PROFIT RISK MODELS FOR SOUTH AFRICAN BANKING SECTOR

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A Thesis submitted in fulfilment of the requirements for

Master of Science degree in **Statistics**

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February 2016

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DECLARATION

I **Albert Antwi** declare that this thesis is my original work and has not been submitted for any degree at any other University or institution. The thesis does not contain other person's writing unless specifically acknowledged and referenced accordingly.

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ACKNOWLEDGEMENT

My greatest appreciation goes to the Almighty God for his mercies, blessings and guidance throughout the duration of this research and beyond.

My sincere gratitude goes to my supervisor Dr. K.A. Kyei for his guidance and support, both academically and financially which has made this research a reality.

I do acknowledge the support offered to me by my co-supervisors; Mr. D.C. Manda and Mr. E.N. Gyamfi. Their constructive criticisms contributed to the success of this research.

My appreciation also goes to Dr. P. Kaburise for proof reading this document. Finally I do acknowledge the immense contributions from ABSA, Ned Bank and World Bank. The availability of various data on the website of these institutions contributed greatly to the success of this research.

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DEDICATIONS

This research work is dedicated to the Almighty God, my parents, Mr. Joseph Antwi-Amponsah and Ms. Rose Boatemaa, my son, Symon- Miguel Brendan Antwi and my wife, Mrs. Kelly Antwi.

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ABSTRACT

The study sought to fit individual multivariate time series regression models for the dependent variables: net-interest margin, return on asset and return on equity against all the lag one independent variables: deposit, size, loan, capital, inflation, gross domestic product and stock-market capitalization for each of the banks under-study using secondary data from ABSA and Ned Bank. The lag one of the dependent variables was also considered as independent variables in the fitted models.

Logarithm to the base of ten transformations of the absolute de-trended data, first differencing and inverse square root transformation were the smoothing techniques applied to the ABSA data. First differencing, logarithm to the base of ten of the absolute data values and natural logarithm transformations were applied to the Ned Bank data to make them stationary.

Multivariate time series regression by the least square approach (Gauss-Newton/ Marquardt steps) with special consideration of the stepwise method was used in fitting models onto the data. The Akaike information criterion was used in selecting the best model from the competing models.

Results from the ABSA data analysis indicated that, there exists a negative log-linear relationship between NIM and each of size and return on equity. The association between ROA and net-interest margin was found to be negative linear and that of ROA and each of inflation, capital and return on equity was positive. The association between ROE and capital was found to be negative log-linear. It was further found out that there exists positive log-linear between ROE and return on asset. It was deduced from these relationships that higher lag one values of loans, asset, stock market capitalization, net-interest margin, return on asset and return on equity were not risky to aggregate profitability except for inflation which was found to be more risky to aggregate profitability of ABSA.

In the case of Ned Bank models, the relationship between NIM and both of capital and gross domestic product was found to be positive log-linear and the relationship between NIM and Inflation was found to be negative log-linear. Positive natural logarithmic association exists between ROA and stock-market capitalization while

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negative natural logarithm association exists between ROA and each of inflation and loan. The relationship between ROE and both of market capitalization and inflation was found to be negative linear. Higher values of all the lag one independent variables in the estimated Ned Bank models were found to be non-risky to aggregate profitability. Even though loans were found to impact negatively on ROA, increasing them result in higher net-interest income if proper credit-risk management procedures are strictly adhered to, leading to an increase in aggregate profitability.

Deposit was the only factor among those considered that did not significantly affect any of the components of profitability of ABSA and Ned Bank. Based on the estimates from the various independent variables considered, models for NIM, ROA and ROE were constructed for ABSA and Ned Bank.

Key words: Profitability; market imperfection; multivariate modelling; risks; lagging.

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CHAPTER ONE

INTRODUCTION

1.1 OVERVIEW OF THE TWO BANKS UNDER STUDY

The two banks, namely ABSA bank and Ned bank were selected for the study because all the necessary data that was needed for the study were available on their websites. Brief overviews of these two banks are presented below.

1.1.1 OVERVIEW OF ABSA GROUP

ABSA (Almagamated banks of South Africa) limited is a wholly owned subsidiary of Barclays Africa Group Limited (formerly ABSA Group Limited) and it is listed on the JSE (Johannesburg Stock Exchange) Limited.

It was formed in 1991 when four financial institutions merged. The four retail banks that merged were Allied, *Volkskas*, United Bank and Trust Bank. These retail banks had initially traded independently within the ABSA group but they resulted in a virtually zero top of mind recollection.

In 1998, a strategic decision was made to unify and re-invent the ABSA brand and Brand Union Agency was tasked to lead the course. The key challenge was for ABSA to stay relevant to their customers, and for the group to become the brand. After careful analysis, the agency came out with a solution was to create a brand and operational synergy.

The team then focussed on creating a new corporate identity for the ABSA Group that would unite the retail banking services (financial services, properties and securities) coupled with the brand merger of four individual retail banks. This was to create an ABSA brand, which would be effective and seamlessly accepted by a broad spectrum of customers as well as employees.

ABSA became one brand providing financial services: a one-stop shop offering simple, uncomplicated banking relationships, value for money, stability, convenience and superior customer service.

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Today ABSA is a household name and it is rated as one of the top (10) brands in South Africa with an identity that continues to remain relevant in a dynamic climate. By October 13th, 2015, its total customer base was around 10.3 million and its total employee was 33879. ABSA offers a wide range of retail, business, corporate and investment banking as well as wealth management products and services to its customers and it has consistently done so which has led to a steady growth in its profitability.

Since it was rebranded in 1998, its headline earnings increased from R1692 million to R4677 million as at 30th June 2015 representing over 276.42% in profit growth. In the same period, its total asset grew from R168.7 billion to about R859.144 trillion representing an asset growth of over 509273%. The net-interest margin, returns on equity, average asset and average risk-weighted asset for the unaudited interim consolidated financial statement ending on 30th June 2015 are 3.84%, 17.1%, 1.1% and 2.05% respectively [Culled from www.ABSA.co.za].

1.1.2 NED BANK OVERWIEW OF NED BANK GROUP

Ned Bank Limited is a wholly owned subsidiary of Ned Bank Group Limited, which is listed on the JSE Limited.

Ned Bank's history dates back to the early 19th century with the establishment of the Cape of Good Hope Bank in 1831. The bank was originally founded in 1888 in Amsterdam as the *Nederlandsche Bank en Credietvereeniging voor Zuid-Afrika* "Dutch Bank and Credit Union for South Africa" and in the same year it opened an office in Pretoria, Republic South Africa.

In 1903, the company was renamed *Nederlandsche Bank voor Zuid-Afrika* ("Dutch Bank for South Africa"). The bank split in 1951 and renamed its South African branch as *Nederlandse Bank in Suid-Afrika Beperk* (Netherlands Bank of South Africa Limited). In 1969, the company became 100% South African-owned after Bank *Mees en Hope* sold its 20% share. In 1992, the name of the bank was changed to Nedcor Bank Limited with Ned Bank being the largest division. In the same year, Ned Bank Investment Bank, UAL and *Syfrets* merged to become Nedcor Investment Bank.

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On January 1, 2003, Nedcor, BoE, Ned[illegible] Investment Bank and Cape of Good Hope Bank merged into one legal entity to become new Nedcor Group that was later renamed Ned Bank Group on 6 May 2005.

Its core business comprises of retail, corporate and investment banking as well as wealth management product and services. It has about 7.1 million customers with a total staff of 30499.

Since the group's inception in 2003, its asset base has grown from R11716 million to R809313 million as at December 31st, 2014 which represents over 6907% growth. In the same period its headline earnings grew about 551% (from R11792 million in 2003 to R9880 million in 2014). As of 20th June 2015, its market capitalization was nearly 120 billion rand [Culled from www.nedbank.co.za].

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1.2 THE SOUTH AFRICAN BANKING SECTOR AND ITS CONTRIBUTION TO THE ECONOMY

The South African economy was traditionally rooted in the primary sectors. However, since the early 1990s it has been driven by the tertiary sector. Currently, the economy is moving towards a knowledge-based, with greater focus on technology, e-commerce and financial sector and other services (The Banking Association South Africa, 2014).

The South African economy has a developed and well-regulated banking sector that compares favourably with the banking sectors of industrialised countries. The sector is made up of seventeen registered banks with Standard Bank, ABSA[1], Ned Bank and First National Bank as the major ones. It has two mutual banks, 14 local branches of foreign banks, two cooperative banks and 43 banks with approved local office (The Banking Association South Africa, 2014).

The sector together with the real estate and business services contributed 0.7% of the growth rate that the country achieved in 2014, representing about 20% of the growth rate. In 2006, the sector together with real estate and business services accounted for 22% of the country's real value added.

The sector is therefore very vital in the economy and it should be given the necessary attention including research into best practices for it to operate efficiently and effectively so that it will be able to contribute its quota to the national growth, continually.

[1] Extensive contributions by the South African banking industry to the economy were not discussed. Only the relevant aspects that are related to the study were discussed.

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1.3 COMMON RISKS IN THE BANKING SECTOR

The banking sector of South Africa is one of the various sectors in the economy whose core objective is to maximise profit by controlling expenses under constrained resources and varied kinds of risks.

According to Alexander *et. al* (Alexander *et. al*, 2005), financial risk is "any event or action that may adversely affect an organisation's ability to achieve its objectives and execute its strategies" or alternatively, "the quantifiable likelihood of loss or less-than expected returns". The most commonly known risks in the banking sector include market, credit, operational, liquidity and model risks.

Market risk is the risk resulting from a change in the value of a financial position, as a result of changing components which affect that position *(*Alexander *et. al,* 2005*)*. For instance, a change in the political status of a country may trigger a panic in the economy resulting in speculative buying of foreign currencies which then will cause the currency of that country to fall. A typical example of this instance occurred in Ghana, in December 2008 before the presidential and parliamentary general elections. Members of the incumbent government had previously accused the opposition party (then incumbent) of mismanagement of the economy, which they claimed accounted for the depreciation of the local currency and the overall high standard of living .So when the opposition party won the 2008 elections many people began to buy foreign currencies based on this speculation to preserve the value of their current wealth and this resulted in the price of the foreign currencies, general price of goods and services soaring, which led to the depreciation of the local currency.

Credit risk is the probability of not receiving promised repayments on outstanding investments, such as loans and bonds as a result of borrowers defaulting *(*Alexander *et. al,* 2005).

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Operational risk occurs when internal processes fail or become inadequate as a result of people and systems or as a result of failures from external events (Alexander *et. al,* 2005).[2]

Liquidity risk arises when financial institution is unable to provide enough cash or cash equivalents to meet demands of depositors and borrowers. In addition it may be due to the value of an asset yielding less than its fair value or assets not being sold at their desired time, due to lack of buyers (Alexander *et. al,* 2005).

Model risk results from using an inappropriate model for measuring risk (Alexander *et. al,* 2005*).* For instance if a regression model that is built by violating the *homoscedascity* assumption is used to make predictions, it may result in an over-estimation or under-estimation of the parameters of the models. Decisions based on these estimates could lead to an increase in the risk of making profit.

[2] There are other known risks affecting the banking industry. Only the most common ones that banks face were discussed.

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1.4 SOME FACTORS AFFECTING THE PROFITABILITY OF THE BANKING INDUSTRY

The world economy is like a man whose life depends on others and whose actions and inactions affect one another and his environment. It consists of several complex interwoven and intertwined processes and entities which directly or indirectly affect one another. For instance, a change in the consumer price index may affect commodity prices in the economy leading to an increase in inflationary rate which directly or indirectly will affect other micro and macro- economic factors. Similarly, a change in the market conditions of one economy in one country may have an effect on the economies of other countries. The great depression in the 1920s and the 2008 financial crunch of the United States of America's economy directly affected the global markets.

The banking industry is part of the world's economy and it is controlled and affected by several interwoven processes and factors. These factors and processes have either positive or negative impact on the operations of the industry, hence the need to study how these factors affect profitability of the industry.

Profitability is a measure of the use of assets of an organisation to generate an acceptable rate of return while controlling expenses. The Profitability of banks is mostly measured by the following ratios but not limited to them: ROA, ROE, ROCE and NIM. The formula for calculating ROA is conceptually the same for ROCE (Fields, 2002 and Newton, 2015) therefore the study will consider only ROA, ROE and NIM.[3]

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[3] 1. According to the risk bearing theory developed by F.B Hawley in 1907, "profit is a reward of risk bearing".

2. The uncertainty-bearing theory of profit developed by Prof. F.H. Knight in 1921 says, "Profits are the rewards for uncertainty bearing rather than risk taking". Non-insurable risk (uncertainty) is the risk whose statistical probability can always be computed. The risk that is neither definite nor foreseen is called non-insurable or uncertainties risk. It cannot be guarded against because its statistical probability cannot be computed. Non-insurable risk arises from business cycle, technological changes, and unhealthy competition among business firms, change in government policy, changes in political state and the likes.

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The profit of any bank is controlled by several variables which can be classified into internal and external factors. Internal factors are those factors that management policies and decisions have effect on. Management decisions, especially regarding loan portfolio concentration are important factors that contribute to a bank's profitability (Zimmerman, 1996).

The external factors are those that the management of banks does not have control over. Most of these factors are usually controlled by market conditions and sometimes, consumer behavior and government decisions.

The internal factors that will be considered under this study are size, capital, deposits and loans while the external factors are gross domestic product, inflation and market capitalization.

Return on assets (ROA) is a measure of profitability of a company relative to its total amount of assets that have been invested by the owners. ROA reflects how well the management of the bank uses the real investment resources of the company to generate profit. It measures the level of profit as compared to the value of net asset invested in the organisation (Fields, 2002 and Newton, 2015).

Return on Equity (ROE) is the ratio of net income to total equity which provides an indication of how well a company uses its investment funds to generate earning growth. It measures the company's ability to use borrowed funds effectively as well as the owners' money (Fields, 2002).

Net-interest margin (NIM) is the net interest relative to total assets of a financial institution. It measures the difference between investment returns and interest expenses relative to the amount of total assets (Farlex Financial Dictionary, 2012).

The total asset of a bank is used as a proxy for its **SIZE**. Larger banks are better placed than smaller ones (Gul *et. al*, 2011 and Bikker and Hu, 2002) because larger banks are able to benefit from higher product and loan diversification possibilities and economies of scales (Smirlock, 1985). Economies of scale implies that the cost of services and products of larger banks per-unit fixed cost or expenses is lesser than the smaller banks' due to an inverse relationship that exists been quantity produced and per-unit fixed costs.

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Products and services of larger banks therefore will be competitively cheaper than the smaller banks and hence the former will tend to enjoy higher levels of profits than the smaller ones. Higher size consequently implies higher profitability. However due to overhead of bureaucratic processes (Ameur and Mhiri, 2013), agency costs and other costs related to managing large firms are extremely large. Banks might illustrate a negative relationship between size and profitability (Stiroh and Rumble, 2006 and Pasiouras and Kosmidou, 2007).

CAPITAL (CAPITAL ADEQUACY) is the ratio of equity capital held as a percentage of risk-weighted assets. The higher the capital, the higher the profit since a bank can easily adhere to regulatory capital standards so that excess capital can be provided as loans (Berger, 1995).

LOAN is a written or oral agreement for a temporary transfer of a property (usually cash) from the lender to the borrower who promises to return it according to the terms of the agreement, usually with interest for its use. Banks derives its major source of income from issuing loans which are expected to have a positive impact on the bank's performance. All things being unchanged, the more deposits are transformed into loans, the higher the interest margin and profits (Gul *et. al*, 2011).

DEPOSITS are considered as the ratio of total deposits to total assets. Deposit is a liquidity indicator but it is considered as a liability. The main source of banks' funding is deposit which is supposed to have a positive impact on the profitability of the bank (Gul *et. al*, 2011).

GDP is the total monetary value of all goods and services produced over a specific time period. It is usually expressed as a comparison to the previous time period. Mirzaei *et. al* (2013) argues that the level of economic activity affects the supply of funds which consequently affects the profitability of banks. For the purpose of this research the average annual GDP rate will be used.

INFLATION is defined as a sustained increase in the general level of prices for goods and services. It is measured as daily, monthly or annual percentages. For the purpose of this study annual inflation rates will be used. Inflation affects a bank's pricing behavior, in the sense that if there is an expectation of higher inflation rate,

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banks believe that they can increase their prices without suffering a drop in demand for their output (www.investopedia.com/university/inflation/inflation1.asp).

STOCK MARKET CAPITALIZATION (MC) is the aggregate valuation of the company based on its current share price and the total number of outstanding stocks. The stock- market capitalization of all listed companies on the JSE will be used as a stock-market capitalization for this study. Under perfect market conditions, debt and equity financing act as perfect substitute. In that respect, in case a bank resort more towards equity financing, it will trigger a negative effect on that bank's profit (Gul *et. al*, 2011).

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1.5 BACKGROUND TO STUDY

The main aim of every bank is to maximise profit under constraint resources while minimizing risks. These risks are beyond the control of the management of the bank but the components of some of these risks such as expenses are within the limit of the management.

Efficient management of expenses leads to increased profitability (Guru *et. al*, 2002). Consequently, inefficient management will result in decline of profitability. In a bid to increase profit, banks sometimes allocate extra resources towards marketing and other operations in a view of attracting more customers to patronage their products and services. Sometimes due to the dynamic nature of the factors that determine profitability of the banking sector and market imperfections that exist in the economy, an increased marketing and other operating expenses do no necessary lead to an increase in profitability hence increasing the risk of making profit. In such situation a minimized operating expenses would have led to the same amount of returns.

These inefficiencies in expenses management is partly due to the fact that some of the banks hardly have any reliable or adequate quantitative models to forecast their targets, making it difficult to match profit with the optimal operating expenses. Thus, these banks end up making some poor or unrealistic a predictions of their annual profit targets which often result in an increase of the risks (model and expenditure risk) they face in achieving their set targets.

To provide good estimates of their annual targets thereby minimizing model, and expenditure risks, there is the need to build a quantitative model which is relevant to the sector to help supplement the individual models of these banks. It is in this direction that the researcher seeks to build a multilevel multivariate time series regression models to help South African banking sector in the estimation of their future annual profit targets.

It is anticipated that these models built from this study will help the banks to improve on their profit by saving considerable amount of money as a result of realistic annual target estimates which matches expected returns with the optimal expenditure. The study will also contribute to the body of knowledge in the field of econometrics and financial statistics.

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1.6 OBJECTIVES OF THE STUDY

The broad aim of the research was to construct individual multivariate time series regression models for the dependent variables: return on asset (ROA), return on equity (ROE) and Net-interest margin (NIM) against the independent variables (*size, capital, deposit, loans, and gross domestic product, inflation and market capitalization*).There is a possibility that the dependent variables may have effect on the prediction of one another. Due to this they will be regressed against each other as one of the independent variables in their respective models.

The relative contributions of each of the variables in their respective models were to be analysed. The effect of each of the variables under consideration in the study on their respective component of profitability was to be established. Akaike information criterion was then to be used to select the best models among the various competing models that will be built.

1.7 STRUCTURE OF THE STUDY

The project is divided into six chapters. Chapter one which is the introduction basically provides an overview of the South African banking sector and its contribution to the economy. In addition, overviews of the selected banks under study and review on banking risks and factors that affect profitability in the banking sector in the South African economy are discussed in this chapter. The background to the study, the objectives and the structure of the study are dealt with in this chapter.

Empirical literature review on factors affecting profitability and review on methodological framework that will be employed in the model-building is thoroughly presented in chapter two. In chapter three the research design and methodology which include data type and source, soft wares, methodological framework, smoothing techniques, scatter plots and the model building will , be extensively covered.

Chapter four provides a detailed analysis of the data, based on the computer-generated output by the software packages to be used. Detailed analysis of the outputs, their relevance and deductions are dealt with in this chapter in addition to forecasting with the models. Chapter five consists of the summary, conclusion,

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limitations of the research and recommendations. The final chapter is dedicated to references and appendices.

1.8 CONCLUSION

The purpose of this research was introduced in this chapter. The objectives, justification, structure of the research and a comprehensive history of South African banks since their establishment were also extensively dealt with.

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CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.0 INTRODUCTION

Review on empirical literature is thoroughly explained in this chapter as well as a brief review on time-series regression analysis.

2.1 EMPIRICAL LITERATURE REVIEW

Dating back as far as the 1960s, researchers like Kaufman (1965) have tried to understand the dynamisms of the profitability of banks by measuring profitability against several factors. In today's economy, due to diversifications and competiveness in the banking sector, researchers have not relented on their efforts to shed more light on other factors that could possibly affect profitability of the modern banking sector.

Duraj and Moci (2015) studied the factors that influence profitability of Albanian banks, *via* returns on equity. A secondary sample data from sixteen (16) banks for the period 1999 to 2014 was considered. Multiple linear regression method on a pooled cross sectional time series was utilized in the study to test for the effects of firm and market specific variables on bank profitability. The estimated results suggested that the profitability of Albanian banks is influenced not only by factors relating to their management decisions and internal factors, but also to changes in the external macroeconomic environment.

Siew and Shaikh (2015) studied the impact of nominal Gross Domestic Product (GDP) and inflation rates on the variables of profitability (return on average equity and return on average asset), liquidity, credit risk, impaired financing and the performance of these variables for Islamic banks in Malaysia during the period 2007 to 2011.[4] The study found out that nominal GDP has significant impact on return on ROAA (average asset), liquidity ratio and equity to net loans. However, even though

[4] The banking systems of most countries in the early 19th century were not as complex and highly competitive as it is today. In some countries monopoly existed and the effect of factors such as competitiveness on banking profitability were given little or no attention.

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inflation rate was found to have negative correlation with return on average equity and ROAA, its effect was not significant.

Ahmad (2014) investigated a comparative impact of internal factors on the profitability of Saudi Arabia and Jordanian banks by using a sample of twenty-three (23) for the two banks from 2005-2011. Statistical tools including Pearson's correlation, descriptive analysis of variance and regression analysis were utilized in testing the hypotheses and measuring the differences and similarities between the sampled banks according to their different characteristics. The factors influencing their profitability were tested empirically. The results indicated that there is a significant positive correlation between ROA of Saudi banks with TEA (total equity to asset ratio), TIA (total investment to asset ratio) and LQR (liquidity risk) variables, as well as a negative correlation with NCA (net credit facility to total assets ratio), CDR (net credit facility to total assets ratio), CIR (cost income ratio) and SZE (size) variables. ROA of Jordanian banks was significantly and positively correlated with LQR, NCA, TEA and CDR variables while it was negatively correlation with CIR, TIA and SZE.

Aremu *et. al* (2013) studied the determinants of banks' profitability in a developing economy with evidence from Nigerian banking industry, using data from 1980 to 2010. Results from the study revealed that contrary to views of some authors, bank size (Natural logarithm of total asset and number of branches) and cost efficiency did not significantly determine bank profitability in Nigeria. However, credit risk (loan loss provision-total assets) and capital adequacy (equity-total assets) were found to be significant drivers which affected bank profitability both in the long and short run respectively, while liquidity affected banks' profitability in the short run. Labour efficiency (human capital, ROI and staff salaries) only affected the banks' profitability in the long- run. However, for the external or macroeconomic variables that determined the banks' profitability, only broad money supply growth rate was found to be a significant driver both in the long and short run.

Houssem (2013) investigated the impact of bank-specific, industry-specific and macroeconomic determinants on the profitability of ten (10) Tunisian commercial banks for the period 2000-2010. To account for the impacts of the 2008-2010

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financial crises the period was divided into two sub-periods: before the crisis (2000-2006) and during the crisis (2007-2010). The dynamic-panel approach *via* the generalized method of moments (GMM) in system was used in the study. The findings indicated that before the US subprime crisis, capital adequacy, liquidity, bank size and yearly real GDP growth positively affected the performance of the Tunisian banking sector. However, cost-income ratio, yearly growth of deposits and inflation rate were negatively correlated across all measures of bank profitability. During the crisis period, bank profitability was mainly explained by operational efficiency, yearly growth of deposits, GDP growth and inflation.

Yong and Christos (2012) examined the effect of GDP growth on bank profitability in China for the period 2003-2009. One-step system GMM estimator was used to test for the persistence of profitability in the Chinese banking industry. The empirical findings pointed out that cost efficiency is positively related to bank profitability, while lower profitability can also be explained by the higher taxes paid by banks. It was also found out that, there is a negative relationship between GDP growth and bank profitability. It was further found that the profitability in the Chinese banking industry is significantly affected by the level of non-performing loans and a higher level of capital was associated with lower profitability.

Javaid *et. al* (2011) analyzed the determinants of profitability of top ten (10) banks in Pakistan for the period 2004 to 2008 focusing on the internal factors. The study used the pooled ordinary least square (POLS) method to investigate the impact of assets, loans, equity and deposits on one of the major profitability indicators of banks, return on asset (ROA).

The empirical results found strong evidence that these variables have a major influence on profitability. However, high total assets may not necessarily lead to high profits due to diseconomies of scales. High loans were found to contribute towards profitability but their impact was not significant. Equity and deposits however have significant impact on profitability.

Gul *et. al* (2011) examined the relationship between bank-specific and macro-economic characteristics for bank profitability by using data from top fifteen (15) Pakistani commercial banks for the period 2005 to 2009. The study used the pooled

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ordinary least square (POLS) method to investigate the impact of assets, loans, equity, deposits, economic growth, inflation and market capitalization on major profitability indicators (return on asset , return on equity, return on capital employed and net-interest margin), separately. The empirical results showed strong evidence that both internal and external factors have a strong influence on the profitability of the top banks.

Naceur and Goaied (2008) examined the impact of bank characteristics, financial structure, and macroeconomic conditions on Tunisian banks' net-interest margin and profitability during the period 1980 to 2000. The evidence suggested that banks that hold a relatively high amount of capital with high overhead expenses tend to exhibit higher net-interest margin and profitability levels. Size was negatively related to bank and stock-market development had positive impact on banks' profitability. The empirical evidence suggested that private banks are relatively more profitable than their state-owned counterparts are.

Heffernan and Fu (2008) examined the performance of different types of Chinese banks during the period 1999 to 2006. The results suggested that economic-value added and net interest-margin do better than the more conventional measures of profitability (return on average asset and return on average equity). Some macroeconomic variables and financial ratios were significant with the expected signs. Although the type of bank was influential, bank size was not and neither the percentage of foreign ownership nor bank listings had any discernible effect.

Havrylchyk *et. al* (2006) found a positive and direct relationship between capital and profits of banks suggesting that a more efficient bank should have higher profits, since it is able to maximise its net interest income.

Chantapong (2005) investigated the performance of domestic and foreign banks in Thailand during the period 1995 - 2000. All these banks were found to have reduced their credit exposure during the crisis years and have gradually improved their profitability during the post-crisis years. The results indicated that profitability of foreign banks is higher than the average profitability of the domestic banks although in the post-crisis period, the gap between foreign and domestic bank profitability had closed.

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Abreu and Mendes (2002) evaluated the determinants of banks' interest margins and profitability for some European countries. They found that well-capitalized banks face lower expected bankruptcy costs and that yielded better profitability. Controlling for macroeconomic environment, financial market situation and taxation, the consequences showed that high *leverage* and large loans to asset ratios lead to higher profitability. There is evidence that taxation impacts negatively on banks' profitability while macroeconomic setting and stock market development have positive impact on profitability.

