be done if the variable is not important or if too many outliers are present. This option will not be applied in this research since the performance measures are the basis of this study.

Another possible option is excluding the found outliers from the sample, this is called trimming. This is a relative simple solution to cope with outliers in the sample, but it could exclude firm years with excellent performance simply for being extraordinary good.

A third option is called winsorisation. In the process of winsorisation, the values of outliers are changed to the nearest non-outlier value. By applying this technique, the firm years with extreme values will still be observed as very high or very low, but in a less extreme extend. This technique also allows for all observations to be included in the sample.

Next both the trimming and the winsorisation technique will be used as methods for coping with the outliers in the sample. After coping with the outliers, both techniques will be used to measure the difference in performance before and during the crisis.

5.1.1 Trimming.

In this chapter the effects of trimming the outliers will be described. New descriptive statistics will first be displayed and discussed, followed by the new performance comparison prior to and during the crisis.

With the outliers removed, the new descriptive statistics can be computed. These are shown in Table 5.1 below. The original sample size per firm year was 39, with a complete sample size per performance measure of 156. The complete sample size of ROA has decreased to 149 and the complete sample size of ROE has decreased to 135. The amount of observations left per firm year is displayed in the column 'N'.

Descriptive Statistics

	N	Mean	Median	1st Quartile	3rd Quartile	Minimum	Maximum	Std. Deviation
ROA5	39	5,302	4,480	1,180	8,650	-0,260	15,610	4,299
ROA6	37	3,647	2,410	1,170	6,865	-4,190	11,640	3,961
ROA7	34	2,642	2,240	0,610	4,375	-2,970	9,360	2,785
ROA8	39	-1,690	-0,930	-5,270	2,050	-14,360	8,450	5,550
PreCrisisROA	39	4,542	4,215	1,230	7,495	0,175	11,545	3,531
DurCrisisROA	39	0,909	0,160	-0,975	3,195	-7,395	9,590	3,657
DifferenceROA	39	3,632**						4,426
ROE5	38	22,686	21,780	12,785	31,018	-6,380	49,670	13,571
ROE6	36	17,765	18,370	9,075	25,705	-11,400	42,160	13,415
ROE7	28	13,249	15,070	8,360	17,665	-1,410	26,190	6,888
ROE8	33	-10,164	-6,640	-30,835	8,580	-68,150	41,670	27,298
PreCrisisROE	39	20,224	18,120	12,900	27,440	0,000	45,610	11,210
DurCrisisROE	36	3,649	3,125	-6,113	14,513	-29,610	41,670	16,473
DifferenceROE	36	16,445**						18,749

**. Difference is significant at the 0.01 level (2-tailed), *. Difference is significant at the 0.05 level (2-tailed).
ROA5, ROA6, ROA7 and ROA8 represent the return on assets during 2005, 2006, 2007 and 2008 respectively.
PreCrisisROA represents the average ROA of the pre-crisis firm years 2005 and 2006.
DurCrisisROA represents the average ROA of the crisis firm years 2007 and 2008.
If 1 value is missing in the pre-crisis or the crisis period, the variables PreCrisisROA and DurCrisisROA will take the value of the other firm year.
DifferenceROA represents the difference in ROA between the pre-crisis and the crisis period.
For the ROE variables the same logic applies as for the ROA variables.

Table 5.1: Descriptive Statistics, Performance Measurements after Trimming

In Table II.3, the observation was that both performance measures scored better in 2007 than in 2006. With this new dataset, this is not the case anymore. The mean value of the ROA and the ROE in 2007 is lower than in 2006, as was expected. It can be seen that the performance measurements in 2007 have had more outliers than in 2006. The outliers in 2006 for both the ROA and the ROE were negative. Excluding them has increased the mean performance values. The outliers in 2007 were mostly positive. Excluding them has decreased the mean performance values. The descriptive statistics now show that both performance measurement score higher in the pre-crisis years than during the crisis.

The statistical significance of the difference between pre-crisis and crisis years has been tested by performing paired sample t-tests. The outcomes of these tests are displayed as DifferenceROA and DifferenceROE.

The amount of pairs for ROE comparison has become smaller by 3 pairs due to outliers in both of the crisis years for these 3 firms. This paired sample t-tests show that, without outliers, the results have become more statistically significant to a level of $p < 0.001$ instead of a level of $p = 0.001$ for ROA and $p < 0.005$. The difference between PRECRISISROA and CRISISROA has become 0.8 bigger after trimming the outliers. The difference between PRECRISISROE and CRISISROE has decreased from 30.382 to 16.445 after trimming the outliers. The standard deviation has decreased even more from 62.549 to 18.749.

5.1.2 Winsorisation.

In this chapter the effects of the winsorised outliers will be described. Again, new descriptive statistics will first be displayed and discussed, followed by the new performance comparison prior to and during the crisis.

After winsorising the outliers, the outliers have stopped being outliers. With the winsorised outliers, a new set of descriptive statistics can be computed. This is visible in Table 5.2 below.

Descriptive Statistics

	N	Mean	Median	1st Quartile	3rd Quartile	Minimum	Maximum	Std. Deviation
ROA5	39	5,302	4,480	1,180	8,650	-0,260	15,610	4,299
ROA6	39	3,245	2,350	0,800	6,110	-4,190	11,640	4,234
ROA7	39	3,749	2,650	0,920	6,240	-2,970	11,310	3,910
ROA8	39	-1,690	-0,930	-5,270	2,050	-14,360	8,450	5,550
PreCrisisROA	39	4,273	3,445	1,200	7,495	0,175	11,545	3,582
DurCrisisROA	39	1,030	0,160	-0,975	3,195	-7,395	9,880	3,864
DifferenceROA	39	3,244**						4,383
ROE5	39	23,377	21,780	12,960	32,570	-6,380	49,670	14,071
ROE6	39	15,522	17,950	6,230	25,690	-11,400	42,160	15,091
ROE7	39	16,501	16,070	7,800	21,460	-5,910	37,550	12,833
ROE8	39	-16,269	-11,330	-41,450	7,350	-68,150	41,670	33,202
PreCrisisROE	39	19,449	18,120	11,550	26,755	0,780	44,850	10,692
DurCrisisROE	39	0,116	1,840	-13,970	11,820	-37,030	39,610	19,417
DifferenceROE	39	19,333**						21,295

**. Difference is significant at the 0.01 level (2-tailed), *. Difference is significant at the 0.05 level (2-tailed).

Table 5.2: Descriptive Statistics, Performance Measurements with winsorised outliers

Compared to the descriptive statistics in Table II.3, the ROA and ROE of 2006 and 2007 lie much closer together, but still the performance measures of 2007 exceed those of 2006. Combined with the trimmed results, this confirms the fact that this is caused by outliers in the data sample.

Coping with the outliers by winsorisation has less effect on the statistics than trimming the outliers altogether. Extreme values are not excluded from the sample, but pushed closer to the main data cluster. To examine the statistical significance of the winsorised observations, paired sample t-tests will be performed next.

The results of the paired sample t-tests are quite similar with the winsorised data compared to the trimmed data. Again, the mean difference between PRECRISISROA and CRISISROA has increased and the difference between PRECRISISROE and CRISISROE has decreased. Also the standard deviation on the ROE t-test has decreased dramatically. Lastly, like with the trimmed sample, the statistical significance for both t-tests has increased to $p < 0.001$.

These results correspond with the findings of Erkens et al. (2012), showing a decrease in performance during the financial crisis.

The results with trimmed outliers and with winsorised outliers are very similar. Trimming the outliers has excluded 28 firm years and entirely excluded 3 firms on DURINGCRISISROE. To keep all of the data in the study, further calculations will be performed using the winsorised dataset.

5.2 ERM index and performance.

In this chapter the correlation between the ERM index scores and the performance will be discussed with the winsorised outliers. A correlation matrix will be given presented in Table 5.3 containing the total sample, the pre-crisis sample and the during crisis sample. The most interesting findings and differences between the samples will be discussed. Next, the difference in performance between firms with high and low ERM implementation levels will be analysed.

