An analysis of the effect of systematic risk factors on returns of the South African banking sector

by

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ABSTRACT

Understanding the risk-return relationship is vital to effectively allocate assets based on investors' risk tolerances and return requirements. To achieve this, it becomes a peerless need to effectively manage investors' exposure given the macroeconomic environment in which their investments operate. Addressing this will ensure a more comprehensive understanding of macroeconomic risk in the process of generating returns. This research seeks to understand the nature of the relation of systematic risk factors on the returns of the South African banking sector while also establishing what the combined impact of the risk factors is. Additionally, this research paper aims to demonstrate the existence, or lack thereof, of a long-term linkage between sectoral banking returns in South Africa and the macroeconomic risk factors.

In addressing the first research objective, the OLS regression is applied. The PCA is used to create the composite index of the risk factors. To establish the existence of a long run link, ARDL test was performed. Of the eight risk factors used in this paper, only three were found to be statistically significant. The JSE ALSI was discovered to be positively related to banking returns while the gold price and rates of interest were surmised to be adversely correlated to returns. Nevertheless, the combined effect of the systematic risk variables was significant in describing the returns of the South African banking sector. Moreover, this research paper established the existence of a long-term linkage between the macroeconomic risk parameters and South African banking sectoral returns. The results of this research report deduce that careful assessment of banking sector exposure must be conducted given the macroeconomic environment movements in which banks operate. This will ensure that necessary adjustments, from Tactical Asset Allocation and Strategic Asset Allocation perspectives, are made so that risk budgets are not exceeded while pursuing returns.

Keywords: Systematic risk factors, Arbitrage Pricing Theory, OLS regression, Banking sector

DECLARATION

I, Tumiso Chris Malatji, declare that the research work reported in this dissertation is my own work, except where otherwise indicated and acknowledged. It is submitted for the degree Master of Management in Finance and Investments at University of the Witwatersrand's Business School, Johannesburg and has not been submitted to any other institution of higher education.

Signature of Candidate: 

Date: 24 March 2023

DEDICATION

I dedicate this thesis to my family without whom it would not have been possible to undertake this massively difficult degree. I am eternally grateful for your love and support throughout this journey.

- My late grandmother, Mmatlala Maria “Koko Five” Malatji. Our bedrock. Your life lessons live on.
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LIST OF ACRONYMS

Abbreviation	Definition
ABSA	Amalgamated Banks of South Africa
ADF	Augmented Dickey-Fuller Test
ALSI	All Share Index
APT	Arbitrage Pricing Theory
ARDL	Autoregressive Distributed Lag
BSE-Sensex	Bombay Stock Exchange Market Weighted Stock Market Index
CAPM	Capital Asset Pricing Model
DDM	Dividend Discount Model
FNB	First National Bank
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GP	Gold Price
GY	Government Yield
INF	Inflation
IPS	Investment Policy Statement
JSE	Johannesburg Stock Exchange
MLR	Multiple Linear Regression
MPT	Modern Portfolio Theory
MSCI	Morgan Stanley Capital International
NSE	National Stock Exchange
NYSE	New York Stock Exchange
OLS	Ordinary Least Squares
OP	Oil Price
PCA	Principal Component Analysis
R	Returns (Banking)
SAA	Strategic Asset Allocation
TAA	Tactical Asset Allocation
USDZAR	Rand-Dollar Exchange Rate
VIF	Value Inflated Factors

1 INTRODUCTION

1.1 Background

A proper grasp of the trade-off in return and risk is relevant in analysing investment opportunities so that the investment decisions made maximise investor utilities by meeting their investment objectives given their stated assessment of risk appetite in the form of willingness and ability to carry such risk; as well as a set of constraints outlined in the Investment Policy Statement ("IPS"). One such important risk is systematic risk. This is the variation in an asset's movement in price that is a consequence of the market and is not unique to the asset in addition to this variation not being diversifiable (Hotvedt & Tedder, 1978). Unsystematic risk, instead, refers to the volatility in an asset's price movement due to factors that are unique to the company and can be diversified away (Hotvedt & Tedder, 1978). Some studies that investigated the return-risk relationship include Fama (1971), Fama and MacBeth (1973), Lee (1977), Bachrach and Galai (1979), Carroll and Wei (1988), Chang and Thomas (1989) and Kim, Hwang and Burgers (1993). To understand this relationship, several models have been proposed, tested, and applied to make clearer the dynamics involved in the risk-return relationship. Early models describing the return-risk association include William Sharpe's Capital Asset Pricing Model ("CAPM") and Stephen Ross' Arbitrage Pricing Theory ("APT"). The CAPM assumes that there is only one factor, the aggregate market, that impacts asset returns (Sharpe W. , 1963); it also presumes that the return expected is impacted by the return on the market only and that this is good enough to describe the movement in returns of individual assets. This is not, in fact, true and is a significant limitation in explaining how returns are generated over time as more than the market factor affects the returns of individual assets and this can be observed when considering Ross' (1976) APT and its basis of multiple factors having an impact on expected returns. The APT does not only use one risk factor to assess the risk-return relationship; instead, it uses several macroeconomic factors to capture the risk factors affecting the returns of an asset. Elshqirat (2019) posits that both single and multifactor CAPM are not valid and instead empirically tests the validity of the APT. In the study, unemployment rate, GDP, industrial producers price index and exports were considered against Amman Stock Exchange Index to test the validity of the APT finding that the model is indeed valid.

Wahyuny and Gunarsih (2020) compared the accuracy of results obtained CAPM and APT to predict stock returns using Mean Absolute Deviation values ("MAD") in the Indonesian Stock Exchange. The variables considered were market risk premium, inflation, exchange rates, interest rates and stock returns. Interestingly, they authors found that the MAD value for CAPM was lower than the MAD value of the APT suggesting that CAPM is more precise than the APT. A probable reason for this may be that the time period considered in this study was relatively short (2015-2018, monthly data), potentially impacting the results from the study. Renault, Van Der Heijden and Werker (2022) developed an APT extension studying the pricing of squared returns and volatilities. The presence of common a variance factor was found in the interplay of return levels and variances; however, no evidence was found that this represented a missing risk variable. It is therefore very well established that the APT has those superior characteristics that make it a better model to assess the risk-return dynamics of stock returns.

1.2 The South African banking sector

Oladejo and Oladipupo (2011) posit that in almost all countries, the biggest owners of financial assets are banks and so the banking sector performance in a country such as South Africa is very significant for the stability of the economy (Greenberg, Simbanegavi, & Gwatidzo, 2015). The four big commercial banking institutions are the dominant players in the country's banking sector (Lawrence, Doorasamy, & Sarpong, 2020). Ifeacho and Ngalawa (2014) found that the South African banking sector accounted for well over 20% of the GDP in terms of contribution and was a significant employer as more than 10% of the labour market was employed in the banking sector which made it the third largest employer. As a result, it is logical to expect that poor performance of the banking sector would subsequently lead to weaker results in South Africa's efforts to combat and reduce unemployment (Ifeacho & Ngalawa, 2014). Kumbirai and Webb (2010) add that commercial banks in South Africa underwent significant transformation from regulatory and technological perspectives over the years. As such, South African banks have had to embrace digital transformation as they undertake to remain relevant and gain advantages ahead of the competition, reduce rising costs and financial crises. According to Kumbirai and Webb (2010), these developments have had a significant impact on how well the banking sector is

performing. Although, relative to global standards, the economy of South Africa is small, it can be said that this economy is the "economic powerhouse of Africa leading the continent in industrial output and mineral production and generating a large proportion of Africa's electricity" (Kumbirai & Webb, 2010). According to Lawrence et al. (2020), although the South African banking sector was not profoundly impacted by the GFC from 2007 to 2009, there was impact that necessitated a more prudent approach to ensure continued good performance in the sector. However, the banking sector is also particularly characterised by linkages to the international environment as it has correspondences with offshore banks and international institutional decisions as well as impacts of the global economy (Kumbirai & Webb, 2010).

Past research analysing the South African banking industry performance was not solely focused on macroeconomic factors, rather on other key performance indicators across the banking sector. Some of these recent studies include Ifeacho and Ngalawa (2014) who researched bank-specific variables to investigate banking sector performance; Simatele (2015) studied the structure of the market and competitiveness in the banking sector in South Africa and Moyo (2018) investigated "the relationship between competition, efficiency and soundness of the South African banking sector". Therefore, this report seeks to research systematic risk parameters impacting the returns of the banking sector. The study selected the APT to understand the pervasive nature of systematic risk factors on returns and reviewed past studies that had been conducted vis-a-vis the pervasive influences that macroeconomic factors exert on the returns. As has been put forward in this paper, it was vital to ascertain how the return-risk relationship in the South African banking sector behaves to ascertain steps are taken to either get in front of potential problems that may impact returns or set in motion decisions to mitigate the impact of market movements that may impact returns. One significant aspect is to understand the systematic risk factors that influence banking industry returns in addition to the level of impact the macroeconomic factors, each factor individually and all factors combined, have on banking sector returns.

1.3 Problem statement

A substantive understanding of the drivers of the risk-return relationship makes it reasonable to expect investors to be adequately compensated for assuming risk. It is not surprising then that one must determine whether assuming increasing risk is

rewarded with similarly increasing return. Whether investors are rewarded for assuming increasing risk remains the main research problem.

There are accompanying sub-problems that make the analysis of the risk-return relationship challenging. For example, one of the sub-problems is the measurement of risk itself, how this risk is measured is important to have clear risk thresholds for given levels of return. The manifestation of this problem is seen in how recent theories have consistently departed from Sharpe's single beta model. One such example of a model that departed from the single market variable assessment of risk is Fama and French's (1993) three factor model that used book-to-market values, size of firms, and excess market returns. Fama and French's (1993) three parameter model infers that small cap stocks and value stocks regularly outperform the market (An, Cheh, & Kim, 2017) and thus incorporates this tendency of outperformance. The Sharpe ratio, created by Sharpe (1966), is another alternative measurement of the association between risk and return. It compares a portfolio's or asset's excess return to the risk, which is expressed by the standard error of returns. It should also be noted that the Sharpe ratio views risk as security movements both downward and upward, unlike some extensions of it such as Sortino's ratio (Sortino & Price, 1994) which posits an assessment of risk similar to the Sharpe ratio, however, instead of using the standard deviation of all returns – only downside variations are considered.

Understanding and selecting the systematic risk factors which significantly influence returns on a stock is another sub-problem. Burmeister et al. (1994) as well as Poon and Taylor (1991) put forward that no predefined number or group of universal systematic risk factors exists that can be used to describe stock returns as different risk factors affect different sectors of the economy differently. In contrast, evidence supporting the potential of an approximate risk factor model with six risk variables – that were randomly and statistically generated - was discovered by Connor and Korajczyk (1993); the macroeconomic variables were statistically significant in describing the volatility in returns on the New York Stock Exchange ("NYSE"). Therefore, it becomes increasingly clear that there is no set of variables that are representative of all risks in all industries in all time periods. This point is elaborated on in later sections of this study.