Guru *et. al* (2002) investigated the determinants of bank profitability in Malaysia. A sample of seventeen (17) commercial banks for the 1986 to 1995 period was used. The profitability determinants were divided into two main categories, namely, the internal determinants (liquidity, capital adequacy, and expenses management) and the external determinants (ownership, firm size, and economic conditions). The findings revealed that efficient expenses-management was one of the most significant factors explaining high bank-profitability. In the same year, Bikker and Hu (2002) found a negative relationship between stock market capitalization and banks' profitability. Similarly, to Bikker and Hu (2002), Demirguc-Kunt and Huizinga (2001) found a negative relationship between stock market capitalization and banks' profitability. This indicates that equity and bank-financing act as substitutes instead of being complements.

Demirguc-Kunt and Maksimovic (1998) identified a positive relationship between size and profitability. They found that, the higher the funds, the more easily a bank could meet their rigid capitals, enabling them to have extra funds for giving loans to borrowers and thereby increasing their profits and earning levels.

Miller and Noulas (1997) found a negative relationship between credit risks and profitability, which confirms that customer default in payment of loan, reduces the net interest-margins on loans.

Molyneux and Thornton (1992) examined the profitability of banking zone on different countries. They considered about eighteen (18) European countries' data during the 1986-1989 period and found a significant positive association with the

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return on equity, the level of interest rate, bank concentration and government ownership.

The above empirical evidence confirms significant associations between the profitability and determinants of banks' profitability.

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2.2 TIME SERIES ANALYSIS

A time series is a set of observations x_t of the same variables recorded at a specific time t. An example is the quarterly returns of stock exchange. A discrete time series is a series in which the set t_0 of times at which observations are made is a discrete set. *Continuous time series* is a series obtained by recording observations continuously over some time interval, for example, when $t_0 = [1,100]$ (*Douglas et. al, 2008).*

2.3 TIME SERIES MODELS

Suppose that each observation x_t of a time series data *is* a realized value of a certain random variable X_t.

Definition: A time series model for the observed data $\{x_t\}$ is a specification of the joint distributions or possibly only the means and co-variances of a sequence of random variables $\{X_t\}$ of which $\{x_t\}$ is postulated to be a realization (*Douglas et. al, 2008).*

The joint distributions of the random vectors $\{X_1, \ldots, X_n\}', n = 1,2,3\ldots$ could be specified by a complete probabilistic time series model for the sequence of random variables $\{X_1, X_2, \ldots\}$. Alternatively, all of the probabilities can be written as $P[X_1 \le x_1,\ldots, X_n \le x_n]$, $-\infty < x_1,\ldots x_n < \infty$, $n = 1,2,\ldots$ (*Douglas et. al, 2008).*

In time series we often specify only the first- order and second-order moments of the joint distributions (the expected values EX_t and the expected product $E(X_t + hX_t)$, ($t = 1,2, \ldots, h = 0,1,2, \ldots,$). If all the joint distributions are multivariate normal, the second-order properties of $\{x_t\}$ completely determine the joint distributions and hence give a complete probabilistic characterization of the sequence (*Douglas et. al, 2008).*

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2.4 TIME SERIES MODELING PROCEDUR

To fit a time series models onto a time series data, it is necessary to follow some general procedures as a form of checklist. The procedures that need to be followed are outlined in the following steps:

Firstly, a sequence chart is plotted for the series and the main features of the graph are examined taking into account if there is a trend or seasonal component, any apparent sharp changes in behaviour or any observations that are potentially outliers. Next, if there is a trend and seasonal component in the series, it must be removed by applying the appropriate smoothing technique to produce a stationary series. Influential outliers need to be also removed *(Peter and Richard, 2002).*

After making the series stationary, the next step is to choose a model to fit the residuals, making use of various sample statistics including the sample autocorrelation function. After choosing the correct model, its parameters are estimated using an appropriate method. Finally, the estimated model is used to forecast future values *(Peter and Richard, 2002).*

2.5 STATIONARY PROCESS

If a process is random and regularly fluctuates around its constant mean then it is said to be stationary otherwise it is said to be 'non-stationary'. A simple stationary process is the white noise. A stationary time series can either be covariance (weak) stationary or strictly (strongly) stationary *(Cochrane, 1997).*

A time series process Y_t is said to be *covariance stationary* if its mean, variance and covariance do not depend on time. Mathematically, $EY = \mu$, $\text{var}(Y_t) = \sigma^2$ and $\gamma(t,\tau) = \gamma(\tau)$. If the distribution of a weak stationary time series is normal, then the process can be classified as strictly stationary *(Cochrane, 1997).*

A *strictly (strongly) stationary* process is the process whose joint probability distribution of the observations of the process $Y_t, Y_{t+1}.....Y_{t+n}$ is the same as the joint probability distribution of the observations $Y_{t+k}, Y_{t+k+1}.....Y_{t+k+n}$. The probability distribution of Y_t is the same for all periods when $n = 0$ and can be denoted as

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$f(Y)$. If a strong stationary process in addition has $E(Y_t), E(Y,Y_t) < \infty$ then it becomes weak stationary *(Cochrane, 1997).*

White noise is a sequence of serially uncorrelated random variables with a zero mean and a constant variance. It is denoted by $\varepsilon_t \sim (0,\sigma^2)$ .However if ε_t is normally distributed, then we can denote the process by $\varepsilon_t \overset{i.d.d}{\sim} N(0,\sigma^2)$ *(Douglas et. al, 2008).*

2.6 DATA ADJUSTMENT AND TRANSFORMATION TECHNIQUES

Smoothing is a process of separating the signals from the noise as much as possible. The smoother therefore acts as a filter used to obtain an "estimate" for the signal. For the estimates obtained by the least square approach to be valid, the data need to be stationary. This condition is catered for in the assumptions underlying time-series regression models. To perform analysis on a time series data, it is therefore always necessary to stabilize the data or to make the data stationary. To achieve this goal, we can either transformed or adjust the data (*Douglas et. al, 2008).*

Some of the transformation methods include exponential smoothing (Brown's models, Holt's model and damped exponential), differencing (remove trend from data by applying the difference operator to the original time series to obtain a new time series) and the power family of transformations (*Douglas et. al, 2008).*

The power family of transformation is given by

$$y^{(\lambda)} = \begin{cases} \dfrac{y^{\lambda}-1}{\lambda y^{\lambda}}, & \lambda \neq 0 \\ \tilde{y}\ln y, & \lambda = 0 \end{cases} \qquad \text{.....1.1}$$

where $\tilde{y} = e^{\frac{1}{T}\sum_{t=1}^{T}\ln y_t}$ is the geometric mean of the observations.

When $\lambda = 1$, no transformation is made to the data. For time series $\lambda = -1, -0.5, 0, 0.5$ are used. When $\lambda = -1$, the transformation is called an inverse transformation and $\lambda = -0.5$ results in reciprocal square root transformation. If $\lambda = 0$, the transformation is logarithm and for $\lambda = 0.5$ we have *square root* transformation.

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The logarithm transformation is used when the variability within the original time series data increases with the average level of the series.

In removing trend from data, a regression model that describe the trend component of the data is fitted and then subtracted from the original observations, leaving a set of residuals which are free of trend.

The regression models that are mostly considered to fit trends on data are the linear, quadratic and exponential trends. The linear trend is of the form

$$E(y_t) = \beta_0 + \beta_1 t \quad \text{.....} \quad 1.2$$

The quadratic trend is modelled using the equation:

$$E(y_t) = \beta_0 + \beta_1 t + \beta_2 t^2 \quad \text{.....} \quad 1.3$$

The exponential form of the trend model is:

$$E(y_t) = \beta_0 e^{\beta_1 t} \quad \text{.....} \quad 1.4$$

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2.7 DETECTING AUTOCORRELATION

There are many statistical procedures developed to detect the presence of autocorrelation. The procedures developed by Durbin and Watson and Cochrane-Orcutt are among the most widely used (*Douglas et. al, 2008).*

2.7.1 THE DURBIN-WATSON TEST

The procedure developed by Durbin and Watson (*Douglas et. al, 2008)* is based on the assumption that the errors in the regression model are generated by a first-order autoregressive process observed at equally spaced periods.

$$\varepsilon_t = \varphi\varepsilon_{t-1} + \omega_t \quad \text{.....1.5}$$

Where ε_t is the error term at time t , ω_t is an NID $(0, \sigma^2{}_{\omega})$ random variable and φ is the parameter that defines the relationship between successive data points of the model errors ε_t and ε_{t-1} (*Douglas et. al, 2008).*

With the model, the error term t is a fraction of the error experienced in the immediately preceding period and a normally and independently distributed random shock, $|\varphi| < 1$.

A simple linear regression with first-order autoregressive errors is represented as

$$y_t = \beta_0 + \beta_1 x_t + \varphi\varepsilon_{t-1} + \omega_t \quad \text{.....1.6}$$

y_t and x_t are the observations on the response and predictor variables at time t.

By successive substitution of $\varepsilon_t, \varepsilon_{t-1}$... equation (1.5) we obtain

$$\varepsilon_t = \sum_{j=0}^{\infty} \varphi^j \omega_{t-j} \quad \text{.....1.7}$$

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The expectation is $E(\varepsilon_t)=0$, variance is $\text{var}(\varepsilon_t)=\sigma^2{}_{\omega}\left(\frac{1}{1-\varphi^2}\right)$ and the co-variance

$$\text{cov}(\varepsilon_t,\varepsilon_{t\pm j})=\varphi^j\sigma^2{}_{\omega}\left(\frac{1}{1-\varphi^2}\right).$$

The autocorrelation at lag one is

$$\rho_1=\frac{\text{cov}(\varepsilon_t,\varepsilon_{t+j})}{\sqrt{\text{var}(\varepsilon_t)}\sqrt{\text{var}(\varepsilon_t)}}$$

$$=\frac{\varphi\sigma^2{}_{\omega}\left(\frac{1}{1-\varphi^2}\right)}{\sqrt{\sigma^2{}_{\omega}\left(\frac{1}{1-\varphi^2}\right)}\sqrt{\sigma^2{}_{\omega}\left(\frac{1}{1-\varphi^2}\right)}}$$

$$=\varphi$$

The autocorrelation between two errors that are k periods apart is

$$\rho_k=\varphi^k,\ \ i=1,2,... \quad \text{.....1.8}$$

Equation (2.4) is called the autocorrelation function (AFC).

When φ is positive, all the error terms are positively correlated but the size of the correlation decreases as the errors grow further apart. This positive autocorrelation is detected by performing the Durbin-Watson test (*Douglas et. al, 2008).*

HYPOTHESES FOR DURBIN - WATSON TEST

The hypotheses under Durbin-Watson test are:

$H_0:\varphi=0$ and $H_1:\varphi>0.$

The test statistic is

$$d=\frac{\sum_{t=2}^{T}(e_t-e_{t-1})^2}{\sum_{t=1}^{T}e_t^{\,2}}$$

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$$= \frac{\sum_{t=2}^{T} e_t^2 + \sum_{t=2}^{T} e_{t-1}^2 - 2\sum_{t=2}^{T} e_t e_{t-1}}{\sum_{t=1}^{T} e_t^2}$$

$$d \approx 2(1-r_1) \quad \text{.....1.9}$$

$e_t, t = 1,2,...T$ are the residuals from the OLS regression of y_t on x_t.

For uncorrelated errors, $d \approx 2$. The Durbin-Watson statistic d lies between the upper and lower bounds d_L and d_U respectively.

DECISION

If $d < d_L$, we reject $H_0 : \rho = 0$;

If $d > d_U$,, we fail to reject $H_0 : \rho = 0$ and

If $d_L \leq d < d_U$, the test cannot be concluded.

2.7.2 THE COCHRANE-ORCUTT METHOD

The Cochrane-Orcutt approach takes into account the auto-correlative structure when the observed autocorrelation in the model errors cannot be removed by addition of new predictor variables to the model (*Douglas et. al, 2008).*

Consider the transformation $y_t' = y_t - \varphi_1 y_{t-1}$ applied to the variables of the linear regression model $y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$. If we substitute the regression model into the transformational equation, we obtain

$$y_t' = \beta_0 + \beta_1 x_t + \varepsilon_t - \varphi(\beta_0 + \beta_1 x_{t-1} + \varepsilon_{t-1})$$

$$y_t' = \beta_0(1-\varphi) + \beta_1(x_t - \varphi x_{t-1}) + \varepsilon_t - \varphi\varepsilon_{t-1} \quad \text{.....1.10}$$

By making the following substitutions: $\beta_0' = \beta_0(1-\varphi)$ and $x_t' = x_t - \varphi x_{t-1}$ equation (1.10) can be written as

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$$y_t' = \beta_0' + \beta_1 x_t' + \omega_t \quad \text{.....1.11}$$

If the first - order autoregressive process is viewed as a simple linear regression model through the origin, the OLS can be used to estimate the new parameter φ

2.8 FORECASTING

The main aim of time series modelling is to build models that can be used to predict or forecast the future values. Assume we are at current period, τ and we want to get a lead forest at time $\tau+1$. To do this, for example, the first order-auto regressive model for the general linear regression model as shown in equation (1.9) becomes

$$y_{\tau+1} = \varphi y_\tau + (1-\varphi)\beta_0 + \beta_1(x_{\tau+1} - \varphi x_\tau) + \omega_{\tau+1} \quad \text{.....1.12}$$

If we assume that $x_{\tau+1}$ is known it means that at the end of the current period, both y_τ and x_τ are known. It is also apparent that the random error at time $\tau+1$, $\omega_{\tau+1}$ is not known, as it has not yet been observed. It is therefore assumed to be zero, $\omega_{\tau+1} = 0$ based on our assumptions underlying regression models that the expected values of the random error are zero. Hence, equation (1.12) becomes

$$\hat{y}_{\tau+1}(\tau) = \hat{\varphi} y_\tau + (1-\hat{\varphi})\hat{\beta}_0 + \hat{\beta}_1(x_{\tau+1} - \hat{\varphi} x_\tau) \quad \text{.....1.13}$$

2.9 INFORMATION CRITERIA

According to Neils Bohr (a Danish Physicist), it is difficult to make predictions, especially about the future. Mazerolle (2004) also argues that there are no true models in reality, models only approximate reality.

With this in mind before modelling any situation, emphasis must be on finding ways to minimize loss of information by finding the model that would best approximate reality given a data. Information criteria methods are often used as a guide in model selection to address such situation.

2.9.1 AKAIKE INFORMATION CRITERIA (AIC)

In 1973, Akaike modified Kullback-Leibler information criterion (Mazerolle, 2004) for model selection to help address the problem of information lost when approximating

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reality. The general Alkaike information criteria has the form $AIC = -2\ln(likelihood) + 2k$, where $\ln(likelihood)$ is the natural logarithm of the value of the likelihood and k is the number of parameters in the model.

The residual sums of squares approach from regression can also be used to calculate AIC. In this case $AIC = n\ln\left(\frac{RSS}{n}\right) + 2K$, where n is the number of observations, and *RSS* is the residual sums of squares. AIC requires a bias-adjustment for small sample sizes. [5]If the ratio of $\frac{n}{K} < 40$ then the bias adjusted AIC is given by $AICc = -2\ln(likelihood) + 2K + \frac{(2K(K+1))}{(n-K-1)}$ where variables are as defined previously. When the size of the dataset n increases relative to the number of parameters K, the bias adjustment term $\frac{(2K(K+1))}{(n-K-1)}$ becomes very small, therefore small sample adjustment is recommended.

[5] There other information criteria methods such as Schwartz and Hannan-Quinn but they will not be discussed here. Derivation of Akaike information criteria will not be considered here as we are only interested in how to use it in this study rather than its derivation.

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2.9.2 MODEL SELECTION WITH AIC

Minimum Akaike value is always preferred when choosing the best model (Mazerolle, 2004). We can further choose the best model by examining their relative distance to the true model.

To do this, we calculate the differences between the models with the lowest AIC and the others as $\Delta_i = AIC_i - min\,AIC$ where Δ_i is the difference between the AIC of the best fitting model and that of model i, AIC_i is AIC for model *I* and min AIC is the minimum AIC value of all models. The estimated likelihood of a model is proportional to the relative likelihood, $exp(-0.5*\Delta_i)$.

2.9.3 IMPORTANCE OF AKAIKE WEIGHTS FOR PARAMETERS

Normalizing the relative likelihood values gives a better means of interpreting the data. The normalized relative likelihood is given as $w_i = \frac{exp(-0.5*\Delta_i)}{\sum_{r=1}^{R} exp(-0.5*\Delta_r)}$ where w_i are known as Akaike weights for the models and the denominator is the sum of the relative likelihoods for all candidate models. Akaike weights can be used to examine the relative importance of individual parameters in the candidate models (Mazerolle, 2004).[6]

2.10 CONCLUSION

This chapter introduced the basic definitions and procedures in time series modeling and the diagnostic measures used in checking the adequacy of estimated models. An extensive review of factors affecting profitability of banks was also discussed.

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[6] Further information on information criteria can be obtained from the following sources:

1. Burnham, K.P., and Anderson, D.R. (2002). Model selection and inference: a practical information-theoretic approach, second edition. Springer-Verlag, New York.
2. Royall, R.M. (1997). Statistical evidence: a likelihood paradigm. Chapman and Hall, New York.

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RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

In this research, secondary data for both the explanatory and the dependent variables will be used. The data will be filtered by applying differencing, de-trending and logarithm and inverse square root filters. A combination of these filters may be considered where necessary.

Selected soft wares will be used to produce scatter plots of the data and the appropriate form of general solutions that best describes the data will be selected and by applying specific model estimating techniques in multivariate time series, the estimates of these general solutions will be found. Below is an elaboration of the research design.

3.2 DATA TYPE AND SOURCE

Historical annual data on the internal factors of bank profitability, from 1998 to 2014 was obtained for ABSA and from 2003 to 2014 for Ned Bank from their respective websites. The external factors were also sourced out from South African Reserve Bank and World Bank's website. All financial data used are nominated in million Rand .

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3.3 SOFTWARE EMPLOYED

Modern technological advancements have led to the development of several statistical and programming software packages which have simplified data analysis. This has replaced the traditional manual computation methods which was not only computationally cumbersome but time consuming and a waste of materials and resources. Some of these Statistical software packages includes Statistical package for Social Scientist (SPSS), *SAS*, *Minitab*, *Genstat*, *EVIEWS* among others. Programming languages such as *Matlab* and *Mathematica* can also be used to generate statistical outputs. In this research IBM's SPSS Version 22, *EVIEWS* 9 and *Minitab* 15 will be used in the data analysis.

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3.4 METHODOLOGICAL FRAMEWORK

Multivariate time series regression with lagged independent and dependent variables by the least square approach was used in fitting models to the data with the help of Minitab, EVIEWS and SPSS Statistical software.

This method was chosen because the data is a time-series and the variables are naturally occurring with the independent variables being continuous and also our goal was to build a predictive model. Least square gives the optimum estimates of the unknown parameters and since financial estimates need high degree of precision, it makes this methodology more useful in building the model.

The backward and forward elimination options in linear regression procedure of Minitab were used to select the variables that needed to be included in each model after which the Least Squares (Gauss-Newton/Marquardt steps) in equation estimation procedure of EVIEWS was used to obtain the estimates of the models. Graphical outputs such us Normal probability plots, *Correlogram* and scatter plots were obtained using Minitab and IBM SPSS packages.

3.5 SMOOTHING TECHNIQUES

In time series data, it is often necessary to filter the signals from the noise in order to reveal hidden patterns. Preliminary analysis of the data revealed that some of the series variables were not stationary throughout the time interval as this is typical of time-series data. To perform meaningful analysis of the data, the following filters were applied.

The variables of ABSA data exhibited quadratic pattern in time so the data was de-trended by quadratic models. After the data was de-trended the variability was found to increase with the average level of the series so it was necessary to further transform it by applying the logarithm filter to remove these variability (*Douglas et. al, 2008).*

At the start of the financial year of banks, the values of the determinants of their profitability are not known except those from the past. In time-series data the, immediate past values have more effect on the immediate future. Due to this, lagging

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of the stationary variables was necessary. Preliminary analysis of the stationary independent variables indicated that the ACF and PACF bars at lag one were outside the 95 percent confidence interval bound, indicating the presence of autocorrelation. Lag one of the stationary variables was therefore necessary to remove the autocorrelation and to help the banks to forecast the immediate future of their profitability based on the immediate past.

As an alternative method, the ABSA data was also first differenced at lag one time interval to make it stationary. The inverse square root transformation technique was also used in smoothing the data to provide other alternative model that could fit the ABSA series. All the three smoothed series were used to fit models onto the different components of the profitability of ABSA (*Douglas et. al, 2008).*

For the Ned Bank series, logarithm to the base of ten of the original data was taken because the variability in the original series increases with the average level of the series. The resulting logarithm-transformed series was lagged at one time period for the same reason stated for the ABSA series *(Douglas et. al, 2008).*

Alternatively, the inverse square root transformation was used to smooth the series. The transformational equation $y = \ln(1 + x)$ was also used to smooth the series and lagged at one time period because the magnitude of the fluctuations in the Ned Bank data appears to grow roughly linearly, with the level of the series (*Douglas et. al, 2008).*

However each of the three smoothed series for Ned Bank was used to fit models onto only one component of the profitability of Ned Bank for the reason being that none of the smoothed data could significantly fit models to all the components of Ned Bank profitability.

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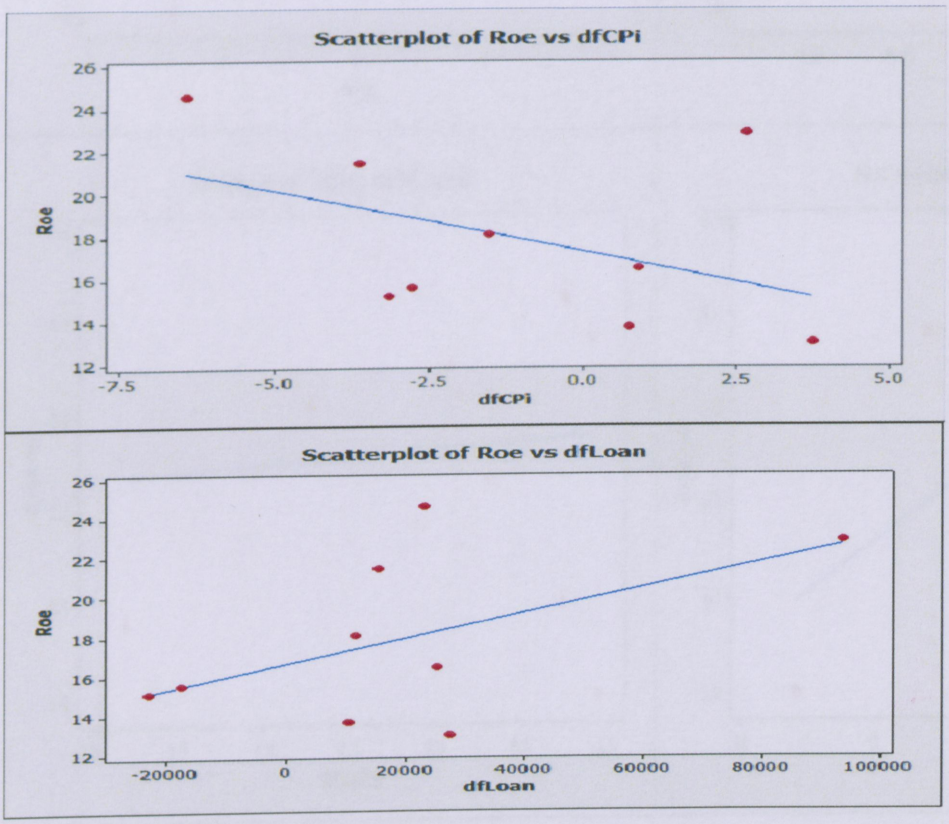
3.6 SCATTER PLOTS

To determine the form of the various Multivariate time series regression models of the different smoothed series for the two banks under study, scatter plot for each of the identified independent variables were obtained.

These plots are indicated in Figures 1 to 9. The various scatter plots reveal some sort of linear relationships that was initially not with the original data during the preliminary analysis.

3.6.1 SCATTER PLOTS FOR DIFFERENCED LAG ONE SERIES FOR ABSA

Figure 1: ROE against lag one Inflation and loan (differenced)

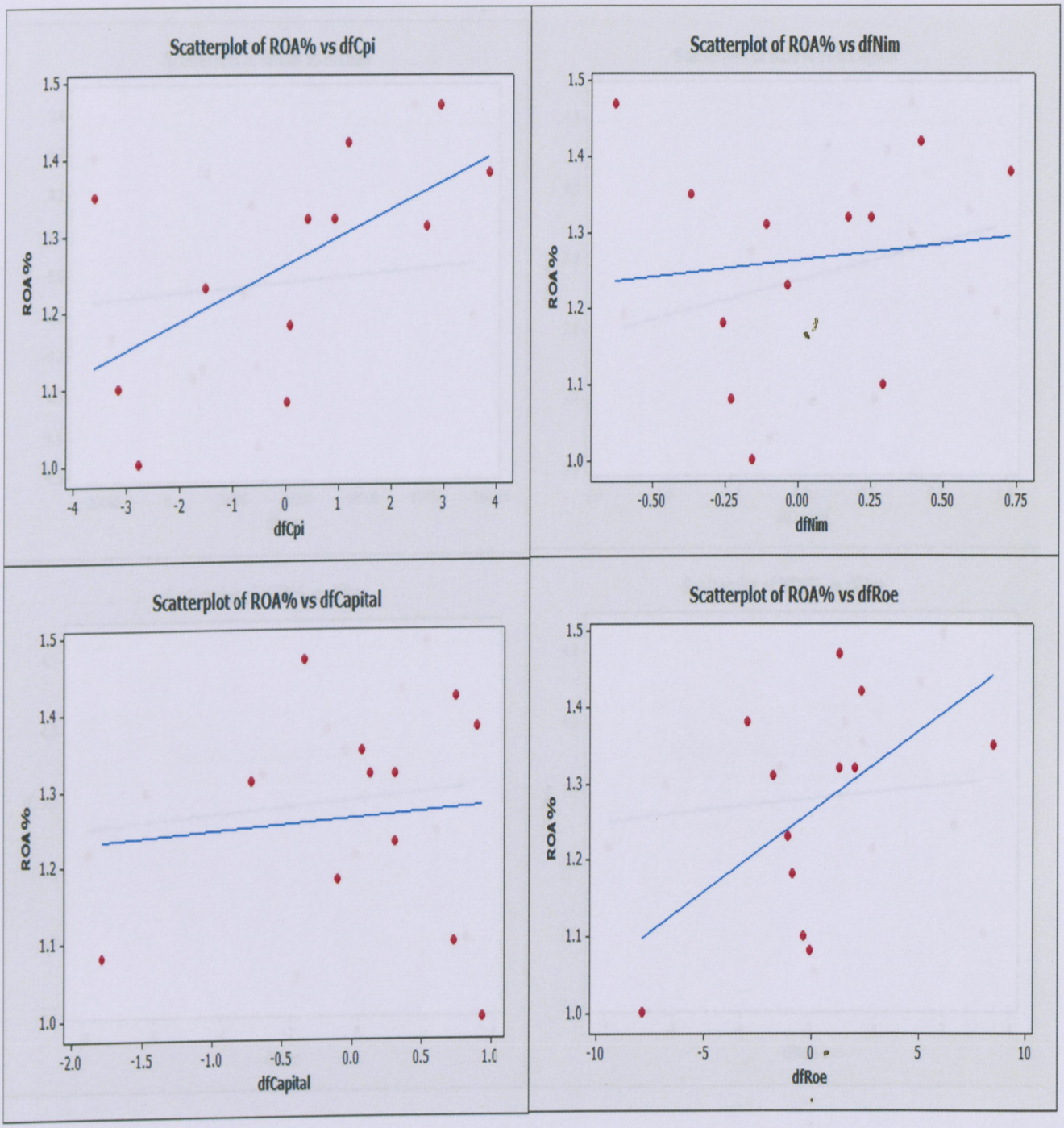


[7]

[7] The sources of all the figures and the subsequent ones in the rest of the study are from the Author's own extracts from the data analysis performed.