Correlation Matrix

		ROA	ROE	CRO	RC	BOARDINST	BIG4	SIZE	LEVERAGE	CONTROWN	MANTA	LIFE	CRISIS
Panel A	ROA	1											
	ROE	,798**	1										
	CRO	,030	,095	1									
	RC	-,168*	-,070	,445**	1								
	BOARDINST	-,011	-,032	,232**	,242**	1							
	BIG4	-,108	,002	,079	,146	-,223**	1						
	SIZE	-,244**	-,057	,284**	,468**	,386**	,168*	1					
	LEVERAGE	,076	-,055	-,071	-,123	-,072	,003	-,202*	1				
	CONTROWN	-,090	,011	,030	,114	-,653**	,871**	-,015	,071	1			
	MANTA	-,173*	-,017	,670**	,790**	,522**	,221**	,782**	-,304**	,000	1		
	LIFE	-,337**	-,094	-,015	,101	,104	,164*	,454**	-,037	,079	,254**	1	
	CRISIS	-,303**	-,380**	,211**	,228**	,064	,000	,037	,013	,003	,181*	,000	1
Panel B	ROA	1											
	ROE	,665**	1										
	CRO	,029	,164	1									
	RC	-,195	,036	,428**	1								
	BOARDINST	,068	,117	-,065	,182	1							
	BIG4	-,299**	-,143	,046	,109	-,270*	1						
	SIZE	-,360**	-,024	,179	,526**	,315**	,173	1					
	LEVERAGE	,097	-,154	-,040	-,099	-,065	-,003	-,248*	1				
	CONTROWN	-,274*	-,162	,138	,109	-,662**	,891**	,036	,062	1			
	MANTA	-,276*	,074	,489**	,808**	,409**	,222	,841**	-,335**	,060	1		
	LIFE	-,450**	-,034	-,141	,165	,015	,164	,461**	-,092	,129	,281*	1	
Panel C	ROA	1											
	ROE	,849**	1										
	CRO	,131	,190	1									
	RC	-,028	,007	,424**	1								
	BOARDINST	-,033	-,081	,349**	,267*	1							
	BIG4	,095	,099	,104	,184	-,189	1						
	SIZE	-,116	-,063	,358**	,436**	,445**	,163	1					
	LEVERAGE	,073	,010	-,094	-,151	-,078	,008	-,163	1				
	CONTROWN	,093	,128	-,021	,122	-,654**	,853**	-,063	,077	1			
	MANTA	-,009	,041	,734**	,768**	,587**	,231*	,765**	-,298**	-,044	1		
	LIFE	-,238*	-,160	,049	,056	,176	,164	,448**	,011	,031	,246*	1	

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Panel A: Total sample (N = 156), Panel B: Pre-crisis sample (N = 78), Panel C: During crisis sample (N = 78)

Table 5.3: Correlation matrix

This correlation matrix shows multiple variables that correlate with each other. A significant correlation can be explained in several ways. First, Variable A can cause variable B, or vice versa. Second, it could be possible a third variable, variable C, is causing both A and B.

Panel A is made up from data covering all four years included in the study, panel B consists of pre-crisis data and panel C covers the crisis period.

From Table 5.3, it can be seen that both performance measurements (ROA and ROE) are significantly correlated in all three panels. This could be explained by the fact that the variables are both calculated using the profit before tax. The correlation between ROA and ROE, and the correlation between ROA and LIFE are the only statistically significant correlation in all three panels in relation to the performance measures.
The negative correlation between LIFE and ROA could mean that insurers focusing on life insurance have lower return on investments than non-life insurers.

Another interesting observation is the statistical significant correlation found between the variables Chief Risk Officer (CRO) and Risk committee (RC) in all of the panels. These two variables both have to do with job positions in the firm for monitoring and managing risks. Next the correlations in individual panels and the differences between panels will be discussed.

In panel A, the variables RC, SIZE, LIFE, MANTA and CRISIS are negatively correlated with ROA. The small negative correlation between SIZE and ROA could be explained by the fact that the variable SIZE is defined by the natural logarithm of the total assets and ROA is calculated by dividing the profit before tax by the total assets. If the book value of assets increases and the profit before tax stay the same, the ROA decreases. This is in accordance to earlier studies where larger firms had a negative relation with performance (Hoyt & Liebenberg, 2011; Dogan, 2013).
When looking at the correlation between the original total assets and ROA, the correlation has become much smaller than the correlation between SIZE and ROA. Also the correlation has stopped being statistically significant. Calculating the firm SIZE based on the natural logarithm has caused the values to be grouped much closer together and has increased the correlation between SIZE and ROA.
The negative correlation between ROA and MANTA is small but statistical significant. This is an indication that ERM is not enhancing performance, but could actually have a negative impact on performance.
The correlation of CRISIS and both the performance measures is negative and statistically significant. This is the only variable with a statistically significant correlation with ROE. The negative correlation between CRISIS and the performance measures supports the earlier evidence of the negative impact the financial crisis has had on performance in Chapter 5.1.

CRISIS is only included in panel A, since panels B and C are based on the firm years before and during the crisis.

In panel B, the negative correlation between MANTA and ROA has increased. Also the negative correlation between CONTROWN and ROA has become statistically significant. This is a further indication of the negative impact of ERM on performance in a standard period.
Next the negative correlation between BIG4 and ROA has become statistically significant. The relevance of this correlation is very small since only 2 out of the 39 firms are not audited by a big four auditing firm.

Panel C, the during the crisis sample, shows low correlation values of ROA and ROE with all of the other variables except LIFE. The correlation values are between -0.116 and 0.190. Only the correlations between the performance measures and LIFE are statistically significant. This observation could be caused by erratic movements on the ROA and the ROE during the crisis years.

5.2.1 Differences in performance.

Next, the difference in performance between firms with a high and with a low implementation level will be analysed. The same division between high and low ERM implementation level will be used as before in Chapter 4.2. Independent sample t-tests will be used for this analysis. The results of the t-tests are presented in Table 5.4.
The mean values per category are shown in the table. “High (1)” represents the firms with high scores on CONTROWN and MANTA, “Low (2)” the firms with low scores on CONTROWN and MANTA and (3) “All” represents the total sample. “(1) - (2) Difference” indicates the difference between high and low scoring firms, “(1) – (3) Difference” indicates the difference between high scoring firms on CONTROWN and MANTA and the total sample. ROA and ROE represent the averaged performance of all the years, both before and during the crisis. Crisis Effect displays the increase or decrease of the performance during the crisis with respect to the years preceding the crisis. Crisis Effect Ratio displays the relative increase or decrease of the performance during the crisis with respect to the years preceding the crisis. A value of -0.5 represents a drop in performance of 50% compared to the pre-crisis years.

Differences in Perfromance

	MANTA level		(1) - (2)		(1) -(3)	CONTROWN level		(1) - (2)		(1) -(3)
	High (1)	Low (2)	Difference	All (3)	Difference	High (1)	Low (2)	Difference	All (3)	Difference
ROA	1,884	3,400	-1,516	2,817	-0,933	2,766	2,838	-0,721	2,817	-0,052
ROA pre-crisis	2,656	5,483	-2,592*	4,251	-1,595	3,596	4,509	-0,912	4,251	-0,655
ROA during crisis	1,010	1,418	-0,408	1,261	-0,251	1,795	1,051	7,431	1,261	0,534
Crisis effect ROA	-1,541	-3,599	2,058	-2,807	1,267	-1,673	-3,259	1,602	-2,807	1,134
Crisis effect Ratio	-0,857	-0,783	-0,074	-0,812	-0,046	-0,734	-0,843	0,109	-0,812	0,078
ROE	12,426	11,038	1,398	11,572	0,854	13,481	10,822	2,659	11,572	1,909
ROE pre-crisis	20,152	19,013	1,139	19,451	0,701	19,321	19,503	-0,182	19,451	-0,130
ROE during crisis	3,571	3,065	0,506	3,260	0,311	6,104	2,142	3,961	3,260	2,844
Crisis effect ROE	-15,450	-15,948	0,498	-15,756	0,306	-11,676	-17,359	5,683	-15,756	4,080
Crisis effect Ratio	-0,885	-0,794	-0,091	-0,829	-0,056	-0,732	-0,867	0,135	-0,829	0,097

**. Difference is significant at the 0.01 level (2-tailed), *. Difference is significant at the 0.05 level (2-tailed).
Total observations in sample: 39, MANTA high: 15, low: 24, CONTROWN high: 11, low: 28
ROA represents the average ROA of all four years, 2005 – 2008
ROA pre-crisis represent the average ROA of the pre-crisis firm years 2005 and 2006.
ROA during crisis represents the average ROA of the crisis firm years 2007 and 2008.
Crisis effect ROA represents the increase or decrease of the performance during the crisis.
Crisis effect Ratio represents the relative increase or decrease of the performance during the crisis.
For the ROE variables the same logic applies as for the ROA variables.

Table 5.4: Differences in Performance

The results in Table 5.4 show only 1 statistically significant result, the difference in the ROA pre-crisis based on the MANTA variable. This result shows that firms with a higher ERM implementation level, based on MANTA, have a statistically significant lower ROA during the pre-crisis period.

