

**The effects that sentiment in the SARB's MPC narrative has on  
changes in the share prices of selected JSE-listed real-estate  
sector companies**

By

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## **Abstract**

Narratives are motive-laden stories that human beings tell to create impressions in the listener's mind. Due to their contagiousness, narratives may influence the thinking and decision-making of a large number of people in society. Both individuals and institutions use narratives to induce favourable behaviour in the target population with respect to their own objectives. Central banks use narratives to affect market participants' understanding of the economy.

The literature review revealed that market participants pay attention to the central bank's narratives to form their future expectations. The purpose of this study was to explain the effects that the SARB narrative sentiment, as disseminated through the MPC's statements, has on the property equity market.

The interest rate announcement in the MPC statements was employed as a moderator variable in the research and its effect was measured along with the sentiment present in the narrative. The results showed that the relationship between the chosen variables was of inverse nature but there was no evidence of strong correlation. The inclusion of interest rate announcement was found to be increasing the strength of correlation between independent and dependent variable.

## **Keywords**

Sentiment analysis, narratives, REIT, share prices

## **Declaration**

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Name: Nabeel Arshed Malik

Date: 1 November 2021

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# Chapter 1: Introduction to the Research Problem

## 1.1 Introduction to the Research Problem

“Narratives are human constructs that are mixtures of fact and emotion and human interest and other extraneous detail that form an impression on the human mind” (Shiller, 2017, p. 973). Narratives present information and evoke emotions in a way that affects the receiver’s beliefs about the content of the narrative. They are created by individuals and organisations to shape the receiver’s understanding of the material that they address.

In pursuing their organisational objectives, central banks attempt to manage future expectations in the market as well as monetary regulations that shape interest rate measures (Vayid, 2013). Bruna and Tran (2020) confirm that central banks create and disseminate narratives with the aim of preparing the market for future policy changes. Central banks present a narrative about how they perceive current economic conditions, how these will change in the future and the effects that these will have on monetary policies (Bennani, Fanta, Gertler, & Horvath, 2020). The reason they are concerned with creating clear and consistent expectations regarding future markets is that it helps them to achieve sustainable growth (Johnson & Tuckett, 2021).

Central banks have played a key role in the stabilisation of economies since the global financial crisis (GFC) of 2007 – 2008. The communications released by these banks are essential to their goal of broader economic stability (Hayo & Neuenkirch, 2015). The GFC demonstrated that the property and real estate sector is prone to destabilising future expectations in the market, which is harmful to the economy. It is important to understand the problem from a South African perspective, to determine how the narrative of the South African Reserve Bank (SARB) affects market expectations.

Various researchers have employed sentiment analysis techniques in their work, to quantify the narratives of central banks using a sentiment score (Bennani, 2020). This paper investigates the relationship between the direction and size of sentiment in the SARB Monetary Policy Committee (MPC) narrative, which is released as a statement, and the changes in the closing share price (CSP) of selected real estate investment trust (REIT) companies that are listed on the Johannesburg Stock Exchange (JSE).

## **1.2 Communication by the South African Reserve Bank**

The Constitution of the Republic of South Africa (Republic of South Africa, 1996) mandates the SARB to create monetary policy in the country: “The primary object of the South African Reserve Bank is to protect the value of the currency in the interest of balanced and sustainable economic growth in the Republic”. The SARB applies inflation targeting, which maintains inflation within a desired range. Inflation targeting is aimed at reducing uncertainty and promoting confidence in the market through price stability (Bruna & Tran, 2020).

The SARB presents its narrative through various means of communication, including statements by the MPC. The MPC is the decision-making body of the SARB. It releases a statement to the public following its regular meetings every two months. The narratives in these statements explain the MPC’s monetary policy decisions, taking into account the perceived prevailing and future economic situation (Cobbett, 2010). In order to promote economic stability and growth in the country, it is important for the central bank to develop successful narratives (Eusepi & Preston, 2010).

## **1.3 Business Rationale for the Research**

Communication by the central banks has become increasingly transparent, particularly since the GFC (Tomuleasa, 2015). The banks use narrative building to manage expectations in the market and guide economic activity. Tuckett (2020) explains that a central bank’s communication should be both regular and credible in order to present an effective narrative. The narrative that the SARB presents through its MPC statements should have the desired effect of fostering confidence in its credibility and policy measures.

According to Johnson and Tuckett (2021), narratives about future economic conditions can motivate individuals to make financial decisions. The central bank’s narrative about changes in the economic climate can influence buyer sentiments and affect prices in the asset market (Farka & Fleissig, 2012). According to Dias and Durate (2019), the direction of monetary policy affects the movement of asset prices in the market. Central banks also use communication as a tool to predict future policies and align their actions accordingly (Bennani, 2020).