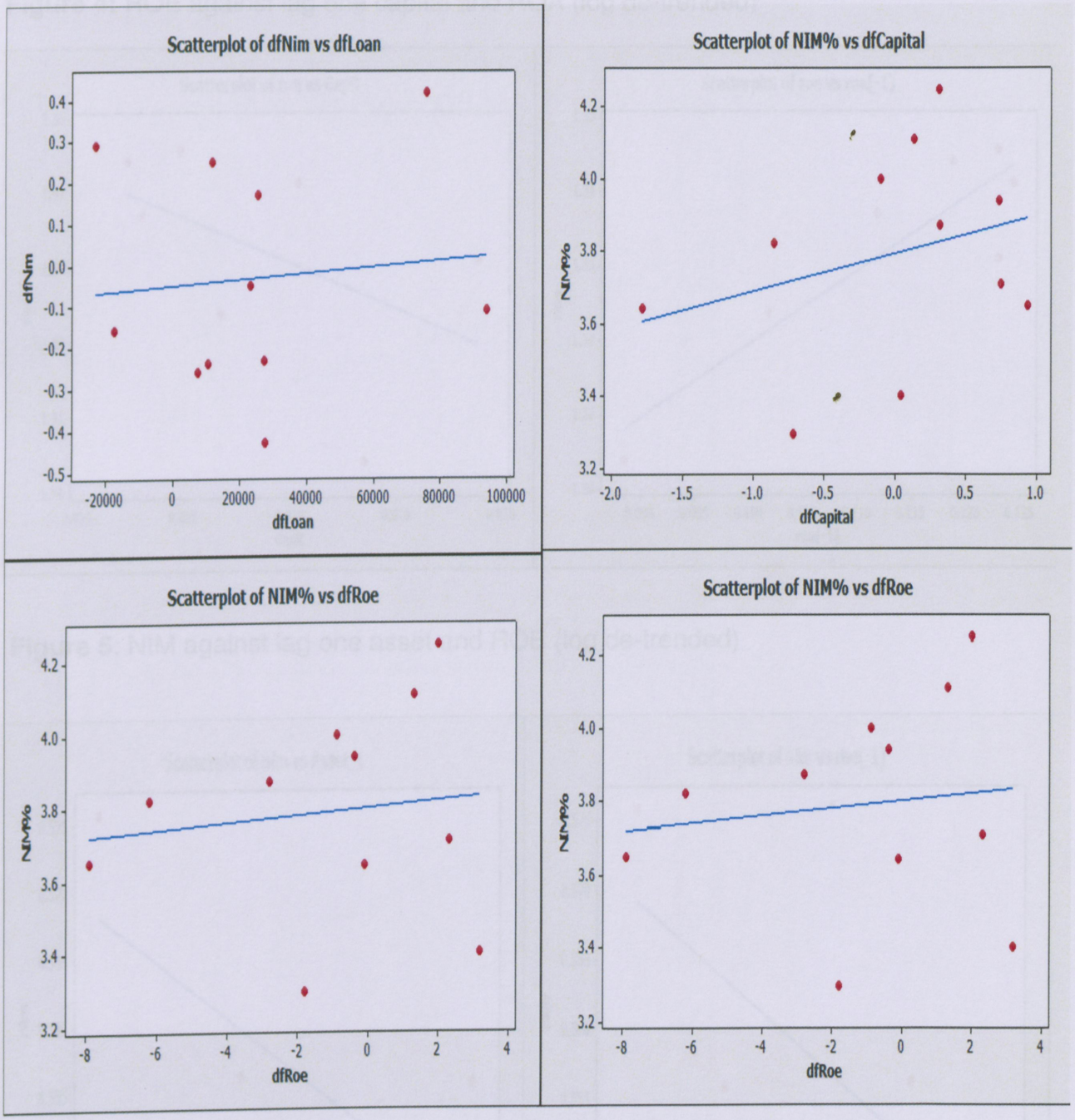
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Figure 2: ROA against lag one Inflation, NIM, capital, ROE (differenced)



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Figure 3: NIM against lag one Loan, capital, ROE and inflation (differenced)



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3.6.2 SCATTER PLOTS OF LOG DE-TRENDED LAG ONE ABSA SERIES

Figure 4: ROE against lag one capital and ROA (log de-trended)

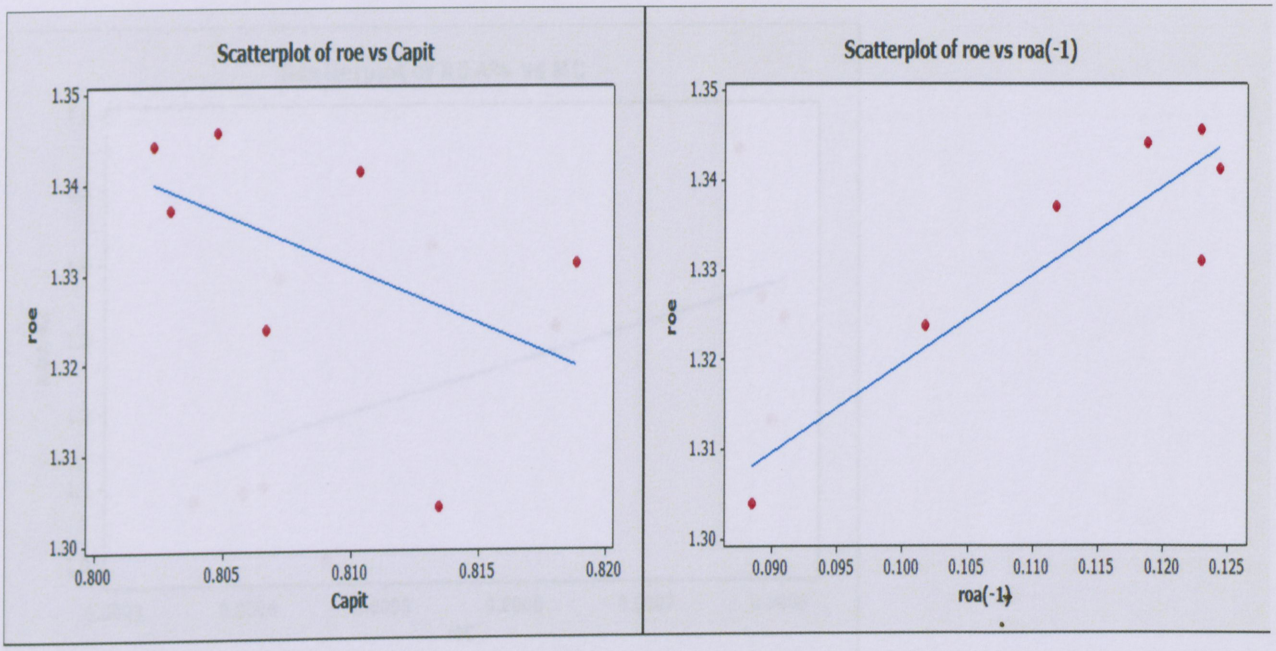
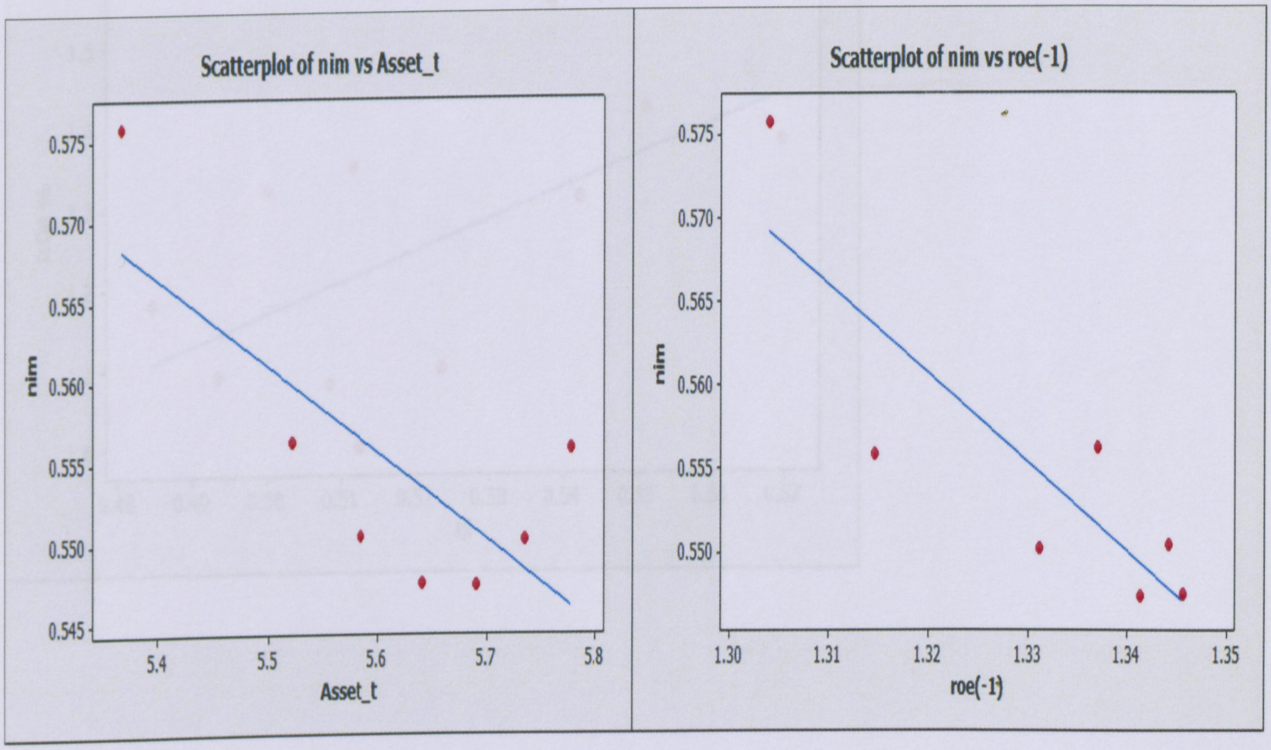


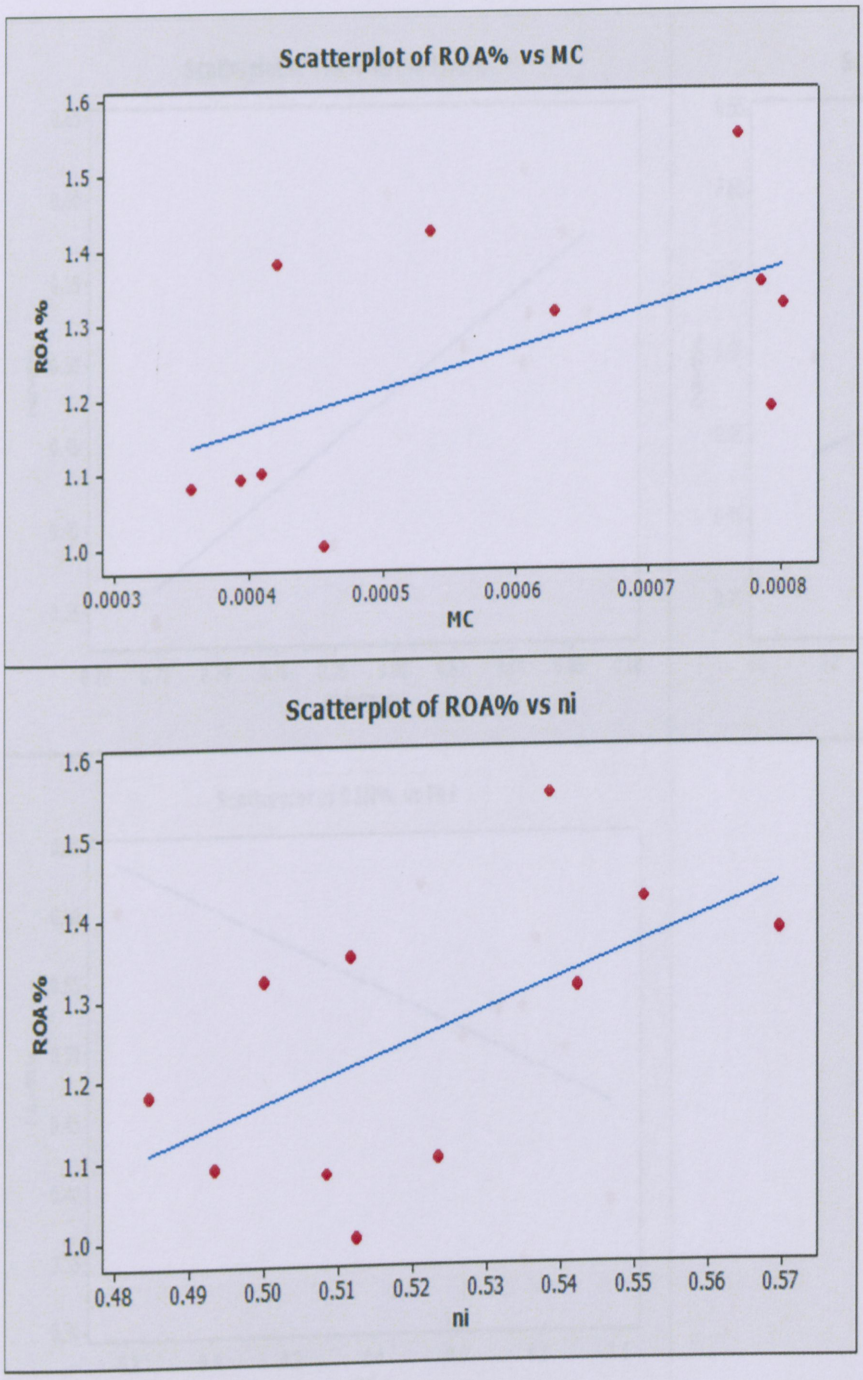
Figure 5: NIM against lag one asset and ROE (log de-trended)



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3.6.3 SCATTER PLOTS OF INVERSE SQUARE ROOT LAG ONE ABSA SERIES

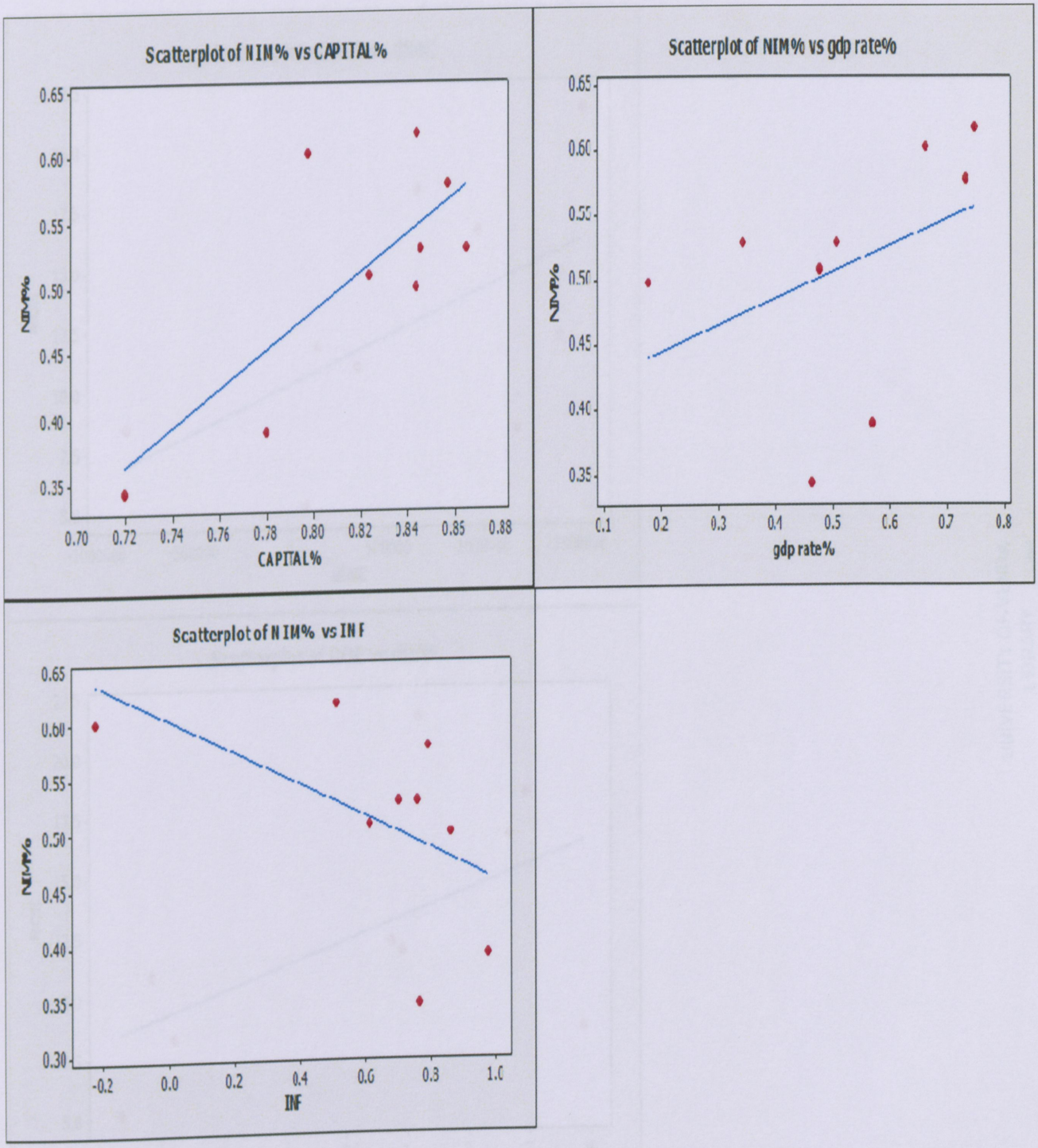
Figure 6: ROA against lag one market capitalization and NIM (inverse square root)



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3.6.4 SCATTER PLOTS OF LOG LAG ONE SERIES FOR NED BANK

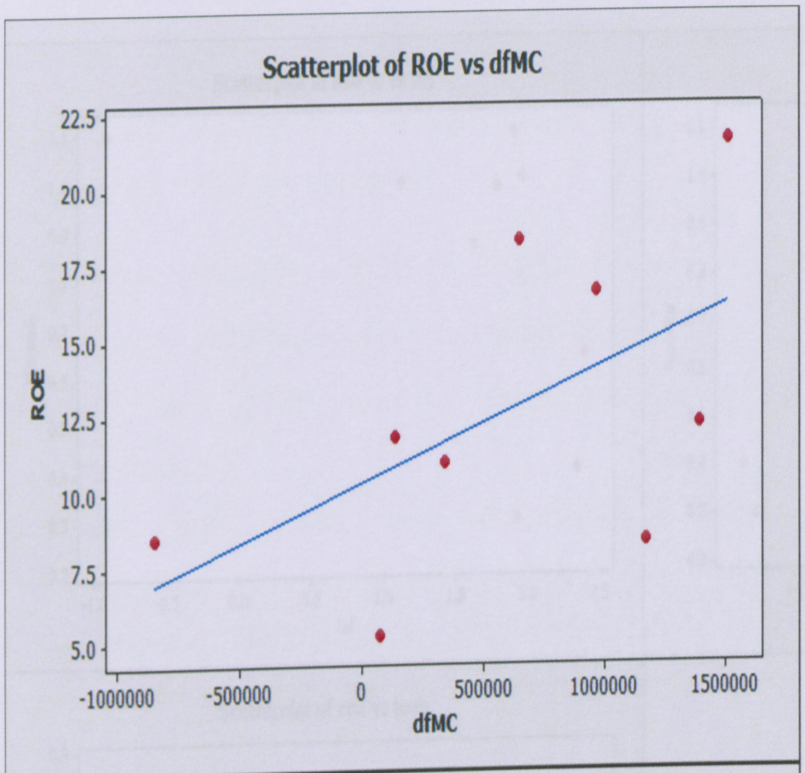
Figure 7: NIM against lag one capital, gross domestic product and inflation (log)

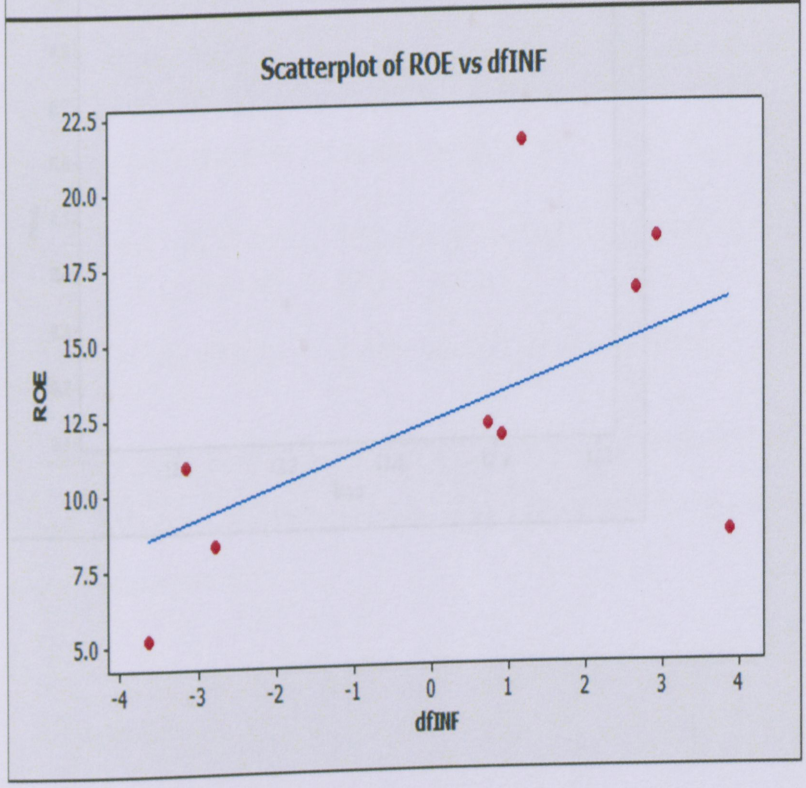


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3.6.5 SCATTER PLOTS OF LAG ONE DIFFERENCED NED BANK DATA

Figure 8: ROE against lag one market capitalization and inflation (log de-trended)



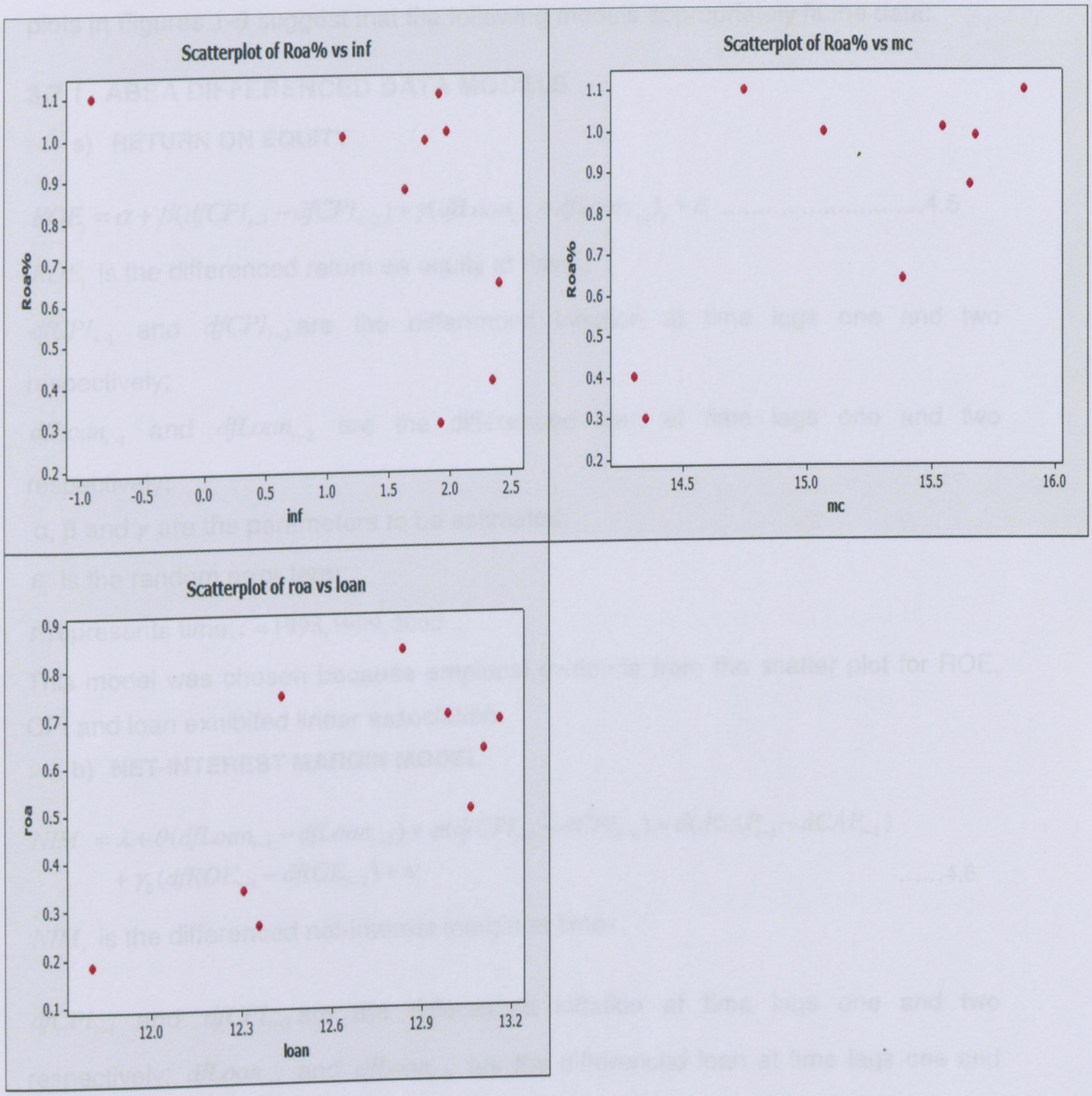


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3.6.6 SCATTER PLOTS OF $y = \ln(1 + x)$ LAG ONE FOR NEDBANK DATA

Figure 9: ROA against lag one inflation, MC and loan ($y = \ln(1 + x)$ transformation)



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3.7 SPECIFICATIONS OF THE MODELS

Empirical evidence from preliminary analysis of the data and a look at the scatter plots in Figures 1-9 suggest that the following models appropriately fit the data:

3.7.1 ABSA DIFFERENCED DATA MODELS

a) RETURN ON EQUITY

$$ROE_t = \alpha + \beta(dfCPI_{t-1} - dfCPI_{t-2}) + \gamma(dfLoan_{t-1} - dfLoan_{t-2})_t + \varepsilon_t \quad \text{.....4.5}$$

ROE_t is the differenced return on equity at time t;

$dfCPI_{t-1}$ and $dfCPI_{t-2}$ are the differenced inflation at time lags one and two respectively;

$dfLoan_{t-1}$ and $dfLoan_{t-2}$ are the differenced loan at time lags one and two respectively;

α, β and γ are the parameters to be estimated;

ε_t is the random error term;

t represents time, $t = 1998, 1999, 2000...$

This model was chosen because empirical evidence from the scatter plot for ROE, CPI and loan exhibited linear association.

b) NET-INTEREST MARGIN MODEL

$$NIM_t = \lambda + \theta(dfLoan_{t-1} - dfLoan_{t-2}) + \varphi(dfCPI_{t-1} - dCPI_{t-2}) + \delta(dCAP_{t-1} - dCAP_{t-2}) + \gamma_0(dfROE_{t-1} - dROE_{t-2}) + \kappa_t \quad \text{.....4.6}$$

NIM_t is the differenced net-interest margin at time t;

$dfCPI_{t-1}$ and $dfCPI_{t-2}$ are the differenced inflation at time lags one and two respectively, $dfLoan_{t-1}$ and $dfLoan_{t-2}$ are the differenced loan at time lags one and two respectively;

$dfCAP_{t-1}$ and $dfCAP_{t-2}$ are the differenced capital at time lags one and two respectively;

$dfROE_{t-1}$ and $dfROE_{t-2}$ are the differenced return on asset at time lags one and two respectively;

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$\lambda, \theta, \varphi, \delta$ and γ_0 are the parameters to be estimated, κ_t is the random error term and t represents time, $t = 1998, 1999, 2000...$

The model was chosen base on the linear relationship between NIM and loan, CPI, CAP and ROE.

c) RETURN ON ASSET MODEL

$$dfROA_t = \lambda_1 + \varphi_1(dfCPI_{t-1} - dfCPI_{t-2}) + \theta_1(dfNIM_{t-1} - dfNIM_{t-2}) + \delta_1(dfCAP_{t-1} - dfCAP_{t-2}) + \gamma_1(dfROE_{t-1} - dfROE_{t-2}) + \omega_t \quad \text{.....4.7}$$

$dfROA_t$ is differenced return on asset at time t

$dfCPI_{t-1}$ and $dfCPI_{t-2}$ are differenced inflation at time lags one and two respectively;

$dfNIM_{t-1}$ and $dfNIM_{t-2}$ are differenced net-interest margin at time lags one and two respectively;

$dfCAP_{t-1}$ and $dfCAP_{t-2}$ are differenced capital at time lags one and two respectively;

$dfROE_{t-1}$ and $dfROE_{t-2}$ are differenced return on equity at time lags one and two respectively ;

ω_t is the random error term and t represents time, $t = 1998, 1999, 2000...$

The model was chosen as a result of the linear relationship between ROA and NIM, CPI, CAP and ROE.

