UNIVERSITY OF KWAZULU-NATAL

An Analysis of Share Prices and Economic Activity in South Africa: An NARDL Approach

By

Thiasha Naidoo

215013353

A dissertation submitted in fulfilment of the requirements for the degree of Master of Commerce by research

School of Accounting, Economics and Finance

College of Law and Management Studies

Supervisor: Dr. Peter Brian Denton Moores-Pitt

2021

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DEDICATION

This dissertation is dedicated to my sister, Thiara Naidoo. May this serve as a source of inspiration and a lesson in ambition that if you reach for the stars, anything is possible.

ACKNOWLEDGEMENTS

"If I have the belief that I can do it, I shall surely acquire the capacity to do it even though I may not have it in the beginning."

~Mahatma Gandhi

A number of people have contributed greatly in my journey to complete my Master's degree over the past two years. I extend my heartfelt appreciation for all their guidance and support. This journey has experienced its hurdles and moments of bliss, and I certainly would not have successfully reached the end without the love and encouragement from my family.

First and foremost, my greatest gratitude goes to my Creator for blessing me with knowledge, good health, resources and the ability to undertake my Master's degree.

My sincere gratitude and heartfelt appreciation are extended to my supervisor, Dr. Peter Moores-Pitt for his unwavering guidance, academic support and helping hand in the development of this dissertation. The confidence that he has shown in my ability throughout this journey has been invaluable. I am extremely grateful for his assistance, patience and academic advice. Thank you.

To my parents, Vini and Deena Naidoo, thank you for always supporting me and being the driving force in my life and my career. Without your love, numerous sacrifices and constant motivation none of this would be possible. Throughout my life, you have both actively supported me in realising my potential and pursuing my dreams. My gratitude and appreciation extend far beyond this dissertation.

To my sister, Thiara Naidoo, thank you for being my emotional pillar of support and best friend through the good and the bad days. I am extremely grateful for having you by my side during this journey.

ABSTRACT

An integral component of economic activity rests on the performance of share prices as it influences consumer and business confidence which in turn affects the performance of the overall economy. The progressive characteristics of share prices and its successive role as an indicator of economic growth has been widely documented in advanced and developing economies such as South Africa but with evidence allowing for nonlinearity and asymmetric movements, being less predominant. The key objective of this thesis is to re-examine an existing issue by using a more complex method of analysis to determine whether fluctuations in the stock market influence the economic growth in South Africa. This study assesses share price fluctuations and its impact on economic growth, with the aim of identifying the nonlinearity and asymmetric effects in the relationship by taking into consideration a primary and sectoral analysis, within a South African context.

As such, this study utilised various different methodological techniques that established cointegration; identified the existence of structural breaks; detected long and short-run relationships and determined the effects of nonlinearity and asymmetric adjustments between the stock market and economic activity, covering the period of 1999 to 2019. It was established that the relationship between economic growth and stock prices exhibit evidence of structural breaks. Furthermore, it was concluded that there is a strong link between the stock market and economic activity with the 2007/2008 global financial crisis.

Most importantly, this thesis intended to determine the nonlinearity and asymmetric impacts that stock market fluctuations have on economic activity in South Africa. It was exhibited that there is evidence of strong nonlinear cointegration in the relationship. Additionally, there is a strong presence of nonlinearity and asymmetric adjustment in the relationship between stock market fluctuations and economic activity. Therefore, this study concluded that there is strong evidence of nonlinearity and asymmetric adjustment in the cointegrating relationship and depicted that economic growth is sensitive to stock market fluctuations in South Africa, which represents a novel contribution to the literature.

Keywords: Nonlinearity, Asymmetric adjustment, NARDL model, Economic growth, Share prices

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LIST OF ACRONYMS

ADF:	Augmented Dickey-Fuller
AIC:	Akaike's Information Criterion
ALSI:	All-Share Index
APT:	Arbitrage Pricing Theory
ARDL:	Autoregressive Distributed Lag
CPI:	Consumer Price Index
CUSUM:	Cumulative Sum of Squares
DDM:	Dividend Discount Model
DPS:	Dividend Per Share
EBIT:	Earnings Before Interest and Tax
ECM:	Error Correction Model
ECT:	Error Correction Term
EFP:	External Financial Performance
EMH:	Efficient Market Hypothesis
EPS:	Earnings Per Share
EVA:	Economic Value Added
FCFE:	Free Cash Flow to Equity
FCFF:	Free Cash Flow to the Firm
FDI:	Foreign Direct Investment
FINI:	Financial Index
FPE:	Final Prediction Error
GDP:	Gross Domestic Product
HQIC:	Hannan-Quinn Information Criterion
IFP:	Internal Financial Performance
INDI:	Industrial Index
IP:	Industrial Production

IPO:	Initial Public Offering
JSE:	Johannesburg Stock Exchange
LR:	Likelihood Ratio
MEC:	Marginal Efficiency of Capital
NARDL:	Nonlinear Autoregressive Distributed Lag
NBFI:	Non-Bank Financial Institution
NPV:	Net Present Value
OLS:	Ordinary Least Squares
P/E:	Price/Earnings
PP:	Philips-Perron
RESI:	Resource Index
RGDP:	Real Gross Domestic Product
ROA:	Return on Assets
ROE:	Return on Equity
SBIC:	Schwarz’s Bayesian Information Criterion
StatsSA:	Statistics South Africa
SVAR:	Structural Vector Autoregression
US:	United States
VAR:	Vector Autoregression
VECM:	Vector Error Correction Model
WACC:	Weighted Average Cost of Capital
YoY:	Year-over-Year

CHAPTER 1: INTRODUCTION

1.1. Background

1.1.1. The Stock Market and Economic Growth

A wide-ranging intellectual understanding of the degree in which the stock market encompasses information regarding economic activity exists and therefore, upholds the theory that the stock market could be a substantial indicator of the rate of growth of an economy (McLeod, 2018). Economic predictions are crucial to the invention of monetary policy from a macroeconomic perspective (Ahmad and Aworinde, 2016). Preceding studies have been able to confirm the validity of the forward-looking nature of share prices; however, a large majority of these studies overlooked the need for a nonlinear method of analysis and asymmetric adjustment, in South Africa.

The theory of economic growth exhibits the idea of economic factors which ultimately determine the rate in which the level of production of an economy is developing, and along these lines contribute as to why some economies grow quicker than others (Peterson, 2017). The critical factors which boost economic growth within a country can be displayed in the population density, flow of innovation and invention and more traditionally, the supply and demand factors (Zahonogo, 2016).

$$Economic\ Growth = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}} \tag{1.1}$$

Where:

- GDP = Gross Domestic Product of a nation

The economic growth of a country is measured by the selling power of industries, the purchasing power of consumers as well as the rate of supply and demand for goods and services. In the event of businesses booming and consumers spending, with a constant low rate of inflation, this phenomenon expands the economic rate of growth of an economy (Adam, 2015). Economic momentum is the propensity of the continuous level of growth in an economy due to positive investor sentiment and confidence as well as consumer spending, providing an appropriate environment for business growth. The momentum declines when consumer spending and business investments are significantly reduced (Gruss, 2014).

The impact of inflation on the stock market is a critical factor when investors want to earn a higher return. The stock market is less attractive to investors when there is an increase in inflation due to income deterioration as a result of the decreasing value of money (Valcarcel, 2012). Moreover, a higher inflation rate brings about higher costs to investors who utilise leverage or exert limits to capital flows into the stock market. Since firms are worsened off by inflation and coupled with escalating costs, this exacerbates the expected profits which negatively affects stock prices (Bandura, 2020). Therefore, resulting in inflation having a negative impact on the stock market.

The theoretical rationale behind economic activity can be built on stock price concepts such as the traditional model of stock valuation as well as the theory of wealth effect (Weyl, 2019). The traditional stock price valuation model specifies that share prices signify economic potential for the future (Burgstaller, 2002). The wealth effect is a behavioural economic theory which postulates that consumer expenditure substantially increases when the performance of the overall portfolio is high (Armantier, Foncel and Treich, 2018). If the stock market rises, investors are equipped to invest more as they are more affluent, hence the economy is growing. In contrast, when stock prices decline, investors are less affluent and spend less (Foresti, 2006). Thus, with the essential valuation models, stock prices are determined on the basis of the expectations of the real economy whilst the wealth effect states that instabilities in the real economy result due to alterations of the stock prices. Although the derivation is different in the two models, they both imply that the stock market predicts the state of the economy (Comincioli, 1996).

The Price Theory stipulates that stock prices signify future company profits. An important aspect of GDP (Gross Domestic Product) is corporate profit, which comprises of consumer investment and consumption. Therefore, the progressive nature of stock prices indicates that stock prices are of value when measuring economic activity (Weyl, 2019). The stock market is viewed as a measure of the performance of an economy, where the stock price affects the rate of growth of that economy. A stock price increase provides a stimulus to firms and households and reduces the uncertainty of any future economic situations that could arise. Similar to cost of equity, a lower cost of capital increases the present value of a company's future cash flows, which can result to higher stock prices (Agrawalla and Tuteja, 2008).

The stock market index comprises of all the stocks on the market and assists investors in comparing the current price levels with past prices in order to calculate the market performance. As the stock price of each firm is affected by economic circumstances, the stock market index is similarly affected by macroeconomic and microeconomic factors (Ahmad and Aworinde, 2016). The stock exchanges are projected to accelerate economic growth by making global risk diversification smoother for investors, increasing liquidity of financial assets and by promoting efficient investment choices by surplus spending units based on available information (Gruss, 2014). Therefore, this allows the channelling of more savings into corporations and allows firms to pursue the best interests of shareholders. In theory, a proficient stock market assists in the development of economic growth through the efficient allocation of resources, the growth of savings and alluring foreign portfolio investments (Agrawalla and Tuteja, 2008).

Amidst the macroeconomic factors discussed above, the money supply is observed as a reassurance for stock market growth. With an expansionary monetary policy, the interest rate is lowered, firms and investors can easily access capital which increases spending and therefore enhances the stock market (Thornton, 2010). On the other hand, a contractionary monetary policy occurs when the money supply declines or the interest rate decreases thereby hindering the stock market. A change in the money supply is deemed to be a key factor of the driving force behind the macroeconomic performance of a country (Chwieroth and Walter, 2019).

1.1.2. The Impact of Trade Imports and Exports on Economic Growth

In South Africa, economic growth has been severely low due to a decrease in capital investment and local companies investing abroad over a period of 19 years, ranging from 2000 to 2019 (Evgenidis, Papadamou and Siriopoulos, 2020). This is a result of Foreign Direct Investments (FDI) as companies pursue cheaper resources and factors of production endowments abroad which further decreases the rate of economic growth in South Africa (Moller, 2007). There are various studies that depict the link between trade components namely; imports, exports, trade restrictions, FDI and growth. The study by Moller (2007) revealed that economies that are open to trade, result in a higher GDP per capita and therefore grow rapidly.

Exports and imports play a pivotal role in many economies and the exchange rate is of the essence. With an appreciation in the exchange rate, domestically produced goods become cheaper and therefore exports are enhanced as the exporting firm's performances have grown, whilst the imports experience hurdles and hinders the stock market (Evgenidis *et al.,* 2020). The incremental exchange rates also entice capital flows from foreign investors into the stock market (Ponce and Alvarado, 2019). Trade exports and imports account for approximately 65 percent of goods and services produced in South Africa, which is also known as GDP (Chipeta and Meyer, 2018). Trade forms part of an essential sector in the economy to promote growth and increase performance. The increase in exports creates opportunities for South African producers while increasing economic growth (WTO, 2020). Similarly, increasing imports will enhance equipment and increase the production of raw materials to manufacturers.

Trade openness has a substantial influence on a country's economic growth due to the various diverging channels such as technological transfers, competitive advantage and a rise in economies of scale (Ponce and Alvarado, 2019). This reveals that trade openness has an advantageous effect on GDP and as a result, trade liberalisation accelerates economic growth as countries have the capability to enter foreign markets without difficulty. According to Ynikkaya (2003), the empirical results presented that for both developing and developed countries, trade openness has a positive effect on accelerating the growth of GDP. The changes to economic growth due to trade have affected the commercial flows and economies worldwide by impacting the performance of capital flows in the financial system (WTO, 2020).

1.1.3. The Banking Sector and Economic Growth

In South Africa and amongst various other countries, banks are the largest principal holders of financial assets and thus play an essential part in the growth of an economy in a country (Okeahalam, 2015). Moreover, the constancy of the economy tends to be significantly impacted by the performance of banks. The South African banking sector takes into account more than 20 percent of GDP and is the third largest employer in the country (Wooldridge, 2017). As a significant component of the financial system, the allocation of reserve funds from lenders to borrowers flows in a streamlined manner and assists in making the overall economy more efficient (Moyo, 2018).

Several studies such as the study conducted by Senbet and Otchere (2010), have investigated the performance of the banking sector to measure the growth of the South African economy. These particular studies have focused on the quantitative methods for evaluating relative efficiency. Similarly, a recent study by Kumbirai and Webb (2015) assessed the South African banking performance by using simple descriptive financial ratio analysis and found that the banking sector does in fact lead to economic growth in South Africa. The stock market and financial system as a whole is therefore crucial due to the perceived benefits it provides to the economy which leads to economic growth. Drawing on this notion, the stock market is the central point for capital market activities and it is often referred to as an indicator of economic development and business direction which leads to an increase in the economic growth of a country (Adam, 2015).

1.1.4. Linear vs. Nonlinear Relationship

The term nonlinearity is utilised to describe two or more variables that do not have a direct affiliation with one another. Therefore, in a nonlinear relationship there is no direct relationship between an independent variable and a dependent variable (Gabaix, 2007). In a nonlinear relationship, the changes in output does not change in direct proportion to a change in inputs. On the other hand, a linear relationship refers to a direct relationship between an independent and dependent variable (Deidda and Fattouh, 2002). Thus, a change affecting an independent variable will produce a corresponding change to the dependent variable. In econometric analysis, a linear relationship produces a straight line when plotted on a graph whereas a nonlinear relationship creates a curve instead of a straight line (Nkoro and Uko, 2016).

Nonlinearity is a profound issue when examining cause and effect relationships. These cases often entail complex modelling and regression analysis to deduce rational explanations of these nonlinear events (Nkoro and Uko, 2016). The use of nonlinear regression is commonly used in the financial industry to model nonlinear data against independent variables in an attempt to explain their relationship. Even though the parameters are nonlinear, nonlinear regression can fit data by utilising methods of successive approximations to offer explanatory outputs (Jude, 2010).

Thus, nonlinear regression models are more complex than the typical linear models due to the considerable trial-and-error undertaken to define the outputs. However, the regression is a vital tool for investors who are attempting to determine the potential risks associated with their investments created on different variables (Gabaix, 2007). The nonlinear regression analysis conducted in this study will serve as an essential tool in examining the nonlinearity affects in the relationship between share price fluctuations and economic growth in a South African context.

1.2. Problem Statement

In South Africa, the significant attributes of stock prices and their succeeding purpose as substantial indicators of economic growth has been analysed and discussed however, without taking into account nonlinearity and asymmetric effects amongst the respective variables examined, in the context of this study. Furthermore, limited research can be found as to whether nonlinearity and asymmetric adjustment play a key role in analysing how economic growth is affected by changes in the South African stock market.

This study will be considering nonlinear techniques to explore the relationship between share prices and economic activity in South Africa. This study will account for nonlinearity and asymmetric adjustment in the relationship by utilising the NARDL model and will be the novel contribution to the analysis of this study. If the empirical results indicate that the positive and negative coefficients of the variables are different in magnitude, this will exhibit that there is evidence of asymmetry and will be a crucial supplement to literature. Moreover, there is a gap in South African literature due to studies only conducting linear tests with the use of linear models in this context. This study will assist in filling the literature gap by conducting this research topic in South Africa and making use of a nonlinear model, the NARDL model.

The methodology of this study will comprise of a primary analysis of the overarching relationship between the Johannesburg Stock Exchange (JSE) All-Share Index (ALSI) and GDP. Thereafter, a sectoral analysis will be conducted to account for stock market segmentation comprising of the Industrial 25 Index (INDI), the Financial 15 Index (FINI) and the Resource 10 Index (RESI) on the JSE. Taking the literature into account, these particular variables were selected for this study to accurately reflect economic growth and account for stock market segmentation on the JSE in South Africa. Given the nature of these variables, it is expected that there will be evidence of nonlinearity and asymmetric adjustment in the underlying relationship; however, since a study of this magnitude has not been conducted before in a South African context, the empirical evidence will provide novel results.

Additionally, in order to determine whether structural breaks exist in the relationship that could have detrimental impacts on the results obtained, structural break testing will be conducted which also takes cointegration into account in the underlying relationship. The analysis will be conducted for comparative purposes since South Africa could have substantially different relationships to a developed country due to the exceptionally turbulent macroeconomic situations experienced over the last few decades (Gumata and Ndou, 2019).

1.3. Research Objectives

The core research objectives that guide this study are specified as follows:

1. To investigate whether cointegration exists between share price fluctuations and economic growth in South Africa.
2. To investigate how fluctuations in the stock market affect economic growth in South Africa (and vice versa).
3. To determine whether the relationship between economic growth and the stock market returns exhibit asymmetric adjustment.
4. To determine whether the relationship between economic growth and the stock market returns exhibit evidence of structural breaks.

1.4. Research Questions

In pursuit of the research objectives, answers to the following questions will be therefore be sought after:

1. Does a cointegrating relationship exist between stock market returns and economic growth in South Africa?
2. How do fluctuations in the stock market affect economic growth in South Africa (and vice versa)?

3. Does the relationship between economic growth and stock market returns exhibit evidence of asymmetric adjustment?
4. Does the relationship between economic growth and stock market returns exhibit evidence of structural breaks?

1.5. Justification and Methodology of This Study

The main purpose of this study is to re-examine an existing issue introduced by Sayed *et al.* (2017) and employ a more complex method of analysis by taking into account nonlinearity and asymmetric effects in the relationship, which has not been examined in literature thus far. Hence, this thesis will be the novel contribution to South African literature. The nonlinear ARDL approach will be utilised to examine whether stock market fluctuations have an impact on economic growth in South Africa.

This study comprises of a primary and sectoral analysis which utilises the sample period ranging from January 1999 to December 2019 respectively. The ALSI will be used as the stock market proxy to examine the principal relationship between the stock market and economic activity. The data employed for GDP will be attained from the Reserve Bank of South Africa Bulletin and Statistics South Africa (StatsSA) respectively and will be adjusted for inflation to obtain real GDP (RGDP). Furthermore, the sectoral indices will be utilised in this study to incorporate stock market segmentation on the JSE which comprise of the variables: INDI, FINI and RESI. The collected share price statistics are adjusted by employing the consumer price index (CPI) to deflate the prices of shares and thereafter, a Year-over-Year (YoY) rate change is calculated to display the data in real terms (Sayed *et al.,* 2017). The stock market proxies will be obtained from McGregor BFA library and the JSE.

Furthermore, a detailed analysis of the data will be conveyed to elaborate on the factors that affect the co-movement of share prices and economic activity. The data analysis will be based on the methodology which is divided into of three parts. Part A is comprised of preliminary testing containing the optimal lag length selection, a VAR analysis and testing of nonlinear unit roots by utilising the modified Augmented Dickey-Fuller (ADF) tests. Part B comprises of testing for cointegration while accounting for structural breaks in the relationship by utilising the Zivot-

Andrews unit root tests, the Gregory-Hansen cointegration tests and Bai-Perron structural break tests. Lastly, Part C is incorporated of testing for cointegration while accounting for asymmetric adjustment in the relationship. The NARDL model will be employed to demonstrate the nonlinearity effects when the assumption of linearity is relaxed. Moreover, parameter instability will be examined by means of a CUSUM test as well as residual diagnostic tests for heteroscedasticity and serial correlation will be conducted to determine the residual variance. Therefore, these various methodological techniques will aid in analysing the how fluctuations in the stock market affect economic growth within the South African environment.

1.6. Structure of This Study

This study consists of five chapters, which are outlined below:

- **Chapter 1: Introduction**

This chapter provides a background on the issues discussed in the study and posits the justification for an analysis of this magnitude within the South African environment. The specific research problem, objectives and questions are then outlined in detail which is followed by a summary of the time period and data that is employed in this study.

- **Chapter 2: Literature Review**

The following chapter builds on the theoretical and empirical concepts of share prices and economic activity. The first part of this chapter comprises of the conceptual framework and will establish a basic understanding of the theoretical components relating to share price fluctuations and economic activity. The second part of the chapter contains an in-depth review of the empirical literature surrounding this topic. This is sub-divided according to an international and South African perspective and is the foundation upon which this particular study is based. This information also serves as a comparison when evaluating the results produced.

- **Chapter 3: Methodology**

Chapter 3 explains the research method employed in this study which comprises of a discussion on the selection of data, sample period, variables to be used and method of obtaining the data. This is followed by a justification of why these methods were chosen. A broad explanation of the method used is given, together with steps involved in developing each of the models.

- **Chapter 4: Data Analysis and Results**

This chapter analyses and discusses in-depth, the empirical results obtained from each of the methodological techniques applied in this study. A detailed discussion of the empirical results as well as suitable conclusions are drawn.

- **Chapter 5: Conclusion and Recommendations**

This final chapter concludes and contains a summary of the whole study and empirical results obtained. Chapter 5 provides answers to the research questions posed and draws conclusions from the data analysed. The final section of this chapter outlines probable weaknesses of this study and provides recommendations for further research in this area.

CHAPTER 2: LITERATURE REVIEW

2.1. Overview

There are various theoretical foundations encompassing the relationship between stock prices and economic activity. A review of these foundations promotes in establishing the magnitude and effect of the relationship on a specific sector or the South African stock market as a whole (McLeod, 2018). The first section of this chapter therefore looks at the theoretical aspects in detail and outlines the theoretical constructs of each, in which the financial environment is examined.

In South Africa, the past two decades has witnessed periods of financial crisis and extreme market movements (David and Veronesi, 2016). Frequently, such periods are linked with the idea of increased co-movement amongst financial markets and question the stability of the financial environment and portfolio diversification benefits. Therefore, the examination of co-movement is vital to access the efficiency and effectiveness of diversification and the functioning of the financial market as a whole (Weyl, 2019). Moreover, the concept in which share prices exhibit co-movement with economic activity can be supported by several theories and will be discussed in the first section of this chapter.

The second section of this chapter reviews the empirical research that has already been done and focuses on the methodologies employed that will form a basis on which this study can be developed. The concept in which share prices co-move with economic growth in South Africa can be supported by various empirical evidence. The first sub-division discusses the empirical literature of studies that investigates the relationship between share prices and economic activity. These studies comprise of data from both a South African and international perspective, focusing on linear models and indicating why linear models are substandard to the nonlinear model. The second sub-division is comprised of a comprehensive review of studies that utilised the NARDL model however, these studies are limited and have not been conducted in the context of this thesis. This indicates a gap in literature from both an international and South African perspective which will be fulfilled by this thesis.

2.2. Theoretical Evidence

The notion in which share prices co-move with economic activity can be supported by multiple theories.

2.2.1. A Discussion of Nonlinearity

The econometric analysis of time series has suggested that a long-run relationship exists between the variables examined. More often than not, researchers have disregarded the essential characteristics of time series while analysing and formulating the traditional regression models (Deidda and Fattouh, 2002). It is presumed that a long-run relationship is exhibited and the underlying time series is stationary around a deterministic trend. Therefore, it is the norm to formulate the econometric model in the conventional way by presuming that the variables do not depend on time and that the means and variances are constant (Gabaix, 2007).

However, it has been revealed that different time series may not display the same features as others. It is probable for some time series to diverge away from their mean over time while on the other hand, the others may converge to their mean over time. The time series that diverge from its mean is deemed nonstationary thus the traditional estimation of variables in this affiliation provides misleading or spurious regression results (Luukkonen, Saikkonen and Teräsvirta, 1988). Therefore, econometric analysis has moved towards the aspect of cointegration in order to overcome this phenomenon. This is due to cointegration being a key tool in the detection of a steady state amongst the variables employed. Hence, cointegration has been a vital requirement for any econometric model that makes use of nonstationary time series data (Hansen, 1999). If the employed variables do not cointegrate, there will be issues of a spurious regression making the results inadequate but if the variables are cointegrated this introduces the phenomenon of cointegration which results in a steady state in the regression (Gabaix, 2007).

When examining the cause and effect of the relationship between two more variables, the phenomenon of nonlinearity is a common occurrence. It is the term used in literature to describe a situation where there is no direct affiliation amongst an independent and dependent variable (Nkoro and Uko, 2016). Nonlinearity requires intricate regression modelling and hypothesis testing to explain its occurrence and can therefore lead to volatile outcomes. Hence, in a nonlinear relationship, there is no direct proportional change to the output for a change in the given inputs (Jude, 2010).

On the other hand, a linear relationship is a direct correlation amongst the dependent and independent variables. As a result, a change that affects the independent variable will generate a corresponding change to the dependent variables thus creating a direct relationship amongst the variables (Deidda and Fattouh, 2002). This relationship can therefore be expressed as a straight line whereas nonlinearity cannot. Consequently, the phenomenon of nonlinearity can lead to wrong conclusions if linearity is the point of focus (Jude, 2010).

Investors make use of nonlinearity to examine benchmark returns. Return market options are suggested to be nonlinear deviations due to the input variables not guaranteeing a proportional change in the output variables (Ketteni, Mamuneas, Stengos, and Savvides, 2007). Thus, nonlinearity in trade can create concavity in the returns of a firm, making it unpredictable. Investors in the financial industry apply the nonlinear regression model to examine nonlinear data against the dependent and independent variables in order to display the relationship. Even though the parameters are nonlinear in the regression, the model employs successive estimates to fit the data (Ketteni et al, 2007).

If a country has a consistently high rate of economic growth, the stock markets will generally perform better than in a country with lower rates of economic growth. Therefore, indicating that the relationship may not be perfect but there is correlation (Ketteni et al, 2007). Moreover, in some cases, it is argued that the stock market does affect the economy. This can be seen in the Wall Street stock market crash of 1929 (Jude, 2010). The rapid decline in the stock markets drastically affected businesses and consumer confidence. The crash is viewed as a factor in contributing to the length and severity of the Great Depression in 1929. Therefore, postulating that there is a direct relationship between the stock market and economic activity (Jude, 2010).

However, the stock market does not always directly affect the economy. The fall in share prices can be due to many reasons other than a recession. More often than not, a fall in share prices stipulate that there is no correlation with the economy (Mishkin, 2009). It could be a correction of over-valued prices or a change in market sentiment. On Black Monday in 1987 the stock markets crashed globally. However, this didn’t precipitate a recession like previous stock market crashes.

Economists have attributed the crash to a combination of geopolitical events and the dawn of computerized program trading that initiated the selloff (Akinboade and Makina, 2010).

This thesis will make use of a nonlinear regression analysis to test for nonlinearity and asymmetric adjustment in the relationship. The NARDL model will serve as a vital tool to examine the nonlinearity affects in the relationship between share price fluctuations and economic growth in this study, and will be the key contributing factor to South African literature.

2.2.2. Supply-Leading and Demand-Following Hypothesis, Linked to Stock Pricing

In theory, the law of supply and demand explains the affiliation between the availability and the desire of a product. This law influences the South African stock market by determining the prices of the individual stocks that make up the market (Chinzara, 2011). Therefore, the South African stock market is driven by forces of supply and demand. The higher the demand of a stock, the higher the price drives and vice versa (Dunne, Nikolaidou and Roux, 2000).

Stock prices fluctuate daily due to market forces. If investors place a high demand on the price of a stock, the price increases. On the contrary, if investors wanted to sell stocks rather than buy, there would be a greater supply than demand and the stock price would fall (McCombie and Thirlwall, 2016). This indicates that supply and demand play a significant role in the economy as it impacts the price of stocks as well as the price of consumer goods and services. Eventually, supply and demand balance out at a specific point called the equilibrium price (Karimo and Ogbonna, 2017).

A rewarding Initial Public Offering (IPO) focuses on consumer demand for firm's shares and a strong demand for the firm's stocks leads to a higher stock price. While in theory, an IPO is valuated at a price equal to its projected upcoming dividend payments, the price essentially fluctuates based on factors of supply and demand (Chow, Sheung Chi, and Vieito, 2018). The movements of stock prices indicate what investors essentially feel the stock price is worth and does not only reflect the firm's current value but also the firm's future prospects. A firm will undertake an IPO in order to raise capital and not necessarily when their stock is in demand. Furthermore, the demand for stocks of unlisted firms is difficult to determine as these firms do not report their financials publicly and are not listed on any stock exchange (Chinzara, 2011). As a result, equity valuation is essential for determining firm valuation.

The financial sector is essential for providing services that are vital to the growth of an economy namely, financial intermediation, reduction of transaction costs and the possibility for diversification (McCombie and Thirlwall, 2016). The primary function of the financial sector is the movement of financial resources between the various different units in an economy through the method of financial intermediation. Financial intermediation can be referred to as the process of channelling funds between economic agents with surplus funds and those with a lack of funds (Odhiambo, 2007). The economy suffers if the financial sector is not efficient and an efficient financial sector can only transpire if there is financial development occurring within it.

According to Tadesse and Abafia (2019), economic growth is dependent on how efficiently the financial sector is developed. As the financial sector develops, this therefore leads to an increase in the supply and demand of financial services. The path through which financial development promotes economic growth can be further explained by the supply-leading hypothesis. The supply-leading hypothesis stipulates that causality moves from financial to economic growth and as a result, there is no response from economic growth (Dunne *et al.,* 2000). A pre-condition for economic growth is a carefully developed financial sector as it suggests that causality flows from economic growth to financial development.

Economists such as Blackburn and Hung (1998), Davis (2004) and Ruiz (2018) affirm that financial development is an essential condition for achieving a high rate of economic growth. Patrick (1966) refers to this as the "supply-leading" role of financial development. The supply-leading hypothesis asserts that financial development causes real economic growth. On the contrary, a distinct opposing viewpoint emerged in literature, in which Patrick (1966) refers to as the "demand-following" role of financial development. The demand-following hypothesis argues for a reverse ordering from real economic growth to financial development.

Therefore, the financial sector is important in forecasting economic growth and can be characterised into two key opposing viewpoints. Schumpeter (1934) and Patrick (1966) firstly highlighted the importance played by the financial sector within the economic development process. Robinson (1952) secondly measured financial systems as a fundamentally important factor for the growth process. These two viewpoints were then presented by Patrick (1966) as two models for the monetary turn of events and financial development. The supply-leading model is the first model and postulates that established financial markets enhances economic growth. This is because when the economy develops, new requests for monetary administrations are produced and along these lines the money related framework will develop (Tadesse and Abafia, 2019). The supply-leading model therefore recommends that financial improvement empowers economic development and positively affects the development of an economy (Dunne *et al.,* 2000). The vital role that financial development plays in economic growth has been highlighted in related capital structure theories.

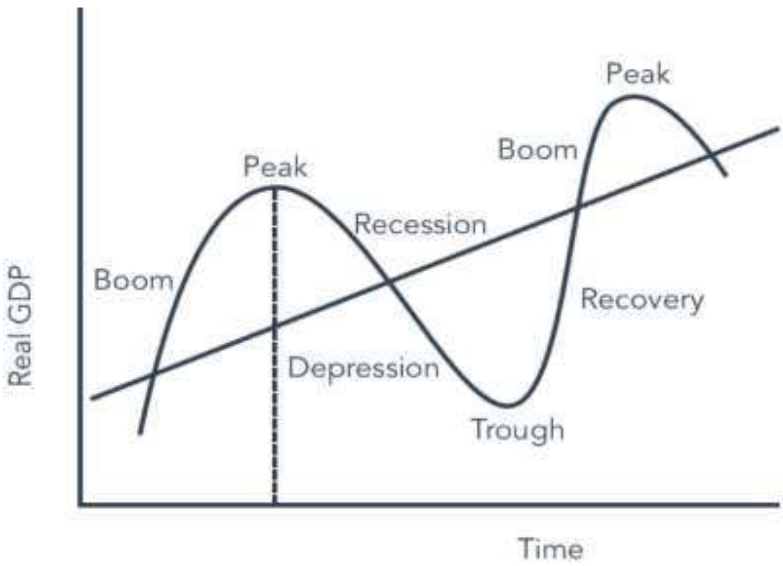
The second model is the demand-following model in which Patrick (1966) presented and emphasised that this particular model forecasts the design of modern financial institutions and services. This is established to respond to a demand for these services provided by investors. Therefore, the development in the financial sector is the outcome of real economic growth (Patrick, 1966). Moreover, developing countries like South Africa are more susceptible to financial repression which in turn hinders economic growth.

Therefore, in principle, a financial market that is well-developed increases savings and effectively allocates capital to productive investments, which leads to an increase in the rate of economic growth (Dunne et al., 2000). A developed financial market plays a key role in the growth and efficiency of the economy which facilitates the accumulation of capital and contributes to the production of goods and services (Tadesse and Abafia, 2019).

2.2.2.1. The Business Cycle

In economic theory, the business cycle is referred to as a cycle of fluctuations of a country's GDP around its long-term natural growth rate. It stipulates the expansion and contraction in economic activity that is experienced over time by an economy (Angeletos, Collard and Dellas, 2020). In the business cycle, a single boom is characterised by rapid economic growth and a single contraction is characterised by relatively stagnant economic growth in sequence (Agarwal, 2020). This is measure of a country's RGDP which is inflation adjusted.

The business cycle is an important factor for the stock market as economic activity creates an economic expansion which increases lending and borrowing in the financial sector. Therefore, this results in increased corporate profits which are vital to higher stock prices. Furthermore, during periods of expansion, inflation often declines as demand and sentiment increases (Akinboade and Makina, 2010). The graph of the business cycle is represented by the cycle in Figure 2.1.



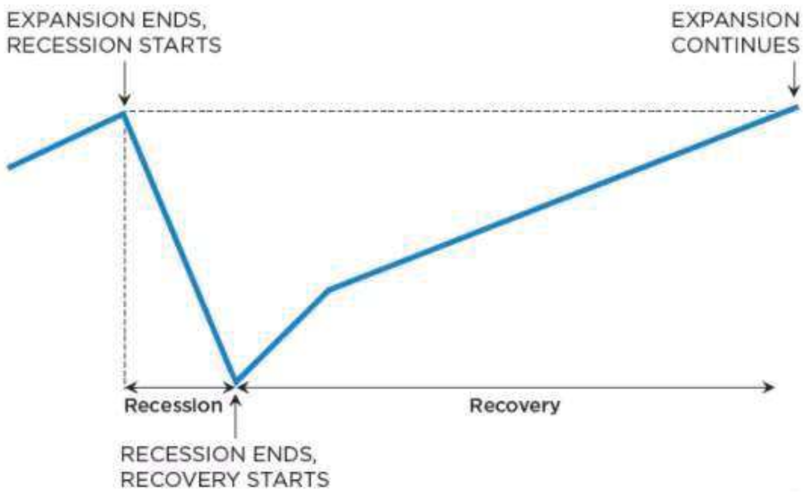
(Source: Agarwal, 2020)

Figure 2.1: Graph of the Business Cycle

According to Keynes (1940), to face the sudden changes brought about by a cyclical shock in the economy, the occurrence of the business cycle is triggered by variations in the rate of investments caused by fluctuations in the marginal efficiency of capital (MEC) and aggregate demand (Angeletos *et al.,* 2020). Keynesian economics stipulate that the business cycle is periodic fluctuations of employment, income and output which brings the economy to short-term equilibriums and are different from full time employment (Konstantakis, Michaelides, and Mariolis, 2014). Keynesian economics brings a novel focus on the use of active government policies to manage aggregate demand and prevent economic recessions. This presented a new way of looking at expenditure, output and inflation in contrast to classical economic theory which stated that cyclical swings in employment and economic output would be self-adjusting (Akinboade and

Makina, 2010). Furthermore, Keynesian models essentially do not specify that business cycles are periodic but imply cyclic responses to shocks via multipliers (Angeletos *et al.,* 2020). The extent of the fluctuations is dependent on the investment levels due to it being the determinant of aggregate output.

A recession is characterised by a cycle of declines in employment, output and income (Konstantakis *et al.,* 2014). This domino effect is critical to the dispersion of a recession across an economy and drives the co-movement amongst the coincident economic indicators and the persistence of the recession. In contrast, a recovery commences when the recessionary cycle converts to a virtuous cycle, with the increasing output level triggering employment and leading to a rising level of income (Boshoff and Du Plessis, 2020). This phenomenon can be explained in Figure 2.2 below:

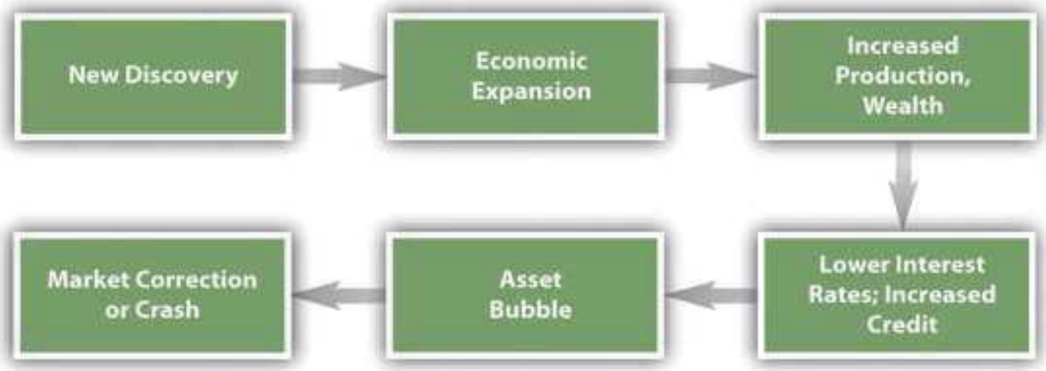


(Source: Boshoff and Du Plessis, 2020)

Figure 2.2: Graph of Expansion and Recession in a Business Cycle

In the South African market economy, the phenomenon of economic crisis has been frequently observed in recent decades which were accompanied by extensive economic turbulences and challenged the market position of many firms (Akinboade and Makina, 2010). The economic factors and financial behaviour can coincide to create extreme market fluctuations or financial crises namely; booms, bubbles, stock market crashes, or meltdowns (Schmitz, 2012). The

2007/2008 financial crisis in South Africa had a rigorous negative impact on the economic state of the country. This can further be explained by the pattern of financial crisis in the Figure 2.3 subsequently.