The role of the SARB, as a central bank, is to create stability around future expectations in the market through the narrative that it shares about the current and future economic outlook (Hayo & Neuenkirch, 2015; Tang, 2019). Knutter and Wagner (2010) note that the narratives adopted by central banks vary, depending on the strategy used in response to boom-and-bust cycles in the economy.

After the GFC, central banks were forced to retain low interest rates in the face of sluggish economic prospects. Various researchers have established that the banks rely on communication to guide market changes when interest rates are zero-bound (Dybowski & Kempa, 2020).

The real estate and property sector is prone to speculative price increases, which can have a negative impact on the market (Vayid, 2013). In order to maintain economic stability, central banks must implement measures to avoid destabilising, excessive price increases in the economy (Yan, 2019).

It is important to understand the effect that the SARB narrative sentiment has on the REIT sector market expectations, as reflected by changes in share prices. A sentiment analysis of the SARB narrative is a scientific means of analysing the sentiment in the language used to describe the SARB's perception of economic conditions in the country. The aim behind a study of this nature is to provide clarity on the relationship between the narrative created by the SARB and the asset market response that it garners, which will also explain the effectiveness of the SARB in managing future expectations in the market and guiding market behaviour.

## **1.4 Academic Rationale for the Research**

Narrative economics is “the study of the spread and dynamics of popular narratives, the stories, [*sic*] particularly those of human interest and emotion, and how these change through time, to understand economic fluctuations” (Shiller, 2017, p. 967). This research adds to the existing literature. It provides a quantitative study, based on narrative economics and conviction narrative theory (CNT), to assist in understanding the effects of the SARB narrative on asset markets (Shiller, 2017; Tuckett & Nikolic, 2017).

Narrative has been explored in the literature from various viewpoints; it has been described as a construct that embodies emotions and which has the potential to create emotional responses in the receiver (Shiller, 2017). Researchers have shown that narratives create an immersive experience for the receiver by activating neurobiological faculties in the brain (Martins, Rindova, & Greenbaum, 2015). The way in which narratives are interpreted by humans makes them helpful in the decision-making process (Tuckett & Nikolic, 2017). In addition, narratives heighten the imagination of the receiver. This has been shown to create a sense of conviction in human beings when their environment is uncertain.

The importance of the effect of narratives on human understanding has been explored in the sociological context as well. Narratives have been described as conduits for human experiences in society.

The potential of a narrative to cause an emotional reaction in the receiver has been linked, by Shiller (2017), to its contagiousness. The author demonstrates that narratives have the same impact as factual information when many people are affected by them. The more emotional value contained in the information in a narrative, the greater the likelihood of dissemination and retention of the narrative.

Narrative economics explains the relevance of narratives in understanding macroeconomic changes (Shiller, 2017). Humans have proven susceptible to herd behaviour, particularly when exposed to a narrative that reaches a large section of the population (Krokida, Makrychoriti, & Spyrou, 2020). The irrational behaviour of economic agents has been described by Keynes using the term “animal spirits” (Shiller, 2021). Researchers acknowledge the role of central banks in taming animal spirits in the market, in order to maintain financial stability (Aggarwal, 2014).

A growing body of literature has quantified the narratives of central banks and analysed their correlation with different economic variables (Bennani et al., 2020; Tang, 2019). Shiller (2017) demonstrates that quantitative studies can be used to highlight the importance of changing narratives in order to cause economic events.

The SARB has produced a sizeable amount of informational data by way of MPC statements. This research will quantify the sentiment contained in the informational data and analyse its effects on the JSE-listed REIT companies.

## **1.5 Research Purpose**

One of the key concerns of central banks in terms of achieving economic stability is the impact of monetary policy on asset prices (Evgenidis & Malliaris, 2020). The SARB's narrative is aimed at managing the expectations of the market to achieve price stability and sustainable growth (Cobbett, 2010). This research will measure the direction and size of sentiment in the SARB MPC statements and analyse the statements' effects on changes in the share prices of selected JSE-listed REIT entities.

The aim behind the central bank's narrative is to foster stable expectations about future economic conditions (Bennani, 2020). User costs, future expectations, housing supply, wealth effects, credit-channel effects and balance sheet effects have been identified as channels that affect property prices (Mishkin, 2007). According to Liow (2006), property stock prices and property prices have a strong contemporaneous relationship. This research will highlight the SARB's effectiveness at influencing the property sector's share prices through the narrative that it presents.

The SARB has been mandated to develop price stability. Dias and Durate (2019) demonstrate that the property prices in an economy react to the monetary policy adopted by the central bank. Yuksel (2016) notes that property stock prices are influenced by the level of property prices. Macroeconomic conditions and monetary policies affect the share prices of companies in the real estate sector (Ligocká, Pražák, & Stavárek, 2016).