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3.7.2 ABSA DE-TRENDED LOG DATA MODELS

a) RETURN ON EQUITY

The preliminary analysis of the data and a look at the scatter plots of return of equity suggest a log-linear association between return on equity and capital and return on asset. The model chosen is of the form:

$$\log(dtROE_t - T_{t-1}) = \alpha_2 + \beta_2 \log(dtCAP_{t-1}) + \gamma_2 \log(dtROE_{t-1}) + \varpi_t \quad \text{.....4.8}$$

which can be transformed as

$$ROE_t = 10\exp\{\alpha_2 + \beta_2 \log(dtCAP_{t-1}) + \gamma_2 \log(dtROA_{t-1}) + \varpi_t\} + T_{t-1}$$

$$ROE_t = 10^{\{\alpha_2 + \beta_2 \log(dtCAP_{t-1}) + \gamma_2 \log(dtROA_{t-1}) + \varpi_t\}} + T_{t-1} \quad \text{..... 4.9}$$

T_{t-1} is the trend component which is given by:

$$T_{t-1} = ROE_{t-1} - \left(\theta_0 + \theta_1\tau_{t-1} + \theta_2\tau_{t-1}^{\ 2}\right) \quad \text{.....5.0}$$

ROE_t is the original data for return on asset at time t.

ROE_{t-1} is the original data for return on asset at time lag one.

$dtCAP_{t-1}$ is the de-trended natural logarithm capital at time lag one.

$dtROA_{t-1}$ the de-trended natural logarithm return on asset at time lag.

α_2, β_2, $\theta_0, \theta_1, \theta_2$ and γ are the parameters to be estimated.

ϖ_t is the random error term.

t represents time, $t = 1998, 1999, 2000...$

T_τ represents the residual of the trend in the original equation.

τ represents time with $\tau = 1, 2, 3...$ where 1998 is the base time.

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b) NET-INTEREST MARGIN MODEL

The preliminary analysis of the data and a look at the scatter plots of net-interest margin suggest a log-linear association between net-interest margin and asset and return on equity. The model chosen is of the form:

$$\log(dtNIM_t - D_{t-1}) = \alpha_4 + \beta_4 \log(dtASS_{t-1}) + \gamma_4 \log(dtROE_{t-1}) + \psi_t \quad \text{.....5.1}$$

which can be transformed be as

$$dtNIM_t = 10\exp\{\alpha_4 + \beta_4 \log(dtASS_{t-1}) + \gamma_4 \log(dtROE_{t-1}) + \psi_t\} + D_{t-1} \quad \text{.....5.2}$$

D_{t-1} is the trend component and is given by:

$$D_t = NIM_{t-1} - \left(\theta_3 + \theta_4 \tau_{t-1} + \theta_5 \tau_{t-1}^{\ 2}\right) \quad \text{.....5.4}$$

NIM_t is the original data for net-interest margin at time t

NIM_{t-1} is the original data of net-interest margin at time lag one.

$dtASS_{t-1}$ is the de-trended natural logarithm of asset at time lag one.

$dtROE_{t-1}$ is the de-trended natural logarithm return on equity at time lag one.

α_4, β_4, $\theta_3, \theta_4, \theta_5$ and γ are the parameters to be estimated.

ψ_t is white noise term.

t represents time, $t = 1998, 1999, 2000...$

D_τ represents the residual of the trend in the original equation.

τ represents time with $\tau = 1, 2, 3...$ where 1998 is the base time.

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3.7.3 RETURN ON ASSET ABSA MODEL FOR INVERSE SQUARE ROOT TRANSFORMED DATA

The preliminary analysis of the data and a look at the scatter plots of return on asset suggest a log-linear association between return on asset and gross domestic product and capital. The model chosen is of the form:

$$ROA_t = \alpha_5 + \beta_5\left(\sqrt{MC_{t-1}}\right)^{-1} + \gamma_5\left(\sqrt{NIM_{t-1}}\right)^{-1} + \phi_t \quad \text{.....5.5}$$

ROA_t is the original data for return on asset at time t

MC_{t-1} is the transformed inverse square root data of market capitalization at time lag one;

NIM_{t-1} is the transformed inverse square root data of net-interest margin at time lag one;

α_5, β_5 and $\gamma_5 \gamma$ are the parameters to be estimated.

ϕ_t is white noise term.

t represents time, $t = 1998, 1999, 2000...$

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3.7.4 NEDBANK NATURAL LOGARITHM DATA MODEL

a) NET-INTEREST MARGIN MODEL

$$\log(NIM_t) = \lambda_1 + \varphi_1 \log(CAPITAL_{t-1}) + \delta_1 \log(|GDP_{t-1}|) + \delta_2 \log(|INF_{t-1}|) + \eta_t \quad \text{.....5.6}$$

$$NIM_t = 10\exp\{\phi_0 + \phi_1 \log(CAPITAL_{t-1}) + \phi_2 \log(|GDP_{t-1}|) + \phi_3 \log(|INF_{t-1}|)\} + \eta_t \quad \text{.....5.7}$$

NIM_t is original net-interest margin data at time t;

$CAPITAL_{t-1}$ is original capital data at time lag one;

$|GDP_{t-1}|$ is the absolute value of original gross domestic product data at time lag one;

$|INF_{t-1}|$ is the absolute value of original inflation data at time lag one;

λ_1, φ_1 , δ_1 and δ_2 are constant parameters,

ϕ_0, ϕ_1, ϕ_2 and ϕ_3 are the transformed parameters to be estimated;

η_t is the random walk term, and

t represents time, $t = 2002, 2003, 2004...$

The model was chosen based on the linear relationship between NIM and deposits, and size or asset.

b) RETURN ON EQUITY MODEL

$$ROE_t = \psi_0 + \psi_1(dfMC_{t-1} - MC_{t-2}) + \psi_2(dfINF_{t-1} - INF_{t-2}) + \eta_t \quad \text{.....5.8}$$

ROE_t is the original returned on equity data at time t;

$dfMC_{t-1}$ and $dfMC_{t-2}$ are the differenced market capitalization at time lags one and two respectively;

$dfINF_{t-1}$ and $dfINF_{t-2}$ are the differenced inflation at time lags one and two respectively;

λ_2, φ_2 and δ_2 are the parameters to be estimated;

ϑ_t is the random walk term and

t represents time, $t = 2002, 2003, 2004...$

The model was chosen based on the linear relationship between return on equity and market capitalization and inflation.

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3.7.5 NEDBANK $y = \ln(1+x)$ TRANSFORMED DATA MODEL

From the scatter plots and the preliminary analysis of the data, the following model is chosen.

$$ROA_t = \pi_0 + \pi_1 \ln(1+INF_{t-1}) + \pi_2 \ln(1+MC_{t-1}) + \pi_3 \ln(1+LOAN_{t-1}) + \Omega_t \quad \text{.....5.9}$$

$dfROA_t$ is the transformed returned on asset at time t;

$dfMC_{t-1}$ is the transformed market capitalization at time lag one;

$dfINF_{t-1}$ is the transformed inflation at time lag one;

π_0, π_1, π_2 and π_3 are the parameters to be estimated;

Ω_t is the random walk component and

t represents time, $t = 2002, 2003, 2004...$

3.8 CONCLUSION

Discussion on the methodology and the software to be employed in the data analysis were dealt with in this chapter as well as the smoothing methods employed to filter the series. The nature and the source of the data to be used for the analysis were stated and the scatters plots that indicate the various relationships between the variables were presented. The models that best fit the filtered data were stated.

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CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

Presentation of the outputs from the data analysed and discussions of the relevance of the estimates are the prime focus of this chapter. Model selection, forecasting and diagnostics check are also dealt with in this chapter.

4.2.1 SUMARIZED RESULT OF DATA ANALYSIS

The summarized results from the data analysis are presented in Tables below. Detailed observations and explanations of these tables are given immediately after these tables. [8]

Table 1: Summary statistics of the performance of ABSA models

Smoothing Method	Differenced			log de-trended		Inverse square root
Model	NIM	ROE	ROA	NIM	ROE	ROA
R-square	0.966627	0.985828	0.961099	0.999522	0.999946	0.839953
Adjusted R-square	0.944379	0.981103	0.938870	0.999284	0.999919	0.799942
Prob (F statistic)	0.000145	0.000003	0.000051	0.000000	0.000000	0.000656
Durbin-Watson Stat	2.759873	2.137329	2.107584	1.899404	2.255209	2.169074
Mean Absolute % Error	1.107028	1.957732	1.535272	0.030315	0.006274	4.543789

Table 2: Summary statistics of the performance of Ned bank models

Model	NIM	ROE	ROA
R-square	0.968085	0.697021	0.966554
Adjusted R-square	0.948935	0.596027	0.946486
Prob (F statistic)	0.000366	0.027812	0.000412
Durbin-Watson Stat	1.800973	1.770126	2.062780
Mean Absolute % Error	2.885054	19.60068	6.136196

[8] Sources of all tables in this study are the extracts from the EVIEW's data analysis except otherwise stated.

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Table 3: Summary statistics for the estimated parameters of ABSA models

Smoothing Method	Model	Para meter	Estimate	P-value	95% CI		99% CI	
					Low	High	Low	High
Differenced	NIM	λ	4.107375	0.0000	4.025893	4.188858	3.983917	4.230833
		θ	-9.60E-06	0.0000	-1.17E-05	-7.53E-06	-1.27E-05	-6.47E-06
		φ	0.109547	0.0000	0.084451	0.134642	0.071523	0.147570
		δ	0.102932	0.0127	0.031154	0.174709	-0.005821	0.211685
		γ_0	0.059375	0.0002	0.041405	0.077344	0.032148	0.086601
	ROE	α	14.10322	0.0000	13.45437	14.75208	13.12011	15.08633
		β	-1.264872	0.0000	-1.441319	-1.088425	-1.532216	-0.997529
		γ	0.000128	0.0000	0.000111	0.000146	0.000102	0.000154
	ROA	λ_1	1.249103	0.0000	1.224036	1.274170	1.212005	1.286201
		φ_1	0.052478	0.0000	0.040562	0.064393	0.034843	0.070112
		θ_1	-0.105109	0.0282	-0.195230	-0.014989	-0.238481	0.028263
		δ_1	0.103779	0.0008	0.059702	0.147856	0.038548	0.169010
		γ_0	0.027871	0.0000	0.020906	0.034836	0.017563	0.038179
logarithm de-trended	NIM	α_4	1.338361	0.0000	1.312871	1.363850	1.296092	1.380629
		β_4	-0.427076	0.0000	-0.446968	-0.407184	-0.460062	-0.394090
		γ_4	-0.038310	0.0000	-0.040574	-0.036045	-0.042065	-0.034554
	ROE	α_2	2.060579	0.0000	5.968694	13.21814	4.101435	15.08540
		β_2	-1.033453	0.0000	5.61E-07	8.30E-06	-1.43E-06	1.03E-05
		γ_2	0.949855	0.0000	0.135553	2.213741	-0.399732	2.749026
inverse square root	ROA	α_5	-1.686185	0.0118	-2.885555	-0.4868	-3.431347	0.058977
		β_5	690.5929	0.0011	371.9650	1009.221	226.9684	1154.217
		γ_5	4.872719	0.0009	2.677881	7.067538	1.679090	8.066329

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Table 4: Summary statistics for the estimated parameters of Ned bank models

Model	Parameter	Coefficient	Prob	95% CI		99% CI	
				Low	High	Low	High
NIM	ϕ_0	-0.742118	0.0026	-1.086310	-0.397927	-1.282007	-0.202229
	ϕ_1	1.558745	0.0002	1.149982	1.967507	0.917571	2.199919
	ϕ_2	0.117558	0.0427	0.005713	0.229403	-0.057878	0.292994
	ϕ_3	-0.135431	0.0020	-0.194789	-0.076073	-0.228538	-0.042324
ROE	ψ_0	9.593415	0.0006	5.968694	13.21814	4.101435	15.08540
	ψ_1	4.43E-06	0.0311	5.61E-07	8.80E-06	-1.43E-06	1.03E-05
	ψ_2	1.174647	0.0326	0.135553	2.213741	-0.399732	2.749026
ROA	π_0	-4.379793	0.0013	-6.118694	-2.640892	-7.107384	-1.652202
	π_1	-0.189279	0.0006	-0.253633	-0.124926	-0.290222	-0.088337
	π_2	0.852351	0.0013	0.515044	1.189658	0.323261	1.381441
	π_3	-0.586781	0.0167	-1.013556	-0.160007	-1.256208	0.082645

Table 5: Quadratic trend estimates

Model	Parameter	Estimate
ROE	θ_0	13.45
	θ_1	2.253
	θ_2	-0.1454
NIM	θ_3	4.59
	θ_4	-0.2242
	θ_5	0.0117

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4.2.2 RISK TABLES FOR ESTIMATED VARIABLES

Table 1: Risk analysis of the estimated ABSA variables

	RISK															
VARIABLES	Loans		Inflation		Capital		ROE		Asset		NIM		Market Cap		ROA	
MODELS	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value
NIM(differenced)	-0.0004	-0.00002	4.71	0.2191	4.43	0.2059	2.55	0.1188								
NIM(de-trended)							4.71	0.7438	6.17	0.9738						
ROA(differenced)			7.46	0.1050	14.75	0.2076	3.98	0.0559			-14.94	-0.2102				
ROA(Inverse sqrt)											1.99	9.7400	281.83	1382		
ROE(differenced)	0.0022	0.0003	-21.86	-2.5297												
ROE(de-trended)					0.45	0.4885									-1.78	1.9317

Source: Author's own calculations

Table 2: Risk analysis of the estimated Ned Bank variables

	RISK									
VARIABLES	LOAN		CAPITAL		GDP		MC		INF	
MODELS	%	Value	%	Value	%	Value	%	Value	%	Value
ROE							0	9E-06	20	2.349
NIM			558.6	2.9485	206	1.085			173	0.911
ROA	-15.01	-0.6446					21.8	0.936	-4.8	-0.208

Source: Author's own calculations

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4.3 EXPLANATIONS OF THE DATA ANALYSIS OUTPUTS

4.3.1 MODELS OF DIFFERENCED DATA FOR ABSA

From Tables 1, the adjusted R-squares: 0.944379, 0.93887 and 0.981103 for NIM, ROA and ROE models respectively indicate that about 94.44%, 93.89% and 98.11% of the total variation in the NIM, ROE and ROA models respectively were accounted for. This indicates that the models are good fit the data.

The mean absolute percentage errors of: 1.1077028, 1.535272 and 1.957732 from Tables 1 for their respective models are quite small, confirming the assertion that the models are adequate. The p-*values* as indicated in Table 1 are approximately 0.000 for each model, confirming that the respective models are significant at 95% level of confidence. In table 3, the p-values of all the estimated parameters of the NIM, ROA and ROE models are less than 5% alpha level of significance hence we fail to reject the null hypothesis that the coefficients are zero and conclude that all the coefficients in each of the models for NIM, ROA and ROE are significant in the estimation of their respective dependent variables. This is also attested to by the fact that all the coefficients in Tables 3 are within the 95% confidence interval.

Among the estimated coefficients of NIM, capital was found to be the least significant since its p-value was the most at 5% significance level. This implies that when estimating NIM, capital is the least important factor at 5% significance level among loan and inflation. Similarly in the ROA model, Net-interest margin is the least important factor at 5% significance level, followed by capital among the factors NIM, ROE and inflation. In the ROE model, all the two factors namely inflation and loans are very important at 5% significant level when forecasting with the model.

All other factors were found not to be significant in the estimation of NIM, ROA and ROE as they were not entered during the stepwise method of linear regression modeling.

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4.3.2 MODELS OF DE-TRENDED LOGARITHM AND INVERSE SQUARE ROOT DATA FOR ABSA

From Tables 1, the adjusted R-squares 0.999284, 0.999919 and 0.799942 for NIM, ROA and ROE models respectively indicate that about 99.92%, 99.99% and 79.99% of the total variance in the NIM, ROE and ROA models were respectively accounted for. This indicates that the models are good fit onto the data.
Furthermore, the mean absolute percentage errors 0.030315, 4.543789 and 0.006274 from Tables 1 respectively for their respective models are very small except that of ROA which is moderately small. This confirms the assertion that the models are adequate.

A look at the *p-values* of the F-statistic for each of the models as indicated in Tables 1 are approximately zero, indicating that all the models are significant at 95% level of confidence. In addition, since the *p-values* of all the coefficients of the NIM, ROA and ROE models are less than 5% alpha level of significance as shown in Table 3, we fail to reject the null hypothesis that the coefficients are zero. It can therefore be concluded that all the coefficients in each of the models for NIM, ROA and ROE are Significant in the estimation of their respective dependent variables. This conclusion is confirmed by the fact that all the coefficients are within the 99% confidence interval as indicated in Tables 3.

All the estimated coefficients of NIM and ROE are equally important at 5% significance level when using the associated models for forecast since the p-values of all of them are zero. In the ROA model, the least important factor at 5% level of significance is stock-market capitalization followed by net-interest margin.

All other factors were found to be insignificant at 5% level of significant in the estimation of NIM, ROA and ROE as they were removed during the stepwise method of linear regression modeling.

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4.3.3 MODELS OF LOGARITHM, Y=LN (1) TRANSFORMED AND DIFFERENCED FOR NED BANK

From Tables 2, the adjusted R-squares for NIM, ROA and ROE models respectively indicate that about 95%, 95% and 60% of the total variance in the NIM, ROE and ROA models respectively were accounted for. This implies that the models are for NIM and ROA are good fit onto the data and that of the ROE is quite moderately good fit to the data.

The mean absolute percentage errors of 2.885054 and 6.136196 from Tables 2 respectively for their respective models are fairly small confirming the assertion that the models are adequate. However the mean absolute percentage error of 19.60068 for ROE from Table 2 is quite big in terms of risk taking for profit estimation indicating that the model is not a good fit to the data.

In Table 2, a look at the p-*values* of the F-statistic of NIM and ROA of 0.000366 and 0.000412 respectively are very small confirming that their respective models are significant at 95% level of confidence. This assertion is further confirmed by relatively big p-value for ROE at 5% significance level.

The p-values of all the coefficients of the NIM, ROA and ROE models are less than 5% alpha level of significance hence we fail to reject the null hypothesis that the coefficients are zero and conclude that all the coefficients in each of the models for NIM, ROA and ROE are Significant in the estimation of their respective dependent variables. This is further confirmed by the existence of all the coefficients of these variables within the 95% confidence interval as shown in Table 4.

Among the estimated coefficients of NIM, gross domestic product was found to be the least significant at 5% significance level since its p-value was relatively bigger, followed by inflation and then capital. This implies that when estimating NIM, gross domestic product is the least important factor with capital being the most important.

Similarly for ROA model, loan is the least important factor at 5% significance level when estimating ROA, followed by stock-market capitalization. However inflation was the most important factor in the estimation of ROA. For the ROE model, inflation was

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the least important at 5% significance level and market capitalization was the most important factor for at the same level of significance when estimating ROE.

All other factors were found not to be significant in the estimation of NIM, ROA and ROE as they were not entered during the stepwise method of linear regression modeling.

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4.4 DEDUCTIONS FROM THE ESTIMATES AND THEIR RELEVANCE

4.4.1 MODELS OF DIFFERENCED DATA FOR ABSA

From Tables 3, it can be deduced that there exists a negative linear relationship between **net-interest margin** and loan and a positive linear relationship between net-interest margin and each of the variables: inflation, capital and return on equity. The findings of a related study conducted by Gul *et. al* (2011), Yong and Christos (2012) and Ameur and Mhiri (2013) are in direct contrast with the findings of this study. However the findings from other related studies by Khediri and Ben-Khedhiri (2011), Naceur and Goaied (2001), Dermerguç-Kunt and Huizingua (1999) and Gul *et. al* (2011) are in agreement with the findings of this study with respect to the effect of capital adequacy and inflation on profitability.

If loan is increased by two million rand and each of inflation, capital and return on equity are increased by 2% loan will contribute to a decline in net-interest margin by 0.0004%. Simultaneously, inflation, capital and return on equity will contribute to a decline in net-interest margin by the following percentages respectively: 4.7%, 4.43% and 2.55%. A high increase in loans is supposed to result in a substantial decrease in net-interest margin but not the overall profitability. This is because high loans lead to high interest-returns which in turn increase net-interest margin, thereby overshadowing the negative effect loan has on net-interest margin.

In respect of the **return on asset's** model, there exists a negative linear relationship between return on asset and net-interest margin and a positive linear association between return on asset and each of inflation, capital and return on equity. These results are not in agreement with previous results by Yong and Christos (2012) and Houssem (2013) but are consistent with other previous findings by Molyneux and Thornton (1992), Bikker and Hu (2002), Goddard *et. al* (2004). and Gul *et. al* (2011)

If each of inflation, capital, and return on equity and net-interest margin are increased 2%, there will be a corresponding simultaneous increase in return on asset by 7.46%, 14.75% and 3.98% except net-interest margin which will cause a decline of 14.94% in return on asset. The implications of these are that, high inflation, capital and return on equity are not risky to return on asset but high net-

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interest margin is risky to return on asset component of profitability but this is not so. This is because net-interest margin is a component of profitability hence the higher its positive change, the higher its relative positive contribution to aggregate profitability.

To buttress this argument, suppose net-interest margin is increased by 10% and 20%. This will trigger in corresponding decreases of 0.01494% and 0.02988% in return on asset and by implication aggregate profitability is supposed to decrease but this is not the case. The declines in return on asset are comparatively less than the overall increases in net-interest margin hence the aggregate contributions of net-interest margin and return on asset to aggregate profitability will be positive.

The relationship between **return on equity** and loans was found to be positive linear and that of return on equity and inflation was negative linear. The result is consistent with previous findings on return on equity and loans by Molyneux and Thornton (1992), Bikker and Hu (2002), Goddard et. al (2004) and Gul *et. al* (2011). Findings by Ben and Kandil (2009) and Duraj and Moci (2015) on the relationship between inflation and return on asset is also consistent with findings with this study. However, findings from the same studies by Duraj and Moci (2015) on loans and profitability and that by Gul *et. al* (2011) on inflation and profitability were inconsistent with the result of this study.

If loan is increased by two million rand and inflation by 2%, there will be an increase of 0.0022% and a decrease of 21.86% in return on equity respectively. High loans are therefore not risky to return on equity component of profitability but high inflationary rate is very risky to return on equity and aggregate profitability.

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4.4.2 MODELS OF DE-TRENDED LOGARITHM AND INVERSE SQUARE ROOT DATA FOR ABSA

Table 3 indicates that there is a negative log-linear association between **net-interest margin** and each of size and return on equity. Even though similar studies conducted by Javaid *et. al* (2011) disagree with the findings of this study, the one conducted by Gul *et. al* (2011) is in agreement with it in terms of the directions of association for net-interest margins and size. However another related study by *Demirguc-Kunt and Maksimovic* (1998) contradicts the finding of this study in terms of the direction of association between size and net-interest margins.

A simultaneous increase of two million rand in the value of asset and a 2% increase in return on equity will trigger a respective inflation of 6.17% and 4.71% in net-interest margin. These deductions indicate that high asset and return on equity have no associated risk with net-interest margin and aggregate profitability.

The model for **return on asset** indicates that a positive inverse square root association exists between return on asset and both of stock-market capitalization and net-interest margin. This result is supported by the findings of Abreu and Mendes (2002) and Naceur and Goaied (2008) in terms of the effect of market capitalization on profitability but another related studies by Bikker and Hu (2002) and Demirguc-Kunt and Huizinga(2001) are inconsistent with it.

A two million rand increase in market capitalization and a 2% increase in net-interest margin will cause a quantum leap of 281.3% and an increase of 1.99% respectively in return on asset. High stock-market capitalization and net-interest margin therefore have positive impact on profitability.

A look at the **return on equity** model estimates in Table 3 revealed the existence of a negative log-linear relationship association between return on equity and capital and a positive log-linear relationship between return on equity and return on asset. In a related study, Havrylchyk et. al (2006) findings were contrary to the that of this study in terms of the direction of association between capital and profitability but findings by Molyneux and Thornton (1992), Bikker and Hu (2002), Goddard et. al (2004), Gul *et. al* (2011) and Yong and Christos (2012) on capital and profitability were consistent with the findings of this study.

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It can be deduced from the coefficients of these relationships that simultaneous increase in return on asset and capital by 2% will lead to a deflation of return on equity by 1.78% and inflation of 0.45% respectively. Contrary to the deduction that an increase in return on asset will cause a deflation in return on equity, the opposite is the case.

The reason is that, return on asset is a component of profitability therefore the higher its positive change, the higher its relative contribution to profitability. For instance if return on asset is increased by 10% and 20% respectively, there will be corresponding decline in return on asset by 0.178% and 0.356%. These declines in return on asset are comparatively less than their corresponding increases in net-interest margin hence the net contributions of a positive change in return on asset is favourable to aggregate profitability. It can therefore be concluded that, a positive change in capital and return on asset are not risky to aggregate profitability.