Another sub-problem that needs investigation is if a long-term association among the systematic risk parameters and returns of the South African banking sector exists. Therefore, understanding these issues will enable stakeholders to effectively manage the influence that macroeconomic risk factors exert on their exposure to the South African banking sector and adjust their positions to manage their risk better as stated in their IPS to inform their Strategic Asset Allocation ("SAA") imperatives.

Although many research studies have employed macroeconomic risk factors in the South African context - (such as Madaree, 2018; Szczygielski & Chipeta, 2015; Szczygielski, Brümmer, Wolmarans, & Zaremba, 2020; Tsunga, Moores-Pitt, & Mccullough, 2020; Van Rensburg, 1995) few have studied the influence of systematic parameters on banking sector returns. Past research (Kumbirai & Webb, 2010; Fatoki, 2014; Ifeacho & Ngalawa, 2014; Simatele, 2015; Moyo, 2018; Coetzee, 2018) investigating the South Africa banking sector performance has focused on other ways to measure banking sector performance. The following research questions and associated objectives were therefore addressed in this research report to provide answers.

1.4 Research questions

1.4.1 Main research question

What is the risk-return relationship interaction like given the level of macroeconomic risk exposure in the banking sector of South Africa?

1.4.2 Sub-research questions

- What are the short-term effects of macroeconomic factors on South African banking sector returns?
- How do systematic risk factors collectively affect the returns of the South African banking sector?
- What are the long-run effects of macroeconomic factors on South African banking sector returns?

1.5 Research objectives

1.5.1 Primary research objective

The principal objective of this research is to analyse the influence of macroeconomic risk parameters on the banking sector returns in South Africa, placing emphasis on both the individual short-term effects of the various macroeconomic factors and their joint/combined effect, as well as their long run effects.

1.5.2 Specific research objectives

The objectives of this research paper are:

- To explore the extent of short-term influence that systematic risk factors exert on the returns of the banking sector in South Africa.
- To probe the combined effect of systematic risk parameters on returns.
- To ascertain the long run effects of macroeconomic factors on the banking sector returns in South Africa.

1.6 Hypothesis testing

1.6.1 The null hypotheses (H_0)

This paper assesses several null hypotheses to address all questions identified for this study.

i. ***First null hypothesis***: the chosen systematic risk parameters have no short-term influence on the variation in banking sector returns in South Africa.
ii. ***Second null hypothesis***: the combined impact of the systematic risk parameters is statistically insignificant in describing the returns of the banking sector in South Africa.
iii. ***Third null hypothesis***: the chosen macroeconomic factors do not significantly influence the South African banking sector returns in the long run.

1.6.2 The alternative hypotheses (H_a)

i. ***First alternative hypothesis***: the chosen macroeconomic risk factors are significant in describing the short-term variability in South African banking industry returns.
ii. ***Second alternative hypothesis***: the combined effect of the systematic risk parameters is statistically significant in describing the returns of the South African banking industry.
iii. ***Third alternative hypothesis***: the macroeconomic risk factors significantly influence the South African banking sector returns in the long run.

1.7 Potential benefits and importance of the research study

The importance of this research is to inform the decision-making of stakeholders' actions regarding the influence of macroeconomic risk parameters on returns in the South African banking industry. The benefit for researchers from this research paper will be added knowledge and new findings about the process of generating return, as proposed by Ross' APT, which can be further built upon as an area of future research. Additionally, investors and portfolio managers will be able to better adjust their portfolios given their banking sector exposure and the circumstances of the macroeconomic environment. Understanding the impact will enable banks mitigate specific macroeconomic risk exposures and warrant the reserve bank to set better guidelines given the macroeconomic climate in South Africa. Overall, this analysis determined which systematic risk factors had the most impact on returns of the banking industry and what the joint significance tells us about the impact of those factors on those returns.

1.8 Limitations

This research paper only assessed a 15-year period from 2004 to 2019. In addition to the time horizon that is outlined, only eight systematic risk factors, discussed in the coming sections, were under consideration. The period chosen is due to the range being the most recent that excludes the once in a century global pandemic that will impact the inferences made in the results. Additionally, this period includes the GFC that was a result of banking sector actions such as the over-extension of credit to borrowers who could not afford the loans. This makes inclusion of this period apt as

the consequences of the GFC were directly linked to the decisions of the banking sector. In several cases, the COVID-19 pandemic period from 2020 to 2022 had insufficient and inconsistent data for the variables chosen from the sources from which the data was gathered. Hence, this period was left out for convenience and ease of attaining data. The macroeconomic factors chosen were those representative of the biggest influences as identified by the author of this paper. Although there are limitations to this study, long-term linkages between the systematic risk factors and South African banking sector returns can be inferred and understood from the results as the horizon chosen is long enough to encompass at least one business cycle.

2 LITERATURE REVIEW

2.1 A brief note on the banking industry performance and returns in South Africa

There is a prevalent need to understand the way in which performance is measured in an industry and what components make up such a measure. Kumbirai and Webb (2010) defined the components that made up performance as profitability, liquidity, and credit quality. They examined the banking sector from 2005 to 2009 and discovered that performance improved in the first two years before taking a sharp turn to perform poorly. The authors attributed a large fraction of the change in performance to the 2008-2009 GFC.

Moreover, Ifeacho and Ngalawa (2014) used banking sector-specific variables as well as a selected group of macroeconomic parameters to study the performance of the sector from 1994-2014. The elements that were unique to banks included capital sufficiency, asset quality, management, profits, and liquidity. They revealed that every aspect unique to a bank is important in determining banking performance. The only macroeconomic variables that were significant were inflation rates, interest rates and unemployment rates.

Undeniably, evidence suggests that a link exists between systematic risk factors, bank-specific variables, and the South African banking industry's performance. This study attempts to isolate linkages that the banking sector returns may have with systematic risk factors and explains the relationship's extent between them.

2.2 Theoretical literature

2.2.1 Initial models to assess the risk-return relationship

The development of understanding the risk and return relationship in finance has led to some very comprehensive research studies being conducted to explain the exact impact that systematic risk factors have on asset returns. These studies have enabled decision makers to understand what, how and why these risk factors drive returns and help to motivate why they chose certain underlying assets over others given specific

economic environments. Such studies include Markowitz's Modern Portfolio Theory ("MPT") (1952), Sharpe's CAPM (1963) and Ross' APT (Ross, 1976).

Mutually, the MPT and CAPM have notable restrictions that hinder an exhaustive description of the return and risk relationship. The MPT had the restrictive assumptions of investor rationality, informational efficiency, and a particular trading structure of the market. Empirical studies, such as Galagedera (2007), Choudhary and Choudhary (2010) and Pettengill et al. (1995), on the CAPM, showed that there were negative returns to the beta relationship. The CAPM was also restrictive in that it assumed a single market risk factor to explain the return on underlying assets, but asset price movements are affected by more than the market beta (Ross, 1976). Instead, systematic risk parameters that together impact the price volatility of the underlying asset have an impact on asset returns (Ross, 1976).

As mentioned, the CAPM has noteworthy limitations that deter the comprehensive description of the relationship existing amongst risk and return. Banz (1981) proclaims that evidence is there to suggest that relevant additional factors exist for pricing assets. A model which was less restrictive than the CAPM was proposed by Ross (1976).

2.2.2 An alternative model to assess the relationship between return- risk: an outline of the APT

Calling it the APT, the model puts forward that asset returns may be modelled as a linear system of different systematic risk factors. The linear multifactor model is an equation whose sensitivity to changes in each of the systematic risk factors is determined by a factor-specific beta coefficient. This model challenges the single market beta coefficient that was proposed by Sharpe (1963) in his CAPM to explain the return expected and pricing of assets underlying these expected returns (Chen, Roll, & Ross, 1986).

The APT, therefore, captures the individual effects that each risk factor has on the overall asset return that is described by the model. These impacts are captured in the form of the direction (sign of the individual risk factor's beta) and degree (numerical value of the betas used to represent the macroeconomic variable risk) to which the macroeconomic risk factor is related to the return (Roll & Ross, 1980). The APT framework's assumptions, according to Ross (1976), imply that the random process

by which assets generate returns may be formulated with a model represented by k-factors.

The first component of the framework is therefore the linear multifactor model represented by this equation:

$R_{it} = E(R_i) + \sum_{i=1}^{k} \beta_i F_{it} + e_{it}$ ..... (1)

With R_{it} being the return realised of the *i*th risk factor in period t;

$E(R_i)$ is the return expected on asset *i*;

β_i is the parameter that captures the magnitude and direction of the sensitivity of the *i*th risk factor;

F_{it} is the *i*th risk factor;

e_{it} is the random error term of the process of generating return, assumed to be entirely diversified away in very big portfolios in addition to having an average value of nought (Ross, 1976).

The assumptions in the first postulate of the APT, according to Burmeister *et al.* (2003), is that firstly, the expectations for all the components in relation to their realisation and idiosyncratic shocks are zero at the beginning of the period such that

$E(f_1(t)) = \cdots = E\big(f_k(t)\big) = E\big(\varepsilon_i(t)\big) = 0$ ..... (2)

Where $E(f_k(t))$ is the expected end-period value realised for the ith risk factor;

and $E\big(\varepsilon_i(t)\big)$ is the expected end-period value of the asset-specific (idiosyncratic) shock.

Secondly, Burmeister et al. (2003) put forward that it is also assumed, in the first assertion of the APT, that there is a correlation between the factor realisations and asset-specific (idiosyncratic) shock such that

$cov\big(\varepsilon_i(t), f_i(t')\big) = 0$ for all i=1, …, k ..... (3)

Lastly, Burmeister et al. (2003) assert that there is an assumption that the realisations of all the factors and asset-specific shocks are not correlated across time such that

$cov\big(f_i(t), f_i(t')\big) = cov\big(\varepsilon_i(t), \varepsilon_i(t')\big) = 0$ for all i = 1, …, k and t≠t' ….. (4)

The second postulate and constituent of the framework for the APT is derived from the premise that returns to an asset are generated by a model of linear parameters, which summarises the requirements. The second postulate of the APT assumes that it is not possible to achieve pure arbitrage profits in the market as there is competition in financial markets which ensures that such arbitrage opportunities dissipate summarily as market participants exploit them. For any profit to be realised, an investor must take some form of risk, one way or the other, which can be compensated and there must be a net amount of funds invested for this positive additional return to be feasible (Burmeister, Roll, & Ross, 2003). Thus, the second component of the framework is the APT relation and may be represented by the equation:

$E(R_i) = \lambda_0 + \sum_{i=1}^{k} \beta_i \lambda_i + e_i$ …… (5)

Where λ_0 represents the return expected from a zero systematic risk asset such as a government bond without any risk;

λ_i is the risk premium or risk cost associated with the exposure (β_i) to the risk factor F_{it} calculated using the linear factor equation;

e_i is the random error term (Roll & Ross, 1980); (Chen, 1983).