For the purposes of this study, the sentiment found in the SARB *Quarterly Bulletin* will be correlated with changes in the share prices of selected JSE-listed REIT companies after the bulletin is released. The significance of the correlation between the SARB narrative sentiment and the SARB REIT share prices will explain the effectiveness of the SARB narrative in shaping asset prices.

The efficient market hypothesis (EMH) explains the stock market's efficiency at disseminating financial information through a change in the company's share prices (Fama, 1970). According to the EMH, a company's intrinsic value, along with relevant information from the environment, is immediately reflected in the company's share prices (Sewell, 2011). This research will look to changes in the share prices of selected companies after the MPC statement has been released. This will assist in measuring the effects of the MPC statement on the market.

In addition, the researcher will attempt to establish how the market is affected when information about interest rate changes is included in the SARB narrative. The information about interest rates will act as the moderator in the relationship between the sentiment of the SARB narrative and the reaction of the asset markets, as measured through changes in the share prices of the chosen JSE-listed REIT companies. Research indicates that communication by central banks may alleviate interest price shocks in the market caused by surprise interest rate announcements (Clements & Reade, 2020). Introducing interest rates as a moderator variable will enable the researcher to test the effectiveness of the SARB narrative in maintaining stability in the market. In addition, introducing this moderator variable will provide information about how the SARB narrative affects the markets with and without information about interest rate changes.

## **1.6 Scope of the Research**

The MPC's statements will be studied to determine the SARB narrative. As noted previously, the MPC releases a policy statement every two months, in which it presents its narrative about the economy and monetary policy. This research will analyse the MPC statements released over a period of 10 years, from January 2010 to December 2019. The researcher has intentionally avoided the period after the onset of the COVID-19 pandemic, as this appears to have had a drastic effect on the market and would therefore be out of scope for this research.

The research is focused on five JSE-listed REIT sector companies. The companies represent different levels of market capitalisation on the JSE. The share prices of the companies were retrieved for one day before and one day after the release of the MPC statements.



## **1.7 Structure of the Research Report**

The research report comprises seven chapters. In Chapter 2, the relevant literature and theories are reviewed. In Chapter 3, the research hypotheses are outlined. In Chapter 4, the research design and the methodology used to test the hypotheses are explored.

Chapter 5 presents the results of the research. Chapter 6 provides a discussion of the results. Finally, Chapter 7 provides a summary of the findings as well as recommendations for further research.

## **Chapter 2: Literature Review**

### **2.1 Narratives**

Shiller (2017) describes narratives as tools for making sense of, and ascribing meaning to, the events that are unfolding around us. The human mind understands constructs more efficiently when they are received in the form of narratives (Kuipers, 2019). Nyman, Kapadia and Tuckett (2021) note that narratives are designed to foster specific perceptions about specific situations and that they resonate with the receiver on an emotional level.

In their research, Cattaneo and Grieco (2021) explain that narratives are rooted in a set of values and that they promote a certain way of thinking. The sentiment contained in a narrative helps the receiver to link the available information with possible future states. Due to their emotional underpinnings and causal orientations, narratives are effective at causing behavioural changes in those who are receiving them.

### **2.2 The Function of Narratives in a Society**

Narratives have the important function of relaying experiences between human beings. Members of a society share information with one another to ensure a common understanding of what is happening around them. According to Kuipers (2019), people ascribe more importance to the learning they derive from narratives than to their direct observations, since narratives have social value.

Heslop and Ormerod (2020) note that the emotional and predictive properties of narratives make them a powerful determinant of human behaviour. In societies, narratives are used to support existing belief systems by creating a link between societal norms and values to current events (Collier, 2016). In this way, they enforce social learning (Collier, 2016).

### **2.3 Institutions and Narratives**

Institutions are structures and mechanisms through which the behaviour of individuals is governed within societies (Wu, 2017). Institutions create and disseminate narratives to foster an understanding of their purpose and to emphasise the need for readers to take action (Kimmich, 2016). Political scientists have noted that governments in modern nation

states use narratives to create a consensus on issues around law making (Spencer & Oppermann, 2020).

Narlikar and Sottilotta (2021) observed that during the beginning stages of the COVID-19 pandemic, there was an inverse relationship between the narratives created by governments, which emphasised the need to protect the economy, and the early and strict implementation of restrictions. The authors argue that the differences in governments' responses and policies can be understood through the narratives that they disseminated to the public.