(Source: Schmitz, 2012)

Figure 2.3: The Pattern of a Financial Crisis

A period of economic expansion is initiated by new technology, a shift in political balances or a discovery of a new resource. Therefore, this leads to increased markets, wealth, production, consumption and investments as well as increased credit and lower interest rates (Akinboade and Makina, 2010). Consumers and investors therefore look to invest their newfound wealth and this ultimately leads to an asset bubble which is characterised by a rapid increase in the price of stocks, bonds and commodities (Mishkin, 2009). Consequently, once this bubble "bursts", it results in a stock market crash and individuals lose money as the economy goes into recession.

Innovation outputs are regarded as the measurement of the extent in which ideas from the innovative sectors are able to reach the market and as a result, provides better job opportunities and a competitive advantage (Moolman, 2004). Even though the economic growth has stabilised, the recovery of an economy is a fragile process and unexpected cyclical shocks could lead to another recession. The increasing unemployment rate has placed a dampening and great demand on state resources and revenues contracted. As a result, there is ever mounting pressure on the economic state of the country (Allen and Giovannetti, 2011). This provides growth opportunities for some firms which as a result, generate a re-adjustment of the economy as a whole. Therefore, whilst firms adjust their innovation inputs to the ups and downs of the business cycle, output is not immediately affected. The firm must thus rely on the innovation output it has already present at the exact time the cyclical shock strikes in order to face the sudden changes brought about by a cyclical shock (Mishkin, 2009).

The basis on which the business cycle theory of Keynes (1940) rests is that firm innovation exerts positive growth stimuli onto the economy and without it, the economy would continue to remain stationary and not experience any change (Moolman, 2004). Therefore, it was argued by economists during the period of The Great Depression in the 1930's, that in the absence of innovation there would be no business cycle activity. In recent decades, the idea of firm innovation being an important factor for economic growth has been widely accepted by theoretical economists (Allen and Giovannetti, 2011). Thus, repeated firm innovation drives the economy forward and leads to continuous economic growth. With the economy growing, firm value increases and this brings about an increase in share prices thus exhibiting co-movement due to both economic growth and share prices being responsive to cyclical shocks (Moolman, 2004).

2.2.3. Stock Price Determinants

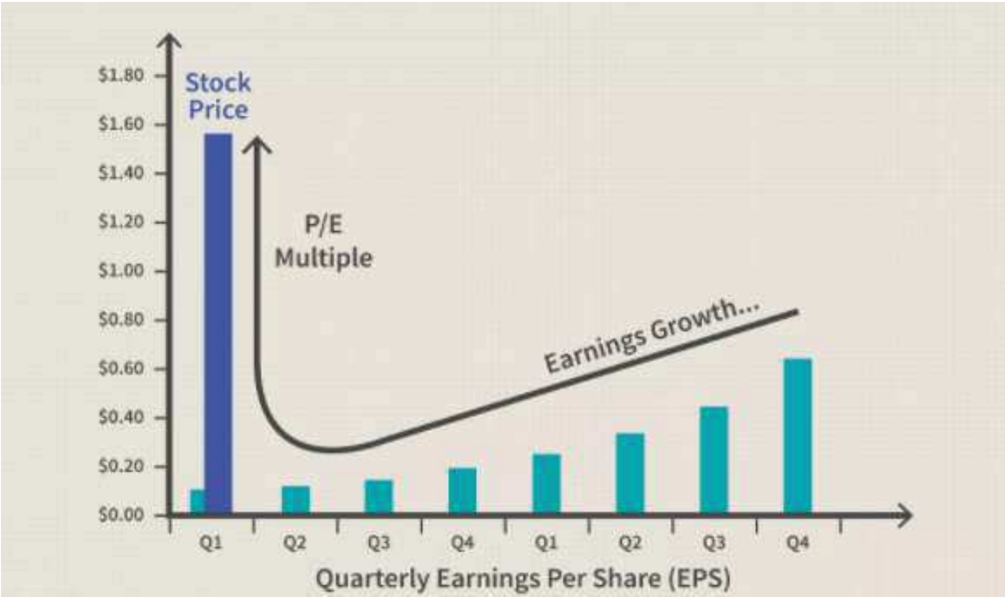
The earliest research of the stock market examined the idea as to whether there are patterns in share prices so that the future share price movements can be forecasted from its past movements (Tandon and Malhotra, 2013). The concept of stock prices originated from the 'random walk' theory presented by Fama (1990). This is a financial model which postulates that the stock market moves in an unpredictable way. This research was extended by Fama (1990) and suggested that there was very little or no correlation between the consecutive movements in share prices (Adhikari and Agrawal, 2014). This observation was termed the 'random walk' theory which stemmed from the walk of a drunken man as the direction could not be predicted. The hypothesis states that the projected stock price is independent of its own historical movement and the price of other securities (Tandon and Malhotra, 2013).

Following this theory, investors believe that due to delays in the stock market, the share price would move rapidly reflecting all available information but would move towards this new level over time, as information becomes dispersed (Adhikari and Agrawal, 2014). Therefore, this could happen gradually or rapidly but might not be instantaneous hence, there could be periods where profits could be exploited. This concept however is challenged in the Efficient Market Hypothesis (EMH) and states that prices adjust immediately to reflect all available information hence no investor can constantly outperform the market without taking on a higher level of risk (Eita, 2012).

Shiller (2000) specifies that there are explanations as to why the random walk behaviour of stock prices should hold and cannot be rejected, as there is evidence portraying that stock prices do follow a random walk. The findings by Shiller (2000) support the theory that stock prices are very uncertain however, this may not hold true due to the organisations' fundamentals having a great influence on stock prices. This argument is reinforced by an early rejection of the random walk theory by Niederhoffer and Osborne (1996) and Porterba (2000) who argue that there is very little theoretical basis for the hypothesis that stock prices follow a random walk.

The stock price could be determined on the basis of microeconomic and macroeconomic factors. The microeconomic factors include the book value of the firm, dividend per share, earnings per share (EPS), price-earnings (P/E) ratio and the dividend cover ratio. The macroeconomic factors comprise of economic growth, unemployment, inflation, interest rates and exchange rates (Gompers, Ishii and Metrick, 2003). The overall health of the economy has a significant impact on the stock market. When the economy is growing investors have the potential to expand and increase profits which in turn, increase share prices.

In an efficient market, the price of stocks would be determined by two fundamentals; the EPS or the price-earnings ratio (P/E). The shareholder has a claim to the earnings and the EPS is the return on the investment received (Tandon and Malhotra, 2013). Figure 2.4 displays the valuation multiple (P/E) ratio and represents the discounted pre-set value of forecasted earnings.



(Source: Investopedia, 2020)

Figure 2.4: The Discounted Present Value of Anticipated Future Earnings

Moreover, Fama and French (2002) use the regression of stock prices on the lagged firm EPS and deduce that it has explanatory power to the movement of stock prices. In addition, the association between the annual changes in stock prices and the annual changes in a firm's EPS have indicated that the annual changes in stock prices cause the firm EPS to change in the following year (Hordahl et al, 2007).

$$EPS = \frac{Total\ Earnings}{Outstanding\ Shares} \tag{2.1}$$

The EPS of a firm is a key factor for investors and individuals who engage in stock market trading. The higher the EPS of a firm, the better the profitability of that particular firm which makes it attractive to potential investors (Eita, 2012). Thus, the valuation of a firm's EPS is vital for economic growth as investors will pay more for a firm's shares if they presume that the firm has higher profits due to its share price (Tandon and Malhotra, 2013).

Drawing on this notion, the stock market is utilised to assist financial participants in coordinating the bid-ask spread which is essentially the difference in the bid and ask prices (Stenfors, 2018).

The bid price is the amount a buyer is willing to pay for a particular security and on the other hand, the ask price is the amount that a seller is willing to receive for that security. If the bid and ask prices are relatively close, this depicts that both parties convey a similar opinion (Balardy, 2018). However, if there is a large difference in the price, it portrays that there is a disagreement in the value of that security.

Volatility is a critical aspect that influences the bid-ask spread. Volatility generally rises during periods of rapid market decline or market progression (Stenfors, 2018). In the financial environment, the ask price is more often than not, slightly higher than the bid price. The bid-ask spread signifies the supply and demand of a specific asset, which may be comprised of stocks (Balardy, 2018). Furthermore, the bid price signifies the demand whilst the ask price signifies the supply. This spread increases when either the demand or supply outweigh the other. The stock price tends to influence the bid-ask spread as a lower stock price will lead to a larger bid-ask spread (Eita, 2012). Therefore, the valuation of stock prices is the key to successful investment decisions and is a critical factor in enhancing economic growth.

2.2.4. Equity Valuation

Firm development is attractive for investors, only if it increases their return on investment, which is either the stock cost or the profits increment. Equity valuation refers to the techniques used by investors to determine the value of a firm's equity and is seen as a key element to successful investment decisions (Nissim and Penman, 2001). The fair value of a financial asset is a reliable indicator of the performance of the asset in the long-run. Therefore, in financial markets, a financial asset with a high intrinsic value is linked to a high price and a financial asset with a low intrinsic value is linked to a low price (Comincioli, 1996).

Jiang and Lee (2005) have proven that the earnings of a firm are directly linked with the real economy's behaviour therefore the future economic expectations will have a substantial impact on stock prices. An example would be if the economy is anticipated to move into a recession, the projected earnings will decrease and thus, the stock prices will diminish. On the other hand, if there is an expected boom in the economy, the projected earnings will increase in value therefore stock prices will rise (Comincioli, 1996). Investors can therefore predict economic activity and if these predictions are accurate, the stock price fluctuations will contribute to the direction of the economy. The traditional equity valuation model is a theoretical foundation that supports the use of stock markets to forecast future economic movements (Bredthauer, 2016):

$$\boldsymbol{Stock\ Price} = \sum_{t=1}^{\infty} \frac{\boldsymbol{Expected\ Profitability}}{(\boldsymbol{k}+\boldsymbol{1})^{t}} \tag{2.2}$$

Where:

Anticipated profitability denotes the projected value of corporate earnings and k, presumed to be constant, denotes the required rate of return used to discount the expected profitability. Equation (2.2) displays that the stock price is the present value of the firm's future earnings therefore if expected earnings are decreasing, there will be a downward pressure on the stock price. This model shows that the relationship between the expected profitability of a company and the stock price is positive (Brealey and Myers, 1998).

Abbas and Satti (2019) indicate that the liberalisation of the flow of equity capital is linked to booms within the stock market. The increased inflow of equity capital also leads to increased productivity, investment and higher economic growth in the domestic country (Abbas and Satti, 2019).

Theorists have documented the adverse effect that information asymmetry and the cost of raising equity capital has among investors. When information asymmetry exists, uninformed investors will most likely be disinclined to trade due to the possibility of larger potential losses as a result of transacting with knowledgeable or well-versed investors (Brealey and Myers, 1998). When distributing new equity, shares must be issued at a discounted price to account for the unwillingness of those uninformed investors. This discounting results in smaller proceeds and an inflated cost of raising equity capital for the firm (Zhang, 2000).

A higher cost of equity has the effect of raising a firm's weighted average cost of capital (WACC) therefore making supplementary projects less financially feasible and because of this, a positive correlation can materialise between future economic activity and stock prices (Easley and O'hara, 2004). Hence, the cost of raising equity capital can serve as a theoretical foundation for share prices leading to economic growth.

Maio and Philip (2014) have stipulated that the stock market provides substantial information about the economy due to share prices representing the risk-adjusted discount rate and the sum of expected future cash flows. This is on a basis of two reasons. Firstly, the cash flows and equity earnings are naturally correlated with the business cycle and economic activity. Secondly, the equity discount rates, which also account for equity risk premia, are associated with systematic common risk factors and are affected by macroeconomic variables (Zhang, 2000). In this manner, even if constant discount rates or discount rates uncorrelated with macroeconomic variables are presumed, the current stock prices will still be linked to future economic activity. Therefore, the valuation of equity is of vital importance to investors and the economy as a whole (Maio and Philip, 2014). Over time, various equity valuation models have been introduced in literature which will be further elaborated on next.

2.2.4.1. The Dividend Discount Model

The Dividend Discount Model (DDM) is a quantitative strategy which predicts the cost of an organisation's stock. This specific valuation model endeavours to compute the fair value of stock regardless of overarching economic situations (Gumata and Ndou, 2019). The DDM specifies that a firm can almost certainly grow while the value of its stock declines. The price of a company's stock will increase if the company can procure a higher rate of return than the necessary rate of return which investors require by reinvesting cash. Therefore, the DDM is a method of firm valuation based on the theory that stock is valued at the discounted sum of all its future dividend payments. It is used to assess stocks based on the net present value (NPV) of expected dividends (Stock and Watson, 2003).

The value of a share is equivalent to the current value of expected dividends as defined by the standard valuation model put forward by Chen, Roll and Ross (1986). Financial theory states that stock value is worth all the future cash flows that are generated by a firm discounted at an appropriate risk-adjusted rate. Thus, dividends are used as a measure of the cash flows which are paid out to the shareholders (Gumata and Ndou, 2019). Any variable which influences the growth rate of dividends or expected dividends is vital in the explanation of stock price movements. Along these lines, if expected dividends are reliant on stock prices, the profitability of firms will also influence dividends. Investor's expectations, with regards to the upcoming level of economic activity, should be embodied by stock prices (Schwert, 1990).

Furthermore, there are three types of DDM models namely; the zero-growth model, the constant growth model and the variable growth model (Stock and Watson, 2003). The zero-growth model assumes that all dividends that are paid by the stock remain the same forever. Whereas, the constant growth model assumes that dividends grow at a fixed percentage annually and the variable growth model divides the growth into three phases. The first phase will be a fast, initial phase, then a transition phase and lastly a slower phase for the infinite period (Foerster and Sapp, 2005). The DDM is characterised by the following models:

$$Vo = \frac{D_1 + P_1}{1 + r} \tag{2.3}$$

$$Vo = \frac{D_1}{1 + r} + \frac{D_2 + P_2}{(1 + r\,)^2} \tag{2.4}$$

$$Vo = \frac{D_1}{1 + r} + \frac{D_2}{(1 + r\,)^2} + \cdots + \cdots \frac{D_n + P_n}{(1 + r)^n} \tag{2.5}$$

The one-period DDM is represented by (2.3), two-stage DDM is portrayed by (2.4) and the multi-period DDM is portrayed by (2.5).

Where:

- Vo = the intrinsic value of the sock;
- D_1 = dividend payment in the current period;
- P_n = the constant growth rate of dividends;
- r = the required rate of return on stock and;

- n = the number of periods, which are assumed to be infinite

However, there are various limitations to the DDM model which proves to be incompetent for some firms (Foerster and Sapp, 2005). Firstly, the DDM model is not useful for firms that do not pay a dividend therefore many firms' stocks cannot be valued in this manner. Secondly, it is difficult to use the model on newer firms that recently started paying dividends or firms that have an inconsistent dividend payout. Furthermore, the DDM model is very sensitive to small changes in dividends or the dividend rates (Jiang and Lee, 2005). Thus, over time various additional models have been developed to account for the valuation of firms as an alternate to the DDM model.

2.2.4.2. Free Cash Flow to the Firm

The Free Cash Flow to the Firm (FCFF) approach is another traditional valuation method which measures company profitability after all expenses have been compensated. The FCFF approach signifies the cash a firm generates after taking into account cash outflows to sustain operations as well as maintain its capital assets (Zhang, 2000). This model is one of the many benchmarks which are used to measure a firm's health. If a growing phase is expected for the economy, this is predicted by increasing stock prices as future profits are expected to grow (Foresti, 2006). The FCFF model is depicted below:

$$FCFF = EBIT\,(1 - tax\ rate) + Depreciation - Capital\ Expenditures - Increase\ in\ net\ working\ capital \tag{2.6}$$

Where:

- EBIT = Earnings before interest, tax and depreciation

The FCFF approach takes into account the changes in working capital and can provide key insight into firm valuation. This can be seen when there is an outflow in accounts payable indicating that suppliers are receiving faster payment and an inflow of accounts receivable indicating that the firm is receiving cash quicker from its customers (Serra, 2018). Furthermore, FCFF is useful to potential shareholders in evaluating how quickly the firm can pay expected dividends and interest as outflows are deducted, which provides a better idea of the amount of cash available for dividend payments (Zhang, 2000).

2.2.4.3. Free Cash Flow to Equity

The Free Cash Flow to Equity (FCFE) approach measures the amount of cash that is available to the shareholders of a firm after all the reinvestments, expenses and debt are paid. Thus, FCFE measures a company's equity capital usage (Foresti, 2006). It is comprised of the capital expenditures, net income, working capital and debt of a firm which is used to determine the firm valuation. This particular valuation method is an alternative to the DDM model, especially in instances where the firm does not pay out a dividend (Serra, 2018).

Moreover, the FCFE approach calculates the amount that is accessible to existing shareholders and determines whether dividend payments as well as stock repurchases are paid for with FCFE or an alternative form of financing (Nissim and Penman, 2001). It is vital for a firm to pay out dividends and repurchase shares fully using FCFE and if this amount is less than the dividend payment or the cost to buy back shares, consequently the firm will need to use debt or retained capital to fund this operation. Therefore, a high FCFE total is imperative for efficient firm operations (Serra, 2018). The FCFE model is depicted below:

$$FCFE = FCFF - Interest\ expense\ (1 - tax\ rate) + Increases\ in\ net\ debt \tag{2.7}$$

Equity valuation provides a valuable insight into the performance of firms that are the driving force behind economic activity within a country. Therefore, the key objective of equity valuation is to observe the efficiency and effectiveness of the strategic decision-making process made by firms and the factors that will ultimately lead to the growth of the economy (Stock and Watson, 2003).

2.2.5. Behavioural Finance Effects

Behavioural finance attempts to explain the psychological factors in the evolution of financial markets and differs from traditional finance as it observes investor and market behaviours rather than theory (Hirshleifer, 2015). Whereas traditional finance is based solely on hypotheses about how investors and markets should behave, behavioural finance focuses on the authentic behaviour of investors and stock markets. Therefore, behavioural finance is a division of financial theory that observes human behaviour and investment psychology on stock market prices and investment decisions (Brunnermeier and Markus, 2001).

Behavioural finance is a relatively novel field in modern finance which has had significant results in the recent decades (Hirshleifer, 2015). The theory of behavioural finance is based on three assumptions namely; investors display behavioural biases which trigger them to over and under-react, rational investors should not be adequate to make markets efficient and the errors made by investors in processing information should be correlated across investors so that they are not averaged out (Shleifer, 2000).

The idea behind traditional finance theories is that capital markets are efficient, there are rational investors in the market and it is not possible to outperform the market in the long-run. Whereas, the psychological theories behind behavioural finance include heuristics and biases, investor overconfidence and other social factors including emotions such as fear, ambition, vanity and greed (Subrahmanyam, 2008). It highlights the psychological factor of the investment decision-making process and is in strong contradiction to the EMH. An efficient capital market is characterised by information being available to all market participants therefore stock prices reflect all relevant information (Singh, 2012). Hence, the stock market should reflect all expectations and knowledge of all market participants. It is imperative that an investor's psychological behaviour cannot be separated from the investment decisions made, so it is of importance to understand the financial behaviour of individuals within the capital markets (Shleifer, 2000). Drawing on this notion, it is vital for an investor to understand his financial personality.

2.2.5.1. Biases

Behavioural finance strives to enlighten investors on the stock investment decision-making process which is strongly influenced by behavioural biases. These behavioural biases include both emotional as well as cognitive biases. Emotional biases stem from intuition or impulse and is founded on feelings rather than facts. On the other hand, cognitive biases stem from memory errors, statistical and information processing (Shiller, 2003). It is imperative to note that biases are the basis for the explanation of stock market anomalies, such as a severe rise or fall in the stock price (Montier, 2009). The stock market is a sentiment indicator and can have a great impact on GDP. As the stock market rises and falls, the sentiment in the economy does too. Thus, as sentiment fluctuates, so does consumer spending which ultimately drives the GDP growth in a country (Shiller, 2003).

These biases play a pivotal role in the life of an investor as it shapes the individual preferences of an investor which in turn, shapes the direction that the economy will flow. Investor behaviour leads to various different predispositions that inhibit objective thinking. Biases can be major obstacles in investment decision-making due to the distort of correct judgement by presenting influences that separate from a rational decision itself (Montier, 2009). There are various different biases that affect the investment decision-making process and will be further elaborated on next.

2.2.5.1.1. Availability Bias

Investors depend on information to make informed decisions however, not all information is readily accessible and therefore leads to the occurrence of availability bias. Investors depend on the latest available information and do not disregard any information that is brought to their attention (Shiller, 2003). For example, the stocks of a firm that receive good media attention would receive a higher return potential due to a higher stock price than stocks with negative media attention which will have a worse return potential. The availability bias can cause investor reactions to be too extreme which leads to an under or overreaction to a change in the market conditions (Montier, 2009).

2.2.5.1.2. Representativeness Bias

Representativeness is the propensity to be optimistic about investments that performed well and pessimistic about investments that performed poorly. Therefore, representativeness bias is investment decision-making that is based on stereotypes and a pattern of beliefs about the scenario (Hirshleifer, 2015). If an investor stereotypes the past performance of a stock as either “strong” or “weak”, this representation will make it difficult to think of the stock performing in a different way or to evaluate the potential. This leads an investor to place too much importance on the past performance of stocks instead of future projections (Subrahmanyam, 2008).

2.2.5.1.3. Overconfidence Bias

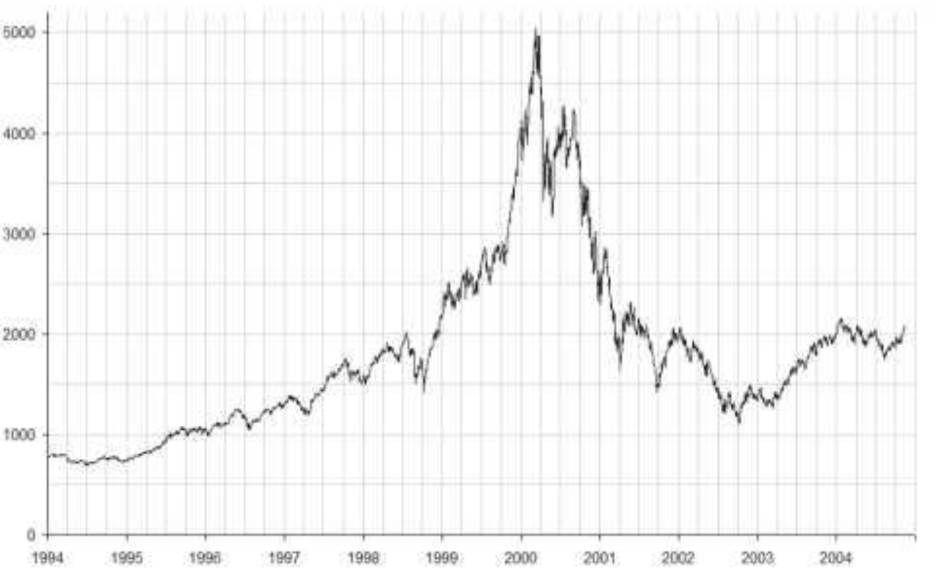
The key objective of investment decisions involves making educated guesses by deducing as much of evidence as possible and forming expectations about what will happen in the markets and economy. The overconfidence bias involves an investor having too much faith in the precision of the estimates and causing an underestimation of the range of possibilities that could occur (Hirshleifer, 2015). This includes underestimating the extent of possible losses as well as underestimating investment risks. This bias stems on the belief that an individual is consistently able to beat the market and the has tendency to characterise good investment results to good investor decisions and poor investment results to poor markets (Kumar and Goyal, 2015).

2.2.5.1.4. Confirmation Bias

Investors are more susceptible to seek information that supports one's perception about an investment rather than to look for contradictory information about it. It is the tendency of individuals to favour information that confirms existing hypothesis or beliefs (Shiller, 2003). For example, an investor takes notice of a favourable stock on the market and upon investigating ignores all the red flags and negative evidence about the stock and only focuses on the positive. This leads to misperception of the stock performance and the overall stock market performance (Kumar and Goyal, 2015).

2.2.5.1.5. Herd Behaviour

Heard behaviour refers to the propensity of individuals to mimic the actions of a larger group, whether it is rational or irrational due to society's belief that a large group of people are right in their decision making (Montier, 2009). Heard behaviour is a common factor that causes price bubbles like the Dot Com Bubble in the year 2000. Stock market bubbles occur when the market participants drive stock prices above their value in relation to stock valuation (Brunnermeier and Markus, 2001). The graph in Figure 2.5 depicts the NASDAQ composite index which spiked in the late 90's and fell sharply due to the Dot Com Bubble.



(Source: Nasdaq, 2020)

Figure 2.5: Graph of the NASDAQ Composite Index

The Dot Com Bubble is one of the famous bubbles of the twentieth century and was based on hypothetical activity surrounding the development of new technologies. The 1990's was the decade that introduced the internet and e-commerce technology (Montier, 2009). The bubble is reinforced by behavioural and market consequences until an event bursts the bubble which causes assets to deflate quickly and credit defaults to rise rapidly which is destructive to the banking sector. Due to the loss of wealth and credit, consumers decrease their demand thus slowing down the economy (Brunnermeier and Markus, 2001).

2.2.6. The Wealth Effect

The wealth effect theory, in essence, is a behavioural economic theory which postulates that individuals spend more as the value of their assets rise and vice versa. Hence, when equity portfolio values escalate due to increasing share prices, individuals are more satisfied and confident regarding their wealth (Chwieroth and Walter, 2019). The wealth effect suggests that individuals feel more financially confident about their wealth when their investment portfolios rise in value and assists economic growth in bull markets. However, in bear markets individuals feel less financially confident about their wealth when their investment portfolios decrease in value thus tearing down economic activity when equity performance is weak (Chen, 2018).

As a result, the wealth effect assesses the impact of how changes in personal wealth influence consumer spending and economic growth. The wealth effect can be applied to firms due to firms increasing their business activity and capital expenditure in response to the increase in asset values, which indicates that economic growth strengthens in bull markets. (Funke, 2004). This notion stipulates that as households become wealthier due to an increase in asset values, these households spend more and thereby contribute to the growth of the overall economy (Paiella and Pistaferri, 2017).

An individual's wealth is comprised of assets, property, savings and bonds. One of the key factors of wealth is property. If the property value increases, it tends to have a positive wealth effect and contrastingly the fall in property value can have a devastatingly negative impact on economic growth and consumer spending (Paiella and Pistaferri, 2017). In addition, the rise in property value has an influence on banks as banks are more willing to lend mortgages to individuals who have a higher net wealth. Moreover, the government will experience a rise in the tax revenue, due to the taxes on wealth. The increased wealth of individuals increases their confidence to borrow more, spend more and take on more risks which causes the savings ratio to decrease during a period of increased wealth (Case and Quigley, 2008).

However, in theory it is problematic to measure the magnitude of the wealth effect as a change in the asset price seldomly occurs without other macroeconomic changes. Thus, researchers have resolved this issue by taking advantage of the geographic variation within the stock market holdings (Kyle and Xiong, 2001). These researchers have estimated the wealth of the stock market for various countries by using data from dividend income for tax returns. It was found that employment is a key factor to a rise in a country's stock market wealth, in addition to consumer spending (Funke, 2004).

Additionally, attention has been fixated on the stock market to be a probable basis for uncertainty in the economy by virtue of the wealth effect (Kyle and Xiong, 2001). The wealth effect of increasing share prices has been beneficial thus far. However, the likelihood of added upsurges poses the risk of increasing the inflation rate (Shirvani and Wilbratte, 2011). For investors that are attracted to stocks which are generating income, periods of high inflation make these stocks less appealing than during periods of low inflation. This is due to dividends not keeping up with inflation levels and decreasing when the inflation rate is high (Abbas and Satti, 2019).

Several studies such as the studies by Paiella and Pistaferri (2017) and Abbas and Satti (2019) have observed the impact of inflation on stock market returns. Due to dividends not being able to keep up with inflation returns, periods of high inflation decrease the demand of stocks to potential investors that are interested in income generating stocks. However, these studies have generated conflicting results when different components are considered; specifically, the time period and geography (Paiella and Pistaferri, 2017). It was concluded by Abbas and Satti (2019) that expected inflation and political factors can either positively or negatively impact stocks, contingent upon the investor's capability to hedge against risk and the government's monetary policy.

2.2.7. The Efficient Market Hypothesis

According to Roberts (1967) and Fama (1970), the EMH otherwise known as the efficient market theory, is a hypothesis stating that share prices reflect all available information, commonly known as informational efficiency. In an efficient market, there are a vast number of rational investors actively competing in order to exploit a profit (Sewell, 2011). As a result, share prices adjust immediately and rapidly to any new information. The EMH is based on numerous assumptions namely; new information arrives erratically, competing investors attempt to adjust prices swiftly to this new information and there are a vast number of competing participants in the market to analyse and value the securities (Timmermann, and Granger, 2004). The concept of market efficiency requires investors who constantly believe that the markets are inefficient and therefore engage in fundamental analysis which allows for new information to be discovered. This in turn, contributes to further stock market efficiency (Sewell, 2011).

The EMH states that stocks will always trade at fair value on the stock exchanges hence making it impossible for investors to make an arbitrage profit by selling stocks at inflated prices or purchasing undervalued stocks (Borges, 2010). It is impossible for an investor to outperform the market overall through market timing or stock selection and the only way in which an investor can profit from higher returns is by purchasing more riskier investments (Yen and Lee, 2008).

This theory stipulates that as new information arrives in the market, it is instantly reflected in the stock prices and neither technical analysis nor fundamental analysis can assist in the generation of abnormal returns. Technical analysis is seen to be valueless (Timmermann, and Granger, 2004). The history of the share prices as well as volume trading is already incorporated and available at minimum cost. Technical analysts believe that any change in prices can be recognised as a trend whereas EMH states any change to the market fundamentals are already reflected within the stock prices and thus investors cannot earn abnormal returns on stocks (Ball, 2009).

Fundamental analysis is also ineffective in comparison to the EMH. If investors depend on publicly available information, it can be problematic to discover information that is not widely known and acted upon. Since the share is already fully priced, the identification of a good firm will not be of much use as fundamental analysis is useful for identifying firms that are better than the norm. An investor requires an analysis that needs to be more enhanced than the competitors in order to make a profit (Borges, 2010).

A vital conclusion to the EMH theory is that since stock prices always trade at fair value, it is impossible to either buy undervalued stocks at a bargain or sell overvalued stocks to gain a profit. Therefore, indicating that the EMH theory is a critical factor in examining share prices (Borges, 2010). In an efficient market, the actual price of a security will be a suitable estimate of its intrinsic value at any point in time due to constant competition amongst the market participants. Fama (1970) classified three levels in which the stock market may be efficient (Ball, 2009). These three concepts are elaborated on next.

2.2.7.1. Weak-Form Efficient

In a market that is weak-form efficient, all historical market information is already reflected in the current stock prices. Therefore, it would not be useful to forecast the future stock prices indicating that in a weak-form efficient market, share price movements in response to new information cannot be predicted from previous movements in the stock price (Timmermann, and Granger, 2004). Since there is no correlation between any consecutive prices, surplus returns cannot be achieved through studying the past stock price movements by means of technical analysis. The only way an investor would be able to beat the market would be to make use public or inside information (Yen and Lee, 2008).

2.2.7.2. Semi-Strong-Form Efficient

A semi-strong-form efficient market reflects all publicly available information namely; dividends, new product developments, earnings, stock splits, financial difficulties as well as historical data. Therefore, it is impractical for investors to use fundamental analysis in order to earn abnormal returns (Ball, 2009). It is only possible to beat the market by making use of inside information. In a semi-strong-form efficient market, the market adjusts rapidly to any new and relevant information by reflecting a new equilibrium price level that affects the supply and demand due to the occurrence of that information (Yen and Lee, 2008).

2.2.7.3. Strong-Form Efficient

When the market is strong-form efficient, it is impossible for an investor to outperform the market due to all information, both public and private, already being reflected in the share price. The strong-form efficient market states that all information is rapidly and instantly reflected in the share price, even if all the information is not publicly available (Borges, 2010). Figure 2.11 displays a diagram portraying the EMH.

(Source: Yen and Lee, 2008)

Figure 2.6: The Efficient Market Hypothesis

However, there have been opposing viewpoints with regards to fundamental analysis and the EMH which have produced a wide range of arguments over the past few decades. These arguments will be discussed in the subsequent section.

2.2.7.4. Critiques of the Efficient Market Hypothesis

In financial theory, it is assumed that investors are rational and make rational investment decisions by evaluating the NPV of the future cash flows which are appropriately discounted for risk (Vulic, 2009). These aspects have shown that investors are affected by namely; herd instinct, asymmetrical judgments about the reasons for profits and losses, a tendency to beat their portfolios and a tendency to over or under react to news (Rossi, 2015). Moreover, there are many anomalies which have been distinguished in the patterns of historical share prices. These anomalies are known as the mean reversion, the small firm effect and the January effect (Malkiel, 2005). It is imperative to note that market anomalies are possible explanatory factors for unanticipated movements in market prices. These anomalies could easily lead to asymmetric responses between the variables and is therefore fundamental to this study.

2.2.7.4.1. Mean Reversion

Mean reversion is the tendency of stocks, individual shares or sectors ensuing a period of continuous under or over-performance to default to a long-term average, through an equivalent period of under or over-performance (Serletis and Rosenberg, 2009). This concept was discovered by De Bondt and Thaler (1985), who exhibited that for each year since 1933, a portfolio of definitive “winners” was created and this would have displayed a poor return for the subsequent five-year period. In contrast, a portfolio of definitive “losers” would have had good returns over the same period (Ozdemir, 2008). The theory of mean reversion has led to the discovery of many investing strategies that include the sale or purchase of stocks whose performance has fluctuated from the historical averages. However, these fluctuations could indicate that the firm no longer has the same growth prospects and therefore mean reversion would less likely occur (Serletis and Rosenberg, 2009).

2.2.7.4.2. The Small Firm Effect

The theory of the small firm effect stipulates that smaller firms, or firms with a small market capitalisation tend to outperform larger firms. This is due to the smaller firms having a higher growth opportunity than the larger firms. The small firm effect is utilised as a rationale for the much higher fees that are charged by fund companies for the small capitalisation funds (Vulic, 2009). There are three categories in which publicly traded companies are classified under namely; small-cap, mid-cap and large-cap. The small capitalisation firms are relatively start-up firms that have a high growth potential. Therefore, the small firm effect is a factor that is employed to explain high return in the Fama French Three-Factor Model, with the three factors being, book-to-market-values, excess market return and the size of the firm (Rossi, 2015).

2.2.7.4.3. The January Effect

The January effect follows on from the small firm effect and postulates that almost all of the net outperformance of small-cap firms was and will be achieved in the month of January. Therefore, the January effect is the seasonal propensity of stock prices to increase in that month (Rossi, 2015). This effect is attributed to the increase in stock buying which is followed by a drop in the stock price that generally occurs in December, when the investors engage in tax-loss harvesting to offset the capital gains realised. Another explanation of this effect is due to investors using their year-end bonuses to purchase investments in January (Thaler, 1987).

The phenomenon of arbitrage is closely linked to the concept of market efficiency. The EMH maintains the notion that the way to consistently earn a greater return in the market, other than a risk-free return, is to accept economic risk. Therefore, the only way for this concept to hold true is if the market does not contain arbitrage opportunities (Serletis and Rosenberg, 2009). The phenomenon of arbitrage opportunities will further be discussed in the next section.

2.2.8. Arbitrage Pricing Theory

Arbitrage is defined as the process of buying a security in one market and simultaneously selling it in another market at a higher price in order to exploit a profit. In the stock market, investors tend to exploit arbitrage opportunities by buying stocks on a foreign exchange where the equity's share price has not been fully adjusted to account for the exchange rate (Ross, 2013). Hence, the stock price is undervalued on the foreign exchange in comparison to the local exchange and an investor can gain from potential profits using this differential. The process of arbitrage is considered to be fairly low risk (Dhankar, and Singh, 2005).

According to Fleischer (2010), if stock markets were perfectly efficient, arbitrage opportunities would cease to exist but markets are more often than not, inefficient which gives investors opportunity to capitalise on pricing discrepancies. Therefore, behavioural biases imply that rational investors fully profit from the mistakes of behavioural investors when there is mispricing due to noise traders. As a result, rational investors react quickly to restore stock market equilibrium (Iqbal and Haider, 2005).