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4.4.3 MODELS OF LOGARITHM, Y=LN (1+X) TRANSFORMED AND DIFFERENCED FOR NED BANK

A look at the estimates of **net-interest margin** model for Ned bank as shown in Table 4 indicates that there exists a negative log-linear association between inflation and net-interest margin and positive log-linear associations between NIM and each of capital and gross domestic product. Results of conducted by Ameur and Mhiri (2013), Houssem (2013), Ben Naceur and Kandil (2009), Dermerguç-Kunt and Huizingua (1999) and Naceur and Goaied (2001) were consistent with the findings from this study but those conducted by Ben Khediri and Ben-Khedhiri (2011), Yong and Christos (2012) and Gul *et. al* (2011) were however in contrast to the findings of this study.

When capital, gross domestic product and inflation are increased by 2%, there will be a corresponding increases in net-interest margin by 558.62%, 205.6% and 172.23%. High capital, gross domestic product and inflation therefore have positive impact on Ned bank profitability.

In the **return on asset** model, a positive natural logarithmic association was found to exist between return on asset and stock-market capitalization and a negative natural logarithm association between return on asset and each of inflation and loan. Studies by Yong and Christos (2012) and Houssem (2013) for return on asset *via* inflation and market capitalization were consistent with the findings of this study but similar studies by Molyneux and Thornton (1992), Bikker and Hu (2002), Goddard *et. al* (2004) and Gul *et. al* (2011) were however contrary to the result of this study.

A simultaneous increase in loans, stock-market capitalization and inflation by one million rand, one billion rand and one percent respectively will trigger in a corresponding decline of 41.89%, an increase of 606.48% and a decrease of 13.51% in return on asset respectively. This implies that high stock-market capitalization have a huge positive impact on profitability while high loans and inflation rates affect return on asset negatively. However if inflation and loans are increased simultaneously with a proportional increase of 10% in stock-market capitalization, loans will then have positive impact on profitability of Ned bank.

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The relationships between **return on equity** and each of stock-market capitalization and inflation were found to be negative linear. Studies by Molyneux and Thornton (1992), Bikker and Hu (2002), Goddard *et. al* (2004) and Gul *et. al* (2011) are in contrast with the result of the study in respect to inflation and profitability. However, investigations conducted by Ben and Kandil (2009), Houssem (2013) and Duraj and Moci (2015), agreed with the findings of this research.

A simultaneous increase of one million rand in stock-market capitalization and 1% in inflation will result in 0.0000411 % and 10.91% respective increases in return on equity. Therefore, high stock-market capitalization and inflation have positive impact on Ned bank's profitability.

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4.4.4 RISK ANALYSIS OF ESTIMATED VARIABLES FOR ABSA

From Table 6, high loans were found to be more risky to net-interest margin for the differenced data model but the same high loans are not risky to the return on equity for the same differenced data model. The aggregate effect of net-interest margin on profitability is therefore positive because the negative impact of loans on net-interest margin is less than their positive impact (Goddard *et. al,* 2004). Hence high loans are not risky to profitability for ABSA.

The combined contributions of inflation rate to profitability for the differenced data are outweighed by the single contribution of inflation on return on equity component of profitability for the same differenced data. This implies that when there is an increase in inflation, the aggregate profitability will be negatively affected hence inflationary increase is a risk factor for profitability of ABSA.

This negative impact of inflation on profitability could be explained by the fact that an increase in inflation results in an upwards adjustment of salaries and benefits for the bank staff, increase in prices of equipment and services rendered to the bank, a rise in exchange rates and sometimes a rise in corporate tax to meet an increased government expenditure. The aggregate effect of all these increases results in a higher operational cost (Duraj and Moci, 2015). ABSA therefore tends to raise interest rates and prices of its products and services to reduce the cost of intermediation (Ben Naceur and Kandil, 2009).

Even though most often employers adjust employee salaries and benefits to cushion them for inflationary pressures, the net effect of an increase in inflation on the market and the pricing behaviour of some banks are such that the propensity to consume and the purchasing power of consumers decline (Ben Naceur and Kandil, 2009). Consequently ABSA will have a relative decline in clients or the quantum of product and services patronize by clients. As a result of this, the relative profitability will be reduced as it should have been increased had inflation decreased.

Capital was found to be non-risky to profitability. The consequence of this is that more capital reduces the costs of external debt for ABSA, compensating for the higher costs of own funds (Houssem, 2013). Dermerguç-Kunt and Huizingua (1999) and Naceur and Goaied (2001) explained that well-capitalized banks have higher

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profit margins, which is consistent with theories stressing that highly-capitalized banks can charge more for loans and or pay less on deposits because they face lower bankruptcy risks. In addition, high capital could mean ABSA can easily adhere to regulatory capital standards so that excess capital can be provided as loans resulting in an increase in profitability.

An increase in size for ABSA is a non-risky determinant of its profitability. Molyneux and Thornton (1992) and Smirlock (1985) explain that large banks are better placed than small ones because the large banks are able to benefit from higher product and loan diversification possibilities and economies of scales. A higher size could also mean that more deposits will be available so that it could be provided as loans and invested in bonds and unit trusts *as* explained by Gul *et. al* (2011).

Yong and Christos (2012) explain that under perfect market conditions, debt and equity financing act as perfect substitutes. In that respect, in case a bank leans more towards equity financing, it will trigger a negative effect on banks' profitability. Since stock- market capitalization for ABSA was found to be non-risky to its profitability, it could be explained that the bank did not resort more to equity financing.

Return on equity has positive impact on profitability. A high return on equity will, therefore, substantially increase profitability as it is a measure of profitability.

Finally even though net-interest margin and return on asset negatively impact on return on asset and return on equity respectively, their negative impacts are outweighed by their positive impacts since they are both components of profitability.

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4.4.5 RISK ANALYSIS OF ESTIMATED VARIABLES FOR NED BANK

From Table 7, Capital was found to have a huge positive impact on profitability of Ned Bank. A higher capital will therefore mean a higher profit since Ned Bank can easily adhere to regulatory capital-standards so that excess capital can be provided as loans.

Stock-market capitalization was found to be less risky to return on equity and non-risky to return on asset. This means that Ned bank resorted relatively less towards equity financing which triggered a negative effect of stock-market capitalization on its profitability (Yong and Christos, 2012).

Gross domestic product has a positive impact on profitability. This could possibly be due to an increase in lending rates with less probability of a defaulting rate as explained by Houssem (2013). Contrary to the argument by Mirzaei *et. al* (2013) an increase in gross domestic product may increases the purchasing power of consumers which results in demand for more credit with less probability of default, leading to higher profitability.

Contrary to the negative aggregate effect of inflation on profitability of ABSA, inflation was found to be non-risky to profitability of Ned Bank as depicted in Table 28. An increase in inflation increases operational costs (Duraj and Moci, 2015) but due to the possibility that the relative pricing behavior of Ned Bank in respect to other banks being competitively lower, more clients might have preferred Ned Bank's products and services or increased the quantum of their demand as a result of the increase in inflation.

Finally, although loans negatively affect return on asset of Ned bank due to a possibility of high loan default rate for bank's clients, its positive contribution to aggregate profitability outweighs its negative impact. This is because high loans will result in high relative net-interest margins so that the positive effect of the latter will cancels the negative effect loans have on aggregate profitability and return on asset.

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4.5 THE ESTIMATED TIME SERIES REGRESSION MODELS

The estimated models for ABSA and Ned bank are shown below:

DIFFERENCE ABSA DATA

$$NIM_t = 4.107375 - 9.60\times10^{-6}(dfLoan_{t-1} - dfLoan_{t-2}) + 0.109547(dfCPI_{t-1} - dfCPI_{t-2}) + 0.102932(dfCAP_{t-1} - dfCAP_{t-2}) + 0.059375(dfROE_{t-1} - dfROE_{t-2}) \quad \text{.....6.0}$$

$$ROA_t = 1.249103 + 0.052478(dfCP_{t-1} - dfCPI_{t-2}) - 0.105109(dfNIM_{t-1} - dfNIM_{t-2}) + 0.103779(dfCAPI_{t-1} - dfCAP_{t-2}) + 0.027971(dfROE_{t-1} - dfROE_{t-2}) \quad \text{..... 6.1}$$

$$ROE_t = 14.10322 - 1.264872(dfCPI_{t-1} - dfCPI_{t-2}) + 0.000128(dfLoan_{t-1} - dfLoan_{t-2})_t \quad \text{.. 6.2}$$

DE-TRENDED LOG DATA FOR ABSA

$$dtNIM_t = 10\exp\{1.338361 - 0.427076\log(dtROE_{t-1}) - 0.03831\log(dtASS_{t-1})\} + \{NIM_{t-1} - (4.59 - 0.2242\tau_{t-1} + 0.0117\tau_{t-1}^{\ 2})\} \quad \text{..... 6.3}$$

$$ROE_t = 10\exp\{2.060579 - 1.033453\log(dtCAP_{t-1}) + 0.949855\log(dtROA_{t-1})\} + \{ROE_{t-1} - (13.45 + 2.253\tau_{t-1} - 0.1454\tau_{t-1}^{\ 2})\} \quad \text{..... 6.4}$$

INVERSE SQUARE ROOT FOR ABSA

$$ROA_t = -1.69 + \frac{691}{\sqrt{MC_{t-1}}} + \frac{4.87}{\sqrt{NIM_{t-1}}} \quad \text{..... 6.5}$$

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DIFFERENCED DATA FOR NED BANK

$$ROE_t = 9.593415 + 4.43\times10^{-6}(dfMC_{t-1} - dfMC_{t-2}) + 1.174647(dfINF_{t-1} - dfINF_{t-2}) \quad \text{.....6.6}$$

LOGARITHM TRANSFORMED DATA FOR NED BANK

$$NIM_t = 10\exp\{-0.742 + 1.56\log(CAPITAL_{t-1}) + 0.118\log(GDP_{t-1}) - 0.135log(INF_{t-1})\}$$
...6.7

Y=LN (1+X) TRANSFORMED DATA FOR NED BANK

$$ROA_t = -4.379793 - 0.189279\ln(1+INF_{t-1}) + 0.852351\ln(1+MC_{t-1}) - 0.586781\ln(1+LOAN_{t-1})$$
.....6.8

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4.6 MODEL SELECTION

Table 8: Information criteria summary for ABSA models

Model	Smoothing Type	Information criteria			
		AIC	weights(w_i)	95% CI for w_i	w_i *ratios*
ROE_t	De-trended	-14.72124	0.999999945	0.499999973	18197631
	Differenced	1.995562	5.49522E-08	2.74761E-08	5.495E-08
NIM_t	De-trended	-13.32496	0.999984856	0.499992428	66030
	Differenced	-2.227100	1.51445E-05	7.57223E-06	0.00003
ROA_t	Differenced	-3.510021	0.810701839	0.40535092	4.2826715
	Inverse square root	-2.055444	0.189298161	0.09464908	0.2334991

Source: Extract and calculations from EVIEWS data analysis

Table 9: Information criteria summary for NEDBANK models

Model	Smoothing Type	Akaike information criteria
		AIC
ROE_t	Differenced	5.282518
NIM_t	Differenced	-4.598035
ROA_t	$y = \ln(1+x)$	-2.175073

Source: Extract from EVIEWS data analysis

From Table 8, the AIC value for the de-trended data for ROE is smaller compared to that of the differenced data, that of the de-trended data for NIM is smaller than the models from the differenced data and the AIC for the differenced data for ROA is quite smaller than the model for the inverse square root data.

Since models with smaller information criteria are preferred (Mazerolle, 2004), the following models are selected for ABSA:

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$$NIM_t = 10\exp\{1.338361 - 0.427076\log(dtROE_{t-1}) - 0.03831\log(dtASS_{t-1})\} + \{NIM_{t-1} - (4.59 - 0.2242\tau_{t-1} + 0.0117\tau_{t-1}^{\ 2})\}$$

$$ROA_t = 1.249103 + 0.052478(dfCP_{t-1} - dfCPI_{t-2}) - 0.105109(dfNIM_{t-1} - dfNIM_{t-2}) + 0.103779(dfCAPI_{t-1} - dfCAP_{t-2}) + 0.027971(dfROE_{t-1} - dfROE_{t-2})$$

$$ROE_t = 10\exp\{2.060579 - 1.033453\log(dtCAP_{t-1}) + 0.949855\log(dtROA_{t-1})\} + \{ROE_{t-1} - (13.45 + 2.253\tau_{t-1} - 0.1454\tau_{t-1}^{\ 2})\}$$

All the models for Ned bank were selected as there were no competing models. These models are[9]

$$NIM_t = 10\exp\{-0.742 + 1.56\log(CAPITAL_{t-1}) + 0.118\log(|GDP_{t-1}|) - 0.135log(|INF_{t-1}|)\}$$

$$ROE_t = 9.593415 + 4.43\times10^{-6}(dfMC_{t-1} - dfMC_{t-2}) + 1.174647(dfINF_{t-1} - dfINF_{t-2})$$

$$ROA_t = -4.379793 - 0.189279\ln(1 + INF_{t-1}) + 0.852351\ln(1 + MC_{t-1}) - 0.586781\ln(1 + LOAN_{t-1})$$

[9] The AIC weights for ROE and NIM of de-trended data and ROA model for differenced data are bigger compared to the AICs of ROE and NIM for differenced data and ROA for inverse square root data provide higher weight of evidence that the chosen models are the best approximating models for their respective data. The respective Confidence Intervals for the chosen models are within the 95% CI interval for the weights. All these evidence affirms to the better choice of the selected models.

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4.7 RESIDUAL ANALYSIS

4.7.1 INDEPENDENCE ASSUMPTION

The residual-time order plot in appendix (III) indicates no pattern in all the tables. This implies that the time-ordered errors neither show positive nor negative autocorrelation, suggesting that the error terms occurs in a random pattern over time (Bowerman *et. al,* 2001). Hence the independence assumption is approximately assumed to be satisfied.

4.7.2 NORMALITY ASSUMPTION

A look at the normal probability plots in appendix (III) indicates a fairly straight-line graph. Furthermore, the histogram plots in appendix (III) exhibit a bell-shaped nature around the mean of Zero (Bowerman *et. al,* 2001). Therefore the normality assumption is approximately satisfied.

4.7.3 CONSTANT VARIANCE

A look at the residual against predicted values plots as shown in appendix (III) indicates no pattern (i.e. funneling in or out) (Bowerman et. al, 2001). This means that the constant variance assumption is approximately satisfied. The satisfaction of this assumption is further affirmed by the non-pattern nature of residual against observation order (Appendix III) plot. The *heteroskedascity* tests shown in the Tables in Appendix I are not significant for all the coefficients of the estimates indicating the satisfaction of the constant variance assumption.

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4.8 F0RECASTING WITH THE MODELS

The 2014, 2013 and 2012 data for ABSA and Ned Bank are shown in are shown in table 10 and 11 respectively.

Table 10: 2012-2014 ABSA data

YEAR	ROA%	ROE%	NIM%	SIZE	CAPITAL%	LOANS	GDP	MC	INF	τ
2012	1.09	13.6	3.87	807939	9.009839	572840	2.2	7841303	5.75	15
2013	1.08	13.5	3.64	792635	7.22388	600126	2.2	9752279	5.77	16
2014	1.08	16.9	3.83	814061	7.238524	619860	1.5	10718200	6.13	17

Source: Extract from financial statements of ABSA and World Bank

Using the information from Table 10, we calculate the estimates for ABSA models as follows:

$$NIM_t = 10\exp\{1.338361 - 0.427076\log(13.5) - 0.03831\log(792635)\} + \{3.64 - (4.59 - 0.2242(16) + 0.0117(16)^2)\}$$
$$= 3.904094$$

$$ROA_t = 1.249103 + 0.052478(5.77 - 5.75) - 0.105109(3.64 - 3.87) + 0.103779(7.22388 - 9.009839) + 0.027971(13.5 - 13.6)$$
$$= 1.086186$$

$$ROE_t = 10\exp\{2.060579 - 1.033453\log(7.22388) + 0.949855\log(1.08)\} + \{13.45 - (13.45 + 2.253(16) - 0.1454(16)^2)\}$$
$$= 17.25049$$

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Table 11: 2012-2014 Ned bank data

YEAR	ROA%	ROE%	NIM%	SIZE	CAPITAL%	LOANS	GDP	MC	INF
2012	0.99	11.8	3.37	645	7.33	520	2.2	6446480.694	5.75
2013	1.1	12.2	3.37	699155	7.39	566947	2.2	7841303.323	5.77
2014	1.27	15.8	3.52	809	8.76	613	1.5	9752278.76	6.13

Source: Extract from financial statements of Ned Bank and World Bank.

Similarly, using the information from Table 11, we calculate the estimates for Ned Bank models as follows:

$$NIM_t = 10\exp\{-0.742 + 1.56\log(7.39) + 0.118\log(|2.2|) - 0.135log(|5.77|)\}$$
$$= 3.5549$$

$$ROA_t = -4.379793 - 0.189279\ln(1+5.77) + 0.852351\ln(1+7841303.323) - 0.586781\ln(1+566947)$$
$$= 1.187786066$$

$$ROE_t = 9.593415 + 4.43\times10^{-6}(9752278.76 - 7841303.323) + 1.174647(6.13 - 5.77)$$
$$= 18.08252913$$

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4.9 ERROR ANALYSIS

The following tables shows the analysis of the forecast errors

Table 12: Forecast errors for ABSA models Summary

Model	Smoothing Type	Forecasting			
		2014 Values	2014 estimates	Estimation error	% Estimation error
ROE_t	De-trended log	16.9	17.25049361	0.350493607	2.073926666
NIM_t	De-trended log	3.83	3.904094427	0.074094427	-1.93458035
ROA_t	Differenced	1.08	1.086185515	0.006185515	0.57273285

Source: Author's own calculations.

Table 13: Forecast errors for Ned Bank models

Model	Smoothing Type	Forecasting			
		2014 Values	2014 estimates	Estimation error	% Estimation error
ROE_t	Differenced	15.8	18.08252913	2.282529126	14.44638688
NIM_t	Natural log	3.52	3.554922103	-0.034922103	-0.992105212
ROA_t	$y = \ln(1+x)$	1.27	1.187786066	0.082213934	6.473538086

Source: Author's own calculations.

From Tables 12 and 13, it can be noted that the errors between the actual values for 2014 and the estimated values for that same year are quite small except that of ROE and ROA models for Ned Bank. These suggest that, the models are good for future forecasts except the ROE and the ROA models for Ned Bank.

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4.10 CONCLUSION

EVIEW's outputs were discussed and the relevance of the estimates from the various models was established. Applying the Akaike information criteria, the best models for ABSA were selected and. All the Ned Bank models were selected, as they did not have any competing models.

The chosen models for the two banks were then used to forecast 2014 values for the respective components of profitability. Errors resulting from these forecasts and residual analyses were discussed. The residual analysis indicated that the assumptions underlying the methodology used in this research were approximately satisfied.

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CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMENDATIONS

5.1 INTRODUCTION

This section presents the challenges that were faced in the research. In addition, it summarizes the findings from the study and provides some recommendations based on the findings.

5.2 SUMMARY AND CONCLUSIONS

The study attempted to fit individual time-series regression models on net-interest margin, return on asset and return on equity against all of the lag one independent variables: deposit, size, loan, capital, inflation, gross domestic product and stock-market capitalization for each of the banks under study, using secondary panel data from 1998 to 2014 fiscal years for ABSA and 2002-2014 for Ned Bank. The lag one of the dependent variables was considered as independent variables in the models.

The absolute de-trended values were transformed by logarithm to the base of ten to smooth the ABSA data. In addition, first differencing and inverse square root transformation were used to smooth the same data for ABSA. First differencing, natural logarithm to the base of ten transformations of the absolute data points and natural logarithm with constant addition were applied to the Ned bank data to make it stationary.

Multivariate time-series regression by the least square approach (Gauss-Newton/ Marquardt steps) with special consideration of the stepwise method was used in fitting models onto the data. Akaike information criterion was used in the selection of the best models among the competing models.

Results from the ABSA data analysis indicated the existence negative log-linear relationship between NIM and each of size and return on equity. Negative linear relationship was found between ROA and net-interest margin and a positive linear association exists between ROA and each of inflation, capital and return on equity. The association between ROE and capital was found to be negative log-linear and that between ROE and return on asset was found to be positive log-linear. It was

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further deduced from these relationships that high lag one values of loans, asset, stock-market capitalization, net-interest margin, return on asset and return on equity were not risky to aggregate profitability except for inflation which was found to be more risky to aggregate profitability of ABSA .

In the case of the Ned Bank data, the relationship between NIM and both of capital and gross domestic product was found to be positive log-linear, and that between NIM and Inflation was found to be negative log-linear. Furthermore the result indicated that, there exists a positive natural logarithmic association between ROA and stock-market capitalization while negative natural logarithm association exists between ROA and each of inflation and loan. The relationship between ROE and both of market capitalization and inflation was found to be negative linear. High values of all the lag one independent variables in the Ned bank models (capital, stock market capitalization, gross domestic product and inflation) were consequently found to be non-risky to aggregate profitability of Ned Bank.

Even though loans were found to impact negatively on return on asset, their increases result in higher net interest income if proper credit-risk management procedures are strictly adhered to.

Contrary to the findings of Houssem (2013), deposit was the only factor among the factors considered that did not significantly affect any of the components of profitability as it was removed from all the models during the stepwise method of regression analysis.

Based on the estimates for the various independent variables, models for NIM, ROA and ROE were constructed for both ABSA and Ned Bank. The empirical evidence from the data analysis in chapter four indicates that the following models were selected for ABSA as they were deemed appropriate:

$$NIM_t = 10\exp\{1.338361 - 0.427076\log(dtROE_{t-1}) - 0.038311\log(dtASS_{t-1})\} + \{NIM_{t-1} - (4.59 - 0.2242\tau_{t-1} + 0.0117\tau_{t-1}^{\ 2})\}$$

$$ROA_t = 1.249103 + 0.052478(dfCP_{t-1} - dfCPI_{t-2}) - 0.105109(dfNIM_{t-1} - dfNIM_{t-2}) + 0.103779(dfCAPI_{t-1} - dfCAP_{t-2}) + 0.027971(dfROE_{t-1} - dfROE_{t-2})$$

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$$ROE_t = 10\exp\{2.060579 - 1.033453\log(dtCAP_{t-1}) + 0.949855\log(dtROA_{t-1})\}$$
$$+\left\{ROE_{t-1} - \left(13.45 + 2.253\tau_{t-1} - 0.1454\tau_{t-1}^{\ 2}\right)\right\}$$

Similarly, the following models were estimated as being appropriate for Ned Bank:

$$NIM_t = 10\exp\{-0.742 + 1.56\log(CAPITAL_{t-1}) + 0.118\log(|GDP_{t-1}|) - 0.135log(|INF_{t-1}|)\}$$

$$ROE_t = 9.593415 + 4.43\times10^{-6}(dfMC_{t-1} - dfMC_{t-2}) + 1.174647(dfINF_{t-1} - dfINF_{t-2})$$

$$ROA_t = -4.379793 - 0.189279\ln(1+INF_{t-1}) + 0.852351\ln(1+MC_{t-1}) - 0.586781\ln(1+LOAN_{t-1})$$

The NIM model for ABSA and Ned Bank and ROE model for ABSA cannot take values of one. All input values or their differences must never be zero or negative for each of the banks. When one of the values or their difference is zero the models will become invalid. However when the difference between two values is negative as it may be in the case of GDP, its absolute values must be used in the forecasting.

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5.3 LIMITATIONS OF THE STUDIES

Some of the financial statement had different reporting periods. For example, ABSA reported its 2005 financial statements for nine months instead of the usual 12 months. These inconsistencies could have accounted for the errors resulting from forecasting with the estimated models.

The salient features for NIM, ROA and ROE for ABSA were inconsistent with its own data. For example in 2009, the reported NIM for ABSA was 3.65, ROA as 1 and ROE as 15.5 on its five-year financial summary for the year ended 31st December 2012. It also reported its NIM, ROA and ROE were reported as 2.81, 0.84 and 14.4 respectively for the financial report for the year ended 31st December 2009 as shown on page 32 and page 3 of the respective financial statements. It was therefore very difficult to agree on which of the two values to be included in the analysis. However the five year summary data was settled on.

Annual average inflation rate was used and since revenue are accrued daily, they are affected much more by daily inflation rates instead of yearly average. This might have introduced some level of error to the estimates based on these models

Other factors such as management decisions to obtain specific threshold of annual targets due to some internal policies or other pressures were not taken into account in building the models.

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5.4 RECOMMENDATIONS

Since asset, capital and loans have positive impact on aggregate profitability, ABSA must endeavor to increase its asset and capital base so that it can adhere to regulatory capital standards leaving excess capital and deposits that could be given out as loans and invested in bonds and unit trusts (Gul *et. al*, 2011).

Not forgetting the fact that high loans were found to negatively affect net-interest margin negatively, proper credit-risk management procedures should be strictly followed when issuing loans so as to minimize credit risk due to default payment on loans by customers, so that the risk might be proportionally insignificant. Due to the relatively small error margins of the constructed models, ABSA can use them to complement their own models so that profit targets are realistically forecasted and the appropriate operational costs budgeted.

Because aggregate effect of inflation on profitability was found to be negative, ABSA must competitively price their products and services in the wake of inflationary hikes so that the bank may not lose significant quantum of income and interest accrued from loans.

Analysis from the Ned Bank data indicated a positive impact of capital, stock market capitalization, gross domestic product and inflation on aggregate profitability. Since stock-market capitalization, gross domestic product and inflation are controlled by market dynamisms, Ned Bank has only capital at its disposal. Ned Bank can therefore increase its capital so that the costs of its external debt will be reduced, compensating for the higher costs of its own funds (Houssem, 2013). The bank can therefore easily adhere to regulatory capital-standards so that excess capital can be provided as loans (Gul *et. al*, 2011) which in turn will contribute positively to aggregate profitability. It is further recommended that Ned Bank must uphold its lower competitive pricing behavior in the wake of inflationary pressure and they must not resort to equity financing.

Even though inflation has positive impact on aggregate profitability, it still has a negative impact on return on asset therefore Ned Bank must not relent on its efforts to competitively price their products and services.

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Notwithstanding the fact that very high loans have very high negative effect on return on asset, an increase in the volume of loans issued is recommended. However credit risk management procedures should be strictly followed when issuing loans so that losses due to default payment on loans by customer will be substantially reduced.

All the constructed models for Ned Bank data except for return on equity model can be used to complement their own models when estimating future profit targets. The ROE model for Ned Bank can be modified in the future by incorporating other factors that affect profitability such as decision by management to adjust forecasted profits or not, credit risk, liquidity, labour efficiency, broad money supply growth rate, expenses managements and ownership type using the same model technique previously used or alternatively other modeling techniques such as GARCH or VAR to model the ROE components of profitability for Ned Bank.