As a result, the full framework can be obtained by replacing equation 5 in equation 1 (Burmeister, Roll, & Ross, 2003), with a simple rearrangement giving effect to the following equation:

$R_{it} - \lambda_0 = \sum_{i=1}^{k} \beta_i (F_{it} + \lambda_i) + e_{it}$ ……. (6)

As can be deduced, this final equation of the APT framework differs significantly from the CAPM as the CAPM puts forward that the return expected can be modelled as the risk-free rate plus an additional premium from multiplying the market beta with the market premium in the form that follows:

$$E(R_i) = \lambda_0 + \beta_i * (R_m - \lambda_0) \quad \ldots\ldots\ldots\ldots \quad (7)$$

With $E(R_i)$ being the anticipated asset *i* return;

λ_0 represents risk-free rate;

β_i represents coefficient measuring the asset's sensitivity in the market;

R_m represents market return (Raja, Chochaa, & Lalakiya, 2017);

However, according to the APT, an asset's return is equal to the risk-free rate plus the product of the macroeconomic betas and their risk factors (Burmeister, Roll, & Ross, 2003).

It is therefore proposed that the APT is grounded on three major assumptions which make the model less restrictive than the Markowitz's (1952) MPT and CAPM developed by Sharpe (1963). The assumptions for the model developed by Ross (1976) are as follows:

- "Capital markets are inherently perfectly competitive, without friction."
- "Investors prefer to have more wealth than less wealth all the time and they are risk averse." The implication here is that risk averse investors will always look for and choose optimal portfolios that are efficient as no other portfolio with expected return that is the same or greater will have lower dispersion of return (Fama & MacBeth, 1973).
- The random process of asset return generation may be illustrated as a linear model of *k* risk factors, with all idiosyncratic risk being able to be diversified away because it will not be rewarded.

Additionally, the APT does not need a Mean-Variance Efficient Portfolio to exist as returns are normally distributed or the independence of factors to exist such as would be required by the CAPM (Roll & Ross, 1980). This paper is based solely on the fact that the APT framework is concerned with only systematic risk that is undiversifiable and will in turn be rewarded. This is the reason this research paper uses risk factors such as macroeconomic variables that are representative of systematic risk hence unsystematic risk is not important.

Connor (1995) outlined three types of models into which multifactor models of security models may be divided. These models are fundamental models, statistical models, and macroeconomic models. The fundamental models place strong emphasis on security attributes, such as portfolio returns connected to “observed security characteristics such as dividend yield, the book-to-market ratio, and industry identifiers that can be observed and tracked overtime.” Statistical models focus on, analyse, and come to conclusions in relation to returns data of a given time. The final type of explanatory model Connor (1995) identified, the macroeconomic model, focuses directly on economic time series variables that can be observed, including inflation and interest rates that change as economic conditions change over time, and measures the shock accordingly to capture the effect these macroeconomic factors built into the model have on stock returns.

According to Poon and Taylor (1991) and Burmeister et al. (1994), there has not been a set of universal macroeconomic factors that can be used to describe the variability in returns of a stock as different risk factors affect diverse sectors of the economy differently. Therefore, a very careful and ad hoc process of the selection of systematic risk factors must be followed for an appropriate representation of stock returns for any model in any given sector to be achieved. However, Connor and Korajczyk (1993) have investigated the possibility of an approximate risk factor model that has found six pervasive risk factors that were statistically generated affecting the returns generating process on the NYSE. Connor and Korajczyk (1993) affirm their approach that they allow to be valid “when asset returns follow an approximate, rather than a strict, factor model”. This is not the approach adopted by Ross (1976) as he follows a strict factor structure that assumes no correlation between diversifiable components of returns across assets and asset classes.

Although the APT framework cannot only be used for a single collection of risk factors, it has been employed in a variety of research projects (Burmeister, Roll, & Ross, 1994; Chen, 1983; Chen, Roll, & Ross, 1986; Van Rensburg, 1995). In the studies mentioned, the researchers have used some common systematic parameters such as economic activity, interest rates, inflation, global market activity, and commodity prices. Van Rensburg (1995) further outlines a criterion for choosing risk factors for the model as follows:

- At the start of each period, a qualifying risk factor must be entirely unexpected to the market.
- A stock's returns must be significantly impacted by each qualifying risk parameter; and
- For each qualifying factor to have an expected return, their prices must not be zero (Berry, Burmeister, & McElroy, 1988).

2.3 Empirical literature

2.3.1 An overview of the model application

The APT framework has been tested and critiqued since it was proposed by Ross (1976) in his paper on the Arbitrage Theory of Capital Pricing. All these applications and critiques have had the result of making this framework more robust and its results more reliable. Fama and McBeth (1973) in their study on the return, risk and equilibrium empirical tests used a model of a two-parameter portfolio to research the equilibrium relationship of risk and return. They investigated if security prices incorporated all the market information available and thus if the markets were efficient. Although not the APT framework, their model had comparable properties to the one advanced by Ross (1976).

Chen et al. (1986) proclaimed that there was a belief that prices of assets responded sensitively to economic news and events. They asserted that part of the long-run return on assets was due to the influence of economic news and that diversifiable risk was not rewarded, thus they investigated if innovations in macroeconomic factors are risks that are compensated. They investigated macroeconomic risk factors that affected market returns including the difference between low- and high-grade bonds, spread of long and short interest rates, both unexpected and expected inflation rates and industrial production.

The findings showed that market portfolio and aggregate consumption were not independently priced, and systematic risk was significantly priced. Chen et al. (1986) also found that the linear relationships between the factors had reduced the individual factor influences on returns which is the basis of diversification theory. They indicated that each stock’s returns followed a factor model such as

$$E(R_i) = \lambda_0 + \sum_{i=1}^{k} \beta_i \lambda_i + e_i \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Hamao (1988) applied the APT framework to look at variables and examine how robust the theory was. The factors that were under consideration were investor confidence, inflation, industrial production, foreign exchange, oil prices and interest rates. In his results, Hamao (1988) found that the CAPM's market beta captured no additional risk that may have been excluded in the model represented by the macroeconomic factors, he considered further emphasising the appropriateness of the APT to model returns.

Berry et al. (1988) postulated that previous testing of the CAPM and APT revealed that the former had inferior explanatory power in assessing what affects returns in the market. They concluded that returns are sensitive to various forms of undiversifiable risk.

Fama and French (1993) used a multifactor model to identify five risk factors that had pervasive influences on the bond market and stock market returns; three factors were identified for the stock market and two for the bond market. The book-to-market equity ratio, the company size factor, and the aggregate market factor were stock market parameters, while the default and maturity were factors for the bond market. They found that the factors identified appeared to explain the average returns in both the bond market and stock market.

Burmeister et al. (1994) developed a guide to using the APT to investigate risk factors and their influence on asset returns. The factors that were considered included confidence risk, inflation risk, time horizon risk, market-timing risk, and business cycle risk. It was discovered that confidence, business cycle and market-timing were positively correlated with returns, while inversely, inflation and time horizon had a negative relationship with returns.

Clare and Priestley (1998) used similar factors to Chen et al. (1986) to derive a description of the return and risk relationship in the stock market of Malaysia. They found that an international market risk proxy could be included to supplement the local version of their research. The systematic risk factors that were under consideration for Clare and Priestley (1998) included the change that was unexpected in the term structure of interest rates, change that was unexpected in the risk-free rate, the change

that was unexpected in inflation, the change that was unexpected in industrial production, and the change in expected inflation. All these factors were established to be significant statistically in describing the variation in returns of the Malaysian stock market.

Burmeister et al. (2003) asserted that unless a portfolio manager was in possession of information that others may not have, a portfolio can only outperform other portfolios if it is riskier than those portfolios to which it is compared. They identified primary systematic risk factors which consistently impact stock returns; these factors were interest rates, investor confidence, real business activity, inflation and a market index.

Al-Zubi and Salameh (2007) probed the association that existed between systematic variables and stock returns in Jordan's industrial sector. Industrial production, anticipated inflation, interest rates term structure and unanticipated inflation were the four factors that were considered. Considering returns without dividends, they found only two risk factors to be affecting returns which were inflation and unexpected inflation. When dividends were taken into consideration, Al-Zubi and Salameh (2007) discovered that only inflation that was unexpected had a pervasive influence on returns. The authors also investigated the existence of short- and long-term linkages between unexpected inflation and returns on stocks and found that only a long-term link exists while no short-term relationship existed.

Türsoy et al. (2008) investigated the Istanbul stock exchange using various macroeconomic variables that they believed represented the economy against industry portfolios to observe the variables' impact on returns. They found that there were differences between industry portfolios indicating that different macroeconomic variables affect different sectors differently.

El-Nader and Alraimony (2012) explored the impact of systematic risk parameters on the stock market returns of Amman using 6 factors which included real GDP, real exchange rate, a dummy variable, real money supply, weighted average interest rates on loans and advances and inflation. The authors discovered that aside from real GDP, all the macroeconomic parameters were negatively correlated with the Amman stock market returns.

Szczygielski and Chipeta (2015) modelled the JSE while using macroeconomic risk factors and discovered that all the factors were statistically significant in describing returns on the JSE. The factors that were under consideration were as follows: building plans passed (which was being used as a substitute for economic activity), exchange rate, international market activity, oil prices, inflation, and inflation expectations.

Fama and French (2015) developed a model that used five factors that expanded on the three-stock market factor model they had put forward earlier in (Fama & French, 1993). They discovered that the five-factor model performed better at capturing "the size, value, profitability and investment patterns in average returns." Although they found the model with five factors to produce better results than the model with three parameters, it also had problems as it could not "capture the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability" (Fama & French, 2015).

Grum and Govekar (2016) investigated the statistical significance of the linkage between residential real estate and selected macroeconomic variables in Greece, France, Slovenia, Norway, and Poland. They considered the current account of the country stock index, unemployment rate, industrial production and GDP and revealed that these variables were all significantly associated with real estate price movements in the different countries.

Amtiran et al. (2017) explored the correlation of interest rates, inflation, exchange rates, economic growth and on Indonesian stock returns. They found out that interest rates, economic growth and exchange rates exhibited a positive association with stock returns as opposed to inflation which had a negative relationship. Chakraborty and Gupta (2017) tested the APT's performance in the Bombay stock exchange using 5 macroeconomic risk parameters (price of gold, supply of money, exchange rate, GDP and inflation). The authors found no significant effects on the stock market by these selected variables.

Madaree (2018) intended to pick out and describe the primary risk factors that were present in the financial sector stocks. He discovered that these factors explained over half of the risk present in the financial sector and that banks have been particularly the riskiest factor in the financial sector.

It is important to understand the variables chosen for inclusion in the models considered for this research and a brief discussion on these factors follows. Macroeconomic variables, on which the APT's linear multifactor model is built, are the systematic risk factors that have been chosen. Systematic risk is described as a market risk that cannot be controlled by any one person or business (Corporate Finance Institute, 2022). This type of risk can be thought of as being external to the company and is additionally non-diversifiable. Unsystematic risk is the opposite of this and is particular to the company and can be diversified away. This type of risk is not rewarded. According to Poon and Taylor (1991) and Burmeister *et al.* (1994) there has not been a group of universal systematic risk factors to be employed to represent the stock returns as different risk factors affect different sectors of the economy. Therefore, a very careful and ad hoc process of selection of systematic risk factors must be followed for an appropriate representation of stock returns for any model in any given sector to be achieved.