The results with positive outcomes for a higher ERM implementation level in relation to the crisis have been underlined. These results show that for firms with high scores on the ERM indicators, the crisis drop in both performance measures is smaller than for firms scoring low on the ERM indicators. Firms scoring high on CONTROWN also experienced a relative smaller effect on performance for both the ROA and the ROE.

The results show a mitigating effect on the crisis impact in firms with a higher ERM implementation level, based on CONTROWN (Crisis effect Ratio). Since none of these effects are statistically significant, hypothesis 3 is not supported by these results.

5.3 Multi regression Analysis.

The regression analysis will show relations between the dependent variables ROA and ROE and several control variables. The regression is used to determine the effects of ERM implementation, leverage, size and life insurance on performance. ERM implementation is measured as CONTROWN and MANTA as output of the PCA. The regression results are displayed below in Table 5.5.

Regression Results

	Performance			
	ROA	t-value	ROE	t-value
Intercept	9,963*	2,390	48,098*	2,527
CONTROWN	-1,045*	-2,117	-2,430	-1,078
MANTA	-0,021	-0,024	5,829	1,504
CONTROWNCRISIS	1,356*	1,998	5,183	1,672
MANTACRISIS	0,820	1,100	-1,812	-0,532
LEVERAGE	0,080	0,932	-0,115	-0,295
SIZE	-0,355	-1,197	-1,891	-1,397
LIFE	-2,724**	-3,307	-2,678	-0,712
CRISIS	-2,954**	-4,204	-17,223**	-5,367

**. Significant at the 0.01 level, *. Significant at the 0.05 level.
Table 5.5: Regression Results (N = 156)

The results for the variables CONTROWN and CONTROWNCRISIS are statistically significant in relation to ROA. The beta (β_1) related to CONTROWN, has a value of -1.045. This means that firms scoring higher on CONTROWN have a lower ROA. The beta related to CONTROWNCRISIS (β_5), has a value of 1.356. This means that scoring higher on CONTROWN during the crisis period results in a higher ROA. The positive beta of CONTROWNCRISIS is the first statistically significant result supporting a positive effect of ERM implementation on performance.

The sign of LIFE is negative relating to both performance measures and is statistically significant in relation to ROA. This implies that life insurers have scored lower on the performance measures than non-life insurers.

The regression also shows a negative relation between CRISIS and both performance measures. This further supports the earlier finding of the negative effect of the crisis on performance.

Some statistically significant evidence has been found relating the implementation of ERM to better performance. These two findings are contradictive for a general argument about ERM implementation and performance.

5.4 Validity.

Before drawing conclusions from the regression results the validity of the results needs to be tested. There are multiple methods for testing the validity. These methods will now be discussed and the appropriate test will be conducted.

5.4.1 R^2.

R^2 is the amount of variation explained by the independent and control variable in the regression model. The score of R^2 can vary from 0 to 1. The higher the score, the more variation is explained by the variables. There are two types of R^2 presented in SPSS when performing regression analysis; the regular R^2 and the adjusted R^2. The adjusted R^2 takes into account the number of variables in the analysis. Adding additional variables would otherwise lead to as higher R^2 and would influence the results. Below both the regular R^2 and the adjusted R^2 are presented in Table 5.6.

R^2 Results

Performance Measure	R^2	Adjusted R^2
ROA	,253	,212
ROE	,188	,143

Table 5.6: R^2 Results

The adjusted R squared (R^2) show very little variation explained by the model for both ROA and ROE. The model only explains 21.2% of the variation of ROA and even less of the variation of the ROE, 14.3%. This low explanatory power harms the validity of the models. To further test the validity, the residuals will be analysed.

5.4.2 Residuals analysis.

A regression analysis should have normally distributed residuals for the results to be valid. There are multiple ways to test for sample normality. This can be achieved by multiple visual methods, like a P-P plot and a histogram, or by using a numerical test like the Shapiro-Wilk test for normality. The visual methods are more difficult to interpret because of the subjectivity of the interpreter where the numerical tests of normality simply give a number. The numerical tests however, can be thrown off by even 1 outlier, showing results for a false non-normality.

The Shapiro-Wilk test for normality will be performed using SPSS because this has been proven the most powerful test of normality (Razali & Wah, 2011). The results of the P-P plots and histogram are visible in Appendix VI. The results of the Shapiro-Wilk test are presented in Table 5.7.

The Histogram for ROA, presented in Figure V.1, does not show a normal distribution of the residuals. The mean is 0 and the standard deviation 1 close to 1, but this is due to the standardisation of the residuals. The residuals do not follow the pattern of the bell shaped line displayed in the graph. The P-P plot presented in Figure V.2 also shows that the distribution is not a normal distribution. A normal distribution would have the residual observations on the diagonal regression line. The visual tests do not deviate a lot from a normal distribution, making discussion of the normality possible.

The Histogram for ROE, presented in Figure V.3, and the P-P plot, presented in Figure V.4, show that the residuals are reasonably normally distributed. The first half of the findings does not match the diagonal line in the P-P plot, but the second half does match the diagonal line. The visual methods provide indicators of normally distributed residuals for ROE.

Now that the visual methods have been investigated, the Shapiro-Wilk tests of normality will now be for mathematical proof.

Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Residuals ROA	,973	156	,004
Residuals ROE	,971	156	,002

Table 5.7: Test of Normality

The Shapiro-Wilk test, tests the hypothesis that the sample is not normal distributed. Both for the residuals of ROA and ROE, the tests are highly statistically significant ($p < 0.05$). This indicates that the hypothesis of a non-normal distribution has been proven.

With proof from both the visual and mathematical tests that the ROA residuals are not normal distributed, the results of the regression analysis have been proven invalid. Therefore no real conclusions could be drawn from the results of the regression analysis on the performance measure ROA.

In an attempt to cope with the non-normality of the ROA residuals in the regression analysis, the ERM indicators have been transformed in multiple ways. First, the ERM indicators have been squared [ERM^2]. This has a huge impact on the data since all of the negative scores become positive. Second, the absolute values of the ERM indicators were used for the next transformations. The square root [$\sqrt{ERM}$] has been used to transform the ERM indicators. Lastly, the natural logarithm of the ERM indicator values was introduced in the regression analysis [ln (ERM)] (Seber & Lee, 2012).

None of these additional variables in the regression analysis has led to a normal distribution of the residuals according to the Shapiro-Wilk test of normality.

Analysis of the residuals has shown that the non-normality of the residuals is caused by the extreme values, both positive and negative. Deleting 10 outliers of the residuals, 3 positive and 7 negative, results in a normally distributed set of residuals according to the Shapiro-Wilk test of normality. The new histogram containing 146 residual statistics looks quite similar to the original histogram displayed in Figure V.1.

When deleting firm years from the original regression analysis. Only 7 firm years have to be deleted in order to provide normally distributed residuals. The regression results also change a little in comparison to the original results, but the signs of the variables stay the same.

Only a few observations are causing the non-normality of the residuals. For this reason, the results of the regression analysis will be taken into consideration for the conclusions in Chapter 6, but they will be handled with care.

In the following part, conclusions are drawn. The results of the winsorised sample will be used to answer the hypotheses. The results of the regression analysis are not valid and do not represent the total population of insurance firms.

6. Conclusions

In this chapter, the conclusions will be drawn based on findings in the earlier chapters. The hypotheses will be answered followed by answering the sub questions of the main research question. Lastly, the main research question will be answered.

6.1 Testing the hypotheses.

First, the hypotheses are discussed based on the findings of the research. Conclusions will be drawn from the findings to see whether the hypotheses are supported.

H1: Performance in the insurance industry level has been worse during the financial crisis.

To answer this hypothesis, information will be drawn from Tables 5.1 and 5.2 from Chapter 5.1 and Table II.3. In these chapters the comparison between performance before and during the crisis was made. All of the t-tests showed, with a statistical significance level of $p < 0.01$, that performance before the crisis was lower than during the crisis years. In the sample after trimming the outliers, the difference in return on assets (ROA) was highest at a level of 3.632. The difference in the original sample was the lowest at a level of 2.829. The winsorised sample was in between the other samples at a level of 3.244.
In the sample with all of the original observations, the difference in return on equity (ROE) was highest at a level 30.382. After trimming the outliers, the difference in ROE was lowest at a level of 16.445. Again, the results of the winsorised sample lay in between the other samples at a level of 19.333.

All of the observations made between performance before and during the crisis show that performance during the crisis was worse than before the crisis. Therefore the hypothesis is supported by the results.