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CHAPTER SIX

REFERENCES AND APPENDICES

7.2 REFERENCES

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6.2 APPENDICES

6.2.1 APPENDIX I

Table A1 : Serial correlation output of NIM for ABSA differenced data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.625134	Prob. F(2,4)	0.3044
Obs*R-squared	4.931259	Prob. Chi-Square(2)	0.0850

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/16/16 Time: 19:32
Sample: 2000 2013
Included observations: 11
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.002095	0.030380	-0.068947	0.9483
C(2)	-4.12E-07	8.36E-07	-0.492654	0.6481
C(3)	0.005518	0.010296	0.535915	0.6204
C(4)	0.028970	0.031561	0.917900	0.4106
C(5)	-0.004605	0.007170	-0.642218	0.5557
RESID(-1)	-0.159100	0.461753	-0.344557	0.7478
RESID(-2)	1.013460	0.730940	1.386515	0.2379

R-squared	0.448296	Mean dependent var	-1.59E-16
Adjusted R-squared	-0.379259	S.D. dependent var	0.052899
S.E. of regression	0.062125	Akaike info criterion	-2.458208
Sum squared resid	0.015438	Schwarz criterion	-2.205002
Log likelihood	20.52014	Hannan-Quinn criter.	-2.617819
F-statistic	0.541711	Durbin-Watson stat	2.016722
Prob(F-statistic)	0.760791		

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Table A 2: Heteroskedasticity output of NIM for ABSA differenced data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.434358	Prob. F(4,6)	0.3295
Obs*R-squared	5.376965	Prob. Chi-Square(4)	0.2508
Scaled explained SS	1.003205	Prob. Chi-Square(4)	0.9093

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/16/16 Time: 19:33
Sample: 2000 2013
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004146	0.001345	3.083253	0.0216
DFLOAN	-5.63E-08	3.41E-08	-1.652117	0.1496
DFCPI	0.000308	0.000414	0.743802	0.4851
DFCAPITAL	0.001369	0.001185	1.155475	0.2918
DFROE	0.000152	0.000297	0.512250	0.6268

R-squared	0.488815	Mean dependent var	0.002544
Adjusted R-squared	0.148025	S.D. dependent var	0.002988
S.E. of regression	0.002758	Akaike info criterion	-8.645697
Sum squared resid	4.56E-05	Schwarz criterion	-8.464836
Log likelihood	52.55133	Hannan-Quinn criter.	-8.759705
F-statistic	1.434358	Durbin-Watson stat	2.075383
Prob(F-statistic)	0.329462		

Table A 3: Serial correlation output of ROA for ABSA differenced data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.554221	Prob. F(2,5)	0.6062
Obs*R-squared	2.177529	Prob. Chi-Square(2)	0.3366

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/04/16 Time: 22:40
Sample: 1999 2013
Included observations: 12
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.000384	0.011354	-0.033855	0.9743
C(2)	0.004854	0.007278	0.666959	0.5343
C(3)	-0.016100	0.043772	-0.367812	0.7281
C(4)	0.010315	0.022347	0.461592	0.6638
C(5)	-0.001157	0.003347	-0.345678	0.7437
RESID(-1)	-0.460628	0.491370	-0.937437	0.3916
RESID(-2)	-0.525121	0.602289	-0.871875	0.4232

R-squared	0.181461	Mean dependent var	-1.94E-16
Adjusted R-squared	-0.800786	S.D. dependent var	0.028808
S.E. of regression	0.038658	Akaike info criterion	-3.376922
Sum squared resid	0.007472	Schwarz criterion	-3.094060
Log likelihood	27.26153	Hannan-Quinn criter.	-3.481647
F-statistic	0.184740	Durbin-Watson stat	1.828497
Prob(F-statistic)	0.968495		

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Table A 4: Heteroskedasticity output of ROA for ABSA differenced data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.149483	Prob. F(4,7)	0.9573
Obs*R-squared	0.944360	Prob. Chi-Square(4)	0.9181
Scaled explained SS	0.473809	Prob. Chi-Square(4)	0.9760

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/04/16 Time: 22:41
Sample: 1999 2013
Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000766	0.000482	1.590422	0.1558
DFCPI	-2.71E-05	0.000229	-0.118226	0.9092
DFNIM	-0.000843	0.001733	-0.486757	0.6413
DFCAPITAL	1.71E-05	0.000847	0.020220	0.9844
DFROE	-6.75E-05	0.000134	-0.504145	0.6296

R-squared	0.078697	Mean dependent var	0.000761
Adjusted R-squared	-0.447762	S.D. dependent var	0.001364
S.E. of regression	0.001642	Akaike info criterion	-9.691782
Sum squared resid	1.89E-05	Schwarz criterion	-9.489738
Log likelihood	63.15069	Hannan-Quinn criter.	-9.766586
F-statistic	0.149483	Durbin-Watson stat	0.930648
Prob(F-statistic)	0.957346		

Table A 5: Serial correlation output of ROE for ABSA differenced data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.936260	Prob. F(2,4)	0.4639
Obs*R-squared	2.869753	Prob. Chi-Square(2)	0.2381

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/04/16 Time: 23:35
Sample: 1999 2012
Included observations: 9
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.163674	0.295638	0.553631	0.6093
C(2)	-0.007313	0.078227	-0.093486	0.9300
C(3)	-7.69E-06	1.11E-05	-0.694237	0.5257
RESID(-1)	-0.695335	0.678239	-1.025207	0.3632
RESID(-2)	0.531909	0.939310	0.566276	0.6015

R-squared	0.318861	Mean dependent var	-8.14E-16
Adjusted R-squared	-0.362277	S.D. dependent var	0.498776
S.E. of regression	0.582154	Akaike info criterion	2.056017
Sum squared resid	1.355613	Schwarz criterion	2.165587
Log likelihood	-4.252078	Hannan-Quinn criter.	1.819567
F-statistic	0.468130	Durbin-Watson stat	1.354536
Prob(F-statistic)	0.759821		

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Table A 6: Heteroskedasticity output of ROE for ABSA differenced data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.203867	Prob. F(2,6)	0.8210
Obs*R-squared	0.572684	Prob. Chi-Square(2)	0.7510
Scaled explained SS	0.198726	Prob. Chi-Square(2)	0.9054

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/04/16 Time: 23:36
Sample: 1999 2012
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.190632	0.150784	1.264269	0.2530
DFCPI	-0.023793	0.041004	-0.580272	0.5829
DFLOAN	2.92E-07	4.04E-06	0.072350	0.9447

R-squared	0.063632	Mean dependent var	0.221135
Adjusted R-squared	-0.248491	S.D. dependent var	0.293096
S.E. of regression	0.327493	Akaike info criterion	0.866504
Sum squared resid	0.643512	Schwarz criterion	0.932246
Log likelihood	-0.899269	Hannan-Quinn criter.	0.724634
F-statistic	0.203867	Durbin-Watson stat	1.293836
Prob(F-statistic)	0.820995		

Table A 7: Serial correlation output of NIM for ABSA de-trended data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.420256	Prob. F(2,2)	0.7041
Obs*R-squared	2.071312	Prob. Chi-Square(2)	0.3550

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/14/16 Time: 21:31
Sample: 2002 2009
Included observations: 7
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.004249	0.011895	-0.357157	0.7551
C(2)	0.005185	0.010412	0.497941	0.6679
C(3)	-0.000475	0.001133	-0.419314	0.7157
RESID(-1)	-0.191266	0.681850	-0.280510	0.8054
RESID(-2)	-0.687066	0.750725	-0.915204	0.4567

R-squared	0.295902	Mean dependent var	1.27E-16
Adjusted R-squared	-1.112295	S.D. dependent var	0.000218
S.E. of regression	0.000316	Akaike info criterion	-13.10437
Sum squared resid	2.00E-07	Schwarz criterion	-13.14301
Log likelihood	50.86530	Hannan-Quinn criter.	-13.58190
F-statistic	0.210128	Durbin-Watson stat	2.327491
Prob(F-statistic)	0.912442		

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Table A 8: Heteroskedasticity output of NIM for ABSA de-trended data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.432938	Prob. F(2,4)	0.6758
Obs*R-squared	1.245641	Prob. Chi-Square(2)	0.5364
Scaled explained SS	0.291455	Prob. Chi-Square(2)	0.8644

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/14/16 Time: 21:32
Sample: 2002 2009
Included observations: 7

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.86E-07	2.01E-06	-0.242036	0.8207
ROE__1_	1.02E-06	1.57E-06	0.653637	0.5490
ASSET	-1.49E-07	1.78E-07	-0.835153	0.4506

R-squared	0.177949	Mean dependent var	4.06E-08
Adjusted R-squared	-0.233077	S.D. dependent var	5.25E-08
S.E. of regression	5.83E-08	Akaike info criterion	-30.18104
Sum squared resid	1.36E-14	Schwarz criterion	-30.20422
Log likelihood	108.6336	Hannan-Quinn criter.	-30.46755
F-statistic	0.432938	Durbin-Watson stat	3.004131
Prob(F-statistic)	0.675768		

Table A 9: Serial correlation output of ROA for ABSA inverse square root data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.023442	Prob. F(2,6)	0.4145
Obs*R-squared	2.798068	Prob. Chi-Square(2)	0.2468

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/14/16 Time: 21:52
Sample: 2000 2013
Included observations: 11
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.325011	0.566387	-0.573831	0.5869
C(2)	81.60442	149.3390	0.546438	0.6045
C(3)	0.513998	1.015537	0.506135	0.6308
RESID(-1)	-0.311565	0.386504	-0.806111	0.4509
RESID(-2)	-0.671112	0.484245	-1.385894	0.2151

R-squared	0.254370	Mean dependent var	-2.84E-16
Adjusted R-squared	-0.242717	S.D. dependent var	0.069132
S.E. of regression	0.077067	Akaike info criterion	-1.985333
Sum squared resid	0.035636	Schwarz criterion	-1.804472
Log likelihood	15.91933	Hannan-Quinn criter.	-2.099341
F-statistic	0.511721	Durbin-Watson stat	2.212481
Prob(F-statistic)	0.730886		

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Table A 10: Heteroskedasticity output of ROA for ABSA inverse square root data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.552435	Prob. F(2,8)	0.5960
Obs*R-squared	1.334843	Prob. Chi-Square(2)	0.5130
Scaled explained SS	0.423109	Prob. Chi-Square(2)	0.8093

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/14/16 Time: 21:53
Sample: 2000 2013
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030581	0.035182	0.869233	0.4100
MC	-8.976804	9.346427	-0.960453	0.3650
NI	-0.040389	0.064382	-0.627337	0.5479

R-squared	0.121349	Mean dependent var	0.004345
Adjusted R-squared	-0.098313	S.D. dependent var	0.004989
S.E. of regression	0.005228	Akaike info criterion	-7.442471
Sum squared resid	0.000219	Schwarz criterion	-7.333954
Log likelihood	43.93359	Hannan-Quinn criter.	-7.510875
F-statistic	0.552435	Durbin-Watson stat	2.598289
Prob(F-statistic)	0.596026		

Table A11: Serial correlation output of ROE for ABSA de-trended data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.857338	Prob. F(2,2)	0.5384
Obs*R-squared	3.231166	Prob. Chi-Square(2)	0.1988

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/06/16 Time: 12:38
Sample: 2001 2007
Included observations: 7
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.004777	0.008452	0.565238	0.6289
C(2)	-0.005847	0.010369	-0.563893	0.6296
C(3)	-0.000515	0.004208	-0.122371	0.9138
RESID(-1)	-0.383133	0.536482	-0.714159	0.5492
RESID(-2)	-0.773695	0.622457	-1.242970	0.3398

R-squared	0.461595	Mean dependent var	7.30E-16
Adjusted R-squared	-0.615215	S.D. dependent var	0.000108
S.E. of regression	0.000138	Akaike info criterion	-14.76896
Sum squared resid	3.79E-08	Schwarz criterion	-14.80759
Log likelihood	56.69135	Hannan-Quinn criter.	-15.24648
F-statistic	0.428669	Durbin-Watson stat	2.471130
Prob(F-statistic)	0.786930		

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Table A 12: Heteroskedasticity output of ROE for ABSA de-trended data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.092159	Prob. F(2,4)	0.4183
Obs*R-squared	2.472420	Prob. Chi-Square(2)	0.2905
Scaled explained SS	0.484336	Prob. Chi-Square(2)	0.7849

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/06/16 Time: 12:39
Sample: 2001 2007
Included observations: 7

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.82E-07	6.42E-07	0.751795	0.4940
CAPIT	-5.16E-07	7.88E-07	-0.654616	0.5484
ROA__1_	-4.91E-07	3.56E-07	-1.378145	0.2402

R-squared	0.353203	Mean dependent var	1.00E-08
Adjusted R-squared	0.029804	S.D. dependent var	1.19E-08
S.E. of regression	1.17E-08	Akaike info criterion	-33.39102
Sum squared resid	5.48E-16	Schwarz criterion	-33.41420
Log likelihood	119.8686	Hannan-Quinn criter.	-33.67753
F-statistic	1.092159	Durbin-Watson stat	3.305222
Prob(F-statistic)	0.418347		

Table A 13: Serial correlation output of NIM for Ned Bank data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.461344	Prob. F(2,3)	0.6688
Obs*R-squared	2.116966	Prob. Chi-Square(2)	0.3470

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/16/16 Time: 19:01
Sample: 2003 2013
Included observations: 9
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.036887	0.169818	0.217215	0.8420
C(2)	-0.047729	0.202404	-0.235808	0.8288
C(3)	0.013709	0.052176	0.262736	0.8098
C(4)	-0.011171	0.028663	-0.389738	0.7228
RESID(-1)	0.019485	0.620392	0.031407	0.9769
RESID(-2)	0.695627	0.730262	0.952571	0.4111

R-squared	0.235218	Mean dependent var	2.64E-15
Adjusted R-squared	-1.039417	S.D. dependent var	0.016515
S.E. of regression	0.023584	Akaike info criterion	-4.421756
Sum squared resid	0.001669	Schwarz criterion	-4.290273
Log likelihood	25.89790	Hannan-Quinn criter.	-4.705496
F-statistic	0.184538	Durbin-Watson stat	1.597007
Prob(F-statistic)	0.950160		

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Table A14: Heteroskedasticity output of NIM for Ned Bank data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.230533	Prob. F(3,5)	0.8716
Obs*R-squared	1.093609	Prob. Chi-Square(3)	0.7786
Scaled explained SS	0.114517	Prob. Chi-Square(3)	0.9900

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/16/16 Time: 19:04
Sample: 2003 2013
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000370	0.001610	-0.229823	0.8273
CAPITAL_	0.000630	0.001912	0.329350	0.7552
GDP_RATE_	-3.61E-05	0.000523	-0.068959	0.9477
INF	0.000180	0.000278	0.649033	0.5449

R-squared	0.121512	Mean dependent var	0.000242
Adjusted R-squared	-0.405581	S.D. dependent var	0.000212
S.E. of regression	0.000251	Akaike info criterion	-13.44019
Sum squared resid	3.15E-07	Schwarz criterion	-13.35253
Log likelihood	64.48084	Hannan-Quinn criter.	-13.62935
F-statistic	0.230533	Durbin-Watson stat	3.008075
Prob(F-statistic)	0.871565		

TableA 15: Serial correlation output of ROA Ned Bank data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.383609	Prob. F(2,3)	0.7106
Obs*R-squared	1.832908	Prob. Chi-Square(2)	0.3999

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/05/16 Time: 08:40
Sample: 2003 2013
Included observations: 9
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.157959	0.800006	0.197447	0.8561
C(2)	0.004579	0.029734	0.154001	0.8874
C(3)	-0.013419	0.157300	-0.085310	0.9374
C(4)	0.002683	0.197503	0.013583	0.9900
RESID(-1)	-0.156257	0.554139	-0.281982	0.7963
RESID(-2)	-0.503100	0.586913	-0.857197	0.4544

R-squared	0.203656	Mean dependent var	-7.20E-15
Adjusted R-squared	-1.123583	S.D. dependent var	0.055464
S.E. of regression	0.080824	Akaike info criterion	-1.958354
Sum squared resid	0.019598	Schwarz criterion	-1.826870
Log likelihood	14.81259	Hannan-Quinn criter.	-2.242094
F-statistic	0.153444	Durbin-Watson stat	2.002299
Prob(F-statistic)	0.964763		

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TableA 16: Heteroskedasticity output of ROA for Ned Bank data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.170805	Prob. F(3,5)	0.9117
Obs*R-squared	0.836610	Prob. Chi-Square(3)	0.8407
Scaled explained SS	0.332989	Prob. Chi-Square(3)	0.9537

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/05/16 Time: 08:41
Sample: 2003 2013
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.033360	0.054104	-0.616584	0.5645
INF	0.000124	0.002002	0.062086	0.9529
MC	0.002213	0.010495	0.210840	0.8413
LOAN	0.000183	0.013279	0.013746	0.9896

R-squared	0.092957	Mean dependent var	0.002734
Adjusted R-squared	-0.451269	S.D. dependent var	0.004658
S.E. of regression	0.005611	Akaike info criterion	-7.227005
Sum squared resid	0.000157	Schwarz criterion	-7.139350
Log likelihood	36.52152	Hannan-Quinn criter.	-7.416165
F-statistic	0.170805	Durbin-Watson stat	2.523284
Prob(F-statistic)	0.911688		

TableA 17: Serial correlation output of ROE for Ned Bank data

F-statistic	0.017057	Prob. F(1,5)	0.9012
Obs*R-squared	0.030598	Prob. Chi-Square(1)	0.8611

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/06/16 Time: 13:01
Sample: 2004 2013
Included observations: 9
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.090168	1.760953	0.051204	0.9611
C(2)	-9.33E-08	1.87E-06	-0.049860	0.9622
C(3)	0.057497	0.639907	0.089853	0.9319
RESID(-1)	-0.104802	0.802453	-0.130603	0.9012

R-squared	0.003400	Mean dependent var	-1.48E-15
Adjusted R-squared	-0.594560	S.D. dependent var	2.907687
S.E. of regression	3.671707	Akaike info criterion	5.740293
Sum squared resid	67.40718	Schwarz criterion	5.827948
Log likelihood	-21.83132	Hannan-Quinn criter.	5.551133
F-statistic	0.005686	Durbin-Watson stat	1.779679
Prob(F-statistic)	0.999329		

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Table A18: Heteroskedasticity output of ROE for Ned Bank data

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.959244	Prob. F(2,6)	0.2214
Obs*R-squared	3.555621	Prob. Chi-Square(2)	0.1690
Scaled explained SS	0.653506	Prob. Chi-Square(2)	0.7213

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/06/16 Time: 13:02
Sample: 2004 2013
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.049781	2.872460	1.409865	0.2083
DFMC	5.89E-06	3.07E-06	1.920881	0.1031
DFINF	-0.195996	0.823444	-0.238019	0.8198

R-squared	0.395069	Mean dependent var	7.515237
Adjusted R-squared	0.193425	S.D. dependent var	7.249238
S.E. of regression	6.510504	Akaike info criterion	6.845912
Sum squared resid	254.3200	Schwarz criterion	6.911654
Log likelihood	-27.80661	Hannan-Quinn criter.	6.704042
F-statistic	1.959244	Durbin-Watson stat	2.164776
Prob(F-statistic)	0.221369		

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6.2.2 APPENDIX II

Figure A 1: ACF and PACF graphs of NIM for ABSA differenced data

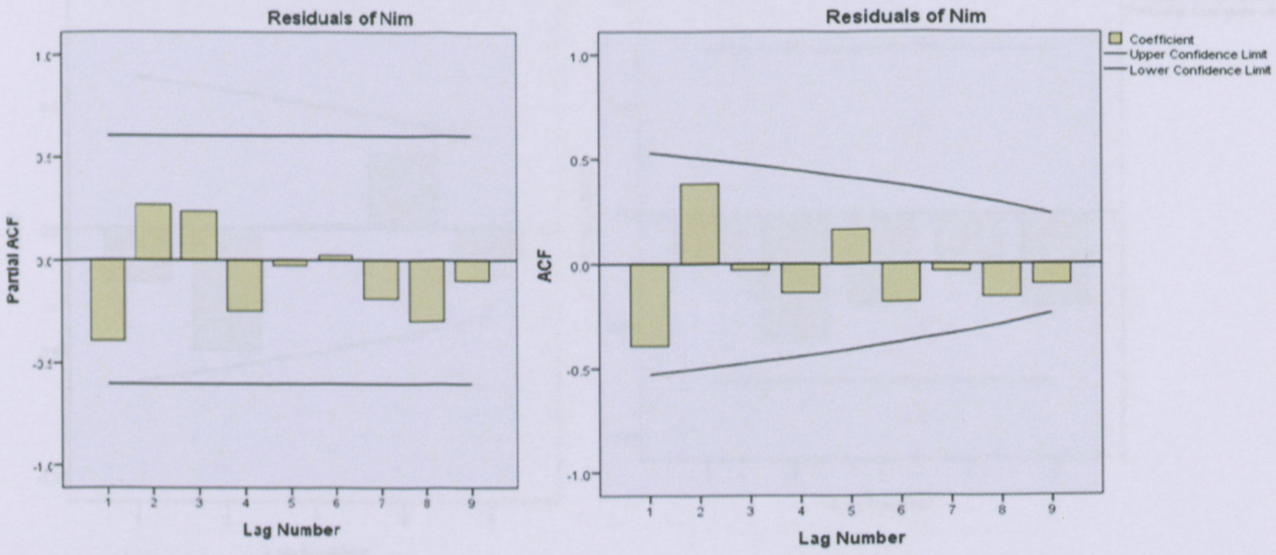
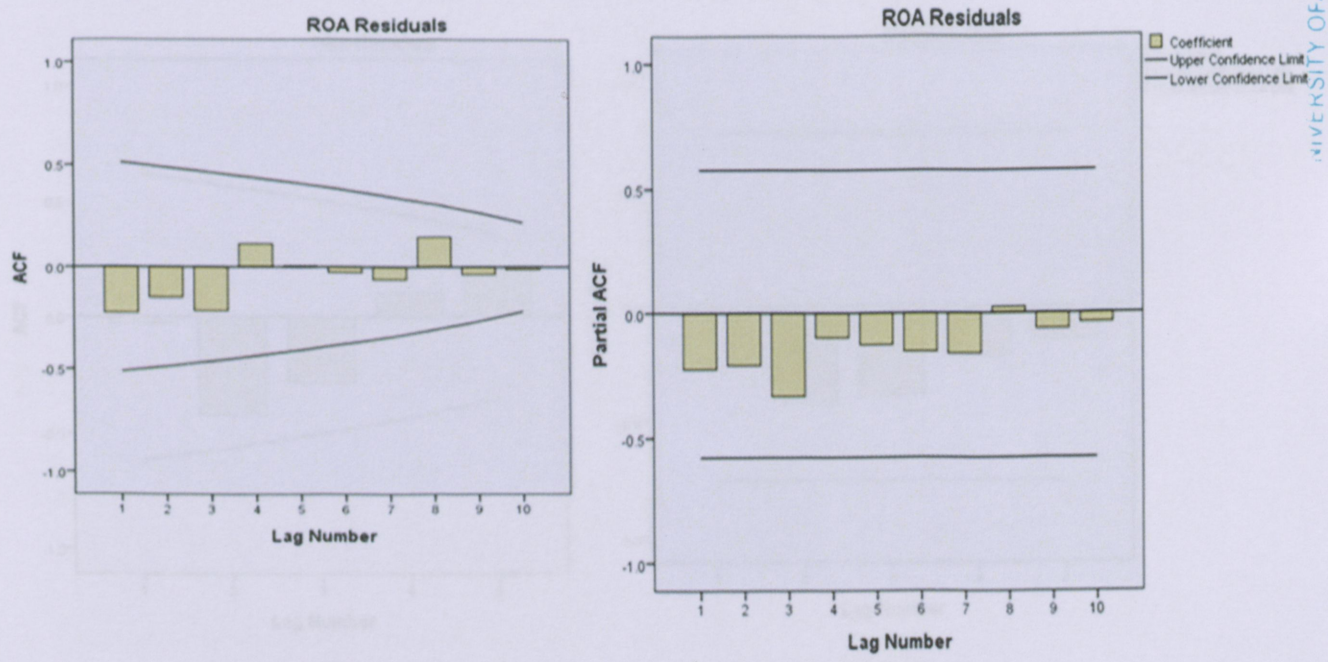


Figure 10: ACF graph and PACF graphs of ROA for ABSA differenced data



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Figure A 3: ACF and PACF graphs of ROE for ABSA differenced data

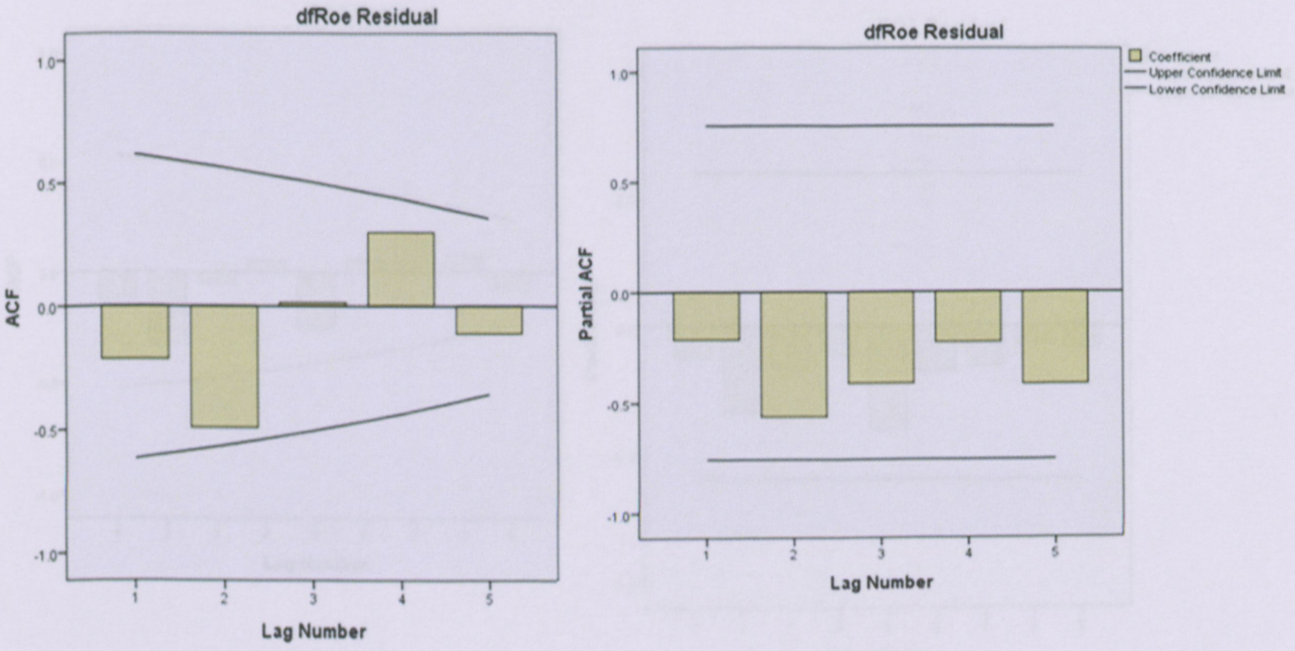
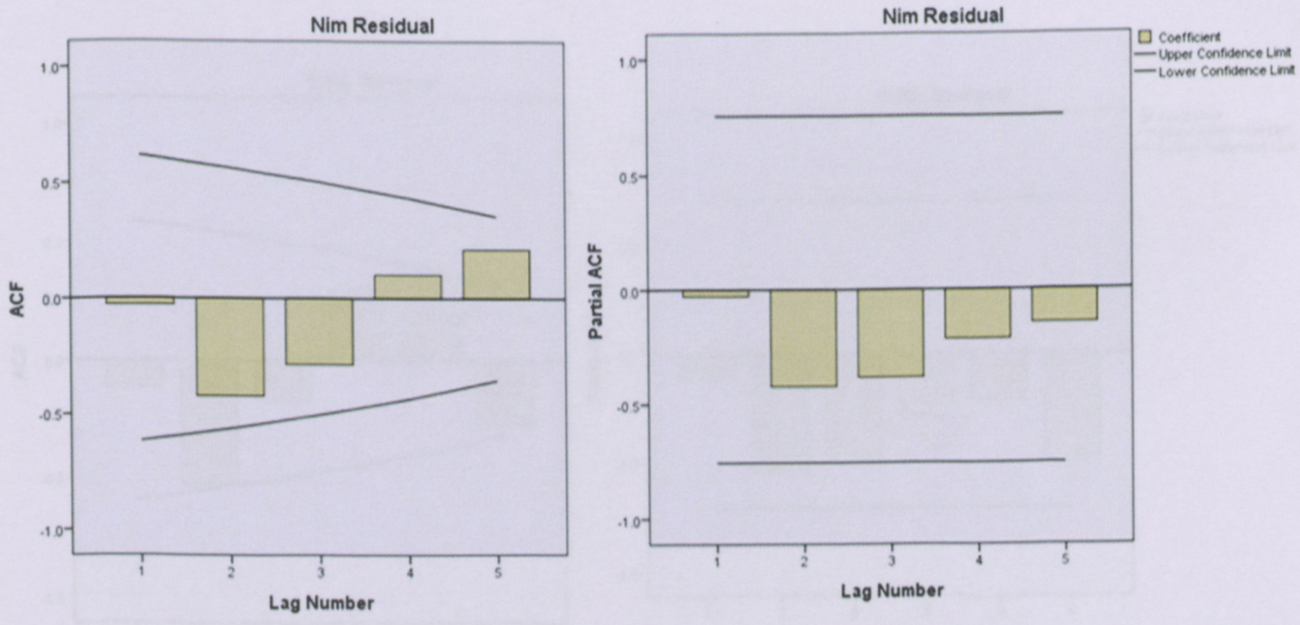