The systematic risk factors that have been selected are macroeconomic variables for which the linear multifactor model of the APT underlies and is based upon. Finding factors that could reasonably affect anticipated cash flows and the rate used to discount those cash flows in order to compute their present values is the method through which relevant risk factors are found; the DDM provides the most compelling proof of the association between macroeconomic factors and stock prices (Panetta, 2002); the pre-described macroeconomic risk factors will aid in the explanation of the systematic risk.

Clare and Priestly (1998) also note that in searching for potential sources of systematic risk in domestic situations, a common beginning point of analysis is the DDM which gives the expected future dividends' present value. The model explicitly indicates that a stock's current value or price is generated from predicted future dividend income that is discounted to its present value at a predetermined discount rate. For the purposes of this research report, eight macroeconomic risk factors were chosen to represent the influences on the stock returns namely real economic activity, fuel prices, interest rates, global market index, domestic market index, exchange rate fluctuations, inflation, and gold prices.

Interest rates

Barakat et al. (2016) established that a casual association between the Egyptian market index and interest rates exists. Additionally, Celebi and Hönig (2019) surmised that interest rates were negatively impacting German stock market returns pre- and post-crisis. Interest rates affect the rate of return in a sector as they form an essential part of the discount rate make up. Thornbeck (1997) advocates that when a country's central bank has a restrictive monetary policy stance, increases in interest rates result in firms losing value as discount factors decrease with increasing discount and borrowing rates. Increasing interest rates lead to higher borrowing costs which would ordinarily mean more profitability for banks; however, higher rates increase affordability restrictions and limit the pool of potential customers that may be extended the credit. The impact of the secondary effect will offset some of the profitability attained from rising interest rates. Furthermore, the interbank borrowing rates will be higher, and this may be yet another negative impact of rising rates on banks' overall profitability.

Inflation

Mukolu and Ilugbemi (2020) recommended that central banks' monetary policy should ensure stabilisation of inflation in pursuit of a more practical price level as inflation negatively impacts stock movements. Celebi and Hönig (2019) established that inflation negatively impacted German stock market returns. Concurringly, Nijam et al. (2015) observed that inflation was negatively related with the Sri Lankan stock market performance. Inflation affects stock returns due to the make-up of the expected and required returns. If these rates of return are computed using Sharpe's (1963) CAPM, the base rate upon which the risk premium will be added is the risk-free rate. Additionally, the composition of the risk-free rate includes an inflation premium. As a result, higher inflation expectations imply a higher risk-free rate which then indicates that the rate of returns are greater. Higher rates of returns or discount rates mean that discount factors are lower which decreases the present values of cash flows.

Exchange rate

Jain and Biswal (2016) observed that the Indian rupee's value and Sensex stock market index dropped with falling crude oil prices and gold prices. This indicates a positive relationship between the US Dollar-Indian rupee exchange rates and the Sensex stock market index. In support of this, Giri and Joshi (2017) found that foreign exchange rates influence asset prices in a positive way. Dahir et al. (2018) also corroborated the conclusion that foreign exchange rates impact asset prices in a positive manner. Exchange rates impact the banking industry differently as the impact is significantly driven by exposure to foreign currencies. Jorion (1990) puts forward that foreign exchange rates are multiple times more volatile than interest rates and tenfold more volatile than inflation which makes them a particularly significant source of uncertainty. Jorion (1990) discovered that the impact of foreign exchange rates on US multinational firms' returns varied systematically across firms. It follows that banks should be lending money to firms importing material or conducting business operations in foreign currencies as they will have indirect exposure to the fluctuations of those currencies because the firms that borrow money face that direct risk.

Moreover, banks are market makers and primary dealers in markets that are fundamentally impacted by foreign exchange rates. Therefore, the importance of exchange rates as a consideration to banks cannot be understated.

Oil prices

Aydogan and Berk (2015) discovered that shocks to oil price have a pervasive and rational impact on the Turkish stock market returns. Additionally, Jain and Biswal (2016) concluded that the oil price influences the Sensex in a positive fashion. Nusair and Al-Khasawneh (2018) established similar findings in their study of oil shocks and their effect on Gulf Corporation Council countries stock market returns. The authors established that rising oil prices increased stock returns with the opposite being true. According to Mokni (2020), demand shocks that were specifically related to oil had a beneficial influence on returns for countries exporting oil while negatively impacting oil-importing countries.

Chen et al. (1986) contend that oil should be added to any macroeconomic model analysing stock returns. Banks offer funding to many companies that use oil as an

input in their operations and thus this variable is especially important for consideration when assessing returns to the banking industry.

Economic activity

Guo (2015) established a strong linkage amongst returns on stocks and real economic growth. Additionally, Pradhan et al. (2015) established that a short-run and long-run linkage between economic growth and stock market movements existed. According to Chen et al. (1986), the process of selecting macroeconomic parameters is based on how the parameters impact cash flows or the required rate of return per valuation model being investigated. Fama (1981) found that variations in stock returns had a positive relation to real activity growth rates. Barro (1990) found a strong linkage between stock returns and future real activity. Fama (1990) applied the growth in production industrials as a proxy for economic activity and, he too, suggests that stock prices and real activity growth are positively linked.

Global index

The linkage between stock markets of the world can be cast in little doubt. Far-reaching events such as the crash in 1987 which was a world financial market catastrophe solidified the belief and evidence of this relationship (1995). Van Rensburg (1995) observed that the Dow Jones industrial index had a direct impact on the South African stock market. Bradfield (1990) concluded that the pricing of the JSE stocks is more bothered by sentiment rather than rudimentary fluctuations on the NYSE. According to Angelidis et al. (2015), global real activity directly and positively affects returns of US stocks.

Domestic index

Traders pay particular attention to indices in the market when they make decisions for investment purposes (Yang & Kwon, 2008). It can be seen to suggest that asset prices indicate variations in market indices. The local market index accounts for other domestic risks that cannot be clearly investigated but their existence does affect stock market returns (Yang & Kwon, 2008). Szczygielski and Chipeta (2015) used the JSE ALSI to investigate its influence on returns; they found that the domestic index explained variations in stock returns.

Gold prices

Prices of gold are a reasonable barometer of how the international market is moving as most countries have use for gold in one way or another (Arouri, Lahiani, & Nguyen, 2015). Gold price movements shift positively with economic growth as the allocation of disposable income to this commodity is usually done during times of economic booms (Chimhete, 2020) and higher disposable incomes; therefore, the more people acquire the precious metal, the more likely it is that there has been an upturn in economic expectations. Gold is also a decent store of value, especially during times of high inflation (Chimhete, 2020). Bhuyan and Dash (2018) concluded that gold and the Indian stock market had a long-run relationship characterised by positive correlation. In addition, Shabbir et al. (2020) concluded that oil price and gold price had a profound impact on stock market prices in Pakistan.

2.4 Summary

The amount of literature available on studies exploring the influence of macroeconomic risk parameters on returns have been largely centred around the APT framework and that the returns can be analysed by a linear model influenced by k-factors (Ross, 1976). The APT framework was created as a CAPM alternative, proposed by Sharpe (1963), which allowed for the investigation of the return and risk relationship between individual stocks instead of using the aggregate market model, which made for a more comprehensive isolation of systematic risk factors and how they affect returns given the level of risk as well as the number of risk factors affecting those returns. Given the difference in how these systematic risk factors influence the returns, care should be taken in choosing the macroeconomic variables that are considered in the representative linear factor model by using some techniques employed by previous researchers in multifactor models such as in Berry et al. (1988) and Fama and MacBeth (1973). It should be noted that this study employed panel data regression to analyse the individual influences and PCA to assess the combined influences of various systematic factors on returns. Furthermore, the paper tested if a steady long run linkage between banking sector returns, and the macroeconomic risk parameters exists by using Autoregressive Distributed Lag (“ARDL”).

2.5 Demarcation and differentiation of the study

This paper deviates from previous research done on the topic of risk-return analysis by focusing on a specific group of systematic risk factors and their impact on banking sector returns, specifically, the South African banking sector using panel data regression. This research employed the APT to a different period to other studies previously undertaken. The author also considered a greater number of factors (8) to be representative of systematic risk factors than most studies (Coetzee, 2018; Fatoki, 2014; Szczygielski & Chipeta, 2015; Van Rensburg, 1995) that averaged between 5 or 6 factors such as those factors included in the review of literature in this paper. Moreover, this study investigated the extant of a steady, long run relation between the chosen set of systematic risk factors and returns of the South African banking sector by considering an ARDL test. This study is adding to the body of existing literature because only a few studies (Kumbirai & Webb, 2010; Lawrence, Doorasamy, & Sarpong, 2020; Moyo, 2018) had assessed the long-term effect of systematic risk parameters on stock prices. Finally, combining various macroeconomic risk factors using the Principal Component Analysis (“PCA”) and estimating their joint effect is another key departure from previous studies.

3 METHODOLOGY

This research paper assumes a completely diversified portfolio with no unsystematic risk and intends to focus more on the linear model structure than the linear model's relation to the APT model. There is a variance in financial data across time and this makes it heteroskedastic and so an appropriate econometric model needs to be applied (Engle, 2001). Financial data such as stock returns does not behave in ways that are ordered, instead their distribution is non-normal and volatile (Lamoureux & Lastrapes, 1990). The model used is the APT to investigate which risk factors influence the returns of the banking industry for the South African case. In accomplishing this, a panel data multiple regression model was used to establish the importance of factors included in this report and to calculate the effect of each parameter on returns. The APT linear model captures the individual impacts that each risk factor has on the return that is included in the model. According to Ross's (1976) hypothesis, the APT framework's premise indicates that the random process through which assets create returns may be articulated with a model that uses *k*-factors. To ascertain if there is a long-term linkage between the returns of the banking sector and the systematic parameters, a ARDL test was also employed. The sections that follow explore more literature on the models.

3.1 Data

This research paper focused on data in a 15-year period from 2004 to 2019 for all the macroeconomic factors in consideration. This horizon was chosen as it is long enough to encompass at least one business cycle as well as the inclusion of the GFC which was a consequence of banking sector decisions. Also, this is the most recent period excluding the years of the Coronavirus pandemic. The data is annual, panel data for the macroeconomic variables that were identified for investigation in this research paper. The banking sector returns data used in the panel data included the big five banks in South Africa that are listed – ABSA Group, FirstRand Group, Capitec Holdings, Standard Bank Group and Nedbank. Several selected international banks with operations in South Africa were included in the research. The selected international banks comprised of Investec Limited, Sasfin Holdings Limited, Citigroup Incorporated, JP Morgan Chase & Co, Bank of America Corporation, Morgan Stanley and Standard Chartered. The South African Banks Index was also considered in the

study. The index is calculated by the Johannesburg Stock Exchange based on share price and free float of each constituent bank once a year. Essentially, the index is a market capitalisation-weighted index. The domestic banks were chosen on the basis that they are the five biggest commercial banks in the country and their performance is very influential in the sector. Additionally, the international banks were chosen because they have operations in the country and indicate the relationship that the banking landscape in the country has with international stakeholders. The listed status of the banks under consideration made it simpler to analyse their performance as the data used in this research was easily obtained and therefore are a matter of public record. The systematic parameters are economic growth, inflation, interest rates, exchange rates, global market activity, domestic market activity, oil prices and gold prices. Some of the variables' data was differenced using natural logarithms to find changes from one year to the next. The reason for differencing some of the data is so that the percentage change in price levels of the variable can be obtained for the purposes of this research. Those that were not differenced were already in percentage form and the differences between the respective natural logs served as the input into the regression model.