H1: Performance in the insurance industry level has been worse during the financial crisis.
Supported.

The results match the findings of Erkens et al. (2012), who found a drop in firm performance during the crisis.

The next hypothesis is related to the difference in performance between firms with high ERM implementation levels and firms with a low ERM implementation level. A division has been made between these groups with the new variables CONTROWN and MANTA from the principal component analysis (PCA).

H2: Insurance companies having higher levels of ERM implementation perform better than insurance companies with lower levels of ERM implementation.

As can be seen in Table 5.4, firms with lower ERM implementation levels have scored better on both of the performance measures than firms with higher levels of ERM implementation. An indicator for this result could also be found in the correlation matrices in Table 5.3 in Chapter 5.2. All statistically significant correlations found between ROA and CONTROWN and MANTA are negative, suggesting that a higher ERM implementation level has a negative impact on the ROA.

There is only 1 statistically significant result in both of the regression analyses between the ERM indicators and the performance measures. CONTROWN has a β of -1.045 in relation to ROA, providing a statistically significant result disproving hypothesis 2.
There are some relations between the ERM indicators and ROE which are positive, but the positive effects however are not statistically significant and therefore provide no proof for the hypothesis.

The only statistically significant results show a negative relation between the ERM indicators and ROA. These findings are opposite to the hypothesis, suggesting not only no performance improvement in firms implementing ERM, but a decrease in performance in firms implementing ERM.

H2: Insurance companies having higher levels of ERM implementation perform better than insurance companies with lower levels of ERM implementation.
Not supported.

The lack of evidence of ERM implementation positively affecting performance is similar to the findings of Baxter et al. (2013), who also found no supporting results.

Hypothesis 3 assumes a mitigating effect of ERM on the negative effects of the crisis on performance.

H3: A higher level of ERM implementation mitigates the effects of a financial crisis on performance of insurance companies.

Results relating to this hypothesis can be found in Chapter 5.2.1. The effects of the crisis are displayed in Table 5.4. In Table 5.4, the drop in performance for firms with high ERM implementation levels is smaller than for firms with low ERM implementation levels. Also the relative performance drop for firms scoring high on CONTROWN is smaller than for firms scoring low on CONTROWN. None of these results, supporting the mitigating effect of ERM implementation, is statistically significant. Due to a lack of statistical significance, these results are no proof of hypothesis 3.

The only statistical significant result, showing a mitigating effect of ERM implementation on performance, can be found in the regression results in Table 5.5. The results show a statistically significant positive relation between CONTROWNCRISIS and ROA. This implies that a positive score on CONTROWN during the crisis positively affects performance.

Very little evidence supporting the hypothesis that a high ERM implementation level has a mitigating effect on performance has been found and for this reason the hypothesis is rejected.

H3: A higher level of ERM implementation mitigates the effects of a financial crisis on performance of insurance companies.
Not supported.

Baxter et al. (2013) found no evidence of ERM implementation mitigating the effects of the crisis. The results of this study match the results found by Baxter et al. (2013).

6.2 Research Question.

Now that the hypotheses have been answered, the answering of the sub questions will take place. The second set of sub questions will be answered on basis of the earlier answered hypotheses. These sub questions have been formulated as a stepping stone to answering the main research question. After discussing all of the sub questions, an answer to the main research will be formulated.

Is there a difference in performance before and during the crisis?

This question is answered based on the same information as hypothesis 1. As was expected based on both earlier research and general knowledge, performance of insurance firms was worse during the financial crisis of 2007 and 2008. The fact that this sub question was positively answer was vital for this research. If performance did not differ during the crisis, the main research question would have been pointless.

The next two sub questions relate to ERM and performance and will be answered together.

Does the implementation of ERM lead to better performance?
Do insurance firms with a higher level of ERM implementation perform better than insurance firms with a lower level of ERM implementation?

This study has found no evidence that firms with high ERM implementation levels perform better than firms with low ERM implementation levels. Evidence, even though not all statistically significant, points to the fact that firms with high ERM implementation levels perform worse than firms with low ERM implementation levels, both before and during the crisis.
To answer the sub questions, we need to look at the variables CONTROWN and MANTA. The only statistically significant correlations between the ERM indicators and the performance variables are negative. This suggests a negative relation between the ERM implementation level and performance. Some of the results of the regression analysis are also negative and some are positive, but most results are not statistically significant.

Only the variable CONTROWNCRISIS has a positive statistically significant effect on ROA. Scoring high on CONTROWN has a positive effect on ROA during the crisis. This is only 1 statistically significant result in the regression analyses, which is not enough evidence for a mitigating effect of ERM implementation.
Based on these findings, the sub questions can be answered with “no”, insurance firms with a higher ERM implementation level do not perform better than firms with a lower ERM implementation level.

Now that the sub questions have been answered, the main research question will be discussed. The main research question relates closely to hypothesis 3.

Does ERM implementation mitigate the effect of the crisis on performance of insurance companies?

Just like the answer to hypothesis 3, the answer to the main research question is also based on findings shown in Chapter 5. The same arguments as in H3 can be used in answering the main research question. None of the results found in this chapter, supporting the mitigating effect of ERM implementation, are statistically significant and therefore are not supportive of the main research question.

The results of this study suggest that the assumed positive relation between ERM and performance was false. Actually, the results point to the fact that performance of insurance firms with a higher level of ERM is lower than that of firms with a lower level of ERM. Some findings showing this negative relation are statistically significant, where only 1 statistically significant positive relation was found. The results of the effect of ERM implementation on performance during a crisis might point to one direction, but no real conclusions can be made because on the absence of statistical significance of these findings. Below is an answer to the research question in one sentence:

Very little evidence has been found to support a mitigating effect of ERM implementation on the negative effects on insurance company performance of the crisis.

In the next chapter, the research contributions, research limitations and directions for future research will be discussed.

7. Research discussion and future research

In this final chapter the relevance of this research will be discussed. This will be followed by a discussion of the limitation of this research and some directions for future research.

7.1 Research contributions.

This research has contributed to the existing literature in the following ways. First, there have not been many studies on the effects of ERM on the impact of the crisis in the insurance industry. This research has shown that ERM might be negatively affecting performance and actually be aggravating the effects of the crisis.

This research has confirmed findings of earlier studies, but has also found results opposite to current literature relating to ERM. This research has confirmed that ERM firms more often have risk committees and are larger in size (Beasley et al., 2005; Aebi et al., 2011). Where studies by Pagach & Warr (2010) and Hoyt & Liebenberg (2011) found that ERM firms have lower leverage than non-ERM firms, this study found the opposite results that firms with a higher level of ERM have higher leverage than firms with a lower level of ERM.

7.2 Research limitations.

Next to contributions, this research also has limitations. First, the developed regression model was invalid, providing no answers to the effects of the ERM implementation level. For this reason all of the statistically significant results gathered, came from correlations and t-tests.

Second, Due to data limitations on the implementation of ERM in the sample firms, an ERM index was constructed. It is possible that some factors indication ERM implementation were not included in the PCA. This could have caused some firms to be scored low on ERM implementation where they actually have a high level of ERM implementation in place and vice versa. Ideally multiple ERM implementation measurement methods would have been used, but due to time considerations this was not possible.

Lastly, the sample only contained 39 firms, which is a small sample to draw conclusions for the entire population of insurance firms. Also this sample contained a mix of subsidiary firms and parent firms. This mix led to the exclusion of 8 firms of the original 48 firms, decreasing the sample. Using subsidiary firms also caused the disability to calculate Tobin's Q, a frequently used indicator for firm value.

7.3 Future research.

Based on the research contributions and limitations, some directions for future research are formulated.

One of the limitations in this research was the measurement of ERM implementation. More research would be needed on the best way of measuring ERM. This could be done by using multiple methods on the same sample to investigate differences between such methods. Also the inclusion of the Standard & Poor's index would be a useful tool.

Also the inclusion of non-traded firms has made the use of Tobin's Q impossible. To get a good understanding of the impact of ERM on firm value, the market value of equity needs to be taken into account. This could be achieved by taking a larger sample of publicly traded European insurance firms, this way stock data are readily available. This would also solve the problem of the high correlation between board independence and institutional ownership. Using a larger sample could also be useful to produce more statistically significant results. The sample size used by Hoyt & Liebenberg (2011) contained over 600 firm years.

Lastly, using a European sample could help to investigate the impact of the Solvency II directive has on insurance firm performance, but also on whether this new directive leads to a higher average ERM implementation level. Is creating new rules for the insurance industry really a good thing to do and what is the impact, both for individual firms and the industry as a whole?