The Arbitrage Pricing Theory (APT) was developed by Ross (1976) and is a multi-factor asset pricing model built on the impression that asset returns can be forecasted by using the linear relationship between asset returns and macroeconomic variables to apprehend systematic risk (Dhankar, and Singh, 2005). The APT is useful for analysing portfolios that are value investing in order to identify securities that may be mispriced. The APT presumes that markets misprice securities before the securities move back to their fair value. By using APT, arbitrageurs anticipate to take advantage of deviations from fair market value (Huberman, 2005).

According to Ross (2013), the APT is characterised by the following model:

$$E(R)_i = E(R)_z + (E(A) - E(R)_Z) \times \beta_i \tag{2.8}$$

Where:

- $E(R)_i$ is the expected return on the asset;
- R_z is the risk-free rate of return;
- β_i is the sensitivity of the asset price to the macroeconomic factor i and;
- E_z is the risk premium associated with factor z

The behavioural biases investigated earlier in this chapter suggest that rational investors could fully profit from the mistakes of behavioural investors. This is because when prices go out of configuration, the rational investors swiftly react in order to re-establish equilibrium (Shleifer and Vishny, 1997). However, in theory, it is argued that this does not happen due to the following aspects; implementation costs, fundamental risk and model risk (Gromb and Vayanos, 2010).

Implementation costs comprise of short-sale constraints as well as transaction costs. These costs include commissions, the bid-ask spread, financial or legal fees and the costs of identifying mispricing (Gromb and Vayanos, 2010). Investors that react rapidly to the mispriced securities are involved in borrowing funds if liquid funds are unavailable to invest. As a result, transaction costs are likely to be higher for arbitrage trades (Fleischer, 2010).

Moreover, in theory, if a stock is mispriced buying it should signify a profit opportunity but in reality, the underpricing could continue further rather than discontinue. This is the concept of fundamental risk (Hanson and Sunderam, 2014). Whilst the stock price eventually will converge to its intrinsic value, the period in which this is done is unknown and ultimately could only occur after a trader's investment horizon. There is risk incurred in exploiting the profit opportunity and this could result in investors not acting on mispricing (Fleischer, 2010).

When a stock is mispriced, the various strategies to correct the mispricing are costly as well as risky thus making it unattractive investments to potential investors, although mispricing suggests a profitable arbitrage opportunity (Hanson and Sunderam, 2014). This is due to the risk of an incoherent model to value the security and is termed model risk. Furthermore, the APT permits various risk factors to be included in the model and allows investors to engage in the reasons as to why stocks move in certain ways regarding the economy (Shleifer and Vishny, 1997). Drawing on this notion, the focal point of this thesis is the phenomenon of nonlinearity and asymmetric adjustments which will be elaborated on subsequently.

This section of the literature review covered the conceptual framework and various economic theories underlying the co-movement of share prices and economic activity as a whole. The first concept discussed was nonlinearity which is the focal point of this thesis. Thereafter, the supply-leading and demand-following models was discussed, which serves as the foundation on which share prices are based. Subsequently, the business cycle was discussed, elaborating on GDP and economic fluctuations in the country. Equity valuation is vital for successful investment decisions and is also a key element to successful firm returns. The three important valuation models were discussed in detail namely; the DDM, FCFF and FCFE models highlighting the importance of each. Behavioural finance effects are a crucial component in the determination of stock prices and economic activity and were intricately elaborated on thereafter. Along these lines, this section expanded on the theoretical aspects of each and elaborated on its importance in the financial environment. Moreover, the wealth effect is a vital concept in explaining the relationship between share price fluctuations and economic growth, and was explained in detail thereafter. The APT was successively discussed with the importance of each aspect and its contribution to both economic growth and share prices. The subsequent section reviews the relevant literature relating to these concepts.

2.3. Empirical Evidence

The notion in which share prices co-move with economic activity can be supported by various empirical evidence. This section reviews empirical research that has already been conducted and highlights the specific methodologies utilised by each.

2.3.1. South African Studies

2.3.1.1. Auret and Golding (2012)

Auret and Golding (2012) undertook an empirical study to investigate the informational content contained within the prices of shares reflected by the JSE between December of 1969 and September of 2010. The study focused predominantly on the forecasting power of stock prices with regards to real output growth and the overall economy, represented by Industrial Production (IP) and GDP by utilising both quarterly and annual data. Within the applied methodology, an autoregressive equation was used, which contained one lag per macroeconomic aggregate.

Their study focused on two key points which were firstly, due to the regression analysis estimating a long-term relationship amongst the variables in contrast to the movement of daily stock prices, the breakdown of the variable's movements into unanticipated or anticipated segments is futile. Secondly, due to the stock prices reflecting the long-term projections of the economy, additional attention is focused on annual data.

The study by Auret and Golding (2012) utilised the Hodrick and Prescott (1981) filter, also known as the HP filter, which detrends the data and is collected on a quarterly and annual basis. The HP filter permits the empirical study of the cycles of the variables. The dataset utilised consists of a strong business cycle element and contains an upward trend movement. Auret and Golding (2012) stipulate that the business cycle fluctuations are identified containing deviations from the trend process.

It is vital to conduct unit root tests to confirm that the variables are not integrated of order two or higher. Utilising both ADF tests and correlograms, all variables in the dataset displayed nonstationarity at levels when the unit root tests were conducted. The unit root tests were then conducted at first differences and all variables exhibited stationarity. Moreover, the HP filter was used to observe and isolate the trend from the cycle to make the data stationary. This allows an estimate of the magnitude and fluctuations of the economic variables to be determined. The null hypothesis of each test is that the series contains a unit root, whilst the alternative is that the series is stationary and can be depicted as follows:

$H_0: \alpha = 0$

$H_A: \alpha < 0$

In their study, Auret and Golding (2012) presented that for the RGDP cycle, there is more explanatory power over the recent data and lags which is due to the increased market efficiency within the JSE over the decades. Their study found key evidence showing that the cycles of real IP and RGDP were led by stock prices within South Africa and a strong and positive relationship existed between the variables examined.

2.3.1.2. Chibvongodze, Kwenda and Sibanda (2014)

The empirical study by Chibvongodze, Kwenda and Sibanda (2014), explored the association between economic growth and financial development in South Africa by applying the Vector Error Correction Model (VECM) and an ARDL bounds approach. The authors employed quarterly data from 1996 to 2011 entailing three variables; stock market development, banking sector development and economic growth.

The ADF and Philips-Perron (PP) unit root tests were conducted first. The empirical results revealed that the variables were nonstationary at levels and therefore contained unit roots. Since the variables were considered to be nonstationary at levels, the authors performed the tests again on the first differences of the variables and the results displayed that the variables were stationary at first differences. The hypothesis of nonstationarity was rejected by the ADF and PP tests therefore Chibvongodze *et al.* (2014) concluded that the series are integrated of order one. Since stationarity of the variables was established, the authors continued with tests for cointegration.

The ARDL results displayed the presence of a cointegrating relationship between the financial development and economic growth indicators. In addition, there was evidence of a strong and positive long-run relationship between the variables examined. The VECM approach indicated that the banking sector is a key determinant of economic growth and additionally displayed a bidirectional relationship between economic growth and financial development in the long-run.

The authors found that the South African financial system plays a significant part in driving the growth of the economy and that financial development boosts the economy. The authors concluded that financial development does lead to economic growth within South Africa and more importance should be placed on the development of this sector. It has been identified by Chibvongodze *et al.* (2014) that the results of their study have important implications for the structured economy in South Africa and it is critical to implement proper policies to boost the economic growth within the country.

2.3.1.3. Odhiambo (2014)

The aim of the study by Odhiambo (2014) was to observe whether the stock markets and banks are complementary to each other in enhancing economic growth within South Africa. The causal relationship between the stock markets and banks was observed by using interactive variables in a standard growth model. The empirical evidence presented by Odhiambo (2014) observed the relationship between banks, economic growth and stock markets in South Africa, over the period ranging from 1994 to 2011. The study aimed to observe the affiliation between the stock markets, economic growth and banks in South Africa by using three proxies namely; stock market traded value, stock market capitalisation and stock market turnover as credit to the private sector, to test the robustness of the results. The study employed the ARDL bounds testing approach as well as the conventional unit root tests.

The unit root test results presented by Odhiambo (2014) displayed that the variables were nonstationary at levels. The variables were differenced once in order to perform the stationarity tests again. The results presented that all variables were stationary at first differences and integrated of order one. Since all variables were found to be stationary at first differences, Odhiambo (2014) applied the ARDL tests and confirmed that a long-run relationship exists between the variables employed. The empirical results indicated that a weak and sensitive relationship exists between stock market development, bank development and economic growth

when stock market development was used as the proxy. Furthermore, complementarity between bank development, stock market development and economic growth was found to exist in the short and long-run when stock market capitalisation was used as the proxy. When stock market traded was used as a proxy, complementarity in the short and long-run was rejected. Similarly, complementarity was also rejected but only in the short-run when the stock market turnover was used as the proxy.

Short-run complementarity is reinforced by the lagged coefficient values of the first difference interaction term as well as the error correction term (ECT) and are both statistically significant. On the other hand, the long-run complementarity is reinforced by the lagged coefficient value of the interaction term and is positive and statistically significant. Odhiambo (2014) concluded that even though the magnitude of the effect of stock market development is largely positive and significant, expect for stock market turnover, the effect of the bank based financial development on economic growth is negative and statistically insignificant.

2.3.1.4. Rateiwa and Aziakpono (2015)

A study by Rateiwa and Aziakpono (2015) examined the existence of a long-run equilibrium relationship and causality between the non-bank financial institutions (NBFI's) and economic growth in three of Africa's largest economies (South Africa, Nigeria and Egypt) between 1971 and 2013. Even though the data used in estimating the model is annual over the period of 1971 to 2013, it was not available for the entire period for some of the variables. This particular study period was chosen by Rateiwa and Aziakpono (2015) due to data limitations which is a common occurrence in African countries.

Firstly, stationarity tests were utilised by means of ADF unit root tests in both levels and first differences. The results displayed that most of the variables were nonstationary at levels but stationary at first differences. Secondly, Rateiwa and Aziakpono (2015) conducted cointegration tests to determine whether or not a long-run relationship exists amongst the variables. The VECM and Johansen cointegration tests were employed in their study to examine the occurrence of a long-run equilibrium relationship amongst financial structures, economic growth and causality. The results showed that a strong long-run relationship existed between the economic growth and NBFI's in South Africa and Egypt, whilst Nigeria had a weak relationship. Therefore, the study reveals that in countries that have a more advanced financial system, the significance and magnitude of NBFI's to economic growth is more distinct thus a strong and positive long-run relationship is exhibited.

Moreover, the direction of causality between the variables in South Africa and Egypt is mainly positive and significant and runs from NBFI's to economic growth, indicating that financial development in these particular countries is supply-leading. The coefficients of the ECT for the three countries employed suggests that there are inefficiencies in the financial system and economies. This is due to the error correction model (ECM) conveying low values which suggest that shocks to the economy or financial system are not swiftly correlated back to full equilibrium. The results presented in the study by Rateiwa and Aziakpono (2015) contributed to literature by providing country specific time-series evidence to support financial growth with the use of NBFI's and indicates causality between economic growth and NFBI's in Africa.

2.3.1.5. Louw (2016)

Louw (2016) carried out a study to test the causal relationship between economic growth, financial development and investment in South Africa, over the period 1969 to 2013 by utilising Granger causality tests. The study employed annual time series data for all variables except for the ratio of broad money stock, minus currency to RGDP which was only available for the period 1979 to 2013. The real terms in the study were used to eliminate the effects of price level changes on the regression results and all variables were transformed into logarithmic forms to ensure an approximate normal distribution for each variable.

The descriptive analysis stipulated that all variables were normally distributed according to the Jarque-Bera statistic besides the two variables; the ratio of private sector credit to RGDP and the ratio of liquid liabilities to RGDP, which are a resultant of significant outliers in the data. Moreover, structural breaks were accounted for by utilising dummy variables for a potential break within the dataset thereby improving the stability of the models.

Unit root tests were conducted in levels and first differences to determine stationarity of the variables. The results displayed that all of the variables were nonstationary at levels therefore the next step was to difference the variables and conduct the unit root tests again at first differences. The results revealed that all variables were stationary at first differences.

The empirical results of the Granger causality tests provided evidence of a strong long-run causal relationship between economic growth, financial development and investment in South Africa. The short-run results however indicated that the causal relationship changes when using stock market development indicators. Moreover, the results showed proof of a short-run, bi-directional link between financial development and economic growth. Evidence of a positive and significant demand-following relationship amongst the banking sector variables existed in the long-run. The outcome also presented proof of bi-directionality between economic growth and financial development. Furthermore, it was recommended by Louw (2016), that in order to validate the results of his study and contribute to literature regarding the causal relationship amongst South Africa's economic growth, financial development and investment, different proxies and methodological techniques should be considered.

2.3.1.6. Sayed, Auret and Page (2017)

The study conducted by Sayed *et al.* (2017) examined cointegration and causality between the JSE ALSI and economic activity in South Africa as represented by GDP and IP. The research methods spanned over the period March 1999 to December 2016. For GDP data that was employed in their study, quarterly data was opted for use and monthly data was used for the stock market variables. The Granger causality and Johansen cointegration tests were employed to assess cointegration and causality between the JSE ALSI against RGDP and real IP. Moreover, the modelling methods that are utilised in time series analysis are interested in data stationarity thus statistical tests are conducted. The use of unit root tests provides statistical evidence on the stationarity of the data and was first applied in their study.

Sayed *et al.* (2017) therefore began the formulation of their analysis with the use of unit root tests in levels. The results indicated that only the variable RGDP contained a unit root and was nonstationary in levels whilst all the other stock market variables namely; ALSI, INDI, FINI and RESI exhibit stationarity in levels. RGDP was stationary in first differences after the unit root tests were employed again. The empirical investigation by Sayed *et al.* (2017) specified that for the Granger causality tests, unidirectional causality was present between all the stock market indices and real macroeconomic variables as well as a strong long-run relationship between the ALSI, GDP and IP existed. Moreover, reverse causality only existed once between the INDI and nominal GDP variables. According to Sayed *et al.* (2017), the pairwise Granger causality null hypothesis between GDP and the stock market are depicted below:

$$DGDP_t = \alpha_0 + \alpha_1 DGDP_{t-1} + \cdots + \alpha_1 DGDP_{t-1} + \beta_1 ALSI_{t-1} + \cdots + \beta_1 ALSI_{t-1} + \mu_t \tag{2.9}$$

$$ALSI_t = \alpha_0 + \alpha_1 ALSI_{t-1} + \cdots + \alpha_1 ALSI_{t-1} + \beta_1 DGDP_{t-1} + \cdots + \beta_1 DGDP_{t-1} + \mu_t \tag{2.10}$$

The empirical results indicated that positive and significant cointegration and causality between the ALSI and economic activity exists in South Africa. This particular study made use of the ALSI as the stock market index as well as three other sector stock market indices to account for market segmentation on the JSE. This technique will also be applied in this thesis to account for stock market segmentation in addition to the overarching relationship between the ALSI and RGDP however, taking a nonlinear approach to the methodology.

2.3.1.7. Du Toit, Hall and Pradhan (2017)

The study presented by Du Toit, Hall and Pradhan (2017) observed the long-run relationship between the annual internal financial performance (IFP) and external financial performance (EFP) of 155 South African firms for the period ranging from 2004 to 2016. The study utilised market price per share and market value added as indicators of EFP, along with six different indicators of IFP; namely the P/E ratio, return on equity (ROE), dividend per share (DPS), economic value added (EVA), return on assets (ROA), and EPS. The South African firms were selected based on data availability and the importance of the chosen industries.

The results of the unit root tests indicated that both IFP and EFP were nonstationary at levels, integrated of order one and are therefore possibly cointegrated. The following VECM were then applied by Du Toit *et al.* (2017), to determine the short-run and long-run casual relationships between the IFP and EFP of the selected firms.

$$\Delta EFP_{it} = \alpha_{1j} + \sum_{k=1}^{p} \beta_{1ik} \Delta EFP_{it-k} + \sum_{k=1}^{q} \lambda_{1ik} \Delta IFP_{it-k} + \delta_{1i} ECT_{it-1} + \varepsilon_{1it} \tag{2.11}$$

$$\Delta IFP_{it} = \alpha_{2j} + \sum_{k=1}^{p} \beta_{2ik} \Delta IFP_{it-k} + \sum_{k=1}^{q} \lambda_{2ik} \Delta EFP_{it-k} + \delta_{2i} ECT_{it-1} + \varepsilon_{2it} \tag{2.12}$$

Where:

- i = 1, 2,…,N represents a firm in the panel;
- t = 1, 2,…,T represents a year in the panel;
- p and q are the lag lengths for the estimation;
- α is the intercept term;
- Δ is the first difference operator and;
- ε_{1t} and ε_{2t} are the independent and normally distributed errors with a zero and a finite heterogenous variance.

The choice of the VECM model was based on the order of integration and the cointegrating relationship amongst the variables IFP and EFP for the firms employed. Furthermore, the study by Du Toit *et al.* (2017) utilised panel cointegration and panel Granger causality tests to substantiate the null hypothesis. The Granger causality tests found a positive and strong long-run cointegrating relationship to exist between IFP and EFP as well as bidirectional causality amongst the variables. As such, the authors concluded that cointegration is significant and exists between share prices and economic growth within South Africa. The main purpose of the study by Du Toit *et al.* (2017) stipulates that the financial performance of firms neglects the dynamic link between the EFP and IFP.

2.3.2. International Studies

2.3.2.1. Foresti (2006)

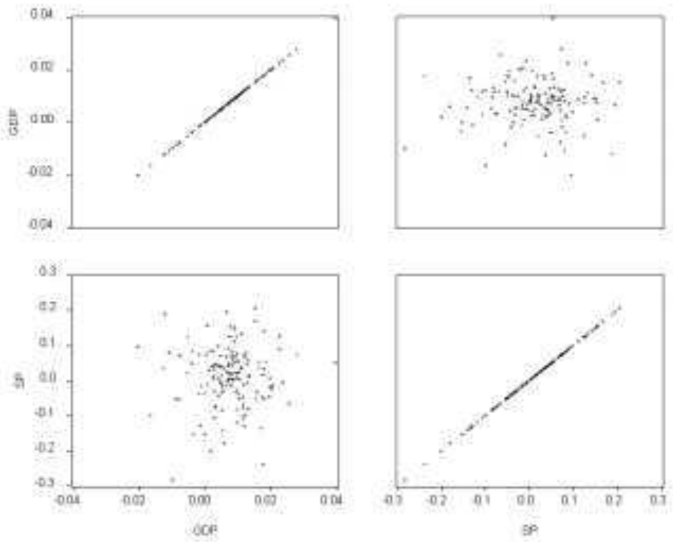
Foresti (2006) conducted a study in the United States (US) over the period of 2001 to 2005 to examine the relationship between the stock prices and economic growth. The study conducted made use of Granger causality tests to calculate whether the stock prices in the US Granger cause and have an influence over the growth in the economy. The Standard and Poor's Composite Index growth rate of real values was used as the indicator of stock prices and RGDP was used to measure the changes in economic growth. The use of quarterly data was chosen since only quarterly data is used to observe GDP over time. Therefore, according to Foresti (2006), the following two equations can be specified:

$$(GDP)_t = \alpha + \sum_{i=1}^{m} \beta_i (GDP)_{t-i} + \sum_{j=1}^{n} \lambda_j \, (SP)_{t-j} + \mu_t \tag{2.13}$$

$$(SP)_t = \delta + \sum_{i=1}^{p} \varphi_i (SP)_{t-i} + \sum_{j=1}^{q} \rho_j \, (GDP)_{t-j} + \varepsilon_t \tag{2.14}$$

The unit root tests were carried out at levels and first differences for all variables. The results indicated that all variables were nonstationary at levels therefore the tests were conducted at first differences and as a result, displayed stationarity amongst all variables. Thus, the variables were integrated of order one. Moreover, the Granger causality test is sensitive to the number of lags included in the regression and both Akaike's Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (SBIC) were opted for use to indicate the appropriate number of lags. The appropriate number of lags chosen were 5 and the coefficients were positive and significant.

The results of equation (2.13) indicate that SP Granger-causes GDP however, GDP does not Granger cause SP. This shows that past values of SP aid in the estimation of the present values of GDP even with the past values of GDP. On the other hand, the results of equation (2.14) displayed that there was no Granger causality present from past values of GDP to future values of SP. The coefficients were statistically insignificant as the results exhibited that there was no causality from the economy to the stock prices however, a weak inverse Granger causality relationship exists. Figure 2.6 displays a view on the data that supports a positive relationship between the two variables employed in the study by Foresti (2006).



(Source: Foresti, 2006)

Figure 2.7: Scatter plots for GDP and SP growth

In conclusion, Foresti (2006) discovered that the stock market prices are significant in forecasting economic growth. The affiliation between the stock prices and economic growth indicated that share prices have a significant effect on the growth of the economy in the US and can be used to predict economic growth.

2.3.2.2. Deidda (2006)

The study by Deidda (2006) provided substantial evidence about the benefaction of stock market liquidity in improving economic growth, through firm information acquisition and improving corporate governance. The author used data from 35 countries (not including South Africa), which were from both developed and underdeveloped countries during the period 1860 to 1963, to study the value of financial intermediary assets as the share of economic output. In his study, Deidda (2006) attempts to explain why financial development may fail to promote economic growth. Furthermore, the model presented by Deidda (2006) explains why financial development occurs even though it is harmful to economic growth and unsustainable. The likelihood of an economy that is competitive and fixated in a low-development trap due to early financial development, can offer some guidance on the financial liberalising policies.

The study examined the economic growth and financial affiliation by including the consumption of resources by the financial sector into a generation model with endogenous growth. This displayed that the growth effect of costly financial development is very ambiguous when the regime switch is more involved with capital intensive technology. Moreover, the author found that the size and growth of the financial intermediary is positively and strongly significant within the quality of the financial function that is measured by the financial sector. Therefore, financial institutions play a pivotal role in economic growth. However, this affiliation is much weaker, insignificant and negative for less developed economies.

2.3.2.3. Gan, Lee, Yong, and Zang (2006)

Gan, Lee, Yong, and Zang (2006) examined the stock index within New Zealand and seven macroeconomic variables namely; the inflation rate, exchange rate, GDP, money supply, long-term interest rate, short-term interest rate and domestic retail oil price for the period 1990 to 2003. These macroeconomic variables were monthly frequencies over this time period. The study by Gan *et al.* (2006) was conducted to determine whether the stock index in New Zealand is a leading indicator for economic growth. The data utilised in their study was used to test the magnitude of the impact on this relationship. The study employed the Johansen multivariate cointegration test and Granger causality tests to distinguish whether the variables are cointegrated.

Gan *et al.* (2006) utilised ADF and PP tests to determine whether the variables in the study were stationary or not. The results displayed that only the short-term interest rate variable was stationary at levels. All the other variables were nonstationary at levels but stationary at first differences thus integrated of order one. The PP tests utilised also presented similar results and indicated that all the macroeconomic variables, as well as the short-term interest rate variable, were nonstationary in levels but were stationary in first differences therefore integrated of order one.

Furthermore, the Johansen multivariate cointegration test showed that the variables are cointegrated with r = 6, indicating that there are six cointegrating vectors. While on the other hand, the max eigenvalue test results exhibited that the variables are cointegrated with r = 4, indicating that there are four cointegrating vectors. The Granger causality tests revealed that the variables did not have a direct influence on the stock index within New Zealand. The results further indicated that the magnitude of the long-run relationship between the variables is very weak and displayed no direct causality. Therefore Gan *et al.* (2006) found no evidence that the stock index was a leading indicator of macroeconomic factors.

2.3.2.4. Deb and Mukherjee (2008)

Deb and Mukherjee (2008) carried out a study to examine the casual relationship between economic growth and stock market development for the Indian economy, over the period ranging from 1996 to 2007. Their study utilised Granger causality tests and the Toda and Yamamoto (1995) alternative causality test. The testing procedure is similar to the Granger causality test however, it is augmented with additional lags which is dependent on the maximum order of integration of the series. The variables employed were stock market volatility, RGDP growth rate, real market capitalisation ratio and the real value traded ratio.

The empirical results of the unit root tests indicated that the stock market volatility variable is stationary at levels whereas all the other variables contain a unit root but are stationary at first differences hence integrated of order one. Therefore, the variables employed in the study by Deb and Mukherjee (2008) are not cointegrated and the F-statistic in the Granger causality test may not be completely reliable in deducing leads and lags amongst variables with different orders of integration. In this case, Toda and Yamamoto (1995) suggested an alternative causality test which accounts for variables that are integrated of an arbitrary order, cointegrated of an arbitrary order and can be applied if the VAR is stationary. Thus, according to Deb and Mukherjee (2008) the following two equations can be specified to test the casual relationship amongst the RGDP growth rate and three stock market development proxies:

$$y_t = \beta_0 + \sum_{k=1}^{m} \beta_k y_{t-k} + \sum_{l=1}^{n} \alpha_1 x_{t-1} + \mu_t$$

(2.15)

$$x_t = \gamma_0 + \sum_{k=1}^{m} \delta_k y_{t-k} + \sum_{l=1}^{n} \gamma_1 x_{t-1} + \varepsilon_t$$

(2.16)

Where:

- y_t and x_t are the respective variables;
- μ_t and ε_t are mutually uncorrelated error terms;
- t is the time period and;
- k and l are the number of lags

The Granger causality results displayed that there is a strong causal flow from stock market development to economic growth, which is in line with the supply-leading hypothesis. Moreover, a bi-directional causal relationship existed amongst the real market capitalisation ratio and economic growth. Additionally, the results propose that unidirectional causality existed from stock market activity and volatility to RGDP growth. Thus, the Toda and Yamamoto (1995) causality test indicated that stock market development leads to economic growth. It was found that a strongly positive and significant relationship existed between RGDP growth and stock market activity for the Indian economy, signifying that stock market capitalisation led to economic growth. In conclusion Deb and Mukherjee (2008) discovered that a vital role in accelerating economic growth is liquidity and a developed financial banking system.

2.3.2.5. Oskooe (2010)

The study by Oskooe (2010) examined the relationship between the stock market performance and economic growth in Iran for the period 1997 to 2008. The data utilised in the study consisted of financial as well as economic time series data and comprised of GDP and the Iran stock market index. Oskooe (2010) conducted various tests in the study including ADF unit root tests, Johansen cointegration analysis, Granger causality tests and the VECM framework.

The results of the ADF unit root tests indicated that the variables employed were nonstationary at levels. The tests were applied again in first differences and revealed that all the variables exhibited stationarity at first differences and thus integrated of order one. Oskooe (2010) converted the variables into logarithmic form which stipulates that the first differences of the stock prices and GDP represent the changes in the stock prices and economic growth respectively.

The empirical results from the Johansen cointegration analysis exhibits that there was only one cointegrating vector present. Moreover, the VECM was used to examine the long-run affiliation between the variables. The empirical results presented that the stock prices in the long-run are positively and significantly affected by the level of GDP. This indicates that the changes to GDP are significant in predicting the stock price movements and the stock price changes that are linked to the economic activity in the long-run. This is due to an increase in GDP leading to an increase in the expected future cash flows thus increasing the stock prices.

The Granger causality results indicated that bilateral causality exists between economic growth and stock price fluctuations. The link connecting stock price movements to GDP growth continues to improve the economic activity on stock market development. It implies that stock prices are utilised to forecast economic growth. Oskooe (2010) concluded that an important factor as to why the stock prices Granger cause economic activity can be attributable to the wealth effect as the variations in the stock prices are due to the change in the wealth level. Therefore, the author concludes that the level of economic activity is influenced by stock market fluctuations and stock prices play a vital role in the rate of economic growth in Iran.

2.3.2.6. Carp (2012)

Carp (2012) investigated the stock market dynamic in Central and Eastern Europe, using data over the period 1995 to 2010, amidst the influence of macroeconomic imbalances which plagued the region at the time. Carp (2012) expressed the importance of emphasising the volatility of foreign capital inflows in his study. The data utilised in his study was employed to test the magnitude of the impact of stock market development on the relationship between economic growth and foreign capital inflows. The author aimed to draw comparisons between the performance of the macroeconomic environment and the identification of suitable procedures through which capital markets can become attractive for potential investors.

The variables used in the study were the growth rate of GDP, real investment, stock value traded and the market capitalisation of listed companies, which were a percentage of GDP. The Jarque-Bera test highlighted that all the variables were normally distributed. Furthermore, ADF tests were implemented to deduce whether the series was stationary or not. The results exhibited that all the variables besides the GDP growth rates were stationary at levels. The variable GDP growth rate was integrated of order one and therefore stationary at first differences.

Thereafter, the Granger causality tests were conducted by Carp (2012) and displayed that the variables stock value traded and market capitalisation did not have a direct influence on the economic growth rates which emphasise the low developments within the stock market. The results further indicated that a higher economic growth rate is enticed by real investments and this creates positive movements on the indicators of the stock market in the real sector. Therefore, the results indicated that the magnitude of the long-run relationship between the variables is weak and displayed no direct causality.

2.3.2.7. Abugamea (2016)

A study carried out by Abugamea (2016) used Ordinary Least Squares (OLS) regression and Granger causality tests to examine the affiliation between the banking sector development and economic growth in Palestine. The data for all the variables that were employed in the study ranged over the period of 1995 to 2014, with an exception of the banking market interest rate spread which was over the time period 2001 to 2014. The proxies used were namely, banking sector assets to GDP ratio, credit to private sector to GDP ratio, banking market interest rate spread and the growth rate of total sector deposits.

Abugamea (2016) employed the GDP growth model which is based on causality to run from banking sector development to economic growth. This model stems from the neoclassical one sector production function in which banking sector development is an input. The particular model is comprised as follows:

$$y_t = \alpha_0 + \alpha_1 K_t + \alpha_2 X_t + \varepsilon_t \tag{2.17}$$

Where:

- y represents the economic growth which proxies the growth of GDP and GDP per capita;
- K is a measure of the level of banking sector development;
- X represents a vector of other factors and variables and;
- t represents time series periods

The empirical results of the unit root tests specified that the variables were nonstationary at levels and were therefore differentiated to conduct unit root tests at first differences. The variables were found to be stationary at first differences and integrated of order one. The empirical results of the OLS regression indicated that the effect of the banking size and credit lending is negative and has an insignificant impact on the efficiency of economic growth. Furthermore, the Granger causality test indicated that there is one-way causality running from the banking size to economic growth and from banking efficiency to economic growth. Therefore, the empirical results display a weak nexus between economic growth and the banking sector development. Moreover, Abugamea (2016) recommends that to improve economic growth, the banking sector lending policy needs to be more effective.

2.3.3. NARDL Studies

This section comprises of South African and international empirical studies that have utilised the NARDL model and outlines the specific methodologies of each, in order to develop an appropriate methodology upon which this study can be based. The studies discussed in this section do not analyse the co-movement of share prices and economic activity within a South African or international context and therefore places a gap in literature, which will be fulfilled by this thesis.

2.3.3.1. South African Studies

2.3.3.1.1. Masih (2018)

An empirical study by Masih (2018) examined the relationship between financial development and income inequality in South Africa over the period of 1975 to 2015. The study first utilised ADF, PP and KPSS unit root tests to examine the stationarity of the variables before proceeding with Engle-Granger and Johansen cointegration tests. Additionally, the ARDL and NARDL methodological techniques were employed to examine whether the variables exhibit symmetry or asymmetry.

As supported by Clarke (2006), Islam (2011) and Piraee (2013), banking sector development was used and proxied by domestic credit as a percentage of GDP. Additionally, domestic credit specified by the financial sector as a percentage of GDP was added as a control variable to also capture financial development. This is due to it measuring the role of all financial institutions in channelling funds to fund users thus tends to be a better indicator than domestic credit by banks only. As control variables, GDP per capita, trade as a percentage of GDP, inflation and government consumption expenditure was included. According to Masih (2018), the justification for the use of GDP per capita is that it is highly correlated with financial sector development.

The variables were first examined in level terms by using the ADF, PP and KPSS tests which indicated nonstationarity for some variables in level terms. Therefore, the nonstationary variables were first differenced and all displayed stationarity at first differences. Since the variables comprised of I(0) and I(1), Masih (2018) could proceed testing the series for cointegration, using the Engle-Granger and Johansen cointegration tests. However, due to the variables being both integrated of I(0) and I(1), the predictive power of these two cointegration tests are affected. The weakness of the Engel-Granger test is that it is designed to examine up to one cointegrating vector whilst on the other hand, the weakness of the Johansen cointegration test is the sensitivity to sample size. Therefore, these weaknesses justified the inclusion of the ARDL model in the study by Masih (2018).

The empirical findings of the ARDL bounds test displayed that there is a long-run cointegrating relationship present amongst the variables as the calculated F-statistic exceeds the upper critical bounds level. It was therefore concluded that the variables are cointegrated thus a long-run cointegrating relationship was present. The results also exhibited that economic growth is positively related to income inequality in South Africa but the increased trade to GDP is negatively related to income inequality and postulates that domestic trade-related factors play a key role in income inequality in the country.

The NARDL empirical results did not indicate the presence of short-run or long-run asymmetry in the affiliation between income inequality and financial development in South Africa. Therefore, indicating that economic growth has been severely low with a single digit increase in GDP and ultimately contributes to the income inequality issue. Masih (2018) also discovered the existence of a negative long-run relationship between GDP and income inequality which indicated the increase in market participation and plays a role in mitigating the income inequality problem. To the best of the author's knowledge, this is the first study in its context to demonstrate such a relationship within the South African environment and implies that there is no marginal difference between the positive and negative asymmetric effects.

2.3.3.1.2. Sarkodie and Adams (2020)

Sarkodie and Adams (2020) investigated the influence of the income level on inequality in the distribution of income and corruption control in South Africa, from 1990 to 2017 by utilising the Bayesian and NARDL approach. Sarkodie and Adams (2020) incorporated the concept of sustainable development to meet the research objectives of their study. As such, they adopted four data series based on the Sustainable Development Goals 7, 8, 10 and 16. The variables used in the study were GDP per capita, access to electricity, control of corruption and gross national income. The study by Sarkodie and Adams (2020) first employed the Jarque-Bera normality test, ADF and PP unit root tests as preliminary tests before the Bayesian and NARDL tests were conducted.

The empirical results of the Jarque-Bera test revealed that the null hypothesis of normal distribution cannot be rejected therefore the variables were normally distributed. The correlation coefficient displays a negative association between corruption control and the other remaining variables, whilst access to electricity displays a positive relationship with GDP per capita and inequality. Furthermore, both ADF and PP tests concluded that all the variables were nonstationary at levels. The variables were then differenced and the results revealed stationarity at first differences therefore the variables were integrated of order one. These results have fulfilled the preconditions for the NARDL testing.

Moreover, the empirical results of the Bayesian tests exhibited a negative relationship between the access to electricity and corruption as well as a positive influence of the income levels on energy consumption in South Africa. The authors concluded that the recent corruption surrounding the monopolistic power supplier, Eskom displayed how corruption in the country led to this power utility plummeting due to financial distress therefore leading to the results obtained. This led to a decline in investor confidence in South Africa's economy.

The NARDL empirical results exhibited asymmetric cointegration amongst the variables in the study. The long-run asymmetric impacts on the income level in the country revealed a positive impact on the electricity access. Furthermore, income inequality had a positive effect on accessibility and indicates that corruption has a critical impact on the access to electricity in the country. The authors concluded that economic development is vital along with effective financing, good governance and institutional quality.

2.3.3.1.3. Ahmad, Khattak, Khan and Rahman (2020)

A recent study by Ahmad, Khattak, Khan and Rahman (2020) examined the effects of positive and negative changes in technological innovation and aggregate domestic consumption spending on industrialisation in South Africa over the period of 1980 to 2014. Ahmad *et al.* (2020) utilised the ARDL and NARDL model in their methodological approach. All the variables were first converted into logarithmic forms before being analysed. Preliminary ADF and PP unit root testing was first conducted to examine the stationarity of the series before proceeding with the ARDL and NARDL modelling techniques.

The results of both the ADF and PP tests indicated that the variables were statistically insignificant at levels thus nonstationary at levels, but were stationary at first differences and integrated of order one. Additionally, as a pre-requisite, a VAR test for the optimal lag length selection was carried out and the empirical results displayed that 1 was chosen as the optimal number of lags based on the AIC.

The empirical results of the ARDL model demonstrated that in the long-run, the aggregate domestic consumption spending has a positive and significant effect on industrialisation. On the contrary, a significant and positive relationship was displayed between aggregate domestic consumption spending and industrialisation in the short-run. Therefore, postulating that the expansion of domestic consumption increased aggregate demand and generated an upsurge in industrial production. This advancement in domestic consumption has contributed to the process of industrial development. Moreover, the long-run coefficient of industrialisation has conveyed that technological innovation has a significant and positive effect on industrialisation in South Africa.

The NARDL empirical results presented in the study suggested that the positive shocks in the variables, technological innovation and aggregate domestic consumption spending, have a positive effect on industrialisation in the long and short-run. The results conveyed that an asymmetrical relationship between industrialisation and technological innovation, and between industrialisation and aggregate domestic consumption spending exists. The authors concluded that aggregate domestic consumption spending is a key factor for industrialisation in both the long and short-run which stipulates that the South African government should formulate policies to improve the household consumption and development of the industrial sector.