## **2.4 The Importance of Narratives in Academic Disciplines**

Narratives are used to make sense of experiences and problems faced at the individual and collective level (Huber, Caine, Huber, & Steeves, 2013). They have garnered a lot of attention in different academic disciplines due to their pervasiveness in societies (Blignaut & Aronson, 2020). Historians and political scientists frequently analyse the dominant narratives of societies, particularly when they are precursors to major events (Mordhorst & Schwarzkopf, 2017; Shiller, 2017).

An example of such an event was the division of the Indian subcontinent into Pakistan and India (Ghosh & Singh, 2021). This division was possible because of the narrative propagated by political actors that the Hindus and Muslims who lived in the region were different nations and could not coexist (Ghosh & Singh, 2021). In this case, the narrative made Muslim minorities fearful of their future in a majority rule democracy.

## **2.5 The Importance of Narratives in Macroeconomics**

Shiller (2017) explains the relevance of narratives in understanding problems in the macroeconomics domain. He argues that combining emotive states with the possibility of personal gain can result in powerful narratives that affect the economy. Narratives can be viewed as constructs that allow generalisations to be made about future outcomes (Collier, 2016). The participants in an economy use narratives to foster an understanding of the implications of their decisions.

A growing body of evidence suggests that narratives play an important role in causing large-scale economic events (Shiller, 2017). The apparent reason for the housing crisis in the United States, and the ensuing economic meltdown, was that complex financial instruments raised the debt levels in the economy until the United States housing bubble exploded (Acharya, Philippon, Richardson, & Roubini, 2009). In addition, the prevailing narrative at the time was that people were accruing wealth by buying property on credit (Heslop & Ormerod, 2020). This fuelled speculative price increases (Heslop & Ormerod, 2020).

As mentioned previously, Keynes described the irrational behaviour of market participants using the term “animal spirits”, which refers to the propensity of economic actors to be motivated by ideas and feelings instead of purely rational thinking (Aggarwal, 2014). Narratives can affect the emotional states of market participants collectively and may cause the emergence of herd behaviour, which can result in abnormal market events (Ferrara, 2020; Krokida et al., 2020).

## **2.6 What Makes Narratives Effective?**

Effective narratives motivate listeners to internalise or adopt the new meaning or new ideas that are communicated within them (Shiller, 2017). Mazzocco, Green, Sapota and Jones (2010) have attempted to explain the effectiveness of narratives in causing favourable behavioural changes. Thompson and Haddock (2012) define transportation as the phenomenon whereby a narrative fosters changes in the listener’s attitude by taking him/her on an emotional journey through the events described. The authors describe narratives that have a greater likelihood of immersing readers in an emotional journey as having more persuasive potential. They reason that in a highly immersed state, the receivers of a narrative may cease focusing on factual knowledge that is extraneous to the information in the narrative.

Narratives that have greater emotional value to the listeners are likely to be recounted more often (Shiller, 2017). Humans are more prone to narrating stories that have an emotional meaning attached to them. Research indicates that narratives that evoke heightened emotions propagate much faster in societies and are considered to have a higher “contagion rate” (Nyman, et al., 2021).

## **2.7 How Narratives Spread in Society**

Shiller (2017) links the spread of narratives to the Kermack-McKendrick mathematical theory of disease epidemics (Brauer, 2005). This theory has provided a means of modelling the spread of infectious diseases. The approach/model can be used to explain narrative economics, which proposes that the contagiousness of a narrative determines the speed with which it spreads throughout a society and assimilates into people's thinking.

According to the susceptible-infected-recovered (SIR) models, which stem from the Kermack-McKendrick epidemiology model, societal networks are essential in the dissemination of narratives. Collier (2016) defines a belief system as a construct formed by the identities, norms and narratives that interact with one's networks to shape behavioural outcomes. The transmissible nature of narratives means that they can direct the behaviour of the collective to bring about significant changes in a society. In addition, the persuasiveness inherent in narratives makes them the tool of choice for policy makers who are shaping changes on a large scale.

## **2.8 The Role of Narratives in Decision-Making**

According to CNT, conviction narratives are used to facilitate the decision-making processes of people who are facing uncertain outcomes (Tuckett & Nikolic, 2017). Conviction narratives provide causal explanations of events that are being observed and help decision-makers to imagine the possible outcomes of the actions they might take in a particular context. An agent's actions will be determined by their perception of future circumstances.

The cognitive functions in the human brain make it possible for people to engage in "mental time travel" using narratives to visualise future possibilities (Suddendorf, Addis & Corbalis, 2009). When a receiver visualises the future, this allows him/her to have a clearer understanding of future states as a result of adopted actions. This feature of narratives (that is, the enhancement of visual imagination in the listener) helps individuals in their decision-making.

As mentioned previously, the emotive attributes of narratives affect the feelings and emotions of receivers (Shiller, 2017).