The data used in this research paper was retrieved primarily from the Refinitiv database – website[1] and terminal, in addition, various other databases such as the SARB[1] and Statistics South Africa[1] were used. The data was secondary data as it was collected from sources that obtained and analysed the data from primary sources.

3.2 Models

The model that was used in this research paper is the panel data regression. Through this model, the effect of each systematic risk factor on returns was investigated and described. This model was constructed within the bounds of the APT framework and was a linear factor model. This model addressed research objective one. For research objective two, an aggregate variable was created to represent all the macroeconomic risk factors included for investigation in this paper. Another model was used to create the aggregate variable, that model is the PCA to cluster the various risk factors. The

[1] Links in table included in the appendix

newly created aggregate variable was then run through a regression model. In addressing research objective 3, a ARDL test was performed.

3.2.1 The APT framework

The APT contends that return on an asset is generated in accordance with a linear factor model and this assertion gives rise to the second postulate and constituent framework of the APT. The second postulate's assumption of the APT is that it is not possible to achieve pure arbitrage profits in the market as there is competition in financial markets. For any profit to be realised, an investor must take some form of risk which can be compensated and there must be a net amount of funds that are invested for this positive additional return (Burmeister, Roll, & Ross, 2003). The equation will take the form of:

$$R_{it} = \alpha + \beta_{GY} GY_{it} + \beta_{GDP} GDP_{it} + \beta_{INF} INF_{it} + \beta_{USDZAR} USDZAR_{it} + \beta_{MSCI} MSCI_{it} + \beta_{ALSI} ALSI_{it} + \beta_{OP} OP_{it} + \beta_{GP} GP_{it} + \mathcal{E}_{it} \quad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

Where R_{it} is the banking sectoral return in South Africa at time t – the subscript t represents a point in time t for all variables, α is the intercept, *β* represents each of the macroeconomic risk factor betas that capture the sensitivity of those factors, GY_{it} is the government yield, GDP_{it} is the real economic growth, INF_{it} is the inflation, $USDZAR_{it}$ is the exchange rate, $MSCI_{it}$ is the MSCI All-World Index ("MSCI AWI") used as a representative for global market activity ["the MSCI All Country World Index covers the large-cap and mid-cap stocks from 23 developed markets and 26 emerging markets across 11 sectors. It comprises the markets form both the MSCI World Index and the MSCI Emerging Market Index and is a market capitalisation-weighted index"], $ALSI_{it}$ is the JSE ALSI used as a representative for domestic market activity ["the FTSE/JSE All Share index is the main index of the local share market calculated as a market capitalisation-weighted index. It consists of companies that represent roughly the largest 99% of the companies listed on the main board of the JSE by market capitalisation and is the largest index in terms of size and overall value"], OP_{it} is the Brent Crude Oil and GP_{it} is the Gold Price.

3.2.2 Principal component analysis (“PCA”)

The PCA is a model of analysing large sets of data with a considerable number of dimensions or features per observation. It increases the interpretability of the observed data while also ensuring that the maximum amount of information is preserved in addition to enabling the visualisation of multidimensional data (Giuliani, 2017). This method lowers the dataset's dimensionality from a statistical perspective (Mishra, et al., 2017). This was particularly crucial for this research report as PCA enabled the creation of an aggregate variable from all the macroeconomic variables used in this study to address research objective 2.

3.3 Evaluation of the models

This research paper used the panel data regression to ascertain the influence of the systematic risk parameters identified. In assessing the impact, the individual statistical significance of each macroeconomic variable in explaining the returns were tested in addition to assessing the combined influence of the group of systematic risk parameters on returns using PCA. An analysis for goodness of fit using an F-test was carried out to explain how well the macroeconomic data and bank returns are captured in the model. To test if the intercept and coefficients of systematic risk factors included are significant in impacting the returns, a t-test was conducted for each of the variables. Additionally, p-values were also analysed to complement the results of the F-test and t-test using a correlation matrix. It must be noted that the panel data regression and PCA evaluate the impact of the systematic risk parameters on the returns of the South African banking sector in the short-term as opposed to the assessment described below.

This study used ARDL to evaluate the data to assess the existence and effects of a consistent long-term linkage between the systematic parameters and returns.

3.3.1 Correlation, heteroskedasticity and multicollinearity

The implicit assumption in regular multiple regression is that the regression's error terms are uncorrelated, however, this is oftentimes inappropriate for financial and economic data. Petersen (2009) stressed this point as a well-known fact about regression, therefore, to obtain unbiased standard errors for the regression in this

paper, the presence of serial correlation was assessed using the Durbin-Watson statistic to establish whether the residuals are correlated or not.

Another issue that needs to be looked at keenly is that of heteroskedasticity. Heteroskedasticity occurs when the variance of residuals is not constant and the result of it is incorrect standard errors. Hence, it was necessary to test for this phenomenon using the Pesaran CD Test. To examine the presence of heteroskedasticity, there are three possible tests – Breusch-Pagan LM test: If the number of time periods is much higher than the number of regressors, then this fits (Breusch & Pagan, 1980); Pesaran scaled LM test: this test is fitting for when both the number of time periods and regressors are very large and approach infinity (Pesaran, 2021); and Pesaran CD test: this test is appropriate for when the number of time periods is small and relatively similar to the number of regressors (Pesaran, 2021). If the test statistic of the Pesaran CD test is discovered to be statistically insignificant, we can surmise that there is no cross-section dependence of residuals.

Finally, another important aspect of regression analysis is that the linkages between the explanatory factors and the dependent factor is isolated. Therefore, multicollinearity amongst the systematic risk factors may be problematic in analysing the goodness of fit and interpretation thereafter if one of the explanatory variables predicts other explanatory variables. As a result, a test for this will be specifically conducted to analyse the degree of multicollinearity and this test will involve variance inflation factors (“VIF”).

4 RESULTS AND DISCUSSION

In this segment of the research paper, results are discussed to infer conclusions based on statistical output. The variables used in this paper will be represented by abbreviations or symbols as follows: R_{it} is the banking sectoral return in South Africa, GY_{it} is the government yield, GDP_{it} is the real economic growth factor, INF_{it} is the inflation, $USDZAR_{it}$ is the exchange rate factor, $MSCI_{it}$ is the MSCI AWI applied as a representative for market activity globally, $ALSI_{it}$ is the JSE ALSI used as a representative for domestic market activity factor, OP_{it} is the Brent Crude Oil factor and GP_{it} is the Gold Price. To attain percentage changes, price data was transformed by log transformation. Yield on government bonds, percentage change in real activity and inflation data was used in their original state.

The preliminary analyses section sets out to test and ensure that the data is suitable to be used in addressing the set objectives. The summary of statistics sums up the features that the data used in the research has and assists in understanding the data. In addressing specific research objective 1, the individual effects of the risk factors on banking returns, a panel data regression was used with several diagnostics tests being performed. These tests included tests for multicollinearity, serial correlation and heteroskedasticity. To address specific research objective 2 - the combined impact of the risk factors – a PCA assessment was performed. This assessment aggregated all the independent variables and evaluated their relationship with the dependent variable. Finally, the long-run relationship between the risk factors and banking returns was assessed using ARDL. All these assessments combine to address the primary research objective.

4.1 PRELIMINARY ANALYSES

4.1.1 Summary of selected statistics

Table 1: Summary Statistics

Statistic	R	ALSI	GDP	GP	GY	INFL	MSCI	OP	USD ZAR
Mean	0.1062	0.1198	0.0234	0.1647	0.0819	0.0567	0.0652	0.1005	0.0604
Median	0.1181	0.1609	0.0240	0.1531	0.0814	0.0528	0.0964	0.1333	0.0704
Std. Dev	0.3283	0.1739	0.0196	0.1593	0.0080	0.0178	0.1791	0.3603	0.0938
Skewness	0.7893	-0.2308	0.0941	0.0948	-0.2190	1.6324	-1.2530	-0.2981	-0.1611
Jarque-Bera	127.4942	2.0075	2.6753	7.3403	1.6981	151.3116	72.3288	7.0471	9.1968

Excess Kurtosis	3.6332	-0.1842	-0.5421	-0.9314	0.1310	2.8221	1.6193	-0.8738	-0.8811

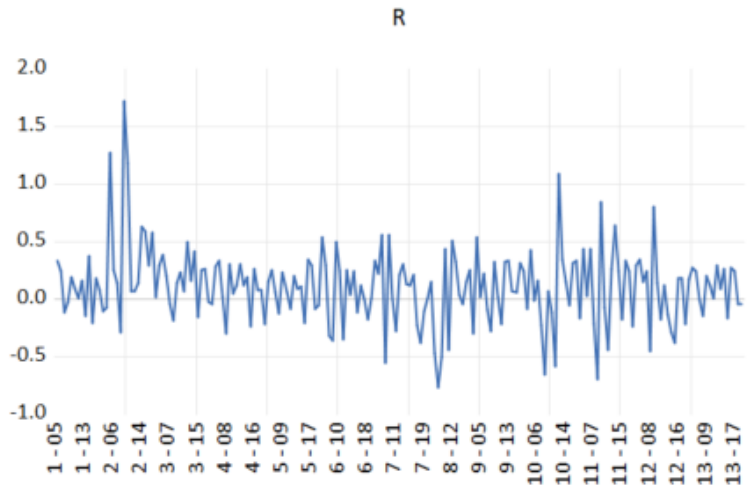
Source: Author's workings

In testing for normality, this research paper used three methods – Kurtosis, Skewness and the Jarque-Bera statistic. When observing all variables from an excess Kurtosis perspective (variable Kurtosis minus normal distribution Kurtosis of 3), it can be noted that BP, INFL and MSCI distributions show evidence of being particularly peaked. GY excess Kurtosis is slightly above zero indicating that it is not too peaked while excess Kurtosis for ALSI, GP, GDP, OP and USDZAR are all below zero. When assessing the skewness of the distribution of the data of each variable, it can be surmised that all the explanatory variables' data distributions are symmetrical as they fall within -0.5 and 0.5. The dependent variable, R, data distribution however indicates a moderate skewness to the right. In contrast, MSCI shows evidence of being very skewed to the left. When assessing the Jarque-Bera statistic for the variable, it can be concluded that R, GP, INFL, OP, USDZAR and MSCI have data whose distributions are statistically significant. This illustrates that there is reasonable evidence to suggest that these variables are not normally distributed. This, however, cannot be assumed for ALSI and GDP whose p-values for the Jarque-Bera indicate that their distributions are not significantly different from the normal distribution. To ensure no negative impacts on regression inference from the data used, problematic parameters' data was transformed by difference once. As can be observed in Table 1, R is the most volatile of all the explanatory with a standard deviation of 32.8% whereas the least volatile variable is GY with a standard error of 0.8%. The low error in GY is because it is often used as a risk-free rate and thus can be assumed to possess almost no risk of variation from its expected value.