2.3.3.2. International Studies

2.3.3.2.1. Atil, Lahiani and Nguyen (2014)

Atil, Lahiani and Nguyen (2014) employed the NARDL model in their study, which was developed in the same year by Shin, Yu and Greenwood-Nimmo (2014) to observe the asymmetric pass-through of crude oil into gasoline and natural gas prices. The study comprised of monthly data of the spot closing prices for WTI crude oil, Henry Hub natural gas and gasoline ranging from January 1997 to September 2012. The commodity prices were expressed in US dollars. Atil *et al.* (2014) used the Jarque-Bera test of normality, Zivot-Andrews unit root tests and NARDL tests in their study.

The empirical results of the Jarque-Bera test demonstrated that the series were positively skewed and displayed significant excess kurtosis and as a result have wider and longer left tails than a normal distribution. The Jarque-Bera test concludes the non-normality of the series. Furthermore, the empirical results of the Zivot-Andrews unit root tests displayed that there were potential structural breaks in the series over the period of the study and these breaks can be characterised by economic crisis, terrorist and geopolitical events which are significant in this context. Additionally, the results indicated that the three-price series were nonstationary at levels but stationarity at first differences and integrated of order one. Thus, the series can be viewed as appropriate for the application of the NARDL model.

The NARDL results examined by Atil *et al.* (2014) observed that by utilising the spot prices, the oil price affects the natural gas and gasoline prices asymmetrically and nonlinearly. Therefore, an asymmetric reaction is exhibited in the long-run for natural gas and in the short-run for gasoline.

Thus, the gasoline absorbs the oil price shocks more quickly than natural gas does. Short-run asymmetry is rejected at the 5% significance level for oil and gasoline but not for the oil and natural gas relationship. Atil *et al.* (2014) concluded that the relationship between the gasoline and oil prices can be explained partially by the fact that gasoline is the resultant of crude oil and accounts for more than 60 percent of the cost. Additionally, asymmetry also occurs due to the constant spending adjustments which keeps the gasoline prices stable. A symmetric response is expected over the long-run since the supply of gasoline can be more easily adjusted. The overall findings by the authors concluded that their results were consistent with literature and stipulate that the linear models are misspecified and do not deliver an accurate fit to the underlying data.

2.3.3.2.2. Ibrahim (2015)

A study presented by Ibrahim (2015) analysed the relationship between food and oil prices in Malaysia by utilising the NARDL model over the period of 1971 to 2012. The corresponding variables used in the study were the oil price index; food price index, which is a component of the CPI and was used to capture the food price; and real income was represented by RGDP. Since the requirement of bounds testing is that no variables are to be integrated of order two, Ibrahim (2015) first made use of ADF and PP tests in order to test the stationarity of the variables.

The test included both constant and trend terms and SBIC was utilised to determine the optimal lag order for the ADF test. The empirical results of both the ADF and PP tests conveyed that RGDP and the oil price variables are integrated of order one. However, the food price variable exhibited stationarity in levels for the ADF test but the PP test indicates stationarity at first differences. As a result, none of the variables were I(2) therefore the author could proceed with the NARDL testing.

The NARDL model bounds test suggests a strong presence of cointegration amongst the variables of oil price, food price and the RGDP results presented evidence of asymmetry in both the long-run and short-run. Moreover, in the long-run, the oil price increase led to increase in the food prices whilst oil price decreases are not related to food prices. Similarly, in the short-run the oil price increases are significantly related to the food price inflation. The results of the low oil price pass-through can be related to public policy schemes, managed prices of critical food items and subsidies. Ibrahim (2015) concluded that since there is evidence that the oil price increase is significantly related to the food price. This could be due to the market power presence in the Malaysian food markets which is shaping the behaviour of the overall market.

2.3.3.2.3. Hu, Liu, Pan, Chen and Xia (2018)

Hu, Liu, Pan, Chen and Xia (2018) undertook a study by adopting the structural vector autoregression (SVAR) and NARDL model in their analysis to examine the long-run and short-run asymmetric effects of structural oil price shocks on the Chinese stock market, over a monthly period from 2004 to 2016. The SVAR model was introduced to literature by Kilian (2009) to identify aggregate demand shock, supply shock and oil market-specific demand shock amidst the oil price shocks.

As an important precondition in time series data, ADF tests were used to determine the stationarity of the data. The results indicated that all variables were nonstationary at levels hence the tests were conducted in first differences, where the variables indicated stationarity. The SVAR model was employed in their study to distinguish three demand and supply shocks. The SVAR model by Kilian (2009) can be displayed as follows:

$$A_0 X_t = \alpha + \sum_{i=1}^{n} A_i X_{t-i} + \varepsilon_t \tag{2.18}$$

Where:

- $X_t = (s_t; y_t; p_t)'; e_t = (e_{st}; e_{yt}; e_{pt})'$

The residual error e_t is in the reduced form and is uncorrelated with the variables.

The optimal lags selected by the AIC for the SVAR model was 4. The results displayed that supply shocks always fluctuated randomly during the entire period examined and the aggregate demand shock displayed a sharp decline due to the financial crisis in 2007/2008. Therefore, the empirical results of the study by Hu *et al.* (2018) revealed that the oil price movements are a result of aggregate demand shocks and oil market-specific shocks however, the supply shocks have little effect on the oil price.

The empirical results of the NARDL model displayed that there is no evidence of an asymmetric impact of the supply shock and the oil-specific demand shock on the Chinese stock market. Thus, only the aggregate demand shock has an asymmetric effect in the short-run. Moreover, the effects of the supply shock and aggregate demand shock on the Chinese stock index were insignificant in the long-run. It was concluded by Hu *et al.* (2018) that positive and negative oil market-specific demand shocks exert significant effects on the Shanghai Composite Index and the ShenZhen Component Index.

2.3.3.2.4. Rahman and Ahmad (2019)

A study by Rahman and Ahmad (2019) observed the relationship between the gross capital formation and carbon dioxide emissions in Pakistan over the period ranging from 1980 to 2016. Rahman and Ahmad (2019) employed the NARDL model in their analysis with the aim of determining whether the effect of the changes in gross capital formation on carbon dioxide emissions is asymmetric or not in Pakistan. Their study used annual data over the time period and examined the variables; GDP per capita, GDP per capita square, total oil use, gross capital formation; and total coal use as the independent variables whilst carbon dioxide emissions was used as the dependent variable.

ADF and PP tests were conducted by Rahman and Ahmad (2019) as an important pre-condition to determine the stationarity of the variables. The results displayed that all the variables were nonstationary at levels but were stationarity at first differences therefore these results permitted the NARDL tests to be run in their study. Moreover, the unit root tests often lead to spurious results by ignoring the presence of structural breaks. Thus, the authors performed the Zivot-Andrews unit root tests subsequently. The empirical results exhibited the structural breaks in the time series which were; 2006 for GDP per capita and GDP per capita squared; 2010 for gross capital formation; 2003 for total coal use and 2001 for total oil use.

In the presence of structural breaks, Rahman and Ahmad (2019) utilised a Brock, Dechert, and Scheinkman (BDS) (1996) independence test proposed by Brock *et al.,* (1996) to detect nonlinearity dependencies in time series data. The empirical results presented that the series were not identically and independently distributed (i.i.d.) thus a dynamic asymmetric framework is required to capture the structural shifts and nonlinear association amongst the variables. Moreover, since the authors concluded nonlinearity and structural breaks in the series, the NARDL model was utilised next.

The empirical findings of the NARDL model confirmed the existence of asymmetric effects of gross capital formation on carbon dioxide emissions in both the short-run and long-run. Furthermore, the results displayed that oil and coal consumptions contribute significantly to carbon dioxide emissions in the short and long-run. Therefore, Rahman and Ahmad (2019) concluded that the implementation and use of technology as well as clean energies are crucial for controlling pollution in Pakistan.

2.3.3.2.5. Ullah, Zhao, Kamal and Zheng (2020)

A research study by Ullah, Zhao, Kamal and Zheng (2020) investigated the impact that military expenditure changes have on the Chinese stock market development by employing the NARDL model. The study by Ullah *et al.* (2020) analysed the asymmetric relationship over the time period ranging from 1992 to 2017 and utilised the variables stock market development, stock market liquidity, market size growth and GDP in the context of their study. The authors first began their analysis by conducting ADF unit root tests in order to determine the stationarity of the variables. Thereafter, Zivot-Andrews unit root tests, BDS tests and the NARDL model was utilised.

The empirical results of the ADF unit root tests displayed that the variables GDP and stock market development were stationary at levels. The remaining variables were nonstationary and had to be first differenced. The ADF test was conducted again at first differences. The remaining variables proved to be nonstationary and integrated of order one. Since the variables in the study were I(0) or I(1), it was therefore appropriate to continue with the NARDL testing.

The Zivot-Andrews test results confirmed the existence of structural breaks in the time series data and these breaks can be linked to both international and domestic events. The structural breaks for the variables; stock market development, stock market liquidity and market size growth occurred in the years 2007 and 2008, and can be linked to the global financial crisis which had a negative impact on the stock markets worldwide. Ullah *et al.* (2020) confirmed that China’s financial and real sectors were severely affected by the global financial crisis. The break for military expenditure occurred in the year 2001 and was linked with the significant increase in the defence budget and the 9/11 terrorist attacks in the US which caused the Chinese B share market to plummet.

Additionally, the presence of structural breaks in the time series allows for the BDS test to be utilised. The empirical results of the BDS test confirmed the time series nonlinear dependencies as the null hypothesis was rejected of i.d.d. residuals across various dimensions. Therefore, the results exhibited a strong presence of nonlinearity and allows for the NARDL model to be utilised subsequently.

Ullah *et al.* (2020) conducted the NARDL tests and concluded that the relationship between stock market development and military expenditure is asymmetric in the long-run. Furthermore, the positive shocks of military expenditure are more significant than the negative shocks and exert a significant and positive effect on stock market development in China. The long-run negative shocks of military expenditure displayed a significant and negative effect on the stock market and demonstrated the importance of military expenditure towards the stock market development in China. The authors concluded that linear modelling would not have been suitable to highlight the hidden long-run asymmetric cointegration amongst the variables examined and indicated that the NARDL is a powerful model in comparison to conventional linear modelling.

The key purpose of this section was to provide a comprehensive insight into studies surrounding share prices and economic growth from both a South African and international perspective. The studies were reviewed in chronological order, dating back to the earliest studies being reviewed in 2006 and the most recent being reviewed in 2020. The studies reviewed in section 2.3.1 and 2.3.2 made use of linear tests only which is seen to be extremely limiting as these studies do not take into account the nonlinearity and asymmetric affects between the variables utilised. The studies reviewed in section 2.3.3 have been recently conducted and made use of the NARDL model however, none of the studies reviewed utilised the NARDL model in the context of this thesis therefore placing a gap in literature, both internationally and locally.

The empirical results of the linear studies that were critically reviewed in this section revealed that the variable GDP in all the studies was seen to be nonstationary in levels but stationarity at first differences. This indicates that GDP is anomalistic and rarely stationary which confers to the literature reviewed (Cuestas and Garratt, 2011). Furthermore, most of the other variables that were utilised in each study was also seen to be nonstationary at levels but stationary at first differences. This stipulates that the variables are nonstationary in levels when using conventional unit root tests thus integrated of order one. Thereafter, the authors conducted tests for cointegration.

The tests for cointegration examined the long-run relationships amongst the variables in each study as well as the magnitude of the relationships. The results exhibited that for the studies conducted in South Africa, a positive and strongly significant cointegrating relationship exists between the stock market and economic activity. Moreover, this postulates that economic activity in South Africa is influenced by stock market fluctuations and economic growth plays a vital role in the price of stocks in the long-run.

On the other hand, four international studies opposed this viewpoint as the relationship was either very weak and insignificant or there was a negative relationship amongst the variables employed, which stipulates that the economic activity is not influenced by the stock market internationally. The studies by Gan *et al.* (2006) and Carp (2012) concluded that a weak and insignificant relationship existed amongst the variables therefore the stock prices within the countries examined did not contribute to economic growth.

Furthermore, the remaining international studies reviewed coincided with the South African studies reviewed and stipulated that there is a positive and strong link between economic growth and the stock market fluctuations. Therefore, the main findings of the studies that were comprehensively reviewed on the topic of share prices and their influence on economic activity, exhibited that majority of the studies postulate that economic activity is largely and strongly influenced by fluctuations in the stock market. Therefore, the stock market is a key factor for determining the magnitude for economic growth in the long-run. Contrastingly, there was evidence exhibited by four studies that opposed this viewpoint.

From the studies reviewed on the NARDL model, it can be seen that there are recent yet limited studies from an international and more especially from a South African context, with the earliest study being conducted in 2018 in South Africa. The authors that undertook international or South African studies that employed the NARDL model, concluded that the NARDL provided more statistically powerful and relevant results than the previous studies which only employed conventional linear tests, based on the recent studies by Ibrahim (2015), Ullah *et al.* (2020) and Ahmad *et al.* (2020). Therefore, this stipulates that the NARDL model is fairly recent and a relevant topic in literature upon which this thesis will be a novel contribution. Amongst the 8 studies reviewed that employed the NARDL methodology, only the study by Masiah (2018) concluded that there was no presence of long-run or short-run asymmetries in the study and the author noted that this is the first study in its context to not exhibit such a relationship, especially within the South African environment. The other 7 studies that were comprehensively reviewed, demonstrated that asymmetric effects play a key role in the context of each study and it would be detrimental not to examine such an effect that could impact the outcome of the results significantly.

Therefore, this thesis aids to re-examine an existing issue by using a more comprehensive analysis by taking into account nonlinearity and asymmetric effects in relationship between economic growth and stock market fluctuations, which has not been conducted thus far and furthermore not conducted in a South African context. Hence, this thesis will be the novel contribution to South African literature. After extensively reviewing literature surrounding this topic, the methodology of this study will be discussed in the subsequent chapter and elaborates on the development of each model in explicit detail.

CHAPTER 3: METHODOLOGY

3.1. Overview

The purpose of this thesis, as mentioned earlier, is to examine the nonlinearity and asymmetric effects of the relationship between stock market fluctuations and economic growth in South Africa. The methodology of this study is quantitative in nature and describes the techniques used to observe the relationship between share price movements and economic growth. Whilst the preceding chapters outlined the theoretical foundations and empirical superiority of nonlinearity and asymmetric effects against the conventional linear tests, this chapter describes the empirical analysis and methodological techniques that will be utilised to answer the following questions:

1. Does a cointegrating relationship exist between stock market returns and economic growth in South Africa?
2. How do fluctuations in the stock market affect economic growth in South Africa (and vice versa)?
3. Does the relationship between economic growth and stock market returns exhibit evidence of asymmetric adjustment?
4. Does the relationship between economic growth and stock market returns exhibit evidence of structural breaks?

The empirical evidence in Chapter 2 exhibited that the conventional linear tests conducted thus far from both an international and South African perspective are inferior to the nonlinear model. The methodological limitations of the studies reviewed displays a gap in literature by employing conventional linear tests only. Therefore, this chapter aids in filling the literature gap by placing emphasis on the NARDL model, when the linearity assumption is relaxed. The methodology of this study will be based on a primary analysis of the overarching relationship between share prices and economic growth and thereafter a sectoral analysis of the sectoral indices on the JSE and economic growth, within a South African context.

3.2. Data Selection

3.2.1. Primary Analysis

The dataset used in this study comprises of quarterly data for GDP in South Africa. Following the methodology of Sayed *et al.* (2017), quarterly data is opted for use for GDP, as it is represented by quarterly data only. The data utilised for GDP will be attained from the Reserve Bank of South Africa Bulletin and StatsSA respectively and will be adjusted for inflation to obtain RGDP from year 1999 to 2019. The variable defined below represents economic activity:

- Real GDP: YoY growth rate of South Africa's real, quarterly GDP.

Previous studies that were performed in South Africa, conservatively use the JSE ALSI as an appropriate stock market proxy. According to the methodology presented by Sayed *et al.* (2017), the stock market is represented by the ALSI for this study and is first adjusted by utilising the CPI to deflate the prices of shares and thereafter, a YoY% change is calculated to display the data in real terms. Furthermore, the research conducted by Page (1986) and van Rensburg and Slaney (1997) indicated that the main practical feature that is exclusive to the JSE is the ambiguity of the data generating process that underlies the mining and industrial shares. Van Rensburg and Slaney (1997) have documented the All-Gold Index and the JSE Industrial index, as appraised bases of risk in a two-factor APT model. The stock market proxy for the price indices in this study was obtained from the McGregor BFA library and the JSE.

3.2.2. Sectoral Analysis

In addition to the primary analysis, a sectoral analysis is employed to examine the relationship between the sectoral indices on the JSE and economic growth in South Africa, thereby introducing stock market segmentation in this study. In March 2000, the JSE was reclassified and listed all the instruments into sectors of namely; Financials, Resources and Industrials. These sector indices divided the All-Share Index components rendering to their South African sector categorisation (Mangena and Chamisa, 2008). This South African sector categorisation is obtained from the Industry Classification Benchmark. The Financial Index comprises of JSE listed firms that specialises in financial services, banking and insurance. The Industrial Index comprises of the firms which are remaining (Russell, 2017).

The variables used to represent the stock market include namely; INDI, FINI and RESI. Similarly, following the methodology by Sayed *et al.* (2017), the collected share price statistics are first adjusted by utilising the CPI to deflate the prices of shares and subsequently, a YoY% change is calculated to display the data in real terms. The stock market indices were obtained from McGregor BFA library and the JSE.

Lastly, the sample period for this study starts in January 1999 and ends in December 2019 respectively. This particular sample period was chosen for this study as it is a large enough time period to obtain accurate results due to data availability and takes into consideration the significant events in South Africa that occurred within those particular years such as, the reclassification of the JSE in March 2000 as well as the 2007/2008 financial crisis, once trade sanctions had been lifted in the post-apartheid era.

3.3. Adjusting for Inflation

As expressed earlier, this study utilises real values therefore it is critical to elaborate on the difference between both nominal and real rates as well as the method of adjusting for inflation (Bandura, 2020). Nominal rates are rates of return or interest rates that are not inflation adjusted whereas real rates are rates of return or interest rates have been adjusted for inflation. Therefore, the Fisher effect stipulates that the real interest rates are equal to the nominal interest rates subtracted by the inflation rate. Real interest rates differ from nominal interest rates by the rate of inflation. The Fisher effect exhibits the relationship between real returns, nominal returns and inflation, and is displayed as follows (Valcarcel, 2012):

$$1 + R = (1 + r) \times (1 + h) \tag{3.1}$$

Where:

- r = the real return;
- R = the nominal return and;
- h = the inflation rate

In order to solve for the real return:

$$r = \left[\frac{(1+R)}{(1+h)}\right] - 1 \tag{3.2}$$

Hence, the following equation is used to adjust the nominal stock prices for inflation:

$$RP_t = \frac{NP_t}{(1+h_{SA})} \tag{3.3}$$

Where:

- NP_t = nominal stock prices;
- RP_t = real stock prices and;
- h_{SA} = monthly changes in the CPI in South Africa

3.4. Model Specification

This study makes use of various different methodological techniques in order to achieve its objectives and is subdivided into three parts. Part A discusses the various preliminary testing; Part B discusses testing for cointegration while accounting for structural breaks in the relationship and Part C discusses the testing for cointegration while accounting for asymmetric adjustment in the relationship by utilising the NARDL model. It is imperative to note that the structural break tests consider a linear model, however, the NARDL considers a nonlinear model and is the focal point of this study.

Furthermore, the following tests will be employed in this study in order to examine the relationship between the stock market fluctuations and economic growth namely; a VAR analysis, ADF nonlinear unit root tests, Zivot-Andrews unit root tests, Bai-Perron structural break tests, Gregory-Hansen cointegration tests, CUSUM tests, heteroscedasticity test, serial correlation test as well as the ARDL and NARDL approach will be applied. The NARDL and ARDL model are utilised for comparative purposes to establish the long-run relationships amongst the variables and the difference between the models when the linearity assumption is relaxed. These tests are initially applied to the overarching relationship between the ALSI and RGDP, and subsequently the sectoral relationships.

3.4.1. Part A: Preliminary Testing

In econometric analysis, preliminary testing is crucial to examine the structure of the relationship to be estimated. This testing involves the dynamic structure of the relationship between the variables and the functional form connecting the variables (Mukoka, 2018). This section describes the preliminary tests that are applicable to this study and provides a detailed description of each.

3.4.1.1. Lag Length Selection

The selection of lag lengths is critical in regression analysis as a lag length that consists of too few lags means that the regression residuals do not behave like a white-noise process while on the other hand, the addition of too many lags reduces the power of the test to detect a unit root (Liew, 2004). Therefore, this depicts that the increase in the number of lags entails the approximation of additional parameters and a loss of degrees of freedom. To establish that the correct number of lags are selected in this study, information criteria is utilised to identify the lag length. Therefore, the various types of information criteria comprise of AIC, SBIC and the Hannan-Quinn Information Criterion (HQIC) (Bruns and Stern, 2019). The equations in which each of these information criteria are calculated, is as follows (Brooks, 2014):

$$AIC = \ln(\sigma^2)\frac{2k}{T} \tag{3.4}$$

$$SBIC = \ln(\sigma^2)\frac{k}{T}\ln T \tag{3.5}$$

$$HQIC = \ln(\sigma^2)\frac{2k}{T}\ln(\ln(T)) \tag{3.6}$$

Where:

- T = the sample size;
- k = the total number of parameters estimated and;

- σ^2 = the residual variance

These three models vary in the degree of strictness displayed in the penalty term. AIC typically chooses larger models as it has the least stringent penalty term, in comparison to SBIC which has the most stringent penalty term, thus penalises the addition of parameters less (Bruns and Stern, 2019). The strictness of HQIC falls in between. SBIC is therefore preferable in a larger sample due to its consistency which means asymptotically it will select the correct model order whereas AIC is preferable in a smaller sample as it is more efficient in a smaller sample size. The consistency of SBIC is not applicable when the sample size is small (Konishi and Kitagawa, 2008).

The combination of these information criteria is utilised to assess that there are no conflicting results. Therefore, AIC and SBIC differ in accordance to the number of parameters in a model. SBIC induces a higher penalisation for models with a higher parametrisation in comparison to AIC (Mangan, Kutz, Brunton and Proctor, 2017). In the fitting of models, likelihood is increased by the addition of parameters however, doing so could result in overfitting. Therefore, SBIC and AIC attempt to resolve this issue by introducing a penalty term for the number of parameters in a model. The penalty term is larger in SBIC than AIC. According to Stock and Watson (2007) it is recommended that the model suggested by AIC should be chosen rather than SBIC if conflicting results arise. Stock and Watson (2007) argue that the inclusion of more parameters is better than omitting significant parameters.

Furthermore, when the abovementioned information criteria suggest different lag lengths, the R^2 and adjusted R^2 can be viewed as the information criteria (Han, Phillips and Sul, 2017). The R^2 value represents the proportion of the total variation in the asset returns and is also termed the coefficient of determination. This is further explained by the explanatory variables in the regression model and can be calculated as follows (Konishi and Kitagawa, 2008):

$$R^2 = \frac{1 - RSS}{TSS} \tag{3.7}$$

Where:

- RSS = the residual sum of squares in the regression and;
- TSS = the total sum of squares

The RSS measures the variation accountable to the relationship amongst the asset returns and the explanatory variables whereas the TSS measures the variation of the asset returns around its mean value (Han *et al.,* 2017). The R^2 value is easy to interpret; however, this criterion's value increases with the number of explanatory variables in the model therefore it often favours larger models (Mukoka, 2018). Hence, the adjusted R^2 was conveyed as a measure of the goodness of fit of the model which is adjusted for the number of explanatory variables in the model (Mangan *et al.,* 2017) The adjusted R-squared can be utilised as long as the lag structure follows the basis of financial theories and is expressed as follows (Konishi and Kitagawa, 2008):

$$R^2 adj = 1 - \left[\frac{(1 - R^2)(n - 1)}{(n - k - 1)}\right] \tag{3.8}$$

Where:

- k = the number of explanatory variables and;
- n = the number of observations

The abovementioned criteria will be employed in this study to examine the appropriate lag length in the regression analysis. It is imperative to note that the lag length selection is applicable to the VAR, while the ARDL and NARDL can endogenously calculate lags in EViews (2020). Lag length selection is a crucial test for confirming the appropriate number of lags to be included in the analysis of unit root tests, which will be discussed subsequently.

3.4.1.2. Nonlinear Unit Root Tests

In time series data, the testing of unit roots is essential to affirm the stationarity of the series in order to avoid a spurious regression outcome. Dickey and Fuller (1979) first introduced the use of unit root tests in literature. However, conventional unit root tests show a propensity to be nonstationary in the case of nonlinearity and structural breaks (Meng, Strazicich and Lee, 2017). A structural break occurs when there is an unexpected change in a time series or relationship between two time series (Solarin and Lean, 2016). A structural break could occur in the event of an unexpected or unique economic shock and can reflect legislative, technical or institutional change (Meng *et al.,* 2017).

Consequently, the change in testing was presented by Perron (1989). According to Perron (1989), conventional unit root tests will show a propensity to be nonstationary in the circumstance of a structural break. Perron (1989) exhibited that the ADF tests are subject to size distortion and misspecification bias when the designated series undergo structural shifts (Cuestas and Regis, 2013). This leads to a spurious acceptance of the unit root hypothesis. However, this limitation is overcome by allowing for a single structural break based on the assumption that the breakpoints are exogenously determined (Aslan and Kum, 2011). Therefore, Perron (1989) illustrates that unit roots and structural change are closely related and consequently, conventional unit root tests are biased towards the data in the circumstance of a structural break (Meng *et al.,* 2017).

Perron (1989) formulated a technique to test a series for the occurrence of an exogenous structural break when the break arises at time $1 < T_b < T$ and was carried out by using the Dickey and Fuller (1979) test. The null hypothesis is that the series contains a unit root with drift whilst the alternative is that there is no unit root present (Moores-Pitt, 2018). Therefore, the series can be viewed as stationary around a deterministic time trend with an exogenous change in the trend function at time T_b. It has been demonstrated by Perron (1989) that conventional unit root tests are unreliable in the event of the alternative being a stationary noise factor with a break in the slope of the deterministic trend (Aslan and Kum, 2011). Therefore, the tests are less suitable than traditional tests when there is no break present. On the other hand, these tests are consistent regardless of whether a break is contained in the series or not and furthermore postulates results that are independent of the break magnitude (Moores-Pitt, 2018).

The order of integration describes whether the data is stationary or not and this integration level can be displayed as follows (Salisu and Isah, 2017):

$X_t \approx I(d)$

Where: d represents the order of integration.

The order of integration depicts the number of unit roots in a series or the number of differencing operations to make a variable stationary. If d = 0, X_t is integrated of order 0, I(0) and the variable is stationary; and if d ≥ 1, the series is integrated of order 1, I(1) or higher and is nonstationary (Salisu and Isah, 2017).

Thereafter, a Dickey-Fuller test equation can be determined which includes both hypotheses:

$$y_t = \mu + \beta_t + \theta DU_t(T_b) + \gamma DT(T_b) + \theta D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} \rho \Delta y_{t-i} + \varepsilon_t \tag{3.9}$$

EViews 11 (2020) compensates for a modified ADF test which allows for levels and trends that differ across a single break date. These tests can be computed where the break can occur gradually or instantly; the break consists of a level shift, a trend break, or both a shift and trend break; the break date is known, or the break date is unknown and is estimated from the data (Salisu and Isah, 2017). This framework considers a variety of specifications for the null and alternative hypothesis, depending on the assumptions made about the break dynamics, trend behaviour and taking into consideration whether the break date is known (Solarin and Lean, 2016). In this study, the ADF model used will allow for a slope and intercept change to occur simultaneously and this allows for a time change in both the slope and level. Therefore, taking into account the structural break dynamics, the null and alternative hypothesis are depicted subsequently.

H_0 = the series contains a structural break with a unit root in both the intercept and the trend

H_A = the series is stationary

Thereafter, a VAR analysis will be utilised which analyses the relationships between the changes of variables over time.

3.4.1.3. VAR Analysis

The literature by Dao, Staszewski and Klepka (2017) stipulated that the VAR model is suitable for describing the dynamic behaviour of financial and economic time series. The VAR regression is a dynamic system of equations in which the current variable employed depends on past movements in that variable and all the other variables in the system (Ampountolas, 2019). In the VAR model, the equation includes the variable's lagged values, the lagged values of the other variables in the model, and an error term. The generalised VAR model with k lags, is specified as:

$$y_t = c + b_1 y_{t-1} + b_2 y_{t-2} + \cdots + b_k y_{t-k} + u_t \tag{3.10}$$

The VAR model is used to capture the affiliation between numerous quantities as it changes over time (Emerson, 2007). This model is a type of stochastic process whereby it generalises a univariate model by allowing for a multivariate time series. The VAR equation comprises of a variable's lagged values, the lagged values of the other variables within the model and a white noise error term, u_t (Ampountolas, 2019). Therefore, the model describes the evolution of an endogenous set of variables over time. The dependent variable is thus a part of a system of simultaneous equations and can be displayed as follows (Mangan *et al.,* 2017):

$$ALSI_{1t} = \beta_{10} + \beta_{11} RGDP_{it-1} + \cdots + \beta_{ik} RGDP_{it-k} + \alpha_{11} ALSI_{jt-1} + \cdots + \alpha_{ik} ALSI_{jt-k} + \mu_{it} \tag{3.11}$$

$$RGDP_{2t} = \beta_{20} + \beta_{21} ALSI_{jt-1} + \cdots + \beta_{j2k} ALSI_{jt-k} + \alpha_{21} RGDP_{it-1} + \cdots + \alpha_{jk} RGDP_{it-k} + \mu_{jt} \tag{3.12}$$

Where:

- μ_t is the white noise disturbance term, with $E(\mu_{it}) = 0$, $I = 1, 2$; $E(\mu_{1t}\,\mu_{2t}) = 0$

Impulse response functions trace the dynamic effect to a "shock" or a change to an input in a system (Solarin and Lean, 2016). The purpose of impulse response functions in regression analysis is due to the following reasons. Firstly, impulse response functions are consistent with the use of theoretical economic and finance models since outcomes change in the face of exogenous changes. Secondly, it can be utilised to forecast the implications of key policy changes in a macroeconomic framework (Ampountolas, 2019). Lastly, it utilises structural restrictions which allow modelling theoretical relationships in the economy. Therefore, in stationary systems the shocks to the system are not persistent and over time the system converges. As a result, it may or may not converge to the original state, depending on the restrictions imposed on the structural VAR model (Mangan et al., 2017). Impulse response functions will be utilised in this study to examine the change to an input in the model.

In addition, recent literature has exhibited use of the Zivot-Andrews (1992) unit root test which displays a variation on Perron's (1989) original test by considering the time of the break as unknown. The Zivot-Andrews (1992) unit root test will be employed in this study which accounts for structural breaks in the underlying relationship.

3.4.2. Part B: Testing for Cointegration While Accounting for Structural Breaks

This section of the methodology explores the notion of structural break testing. A key aspect of structural break testing is that it only considers the use of linear models to test for the occurrence of structural breaks within the relationship (Raza and Afshan, 2017). As a result, the Zivot-Andrews unit root tests, the Bai-Perron structural break tests and the Gregory-Hansen cointegration tests will be elaborated on further.

3.4.2.1. The Zivot-Andrews Unit Root Test

As discussed in section 3.4.1.2., conventional ADF tests have a tendency of being biased towards a conclusion of a unit root in the presence of a structural break. The shock could have a permanent effect on the series and the condition worsens if the series is stationary (Khan, Hou and Le, 2020). This effect arises due to the shock initially having a transitory effect and the existence of a structural break in the series will therefore make the shock have a permanent effect, which indirectly leads to the non-rejection of a unit root (Baum, 2015).

Based on the assumption that the time of the break is an exogenous phenomenon, Perron (1989) exhibited that the power to reject a unit root significantly decreases when the structural break is ignored and the stationary alternative holds true. Zivot and Andrews (1992) proposed a variation and improve on Perron's (1989) original test by treating the exact time of the break as unknown (Rahman and Saadi, 2008). The Zivot-Andrews test is a variation of Perron's (1989) test which allows the breakpoint to be estimated rather than fixed by utilising a data dependent algorithm to proxy Perron's (1989) methodology in order to determine the structural break (Baum, 2015). This variation of the test allows for the simultaneous testing for the presence of a structural break within the series and is considered to be a key advantage over conventional linear tests. The Zivot-Andrews test observes the null hypothesis of a unit root against the alternative hypothesis of a trend stationary process with a structural break (Khan *et al.,* 2020).

The Zivot-Andrews test proceeds with three models to test for a unit root. Model A permits a one-time change in the level of the series; Model B permits a one-time change in the slope of the trend function; and Model C combines the one-time changes in the level and slope of the trend function of the series. In essence, Model C essentially captures the functions of both Models A and B simultaneously (Moores-Pitt, 2018). In the event where the unit root captured in Model C is rejected, testing is reverted to Models A and B. Therefore, the null hypothesis of each model are as follows; for Model A, the null hypothesis is a structural break with a unit root in the intercept, for Model B the null hypothesis is a structural break with a unit root in the trend and for Model C the null hypothesis is a structural break with a unit root in both the intercept and trend (Baum, 2015). According to Zivot-Andrews (1992), these models are presented subsequently:

Model A: Intercept

$$\Delta y_t = \mu + \theta DU_t(\tau_b) + \beta_t + \alpha y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-1} + e_t \tag{3.13}$$

Model B: Trend

$$\Delta y_t = \mu + \gamma DT_t(\tau_b) + \beta_t + \alpha y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-1} + e_t \tag{3.14}$$

Model C: Intercept and Trend

$$\Delta y_t = \mu + \theta DU_t(\tau_b) + \beta_t + \gamma DT_t(\tau_b) + \alpha y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-1} + e_t \tag{3.15}$$

Where:

- Δ is the first difference operator;
  e_t is the white noise disturbance term;
- The breakpoint (τ_b) is estimated using an OLS methodology for T = 2, 3, …T – 1;
- *k* represents the number of lagged first-differences;

- τ_b is chosen by the minimum t- statistic;
- DUt (τ_b) is a sustained dummy variable that captures a shift in the intercept; and
- DTt (τ_b) is a corresponding trend shift variable occurring at time τ_b and is defined as follows:

$$DU_t(\tau_b) = \begin{pmatrix} 1 & if\ t > \tau_b \\ 0 & otherwise \end{pmatrix} \quad \text{and} \quad DT_t(\tau_b) = \begin{pmatrix} t - \tau_b & if\ t > \tau_b \\ 0 & otherwise \end{pmatrix}$$

In all three models, the null hypothesis $\alpha = 0$, indicates that the series (y_t) comprises of a unit root with drift that excludes a structural break. The alternative hypothesis $\alpha < 0$, indicates that the series is a trend stationary process with a one-time break occurring at an unknown point in time (Khan *et al.,* 2020). Furthermore, the Zivot-Andrews test regards every point as a possible break date (τ_b) and a regression is run for every possible break date sequentially. This procedure selects a break date from all possible breakpoints which minimizes the one-sided t-statistic (Rahman and Saadi, 2008).

The Zivot-Andrews endogenous structural break test uses a different dummy variable for each possible break date. The break date is selected where the ADF t-statistics of a unit root is at its minimum and the break date will be selected where the evidence is least favourable for the unit root null (Baum, 2015). The minimum t-statistic for the Zivot-Andrews unit root test has its own asymptotic theory and critical values. The critical values are more negative than those given by Perron (1989) and may propose more difficulty in rejecting the unit root null.

The testing of unit roots is utilised to demonstrate if the dataset should be regressed or first differenced on the deterministic time functions in order to render the data stationary. In economic theory, it has been suggested by Baum (2015) and Meng *et al.* (2017) that the nonstationarity of data proposes long-run relationships amongst the variables. Whereas the Zivot-Andrews test accounts for a one-time structural break occurring at an unknown point in time, Bai-Perron (2003) proposed a test to account for multiple structural breaks in a linear model. The phenomenon of multiple structural break testing will be discussed in detail in the subsequent section.

3.4.2.2. Bai-Perron Structural Break Test

It is imperative that structural break models be considered as part of any time series analysis as it is an essential modelling method (Inoue and Rossi, 2011). In literature, there is evidence supporting both the detrimental impacts of disregarding structural breaks and the prevalence of structural breaks in time series data. There are various studies that displayed evidence of structural breaks impacting forecast performance. A study by Pettenuzzo and Timmermann (2011) exhibited that the inclusion of structural breaks in asset allocation models improve the long-horizon forecasts and disregarding the breaks can lead to large welfare losses.

Macroeconomic time series can comprise of more than one structural break. Bai and Perron (2003) estimated multiple structural changes in a linear model. The results are attained within a framework of partial structural changes that allows a subset of the parameters to remain unchanged (Raza and Afshan, 2017). The testing for multiple structural changes under general conditions of the data and the errors is also addressed by a method that allows the testing of the null hypothesis of L changes against the alternative hypothesis of L + 1 changes and testing of the null hypothesis of no change against an alternative of pre-specified number of changes (Weideman, Inglesi-Lotz and Van Heerden, 2017). This thesis will apply the Bai-Perron test of L vs. L + 1 sequentially determined breaks as it is statistically useful by permitting detail to a general modelling strategy to consistently determine the appropriate number of changes in the data. Furthermore, the tests can be generated to allow for different serial correlation of errors, diverse distribution of the data as well as errors across the segments (Weideman *et al.,* 2017).