Kathiravan et al. (2021) developed the conceptual framework in Figure 1, below. It outlines the connection that feelings and emotions have to cognitive analysis and decision-making.

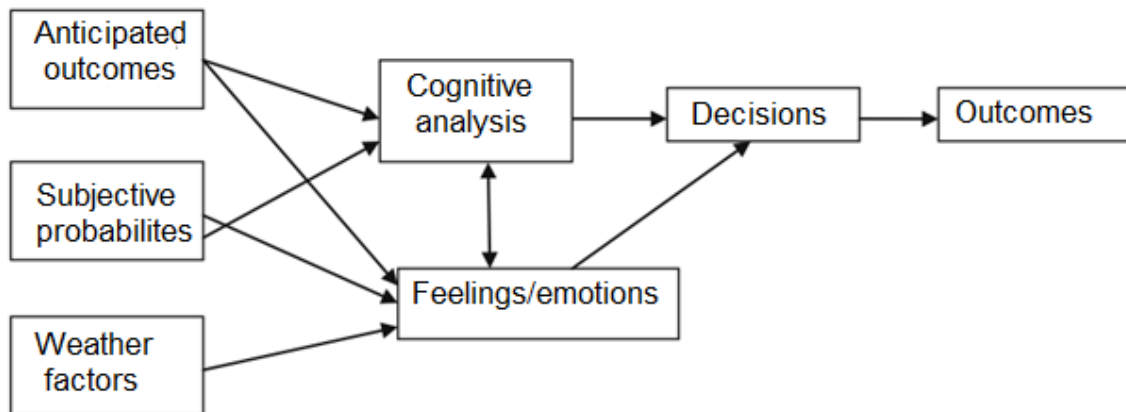


Fig. Conceptual frame for investors' decisions making process. Source: (Kathiravan, C., Selvam, M., Venkateswar, S. & Balakrishnan, S., 2021)

Figure 1: Conceptual framework for investors' decision-making process

Research indicates that individuals prefer narratives that originate from trusted networks to relying on analytical information that they unearth through their own observations (Collier, 2016). Narratives form part of people's belief systems and help them to remain steadfast in their behavioural changes (Johnson & Tuckett, 2021).

### 2.8.1 Radical Uncertainty and the Role of Narratives

Tuckett and Nikolic (2017, p. 502) define radical uncertainty as

equivocal situations in which uncertainty about the outcomes of actions is so profound that it is both difficult to set up the problem structure to choose between alternatives and impossible to represent the future in terms of a knowable and exhaustive list of outcomes to which to attach probabilities.

The authors explain that investment decisions are made during times of radical uncertainty and that narratives and emotions allow decision-makers to deliberate and make choices. They categorise "approach" and "avoidance" as key emotions entailed in narratives, which affect the decision-making process. Researchers have shown that market participants

make decisions in an environment of radical uncertainty and that they are influenced by the narratives they are exposed to (Frydman, Mangee, & Stillwagon, 2020).

### **2.8.2 Radical Uncertainty and Monetary Policy**

Researchers argue that when the perspective of radical uncertainty is not incorporated into macroeconomic theories, the theories are not able to inform the public about the emergence of grave economic threats, such as the GFC. Johnson and Tuckett (2021) demonstrate that in an environment of radical uncertainty, narratives can be used to develop predictions about the future, which motivate the actions of the market participants. According to Johnson and Tuckett (2021), it is important for central banks to provide the market with a narrative when the environment is uncertain, as this arms the market with the conviction to respond favourably to monetary policies.

## **2.9 The Function of the Central Bank**

The central bank plays a central role in the economy of a country (Lustenberger & Rossi, 2020). All the business activities in a country are governed by the laws and procedures that have been set up by governmental institutions, working in collaboration with the central bank (Cobbett, 2010). This bank also issues the legal tenders that are necessary for commerce activities to take place. In addition, it acts as the lender of last resort for private banks as well as the government, and it executes monetary policy to regulate the flow of the currency within a market.

Gertler and Hofmann (2018) used data from 46 countries to analyse the effects of monetary policies adopted by the central banks. In their research, they reveal that the link between credit growth and financial crises has strengthened post–World War II, while the link between money growth and inflation has weakened. They also demonstrate that an increase in money supply is linked to inflation, particularly in high-inflation environments that are less liberalised.

### **2.9.1 Background of the SARB**

The SARB was established on the 30<sup>th</sup> of June 1921. The management of finances in South Africa, which also related to lucrative precious metals, was a sensitive subject in national discourse prior to the country becoming a democracy in 1994 (Cobbett, 2010). There were a number of competing demands on the economy for greater national control, and there was a requirement for integration with global markets in order to achieve more growth.