4.1.2 Test for unit root

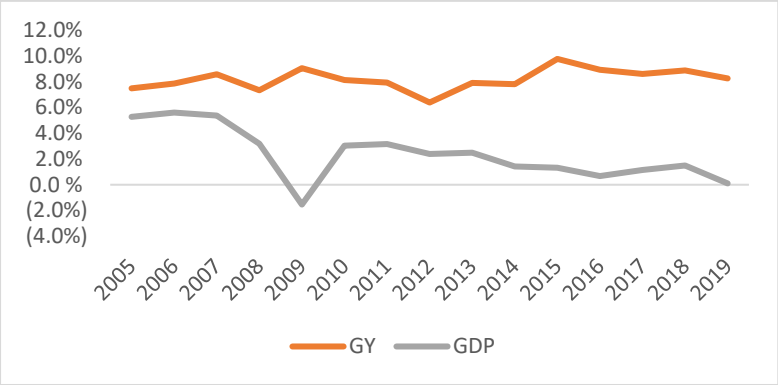
The ADF test was performed to assess if the data employed in this research contained a unit root. A unit root test was undertaken for every variable in the selected macroeconomic risk factors. The results of the test are presented below.

Figure 1: R Trend (Banking Returns)



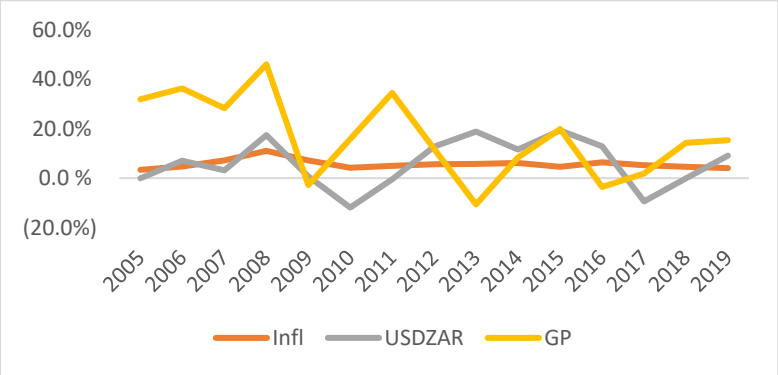
Source: Author's workings

Figure 2: GY and GDP Trends



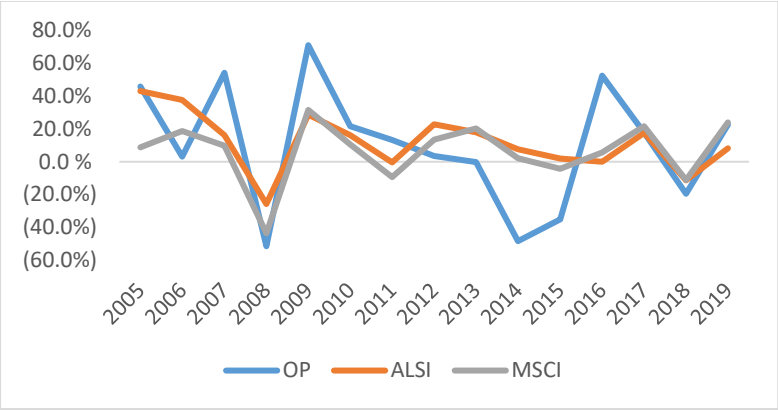
Source: Author's workings

Figure 3: INFL, USDZAR and GP Trends



Source: Author's workings

Figure 4: OP, ALSI and MSCI Trends



Source: Author's workings

The graphs above indicate that all variables, including the dependent variable, have mean reversion characteristics. This suggests that the data may be stationary, so unit root tests are performed below to definitively establish this fact.

Table 2: Augmented Dicky-Fuller ("ADF") Unit Root Test

	Level		1st Difference	
Variable	t-Statistic	P-value	t-Statistic	P-value
BP1	-5.5837	0.0006	-4.9689	0.0026
BP2	-3.6346	0.0208	-6.0846	0.0009
BP3	-3.8588	0.0130	-6.1117	0.0004
BP4	-4.0182	0.0098	-5.9944	0.0004
BP5	-4.4780	0.0056	-5.4679	0.0016
BP6	-6.1278	0.0003	-3.5514	0.0300
BP7	-5.3760	0.0052	-5.4796	0.0012
BP8	-3.1955	0.0423	-3.6139	0.0231
BP9	-9.1994	0.0000	-9.1994	0.0000
BP10	-3.6450	0.0191	-4.7179	0.0039
BP11	-5.6252	0.0008	-5.5540	0.0014
BP12	-4.4236	0.0047	-4.6609	0.0042
B13	-4.3779	0.0051	-4.3843	0.0076

ALSI	-3.8435	0.0133	-8.9341	0.0066
GDP	-3.3959	0.1731	-8.2281	0.0249
GP	-4.0763	0.0121	-10.634	0.0016
GY	-3.1195	0.0483	-7.6768	0.0166
INF	-3.2825	0.0380	-6.4946	0.0358
MSCI	-5.1437	0.0016	-11.4267	0.0008
OP	-4.3705	0.1127	-7.9438	0.0138
USDZAR	-5.3979	0.0672	-3.3764	0.0342

Notes: noted that BP1 is ABSA, BP2 is Capitec, BP3 is FirstRand, BP4 is Nedbank, BP5 is Standard Bank, BP6 is Investec, BP7 is Sasfin, BP8 is Citigroup, BP9 is JP Morgan Chase, BP10 is Bank of America, BP11 Morgan Stanley, BP12 is Standard Chartered and BP13 is the Banking Index in South Africa.

Source: Author's workings

In this section, the dependent variable (all the banking institutions' returns) and independent variables were evaluated for stationarity. According to the ADF tests performed in Table 2, at level, the null hypothesis that there is a unit root can be rejected in the case of each of the banking institutions considered for this research.

The ADF tests in Table 2 displays that, at level, the ALSI, GP, GY, INF, MSCI, and OP can all be used to not accept the null hypothesis that the data contains a unit root. The unit root null hypotheses for OP, GDP, and USDZAR were rejected after differencing the data once.

Additionally, Table 2 demonstrates that for all independent variables, the null hypothesis can be rejected that there is a unit root in the data at first difference.

4.1.3 Correlation Matrix

Table 3: Correlation Matrix

Correlation / *Probability*	*R*	*ALSI*	*GDP*	*GP*	*GY*	*INFL*	*MSCI*	*OP*	*USDZAR*
R	1.0000								
	-								
ALSI	0.5230	1.0000							
	0.0000	-							

GDP	-0.1299	0.2785	1.0000						
	0.0703	*0.0001*	-						
GP	-0.3726	-0.1480	0.6765	1.0000					
	0.0000	*0.0389*	*0.0000*	-					
GY	-0.0679	-0.1808	-0.4361	-0.3033	1.0000				
	0.3454	*0.0114*	*0.0000*	*0.0000*	-				
INFL	-0.2625	-0.5092	-0.0785	0.1577	-0.1372	1.0000			
	0.0002	*0.0000*	*0.2753*	*0.0277*	*0.0558*	-			
MSCI	0.5470	0.7834	-0.2230	-0.5919	0.1263	-0.5087	1.0000		
	0.0000	*0.0000*	*0.0017*	*0.0000*	*0.0785*	*0.0000*	-		
OP	0.3545	0.5573	-0.0444	-0.2658	0.1830	-0.2158	0.6342	1.0000	
	0.0000	*0.0000*	*0.5378*	*0.0002*	*0.0105*	*0.0024*	*0.0000*	-	
USDZAR	-0.1242	-0.3022	-0.0815	-0.0244	-0.1003	0.3740	-0.2803	-0.4592	1.0000
	0.0836	*0.0000*	*0.2576*	*0.7354*	*0.1629*	*0.0000*	*0.0001*	*0.0000*	-

Source: Author's workings

Table 3 results display the correlation matrix of the risk factors and their associated p-values. As can be deduced at the 5% level of significance, only ALSI, GP, INFL, OP, USDZAR and MSCI are statistically significant with p-values below the level of significance. It must be noted that USDZAR and GDP represent variables whose data has been first differenced to ensure stationarity. It can be concluded that GP, GDP, GY, INFL and USDZAR are negatively correlated with R. As can be expected, INFL and USDZAR are negatively correlated with R as negative movements in foreign currencies are a major risk for banks that have exposure to foreign markets and higher inflation rates reduce the real value of banking sector profits. Although GDP has been shown to be statistically insignificant, it is interesting to observe that GDP growth is negatively correlated to banking sector returns. ALSI, OP and MSCI show positive correlation with R. When the ALSI is trending up, it can be expected that constituents of ALSI are trending up on aggregate and many of these constituents are financed by banks and thus in a better position to service their financial obligations in addition to banks also being invested in the underlying constituents. Similarly, oil exporters often use leverage in their operations which is provided by banks. When oil prices boom, oil exporters reap the benefits of such time, as do their capital providers including providers of debt. As many banks are invested and integrated with the global

economy, times of boom globally are often shared by banks with exposure to the global economy.

When comparing the magnitude of sensitivity based on correlation, it is evident that R is particularly sensitive to movements in the domestic and international stock market as shown by the correlations with the MSCI and ALSI. This is closely followed by sensitivity to GP, OP, USDZAR, and INFL. R is less sensitive to GDP and GY.

4.2 INDIVIDUAL EFFECTS OF MACROECONOMIC RISK FACTORS

This section presents results for the first secondary research objective of this study. It shows how each macroeconomic risk factor can influence the returns in the banking sector, and the results are shown in Table 4. These are short-term effects estimated using a multiple linear regression ("MLR") model.

Table 4: Individual Effects of Macroeconomic Risk Factors [Short-Term Effects]

Parameter	Coefficients	Std. Error	t-Statistic	p-value
ALSI	0.8811	0.3654	2.4115	0.0169
GDP	-2.7960	1.7122	-1.6330	0.1043
GP	-0.6278	0.2158	-2.9090	0.0041
GY	-7.3478	3.4140	-2.1523	0.0328
INFL	-3.4905	2.5885	-1.3485	0.1793
MSCI	-0.3459	0.4899	-0.7060	0.4811
OP	0.0565	0.086	0.6566	0.5123
USDZAR	-0.4469	0.2810	-1.5902	0.1136
C	0.9223	0.3931	2.3462	0.0201
R-squared	0.3910			
Adj. R-squared	0.3629			
F-Stat	13.8863			
p-value (F-Stat)	0.0000			
DW Stat	1.7306			

Source: Author's workings

A panel data regression was employed to assess the short run explanatory power of the systematic elements related to the returns of the banking sector. Table 4 above

shows that there are only three risk factors that are statistically significant in explaining the returns of the banking industry. These three macroeconomic risk factors are ALSI, GP and GY and of the three factors identified as being statistically significant, only the ALSI is positively related to R. GP and GY on the other hand are negatively related to R. This is consistent with the matrix's findings in Table 3 from the perspective of relationships. The only statistically significant and positive relationship established from the regression is ALSI and this is expected as the ALSI has several constituents making up the index. A direct and positive relationship makes sense because as the underlying constituents' trend upwards, the index itself similarly trends upwards. Szczygielski, Brümmer and Wolmarans (2020) found comparable results where industrial returns were positively correlated with the domestic market index.