The Bai and Perron (2003) methodology can be decomposed into two distinct parts. Firstly, any number of structural breaks can be identified in the time series dataset despite the statistical significance. Secondly, once the structural breaks have been identified a series of statistics are used to test for the statistical significance of the breaks by utilising asymptotic critical values (Westerlund and Edgerton, 2008). The Bai and Perron (2003) analysis can be portrayed by the following multiple linear regression with m breaks (m + 1 regimes).

$$y_t = x_t\beta + z_t\delta_i + u_t \tag{3.16}$$

$$y_t = x_t\beta + z_t\delta_j + u_t$$

(3.17)

$$y_t = x_t\beta + z_t\delta_{m+i} + u_t$$

(3.18)

$$t = T_{j-i} + 1 \dots . T_j$$

(3.19)

Where:

- The dependent observed variable is y_t at time t;
- $x_t(p \times 1)$ and $z_t(q \times 1)$ are the vectors of covariates;
- β and δ (j =1.....m + 1) are the corresponding vectors of coefficients and;
- u_t is the white noise disturbance at time t

The indices ($T_{1,...,}T_m$), also referred to as the break points are considered as unknown (the convention that $T_0 = 0$ and $T_m + 1 = T$). The key function is to estimate the unknown regression coefficients together with the break points (β, δ_i,…,$T_{i...}T_m$) when T observations on ($y_{t;}$ $x_{t;}$ z_t) are obtainable.

The Bai and Perron method includes finding the best mix of 'T' possible breaks exposed to the constraint that separation between break interims should be above some minimum length. The Bai and Perron test is utilised to test the null of T breaks against the alternative of T + 1 breaks. This test is done originally for T = 0 and the null is rejected for T = 1, 2 etc. until the test fails to reject the null (Arai and Kurozumi, 2007). The strategy yields the ideal number of breaks and OLS evaluations of the mean unemployment rate during each interval and therefore these means serve as the natural rate estimates (Westerlund and Edgerton, 2008).

Over the past decade, economic literature has witnessed an increase in the testing for structural breaks in time series (Ceesay and Fanneh, 2019). In a nonstationary framework, Gregory and Hansen (1996) propose a test of cointegration that accounts for a single endogenous structural break of an unknown timing in the cointegrating vector. This is modelling technique is further elaborated on subsequently.

3.4.2.3. Gregory-Hansen Cointegration Test

Cointegration is a vital tool for modelling long-run relationships in time series datasets and determining whether correlation exists between several datasets. Economic theory proposes that various time series datasets will move together, shifting around a long-run equilibrium (Gregory, Nason and Watt, 1996). In econometrics, this long-run equilibrium is tested and measured using the concept of cointegration. Two series are considered to be cointegrated if a linear combination results in an equilibrium relationship through an error correction mechanism (Bilgili, 2012). Therefore, two I(1) series are cointegrated if some linear combination of both results in a I(0) series. Whenever the series deviates from this equilibrium, the error correction mechanism restores equilibrium (Sadeghi and Ramakrishna, 2014).

Gregory and Hansen (1996) posed a method to allow a structural break into the estimation of a cointegration model with a single equation approach framework as opposed to a multivariate one. This permits a verification of the hypothesis in a generalised framework and to perform an analysis of the long-run properties of the dynamics (Bilgili, 2012). The Gregory-Hansen test is an extension of the Engle and Granger (1987) and Johansen and Juselius (1990) residual tests for cointegration that allows for unknown regime shifts in either the intercept or the coefficient vector. The conventional Engle and Granger (1987) test tends to under-reject the null hypothesis of no cointegration in the presence of a single regime shift (Narayan, 2005).

Considering the pivotal effects of a potential structural break in a series, the Gregory-Hansen method is essential in determining the most significant structural break amongst the relationships in a time series analysis. It is of importance to test for a structural break within a series to account for the unexpected change over time in the parameters of the models as this could lead to forecasting errors and unreliability of the model (Sadeghi and Ramakrishna, 2014). In order to test whether cointegration holds over a period of time but eventually shifts to a new long-run relationship, this test is used and the timing is treated as unknown (Bilgili, 2012).

The null hypothesis of no cointegration is maintained from conventional tests whereas the alternative hypothesis differs. The Gregory-Hansen model has enticed the possibility of regime shifts where several series are cointegrated but the cointegrating vector shifted during the sample period at an unknown time (Ceesay and Fanneh, 2019). It is a variant of the conventional cointegration tests, as standard tests assume that the cointegrating vector is time-invariant. The standard model of cointegration with a trend and no structural change is depicted subsequently (Dar and Asif, 2018).

$$y_{it} = \mu + \beta_t + \alpha^T y_{jt} + \varepsilon_t \tag{3.20}$$

Where:

- t = 1, …, n;
- y_{it} = I(1) and;
- ε_t = I(0)

The problem of estimating cointegrating relationships in the presence of a potential structural break is addressed by Gregory and Hansen by introducing a residual based technique. However, it is more reasonable to consider cointegration as holding over a longer period and then shifting to a new long-run relationship (Ceesay and Fanneh, 2019). Therefore, the timing of the shift is unknown but can be determined endogenously. To model a structural change, Gregory and Hansen (1996) defined the indicator variable as follows:

$$\varphi_t = \begin{cases} 0, & if\ t \leq [n\tau] \\ 1, & if\ t > [n\tau] \end{cases}$$

Where:

- The unknown parameter $\tau \in (0, 1)$ depicts the relative timing of the change point and;
- [ ] depicts the integer part

The Gregory-Hansen cointegration approach is an extension of similar tests with unit roots that account for a structural break such as the Zivot and Andrews (1992) unit root tests. Gregory and

Hansen exhibit cointegration tests that accommodates a single endogenous break in an underlying cointegrating relationship (Esso, 2010). Thus, in order to test for cointegration in the presence of a structural break, the following four models were proposed. The following four models incorporate the assumptions about the specifications of structural breaks (Bilgili, 2012).

Model 1: Level Shift

$$Y_t = \mu_1 + \mu_2 D(T_b) + \alpha_1 X_t + e_t \tag{3.21}$$

Model 2: Level Shift with Trend

$$Y_t = \mu_1 + \mu_2 D(T_b) + \beta_1 t + \alpha_1 X_t + e_t \tag{3.22}$$

Model 3: Regime Shift where the Slope and Intercept coefficients change

$$Y_t = \mu_1 + \mu_2 D(T_b) + \beta_1 t + \alpha_1 X_t + \alpha_2 X_t D(T_b) + e_t \tag{3.23}$$

Model 4: Regime Shift where the Slope, Intercept and Trend change

$$Y_t = \mu_1 + \mu_2 D(T_b) + \beta_1 t + \beta_2 t D(T_b) + \alpha_1 X_t + \alpha_2 X_t D(T_b) + e_t \tag{3.24}$$

Where:

- Y is the dependent (RGDP) and X is the independent (ALSI) variables;
- t is the time subscript;
- μ_1 represents the intercept before the shift;
- μ_2 represents the change in the intercept at the time of the shift;
- β_1 is the trend slope before the shift;

- β_2 is the change in the trend slope at the time of the shift;
- α_1 is the cointegrating slope coefficient before the regime shift;
- α_2 is the change in the cointegrating slope coefficient at the time of the regime shift and;
- e_t is the white noise disturbance term;

The dummy variable is $D(T_b) = 1 if\ t > T_b$ and 0 otherwise, where the unknown parameter T_b denotes the timing of the change point.

The Gregory and Hansen (1996) test consists in computing the standard ADF and PP Zt and Za cointegration tests which allow for a one-time structural break of unknown timing in either the intercept alone or the intercept and slope (Bilgili, 2012). Moreover, the null hypothesis of no cointegration with structural breaks is tested against the alternative of cointegration and the break date is endogenously determined. The unknown break point is determined when the unit root statistics are at a minimum (Esso, 2010). The Gregory-Hansen test is able to simultaneously account for cointegration as well as the most significant structural break in the series. This will postulate the possible effect that the structural breaks have had on the relationship between share price fluctuations and economic activity over time, within a South African context. In this study, the Gregory-Hansen level shift and trend test will be employed to establish the most significant structural break within the underlying relationship.

3.4.3. Part C: Testing for Cointegration While Accounting for Asymmetric Adjustment

This section of the methodology explores the notion of testing for nonlinearity and asymmetric adjustment in the relationship. The literature reviewed in Chapter 2 of this study, revealed that conventional linear tests are inferior to the nonlinear model. Therefore, this chapter first provides a detailed explanation of the linear ARDL model and subsequently the NARDL model thereafter, when the linearity assumption is relaxed.

3.4.3.1. The ARDL Model

The ARDL bounds testing approach was first introduced in literature by Pesaran and Shin (1999) and later extended by Pesaran, Shin and Smith (2001) to observe cointegration amongst variables namely, market and bank based financial development and economic growth. The ARDL method is considered superior in identifying the long-run affiliation between two or more variables in comparison to the residual-based Engle and Granger’s (1987) and the likelihood-based Johansen and Juselius (1990) approaches, particularly in small sample sizes due to the ability of being able to account for different orders of integration (Dell'Anno and Halicioglu, 2010). Pesaran *et al.* (2001) concluded that the estimators of the long-run coefficients are very consistent in an ARDL framework for small sample sizes in comparison to the Johansen and Juselius (1990) cointegration methodology which requires a large sample size (Busu, 2020). Furthermore, according to methodologies of both Majid (2008) and Dritsakis (2011), the ARDL is selected as an appropriate model in small sample sizes due to its consistency.

Unlike the conventional cointegration techniques, the ARDL approach does not impose the restrictive assumption that the variables need to be integrated of the same order and has the ability to model the series even if they are a different order of integration. This is considered to be one of the key advantages of this approach (Dell'Anno and Halicioglu, 2010). The ARDL framework is efficient in modelling a series if it is integrated of order zero, I(0), order one, I(1) or fractionally integrated. However, the method is inconsistent if the series is found to be I(2) or above (Ahmad, 2010). Furthermore, whereas conventional cointegration methods estimate the long-run relationship within a system of equations, the ARDL method uses only a single reduced form equation and all variables in the model are assumed to be endogenous (Chang, 2020).

According to Boutabba (2014) and Tursoy and Faisal (2018), the ARDL method identifies unbiased estimates of the long-run model and valid t-statistics, although the regressors are endogenous. The ARDL method delivers valid t-statistics and unbiased estimates, regardless of the endogeneity of some regressors. Additionally, since the ARDL model tolerates different lags in different variables, it makes this method very versatile and flexible (Boutabba, 2014). Due to the appropriate lag selection, the residual correlation is eliminated therefore the endogeneity problem is mitigated. Another key advantage that is unique to the ARDL model from other conventional cointegration tests is that the short-run and long-run coefficients are estimated simultaneously and the model has the ability to test hypotheses on the estimated coefficients in the long-run. The short-run adjustments can be integrated with the long-run equilibrium through the ECM (Tursoy and Faisal, 2018). Furthermore, this method allows for the correction of outliers with impulse dummy variables and distinguishes between the independent and dependent variables (Dritsakis, 2011).

A conventional time series regression model comprises of constant parameters and assumes that any change in an explanatory variable has the same effect over time (Ahmad, 2010). The conventional cointegration techniques such as the Engel-Granger cointegration and VECM suggest a constant speed of adjustment, namely a constant ECT, to a long-run equilibrium after a shock. However, this does not always hold true when there are market frictions (Chang, 2020). Drawing on this notion, a critical distinction between the VECM and ARDL models it that the ARDL model has the ability to model series that are integrated of different orders, whereas the VECM can only measure relationships between series that are both I(1) (Dritsakis, 2011).The Engel-Granger cointegration approach is similar to the ARDL model due to the assumption of linearity. The ARDL bounds testing approach has been considered suitable for analysing the cointegrating relationship between variables and has become increasingly popular in recent years (Busu, 2020).

The VAR model determines the appropriate lag length to be used in the VECM. The optimal lag length minimises the AIC and SBIC. Following the methodologies of Dritsakis (2011) and Boutabba (2014), this study first begins with the generalised VAR model with k lags and is specified in equation (3.30) subsequently.

$$y_t = c + b_1 y_{t-1} + b_2 y_{t-2} + \cdots + b_k y_{t-k} + u_t \tag{3.25}$$

Where:

- The current value of y_t is dependent on different combinations of the independent variables up to k;
- u_t is the white noise disturbance term;
- c is the intercept and;
- y_t is a 2 x 1 matrix where the dependent variable is RGDP and the independent variable is ALSI in the context of this study for the overarching relationship.

Furthermore, the ARDL model is frequently shown differently to suit different studies by manipulation of a VAR model which is similar to equation (3.30). The ARDL approach comprises of the following two steps. The first step entails that any long-term relationship that exists amongst the variables is determined using an F-test. The second step of the analysis estimates the coefficients of the long-run relationship and determines their values which is then followed by the estimation of the short-run elasticity of the variables, with the ECM representation of the ARDL model (Ahmad, 2010). The speed of adjustment to equilibrium will thus be determined by applying the ECM representation of the ARDL model. Following Ahmad (2010), the VAR is primarily written as a VECM of the subsequent form.

$$\Delta Y_t = C + \alpha Y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \mu_t$$

(3.26)

Where:

Y_t is the representation of a matrix of the dependent and independent variables. This model is then further extended to the ARDL (p,q) model form. It is crucial to note that this study is comprehensive in nature and utilising RGDP as the independent variable has been considered; however, the effect of RGDP based on share prices as an independent variable is what is significant to this study. Therefore, the ALSI and sectoral indices are utilised as the independent variables to examine the effects that the stock market fluctuations have on economic activity in South Africa. The variables RGDP and ALSI interchange the depended position due to this relationship being the overarching relationship in this study. However, the sectoral variables are only considered as the independent variable due to this study being comprehensive in nature. The ARDL (p,q) representation of the model is expressed as follows (Menegaki, 2019):

$$\Delta RGDP_t = \alpha_1 + \beta_1 \Delta RGDP_{t-1} + \delta_1 ALSI_{t-1} + \sum_{j=1}^{p} \gamma_{1,j} \Delta RGDP_{t-j} + \sum_{j=1}^{q} \gamma_{1,j} \Delta ALSI_{t-j} + e_{t1}$$

(3.27)

Where:

- RGDP is the dependent variable;
- Δ is the first difference operator;
- β; δ; γ and are the coefficients associated with a linear trend and represents the speed of adjustment;
- The parameter γ represent the short-run dynamic coefficients;
- α is the intercept term;
- p and q the optimal lag lengths of the ARDL model;
- t-i are lags of t and;
- e_t is the white noise error term

$$\Delta ALSI_t = \alpha_2 + \beta_2 \Delta ALSI_{t-1} + \delta_2 RGDP_{t-1} + \sum_{j=1}^{p} \gamma_{2,j} \Delta ALSI_{t-j} + \sum_{j=1}^{q} \gamma_{2,j} \Delta RGDP_{t-j} + e_{t2} \tag{3.28}$$

Similarly, as described previously, where:

- ALSI is the dependent variable;
- Δ is the first difference operator;
- β; δ; γ and are the coefficients associated with a linear trend and represents the speed of adjustment;
- The parameter γ represent the short-run dynamic coefficients;
- α is the intercept term;
- p and q the optimal lag lengths of the ARDL model;
- t-i are lags of t and;
- e_t is the white noise error term

$$\Delta FINI_t = \alpha_3 + \beta_3 \Delta FINI_{t-1} + \delta_3 RGDP_{t-1} + \sum_{j=1}^{p} \gamma_{3,j} \Delta FINI_{t-j} + \sum_{j=1}^{q} \gamma_{3,j} \Delta RGDP_{t-j} + e_{t3} \tag{3.29}$$

Similarly, as described previously, where:

- FINI is the dependent variable;
- Δ is the first difference operator;
- β; δ; γ and are the coefficients associated with a linear trend and represents the speed of adjustment;
- The parameter γ represent the short-run dynamic coefficients;
- α is the intercept term;
- p and q the optimal lag lengths of the ARDL model;
- t-i are lags of t and;
- e_t is the white noise error term

$$\Delta RESI_t = \alpha_4 + \beta_4 \Delta RESI_{t-1} + \delta_4 RGDP_{t-1} + \sum_{j=1}^{p} \gamma_{4,j} \Delta RESI_{t-j} + \sum_{j=1}^{q} \gamma_{4,j} \Delta RGDP_{t-j} + e_{t4} \tag{3.30}$$

Similarly, as described previously, where:

- RESI is the dependent variable;
- Δ is the first difference operator;
- β; δ; γ and are the coefficients associated with a linear trend and represents the speed of adjustment;
- The parameter γ represent the short-run dynamic coefficients;
- α is the intercept term;
- p and q the optimal lag lengths of the ARDL model;
- t-i are lags of t and;
- e_t is the white noise error term

$$\Delta INDI_t = \alpha_5 + \beta_5 \Delta INDI_{t-1} + \delta_5 RGDP_{t-1} + \sum_{j=1}^{p} \gamma_{5,j} \Delta INDI_{t-j} + \sum_{j=1}^{q} \gamma_{5,j} \Delta RGDP_{t-j} + e_{t5} \tag{3.31}$$

Similarly, as described previously, where:

- INDI is the dependent variable;
- Δ is the first difference operator;
- β; δ; γ and are the coefficients associated with a linear trend and represents the speed of adjustment;
- The parameter γ represent the short-run dynamic coefficients;
- α is the intercept term;
- p and q the optimal lag lengths of the ARDL model;
- t-i are lags of t and;
- e_t is the white noise error term

In the ARDL(p,q) model represented in equations (3.32) to (3.36), the variables are allowed to exhibit different lag lengths, with p representing the lag length of the first difference of the stock market proxies and q is the respective representation for RGDP. Likewise, in equation (3.32) where RGDP is the dependent variable, p represents the lag length of the first difference of RGDP and q represents ALSI.

It is observed in the equations demonstrated in this section, that each variable is represented as dependent on the past values of itself and the other variable. Similarly, as presented in the studies by Majid (2008), Pahlavani, Wilson and Worthington (2005) and Menegaki (2019), the ARDL model is applied to determine the magnitude of the long-run cointegrating relationship. The model outputs are then compared with the NARDL outputs, which accounts for asymmetric adjustment with the use of a nonlinear model. This method will be applied to the primary and sectoral analysis in this study.

3.4.3.2. The NARDL Model

A nonlinear version of the ARDL model was introduced to literature by Shin *et al.* (2014) and is an extension of the method introduced by Pesaran *et al.* (2001). The nonlinear ARDL model is applied to test whether the positive shocks of the independent variables have the same effect as the negative shocks on the dependent variables (Pal and Mitra, 2016). Shin *et al.* (2014) developed the NARDL model by utilising negative and positive partial sum decompositions that classify the asymmetric effects in the short and long-run. Nonlinear cointegration is presented by breaking down a time series into its positive and negative partial sums therefore, can be decomposed into its initial value and its positive and negative cumulative sums (Demir, Simonyan, García-Gómez and Lau, 2020).

The possibility of nonlinear relationships between various macroeconomic variables and progressions needs to be recognised. Keynes (1936) stated that the replacement of a downward for an upward tendency occurs abruptly and aggressively; however, no sharp turning point occurs when an upward is replaced for a downward tendency (Demir *et al.,* 2020). The demonstration that this model is reputable by OLS and that consistent long-run implications can be attained by bounds-testing, irrespective of the integration orders of the variables will be tested in this study. The origin of asymmetric dynamic multipliers that explicitly portray the distinction between the short and the long-run will be exhibited (Ahmad, 2010). In the conventional ARDL model, a symmetric relationship exists between the dependent and the explanatory variables. However, this is not the case with the NARDL model and the relationship is formulated as follows (Liang, Troy and Rouyer, 2020):

$$y_t = \alpha^+ x_t^+ + \alpha^- x_t^- + e_t \tag{3.32}$$

Where:

α is the long run parameters; e_t is the white noise error term and x_t is the following vector regressor:

$$x_t = x_0 + x_t^+ + x_t^- \tag{3.33}$$

Where:

x_t^+ is the positive partial sum positive changes in x_t and x_t^- is the negative partial sum changes in x_t which is displayed next.

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0)$$

(3.34)

$$x_t^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \max(\Delta x_i, 0)$$

(3.35)

Therefore, the corresponding ECM can be demonstrated as follows:

$$\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{j-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^{p} (\pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-i}^-) + e_t$$

(3.36)

Where:

$\theta^+ = \frac{\alpha^+}{\rho y_{t-1}}$ and $\theta^- = \frac{\alpha^-}{\rho y_{t-1}}$

By making use of the F-statistic developed by Pesaran *et al.* (2001), the hypothesis can be tested that $\theta^+ \theta^- = \theta = 0$

Therefore, the rejection of the null hypothesis indicates the presence of cointegration. The hypothesis of $\theta = 0$ against the alternative that $\theta < 0$ is examined through a t-test.

Furthermore, the process steps for the NARDL model are the same as the ARDL model which has been discussed earlier in this chapter but in addition, the NARDL method provides the cumulative dynamic multiplier effects of x^+ and x^- on y_t and is exhibited subsequently (Liang *et al.,* 2020).

$mk^+ \sum_{i=0}^{k} \frac{\partial y_{t+i}}{\partial x_t^+}$ and $mk^- \sum_{i=0}^{k} \frac{\partial y_{t+i}}{\partial x_t^-}$

As *k* increases to infinity; the multipliers converge to ∂.

This model is similar to the ARDL model due to the advantages it has over the classical cointegration techniques, where it allows the regressors of mixed order of integration, I(0) and I(1) and works effectively in small sample sizes. However, the restriction of this particular method is that it cannot be applied if any of the variables are I(2) (Nandelenga and Oduor, 2019). The NARDL approach solves the issue of multicollinearity through choosing appropriate lag lengths of the variables. Additionally, the NARDL bounds test examines the presence of cointegration whilst examining the asymmetric effects (Hu *et al.,* 2018).

The idea behind this model is to question the standard assumption of symmetric estimates, by which the effect of the increasing of a variable is equal and opposite to the decreasing of the same variable (Nandelenga and Oduor, 2019). Therefore, indicating that the NARDL is considerably far more statistically powerful than the other techniques proposed to account for asymmetry as it considers the dynamic adjustment of a model (Pal and Mitra, 2016). A random walk process can be unravelled into two random walk processes with drift. A new form of cointegration is examined by investigating the multivariate combinations arising from this decomposition (Hu *et al.,* 2018). This nonlinear version of cointegration is important to model asymmetric behaviour. The superiority of this model can be shown as it addresses the shortfalls of the conventional linear cointegrating relationship by modelling asymmetric behaviour between variables (Pal and Mitra, 2016).

As explained in the previous section, utilising RGDP as the independent variable has been considered; however, the effect of RGDP based on share prices as an independent variable is what is significant to this study. The variables RGDP and ALSI interchange the depended position due to this relationship being the overarching relationship in this study. Therefore, the ALSI and sectoral indices are utilised as the independent variables to examine the effects that the stock market fluctuations have on economic activity in South Africa. However, the sectoral variables are only considered as the independent variable due to this study being comprehensive in nature. The following NARDL (p,q) models follows the model by Van Hoang *et al.* (2016) and will be considered for this study.

$$\Delta RGDP_t = \mu + \lambda_i RGDP_{t-1} + \rho_i{}^{+} ALSI_{t-1}^{+} + \rho_i{}^{-} ALSI_{t-1}^{-} + \Sigma\alpha_i\, \Delta RGDP_{t-1} + \Sigma\left(\beta_i^{+} \Delta ALSI_{t-1}^{+} + \beta_i^{-} \Delta ALSI_{t-1}^{+}\right) + \varepsilon_t \tag{3.37}$$

Where:

- RGDP is the dependent variable;
- Δ is the first difference operator;
- The superscripts (–) and (+) represent the positive and negative partial sum decompositions;
- ρ^{+} represents the coefficient of positive short-run adjustments;
- ρ^{-} represents the coefficient of negative short-run adjustments;
- β^{+} represents the coefficient of a positive response;
- β^{-} represents the coefficient of a negative response;
- α represents the coefficient of the first difference for RGDP;
- $RGDP_{t-1}$ is the first lag for RGDP;
- $ALSI^{+}_{t-1}$ is the first lag of 'partial sum of positive change' in $ALSI_t$
- $ALSI^{-}_{t-1}$ is the first lag of 'partial sum of negative change' in $ALSI_t$;
- μ is the constant and;
- ε_t is the associated error term

$$\Delta ALSI = \mu + \lambda_i ALSI_{t-1} + \rho_i{}^{+} RGDP_{t-1}^{+} + \rho_i{}^{-} RGDP_{t-1}^{-} + \Sigma\alpha_i\, \Delta ALSI_{t-1} + \Sigma\left(\beta_i^{+} \Delta RGDP_{t-1}^{+} + \beta_i^{-} \Delta RGDP_{t-1}^{+}\right) + \varepsilon_t \tag{3.38}$$

Similarly, as described previously where:

- ALSI is the dependent variable;
- Δ is the first difference operator;
- The superscripts (–) and (+) represent the positive and negative partial sum decompositions;
- ρ^{+} represents the coefficient of positive short-run adjustments;

- ρ^- represents the coefficient of negative short-run adjustments;
- β^+ represents the coefficient of a positive response;
- β^- represents the coefficient of a negative response;
- α represents the coefficient of the first difference for RGDP;
- $RGDP^+_{t-1}$ is the first lag of 'partial sum of positive change' in $RGDP_t$
- $RGDP^-_{t-1}$ is the first lag of 'partial sum of negative change' in $RGDP_t$;
- μ is the constant and;
- ε_t is the associated error term

$$\Delta FINI = \mu + \lambda_i FINI_{t-1} + \rho_i{}^+ RGDP^+_{t-1} + \rho_i{}^- RGDP^-_{t-1} + \Sigma\alpha_i\, \Delta FINI_{t-1} + \Sigma\left(\beta_i^+ \Delta RGDP^+_{t-1} + \beta_i^- \Delta RGDP^+_{t-1}\right) + \varepsilon_t \tag{3.39}$$

Similarly, as described previously where:

- FINI is the dependent variable;
- Δ is the first difference operator;
- The superscripts (–) and (+) represent the positive and negative partial sum decompositions;
- ρ^+ represents the coefficient of positive short-run adjustments;
- ρ^- represents the coefficient of negative short-run adjustments;
- β^+ represents the coefficient of a positive response;
- β^- represents the coefficient of a negative response;
- α represents the coefficient of the first difference for RGDP;
- $RGDP^+_{t-1}$ is the first lag of 'partial sum of positive change' in $RGDP_t$
- $RGDP^-_{t-1}$ is the first lag of 'partial sum of negative change' in $RGDP_t$;
- μ is the constant and;
- ε_t is the associated error term

$$\Delta RESI_t = \mu + \lambda_i RESI_{t-1} + \rho_i{}^{+} RGDP^{+}_{t-1} + \rho_i{}^{-} RGDP^{-}_{t-1} + \Sigma\alpha_i \, \Delta RESI_{t-1} + \Sigma\left(\beta_i^{+} \Delta RGDP^{+}_{t-1} + \beta_i^{-} \Delta RGDP^{+}_{t-1}\right) + \varepsilon_t$$

(3.40)

Similarly, as described previously where:

- RESI is the dependent variable;
- Δ is the first difference operator;
- The superscripts (–) and (+) represent the positive and negative partial sum decompositions;
- ρ^{+} represents the coefficient of positive short-run adjustments;
- ρ^{-} represents the coefficient of negative short-run adjustments;
- β^{+} represents the coefficient of a positive response;
- β^{-} represents the coefficient of a negative response;
- α represents the coefficient of the first difference for RGDP;
- $RGDP^{+}_{t-1}$ is the first lag of 'partial sum of positive change' in $RGDP_t$
- $RGDP^{-}_{t-1}$ is the first lag of 'partial sum of negative change' in $RGDP_t$;
- μ is the constant and;
- ε_t is the associated error term

$$\Delta INDI_t = \mu + \lambda_i INDI_{t-1} + \rho_i{}^{+} RGDP^{+}_{t-1} + \rho_i{}^{-} RGDP^{-}_{t-1} + \Sigma\alpha_i \, \Delta INDI_{t-1} + \Sigma\left(\beta_i^{+} \Delta RGDP^{+}_{t-1} + \beta_i^{-} \Delta RGDP^{+}_{t-1}\right) + \varepsilon_t$$

(3.41)

Similarly, as described previously, where:

- INDI is the dependent variable;
- Δ is the first difference operator;
- The superscripts (–) and (+) represent the positive and negative partial sum decompositions;
- ρ^{+} represents the coefficient of positive short-run adjustments;
- ρ^{-} represents the coefficient of negative short-run adjustments;

- β^+ represents the coefficient of a positive response;
- β^- represents the coefficient of a negative response;
- α represents the coefficient of the first difference for RGDP;
- $RGDP^+_{t-1}$ is the first lag of 'partial sum of positive change' in $RGDP_t$
- $RGDP^-_{t-1}$ is the first lag of 'partial sum of negative change' in $RGDP_t$;
- μ is the constant and;
- ε_t is the associated error term

In equation (3.43), the long-run coefficients of $ALSI_t^+$ can be calculated by dividing the positive of the coefficient of $ALSI_t^+$, ρ^+, by the coefficient of $RGDP_t$, λ; and the long-run coefficient of $ALSI_t^-$ by dividing the negative of the coefficient of $ALSI_t^-$, ρ^-, by the coefficient of $RGDP_t$, λ. (ρ^- / λ) and (ρ^+ / λ) are the long-run coefficients of $ALSI_t^-$ and $ALSI_t^+$ respectively. These coefficients measure the relationship between x and y at the long-run equilibrium.

Short-run analysis aims to assess the immediate impacts of changes in the exogenous variable on the dependent variable. In contrast, the long-run analysis is meant to measure the reaction time and speed of adjustment towards an equilibrium level (Cho *et al.,* 2015). The summation notation Σ implies that the NARDL model considers the addition of differenced variables up to some lags in the model. In the case of $\Delta RGDP_{t-1}$, the NARDL considers the addition of its first lagged term up to the maximum lag that is chosen, if suitable. Similarly, in the case of $\Delta ALSI^-_t$ it considers the addition of its zero lag ($\Delta ALSI^-_t$ itself) up to the maximum lag that is chosen, if suitable (Demir *et al.,* 2020). Furthermore, this method will also be applied to the sectoral indices in this study.

The bounds test hypothesises that the variables employed in the study are bound together in the long-run. The equilibrium correction is also significant in validating the existence of the long-run relationship (Hu *et al.,* 2018). The bounds test is primarily based on the joint F-statistic so that the asymptotic distribution is non-standard under the null hypothesis of no cointegration. The first step in the bounds approach is to estimate the equations using OLS (Pal and Mitra, 2016). The estimation of the equation tests for the presence of a long-run affiliation between the variables by conducting an F-test for the joint significance of the coefficients in the lagged levels of the variables. The null hypothesis of no cointegration is rejected when the F-statistic value exceeds the upper critical bounds value but is accepted when the F-statistic is lower than the lower bounds value (Van Hoang *et al.,* 2016).

Table 3.1 below summarises the possible outcomes of the Wald test in the ARDL model. The computed F-statistics are compared with the lower and upper bound critical values (Menegaki, 2019):

Table 3.1: Table showing the summary of possible results of the NARDL tests

If the Wald F-statistic falls:	Conclusion
1. Above the upper critical value	Cointegration
2. Between the lower bound and upper bound critical value	Inconclusive
3. Below the lower bound critical value	No Cointegration

(Source: Menegaki, 2019)

Therefore, the NARDL bounds testing approach will be applied in this study to examine the asymmetric cointegration between the variables and will be the major contributing analysis of this study. The results will indicate whether there is cointegration between the variables in the presence of asymmetries and the impact the shocks will have on economic growth in South Africa. The identification of the relationship being nonlinear and the magnitude of the relationship will be key contributing factors to literature. The magnitude of the results will provide an insight to improve long-term prospective goals and economic growth in South Africa as well as the financial markets respectively. Therefore, ultimately providing a better insight to the key contributing factors of the South African economy.

In addition, the identification of structural breaks in the relationship will also make a further contribution to literature. The results of the NARDL tests will be compared to the linear ARDL tests to conclude the differentiation in the empirical results when linearity is relaxed, therefore in turn analysing the co-movement of share prices and economic growth in South Africa.

3.4.3.3. Residual Diagnostic Tests

Residual diagnostic tests are applied to examine whether the stochastic properties of a model are met in order to avoid a violation of the assumptions of the classical linear regression model. In this study, tests for the stochastic properties of residual autocorrelation and heteroscedasticity will be conducted, and are elaborated on subsequently.

3.4.3.3.1. Testing for Heteroscedasticity

In time series analysis, heteroscedasticity occurs when the standard deviations of a variable are non-constant which leads to unbiased coefficient estimates. A critical assumption of hypothesis testing is that the variables of the residual errors are constant and this assumption of conditional variance is termed homoscedasticity (Tse, 2002). According to Brooks (2014), there are various different methodological techniques to examine heteroscedasticity namely; the graphical method, Glejser test, Breusch-Pagan-Godfrey test, Park test and White's general heteroscedasticity test, to name a few. White's heteroscedasticity test is commonly used because it is simple and easy to implement and the test depends on assumptions about the possible form of the heteroscedasticity (Tse, 2002). Therefore, this study will use White's heteroscedasticity test to examine the presence of heteroscedasticity and is conducted using the LM test and is displayed as follows (Tse, 2002):

$$Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + u_t \tag{3.42}$$

Furthermore, to test for $var\ (u_t) = \sigma^2$ the auxiliary regression from equation 3.48 is attained:

$$u_t = \alpha_1 + \alpha_2 x_{2t} + \alpha_3 x_{3t} + \alpha_4 x_{4t} + \alpha_5 x_{5t} + \alpha_6 x_{6t} + v_t \tag{3.43}$$

Where:

- v_t is a normally distributed disturbance term independent from u_t

Thereafter, the LM test for heteroscedasticity uses the R^2 from (3.49) multiplied by the number of observations, T. The product of the two is then compared to the critical values from the Chi-squared (χ^2) distribution:

$$\mathrm{T\ R2} \sim \chi 2\ (\mathrm{m})$$

Where:

m is the number of regressors in the auxiliary regression that is excluding the constant term. If the χ^2 test is greater than critical values then the null hypothesis is rejected and it can be concluded that the residual errors are heteroscedastic.

3.4.3.3.2. Testing for Serial Correlation

Autocorrelation, commonly referred to as serial correlation describes the relationship between observations of a variable over two successive time intervals (Coad and Hölzl, 2009). The value of autocorrelation ranges from -1 to 1. If the value is zero, there is no correlation therefore the observations are independent of one another. A value between -1 and 0 represents negative autocorrelation and a value between 0 and 1 represents positive autocorrelation (Brooks, 2014). In this study, the Breusch-Godfrey test of autocorrelation will be utilised, which is similar to the LM test, and is elaborated successively:

$$Y_t = \beta_1 + \beta_2 X_t + u_t \tag{3.44}$$

Given the regression in (3.50), the assumption of the error term is as follows (Coad and Hölzl, 2009):

$$u_t = \alpha_1 u_{t-1} + \alpha_2 u_{t-1} + \cdots + \alpha_n u_{t-n} + \varepsilon_t \tag{3.45}$$

Where:

- X includes lagged dependent variables and;
- ε_t is normally distributed

Moreover, the test statistic by obtaining R^2 from the auxiliary regression, is as follows:

$$(T-n)R^2 \sim \chi^2 n$$

If $(T-n)R^2$ is greater than critical value, $\sim\chi^2 n$ the null hypothesis is rejected and it can be concluded that there is autocorrelation present.

3.4.3.4. Parameter Instability

3.4.3.4.1. Cumulative Sum of Squares Test

Parameter stability is a necessary condition in regression analysis. Since an econometric model described by its parameters, model stability is a result of parameter stability (Coad and Hölzl, 2009). Model instability may be caused by the omitting of a significant variable or could be due to a regime shift and makes it difficult to interpret regression results accurately (Tse, 2002).

The Cumulative Sum of Squares (CUSUM) test introduced by Brown, Durbin, and Evans (1975) is based on the cumulative sum of the recursive residuals and plots the cumulative sum together with 5% critical value bands. The CUSUM test indicates parameter instability if the cumulative sum exceeds either one or both of the 5% critical lines. The CUSUM test statistic is founded on the normalised form of the cumulative sum of the residuals (Xiao and Phillips, 2002).

The CUSUM test is based on the statistic:

$$W_t = \sum_{r=k+1}^{t} w_r/s \tag{3.46}$$

Where:

- $t = k + 1 \ldots T$;
- w is the recursive residual and;
- s is the standard deviation of the recursive residuals w_t

If the vector β remains constant, $E(W_t) = 0$; however, if β changes W_t will deviate from the zero mean value line. The significance of the deviation from the mean zero line is assessed by reference of two 5% significance lines, the distance between which increases with t. The 5% significance lines are found by joining the points (Zeileis, 2004):

$[k \pm -0.948(T-k)^{1/2}]$ and $[T \pm 3 \times 0.948(T-k)^{1/2}]$

The movement outside of W_t outside the critical lines is indicative of coefficient instability. The CUSUM test is applied in this study to examine the stability of ARDL and NARDL models. Additionally, the CUSUM of squares test is based on the following test statistic (Xiao and Phillips, 2002):

$$S_t = \left(\sum_{r=k+1}^{t} w_r^2 \right) / \left(\sum_{r=k+1}^{T} w_r^2 \right) \tag{3.47}$$

The expected value of S_t under the hypothesis of parameter stability is displayed as follows (Zeileis, 2004):

$$E(S_t) = \frac{(t-k)}{(T-k)} \tag{3.48}$$

Where:

- $t = k$ goes from zero to unity at $t = T$

The significance of the movement of S_t from its expected value is evaluated by referring to a pair of parallel straight lines around the expected value. The CUSUM of squares test provides a graphical representation of S_t against t and the pair of 5% critical value bands. In line with the CUSUM test, any movement outside the critical value bands is indicative of parameter or variance instability (Zeileis, 2004).