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Appendices

Appendix I: Sample.

ABN AMRO Levensverzekeringen N.V.
ABN AMRO Schadeverzekeringen N.V.
Achmea B.V.
Achmea Pensioen en Levensverzekeringen N.V.
AEGON N.V.
Allianz Nederland Groep N.V.
Allianz Risk Transfer N.V.
ASR Nederland N.V
Atradius Dutch State Business N.V.
Automatiseringsmaatschappij Gouda B.V.
Bovemij Verzekeringsgroep N.V.
Chubb Nederland B.V.
Coöperatie TVM U.A.
DELA Coöperatie
Delta Lloyd Levensverzekeringen N.V.
Delta Lloyd Schadeverzekeringen N.V.
Goudse Levensverzekeringen N.V.
Goudse Schade verzekeringen N.V.
Klaverblad Schadeverzekeringsmaatschappij N.V.
Legal & General Nederland Levensverzekering Maatschappij N.V.
Loyalis Leven N.V.
Maatschappij voor zorgverzekering Gouda N.V.
Manuta Holding N.V.
MOVIR
Nationale Nederlanden Schadeverzekering Maatschappij N.V.
N.V. Schadeverzekering voor de Metaal en Technische Bedrijfstakken
N.V. Univé Zorg
Univé Schade te Zwolle
OHRA Ziektekostenverzekeringen N.V.
Onderlinge Noordhollandsche Brandwaarborg Maatschappij U.A.
ONVZ Ziektekostenverzekeraar N.V.
Robein Leven N.V.
Univé Services B.V.
UVM Verzekeringsmaatschappij N.V.
Verenigde Assurantiebedrijven Nederland N.V.
VGZ Zorgverzekeraar N.V.
VVAA Levensverzekeringen N.V.
VVAA Schadeverzekeringen N.V.
Yarden Uitvaartverzekeringen N.V.

Appendix II: Data collection

DELA COOPERATIE	2005	2006	2007	2008
CRO	0	0	0	0
RISK COM	0	0	1	1
BOARD INDEP	100%	100%	100%	100%
BIG4	1	1	1	1
SIZE	14,9	15,2	15,4	15,3
LEVERAGE	0,75	0,74	0,74	0,82
1/LERERAGE	1,33	1,35	1,35	1,23
INSTITUTIONS	0%	0%	0%	0%
ROA	4,48	2,41	2,92	-6,28
ROE	18,11	9,33	11,17	-34,19
LIFE	0	0	0	0
Book Value Assets (Th $)	3.030.542	4.039.792	4.729.606	4.376.438
Shareholder Value (Th $),	750.528	1.042.999	1.236.768	803.960
Debt (Th $)	2.280.014	2.996.793	3.492.838	3.572.478

Table II.1: Example of gathered data: DELA COOPERATIE

Descripive Statistics

Variable	Mean	Median	1st Quartile	3rd Quartile	Min	Max	Std Dev
ROA	2,587	1,725	0,470	4,730	-3,710	10,100	3,349
ROE	7,978	7,050	-0,755	18,635	-104,650	159,390	37,945
CRO	0,103	0,0	0,0	0,0	0,0	1,0	0,235
RC	0,282	0,0	0,0	0,5	0,0	1,0	0,372
BOARDINDEP	0,162	0,0	0,0	0,0	0,0	1,0	0,341
BIG4	0,949	1,0	1,0	1,0	0,0	1,0	0,223
SIZE	14,082	13,875	12,600	15,050	10,100	19,800	2,139
LEVERAGE	0,767	0,803	0,693	0,930	0,170	0,990	0,197
1/LEVERAGE	2,033	1,252	1,075	1,449	1,010	19,650	3,286
INSTITUTIONS	0,904	1,000	1,000	1,000	0,000	1,000	0,281
LIFE	0,333	0	0	1	0	1	0,478
NONLIFE	0,667	1	0	1	0	1	0,478
TOTAL ASSETS (Mil $)	$17.938	$1.062	$302	$3.458	$28	$398.214	66129

Table II.2: Descriptive statistics, averaged over years (N = 39)

Descriptive Statistics

	N	Mean	Median	1st Quartile	3rd Quartile	Minimum	Maximum	Std. Deviation
ROA5	39	5,302	4,480	1,180	8,650	-0,260	15,610	4,299
ROA6	39	2,702	2,350	0,800	6,110	-19,190	11,640	5,730
ROA7	39	4,035	2,650	0,920	6,240	-2,970	16,960	4,611
ROA8	39	-1,690	-0,930	-5,270	2,050	-14,360	8,450	5,550
PreCrisisROA	39	4,002	3,445	1,140	7,495	-7,030	11,550	4,053
DurCrisisROA	39	1,172	0,160	-0,975	3,195	-7,400	12,710	4,200
DifferenceROA	39	2,829**						4,824
ROE5	39	36,863	21,780	12,960	32,570	-6,380	575,620	89,547
ROE6	39	9,475	17,950	6,230	25,690	-158,790	42,160	35,531
ROE7	39	19,884	16,040	7,800	21,460	-19,880	137,600	25,469
ROE8	39	-34,311	-11,330	-41,450	7,350	-438,970	130,880	91,142
PreCrisisROE	39	23,169	18,120	11,065	27,440	-56,590	287,810	47,234
DurCrisisROE	39	-7,214	0,805	-13,970	11,820	-227,190	91,830	50,983
DifferenceROE	39	30,382**						62,459

**. Difference is significant at the 0.01 level (2-tailed), *. Difference is significant at the 0.05 level (2-tailed).

Table II.3: Descriptive Statistics Performance Measurements

Appendix III: ERM index.

Correlation Matrix

	CRO	RC	BOARDINDEP	BIG4	SIZE	LEVERAGE	INSTITUTIONS
CRO	1						
RC	,445**	1					
BOARDINDEP	,051	,083	1				
BIG4	,079	,146	-,398**	1			
SIZE	,284**	,468**	,139	,168*	1		
LEVERAGE	-,071	-,123	-,060	,003	-,202*	1	
INSTITUTIONS	,095	,061	-,836**	,338**	,091	,025	1

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Total observations in sample: 156

Table III.1: Correlation matrix

Correlation Matrix

	CRO	RC	BOARDINST	BIG4	SIZE	LEVERAGE
CRO	1					
RC	,445**	1				
BOARDINST	,232**	,242**	1			
BIG4	,079	,146	-,223**	1		
SIZE	,284**	,468**	,386**	,168*	1	
LEVERAGE	-,071	-,123	-,072	,003	-,202*	1

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Total observations in sample: 156

Table III.2: Correlation matrix

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,616
Bartlett's Test of Sphericity	Approx. Chi-Square	129,667
	df	15
	Sig.	,000