The 1989 banking laws, which were introduced before the transition to a majority rule democratic system, affirmed intent towards liberalisation of the national economy as well as independence of the SARB in the post-democracy era. Subsection 224 (2) of the Constitution of the Republic of South Africa states that “the South African Reserve Bank, in pursuit of its primary object, must perform its functions independently and without fear, favour or prejudice...” (Republic of South Africa, 1996, p. 115).

### **2.9.2 The Function of Interest Rates**

Central banks lend money to private banks using interest rates (a percentage of the loan amount) as leverage to control the money supply in a market (Tang, 2019). A country’s monetary policy has a direct effect on credit growth within a country; in addition, central banks raise interest rates to push credit levels to manageable levels within the economy (Gertler & Hofmann, 2018).

Any change in the monetary policy has a ripple effect throughout the economy, as the appetite for borrowing money changes in the economic actors, ultimately impacting the economy as a whole (Bruna & Tran, 2020). The level of inflation tolerance may be different between countries, but low and stable inflation levels are components of monetary policy in most countries (Kim & Mehrotra, 2017).

The Constitution of the Republic of South Africa requires the SARB to protect the value of the country’s currency. “The primary object of the South African Reserve Bank is to protect the value of the currency in the interest of balanced and sustainable economic growth in the Republic” (RSA, 1996, p. 224).



## **2.10 The Central Banks' Objective of Creating Financial Stability**

Central banks are tasked with maintaining economic stability. Historically, the function of central banks was related to ensuring price stability, but since the GFC of 2008, policy makers are more concerned with financial stability (Dybowski & Kempa, 2020).

In the South African context, the Financial Sector Regulation Act 9 of 2017 (FSR Act) has mandated the SARB with protecting and enhancing financial stability in the country. The regulation requires the SARB to partner with other stakeholders to ensure stability in the financial system.

In terms of overseas economies, Dybowski and Kempa (2020) note that a dual approach is adopted by the European Central Bank (ECB) in maintaining both price and financial stability. In his research, Jeanneau (2014) notes that 82% of global central banks are mandated to ensure financial stability. Central banks need to strike a delicate balance between maintaining low inflation levels and keeping the credit growth in an economy under control, in order to maintain stability (Kim & Mehrotra, 2017).

## **2.11 Asset Bubbles and Financial Stability**

The GFC resulted in significant macroeconomic costs for the economies of the world, and it crippled the growth rates within many countries (Shirakawa, 2013). Central banks lower interest rates to counter downward slides of the economy (Yan, 2019). Researchers have shown that low interest rates lead to the appearance of asset bubbles in an economy (Dybowski & Kempa, 2020). Utilisation of increased money supply is initially concentrated in selected asset classes, spurring the prices of these assets, and creating asset bubbles. Asset bubbles are further fuelled by speculations in the market until the market reaches an unsustainable level and bursts.

Late entrants to the bubble cycle invariably witness a destruction of wealth that ultimately affects financial institutions, including private banks, which are generally the debtors of the money. Central banks must take a proactive role in ensuring financial stability (Evgenidis & Malliaris, 2020). This role should support growth while dealing with any destabilising asset bubbles that may emerge in the system (Evgenidis & Malliaris, 2020).

## **2.12 Central Bank Communication and How this Relates to Financial Stability**

Communication is currently a key tool in the strategy that central banks use to improve the effectiveness of their monetary policies (Tang, 2019). The way in which these banks communicate with other participants in the economy has evolved over the years. In the past, they were secretive about changes in monetary policy and attempted to use surprise changes in policy to maximise their desired outcomes (Makrychoriti & Pasiouras, 2021).

In the aftermath of the GFC, central banks played a leading role in restoring the health of the global economy. The crisis resulted in increased scrutiny of the actions of financial institutions. Because of this, central banks developed a renewed sense of urgency to communicate their monetary policy decisions as well as their understanding of future economic developments (Tomuleasa, 2015). An improved understanding on the part of market participants results in better decision-making and assists in the growth and stability of the economy as a whole (Eusepi & Preston, 2010).

Participants' future expectations about the economy are important for central bank policy makers. Researchers have determined that forecast information in the market improves with consistent communication by the central banks (Dräger, Lamla, & Pfajfar, 2016).

Theorists have expanded on the macroeconomic theories, noting that an integral part of implementing monetary policies is managing expectations through communication. The central bank's narrative provides a preview of the future for market participants, who form their expectations based on this (Bennani, Fanta, Gertler, & Horvath, 2020).

Stabilisation of market expectations is one of the ways in which central banks manage inflation and prevent destabilising fluctuations (Eusepi & Preston, 2010). According to Blinder (1998, pp. 70 – 72), "by making itself more predictable to the markets, the central bank makes market reactions to monetary policy more predictable to itself. And that makes it possible to do a better job of managing the economy".