3.5. Summary

The key purpose of this chapter was to describe the selection of the data and methodological techniques as well as to specify the models that will be employed in the next chapter. Each model that will be utilised in this study was outlined comprehensively, together with a justification of the proxies chosen. The methodology of this study is split into a primary analysis and sectoral analysis. The primary analysis examines the principal relationship between share price fluctuations and economic growth by utilising ALSI and RGDP as the proxies for the stock market and economic activity respectively. While the sectoral analysis examines the relationship between the sectoral indices on the JSE namely; RESI, INDI and FINI to RGDP. This study is conducted in a South African context spanning over the period of 1999 to 2019. This particular time period was chosen in order to allow for a large enough time span of twenty years due to data availability and taking into account the significant events that occurred in South Africa within that time period namely, the reclassification of the JSE in March 2000 and the 2007/2008 financial crisis, once trade sanctions had been lifted in the post-apartheid era. The sources of data for this study are the Reserve Bank of South Africa Bulletin, StatsSA, McGregor BFA library and the JSE.

In this chapter, the various methodological techniques were outlined and incorporated the different ways in which each of the estimated models will be evaluated. The following methodological techniques will be applied in the next chapter and the results will be discussed in detail: In Part A, preliminary tests of optimal lag length selection, the modified ADF nonlinear unit root tests and a VAR analysis will be discussed. In Part B, the Zivot-Andrews unit root tests, Bai-Perron structural break tests and Gregory-Hansen cointegration tests will be examined in detail, to determine whether the relationship between economic growth and the stock market returns exhibit evidence of structural breaks.

Finally, in Part C the ARDL model, NARDL model, residual diagnostic and parameter instability tests will be elaborated on. Most importantly, the key purpose of this thesis is to determine whether the relationship between economic growth and the stock market returns exhibit asymmetric adjustment. This will be conducted by means of the NARDL model establish the differentiation in the magnitude of the results once the linearity assumption is relaxed. Therefore, examining how fluctuations in the stock market affect economic growth in South Africa. The following chapter discusses all of the results produced from each different methodological technique utilised.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1. Overview

The previous chapter highlighted the discussion of the data and models which will be exercised in this study to achieve its objectives. This chapter therefore elaborates on all of the results attained from each analysis which will allow viable conclusions to be drawn on this study. Furthermore, this chapter continues with the analysis of the results obtained from applying the methodological techniques elaborated on in the preceding chapter. The methodology described in Chapter 3 was conducted in attempt to determine the nature of the relationship between the stock market and economic activity, in order provide answers to the research questions presented in Chapter 1. The discussion of these results will indicate whether or not the results obtained coincide with the expected outcomes considered in literature.

4.2. Results Analysis

This section discusses the final results obtained from utilising the models elaborated on in the preceding chapter and will answer the research questions posed in this study. This section is divided into three parts where: Part A first analyses and elaborates on the results of the preliminary testing; Part B discusses the results of the structural break testing in the relationship and Part C discusses the nonlinearity results of the cointegrating relationship.

4.2.1. Part A: Preliminary Test Results

4.2.1.1. Lag Length Selection Results

As discussed in section 3.4.1.1., lag length selection is vital in regression analysis as too few lags concludes that the regression residuals do not behave like a white-noise process, whilst the addition of too many lags decreases the power of the test to detect a unit root (Emerson, 2007). It is crucial to note that the lag length selection is applicable to the VAR, while the ARDL and NARDL can endogenously calculate lags in EViews (2020). For the purpose of this study, it is the overarching relationship between RGDP and ALSI that is important. Table 4.1 shows the results obtained when estimating the lag length selection criteria.

Table 4.1: Table showing the results of the lag length selection criteria

Lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	-3083.445	NA	1.36e+29	81.27486	81.42820	81.33614
1	-2704.211	698.5894	1.22e+25*	71.95291	72.87294*	72.32060*
2	-2681.081	39.56428	1.29e+25	72.00212	73.68884	72.67622
3	-2663.803	27.28061	1.62e+25	72.20534	74.65874	73.18584
4	-2630.071	48.82229	1.34e+25	71.97556	75.19565	73.26246
5	-2615.638	18.99060	1.90e+25	72.25364	76.24042	73.84695
6	-2584.159	37.27761	1.79e+25	72.08314	76.83661	73.98286
7	-2558.625	26.87795	2.07e+25	72.06909	77.58925	74.27521
8	-2508.872	45.82558*	1.35e+25	71.41768*	77.70453	73.93021

*Notes: The asterisk * denotes the optimal lag length selected by the different information criteria.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

The results in Table 4.1 above provide contrasting conclusions for selecting the optimal number of lags, indicating the robustness of the results. The SBIC and HQIC selected one lag and this is further supported by the Final Prediction Error (FPE) which also selected one lag. The AIC selected 8 lags and this is further supported by the Likelihood Ratio (LR) statistic which also selected 8 lags. The AIC and SBIC vary in accordance to the number of parameters in a model. According to Mangan *et al.* (2017), SBIC induces a higher penalisation for models that contain more parameters in comparison to AIC. Both SBIC and AIC attempt to resolve the problem of overfitting by introducing a penalty term for the number of parameters in a model. The penalty term is larger in SBIC than AIC. In Table 4.1, AIC has selected the larger model order due to AIC having the least stringent penalty term, in comparison to SBIC and HQIC. Therefore, AIC penalises the addition of parameters less and should be selected in the event of conflicting results. Hence, AIC is preferable in a smaller sample size whilst SBIC is preferable in a larger sample size (Stock and Watson, 2007).

According to Dao *et al.* (2017), a sample size is considered small for n = 100. In this study, the sample size of 80 is estimated and considered to be small when dealing with time series data but given that quarterly data was used, it includes twenty years of information. However, it is still considered a small sample size therefore AIC is more appropriate to consider. AIC is preferable in a smaller sample as it is more efficient whilst SBIC is consistent in a larger sample (Dao *et al.,* 2017). The choice of 8 lags can be depicted as 2 years and therefore equivalent to 1 lag per every 3 months or one lag per each quarter in a year. The interval of these lags can be based on two main reasons. Firstly, shocks to the economy, like any economic process, could take some time to arise. Secondly, measuring economic activity likewise takes a while to occur (Stock and Watson, 2007). Thus, 8 is the optimal number of lags to be utilised in this study. Since the optimal number of lags was determined it now necessary to proceed with preliminary tests for nonlinear unit roots.

4.2.1.2. Nonlinear Unit Root Test Results

As discussed in section 3.4.1.2, conventional unit root tests have a tendency to be nonstationary in the circumstance of a structural break (Meng *et al.,* 2017). Therefore, as a result, EViews 11 (2020) compensates for a modified ADF test which allows for levels and trends that differ across a single break date. The null and alternative hypothesis for each series is portrayed below:

H_0 = The series contains a structural break with a unit root

H_A = The series is stationary

Table 4.2: Table showing the summarised results of the ADF nonlinear unit root tests

Variables	Level (p-value)	Test Critical Values				Break Date
		t-stat	1% level	5% level	10% level	
RGDP	0.1979	-4.2979	-5.1475	-4.8598	-4.6073	2008Q1
D(RGDP)	0.0000	-6.8870***	-5.1475***	-4.8598**	-4.6073*	2008Q1
ALSI	0.3103	-4.1058	-5.3475	-4.8598	-4.6073	2009Q2
D(ALSI)	0.0000	-8.4820***	-5.3475***	-4.8598**	-4.6073*	2009Q2
INDI	0.8113	-2.7789	-5.3475	-4.8598	-4.6073	2008Q2
D(INDI)	0.0000	-8.4146***	-5.3475***	-4.8598**	-4.6073*	2008Q2
FINI	0.1456	-4.4594	-5.3475	-4.8598	-4.6073	2013Q2
D(FINI)	0.0000	-9.1517***	-5.3475***	-4.8598**	-4.6073*	2013Q2
RESI	0.4708	-3.8463	-5.3475	-4.8598	-4.6073	2014Q2
D(RESI)	0.0000	-9.7954***	-5.3475***	-4.8598**	-4.6073*	2014Q2

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5%, 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

As presented in Table 4.2, the modified ADF test for a unit root in levels displays that the series is nonstationary and the results indicate that the series exhibit unit root processes. Therefore, the results in Table 4.2 display the null hypothesis that the series contains a structural break cannot be rejected in favour of the alternative hypothesis at all significance levels for all the variables employed in this study; RGDP, ALSI, FINI, INDI and RESI. Thereafter, the variables were differenced and the modified ADF test was conducted again. Taking the first difference of the series indicated that the series is stationary at first differences and therefore integrated of order one. As indicated from previous literature, GDP is viewed as anomalistic and rarely stationary hence this study complements the previous findings by Sayed *et al.* (2017).

The most significant and largest break for RGDP occurred in 2008Q1 and for ALSI in 2009Q2. The breaks in these two variables in particular could most likely be linked to the 2007/2008 global financial crisis and the aftereffects thereof. The global financial crisis had a devastatingly negative impact on the South African economy. The country experienced a turbulent and negative impact to the economy due to decreased investor confidence and trade disruptions (Erkens, Hung, and Matos, 2012). The South African economy went into recession in the year 2007/2008 for the first time in 19 years and over a million jobs were lost which triggered the unemployment rate to increase rapidly (Feldkircher, 2014). The breaks around the period of the financial crisis can be seen in previous literature by Xing, Wang, Li and Chen (2020) and Kekolahti, Kilkki, Hämmäinen, and Riikonen (2016). This study supports these findings postulating that the financial crisis crippled the local economy and worldwide.

Moreover, the largest and most significant breaks occurred in 2008Q2 for INDI; 2013Q2 for FINI and 2014Q2 for RESI respectively. This further confirms that the break date identified by the modified ADF test for INDI could be a result of the global financial crisis that crippled the South African economy. The industrial sector was evidently more drastically affected by the global financial crisis relative to the financial and resource sectors, suggesting that a) the industrial sector may be more sensitive to international affairs and b) the industrial sector may have led the recession in South Africa. While such effects are outside the scope of this study, it may represent an interesting extension to it.

The break dates identified in years 2013 and 2014 for the financial and resource sectors can be attributed to the South African government policy changes and political actions that occurred within that specific timeframe. In 2013, the South African government introduced the National Development Plan as the country's long-term socio-economic development roadmap. This particular policy was adopted as the cornerstone for future socio-economic and economic development strategies for South Africa (Thompson and Wissink, 2018). The National Development Plan is viewed as a roadmap to eliminating poverty and inequality within the country by identifying key constraints to faster economic growth. Furthermore, in the years 2013/2014 the South African government expenditure drastically increased by R20 billion and could be indicative of the significant structural breaks identified (StatsSA, 2021).

Although economic growth has resumed within the country, the economy recovery process is very fragile and takes several years in order to stabilise (Erkens *et al.,* 2012). Therefore, another recession is extremely likely. The global crisis and the recession that followed thereafter have merely exacerbated the numerous financial issues already faced by the South African economy (McLeod, 2018). Since the global financial crisis, investors have pursued to invest in emerging markets in order to diversify away from investments in slow-growing and heavily indebted economies (StatsSA, 2021).

The modified ADF test results display evidence of a random walk with a time trend in the series. These findings indicate that shocks to the macroeconomic variables have a permanent effect. This led to the conclusion that nonstationarity is pervasive in the dataset and empirical solutions to deal with nonstationarity should be pursued. The findings of structural breaks in the relationship suggest that the variables analysed have historically been susceptible to exogenous macroeconomic shocks. It is probably that the long-run relationships between variables have changed over time. The above results are robust since the nonlinear unit root tests conclude that the variables are stationary at first differences. This could indicate that the variables are nonstationary in levels when using conventional unit root tests.

In line with the empirical results presented above, the Gregory-Hansen cointegration test and Bai-Perron structural break test that accounts for multiple structural breaks in the relationship will be employed further on in this chapter. Given that the modified ADF unit root test results and the necessary preconditions are met, the VAR analysis can now be applied.

4.2.1.3. VAR Results

The VAR model permits the value of a variable to depend on more than just its own lags or combinations of white noise terms therefore it is likely to capture more features in the data. The VAR regression was conducted using EViews 11 (2020) and displayed in Table 4.3. A two-tailed test of significance was conducted based on 80 observations and at a 5% level of significance (with 2.5% in each tail). The critical value is 1.9901. This indicates that the null hypothesis test coefficient is significant and will be rejected if it falls outside the range -1.9901 to +1.9901 and not rejected if it falls in between. This study is comprehensive in nature therefore 8 lags were selected by the VAR model however, 2 lags are displayed for compact purposes. The null and alternative hypothesis are displayed as follows:

H_0 = The test coefficient is insignificant

H_A = The test coefficient is significant

As described in section 3.4.1.4., the results of the VAR are presented below:

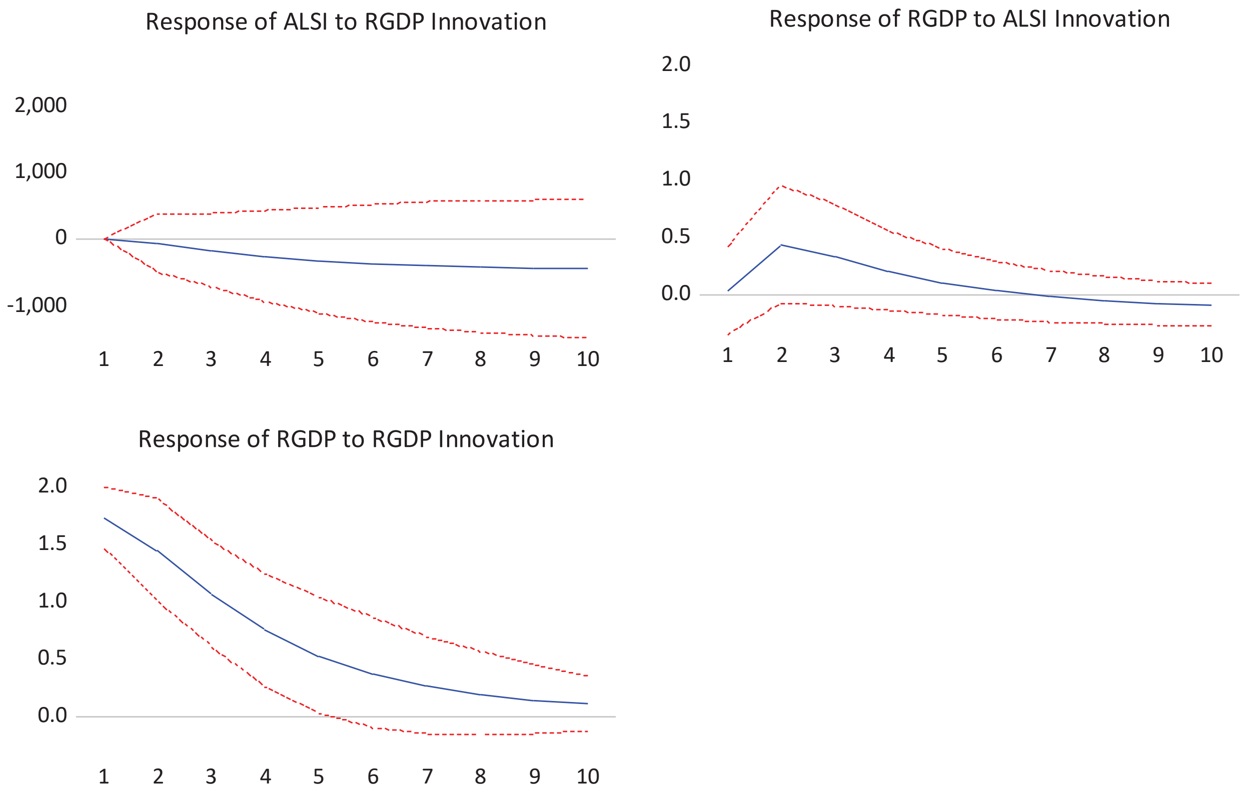
Table 4.3: Table showing the results of the Vector Autoregression estimates of ALSI and RGDP

Dependent Variable: ALSI			**Dependent Variable: RGDP**		
Lagged	**T-Statistic**	**Standard Error**	**Lagged**	**T-Statistic**	**Standard Error**
ALSI(-1)	-0.2882	0.1145	ALSI(-1)	2.0245*	0.0001
ALSI(-2)	-0.2109	0.1145	ALSI(-2)	-2.1906*	0.0001
RGDP(-1)	-0.2670	0.1116	RGDP(-1)	7.5254*	0.1107
RGDP(-2)	-0.2821	0.1539	RGDP(-2)	-2.0843*	0.1111

*Notes: The asterisk * denotes the significance at the 5% level respectively with 2.5% in each tail.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

As can be seen from the results presented in Table 4.3, when RGDP was employed as the dependent variable, the test statistics of all lagged variables for ALSI and RGDP itself were significant as all fell into the rejection region, which is outside the range of -1.9901 to +1.9901. Thus, the null hypothesis was rejected and it can be concluded that the stock market contributes to RGDP as the variables are highly significant in the equation.

On the other hand, when the ALSI was used as the dependent variable, all the test statistics fell into the non-rejection region, which is between the range of -1.9901 to +1.9901. Therefore, the null hypothesis was not rejected and the coefficients are not significant. The results indicate that there is no evidence from the VAR that GDP affects share prices. It is imperative to note that the VAR analysis does not account for structural breaks or nonlinearity and postulates that the results may be incorrect. Therefore, the VAR results presented in this section are a motivation for the use of the ARDL model. The ARDL model is useful for forecasting long-run relationships from the short-run dynamics. As a result, it is expected to see differing results as the underlying assumptions are relaxed. Impulse response functions trace the dynamic path of the variables in the system to shocks to other variables in the system (Ampountolas, 2019). Additionally, to explore the short-run relationship between economic growth and the stock market, impulse response functions were generated from the VAR. If the confidence band does not contain zero, the horizontal axis, then it is statistically significant.



(Source: Estimated by the current author with the use of EViews 11, 2020)

<u>Figure 4.1: Impulse Response Analysis Between ALSI and RGDP</u>

The impulse response functions displayed in Figure 4.1 stipulate that RGDP responds to a shock in ALSI with no immediate response but starts responding positively and significantly until two periods after the shock. However, by two periods after the shock the response starts declining, eventually becoming insignificant and negative by the seventh period after the shock and dies away quickly. The impulse responses are insignificant for all periods.

Furthermore, RGDP responds to shocks in its own value with immediate positive and significant movement. However, by two periods after the shock, the response starts declining rapidly. The response of ALSI to a shock in RGDP displays no immediate response, declining gradually and is insignificant. The impulse responses are significant for five periods after the shock and thereafter insignificant.

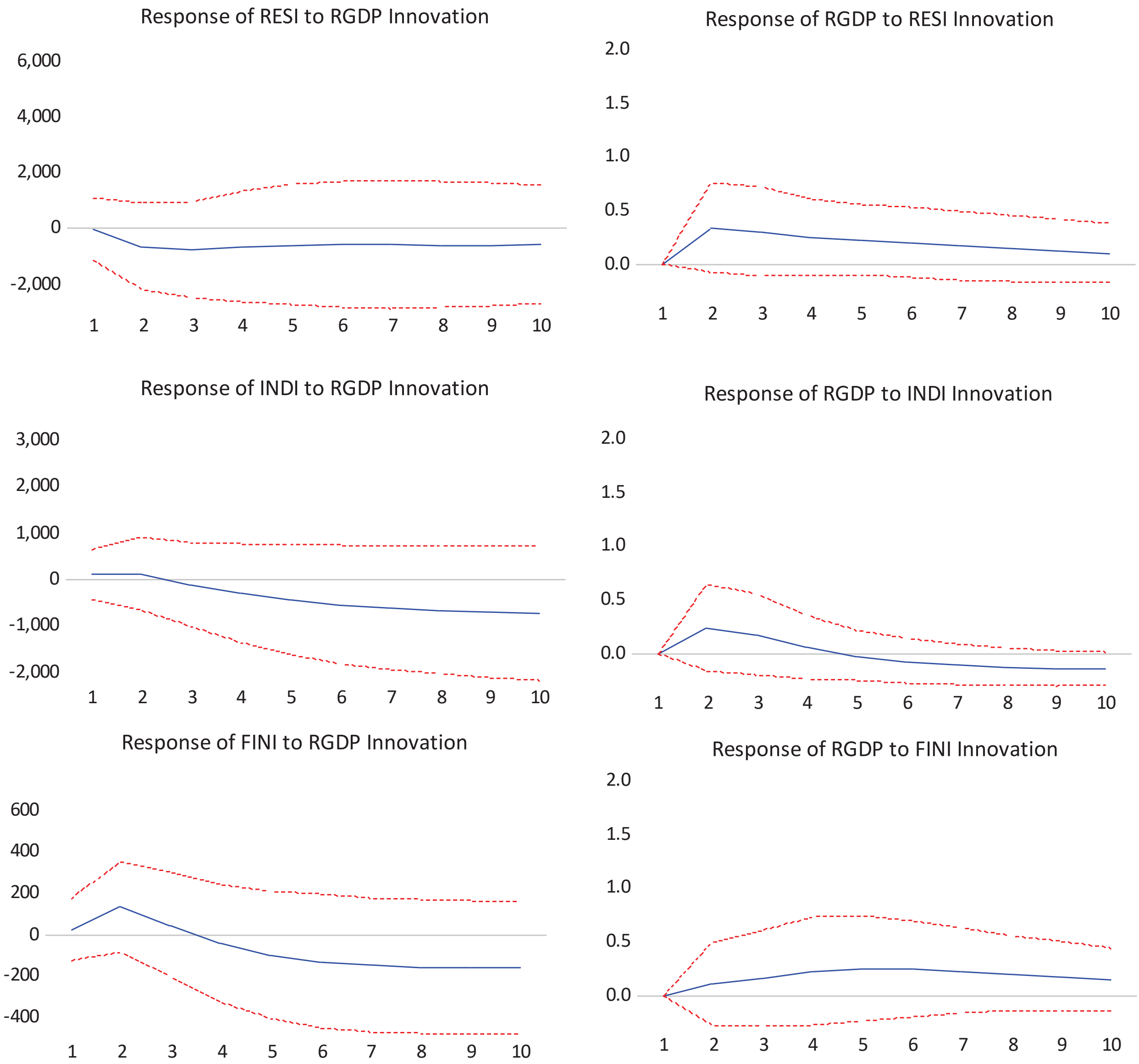
Table 4.4: Table showing the results of the Vector Autoregression estimates of the Sectoral Indices and RGDP

Dependent Variable: RGDP			**Dependent Variable: FINI**		
Lagged	**T-Statistic**	**Standard Error**	**Lagged**	**T-Statistic**	**Standard Error**
RGDP(-1)	6.9380*	0.1142	RGDP(-1)	1.3278	0.0951
RGDP(-2)	-2.8370*	0.1141	RGDP(-2)	-1.7234	0.0553
FINI(-1)	2.5884*	0.0003	FINI(-1)	1.0424	0.1234
FINI(-2)	-2.2777*	0.0003	FINI(-2)	0.3156	0.1277
INDI(-1)	2.8458*	0.0563	INDI(-1)	1.3735	0.0356
INDI(-2)	-2.1926*	0.0231	INDI(-2)	-1.2441	0.0373
RESI(-1)	2.3786*	0.0123	RESI(-1)	0.9051	0.0159
RESI(-2)	-2.0743*	0.0215	RESI(-2)	-0.4276	0.0152
Dependent Variable: INDI			**Dependent Variable: RESI**		
Lagged	**T-Statistic**	**Standard Error**	**Lagged**	**T-Statistic**	**Standard Error**
RGDP(-1)	0.1354	0.1051	RGDP(-1)	-1.1016	0.1078
RGDP(-2)	-1.0343	0.1036	RGDP(-2)	0.3733	0.1048
FINI(-1)	0.1321	0.4492	FINI(-1)	1.3339	0.9286
FINI(-2)	0.9609	0.4649	FINI(-2)	0.8576	0.9611
INDI(-1)	1.0502	0.1296	INDI(-1)	-0.5712	0.2679
INDI(-2)	-1.0195	0.1360	INDI(-2)	-0.7929	0.2813
RESI(-1)	-0.1854	0.0580	RESI(-1)	1.6168	0.1200
RESI(-2)	1.4397	0.0555	RESI(-2)	-0.4946	0.1148

*Notes: The asterisk * denotes the significance at the 5% level respectively with 2.5% in each tail.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Thereafter, the relationship between the sectoral indices and economic growth was analysed with the use of a VAR analysis and the results displayed in Table 4.4. above. The empirical evidence presented that when RGDP was employed as the dependent variable, the test statistics of all lagged variables for the sectoral indices namely; FINI, RESI, INDI and RGDP itself were significant as all fell into the rejection region, which is outside the range of -1.9901 to +1.9901. Thus, the null hypothesis was rejected and this concludes that the stock market contributes to RGDP as these variables are highly significant in the equation.

On the contrary, when the sectoral indices FINI, INDI and RESI were used as the dependent variables, all the test statistics fell into the non-rejection region, which is between the range of -1.9901 to +1.9901. Therefore, the null hypothesis was not rejected and the coefficients are not significant. The results indicate that there is no evidence from the VAR that GDP affects share prices.



(Source: Estimated by the current author with the use of EViews 11, 2020)

Figure 4.2: Impulse Response Analysis Between the Sectoral Indices and RGDP

The impulse response functions in Figure 4.2 display that RESI exhibits no immediate response to a shock in RGDP and is negative and insignificant. The response of INDI to a shock in RGDP displays no immediate response but is positive and significant. However, two periods after the shock the response becomes negative and insignificant. FINI responds with no immediate effect to RGDP, however two periods after the shock FINI responds positively and significantly, but thereafter the response declines and becomes negative and insignificant four periods after the shock.

RGDP has no immediate response to RESI but two periods after the shock, RGDP responds positively and significantly thereafter the response starts declining rapidly. The response of RGDP to shocks in INDI has no immediate response, but two periods after the shock RGDP responds positively and significantly. However, the response starts declining rapidly becoming insignificant and negative in period five, and dies away rapidly. The response of RGDP to a shock in FINI displays no immediate response and is significant throughout the periods. All of the impulse responses displayed in Figure 4.2 are insignificant for all periods due to the confidence band containing zero. Furthermore, the testing for cointegrating while accounting for structural breaks in the relationship will be conducted subsequently to determine if the variables analysed have been susceptible to exogenous macroeconomic shocks.

4.2.2. Part B: Testing for Cointegration While Accounting for Structural Breaks

4.2.2.1. The Zivot-Andrews Unit Root Test Results

As described in section 3.4.2.1., Table 4.5 displays the results of the Zivot-Andrews unit root tests for each variable using each of the models and indicates the Zivot-Andrews test statistic for each case. The VAR analysis described earlier is used to determine the maximum lag length which will be included in each series. Thereafter, the Zivot-Andrews test selects the optimal lag length for each test conducted. The lag lengths are 0 for RGDP, RESI and FINI; 3 for ALSI and 8 for INDI.

Table 4.5: Table showing the summarised results of the Zivot-Andrews unit root tests

Variable	Lag Length	Break Date	Model A	Model B	Model C
RGDP	0	2009Q3	-3.9319	-3.5541	-4.0487*
5% Critical Value			-4.93	-4.42	-5.08
ALSI	3	2009Q3	-4.0801	-4.1581	-4.1561*
5% Critical Value			-4.93	-4.42	-5.08
RESI	0	2007Q3	-3.7329	-3.2135	-3.7337*
5% Critical Value			-4.93	-4.42	-5.08
FINI	0	2012Q4	-3.2903	-3.3235	-3.0286*
5% Critical Value			-4.93	-4.42	-5.08
INDI	8	2008Q2	-4.3199	-2.7789	-3.0052*
5% Critical Value			-4.93	-4.42	-5.08

*Notes: The asterisk * denotes the optimal model for use in each series, where the null cannot be rejected.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

The results indicate that for all the variables employed in this study; RGDP, ALSI, FINI, INDI and RESI, the null hypothesis cannot be rejected at the 5% significance level in Model C, which exhibits that a unit root with a structural break exists in both the trend and intercept. Table 4.5 shows that Model C contains significant terms for each of the four variables considered. Consequently, Model A and B fall away, and the focus is on Model C (Baum, 2015). This shows the presence of a structural break in the intercept and the trend. Therefore, the results of Models A and B does not need to be considered due to the null hypothesis of a unit root with a structural break in both the intercept and the trend, being reverted for use in either case for the series.

Furthermore, the break occurred in 2009Q2 for the stock market proxy, ALSI and economic growth proxy RGDP respectively, whilst the break occurred in 2007Q3 for RESI; 2012Q4 for FINI and 2008Q2 for INDI. Similarly, to the results presented in this thesis by the modified ADF tests discussed in the previous section, the breaks in the stock market variable ALSI and economic variable RGDP could most likely be linked to the 2007/2008 global financial crisis which had an evident negative impact on the South African economy.

Moreover, these breaks could have resulted due to the sudden and rapid shift in the market expectations and investor confidence that crippled the economic state of the country. The crisis led to stock market declines and reductions in trade imports and exports. This highlighted the findings by Fowowe (2015) who also emphasised that the financial crisis drastically affected the economic activity within the country. The breaks identified for the sectoral variables INDI and RESI further confirm this phenomenon. These breaks could be the result of the reduction in foreign capital inflows into the country which led to a reduction in the imports of commodities and labour-intensive products that have a profound effect on developing economies (Fowowe, 2015). A possible explanation for the break in 2012 in the financial sector can be attributed to the decline in economic growth from 3.5% to 2.5% in 2012. The economy recovery process is largely dependent on the government's policy changes and actions which could take many years to fully recover. Additionally, the Bai-Perron structural break test was applied subsequently in order to identify multiple structural breaks in the relationship.

4.2.2.2. Bai-Perron Structural Break Test Results

As discussed in section 3.4.2.2., the Bai-Perron structural break tests were conducted in EViews 11 (2020) using the sequential L + 1 breaks vs. L breaks for this study and displayed in Table 4.6. The null and alternative hypothesis for each series is depicted below:

H_0 = The series contains 0 breakpoints

H_A = The series contains 1 breakpoint up until the test fails to the reject the null

Table 4.6: Table showing the summarised results of the Bai-Perron structural break tests

Variables	RGDP	ALSI	INDI	FINI	RESI
Breakpoints	3	2	2	2	1
Sequential Break Dates	2010Q3 2016Q1 2008Q3	2008Q4 2003Q2	2008Q4 2005Q1	2008Q4 2004Q4	2008Q3
Repartition Break Dates	2008Q3 2010Q3 2016Q1	2003Q2 2008Q4	2005Q1 2008Q4	2004Q4 2008Q4	2008Q3

(Source: Estimated by the current author with the use of EViews 11, 2020)

As can be seen from Table 4.6 above, the Bai-Perron test results indicate that the variables ALSI, INDI and FINI contains 2 breakpoints. Therefore, the null hypothesis was rejected for nulls of 0 and 1 breakpoints in favour of the alternatives of 1 and 2 breakpoints for these particular variables. Additionally, the results depicted that RGDP contains 3 breakpoints thus the null hypothesis was rejected for nulls of 0, 1, and 2 breakpoints in favour of the alternatives of 1, 2, and 3 breakpoints. On the other hand, RESI only has 1 breakpoint and therefore the null hypothesis was rejected for a null of 0 breakpoints in favour of the alternative of 1 breakpoint. EViews 11 (2020) displays break dates obtained from the original sequential procedure and those obtained following the repartition procedure. In this case, the dates do not change for both sequential and repartition which can be seen in Table 4.6.

It is vital to take into consideration that the break dates for all variables occur around the period in which South Africa experienced significant turbulent conditions to the economy. This coincides with the unit root test results discussed earlier which also selected break dates that could most likely be linked to the global financial crisis. The most common occurring year depicted by the Bai-Perron structural break results was 2008. It is symbolic as this was the year in which South Africa experienced a financial crisis that impacted the economy severely, as one might expect, given that the dates coincide with the financial crisis of 2007/2008. As stated previously, the impact on the South African economy was extensive, GDP growth and investment were severely low and this led the country into a recession for the first time in 19 years (Schmitz, 2012). This can be viewed as a factor that contributed to the recession given that there were various other geopolitical factors involved that led to the recession.

In early 2003, there were reassuring indications that inflation was swiftly being brought under control with the strengthening of the Rand. The year 2004 marked the First Decade of Freedom and was celebrated throughout the country. The South African economy recorded real economic growth during the period of 2003/2004 due to the increases in real output in the secondary and tertiary sectors. However, a weakening of the international economy had a ripple effect on the South African economy with a decrease of 3.3% in 2003 and a rise to 4% during 2005 (StatsSA, 2020). These could be probable factors for the break dates occurring in 2003 for ALSI and 2004 for FINI.

South Africa is a vastly attractive tourist destination and it was announced by government in March 2003 that the country is one of the world's fastest growing tourist destinations. In the year 2010, South Africa hosted the FIFA World Cup therefore leading to a surge in economic profits as can been seen by the break date in the year 2010 for RGDP. The hosting of the 2010 FIFA World Cup led to R93-billion being injected into the local economy. This has rebranded South Africa and created a favourable climate for FDI (StatsSA, 2020). Moreover, the world economy rose by 4% in the year 2010 and was largely driven by the momentum of China's urbanisation, industrial expansion and modernisation.

However, in the year 2016 a drastic decrease in the mining and manufacturing production sector decreased economic growth in the country substantially. According to StatsSA (2020) the country's GDP decelerated from 1.3% in 2015 to 0.9% in 2016 however, improving progressively to 1.7% in 2017 and 2.4% in 2018. The decline in 2016 can be attributed to the mining industry's 11.5% decline in production and was the key factor of the economic growth decline. This was due to a fall in the production of gold, coal and other metals, such as iron ore and platinum. The decline in economic growth caused by the industrial sector could be the factor which caused the break date in GDP, identified by the Bai-Perron test in the year 2016.

The fragile state of the economy in the country is due to weak economic growth and structural challenges faced by the various political and economic instabilities that the country has faced over the past few decades. Furthermore, this is also due to the high unemployment rate led by poor labour market developments. The South African economy has struggled through the aftereffects of the recession and the economy has yet to fully recover (Maredza and Ikhide, 2013).

Therefore, given that there is evidence that structural breaks exist in the relationship, it is imperative to continue with a Gregory-Hansen test for cointegration in order to determine whether a significant long-run cointegrating relationship exists when structural breaks are accounted for within the model. Thus, the Gregory-Hansen cointegration test was then applied and the results presented subsequently.

4.2.2.3. Gregory-Hansen Cointegration Test Results

As discussed in section 3.4.2.3., the Gregory and Hansen (1996) test addressed the issue of cointegration estimation in the presence of a structural break by introducing a residual based technique. The particular break point is unknown and is determined by finding the minimum values for the ADF t-statistic. For this analysis, the independent variable is the stock market and the dependent variable is economic activity. The motivation for the Gregory-Hansen level shift and trend test is to examine whether cointegration holds over a fairly long period of time but then shifts to a new long-run relationship. For this study that time period is 20 years. In this model, the structural break affects the constant. However, there is also a time trend included in the model. The null and alternative hypothesis for each series is depicted below:

H_0 = There is no cointegration present

H_A = There is cointegration present with a structural break

Table 4.7: Table showing the summarised results of the Gregory-Hansen cointegration tests

	Model 1	**Model 2**	**Model 3**
ADF t-statistic	-5.7324*	-5.7924*	-5.7824*
PP Za-stat	-46.3469	-47.3469	-48.3469
PP Zt-stat	-5.7210	-5.7210	-5.7210
Break Date	2008Q1	2008Q1	2008Q1
Lags	2	2	2

*Notes: The asterisk * denotes the rejection of the null hypothesis at the 5% level of significance.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

The results of the Gregory-Hansen cointegration tests are presented in Table 4.7 for different cases of a level shift, a level shift with trend and a regime shift. These different cases are referred to as Model 1, Model 2 and Model 3 respectively and the critical values are calculated in the Gregory-Hansen test. In Table 4.7, the test statistic presented is the ADF test statistic in accordance to the AIC. The number of lags included in the model and the estimated break dates are uniform regardless of the model used. From the results presented in Table 4.7, the lag length selected by each of the models is 2 lags, irrespective of the model utilised. The null hypothesis of no cointegration can be rejected at the 5% level of significance in each model in favour of the alternative hypothesis of cointegration with a structural break between the economic and stock market variables. Therefore, the results indicate that each model displays significant evidence of cointegration with a presence of a structural break and is significant in the context of this study. This indicates that for an analysis of a similar nature, it is imperative to account for structural breaks when testing for cointegration.

Drawing on this notion, the results of the Gregory-Hansen test can be seen as a vital contribution to this study namely; the existence of structural breaks in the relationship and the existence of a strong significant cointegrating relationship when accounting for these structural breaks. Therefore, contributing the core research objectives of this study as the results display strong evidence of cointegration between share price fluctuations and economic growth in South Africa.

Thus, in line with previous literature by Xing *et al.* (2020), Kekolahti *et al.* (2016) and other tests that accounted for structural breaks in the underlying relationship, the empirical results have identified structural breaks in accordance with the global financial crisis and have indicated that the most significant structural break occurs in 2008. This leads to the conclusion that the 2007/2008 global financial crisis had a distressing economic impact on the state of the South African economy and led the country into a recession. Therefore, testing the magnitude of the long-run relationship and whether the relationship displays evidence of asymmetric adjustment will be conducted subsequently by means of NARDL models, in order to determine the magnitude of the positive and negative adjustments.