Table III.3: KMO and Bartlett's Test

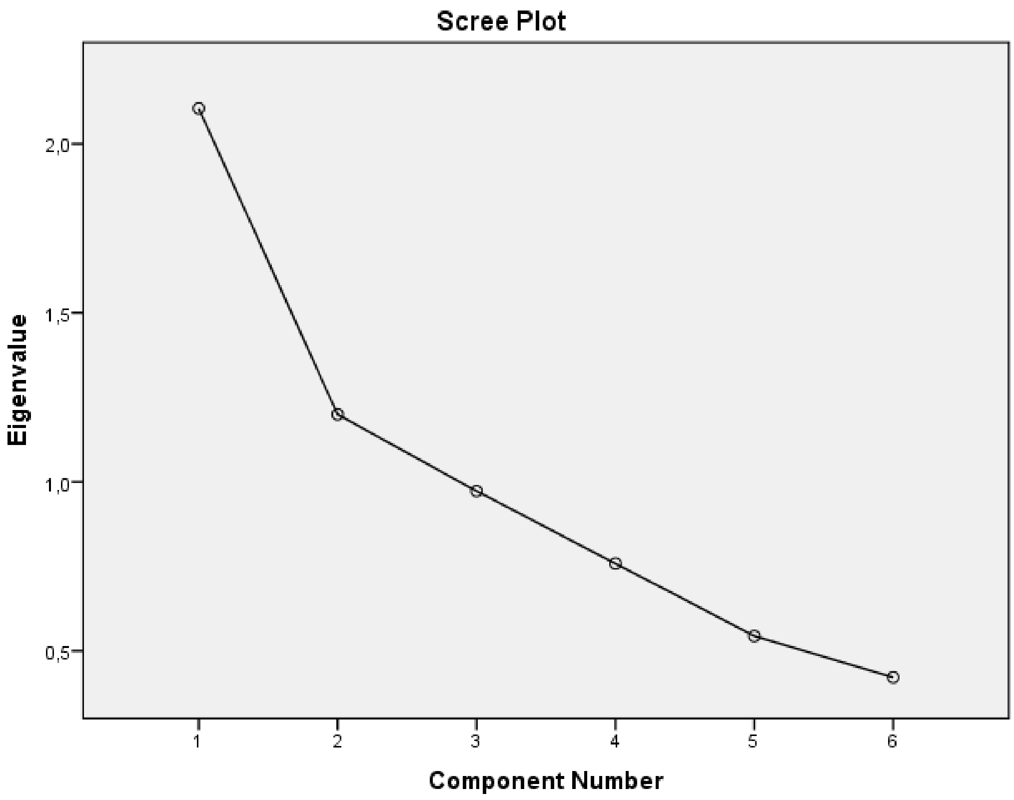

Figure III.1: Scree Plot

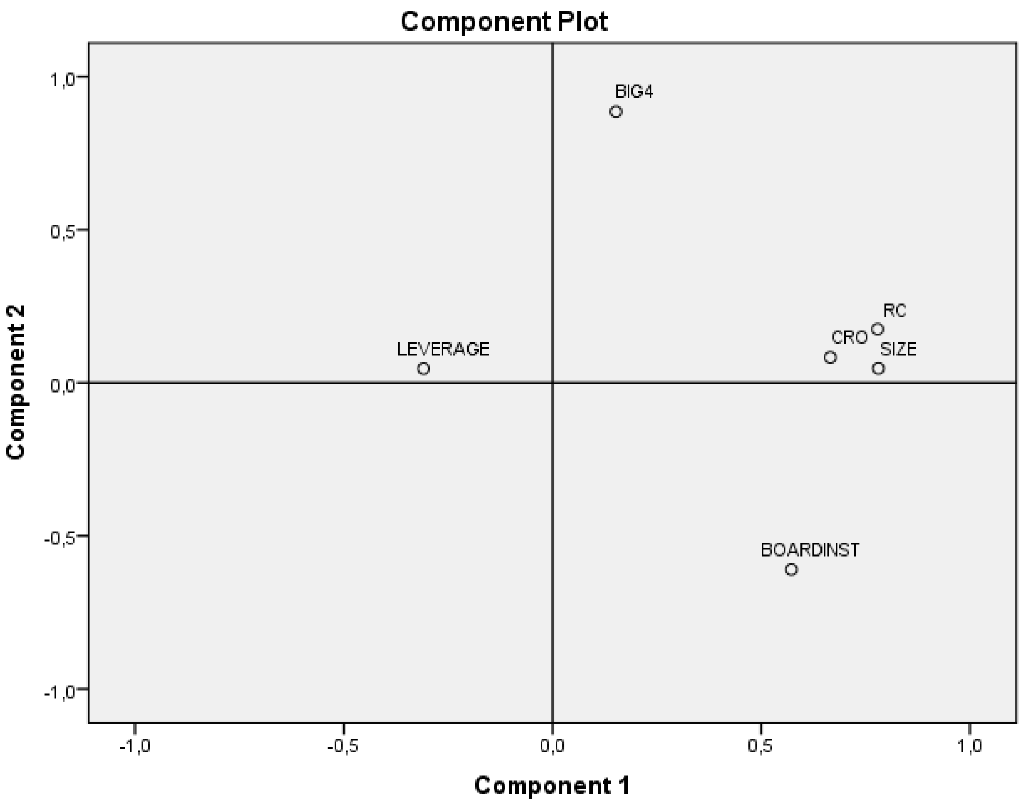

Figure III.2: Component Plot before rotation

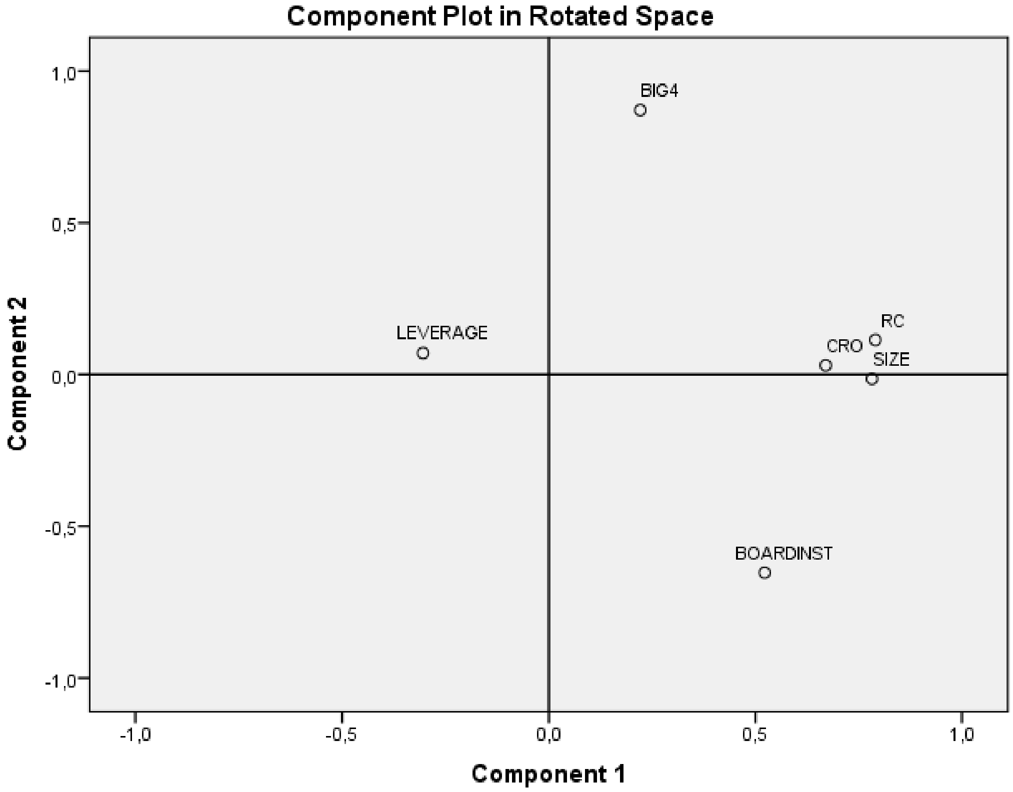

Figure III.3: Component Plot after rotation

Appendix IV: Performance.