Central banks are required to craft a narrative that will tame animal spirits, which Keynes (1936) describes as the reason behind irrational decisions by actors in the economy (Aggarwal, 2014). The narrative also persuades the actors to behave in ways that are

more suited to the sustainable growth of the economy (Aggarwal, 2014). In their research, Dräger, Lamla and Pfajfar (2016) found that increased transparency on the part of the central bank can improve the effectiveness of monetary policy, as it increases the credibility of the central bank (Lustenberger & Rossi, 2020).

### **2.13 Using Narratives in Forward-Looking Communications**

Central banks provide forward guidance on interest rates to guide the market through their communications instead of expecting the market to rely solely on interest rate changes (Farka & Fleissig, 2012). Forward guidance offers a narrative around future interest rates, based on inflation, gross domestic product (GDP) growth and similar parameters. The forward guidance provides the central banks with additional leverage to shape stable future expectations in the market.

Central banks also have an objective to control inflation. They are required to communicate their understanding of the economy and provide a preview of future circumstances in order to protect the market from shocks (Kim & Mehrotra, 2017).

### **2.14 The Socio-Economic Environment and the Narrative of Central Banks**

Central banks do not exist in isolation from the social and political environments in which they are based. Businesses have become more global in nature, and economies around the world are more interlinked than ever. Central banks work with the government of a country to align the economy with international standards. Every country has its own distinct political and social characteristics, which also affect the way in which economic reforms are implemented. Central banks should be mindful of these nuances in their communications and develop narratives that explain the rationale behind the monetary policies being implemented.

There is consensus in the literature that a successful monetary policy cannot be achieved solely through movement of monetary levers, like interest rates, but that they should also be augmented with communication that conveys future stability. Sound communication enhances transparency, which, in turn, improves the effectiveness of monetary policy,

underpins central bank accountability in a democratic society and bolsters the credibility of the central bank.

## **2.15 Sentiment in Narratives**

Sentiments are subjectively evoked, measurable emotional states. They motivate action and create expectations about the future. Narratives have an emotional underpinning, which instils feelings through the story that is being narrated. In addition, they have an emotional meaning for the listener, which helps him/her to perceive the effect of their intended action.

The sentiment in a narrative also provides information about what changes it will create in the emotional state of the receiver. Shiller (2019) argues that the emotional value that a receiver assigns to a narrative greatly improves the narrative's effectiveness in creating a desired response.

## **2.16 Sentiment in the Central Bank Narrative**

The narrative of textual forms of communication, such as central bank statements, consist of content and sentiment (Nyman et al., 2021). Shiller (2019) argues that changes in sentiment can drive market events.

Ardia, Bluteau and Boudt (2019) use big data methods and sentiment analysis techniques to demonstrate significant improvements in financial forecasting. The sentiment measurement of a central bank narrative provides a way for the bank to gauge the accuracy of its perception of the economy.

Research indicates that the sentiments present in central bank statements can provide a sense of future changes. Bennani et al. (2020) note that a narrative sentiment that is overconfident about the economy may result in an increase in interest rates.

## **2.17 Sentiment Analysis Techniques**

"Sentiment analysis" refers to the methods used to investigate semantic orientation in a text. Semantic orientation in a text is defined as the subjectivity and orientation in a text towards a topic (Taboada, Brooke, & Voll, 2011). The sentiment orientation is described

as having an evaluation factor (positive or negative) and a degree of strength assigned to it (Taboada et al., 2011).

Sentiment analysis has been used to take advantage of the digitisation of almost every type of data source, offering immense resources for problem-solving in different domains by creating a better understanding of underlying sentiments that may otherwise be overlooked (Rojratanavijit, Vichitthamaros, & Phongsuphap, 2018). Sentiment analysis is applied in domains such as economics, sociology and management (Philander & Zhong, 2016). Automated methods of sentiment analysis, using natural language processing techniques (NLP) and machine learning, have gained popularity among researchers due to their applicability in different domains (Fernández-Gavilanes et al., 2016).

### **2.17.1 Types of Sentiment Analysis Techniques**

Sentiment analysis techniques are categorised into supervised and lexicon-based approaches (Saif, He, Fernandez, & Alani, 2016). The supervised approaches use machine learning. This encompasses training the model, using data with known classifications of polarity and strength, and then using the model to assign sentiment to real-world data. The supervised methods for sentiment analysis have been found to perform better in domain-specific applications but lack in domain transferability (Ghiassi & Lee, 2018).