GP was discovered to be statistically significant in addition to being negatively associated with South African banking sector returns. A probable reason may be that gold as an alternative store of value takes away potential depositors from banks who may choose to invest in gold during times of high inflation and uncertainty related to the banking sector. Gokmenoglu and Fazlollahi (2015) established that gold prices were negatively related to the S&P 500 returns. In contrast, Mokhuti (2018) found gold prices to be positively related to the BSE-Sensex and NSE-Nifty. Van Rensburg (1996) found that gold was not statistically significant when assessing whether its movements were priced in against returns on the JSE. A probable reason for the lack of consensus may be that some markets in which these studies have been conducted, experience varying levels of inflation and thus different decisions are necessary depending on the market an investor is in.

GY was also concluded to be statistically significant and negatively related to returns in the banking sector. A potential reason for this may be that higher interest rates make credit extensions difficult and thus squeeze the number of available clients that are able to afford the higher interest rates. Van Rensburg (1996) found parallel results where interest rates were negatively related to returns on the JSE.

INFL, GDP, MSCI, OP and USDZAR were found to be statistically insignificant in explaining South African banking sector returns in the short-term. A conceivable explanation for this may be that the impact of these macroeconomic risk factors takes longer to filter through the system to eventually affect banking sector returns. Van

Rensburg (1996) found inflation to be statistically significant and negatively related to returns when assessing them against returns on the JSE. Correspondingly, Szczygielski and Chipeta (2015) found inflation to be statistically significant and had a negative association with market returns.

GDP is, surprisingly, also negatively correlated to South African banking sector returns. This may be because at times of economic certainty and good growth, consumers may choose to spend disposable income instead of saving with banks. Gou (2015) established a strong association that exists between real economic growth and returns to stock. Likewise, Barro (1990) also discovered a strong linkage between real activity and stock returns.

OP in this study was found to be insignificant statistically in the short-term. The reason for this may be that as oil prices increase, banking clients who have oil prices as inputs into their operations use inventory stockpiles to avoid severe price movement impacts. However, this relationship may be statistically significant in the long run. This will be probed in later sections, for all the macroeconomic variables. Other authors that have studied the link between stock returns and oil price movements include Szczygielski and Chipeta (2015). They discovered oil price to be positively associated to stock market returns in South Africa. Equivalently, Hussin et al. (2013) found that oil prices are statistically significant and positively correlated to Islamic stock market returns in the short-term.

MSCI and USDZAR were similarly found to be statistically insignificant in this study. This may be attributed to the fact that banks hedge themselves against foreign exchange movements on their exposure and correspondingly protect themselves contractually against adverse outcomes with international exposures that minimise the short-term impact of global economy movements and foreign exchange fluctuations. Giri and Joshi (2017) concluded that exchange rates positively impacted stock prices. Dahir et al. (2018) found comparable conclusions that foreign exchange rates had positive impacts on stock prices. Moreover, Van Rensburg (1996) found that the Dow-Jones Industrial – a proxy for global market activity – was statistically significant and positively related to JSE stock market returns. Angelidis et al. (2015) concluded that global activity has a direct and positive influence on US stock returns.

Finally, when assessing the size of the coefficients, only GY has a coefficient higher than one for the statistically significant variables in the short-term. When extending this to those variables which were found to be statistically insignificant, only INFL and GDP were found to have coefficients higher than one.

From the model, with an F-statistic of 13.88634 whose p-value indicates statistical significance, the macroeconomic risk factors jointly do explain some portion of variation in returns. This fraction can be inferred using the adjusted R-squared value and in the case of this panel data regression model, notably, the chosen set of macroeconomic variables explains 36.29% of the returns.

As already alluded to in the previous section of this research report, financial data presents some problems that may hinder what conclusions we may draw from statistical output. The issues directly identified in this research paper pertain to serial correlation, heteroskedasticity and multicollinearity. However, there are some differences in the recognition of significant macroeconomic risk factors in the regression output and correlation matrix. A plausible explanation for the conflicting results is multicollinearity. The regression model is the primary model of assessment compared to the correlation matrix and thus further interrogation of the model follows below. In this section, diagnostic tests for the regression model are discussed. These tests include multicollinearity, serial correlation and heteroskedasticity.

4.2.1 Model 1: Multicollinearity

Table 5 presents the results of testing for multicollinearity using centred VIF. As can be observed, the centred VIFs for the macroeconomic risk factors in the chosen are less than 10. This indicates that although multicollinearity exists among some independent variables (specifically ALSI and MSCI in this study), the impact of the multicollinearity is not severe enough to warrant correction and thus this regression model remains valid.

Table 5: Multicollinearity - Variance Inflated Factors ("VIF")

Variable	Coefficient Variance	Centred VIF
ALSI	0.0792	6.7264

GDP	2.8491	3.0637
GP	0.0458	3.2642
GY	8.3728	1.4966
INFL	2.0630	1.8416
MSCI	0.1009	9.0849
OP	0.0065	2.3691
USDZAR	0.0609	1.5052
C	0.0821	NA

Source: Author's workings

4.2.2 Model 2: Serial correlation

In addition to testing for and ensuring that severe multicollinearity is avoided, it is important to consider serial correlation. For the purposes of this research paper, a Durbin-Watson statistic will be used to ascertain if there is serial correlation. As can be observed in Table 4, the Durbin-Watson statistic for the regression is 1.7306. Using a rule of thumb approach of test statistic > 1.50 to indicate no autocorrelation (King, 1983), therefore it can be concluded that the statistic was found to be above the lower-limit of the Durbin-Watson critical values suggesting the absence of positive autocorrelation.

4.2.3 Model 3: Heteroskedasticity

Lastly, another issue that requires special attention is the presence of heteroskedasticity. To test for the presence of heteroskedasticity, there are three possible tests – Breusch-Pagan LM test: If there are significantly more time periods than regressors, then using this is suitable (Breusch & Pagan, 1980); Pesaran scaled LM test: this test is fit for when both the number of time periods and regressors are very large and approach infinity (Pesaran, 2021); and Pesaran CD test: this examination is appropriate for when the number of time periods is small and relatively similar to the number of regressors (Pesaran, 2021). As the number of times in this study is small and like the number of regressors in a relative perspective, the Pesaran CD test was used.

Table 6: Cross-Section Dependence

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	168.4129	78	0.0000
Pesaran scaled LM	7.238829		0.0000
Pesaran CD	1.394162		0.1633

Source: Author's workings

There is no cross-section dependence of residuals, as determined by the Pesaran CD test, which has a p-value higher than the level of significance (5%).

4.3 THE COMBINED IMPACT OF SYSTEMATIC RISK PARAMETERS ON RETURNS

The results for the second secondary research objective are presented in this section. To analyse the joint effect of the macroeconomic risk factors, this study applies the principal component analysis (PCA) to create an aggregate index that combines the various macroeconomic risk factors. The following subsection shows the results of the PCA.

4.3.1 Principal component analysis

It must be noted that although the F-statistic discussed in Section 4.2. gives a good indication of how much of the volatility in the banking sector returns is described by the model with all systematic risk factors, this paper prioritises the results of the PCA to address research objective 2. To achieve this, a principal component was created by using the chosen set of macroeconomic variables. This principal component is a composite or index constructed with the data of the macroeconomic variables. PCA has the added benefit of addressing issues of multicollinearity usually experienced when many variables are run in a regression.

4.3.1.1 Eigenvalues and Eigenvectors analysis

Table 7: Eigenvalues and Eigenvectors Output

	Eigenvalues	Proportion	Cumulative

PC 1	3.096	0.387	0.387
PC 2	2.010	0.251	0.638
PC 3	1.034	0.129	0.768
PC 4	0.791	0.099	0.867
PC 5	0.571	0.071	0.938
PC 6	0.228	0.028	0.966
PC 7	0.205	0.026	0.992
PC 8	0.065	0.008	1.000

Eigenvectors (loadings)

Variable	PC 1	PC 2	PC 3
ALSI	0.436	0.340	0.291
GDP	-0.113	0.631	-0.032
GP	-0.315	0.479	-0.309
GY	0.138	-0.426	-0.561
INFL	-0.359	-0.164	0.158
MSCI	0.529	-0.028	0.272
OP	0.431	0.067	-0.131
USDZAR	-0.291	-0.205	0.623

Source: Author's workings

Table 7 shows the output of the intermediate step in creating the index via PCA. Once the index is created, a regression will be run using the index as an independent variable against banking returns. In deciding which principal components to retain, those with Eigenvalues of greater than 1, which is the average, were retained. As a result, PC 1, PC 2, and PC 3 were retained. PC 1 has the highest proportion at 38.7% indicating that it explains the highest variation in the data set. PC 2 and PC 3 have proportions of 25.1% and 12.9%, respectively. Cumulatively, PC1, PC2 and PC3 have a proportion of 76.8% indicating that they explain most of the variation in the dataset. As a result, the average of the three retained PCs was taken to create the composite index used to run a regression against South African banking sector returns. ALSI, GY, MSCI and OP show positive Eigenvectors (loadings), and most are above the 0.4 level, apart from GY for PC 1. The rest of the variables show negative loadings. ALSI, GDP, GP and OP show positive loadings in PC 2. However, only GDP and GP are

above 0.4. For PC 3, there are positive Eigenvectors for ALSI, INFL, MSCI and USDZAR with only USDZAR having a loading greater than 0.4.

4.3.1.2 Combined impact of chosen systematic risk factors on returns

In this section, the results concerning the combined effect of the macroeconomic parameters on returns are shown. The new variable that captures information of the several factors was created using PCA as discussed earlier.

Table 8: Regression Using PCA Index

Parameter	Coefficient	Std. Error	t-Statistic	p-value
Macroeco	0.0976	0.0114	8.5606	0.0000
C	0.1062	0.0201	5.2956	0.0000
R-squared	0.2752			
Adj. R-squared	0.2715			
F-Stat	73.2837			
DW stat	1.7735			
p-value	0.0000			

Source: Author's workings

The index created is named Macroeco in the output above. As can be seen in Table 8, the index is statistically significant in explaining the variance of the returns as its p-value shows statistical significance. The index is positively related to the returns. Additionally, from the model perspective, with an F-statistic of 73.2837 whose p-value is well below the 5% level of significance, the index does explain some portion of variation in returns. This fraction can be inferred using the adjusted R-squared value - that 27.15% of the variation of the returns can be described by the systematic factors.

4.3.1.2.1 Diagnostic checks

As there is only one independent variable in the regression, multicollinearity is not an issue. Therefore, a multicollinearity test is not applicable. The DW statistic is 1.7735

which is higher than the rule of thumb threshold suggesting the absence of positive serial correlation.