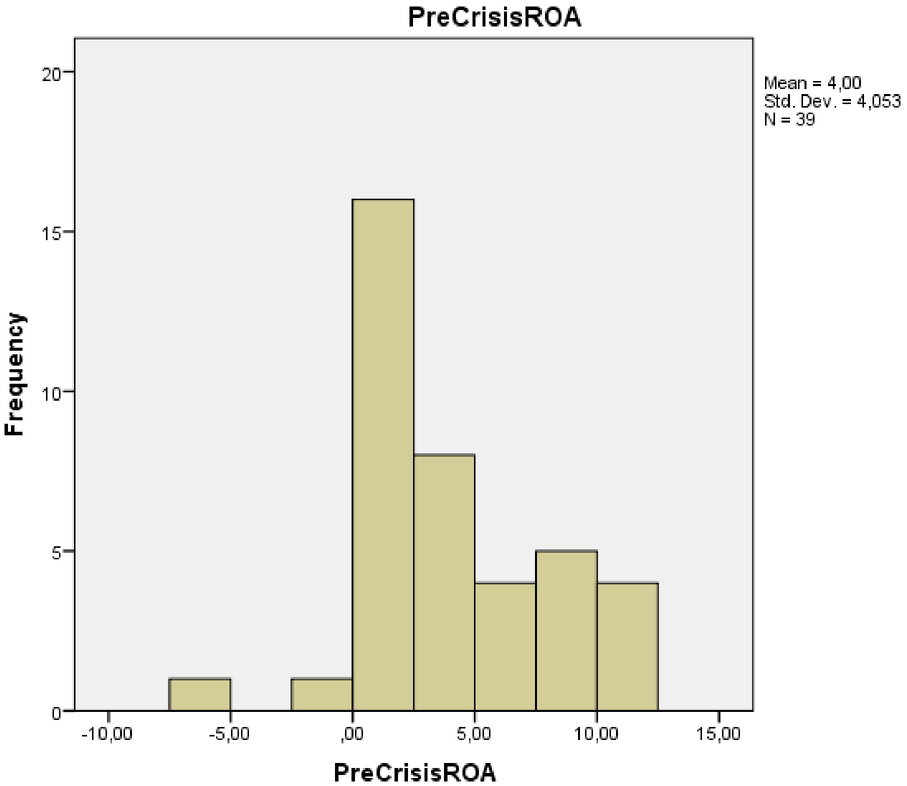

Figure IV.1: Histogram PreCrisisROA

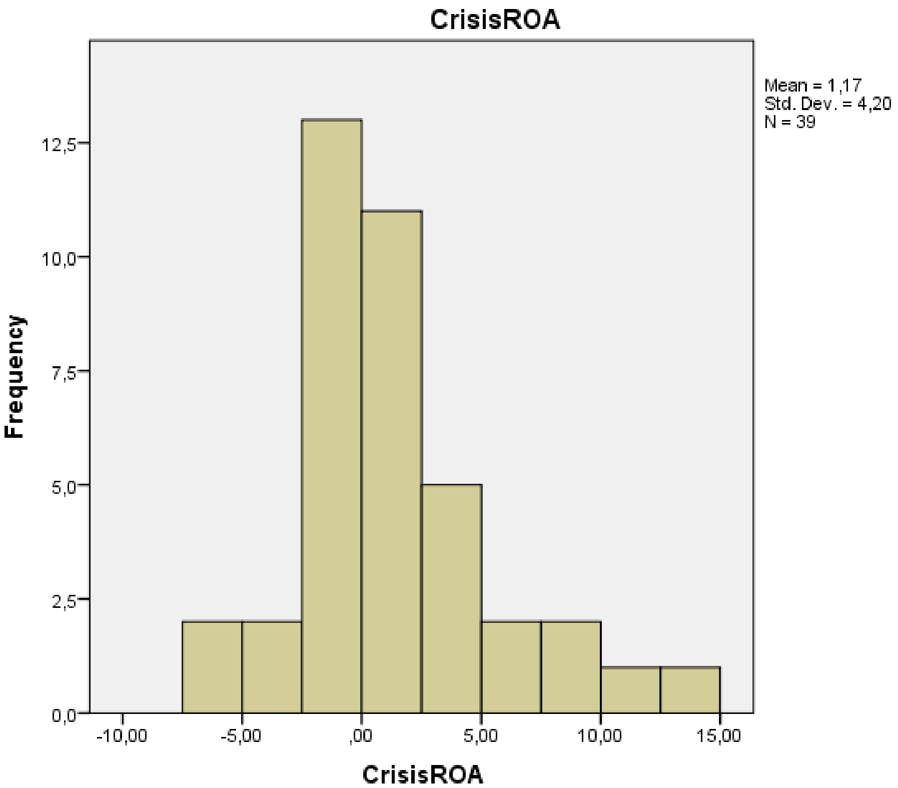

Figure IV.2: Histogram CrisisROA

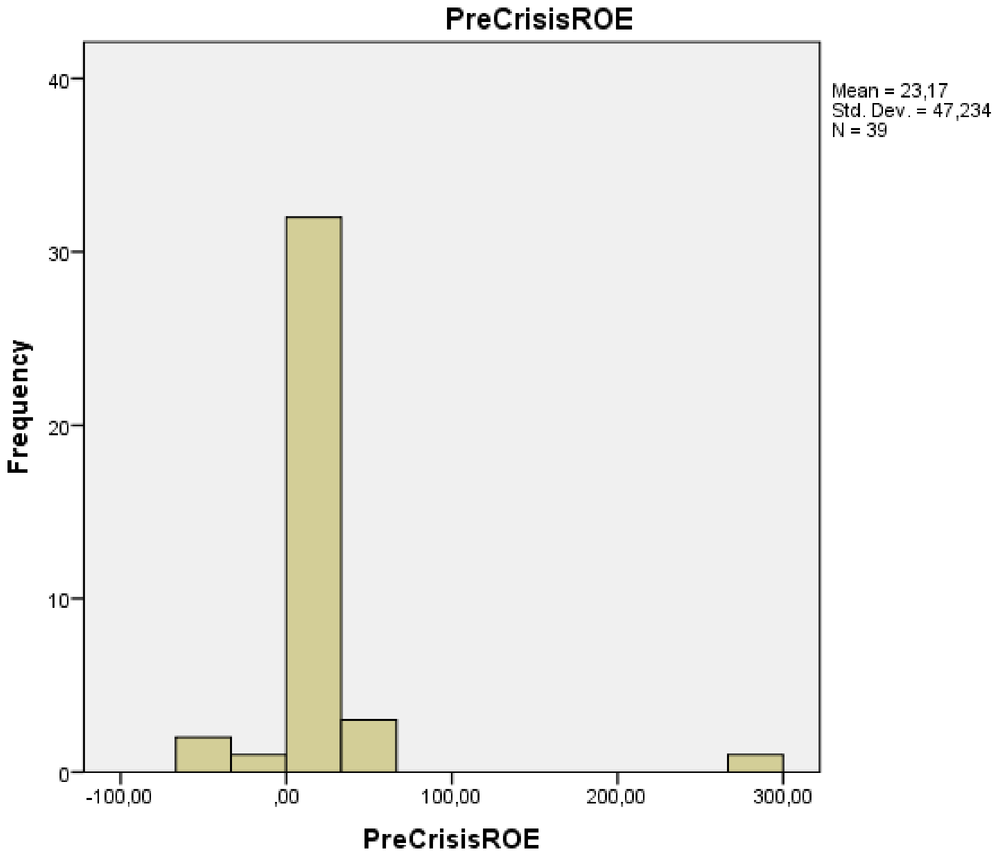

Figure IV.3: Histogram PreCrisisROE

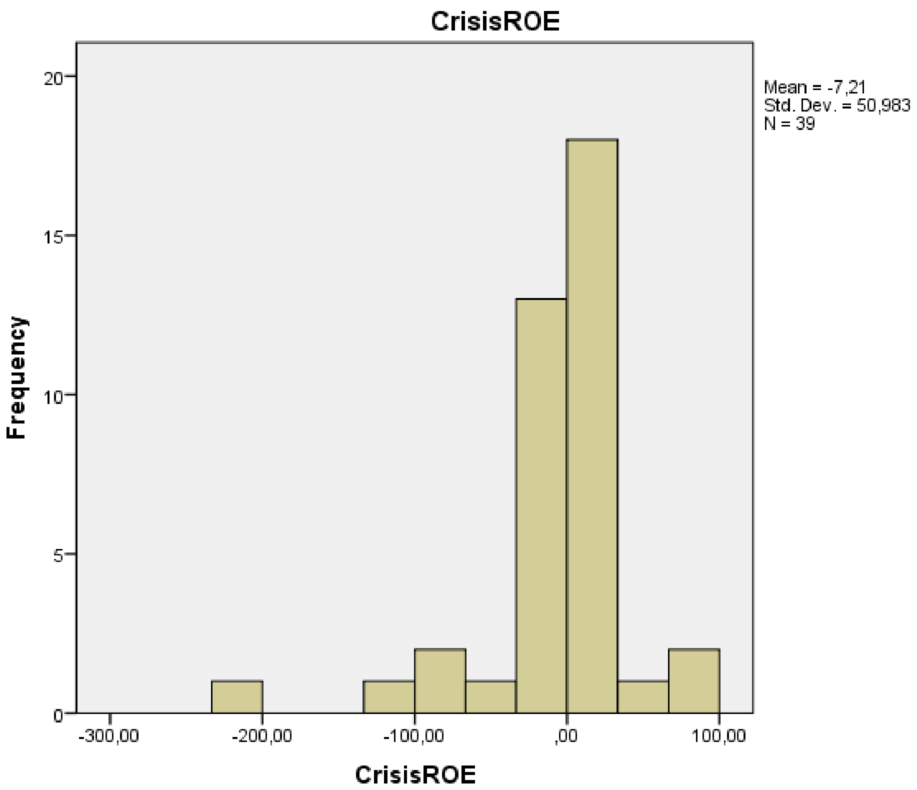

Figure IV.4: Histogram CrisisROE

Appendix V: Tests of Normality