Figure A 4: ACF and PACF graphs of NIM for ABSA de-trended data



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Figure A 5: ACF and PACF graphs of ROA for ABSA inverse square root data

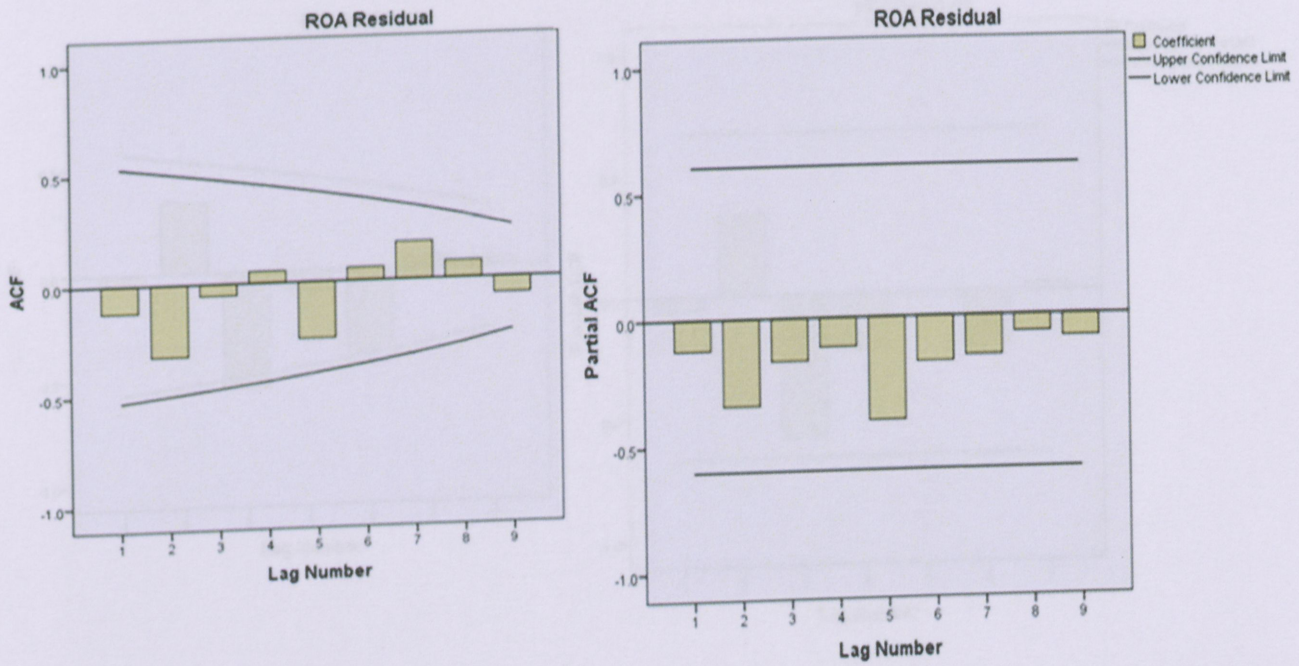
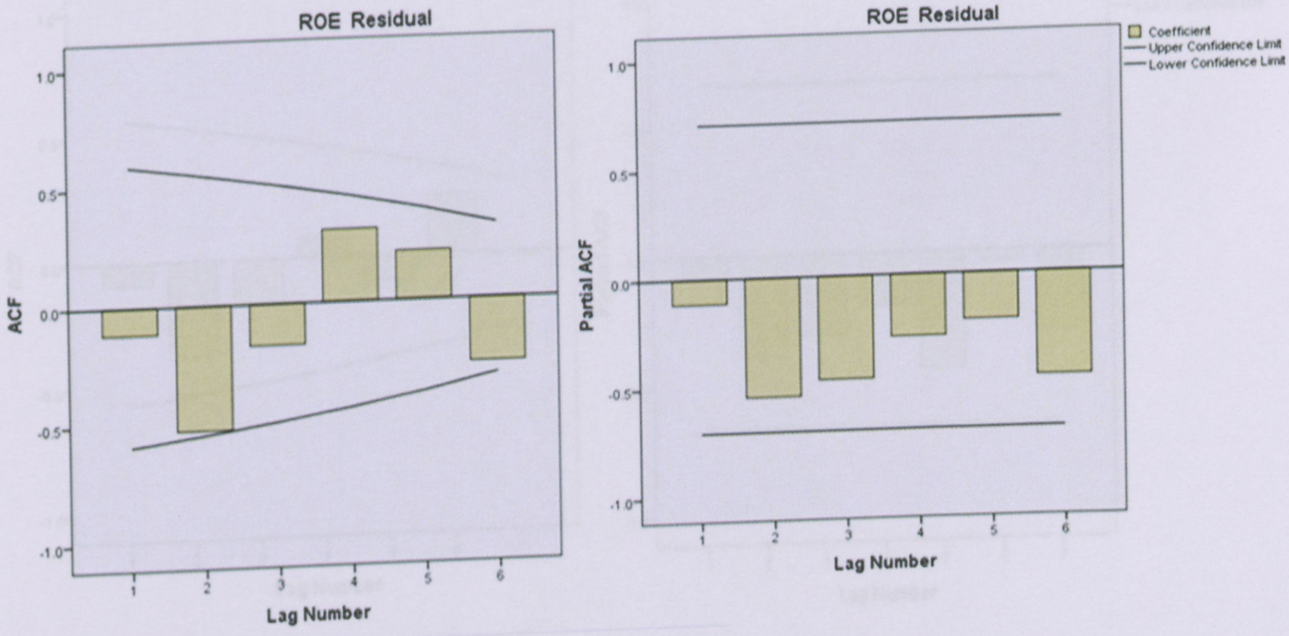


Figure A 6: ACF and PACF graphs of ROE for ABSA de-trended data



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Figure A 7: ACF and PACF graphs of NIM for Ned Bank data

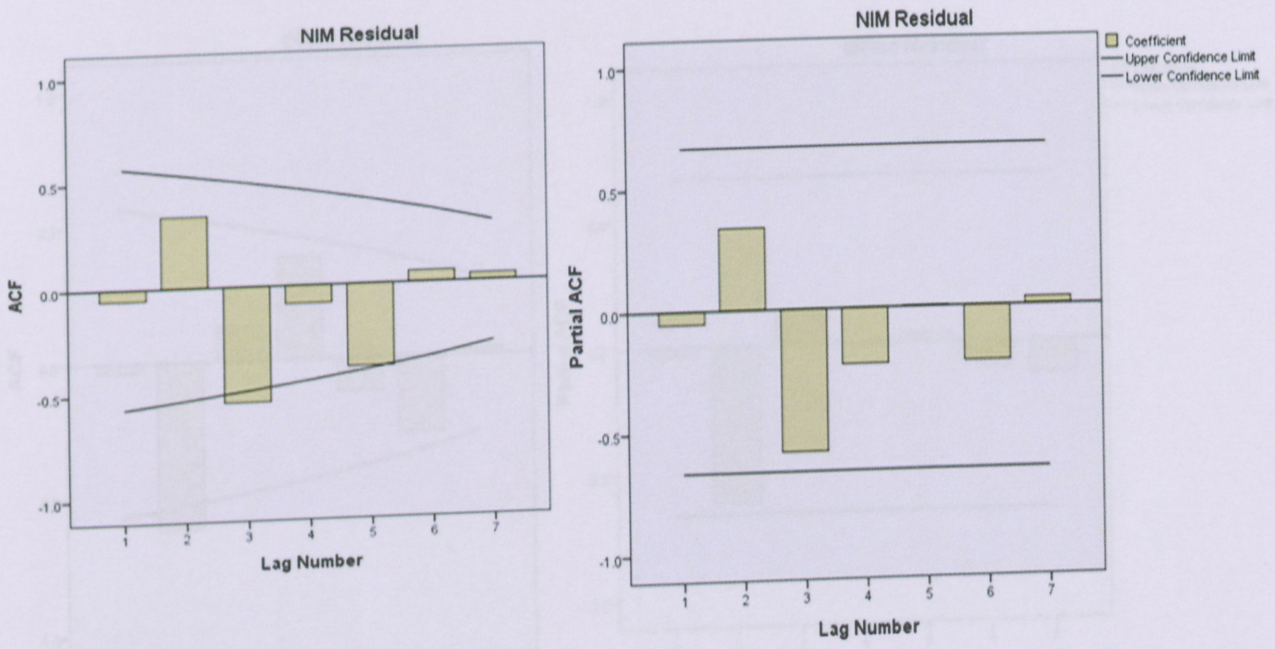
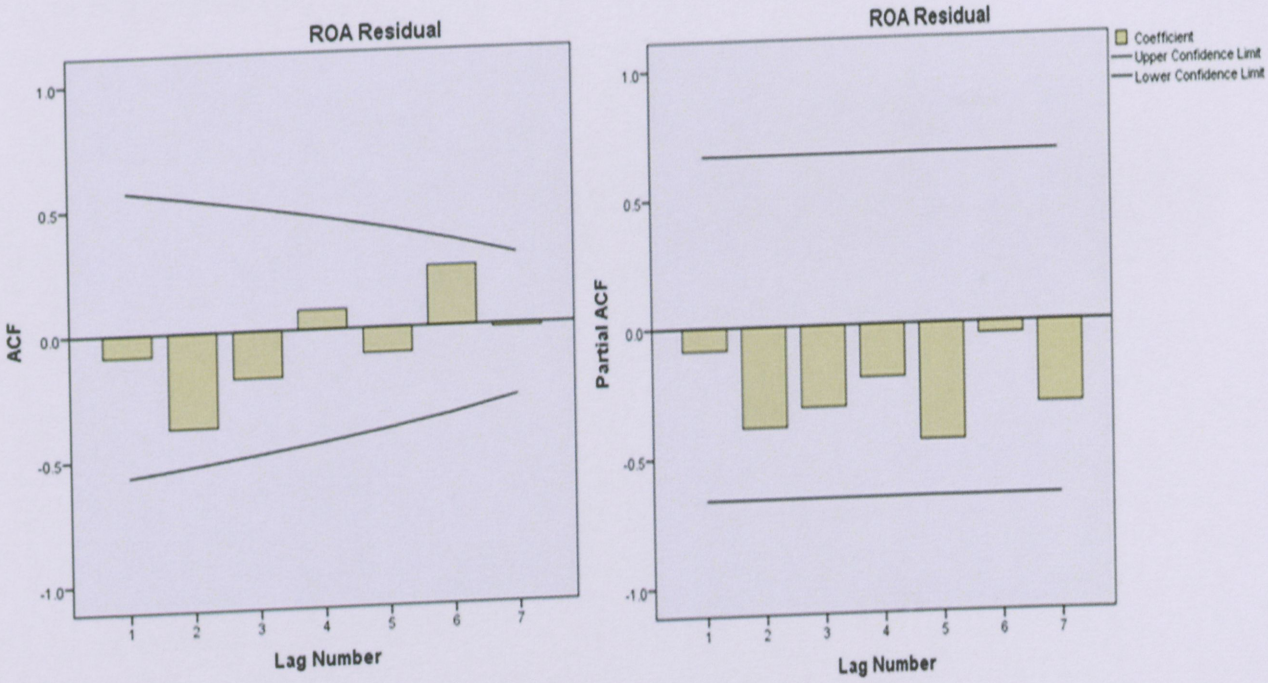


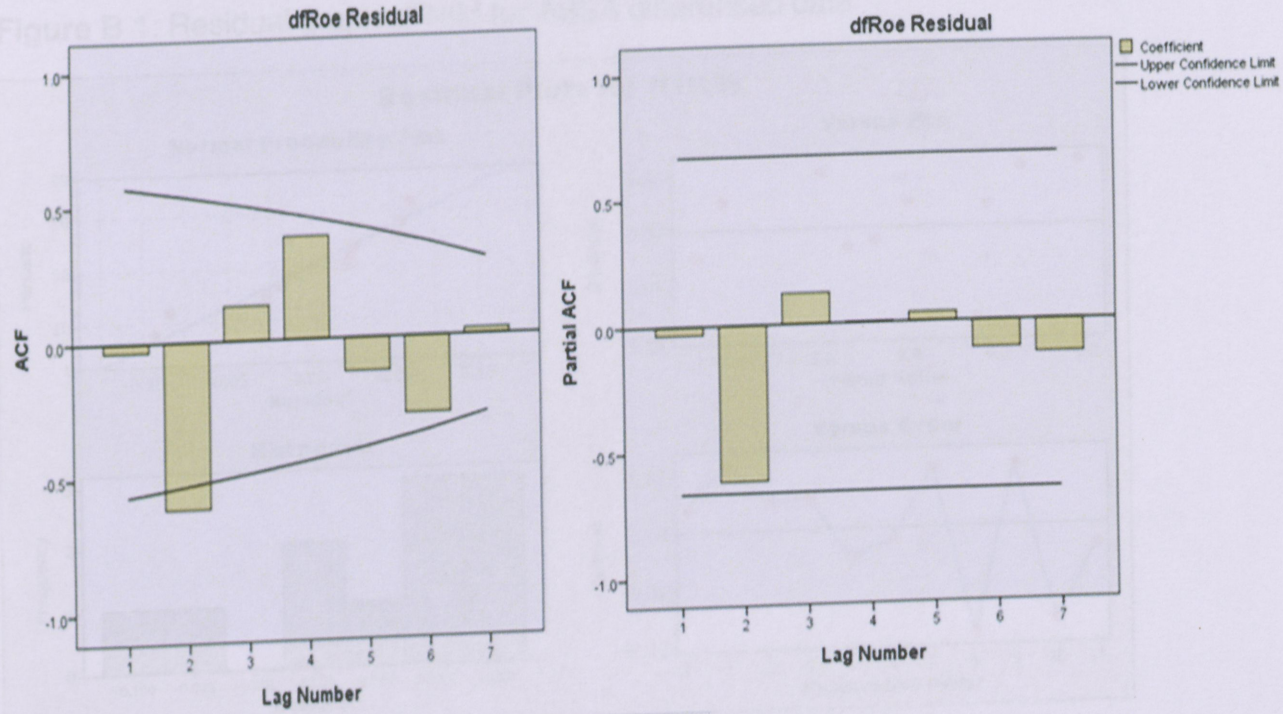
Figure A 8: ACF and PACF graphs of ROA Ned Bank data



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Figure A 9: ACF and PACF graphs of ROE for Ned Bank data



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6.2.3 APPENDIX III

Figure B 1: Residual graph of NIM for ABSA differenced data

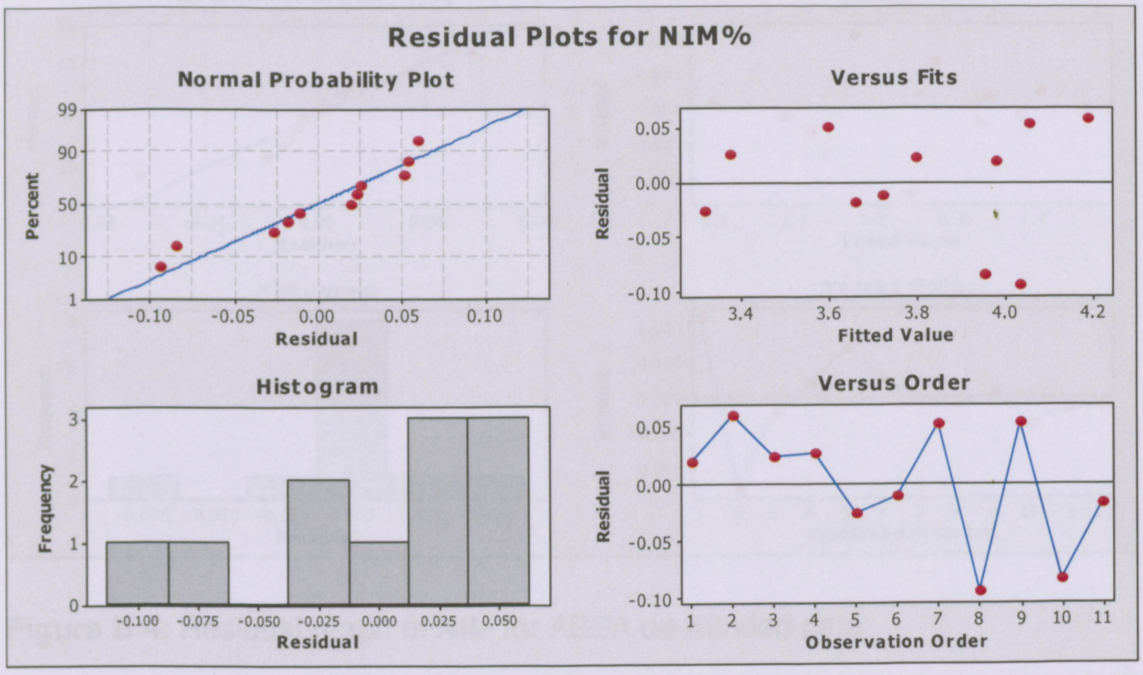
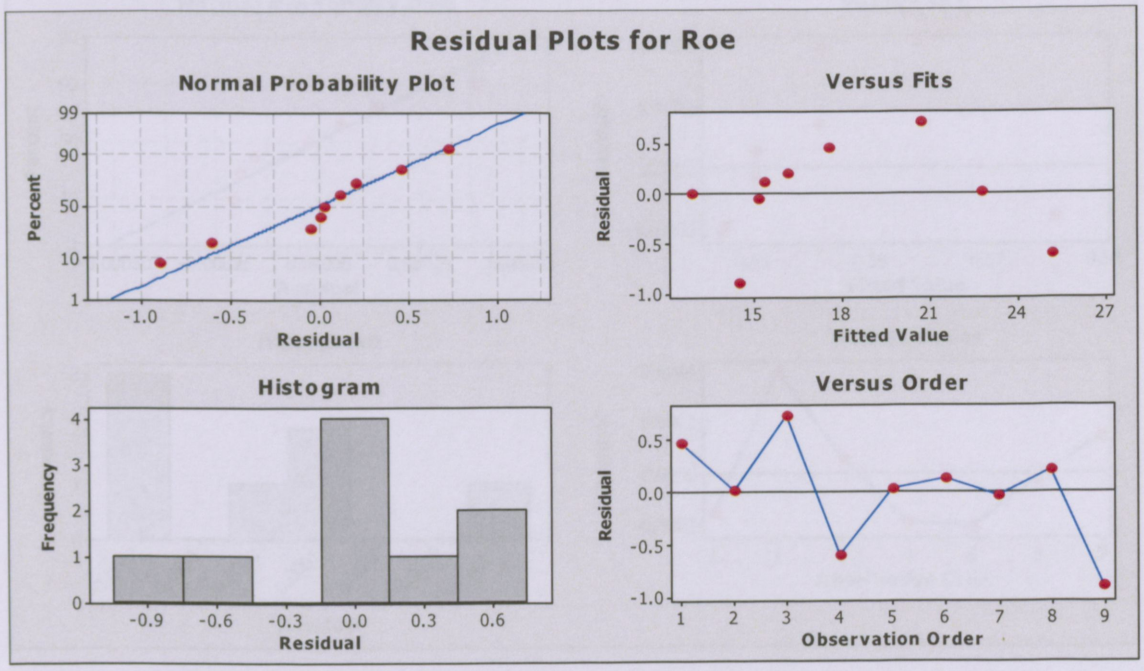


Figure B 2: Residual graph of ROA for ABSA differenced data



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Figure B 3: Residual graph of ROE for ABSA differenced data

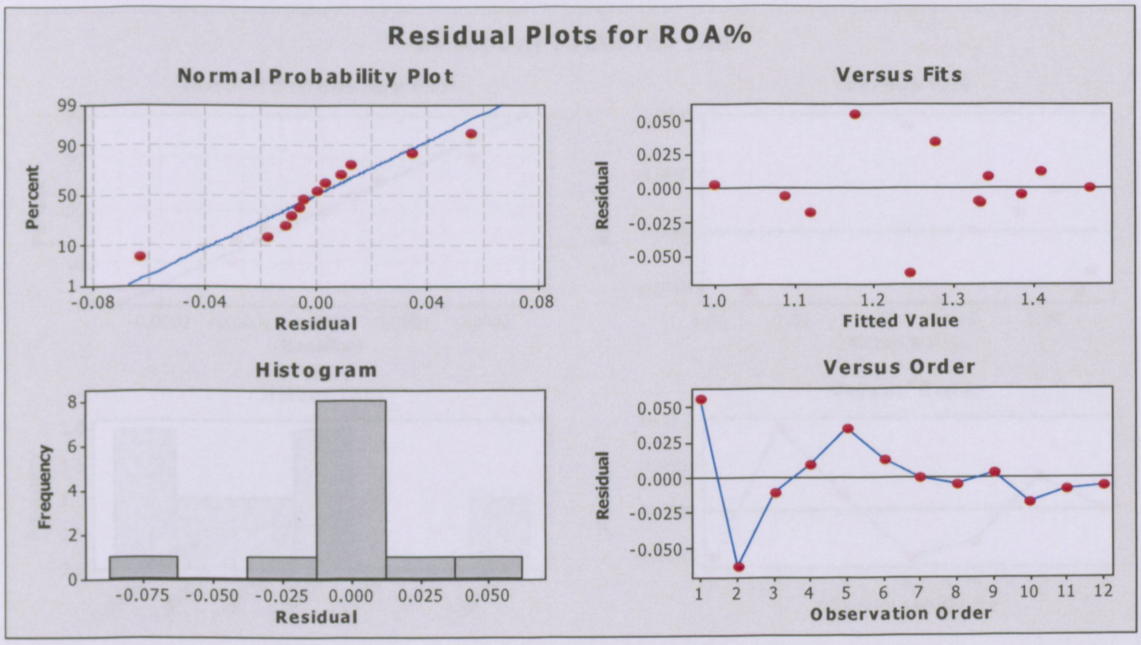
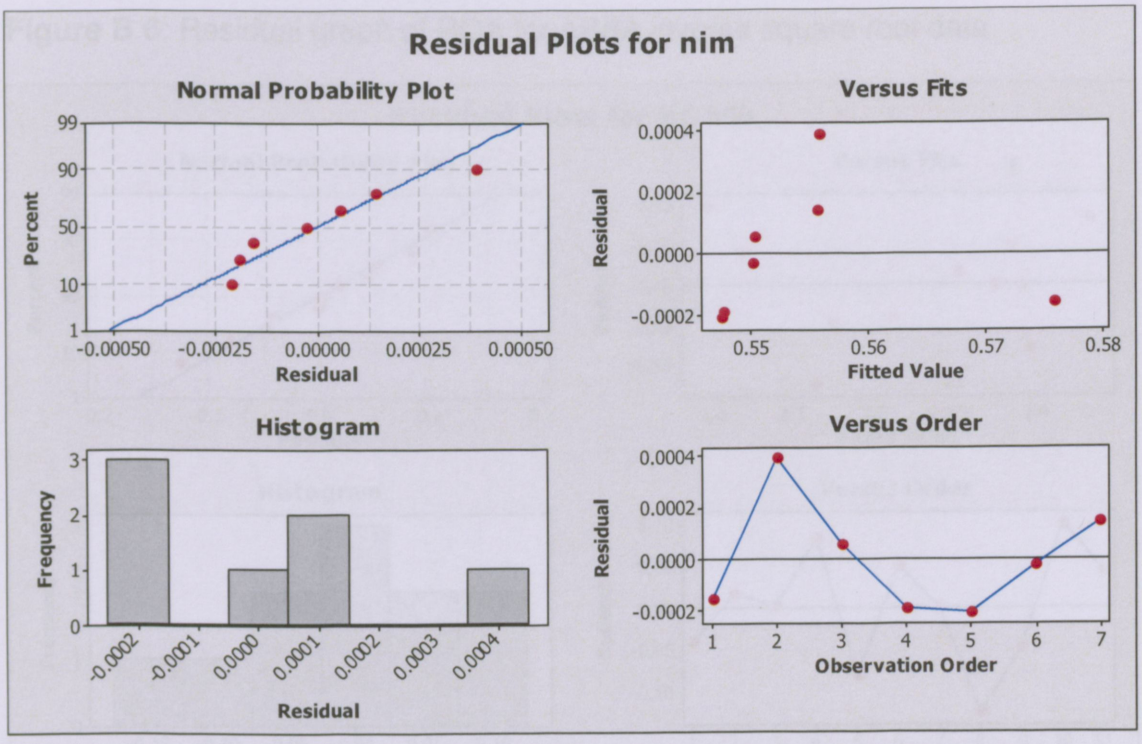


Figure B 4: Residual graph of NIM for ABSA de-trended data



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Figure B 5: Residual graph of ROE for ABSA de-trended data