Table 9: Heteroskedasticity – Aggregate Variable

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	217.2183	78	0.0000
Pesaran scaled LM	11.14638		0.0000
Pesaran CD	8.802750		0.0000

Source: Author's workings

A Breusch-Pagan LM test was performed to assess whether heteroskedasticity existed and the results are shown in Table 9. It can be concluded that there is no heteroskedasticity as the p-value is lower than the level of significance.

4.4 LONG RUN ASSOCIATION BETWEEN SYSTEMATIC RISK FACTORS AND THE BANKING INDUSTRY RETURNS

This section presents results for the third secondary research objective of this study, which seeks to ascertain the long-run effect of each systematic risk parameter on the returns in the banking sector. Using ARDL by Pesaran, the variables are tested for whether there exists a long-term linkage amongst them in addition to determining the long run effects.

4.4.1 Test for long-term linkages and effects

This research paper employs the ARDL test for longer-term linkages. This test is used as some variables are stationary at level while others are not stationary at level and become stationary at first difference.

Table 10: ARDL Test Output

Parameter	Coefficient	Std. Error	t-Stat	p-value
		Long Run Equation		
ALSI	0.9700	0.1486	6.526	0.0000
GDP	-2.9908	1.1428	-2.6172	0.0098
GP	-0.7029	0.1290	-5.4473	0.0000
GY	-4.8488	2.5209	-1.9234	0.0564
INFL	-3.2154	1.2738	-2.5242	0.0130
MSCI	-0.0068	0.2181	-0.0312	0.9752

OP	0.2023	0.1059	1.9100	0.0587
USDZAR	0.7212	0.2944	2.4489	0.0159
		Short Run Equation		
COINTEQ01	-0.9931	0.0866	-11.4733	0.0000
ALSI	0.9700	0.1486	6.5276	0.0000
GDP	-2.9908	1.1428	-2.6171	0.0098
GP	-0.7029	0.1290	-5.4488	0.0000
GY	-4.8488	2.5209	-1.9234	0.0564
INFL	-3.2154	1.2738	-2.5243	0.0130
MSCI	-0.0068	0.2181	-0.0312	0.9752
OP	0.2023	0.1059	1.9099	0.0587
USDZAR	0.7212	0.2944	2.4497	0.0159

Source: Author's workings

An ARDL regression was undertaken to evaluate long-run the influence of systematic risk parameters on returns.

The output of the ARDL assessment in Table 10 illustrates that there are two variables which have a statistically significant and positive relationship with South African banking sector returns in the long term. These variables are ALSI and USDZAR. Szczygielski, Brümmer and Wolmarans (2020) also found that the ALSI was positively related to South African industrial sector returns. The results in this report may be ascribed to banks being part of the ALSI and positive movements in ALSI intuitively result from those positive shifts in its constituents. The impact of exchange rates varies by industry and what foreign currency means for the industry – either as input currency normally associated with costs or output associated with sales. Some industries have both costs and sales being impacted by foreign currency and thus the result may very well be determined by the net effect. Dahir et al. (2018) and Giri and Joshi (2017) found exchange rates to be positively correlated to asset prices. For South African banks, the reason for this is that the bank funds dollar denominated companies where they benefit with positive movements in USDZAR and vice versa.

GP, INFL and GDP are all negatively related to the returns in the long term and statistically significant. Gokmenoglu and Fazlollahi (2015) found that gold prices negatively impacted the S&P 500 returns. However, Singhal, Choudhary and Biswal (2019) discovered a positive association between the Mexico stock market and gold prices. This study found gold prices were negatively related to the banking sector returns, a probable reason for this may be that as gold is an alternative store of value,

consumers choose gold over traditional banking according to when gold prices are trending upwards or not. Inflation and interest rates go hand in hand as interest rates are already pricing in expectations of inflation. A surprising result is the negative relationship of GDP and the banking sector returns obtained in this research. One would expect that when times are plenty, and consumers have more disposable income with easier access to credit, there would be a positive relationship with banking sector returns. This is not the case. A probable reason for this relationship is that as the economy is budding, more consumers may be investing their incomes in more risky assets such as stocks to achieve higher returns compared to the modest returns that banks offer for depositing funds.

It must be noted in Table 10 that there are three risk factors that appear not to be statistically significant in the long-term. These risk factors are GY, MSCI and OP. Thornbeck (1997) alluded to higher interest rates leading to higher discount factors and thus lower cash flows on a present value basis. Additionally, higher rates make it difficult for consumers to obtain credit from banks as credit becomes more expensive with higher interest rates. Bradfield (1990) found that the pricing of the JSE stocks is more perturbed with sentiment rather than foundational movements on the NYSE. A probable reason for this is that global risk aversion may be driving capital flows to seek sanctuary in banks during times of global strife while global optimism drives capital to opportunities in the global environment during times of economic prosperity. Kang, Ratti and Yoon (2015) found that shocks to oil price are positively linked to returns in the market. Additionally, Zhu et al. (2016) established that prices of oil and Chinese industrial market returns were positively associated. For the banking industry, a plausible reason for the positive correlation is that companies that trade in this oil are financed by banks.

From a coefficient quantum perspective, INFL, GDP and GY have the highest impact on the banking sector. It must also be noted that all these variables have a negative relationship with the banking sector returns.

Table 10 also shows the short-term effects results. Three of the eight factors are not statistically significant – GY, MSCI and OP. This is different to five insignificant factors from the panel data regression – GDP, INFL, MSCI, OP and USDZAR. The statistically significant variables using Table 10 short-run results are ALSI, GDP, GP, INFL and

USDZAR compared to the OLS statistically significant parameters which were ALSI, GP and GY.

4.5 SUMMARY

This research undertook to address the primary research objective of analysing the influence of macroeconomic risk parameters on the banking sector returns in South Africa, placing emphasis on both the individual short-term effects of the various macroeconomic factors and their joint/combined effect, as well as their long run effects. Some macroeconomic risk factors were found to be individually statistically significant in influencing returns of the South African banking sector in the short-term through panel regression – ALSI, GP and GY – while others were not statistically significant – GDP, INFL, MSCI, OP and USDZAR. Additionally, the combination of all the macroeconomic risk factors was found to be statistically significant in influencing banking returns through aggregation of the risk factors to produce one variable and regressing that variable against banking sector returns. Finally, using ADRL to assess the long-run effects, it was found that almost all the macroeconomic risk factors have a relationship with banking sector returns. These statistically significant factors include ALSI, GDP, GP, INFL and USDZAR. Three factors that were found to be statistically insignificant include GY, MSCI and OP. ADRL provided short-term effects of the variables on banking sector returns with ALSI, GDP, GP, INF and USDZAR being statistically significant while GY, MSCI and OP being found to be statistically insignificant.

5 SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

5.1 SUMMARY AND CONCLUSIONS

The focus of this report was to evaluate the impact of the chosen systematic risk parameters on the banking sector returns in South Africa. The parameters used in this paper were represented by abbreviations or symbols as follows: R as the banking sector return, GY as the government yield, GDP as the real economic growth, INF as inflation, USDZAR as the exchange rate, MSCI as the MSCI AWI applied as a representative for market activity globally, ALSI as the JSE ALSI used as a proxy for domestic market activity, OP as the Brent Crude Oil, and GP as the Gold Price. Moreover, this study also had the aim of establishing whether there existed a linkage between the chosen group of systematic risk parameters and the returns of the banking sector in the longer term. The APT was used to determine the risk-return relation. An ARDL assessment was also undertaken to test the existence of associations between systematic risk factors and banking returns in the long-term.

The panel data method was used to perform regression tests. As regression is primarily used to build models that assess the response of the explained variable when explanatory variables change, it is appropriate in achieving the objectives of this study – specifically objectives one and two. From the panel data regression analysis, three macroeconomic risk factors were found to be statistically significant. These variables were the ALSI, GP and GY, which proved to have a short-term effect on returns. In particular, the ALSI was discovered to be positively correlated to the banking sector returns while GP and GY were established to have a negative relation with banking returns.

The systematic risk factors were collectively statistically significant in describing a portion of the variation in returns when the components were combined to generate an aggregate variable that could be compared to the banking returns variable.

The report's final objective was to establish whether there was a long-term correlation — or not — between systematic risk parameters and the returns on the South African banking industry. An ARDL test was used to establish that indeed there existed a long-term linkage between the systematic risk factors and banking returns. It was established that there is a long-term effect, and the results reveal that all the

macroeconomic risk factors – except for GY, MSCI and OP - were statistically significant in explaining some variation in returns.

5.2 RECOMMENDATIONS

It is advised that investors with South African banking assets in their portfolios pay close attention to the performance of the domestic market, gold price, and interest rates for tactical asset allocation purposes in the short term as these have been found to affect banking sector returns. From a strategic asset allocation purpose, investors must track all the macroeconomic risk factors to ensure appropriate risk management in the long-term.

It can also be argued that another implication of this study is that a sober, proper, and comprehensive assessment of an investor's return requirements and risk appetite needs to consider the macroeconomic environment in which their asset allocations are set to be performed. This ensures that an investor's risk budgeting limits are not exceeded in search of returns and that adequate processes can be formulated in anticipation of changes that may adversely impact asset/industry returns given macroeconomic shifts. For commercial banks, their risk management processes need to incorporate macroeconomic parameters to ensure that prudence is undertaken to adequately account for risk of macroeconomic changes. For researchers, the outcomes of this research will help in selecting appropriate variables to include in the assessment of systematic risk. Government agencies such as the central bank can incorporate several more macroeconomic parameters when assessing which policy direction to take given the macroeconomic landscape and bank's mandate.

5.3 LIMITATIONS AND AREAS FOR FUTURE RESEARCH

This study only considered eight variables encompassing a 15-year horizon between 2004 and 2019. The period excludes COVID-19 period as information was difficult to obtain or inconsistent across databases used.

In future research, the period of analysis can be extended to incorporate the COVID-19 affected pandemic period as the data for this period may be available. Perhaps a different set of factors that are not macroeconomic risk factors such as capital adequacy, loss ratios, etc. may be assessed against banking sector returns. It is

conceded in this study that some methods used for analysis in this research report may have limitations and thus alternative models of assessment may be employed. As such, other statistical models or methods of analysis may be employed such as the ADRL to examine short-run effects for variables exhibiting non-stationarity. Gaussian Mixture Models (“GMMs”) may be used to cluster data as the multivariate normal components that maximise the component posterior probability are assigned query data points by the GMM.

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7 APPENDIX

Table A1: Data and the sources		
Variable	***Period***	***Source***
Banking returns (all banks considered) - R	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Government bond yield - GY	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Real economic growth - GDP	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Inflation - INF	2004 - 2019	Stats SA (https://www.statssa.gov.za/?page_id=593)
Exchange rate - USDZAR	2004 - 2019	SARB (https://www.resbank.co.za/en/home/what-we-do/statistics/key-statistics/selected-historical-rates)
Global index - MSCI	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Domestic index - ALSI	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Oil price - OP	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)
Gold price - GP	2004 - 2019	Refinitiv database (https://www.refinitiv.com/en/financial-data/economic-data)