4.2.3. Part C: Testing for Cointegration While Accounting for Asymmetric Adjustment

In this section, the ARDL model is utilised for comparative purposes and will build into the NARDL model to examine a linear cointegrating relationship in comparison to a nonlinear cointegrating relationship. This is conducted due to the ARDL model not taking into account the nonlinearity and asymmetric impacts of the respective relationship and will solidify the superiority of nonlinear testing. In this section, when examining the overarching relationship, the independent variable is the stock market and the dependent variable RGDP.

4.2.3.1. ARDL Long-Run Form and Bounds Test Results

The ARDL long-run form and bounds test was estimated using EViews 11 (2020). As discussed in section 3.4.2.2., the ARDL model is superior in identifying the long-run affiliation between two or more variables in comparison to the residual-based Engle and Granger's (1987) and the likelihood-based Johansen and Juselius (1990) approaches, particularly in small sample sizes. The null and alternative hypotheses are exhibited below:

H_0 = There is no long-run cointegrating relationship present; $\varphi_1 = \varphi_2 = 0$

H_A = There is a long-run cointegrating relationship present; $\varphi_1 \neq 0$ and $\varphi_2 \neq 0$

The bounds test, estimation output, ARDL cointegration and long-run form are presented in this section to examine the linear relationship between stock market fluctuations and economic growth in South Africa. The bounds testing as an extension of ARDL modelling uses F and t- statistics to test the significance of the lagged levels of the variables in a univariate equilibrium correction system (Van Hoang et al., 2016). This test is utilised to determine is the underlying a time series is trend or first difference stationary. The ARDL model is applied to examine the short and long run association between variables.

Table 4.8: Table showing the summary of results of the ARDL bounds tests

F- statistic	**Value**	**K**
ALSI	5.441527****	1
RESI	4.985052****	1
FINI	4.394329****	1
INDI	4.793599****	1
Critical Value Bounds		
Level of Significance	**I(0) Bound**	**I(1) Bound**
10%	3.02	3.51
5%	3.62	4.16
2.5%	4.18	4.69
1%	4.14	4.30

*Notes: The asterisks *, **, ***, **** denote the significance at the 10%, 5%, 2.5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

In Table 4.8, the results of the ARDL bounds test are presented. The differing numbers of variables are represented by the k term in the test output. The lower bound is stipulated by I(0) and the upper bound by I(1). The results displayed in Table 4.8 specify that the stock market variables; ALSI, INDI, FINI, RESI exhibit cointegration as the F-statistic values were above the I(0) and I(1) critical value bounds. Therefore, the null hypothesis that there is no long-run cointegrating relationship can be strongly rejected in favour of the alternative hypothesis, hence there is strong cointegration present at all levels of significance. The variables are seen to be statistically significant at the 1% level of significance evidencing a strong presence of cointegration in the underlying relationship. Hence, as displayed in Table 3.1 in the previous chapter, the empirical results of the ARDL bounds test depicts that there is evidence of strong long-run cointegrating relationships due to the Wald F-statistic exceeding the upper critical bound value.

It is imperative to note that this study is comprehensive in nature and utilising RGDP as the independent variable has been considered; however, the effect of RGDP based on share prices as an independent variable is what is important to this study. Therefore, the ALSI and sectoral indices are utilised as the independent variables to examine the effects that the stock market fluctuations have on economic activity in South Africa. As can be seen in Table 4.8, this study confirmed the existence of a strong long-run linear cointegration amongst the variables. As a result, this study then proceeded to determine the nonlinear long-run form and bounds test results by utilising the NARDL model.

4.2.3.2. NARDL Long-Run Form and Bounds Test Results

The NARDL long-run form and bounds test was estimated using EViews 11 (2020). The NARDL model is a dynamic model and an extension of the ARDL model by Pesaran and Shin (1998) and Pesaran *et al.* (2001), therefore developing a dynamic parametric framework that is flexible in which both long-run and short-run asymmetries can be modelled and exhibited.

The null and alternative hypotheses are:

H_0 = There is no long-run cointegrating relationship present; $\varphi_1 = \varphi_2 = 0$

H_A = There is a long-run cointegrating relationship present; $\varphi_1 \neq 0$ and $\varphi_2 \neq 0$

The NARDL model incorporates the possibility of asymmetric effects of positive and negative changes in the explanatory variables on the dependent variable in contrast to the ARDL model, where the possible impact of the explanatory variables remains the same (Van Hoang *et al.,* 2016). However, if the impact of the segregated components of an explanatory variable are found to be same, the NARDL model will therefore be in line with the standard symmetric ARDL model.

Table 4.9: Table showing the summary of results of the NARDL bounds tests

F- statistic	Value	K
ALSI	6.384575****	2
RESI	3.883443**	2
FINI	3.915437**	2
INDI	4.272135**	2
Critical Value Bounds		
Level of Significance	**I(0) Bound**	**I(1) Bound**
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.15	5.00

*Notes: The asterisks *, **, ***, **** denote the significance at the 10%, 5%, 2.5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Table 4.9 above indicates the results of the NARDL bounds test. The differing numbers of variables are represented by the k term in the test output. The lower bound is specified by I(0) and the upper bound by I(1). The F-statistic value for the stock market variables namely; RESI, FINI and INDI were above the I(0) and I(1) critical value bounds at the 5% level of significance and ALSI at the 1% level of significance. The null hypothesis that that there is no long-run cointegrating relationship present was rejected in favour of the alternative hypothesis. Thus, the results exhibited that there is evidence of strong long-run cointegration present. The sectoral indices are seen to be statistically significant at the 1% level and ALSI at the 5% level of significance evidencing a strong presence of cointegration in the underlying relationship. As discussed previously and taking Table 3.1 in the previous chapter into account, the empirical results of the NARDL bounds test depicts that there is evidence of strong long-run cointegrating relationships due to the Wald F-statistic exceeding the upper critical bound value. Once again, it is imperative to note that this study is comprehensive in nature and utilising RGDP as the independent variable has been considered, however, the effect of RGDP based on share prices as an independent variable is what is important to this study.

Furthermore, nonlinear cointegration is exhibited by breaking down a time series into its positive and negative partial sums thus it can be decomposed into its initial value and its positive and negative cumulative sums (Ahmad, 2010). This model is more flexible than the ARDL model as it addresses the shortfalls of the conventional linear cointegrating relationship by modelling asymmetric behaviour between variables (Liang *et al.,* 2020). As can be seen in Table 4.9, this study confirmed the existence of strong long-run nonlinear cointegration in the relationship. Hence, this study then proceeded to estimate both short-run and long-run elasticities. Firstly, the primary relationship between the stock market and economic growth will be discussed. Secondly, the relationship between the sectoral indices and economic growth, for both the ARDL and NARDL model will be discussed.

4.2.3.3. The ARDL and NARDL Estimation Output for RGDP and ALSI

4.2.3.3.1. ARDL Short and Long-run Estimation and Cointegration Form

Table 4.10: Table showing the ARDL Short-run estimation and Cointegration Form of the ALSI

Variable	Coefficient	Standard Error	T-statistic	Prob
Independent variable: ALSI				
LOG(RGDP(-1))	0.747589***	0.081193	9.207508	0.0000
ECM(-1)	−0.991432***	0.126128	−2.843661	0.0000
C	0.475483	0.407206	1.167673	0.2467

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Table 4.10 displays the ARDL short-run estimation and cointegration form for the overarching relationship between the ALSI and RGDP. The short-run results indicate that RGDP is affected by changes to the ALSI due to the coefficient being positive and highly significant at the 1% level of significance. It can be seen that a 1% increase in the ALSI increases RGDP by 0.75%. This result exhibits that stock market fluctuations have a great impact on the economic growth in South Africa. A bull market is generally aligned with a growing economy and leads to greater investor confidence. A greater investor confidence brings about an increase in the buying of stocks leading to an increase in the stock price thus contributing to economic growth (Osamwonyi and Kasimu, 2013).

The ECM is based on the behavioural assumption that two or more time series exhibit an equilibrium relationship that establishes short and long-run behaviour. This model estimates the speed of adjustment towards equilibrium in a cointegrating relationship. The coefficient of this regressor is the speed of adjustment to equilibrium in each period. If the variables are cointegrated, the coefficient will be negative and highly significant. The ECT(-1) of -0.99% is negative and statistically significant at the 1% significance level with a high coefficient where the negative sign indicates the degree of correction. This means that 99% of disequilibrium is corrected before the next time period and 1% remains. It reveals that disequilibrium can be adjusted quickly to the long-run and that equilibrium in the long-run will be attained. It is critical to note that the main focus of this study is on the long-run relationships which will be discussed subsequently.

Table 4.11: Table showing the ARDL Long-run estimation and Cointegration Form of the ALSI

Conditional Error Correction Regression				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: ALSI				
C	0.650441	0.413221	1.574076	0.1200
LOG(RGDP(-1))	0.204835***	0.085292	2.401578	0.0090
Cointeq(-1)	-0.150982***	0.009216	-3.448932	0.0005
Long-Run Coefficients				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: ALSI				
LOG(ALSI)	0.087216*	0.132797	-0.656764	0.0000
C	3.175434	1.359376	2.335950	0.0224

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Table 4.11 above displays the ARDL long-run estimation and cointegration form. It can be seen that the variables are positive and significant at the 1% level of significance. For the overarching relationship between the ALSI and RGDP, the long-run empirical results indicate that economic growth is affected by changes in the share prices. The results depict that a 1% increase in the ALSI increases RGDP by 0.20%. The CointEq(-1) of -0.15% is negative and statistically significant at the 1% significance level with a low coefficient and therefore disequilibrium can be adjusted to the long-run at a low and constant speed. The respective long-run linear cointegrating equation for the ALSI and RGDP is presented as follows:

$$Log(RGDP)_t = 3.1754 + 0.0872 Log(ALSI)_t + \text{Cointeq}(-1) \quad (4.1)$$

The estimated coefficients for the overarching relationship between the ALSI and RGDP in the long-run depicts positive coefficients that are significant at the 1% level of significance. Thus, when RGDP was employed as the dependent variable this indicated that economic growth is affected by changes in the share prices in the long-run as the coefficient is positive and significant.

The coefficient of 0.08% is very small in magnitude and is seen as positive and significant at the 1% level of significance. The sensitivity of economic growth to changes in the stock market is explained by the wealth effect theory as investor confidence rises, leading to an increase in spending thus increasing economic growth. Furthermore, trading stock on a public exchange allows firms to raise capital through public funding, avoid incurring debt and expansion of the business which further increases economic growth (Kyle and Xiong, 2001).

4.2.3.3.2. NARDL Short and Long-run Estimation and Cointegration Form

Table 4.12: Table showing the NARDL Short-run estimation and Cointegration Form of the ALSI

Variable	Coefficient	Standard Error	T-statistic	Prob
Independent Variable: ALSI				
RGDP(-1)	0.629239	0.123144	5.109801	0.0000
ALSI_POS	0.010190***	0.000197	0.963095	0.0396
ALSI_NEG	0.020246***	0.000219	1.123566	0.0660
C	3.931017	1.350032	2.911796	0.0052

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

The results presented in Table 4.12 above exhibits the NARDL short-run estimation and cointegration form. The evidence presented that economic growth is more sensitive to negative effects in the stock market. This result can be also be attributed to the phenomenon of the wealth effect as individuals decease spending when the value of their assets decreases. Thus, in the short-run, negative changes of the stock market on economic growth showed that unfavourable share prices had a greater effect on GDP than an increase of the same magnitude.

From the empirical results presented for the relationship between the ALSI and RGDP, when the ALSI was utilised as the independent variable and RGDP as the dependent variable, a 1% increase in the ALSI increases RGDP by 0.01% and 1% decrease in the ALSI decreases RGDP by 0.02%. Table 4.12 displays the response of negative changes to the dependent variable RGDP. The response of the dependent variable to negative changes is positive. Therefore, for every 1 unit decrease in ALSI, the dependent variable is going to decrease by 0.02%. This confirms that the partial sum of positive changes exhibits different magnitudes for both the positive and negative effects indicative of short-run asymmetry for the ALSI, however the magnitude is very low. This can be substantiated from the study by Mazorodze and Siddiq (2018).

Table 4.13: Table showing the NARDL Long-run estimation and Cointegration Form of the ALSI

Conditional Error Correction Regression				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: ALSI				
C	3.931017	1.350032	2.911796	0.0052
ALSI_POS	0.000190***	0.000197	0.963095	0.0396
ALSI_NEG	0.000246***	0.000219	1.123566	0.0660
Cointeq(-1)	-0.610908	0.089211	-3.898945	0.0007
Long-Run Coefficients				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: ALSI				
ALSI_POS	0.117005***	9.46E-05	1.844612	0.0004
ALSI_NEG	2.210005***	0.000258	2.726512	0.0009
C	8.932403	1.368830	6.525575	0.0000

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Nevertheless, it is essential to note that the primary focus of this study is based on the long-run effects of the models. Table 4.13 above displays the nonlinear long-run cointegration and ECT that are derived as the levels equation and denoted as Cointeq(-1). The coefficient of this regressor is the speed of adjustment to equilibrium in each period. If the variables are cointegrated, the coefficient will be negative and highly significant. The significant error correction term for the stock market indicated an adjustment to the long-run equilibrium when short-run deviations occurred. The readjustment term value of 61% for the stock market suggests that the relationship deviated considerably in the short-run.

A critical distinction of the NARDL model is the splitting of the variables into positive and negative components. An important factor displayed Table 4.13 is that the positive and negative adjustment coefficients provide evidence of long-run asymmetry and nonlinearity. The empirical results indicated that economic growth is more sensitive to a decrease in share prices in the long-run. The examined results stipulate that a 1% increase in the ALSI positively affects economic growth by 0.17% whilst a 1% decrease negatively affects economic growth by 2.21%. The impact of the negative coefficient being more than the positive coefficient is an asymmetry effect. For the stock market, the negative coefficients were of greater magnitude with the negative shocks to GDP being higher than the positive shocks and are seen to be significant at the 1% level of significance. This finding is logical as a freefall in share prices tends to severely impact the GDP of a country. Investor confidence in the long-term prospects of a company declines and consumers hold on tighter to cash, resulting in less inflow into the economy. Economic factors that tend to impact the share price negatively include, interest rate changes, inflation and market sentiment. A rise in the interest rate and inflation tends to decrease demand leading to a fall in GDP (Lettau and Ludvigson, 2004). Therefore, stipulating that GDP is more sensitive to negative shocks to the stock market. The results are presented in the nonlinear long-run cointegrating equation subsequently.

$$Log(RGDP)_t = 8.9324 + 0.1170Log(ALSI_tPOS) + 2.2100Log(ALSI_tNEG) + \text{Cointeq}(-1) \tag{4.2}$$

The findings of the relationship between share price fluctuations and economic growth were two-fold. Firstly, it confirmed the existence of long-run asymmetry in the relationship. Secondly, it showed that the stock market fluctuations effect the economic activity in South Africa. This represents a significant contribution to literature as the relationship was previously overlooked in terms of nonlinearity. Given that this is the first study of its context that employed a nonlinear methodological approach, this study could not be compared to previous literature to evaluate the robustness of the results obtained thus leading to a possible area for future research.

Table 4.14: Table showing the Wald Test results for ALSI

Equation: ALSI		**Null Hypothesis: Symmetry**	
Test Statistic	**Value**	**Df**	**Probability**
t-statistic	0.596205	56	0.0034
F-statistic	0.355460	(1, 56)	0.0014
Chi-square	0.355460	1	0.0012
Null Hypothesis c(2)=c(3)			
Normalized restriction (=0)		**Value**	**Std. Error**
C(2) - C(3)		0.148606	0.249254

(Source: Estimated by the current author with the use of EViews 11, 2020)

According to Shin *et al.* (2014), a Wald test can thereafter be utilised to determine whether or not the null hypothesis of symmetric adjustment can be rejected. The empirical results of a Wald test with a null of symmetric adjustment are presented in Table 4.14. The results demonstrate that the null hypothesis of symmetry is strongly rejected thus leading to the conclusion that the long-run adjustment is asymmetric between the JSE ALSI and economic growth in South Africa. This further complements the results presented by the NARDL model, indicating that the relationship is in fact asymmetric and nonlinear between share price fluctuations and economic growth.

4.2.3.4. The ARDL and NARDL Estimation Output for RGDP and the Sectoral Indices

4.2.3.4.1. ARDL Short and Long-run Estimation and Cointegration Form

Table 4.15: Table showing the ARDL Short-run estimation and Cointegration Form of the Sectoral Analysis

Variable	Coefficient	Standard Error	T-statistic	Prob
Independent variable: RESI				
LOG(RGDP(-1))	0.648687***	0.080921	8.016252	0.0000
ECM(-1)	−0.105912***	0.026327	−2.946641	0.0000
C	1.216533	0.569947	2.134469	0.0361
Independent variable: FINI				
LOG(RGDP(-1))	0.698625***	0.080651	8.662335	0.0000
ECM(-1)	−0.111432***	0.116325	−1.446652	0.0000
C	0.459022	0.420734	1.091004	0.2785
Independent variable: INDI				
LOG(RGDP(-1))	0.753555***	0.080542	9.356066	0.0000
ECM(-1)	−0.9913632***	0.114138	−2.843561	0.0000
C	0.465367	0.331903	1.402118	0.1651

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Furthermore, the relationship between the sectoral indices and RGDP was examined subsequently to observe the impacts that the sectoral indices have on the economic growth in the country and is displayed in Table 4.15. The short-run empirical results of the relationship between the resource sector and RGDP revealed that the economic growth in the country is affected by changes in the resource sector. A 1% increase in RESI raises RGDP by 0.65% and is positive and highly significant at all levels of significance. The ECT(-1) of -0.11% can be seen as negative and statistically significant at the 1% level of significance. However, the coefficient is low and this demonstrates a slow and constant speed of adjustment to the long-run.

Additionally, the relationship between the financial sector and RGDP was examined. The results depict that a 1% increase in FINI increases RGDP by 0.70% and is highly significant and positive.

The ECT(-1) of -0.11% is negative and statistically significant at the 1% significance level with a low coefficient and disequilibrium can be adjusted to the long-run at a slow and constant speed.

Similarly, the empirical results of the relationship between the industrial sector and RGDP revealed that economic growth is affected by changes in the industrial sector with a 1% increase in INDI increasing RGDP by 0.75%. The ECT(-1) of -0.99% is negative and statistically significant at the 1% significance level with a high coefficient and disequilibrium can be quickly adjusted to the long-run at a high speed. Given the results of the ARDL short-run estimation, the ARDL long-run estimation was examined and the results presented subsequently.

Table 4.16: Table showing the ARDL Long-run estimation and Cointegration Form of the Sectoral Analysis

Conditional Error Correction Regression				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: RESI				
C	0.051123	0.443635	0.115237	0.9086
LOG(RGDP(-1))	0.175286***	0.081081	2.161869	0.0040
CointEq(-1)	-0.120899***	0.006213	-3.416839	0.0007
Independent Variable: FINI				
C	1.055959	0.405051	2.606976	0.0110
LOG(RGDP(-1))	0.270423***	0.074575	3.626184	0.0005
CointEq(-1)	-0.120789***	0.006011	-3.478169	0.0007
Independent Variable: INDI				
C	0.702228	0.304098	2.309215	0.0237
LOG(RGDP(-1))	0.199414***	0.066569	2.995571	0.0037
CointEq(-1)	-0.110899***	0.005785	-3.736979	0.0006
C	0.465367	0.331903	1.402118	0.1651
Long-Run Coefficients				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: RESI				
LOG(RESI)	0.195253***	0.235864	0.827819	0.0000
C	0.291655	2.476943	0.117748	0.9066
Independent Variable: FINI				
LOG(FINI)	0.168351***	0.120063	-1.402183	0.0000
C	3.904835	1.080688	3.613288	0.0005
Independent Variable: INDI				
LOG(INDI)	0.126854***	0.100468	-1.262630	0.0000
C	3.521465	1.007019	3.496919	0.0008

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*

(Source: Estimated by the current author with the use of EViews 11, 2020)

Thereafter, the relationship between the sectoral indices and RGDP was examined to determine the linear impacts that the sectoral indices have on economic growth. The results are displayed in Table 4.16. The long-run empirical results of the relationship between the resource sector and RGDP exhibited that when RESI was utilised as the independent variable, economic growth is affected by changes in RESI. Thus, a 1% increase in RESI increases RGDP by 0.18% which is viewed as positive and highly significant. The CointEq(-1) of -0.12% is negative and statistically significant at the 1% significance level with a low coefficient therefore disequilibrium can be adjusted to the long-run at a slow and constant speed.

Moreover, for the long-run relationship between the resource sector and RGDP, the coefficient of 0.20% is small in magnitude as well as positive and significant at the 1% level of significance. This exhibits that economic growth is affected by changes to the resource sector in the long-run. The respective linear long-run cointegrating equation for RESI and RGDP is presented as follows:

$$Log(RGDP)_t = 0.2916 + 0.1952Log(RESI)_t + \text{Cointeq}(-1) \tag{4.3}$$

Similarly, the relationship between the financial sector and RGDP was observed. The long-run empirical results of the relationship exhibited that when FINI was employed as the independent variable, economic growth is affected by changes in the financial sector. Thus, a 1% increase in FINI increases RGDP by 0.27%. The CointEq(-1) of -0.12% is negative and statistically significant at the 1% significance level with a low coefficient thus disequilibrium can be adjusted at a slow and constant speed. Furthermore, for the long-run relationship between the financial sector and RGDP, the coefficient of 0.17% is small in magnitude and is positive and significant at the 1% level of significance exhibiting that economic growth is affected by changes to the financial sector in the long-run. The respective linear long-run cointegrating equation for FINI and RGDP is as follows:

$$Log(RGDP)_t = 3.9048 + 0.1683Log(FINI)_t + \text{Cointeq}(-1) \tag{4.4}$$

Lastly, the empirical results of the relationship between the industrial sector and RGDP revealed that when INDI was employed as the independent variable, the economic growth in the country is affected by changes to INDI with a 1% increase in INDI increasing RGDP by 0.20%. The CointEq(-1) of -0.11% is negative and statistically significant at the 1% significance level with a low coefficient and disequilibrium can be adjusted to the long-run at a slow and constant speed. Thereafter, the long-run relationship between the industrial sector and RGDP exhibited that the coefficient of 0.13% is small in magnitude and is positive and significant at the 1% level of significance. Thus, economic growth is affected by changes to the industrial sector in the long-run. The respective linear long-run cointegrating equation for INDI and RGDP is displayed as follows:

$$Log(RGDP)_t = 3.5214 + 0.1268 Log(INDI)_t + \text{Cointeq}(-1) \tag{4.5}$$

Therefore, the empirical results presented that the long-run cointegrating relationships provide evidence that share price fluctuations play a vital part in the economic growth of the country. This stipulates that share prices have a very significant impact on economic growth as expected from the literature. However, the coefficients for both the primary and sectoral analysis are very low with the magnitude of the ALSI being the lowest at 0.08%. The ARDL linear results presented that the stock market fluctuations play a crucial and significant part in the economic growth of South Africa. Given the results of the ARDL tests, it is now essential to examine if the relationship exhibits nonlinearity and asymmetry.

4.2.4.3.2. NARDL Short and Long-run Estimation and Cointegration Form

Table 4.17: Table showing the NARDL Short-run estimation and Cointegration Form of the Sectoral Analysis

Variable	Coefficient	Standard Error	T-statistic	Prob
Independent Variable: RESI				
RGDP(-1)	0.768811	0.117517	6.542125	0.0000
RESI_POS	0.106896***	0.002805	0.053372	0.0576
RESI_NEG	1.305805***	0.002595	1.365542	0.0765
C	3.545041	1.284725	2.759378	0.0074
Independent Variable: FINI				
RGDP(-1)	0.761336	0.071654	10.62512	0.0000
FINI_POS	1.120805***	0.005895	0.624111	0.0344
FINI_NEG	0.110175***	0.000181	0.964135	0.0379
C	3.247275	1.000834	3.244568	0.0017
Independent Variable: INDI				
RGDP(-1)	0.738223	0.073215	10.08298	0.0000
INDI_POS	0.206305***	0.000132	0.370393	0.0122
INDI_NEG	1.410689***	0.000255	-0.851735	0.0971
C	2.875987	1.002523	2.868748	0.0054

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

The relationship between RGDP and resource sector revealed short-run asymmetry and nonlinearity in the relationship. A 1% increase in RESI increases RGDP by 0.1% and a 1% decrease in RESI decreases RGDP by 1.3%. The partial sum of positive changes is lower in magnitude in comparison to the partial sum of negative changes to RGDP which stipulates the presence of strong short-run asymmetry. This proposes that economic growth is more sensitive to negative changes in the resource sector in the short-run; suggesting that declining prices of natural resources such gold and iron ore yielded a greater response in GDP than price increases in the short-run.

The empirical results of the relationship between the financial sector and economic growth revealed the presence of short-run asymmetry as the partial sum of positive changes is greater in magnitude than the partial sum of negative changes. The results indicate that a 1% increase in FINI increases RGDP by 1.12% and a 1% decrease in FINI decreases RGDP by 0.11%. These results stipulate that economic growth is sensitive to the positive changes in the financial sector. It implies that if the financial sector grows due to the capital inflows being injected into the economy from taxation received, commercial, investment and insurance, the economy also grows and is more responsive to a growth than a decline in this sector in the short-run.

The banking sector is a vital component of the financial system. Additional wealth is created in the economy by attracting funds from depositors and these funds are then channelled to investors. It has been expressed in literature that the smooth running of a country's economic activity depends on an efficient banking system (Chen, 2018). An efficient financial sector plays a critical role in the growth and productivity in a country. It assists in the direct flow of investments and savings in the economy which enables the accumulation of capital for the production of goods and services (Chwieroth and Walter, 2019). Therefore, a high economic growth rate provides firms with the confidence to invest more and lays the foundation for future economic activity. This can be seen from the results presented by the FINI POS and NEG values as GDP is more sensitive to positive changes in the financial sector than negative changes.

Furthermore, the empirical results of the relationship between the industrial sector and economic growth revealed the presence of short-run asymmetry and nonlinearity as the results exhibited a greater magnitude in the negative adjustments compared to the positive adjustments. It can also be seen that a 1% increase in INDI increases RGDP by 0.2% and a 1% decrease in INDI decreases RGDP by 1.41%. This suggests that the negative impacts to the industrial sector in the short-run tend to have a greater impact on economic growth within the country. Thus, a decline in the mining and manufacturing production sector decreases economic growth in the country substantially.

The results of the short-run estimates stipulate the presence of short-run asymmetry and provides evidence of the superiority of the NARDL model in comparison to the linear conventional tests which do not take into account the asymmetric effects between the variables. Thereafter, the long-run estimation is exhibited in Tables 4.18 subsequently which is crucial to this study.

Table 4.18: Table showing the NARDL Long-run estimation and Cointegration Form of the Sectoral Analysis

Conditional Error Correction Regression				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: RESI				
C	3.545041	1.284725	2.759378	0.0074
RESI_POS	0.012005***	1.96E-05	1.091237	0.0090
RESI_NEG	0.011325***	2.43E-05	1.365542	0.0065
CointEq(-1)	-0.158907	0.078210	-3.529897	0.0007
Independent Variable: FINI				
C	3.247275	1.000834	3.244568	0.0017
FINI_POS	0.008905***	9.35E-05	0.624111	0.0044
FINI_NEG	0.000175***	0.000181	0.964135	0.0079
CointEq(-1)	-0.221714	0.050878	-3.468178	0.0008
Independent Variable: INDI				
C	2.875987	1.002523	2.868748	0.0054
INDI_POS	0.006505***	1.65E-05	-2.050430	0.0039
INDI_NEG	0.002505***	4.61E-05	-0.851735	0.0071
CointEq(-1)	-0.422778	0.078696	-3.469185	0.0007
Long-Run Coefficients				
Variable	**Coefficient**	**Standard Error**	**T-statistic**	**Prob**
Independent Variable: RESI				
RESI_POS	0.201525***	5.16E-05	1.215844	0.0282
RESI_NEG	1.302545***	6.11E-05	1.591740	0.0160
C	10.39833	1.404326	7.404498	0.0000
Independent Variable: FINI				
FINI_POS	1.102145***	0.000398	0.614533	0.0406
FINI_NEG	0.407132***	0.000771	0.948799	0.0456
C	13.60606	1.557996	8.733055	0.0000
Independent Variable: INDI				
INDI_POS	0.202129***	6.66E-05	-1.937009	0.0566
INDI_NEG	2.501150***	0.000181	-0.829855	0.0093
C	10.98640	1.512754	7.262515	0.0000

*Notes: The asterisks *, **, *** denote the significance at the 10%, 5% and 1% levels respectively.*
(Source: Estimated by the current author with the use of EViews 11, 2020)

Thereafter, the relationship between the sectoral indices and RGDP was examined. The long-run empirical results of the relationship between the resource sector and RGDP exhibited that economic growth is affected by changes in the resource sector. The readjustment term value of 15% for the resource sector suggests that the relationship deviated slightly in the short-run.

As discussed previously, a critical distinction of the NARDL model is the splitting of the variables into positive and negative components. An important factor displayed in Table 4.18 is that the positive and negative adjustment coefficients provide evidence of long-run asymmetry and nonlinearity. The empirical results presented in Table 4.18 indicate that economic growth is more sensitive to the negative shocks to the resource sector in the long-run. The examined results stipulate that a 1% increase in RESI positively affects RGDP by 0.2% whilst a 1% decrease negatively affects RGDP by 1.3%. This exhibits that changes to the resource sector effect economic growth in South Africa in the long-run. The positive coefficient of RESI is vastly lower in magnitude than the negative coefficient of RESI and both variables are significant, indicating that there is evidence of asymmetric adjustment. This proposes that as the prices of South Africa's natural resources plummet, it severely and negatively affects the economic growth in country. As such, investors may react to a plummet in the resource sector leading to a decline in GDP. The nonlinear long-run cointegrating equation is demonstrated below:

$$\begin{aligned} Log(RGDP)_t = {} & 10.3983 + 0.2015Log(RESI_tPOS) + 1.3025Log(RESI_tNEG) \\ & + \text{Cointeq}(-1) \end{aligned} \tag{4.6}$$

Table 4.19: Table showing the Wald Test results for RESI

Equation: RESI		Null Hypothesis: Symmetry	
Test Statistic	**Value**	**Df**	**Probability**
t-statistic	0.681824	69	0.0006
F-statistic	0.464884	(1, 69)	0.0016
Chi-square	0.464884	1	0.0014
Null Hypothesis c(2)=c(3)			
Normalized restriction (=0)		**Value**	**Std. Error**
C(2) - C(3)		0.164826	0.241743

(Source: Estimated by the current author with the use of EViews 11, 2020)

The results of the Wald test presented in Table 4.19 display the null hypothesis of symmetric adjustment. The results indicate that the null hypothesis of symmetry is strongly rejected thus concluding that there is long-run asymmetric adjustment between the resource sector and economic growth in South Africa. The results of the Wald test coincide with the results presented in the NARDL model for the resource sector and provide evidence of asymmetry in the relationship.

Similarly, the relationship between the financial sector and RGDP was observed. The long-run empirical results of the relationship display that economic growth is sensitive to positive changes in the financial sector. The readjustment term value of 22% for the financial sector suggests that the relationship deviated slightly in the short-run therefore disequilibrium can be adjusted at a slow and constant speed.

The long-run coefficients displayed that for economic growth and the financial sector, a 1% increase in FINI positively affects RGDP by 1.1% and a 1% decrease negatively affects RGDP by 0.4%. Therefore, indicating that economic growth is affected by changes in the financial sector as the variables exhibit differing magnitudes and are significant with the positive coefficient being higher in magnitude than the negative coefficient. The results can be attributable to the inflow into the economy from the financial sector by means of banking, income tax and a decrease in government spending thus leading to a growth in the country's economy in the long-run. A well-developed financial system promotes opportunities for investment to potential businesses, enables trading and diversifies risk (Lettau and Ludvigson, 2004). The empirical results of the nonlinear long-run cointegrating equation are demonstrated below:

$$Log(RGDP)_t = 13.6060 + 1.1021Log(FINI_tPOS) + 0.4071Log(FINI_tNEG) + \text{Cointeq}(-1) \tag{4.7}$$

Table 4.20: Table showing the Wald Test results for FINI

Equation: FINI		**Null Hypothesis: Symmetry**	
Test Statistic	**Value**	**Df**	**Probability**
t-statistic	-3.244528	79	0.0017
F-statistic	10.52696	(1, 79)	0.0017
Chi-square	10.52696	1	0.0012
Null Hypothesis c(2)=c(3)			
Normalized restriction (=0)		**Value**	**Std. Error**
C(2) - C(3)		3.247100	1.000793

(Source: Estimated by the current author with the use of EViews 11, 2020)

As discussed, to confirm the existence of long-run asymmetric adjustment, a Wald test is conducted. The results of a Wald test presented in Table 4.20 indicate that the null hypothesis of symmetry is strongly rejected and concludes that there is long-run asymmetric adjustment present between the financial sector and economic growth in South Africa.

Furthermore, the empirical results of the relationship between the industrial sector and RGDP revealed that economic growth is affected by changes in the industrial sector. The readjustment term value of 42% for the resource sector suggests that the relationship deviated considerably in the short-run. The results presented that a 1% increase in INDI positively affects RGDP by 0.2% and a 1% decrease negatively affects RGDP by 2.5%. For the industrial sector, a decline of the relative price had a greater response than an increase in the long-run; suggesting that economic growth is sensitive and wielded a greater response to a negative shock than a positive shock. As discussed previously, the industrial sector was evidently more drastically affected by the global financial crisis relative to the financial and resource sectors depicted by the large and significant coefficient, suggesting that a) the industrial sector may be more sensitive to international affairs and b) the industrial sector may have led the recession in South Africa. This result represents an interesting extension to this study. The long-run cointegrating equation is presented subsequently.

$$Log(RGDP)_t = 10.98640 + 0.2021Log(INDI_tPOS) + 2.5011Log(INDI_tNEG) + \text{Cointeq}(-1) \tag{4.8}$$

Table 4.21: Table showing the Wald Test results for INDI

Equation: INDI		Null Hypothesis: Symmetry	
Test Statistic	**Value**	**Df**	**Probability**
t-statistic	0.953279	73	0.0016
F-statistic	0.908742	(1, 73)	0.0014
Chi-square	0.908742	1	0.0004
Null Hypothesis c(2)=c(3)			
Normalized restriction (=0)		**Value**	**Std. Error**
C(2) - C(3)		0.000320	0.000336

(Source: Estimated by the current author with the use of EViews 11, 2020)

Thereafter, the Wald test was conducted and presented in Table 4.21. The null hypothesis of symmetry is strongly rejected and concludes that there is long-run asymmetric adjustment present between the industrial sector and economic growth in South Africa.

The long-run results highlight the importance of the positive and negative adjustment coefficients being different in magnitude, indicating that while cointegration is evident between economic growth and the stock market, the relationship is in fact asymmetric. The results provide two key findings to literature, firstly the relationship between the economic growth and sectoral indices are asymmetric, secondly the stock market fluctuations have a considerable effect on the economic growth in the country and GDP is sensitive to price changes in the respective sectors. These empirical results answer the core research objective of this study and provides a novel contribution to both South African and international literature as a study of this context and magnitude has not been conducted thus far, to the best of the author's knowledge.

4.2.3.3. Residual Diagnostic Tests

4.2.3.3.1. Heteroscedasticity Test Results

Furthermore, in order to determine whether the included lags are appropriate for the NARDL models, a residual diagnostic test for heteroscedasticity was conducted and the results are presented in Table 4.22. A critical assumption of hypothesis testing is that the variance of the errors is constant. The assumption of constant variance is termed homoscedasticity and when the errors do not have a constant variance, they are said to be heteroscedastic (Russell, 2017).

Table 4.22: Table showing the results of White's Test for Heteroscedasticity

Heteroscedasticity Test: White			
Test Statistic	**Value**	**Prob. Chi-Square**	**Probability**
F-statistic	0.706679	Prob. F(4,79)	0.9725
Obs*R-squared	8.545223	Prob. Chi-Square(4)	0.9435
Scaled explained SS	9.464300	Prob. Chi-Square(4)	0.8505

(Source: Estimated by the current author with the use of EViews 11, 2020)

The null and alternative hypothesis are displayed as follows:

H_0 = There is no heteroscedasticity in the model

H_A = There is heteroscedasticity in the model

The empirical results in Table 4.22 demonstrate that the null hypothesis cannot be rejected. It is concluded that there is significant evidence of no heteroscedasticity in the model as the p-values are in considerable excess of 0.05 and the F-statistic is low at 0.7066.