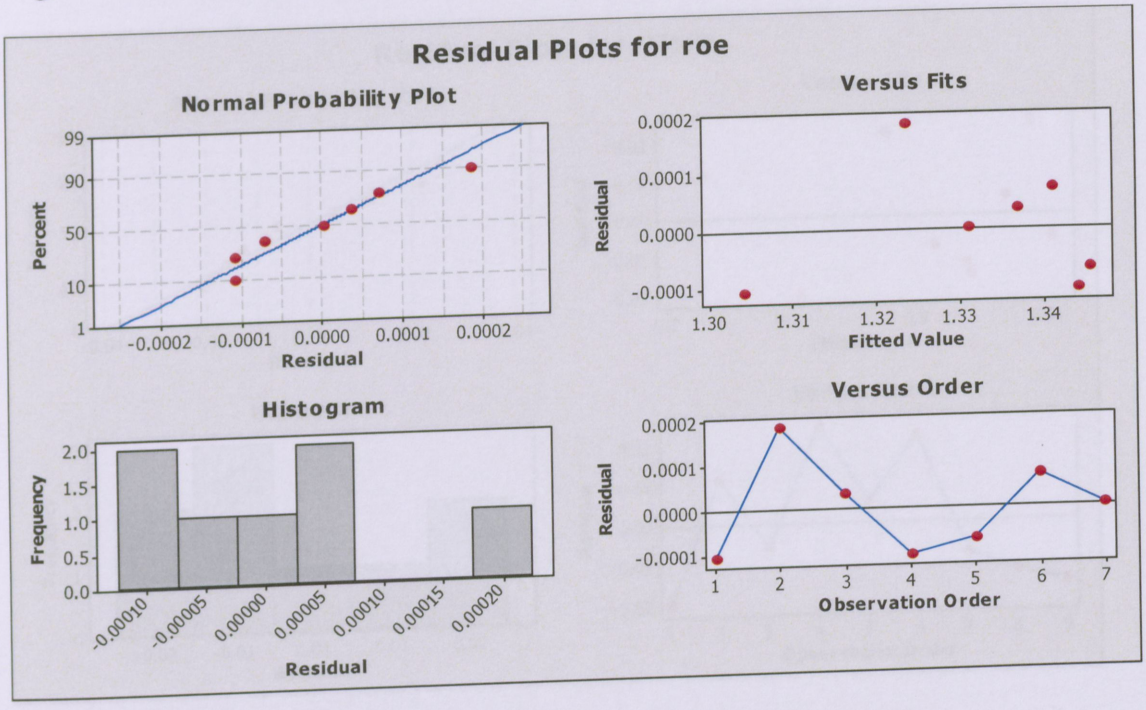
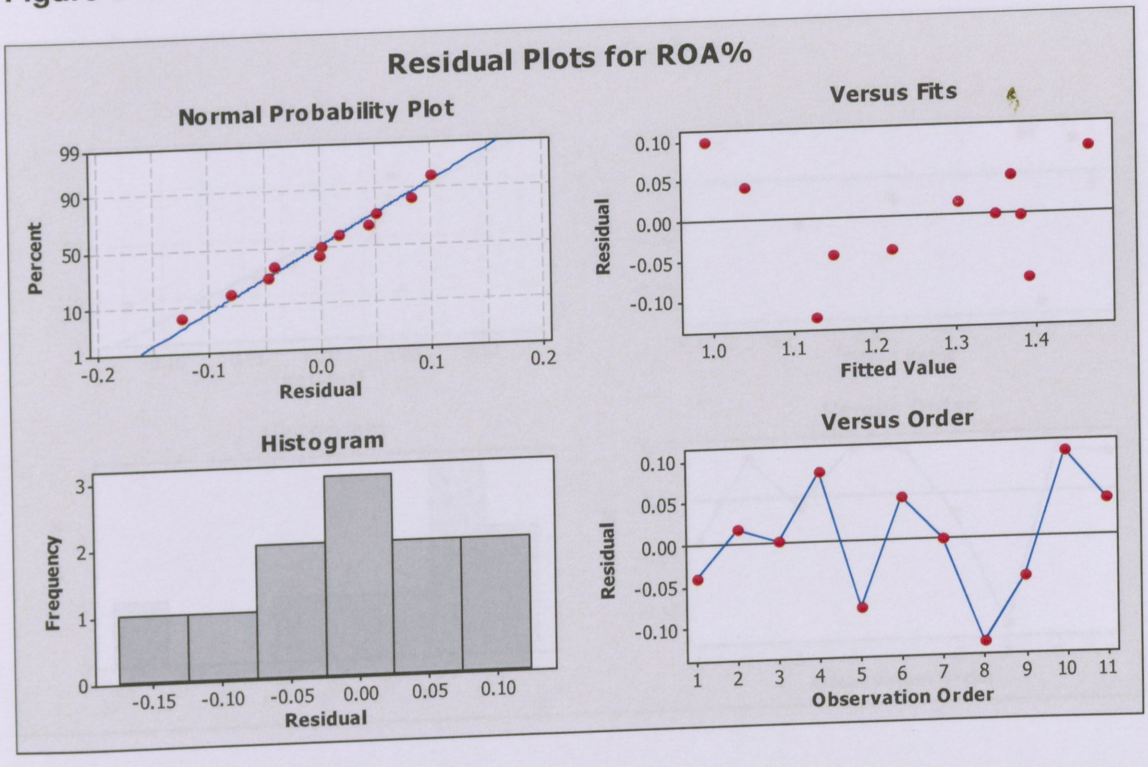


Figure B 6: Residual graph of ROA for ABSA inverse square root data



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Figure B 7: Residual graph of NIM for Ned Bank data

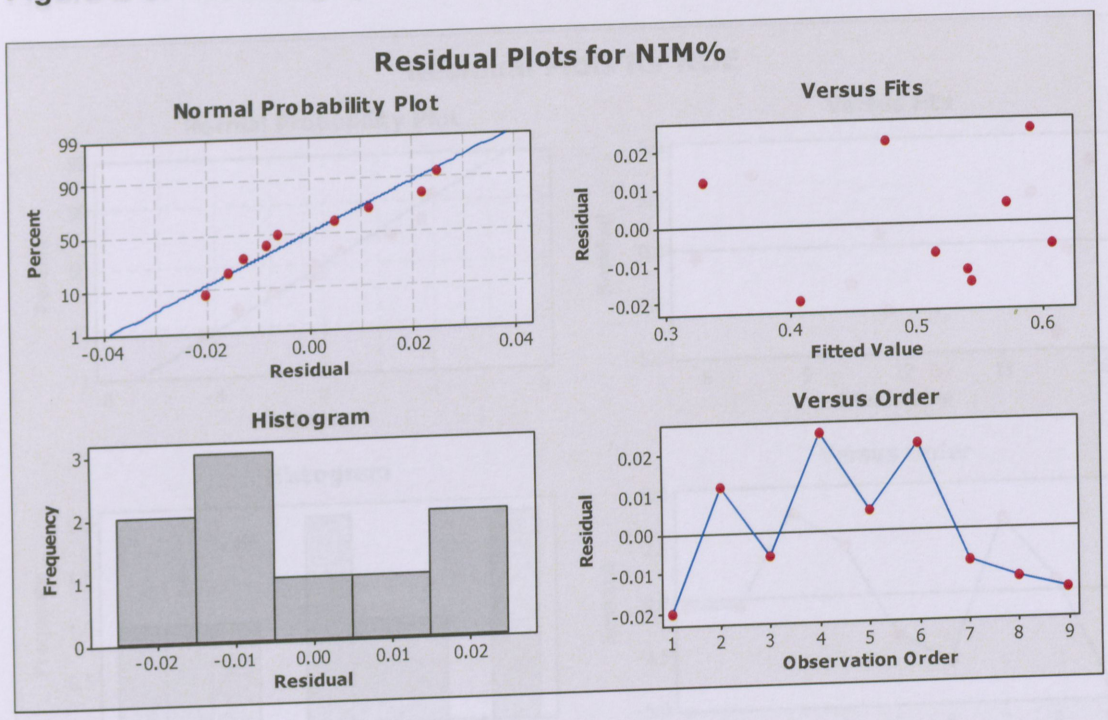
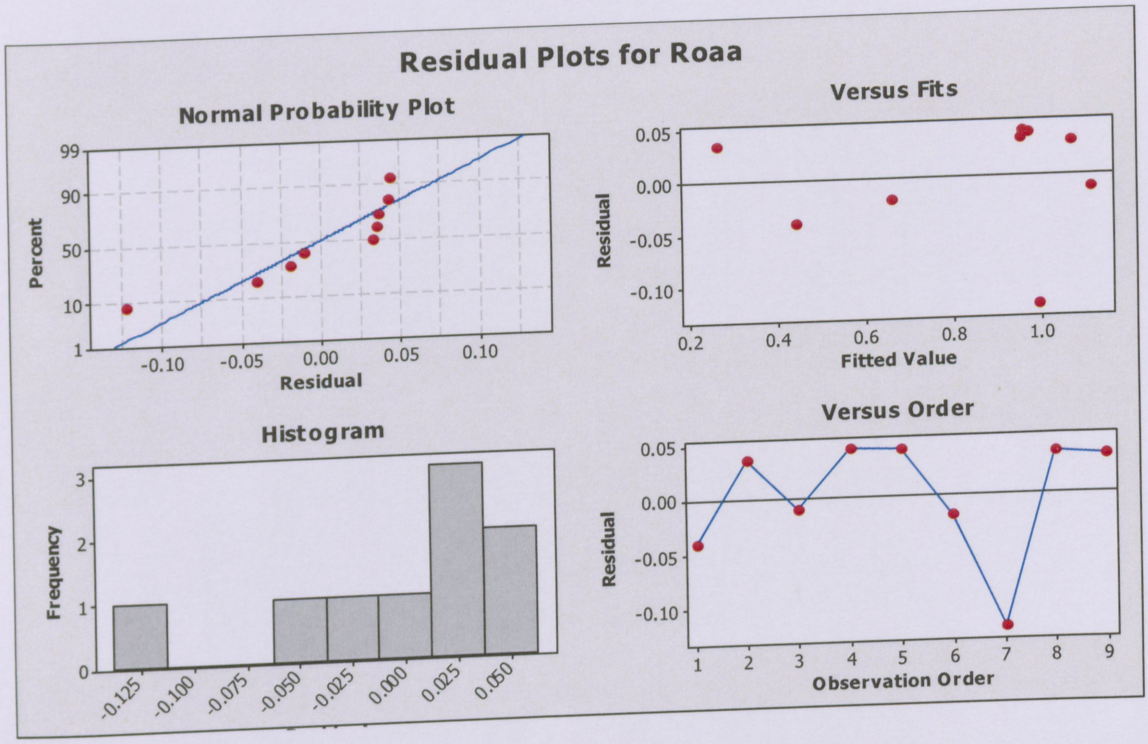
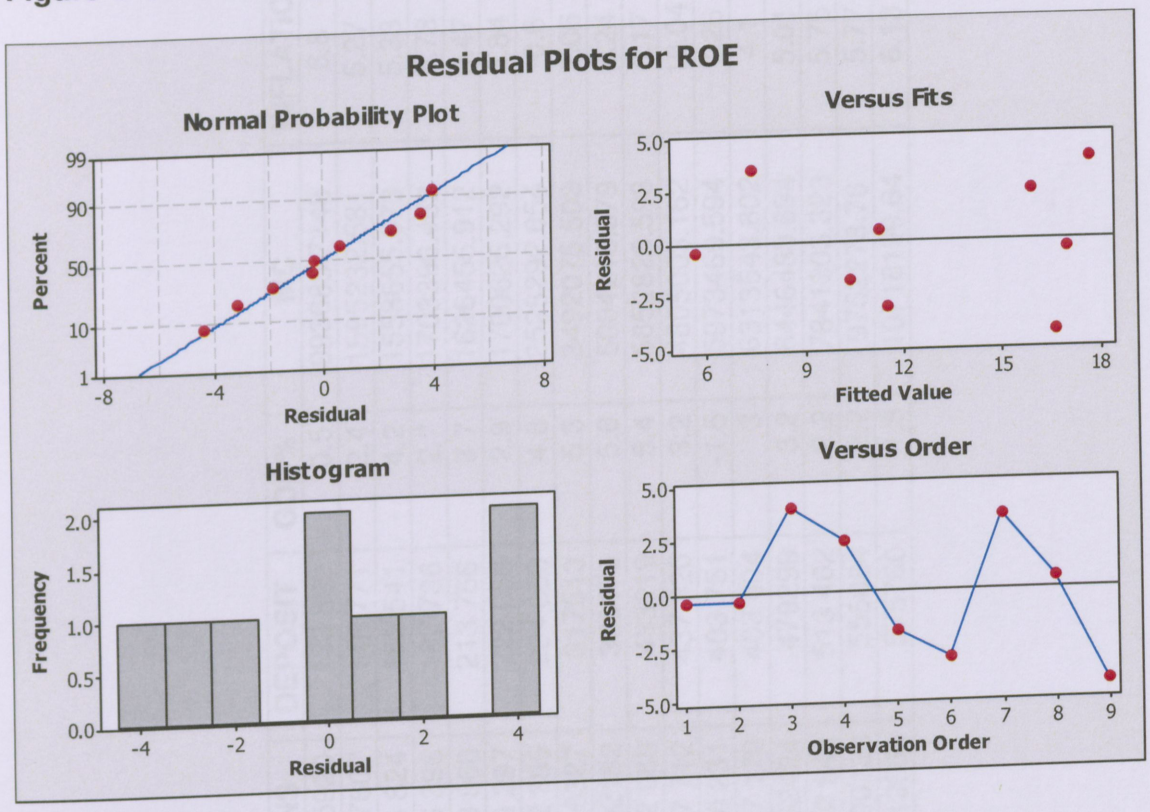


Figure B 8: Residual graph of ROA for Ned Bank data



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Figure B 9: Residual graph of ROE for Ned Bank data



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6.2.4 APPENDIX IV

6.2.4.1 TABLES OF DATA FOR ABSA

Table B 1: Original ABSA data

YEAR	ROA%	ROE%	NIM%	SIZE	CAPITAL	LOANS	DEPOSIT	GDP%	MC	INFLATION
1998	1.19	19.1	4.3	152 636	6.55	125920	133 899	0.5	993685.7148	6.8
1999	1.23	18	4.26	168475	6.86	137607	146 771	2.4	1595232.581	5.27
2000	1.18	17.1	4	177 234	6.75	144 824	153 541	4.2	1558655.673	5.33
2001	1.32	19.1	4.25	196 514	7.06	156 396	167 736	2.7	1703396.452	5.73
2002	0.86	12.9	3.82	247 300	6.20	183 860	213 766	3.7	1626455.912	9.47
2003	1.35	21.4	3.45	269 064	6.27	199 297	222 056	2.9	1700626.292	5.84
2004	1.55	24.6	3.4	306 848	6.31	222 395	234 380	4.6	2528292.054	-0.6
2005	1.31	22.8	3.29	376 687	5.59	316327	317513	5.3	3492075.503	2.06
2006	1.42	25.1	3.71	453 726	6.33	392182	388170	5.6	5004216.379	3.24
2007	1.47	26.4	3.08	592 959	5.99	592 968	433219	5.4	5652828.593	6.17
2008	1.38	23.4	3.81	773 316	6.89	577 712	437 820	3.2	4805003.162	10.04
2009	1	15.5	3.65	721641	7.83	560 231	403 751	-1.5	5973469.594	7.26
2010	1.1	15.1	3.94	725 957	8.56	537 170	403 004	3	6313543.802	4.1
2011	1.32	16.4	4.11	786 719	8.69	562424	479299	3.2	6446480.694	5.01
2012	1.09	13.6	3.87	807 939	9.01	572 840	513 462	2.2	7841303.323	5.75
2013	1.08	13.5	3.64	792635	7.22	600126	555084	2.2	9752278.76	5.77
2014	1.08	16.9	3.83	814 061	7.24	619860	575760	1.5	10718199.64	6.13

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Table B 2: Net-interest margin Data for ABSA (Differenced at Lag1)

YEAR	NIM%	dfRoe	dfNim	dfSize	dfCapital	dfLoan	dfGdp	dfMc	dfCpi	dfRoa
2000	4	-0.9	-0.26	8759	-0.10465	7217	1.8	-36576.9	0.06	-0.05
2001	4.25	2	0.25	19280	0.30655	11572	-1.5	144740.8	0.4	0.14
2002	3.82	-6.2	-0.43	50786	-0.85654	27464	1	-76940.5	3.74	-0.46
2004	3.4	3.2	-0.05	37784	0.037657	23098	1.7	827665.8	-6.44	0.2
2005	3.29	-1.8	-0.11	69839	-0.71813	93932	0.7	963783.4	2.66	-0.24
2006	3.71	2.3	0.42	77039	0.743205	75855	0.3	1512141	1.18	0.11
2009	3.65	-7.9	-0.16	-51675	0.936501	-17481	-4.7	1168466	-2.78	-0.38
2010	3.94	-0.4	0.29	4316	0.732983	-23061	4.5	340074.2	-3.16	0.1
2011	4.11	1.3	0.17	60762	0.133997	25254	0.2	132936.9	0.91	0.22
2012	3.87	-2.8	-0.24	21220	0.314866	10416	-1	1394823	0.74	-0.23
2013	3.64	-0.1	-0.23	-15304	-1.78596	27286	0	1910975	0.02	-0.01

Table B 3: Return on Asset Data for ABSA (Differenced at Lag1)

YEAR	ROA	dfRoe	dfNim	dfSize	dfCapital	dfLoan	dfGdp	dfMc	dfCpi
1999	1.23	-1.1	-0.04	15839	0.309979	11687	1.9	601546.9	-1.53
2000	1.18	-0.9	-0.26	8759	-0.10465	7217	1.8	-36576.9	0.06
2001	1.32	2	0.25	19280	0.30655	11572	-1.5	144740.8	0.4
2003	1.35	8.5	-0.37	21764	0.067427	15437	-0.8	74170.38	-3.63
2005	1.31	-1.8	-0.11	69839	-0.71813	93932	0.7	963783.4	2.66
2006	1.42	2.3	0.42	77039	0.743205	75855	0.3	1512141	1.18
2007	1.47	1.3	-0.63	139233	-0.33949	200786.1	-0.2	648612.2	2.93
2008	1.38	-3	0.73	180357	0.899845	-15256.1	-2.2	-847825	3.87
2009	1	-7.9	-0.16	-51675	0.936501	-17481	-4.7	1168466	-2.78
2010	1.1	-0.4	0.29	4316	0.732983	-23061	4.5	340074.2	-3.16
2011	1.32	1.3	0.17	60762	0.133997	25254	0.2	132936.9	0.91
2013	1.08	-0.1	-0.23	-15304	-1.78596	27286	0	1910975	0.02

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Table B 4: Return on Equity Data for ABSA (Differenced at Lag1)

YEAR	Roe	dfNIM	dfSize	dfCapital	dfLoan	dfDepo	dfGdp	dfMc	dfCPi	dfRoa
1999	18	-0.04	15839	0.309979	11687	12872	1.9	601546.9	-1.53	0.04
2002	12.9	-0.43	50786	-0.85654	27464	46030	1	-76940.5	3.74	-0.46
2003	21.4	-0.37	21764	0.067427	15437	8290	-0.8	74170.38	-3.63	0.49
2004	24.6	-0.05	37784	0.037657	23098	12324	1.7	827665.8	-6.44	0.2
2005	22.8	-0.11	69839	-0.71813	93932	83133	0.7	963783.4	2.66	-0.24
2009	15.5	-0.16	-51675	0.936501	-17481	-34069	-4.7	1168466	-2.78	-0.38
2010	15.1	0.29	4316	0.732983	-23061	-747	4.5	340074.2	-3.16	0.1
2011	16.4	0.17	60762	0.133997	25254	76295	0.2	132936.9	0.91	0.22
2012	13.6	-0.24	21220	0.314866	10416	34163	-1	1394823	0.74	-0.23

Table B 5: Net-interest margin Data for ABSA (de-trended and at Lagged 1)

YEAR	NIM	SIZE	CAPIT	LOANT	GDPT	MCT	CPIT	ROE(-1)
2005	0.550397	5.58426	0.804777	5.502728	0.632983	6.465642	0.709057	1.344226
2006	0.547424	5.639739	0.810345	5.554068	0.644149	6.532696	0.704799	1.345633
2007	0.547336	5.68969	0.818872	5.598934	0.644641	6.596138	0.704297	1.341318
2008	0.550136	5.73517	0.830188	5.638648	0.634497	6.656155	0.707565	1.331107
2009	0.555768	5.776959	0.844075	5.674157	0.61294	6.712972	0.714518	1.314571
2010	0.564125	5.815648	0.860286	5.706168	0.578167	6.766825	0.724984	1.290965
2011	0.57505	5.851695	0.878554	5.73522	0.526783	6.817945	0.738711	1.259101
2012	0.588351	5.885463	0.898605	5.761735	0.452418	6.866549	0.755393	1.217119

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Table B 6: ROA Data for ABSA (Inverse square root at Lagged 1)

YEAR	ROA%	SIZE	CAPITAL%	LOANS	gdp(rate)	MC	INF	ni
2000	1.18	0.002436	0.381924	0.002696	0.645497	0.000792	0.43561	0.484502
2001	1.32	0.002375	0.384873	0.002628	0.48795	0.000801	0.43315	0.5
2003	1.35	0.002011	0.401578	0.002332	0.519875	0.000784	0.32496	0.511645
2004	1.55	0.001928	0.399413	0.00224	0.58722	0.000767	0.4138	0.538382
2005	1.31	0.001805	0.398218	0.002121	0.466252	0.000629	1.29099	0.542326
2006	1.42	0.001629	0.423033	0.001778	0.434372	0.000535	0.69673	0.551318
2008	1.38	0.001299	0.408533	0.001299	0.430331	0.000421	0.40258	0.569803
2009	1	0.001137	0.380928	0.001316	0.559017	0.000456	0.3156	0.512316
2010	1.1	0.001177	0.357417	0.001336	0.816497	0.000409	0.37113	0.523424
2012	1.09	0.001127	0.33913	0.001333	0.559017	0.000394	0.44677	0.493264
2013	1.08	0.001113	0.333151	0.001321	0.6742	0.000357	0.41703	0.508329

Table B 7: Return on Equity (ROE) Data for ABSA (de-trended differenced Lag1)

year	roe	Asset_t	Capit	Loant	Gdpt	Mct	Cpit	roa(-1)
2001	1.303875	5.263043	0.813471	5.173101	0.443907	6.162961	0.760276	0.08853
2002	1.323781	5.365739	0.80668	5.284908	0.520933	6.242842	0.742866	0.101785
2003	1.33704	5.450059	0.802925	5.371992	0.574133	6.320473	0.728322	0.111818
2004	1.344226	5.521762	0.802286	5.443007	0.610284	6.394875	0.716964	0.118841
2005	1.345633	5.58426	0.804777	5.502728	0.632983	6.465642	0.709057	0.122994
2006	1.341318	5.639739	0.810345	5.554068	0.644149	6.532696	0.704799	0.124358
2007	1.331107	5.68969	0.818872	5.598934	0.644641	6.596138	0.704297	0.12296

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6.2.4.2 TABLES OF DATA FOR NED BANK

Table C 1: Original data for Ned Bank

YEAR	ROA	ROE	NIM	SIZE	CAPITAL	LOANS	DEPOSIT	GDP%	MC	INFLATION
2002	0.2	2.8	2.35	207 159	6.02	133 627	152 891	3.7	1626456	9.47
2003	0.4	6.8	2.44	305 822	5.25	220 608	250 253	2.9	1700626	5.84
2004	0.3	5.2	2.2	321 054	6.27	232 118	260 310	4.6	2528292	-0.6
2005	1.1	18.4	4	326980	7.45	250410	272492	5.3	3492076	2.06
2006	1.0	16.6	4.1	401 888	6.98	321724	341708	5.6	5004216	3.24
2007	1.31	21.6	4.14	460 627	7.19	375 421	391526	5.4	5652829	6.17
2008	1.01	18.3	3.78	547 132	6.66	436 420	464 082	3.2	4805003	10.04
2009	0.64	8.5	3.47	544990	6.97	446 428	467 924	-1.5	5973470	7.26
2010	0.65	8.3	3.15	576 490	6.66	471 447	491 038	3	6313544	4.1
2011	0.87	10.9	3.21	613 540	7.01	493107	516540	3.2	6446481	5.01
2012	0.99	11.8	3.37	645 350	7.33	520 116	542 671	2.2	7841303	5.75
2013	1.1	12.2	3.37	699155	7.39	566947	585497	2.2	9752279	5.77
2014	1.27	15.8	3.52	809 313	8.76	613 021	653 450	1.5	10718199.64	6.13

Table C 2: Net-interest margin Data for Ned Bank (Log lag 1)

YEAR	ROE%	NIM%	SIZE	CAPITAL%	LOANS	GDP%	MC	INF
2003	0.832509	0.38739	5.316304	0.779563	5.125894	0.568202	6.211242	0.97635
2004	0.716003	0.342423	5.485469	0.719952	5.343621	0.462398	6.230609	0.766413
2005	1.264818	0.60206	5.506578	0.797115	5.365709	0.662758	6.402827	-0.22185
2007	1.334454	0.617	5.604105	0.843936	5.507483	0.748188	6.699336	0.510545
2008	1.262451	0.577492	5.663349	0.856898	5.574519	0.732394	6.752266	0.790285
2010	0.919078	0.498311	5.736389	0.843315	5.649751	0.176091	6.776227	0.860937
2011	1.037426	0.506505	5.760792	0.823539	5.673433	0.477121	6.800273	0.612784
2012	1.071882	0.52763	5.787843	0.845494	5.692941	0.50515	6.809323	0.699838
2013	1.08636	0.52763	5.809795	0.864937	5.7161	0.342423	6.894388	0.759668

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Table C 3: Return on Asset (ROA) Data for Ned Bank(y=Ln (1+x) at Lag1)

YEAR	ROA%	ROE	ASSET	CAPI	LOAN	GDP	MC	INF
2003	0.4	1.335001	12.24125	1.948696	11.80282	1.547563	14.30191	2.348514
2004	0.3	2.054124	12.63076	1.832181	12.30415	1.360977	14.34651	1.922788
2005	1.1	1.824549	12.67937	1.983453	12.35501	1.722767	14.74305	-0.91629
2006	1	2.965273	12.69766	2.133949	12.43086	1.84055	15.06601	1.118415
2008	1.01	3.11795	13.04035	2.103256	12.83581	1.856298	15.54767	1.969906
2009	0.64	2.960105	13.21245	2.036084	12.98636	1.435085	15.38517	2.401525
2011	0.87	2.230014	13.26472	2.036143	13.06356	1.386294	15.65821	1.629241
2012	0.99	2.476538	13.327	2.08024	13.10848	1.435085	15.67905	1.793425
2013	1.1	2.549445	13.37755	2.119526	13.16181	1.163151	15.87492	1.909543

Table C 4: Return on Equity (ROE) Data for Ned Bank (Differenced at Lag1)

YEAR	ROE	dfSIZE	dfCAPITAL	dfLOAN	dfGDP	DFMC	DFINF	DFROA	DFNIM
2004	5.2	98663	-0.77203	86981	-0.8	74170.38	-3.63	0.2	0.09
2006	16.6	5926	1.180369	18292	0.7	963783.4	2.66	0.8	1.8
2007	21.6	74908	-0.46686	71314	0.3	1512141	1.18	-0.1	0.1
2008	18.3	58739	0.211506	53697	-0.2	648612.2	2.93	0.31	0.04
2009	8.5	86505	-0.53225	60999	-2.2	-847825	3.87	-0.3	-0.36
2010	8.3	-2142	0.310771	10008	-4.7	1168466	-2.78	-0.37	-0.31
2011	10.9	31500	-0.31032	25019	4.5	340074.2	-3.16	0.01	-0.32
2012	11.8	37050	0.345389	21660	0.2	132936.9	0.91	0.22	0.06
2013	12.2	31810	0.320798	27009	-1	1394823	0.74	0.12	0.16

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