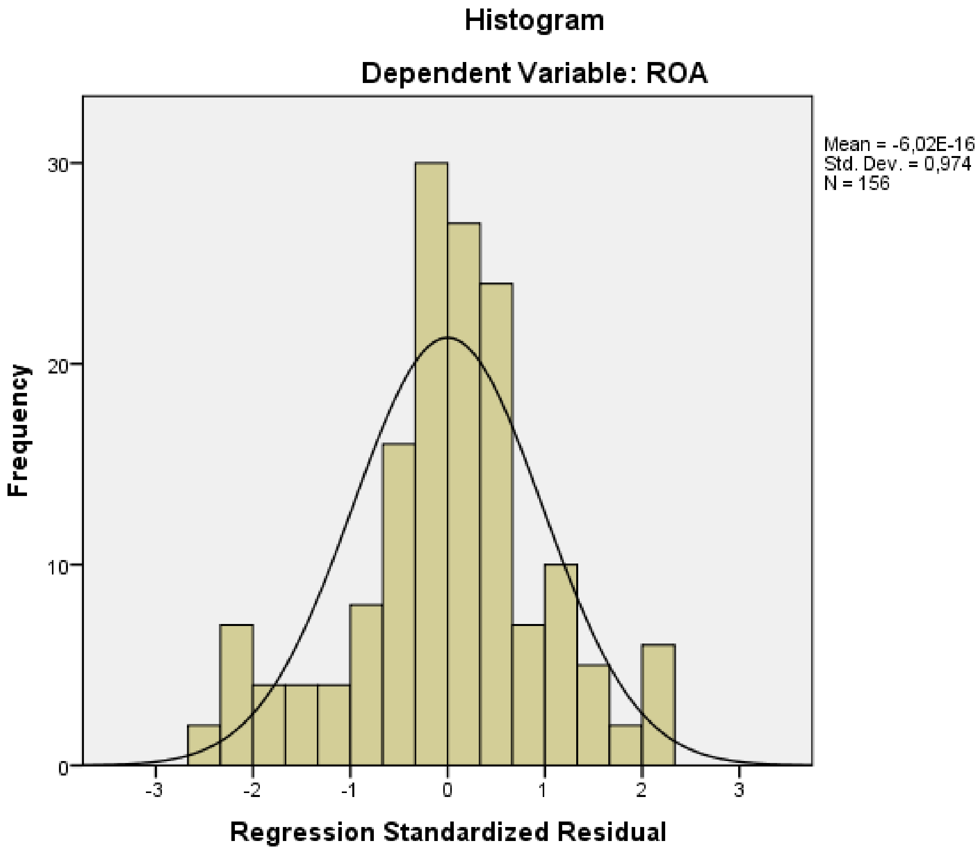

Figure V.1: ROA Residuals Histogram

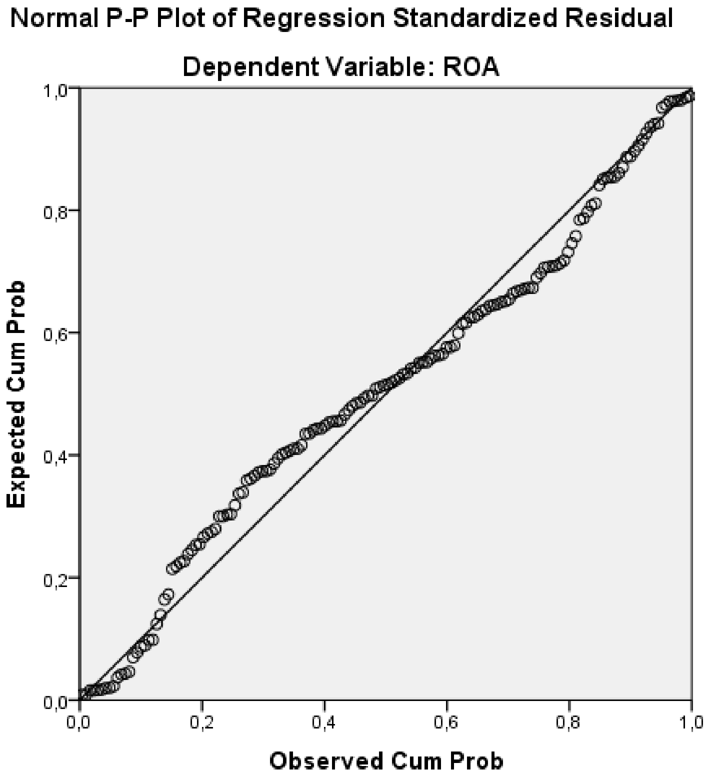

Figure V.2: ROA Residuals P-P Plot

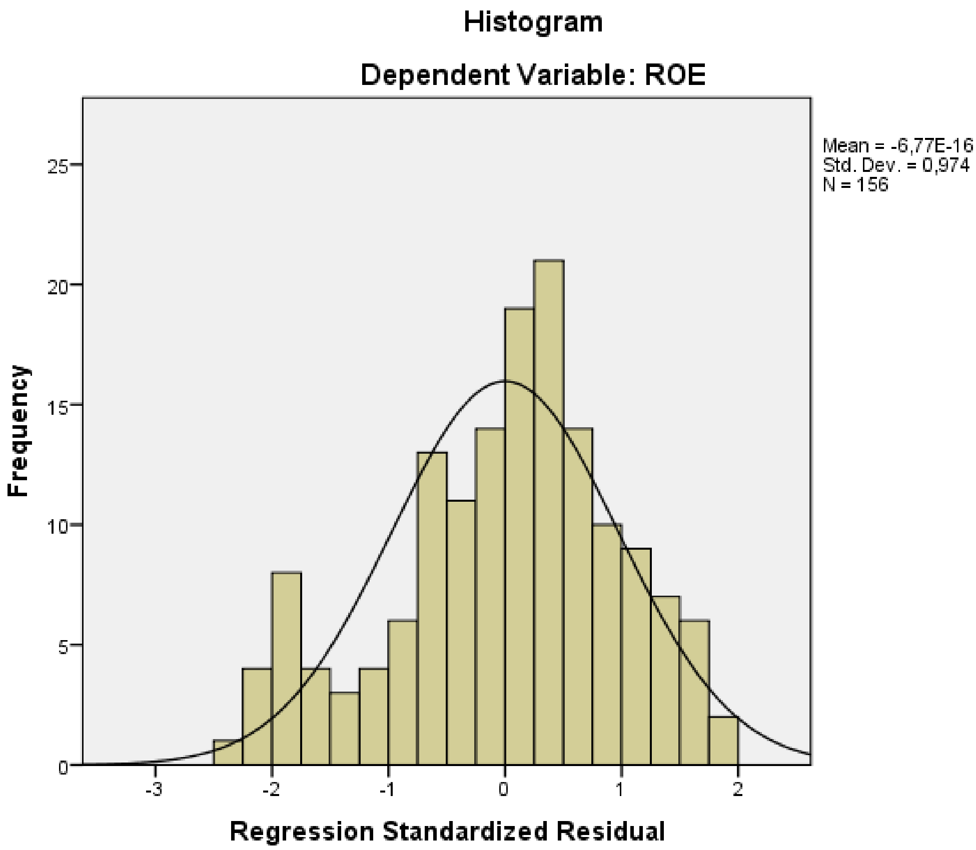

Figure V.3: ROE Residuals Histogram

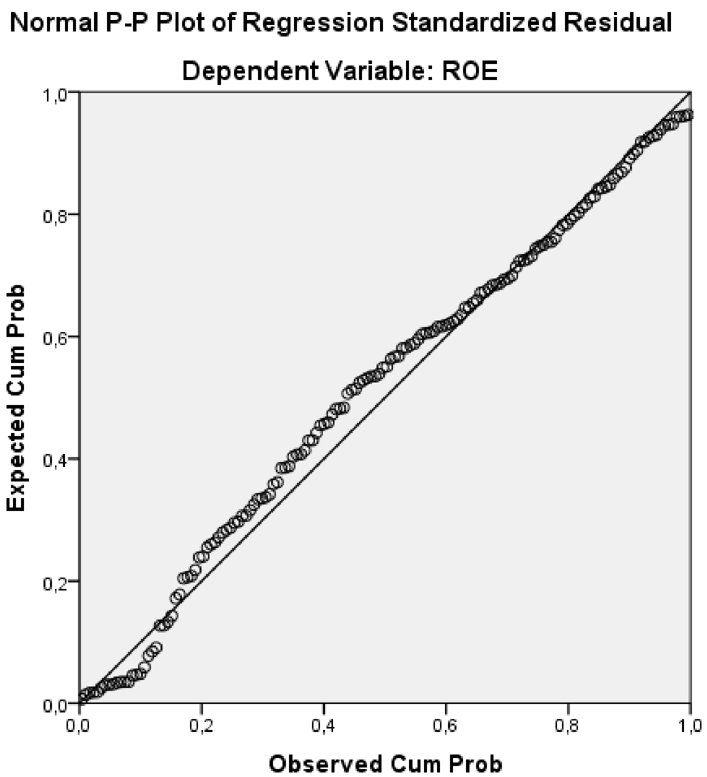

Figure V.4: ROE Residuals P-P Plot