4.2.3.3.2. Serial Correlation Test Results

Table 4.23: Table showing the results of the Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test			
Test Statistic	**Value**	**Prob. Chi-Square**	**Probability**
F-statistic	19.37598	Prob. F(10,70)	0.3957
Obs*R-squared	15.70699	Prob. Chi-Square(4)	0.3879

(Source: Estimated by the current author with the use of EViews 11, 2020)

H_0 = There is no serial correlation in the model

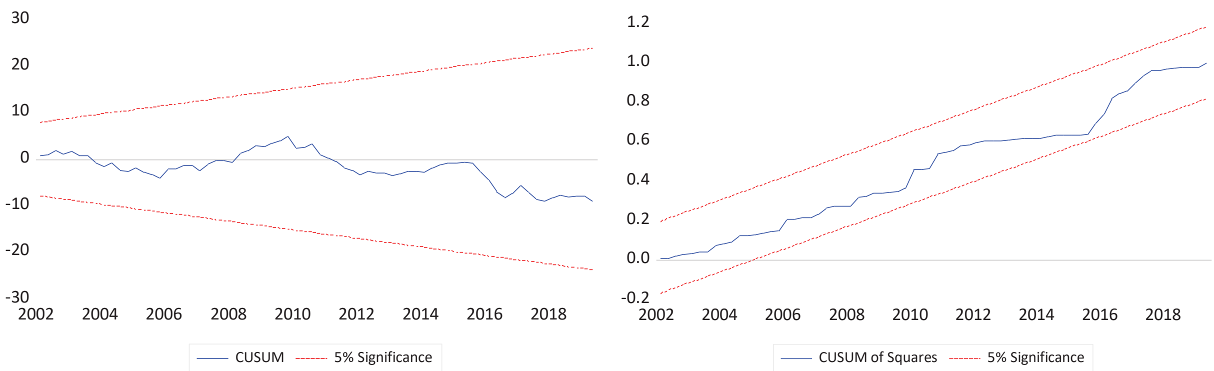
H_A = There is serial correlation in the model

The test for serial correlation was conducted by utilising the Breusch-Godfrey Serial Correlation LM Test. The LM test was based on an ECM with 4 lags. The results presented in Table 4.23 display that the null hypothesis of no serial correlation cannot be rejected as the p-value is in considerable access of 5% for all lags. Therefore, it can be concluded that there is no serial correlation at the 5% and 1% levels of significance.

4.2.3.3.3. Parameter Instability Test Results

CUSUM CUSUM Squared

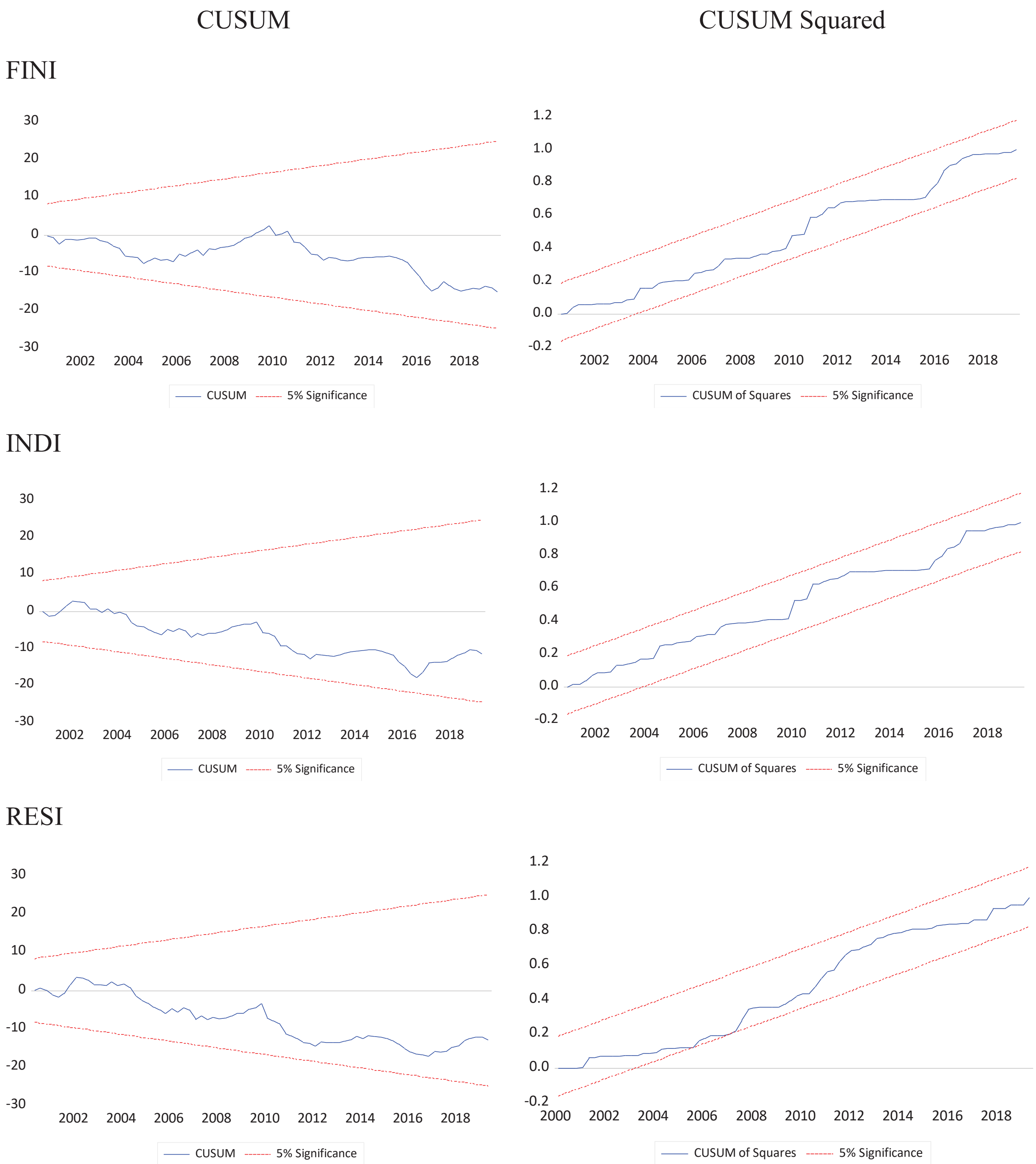
ALSI



(Source: Estimated by the current author with the use of EViews 11, 2020)

Figure 4.3: Graph of the NARDL CUSUM and CUSUM Squared Test of the ALSI Relationship Between 1999 and 2019

The CUSUM and CUSUM of squares stability tests were conducted to determine if the observed relationships were stable for the period of this study and the results are presented in Figure 4.3. The CUSUM graph displays that the relationship is stable due to the deviations from the mean relationship remaining within the 5% significance value bands. The CUSUM squared test complemented the CUSUM test and similarly indicated parameter stability.



(Source: Estimated by the current author with the use of EViews 11, 2020)

Figure 4.4: Graph of the NARDL CUSUM and CUSUM Squared Test of the Sectoral Relationship Between 1999 and 2019

Similarly, as discussed previously the CUSUM and CUSUM of squares stability tests were utilised to determine if the relationships that are observed were stable for the period of this study and the results are presented in Figure 4.4. The CUSUM graphs for the sectoral relationships display that the relationship is stable due to the deviations from the mean relationship remaining within the 5% significance value bands. The CUSUM squared tests further complemented the CUSUM test and also demonstrated parameter stability.

The empirical results presented in this section indicate the superiority of the NARDL model in analysing the asymmetric effects of the relationship between share price fluctuations and economic growth in South Africa, in comparison to the linear models employed thus far within this research area.

4.3. Summary of Results

This chapter contained the results and discussion of each model analysed. These tests and their respective conclusions will therefore be summarised in the discussion below.

4.3.1. Part A: Preliminary Test Results

- **Lag Length Selection Results**

In this study, the lag length selection sample size of 80 was estimated and is considered to be small when dealing with time series data. The AIC selected 8 to be the optimal number of lags and this was further supported by the LR statistic which also selected 8 lags. AIC is preferable in a smaller sample as it is more efficient in comparison to HQIC and SBIC. Therefore, the AIC was chosen as the suitable information criteria due to its consistency in smaller sample sizes.

- **Nonlinear Unit Root Test Results**

The results of the nonlinear unit root tests displayed that all variables; RGDP, ALSI, FINI, INDI and RESI were seen as nonstationary in levels and the null hypothesis that the series contains a structural break with a unit root in both the intercept and trend cannot be rejected in favour of the alternative hypothesis at all significance levels. The variables were differenced and the ADF test was conducted again at first differences. The ADF test at first differences indicated that the variables were integrated of order one. The results displayed that at first differences the series was stationary therefore the null hypothesis could not be rejected and this was further confirmed by the literature.

The most significant and largest break occurred in 2008 for RGDP and 2009 for ALSI. Furthermore, the largest and most significant breaks occurred in 2008 for INDI; 2013 for FINI and 2014 for RESI respectively. The breaks in the relationship in this study could most likely be linked to the global financial crisis that led to severe turbulent macroeconomic impacts on the South African economy. The break date for INDI led to the conclusion that the industrial sector is more sensitive and evidently more drastically affected by the financial crisis. The break dates identified for FINI and RESI were associated with South African government policy changes and political actions.

- **VAR Results**

The VAR regression results exhibited for the overarching relationship in this study, when RGDP was employed as the dependent variable, the test statistics of all lagged variables for ALSI and RGDP itself were highly significant as all fell into the rejection region. Thus, the null hypothesis was rejected and this concluded that the stock market contributes to RGDP as the variables are significant. However, the results indicated that there is no evidence from the VAR that RGDP affects share prices when the ALSI was used as the dependent variable as all the test statistics fell into the non-rejection region.

Similarly, for the relationships between the sectoral indices and economic growth, it was concluded that the sectoral indices contribute to RGDP as these variables were highly significant. However, when the sectoral indices were employed as the dependent variables, the null hypothesis was not rejected and the coefficients were not significant. The results indicated that there is no evidence from the VAR that GDP affects share prices.

4.3.2. Part B: Structural Break Test Results

- **The Zivot-Andrews Unit Root Test Results**

The lag lengths selected were 0 for RGDP, RESI and FINI; 3 for ALSI and 8 for INDI. The results indicated that for all the variables employed in this study, the null hypothesis is not rejected at the 5% significance level in Model C, which displays that a unit root with a structural break occurs in both the trend and intercept. Therefore, the results of Models A and B does not need to be considered due to the null hypothesis of a unit root with a structural break in both the intercept and trend not being rejected.

The largest break occurred in 2009 for ALSI and RGDP respectively, whilst the largest break occurred in 2007 for RESI; 2012 for FINI and 2008 for INDI. These results conform to the results presented in this thesis by the modified ADF tests as the breaks could mostly likely be linked to the global financial crisis and the aftereffects thereof. Moreover, it was suggested that for the financial sector, the break in 2012 can be attributed to the decline in economic growth from 3.5% to 2.5%. Previous literature indicated that the economy recovery process is largely dependent on the government's policy changes and actions, most of which could take many years to fully recover.

- **Bai-Perron Structural Break Test Results**

The results displayed that the variables ALSI, INDI and FINI contains 2 breakpoints. Therefore, the null hypothesis was rejected for nulls of 0 and 1 breakpoints in favour of the alternatives of 1 and 2 breakpoints for these particular variables. Additionally, the results depicted that RGDP contains 3 breakpoints thus the null hypothesis was rejected for nulls of 0, 1, and 2 breakpoints in favour of the alternatives of 1, 2, and 3 breakpoints for RGDP. On the other hand, RESI only has 1 breakpoint therefore the null hypothesis was rejected for a null of 0 breakpoints in favour of the alternative of 1 breakpoint.

The results estimated by EViews 11 (2020) indicated the following results: for RGDP, the sequential and repartition break dates are 2010, 2016 and 2008; for ALSI, 2008 and 2003; for INDI, 2008 and 2005; for FINI, 2008 and 2004 and lastly for RESI 2008. It is vital to take into consideration that the break dates for all variables occur around the period of the global financial crisis, similar to the results exhibited by the nonlinear unit root tests that accounts for a structural break in the relationship. The most common occurring year was 2008 for all variables, which is symbolic as this was the year in which the country experienced detrimental economic impacts to the economy due to the financial crisis.

- **Gregory-Hansen Cointegration Test Results**

The results of the Gregory-Hansen tests were displayed for different cases of a level shift, a level shift with trend and a regime shift. This can be referred to as Model 1, Model 2 and Model 3 respectively. From the results exhibited, the null hypothesis of no cointegration can be rejected in each model in favour of the alternative hypothesis of cointegration with a structural break between the economic and stock market variables. Therefore, the results indicated that the different models each display evidence of cointegration with a presence of a structural break and is significant.

The Gregory-Hansen cointegration test results indicated that the most significant structural break occurs in 2009, which coincides with the other tests conducted thus far as the 2007/2008 global financial crisis and the recession that occurred thereafter arose over this time frame. Therefore, in line with the nonlinear unit root tests, Zivot-Andrews unit root tests and Bai-Perron structural break tests, these tests have identified structural breaks in accordance to the global financial crisis as 2007/2008 is seen as the common occurring year amongst the tests employed in this study. The structural break test results of this thesis concludes that the 2007/2008 financial crisis had a distressing economic impact on the state of the South African economy and stock market as most of the break dates occur around this time period.

4.3.3. Part C: Nonlinearity Test Results

- **ARDL Test Results**

The results of the ARDL bounds test indicated that the Wald F-statistic values for the stock market variables exceeded all the critical values as the F-statistic value was above the I(0) and I(1) critical value bounds and is indicative of cointegration. Therefore, the null hypothesis can be strongly rejected in favour of the alternative hypothesis that there is strong cointegration present amongst the variables. The variables are seen to be highly significant at the 1% level of significance thus a strong presence of cointegration in the relationship between the stock market and economic growth exists in the long-run.

Both the short and long-run results of the ARDL tests revealed that when the stock market proxies were employed as the independent variables and economic growth as the dependent variable, economic growth is highly affected by changes in the stock market fluctuations. The long-run relationships are crucial to this study and the results exhibited that share prices play a vital role and has a very significant impact on the economic growth of the country as anticipated from the literature. It is revealed that economic growth is very sensitive to stock market fluctuations in the long-run. These results can be attributed to the wealth effect theory which stipulates that as investor confidence declines so does consumer spending thus economic activity decreases in the country. The coefficients for both the primary and sectoral analysis were very high in magnitude therefore confirming this phenomenon. It was concluded by the ARDL linear results that the stock market plays a crucial and significant part on the economic growth in South Africa, however linear conventional tests are seen to be extremely limiting as it does not take into account the asymmetric and nonlinearity effects in the underlying relationship.

- **NARDL Test Results**

The results of the NARDL bounds tests exposed that for the stock market variables namely; RESI, FINI and INDI the F-statistic values were above the I(0) and I(1) critical value bounds at the 5% level of significance and ALSI at the 1% level of significance. The null hypothesis was strongly rejected in favour of the alternative hypothesis that there is a strong long-run cointegrating relationship present amongst the variables. The variables were highly significant and the results confirmed that the relationship between the stock market and economic growth is strongly cointegrated in the long-run.

The key factor indicated by the NARDL results emphasised the superiority of a nonlinear model analysing the asymmetric effects between the relationship in comparison to the linear models employed thus far within this research area. The results were similar to that of the ARDL and it was concluded that economic growth in the country is affected by stock market fluctuations. An important point to note is that the long-run relationship between the variables is the key focus of this study.

In the long-run, the empirical results presented that economic growth is sensitive to changes in the ALSI as there is a presence of strong asymmetry and the coefficient is highly significant. The results revealed that economic growth is more sensitive to negative shocks in ALSI in the long-run. The results also revealed that economic growth is sensitive to negative shocks in the resource and industrial sectors. However, economic growth is more sensitive to positive shocks in the financial sector. These results indicate that the relationship between economic growth and the sectoral indices is in fact asymmetric and highly significant. These results provide a vital contribution to a study of this context indicating that stock market fluctuations have a critical impact on the economic growth of the country.

- **Heteroscedasticity Test Results**

A residual diagnostic test for heteroscedasticity was conducted to examine whether the variance of the errors is constant. The results displayed evidence of homoscedasticity as the null hypothesis could not be rejected. Therefore, it was concluded that there is no heteroscedasticity in the model as the p-values are in considerable excess of 0.05 and the F-statistic is low at 0.7066.

- **Serial Correlation Test Results**

The residual diagnostic test for serial correlation was conducted by utilising the Breusch-Godfrey Serial Correlation LM Test. The results presented that the null hypothesis of no serial correlation cannot be rejected as the p-value is in considerable access of 5% for all lags and it can be concluded that there is no serial correlation present.

- **Parameter Instability Test Results**

Parameter instability was examined by means of the CUSUM and CUSUM of squares tests to determine if the relationships that are observed were stable for the period of this study. The results of the CUSUM and CUSUM of squares graph for the relationship between stock market fluctuations and economic growth exhibit stability for the primary and sectoral analysis. The CUSUM graphs display that the relationship is stable due to the deviations from the mean relationship remaining within the 5% significance value bands and is further complemented by the CUSUM squared tests which also demonstrated parameter stability.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

The forward-looking nature of share prices and its progressive role as an economic growth indicator has been broadly documented in emerged and underdeveloped economies however, without considering that the relationship may be nonlinear in nature. Over the past decade, the concept of nonlinearity and asymmetric adjustments have become increasing popular which challenged the conventional way of thinking that the relationship between the respective time series is linear. To the best of the author's knowledge, no studies of this magnitude considered the possibility of the relationship between stock market fluctuations and economic growth being nonlinear. Therefore, in the context of macroeconomic time series analysis, the phenomenon of analysing the fluctuations of share prices and economic activity by taking into account asymmetry and nonlinearity will be a substantial contribution to international and South African literature in particular.

This study aimed to address four primary research questions for the South African case. Drawing on this notion, the objectives of this study are as follows:

- To investigate whether cointegration exists between share price fluctuations and economic growth in South Africa.
- To investigate how fluctuations in the stock market affect economic growth in South Africa (and vice versa).
- To determine whether the relationship between economic growth and the stock market returns exhibit asymmetric adjustment.
- To determine whether the relationship between economic growth and the stock market returns exhibit evidence of structural breaks.

In order to achieve the objectives mentioned above, various methodological techniques discussed in the previous chapter were employed. The empirical results presented in this thesis indicate the superiority of a nonlinear model in analysing the asymmetric effects between the variables in comparison to the conventional linear models that have only been employed thus far within this research area. The empirical results exhibited by the NARDL model indicate that there is strong evidence of nonlinearity and asymmetric adjustment in the relationship between stock market fluctuations and economic growth in South Africa. It can be seen from the results presented that economic growth is highly sensitive to negative shocks in the stock market and the relationship is highly significant thus exhibits evidence of asymmetry. Similar results are also presented for the sectoral analysis as economic growth is very sensitive to negative shocks in the resource and industrial sectors. However, for the financial sector, economic growth is highly sensitive to positive shocks. The findings of this study indicate that the fluctuations in the stock market have a substantial impact on the economic growth in South Africa. It is imperative to note that a study of this magnitude and context has not been considered in the South African environment and will aid to existing literature.

5.1. Contributions of This Study

The stock market is typically viewed as a sentiment indicator and impacts GDP. As the sentiment fluctuates, so does consumer spending which drives GDP growth. When the economy is facing a bear market, this has a negative impact on sentiment. There is an urgency for investors to sell off stocks to prevent losses on investments (Osamwonyi and Kasimu, 2013). More often than not, these losses lead to a decrease in consumer spending and a lingering fear of a recession. Once consumer spending decreases, it has a ripple effect on businesses as profits begin to plummet leading to less investment in the stock market and a negative impact on the country's economic growth. The stock prices usually reflect investor expectations for future corporate earnings and future economic growth (Fowowe, 2015). This phenomenon can be viewed by the empirical results presented in the study as the negative shocks to the stock market tend to have a bigger and more significant impact on economic growth than the positive shocks with an exception of the financial sector.

In conclusion, the findings and core contributions made by this study can be summarised into three key propositions. The first key finding is that the relationship between economic growth and the stock market returns exhibit strong evidence of nonlinearity and asymmetric adjustment. This finding stems from the negative shocks being greater in magnitude than the positive shocks implying that negative fluctuations in the stock market have a more significant impact on economic growth in South Africa. The second key finding proposes that fluctuations in the stock market have a significant impact on economic growth in South Africa. This can be stemmed from the wealth effect theory as when stock prices rise, investors are more optimistic and confident about future prospects thus spending increases and as a result boosts GDP. Lastly, the third proposition is the evidence of structural breaks in the relationship. This finding is a result of various macroeconomic conditions to the economy and stock market that arose within the timeframe of this study, a key distinction being the 2007/2008 financial crisis.

To the best of the author's knowledge, this is the first study of its context to examine the nonlinearity and asymmetric impacts of the relationship between share price fluctuations and its effect on economic activity in the South African environment therefore contributing substantially to literature. This study makes a vital contribution to literature by taking a nonlinear approach to existing macroeconomic studies of this context. The findings made by this thesis indicate that South Africa's economic growth is extremely sensitive to stock market fluctuations thus validating the expected outcomes.

5.2. Limitations and Areas for Future Research

This thesis has made several key contributions to South African literature however, there were a few limitations that were encountered. A vital distinction which was discovered is the limitation of other South African studies that employed a nonlinear methodological approach in the context of macroeconomic analysis. The comparative analysis would have enabled this thesis to improve robustness of the results and assess the commonality of the findings in the relationship between the stock market and its impact on economic activity from a nonlinear perspective. However, this limitation creates an opportunity for future research in this area.

An extension of this thesis would be to employ the novel quantile autoregressive distributed lag model (QARDL). The QARDL model is an extension of Pesaran and Shin's (1998) ARDL model and jointly analyses the short-run and long-run cointegrating relationships across a range of quantiles, to model the asymmetric behaviour in time series. The quantile regression estimation will provide a robust estimation and an interesting research avenue to a study of this magnitude. Furthermore, the addition of Monte Carlo simulations will be able to affirm the results attained as the simulation method focuses on constantly repeating random samples to achieve certain results therefore directly observing the results.

Moreover, an important concept overlooked by this thesis is the objective of examining regime-switches and their significance on the South African stock market and economic growth. As discovered by this study, the series exhibit asymmetric adjustments to the positive and negative shocks and are considered to be nonlinear. This nonlinear behaviour that predominantly changes the mean and volatility can be referred to as 'regime switching' behaviour. Thus, the Markov-Switching model which was introduced by Hamilton (1989) and the threshold autoregressive model (TAR) were developed to examine such behaviour and would provide an interesting dynamic to a study of this nature.

Furthermore, seeing as the break date for the industrial sector occurred in 2008, a thought-provoking extension to this thesis uncovered from the empirical results would be to examine whether the industrial sector did in fact lead to the recession in South Africa. It is suggested by this thesis that this sector is more sensitive to international affairs. Additionally, the examination of whether a different sector, such as the banking sector co-moves with economic growth within the country is a factor that has been overlooked in much of the existing literature.

Another major limitation to this study is the time period of the data sample which should be extended to account for the COVID-19 pandemic. This can be viewed as a major limitation and could impact the outcome of the results significantly as the pandemic had detrimental effects to the stock market which experienced a high level of unprecedented volatility and a freefall in the share prices. During the unprecedented time of the pandemic and recent civil unrest in the country, there are indications that the economic growth has plummeted due to South Africa being the hardest-hit African country. The pandemic has led to a fall in formal employment compounding the high unemployment rate that is already present. It would therefore be imperative to extend this study to account for these unprecedented times that South Africa is currently facing. Extended research on this topic will provide a better understanding on South Africa's current economic situation and will highlight the critical economic strategies being put into place to restore long-run economic growth in the post-pandemic period.

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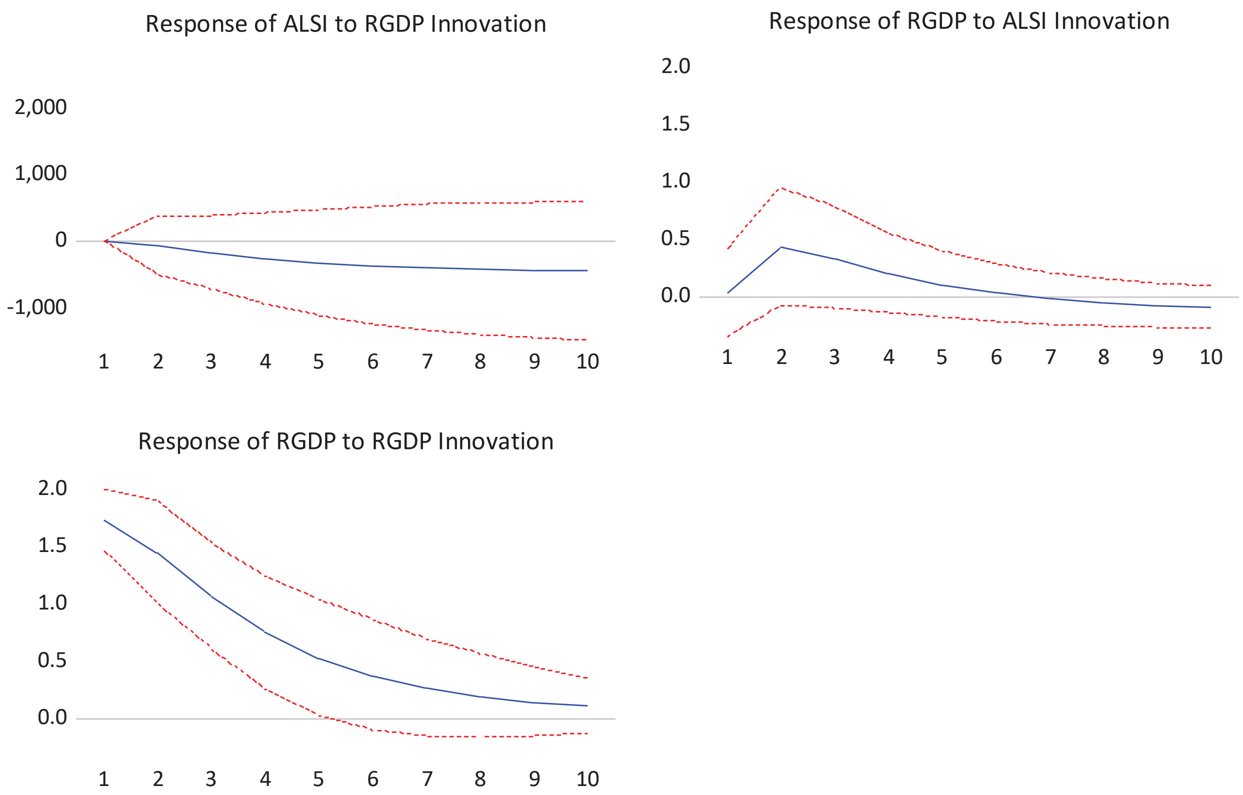
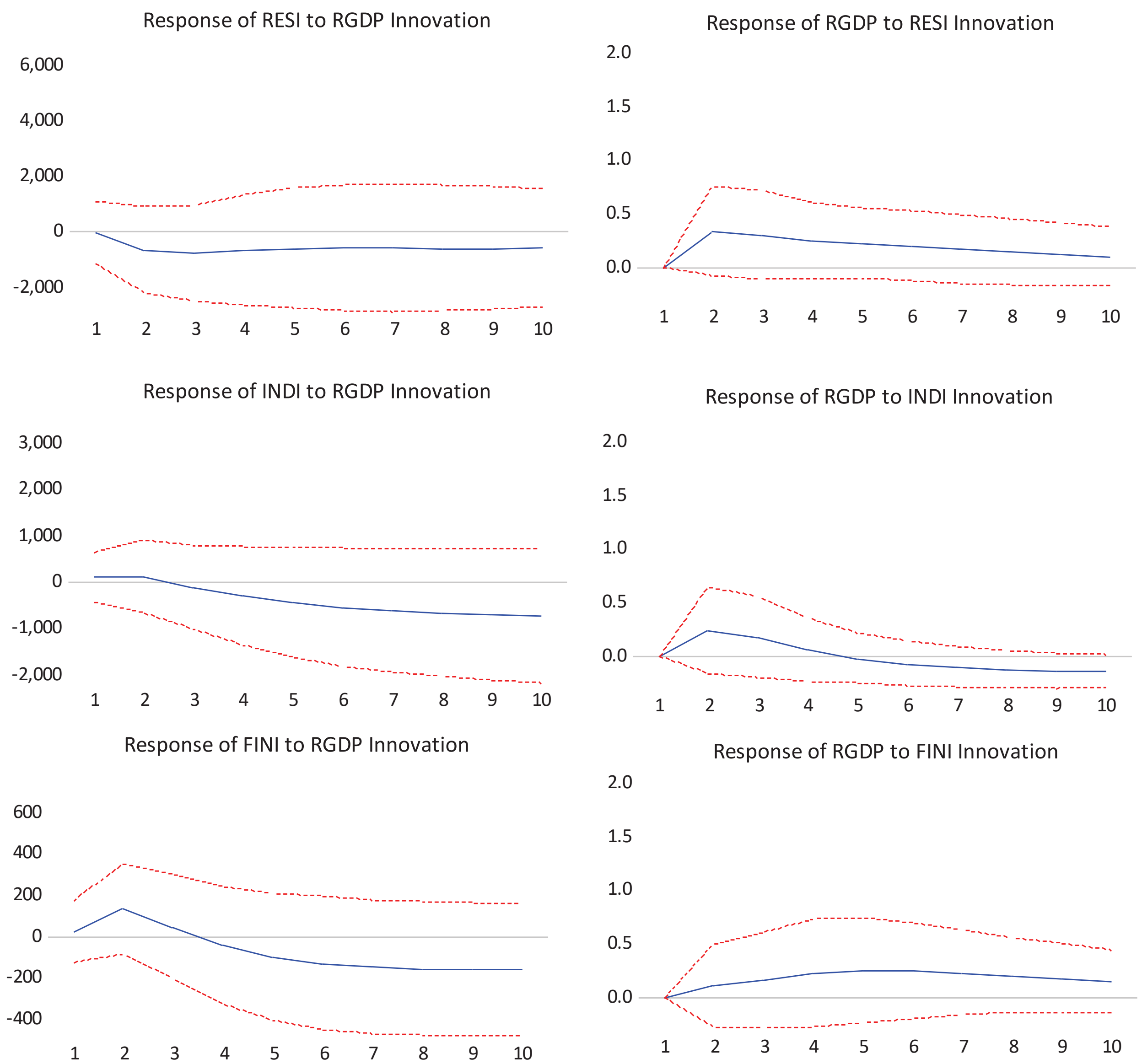
APPENDICES

Appendix A: Results of the Impulse Response Functions of the relationship between the primary and sectoral analysis

Graph A1.1. Impulse Response Analysis Between ALSI and RGDP



Graph A1.2. Impulse Response Analysis Between the Sectoral Indices and RGDP



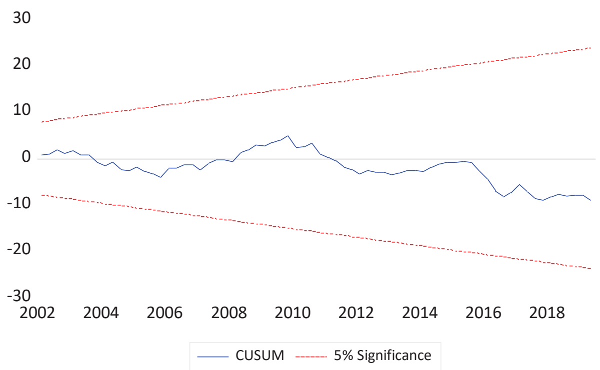
Appendix B: Results of the CUSUM and CUSUM Squared test of the relationship between the primary and sectoral analysis.

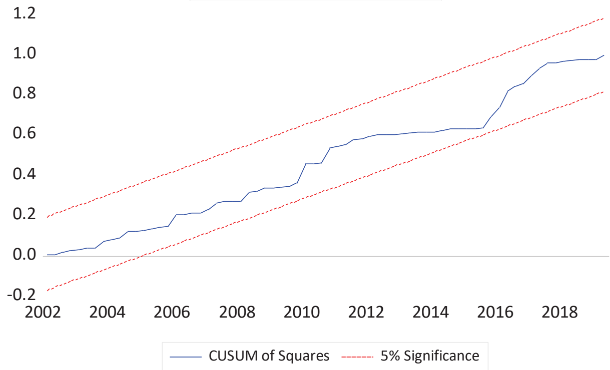
Graph B1.1. Graph of the NARDL CUSUM and CUSUM Squared Test of the ALSI Relationship Between 1999 and 2019

CUSUM

CUSUM Squared

ALSI



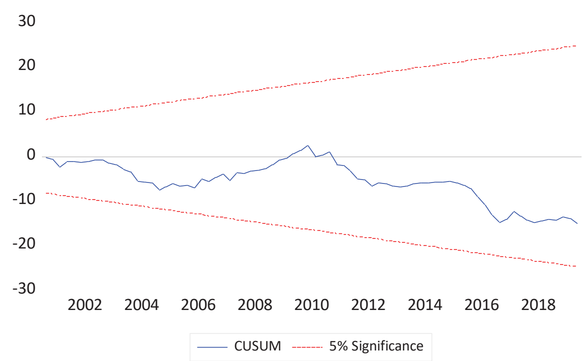


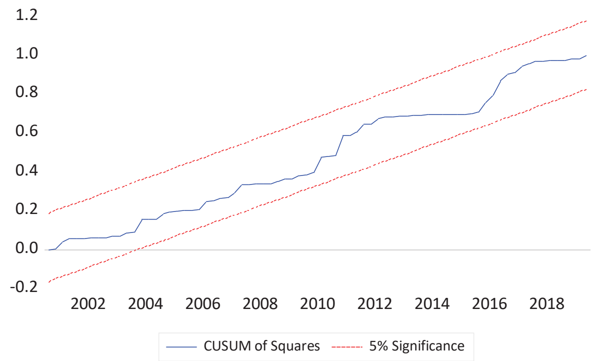
Graph B1.2. Graph of the NARDL CUSUM and CUSUM Squared Test of the Sectoral Relationship Between 1999 and 2019

CUSUM

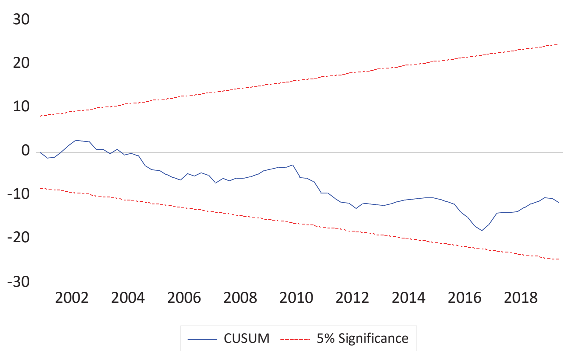
CUSUM Squared

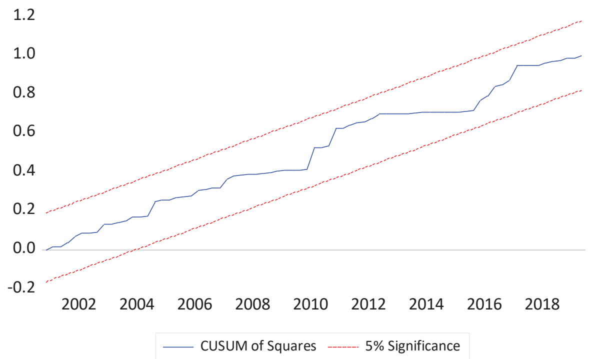
FINI



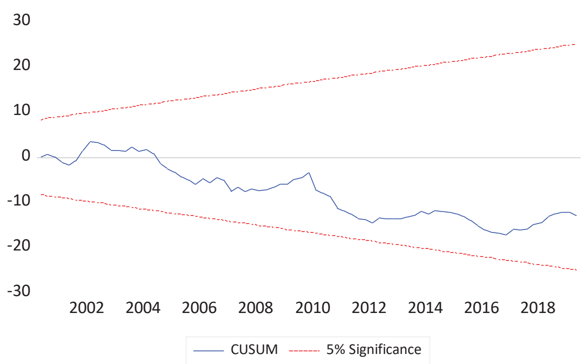


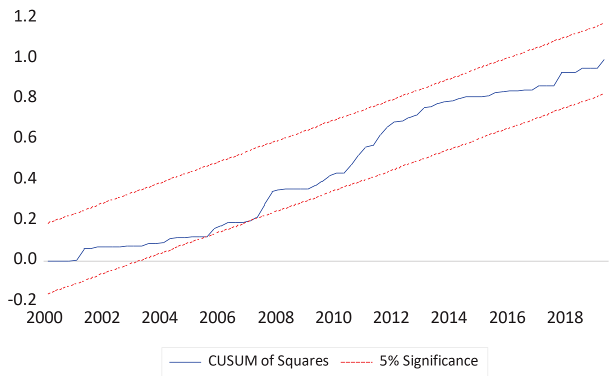
INDI





RESI





UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Miss Thiasha Naidoo (215013353)
School Of Acc Economics&Fin
Westville

Dear Miss Thiasha Naidoo,

Protocol reference number: 00007131
Project title: An analysis of share prices as a leading indicator of economic activity in South Africa

Exemption from Ethics Review

In response to your application received on 27 July 2020, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW.**

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:
Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,

[redacted] 28 July 2020

Prof Josue Mbonigaba
Academic Leader Research
School Of Acc Economics&Fin

22 January 2020

Ms Thiasha Naidoo (215013353)
School of Acc, Economics and Finance
Westville

Dear Ms Naidoo,

System Nr: 00007131
Project title: An analysis of share prices and economic activity in South Africa: An NARDL approach.

Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on Date 2020 has now been approved as follows:

- Change in Title

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

Best wishes for the successful completion of your research protocol.

Yours faithfully

Prof Josue Mbonigaba 3 Feb 2021 Date ~~2020~~

……………………………………………………………………………………………

ACADEMIC LEADER RESEARCH

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