The lexicon-based methods, also known as “unsupervised methods”, employ dictionaries with pre-assigned sentiment levels to assign scores to words that appear in a text (Saif et al., 2016). The overall sentiment is determined in this way (Saif et al., 2016). The dictionary methods have been found to be transferable to multiple domains but offer less accuracy compared to the supervised methods (Gentzkow, Kelly, & Taddy, 2019).

## **2.18 Sentiment Analysis of Central Bank Communication**

Sentiment analysis techniques provide a mapping of sentiment according to a numerical index, which is useful for applying further statistical tests. The statistical analysis can be used to study the effects of sentiment on a range of phenomena. Over the years, more researchers have deployed sentiment analysis techniques to central bank statements to study their effects on the economy.

Tadle (2021) has applied dictionary methods to analyse sentiment in the Federal Open Market Committee (FOMC) meeting minutes and has analysed its effects on the financial markets. The researcher selected financial instruments from multiple global equity markets and foreign exchange rates between major currencies to gauge market reactions to the release of the FOMC meeting minutes. The log returns of each financial instrument are calculated to normalise the data being studied. The data are then analysed further, using standard deviation measures, to check for market volatility when the FOMC minutes are released. This research demonstrates, through the presence of market volatility, that sentiment in FOMC minutes is important to the market participants.

Cross-correlation between the minutes sentiment and monetary policy rates also revealed a strong correlation between hawkish sentiment and interest rate increases. According to the research, hawkish sentiment in the FOMC minutes precedes interest rate increases by more than a year. This highlights the necessity of market participants understanding sentiment in the FOMC minutes in order to forecast future policy rates more effectively.

Bennani (2020) used sentiment in the coverage of the Fed chair's communication by the media as a proxy to gauge the level of confidence and optimism expressed by the Fed. His research analyses the effect of the Fed's confidence in investor sentiment, measured through a composite sentiment index, which was derived by Baker and Wurgler (2006). The results show that a confident Fed is positively and significantly associated with investor sentiment.

Mangee (2017a) used *Bloomberg News's* end-of-the-day stock market report as a proxy for measuring stock market sentiment. This methodology takes into account psychological factors that may affect stock market pricing. The so-called "bubble model" for forecasting returns focuses on factors such as crowd psychology, psychological biases and momentum trading.

In Mangee's research, a manual method has been used to analyse textual data and derive a net psychological index (NPI) for the report being analysed. The research suggests that psychological considerations, such as fear and confidence, are related to the fundamental factors (such as interest rate changes and inflation statistics).

Mangee (2018) investigated the relationship between market sentiment and stock returns using a context-free classification dictionary, the *Harvard IV-4* psychosocial dictionary, and the context-aware classification dictionary, the *Loughran-McDonald Master Dictionary* (LM). The context is important, as it helps market participants to understand the factors behind current prices and how they could change in the future.

In the LM dictionary, sentiment has been assigned to words, taking into consideration the meaning of the words in a financial context. This research has demonstrated that there is a significant inverse relationship between pessimism in market sentiment and stock price returns.

## **2.19 Equity Markets and Central Bank Narrative**

Equity markets are sensitive to macroeconomic news about the state of the economy in which they operate (Mangee, 2014). Changes in market sentiment are reflected in share prices.

The beliefs of economic actors in the market may be influenced by the prevailing narratives, including narratives that have gone viral (Bennani, 2020; Shiller, 2017). Yellen (2013) notes that narrative building is the most important factor in a central bank's ability to placate the markets during periods of economic hardship. In addition, Bennani (2020) demonstrates that central bank communication has a strong relationship with changes in equity market asset prices through the effect that it has on market sentiment.

## **2.20 The Role of Central Bank Sentiment in Share Price Changes**

The rational expectations hypothesis (REH) suggests that individuals base their decisions on their human rationality, the information available to them and their past experiences. According to the REH model of share price returns, only the participant's knowledge of the fundamentals can assist in estimating future share prices (Hoover & Young, 2013). However, Frydman et al. (2020) demonstrate that market sentiment has a significant effect on share price returns.

According to Mangee (2017), sentiment can be used to analyse share price fluctuations in the equity market. Central banks play an important role in shaping the narrative about the economy and the sentiment around it in the market. Research shows that during times of economic turmoil, the nature of sentiment adopted by central banks can increase or reduce equity market volatility (Gower, Meier, & Shutes, 2019; Tadle, 2021).

## **2.21 Central Bank Communication and Property**

The 2007 – 2008 GFC was sparked by the housing crisis in the United States. The property sector has proven susceptible to boom and bust cycles. For these reasons, central banks are mindful of trends in the property sector (Vayid, 2013).

Central bank communication plays a role in providing stability to the equity markets, including the property sector (Eusepi & Preston, 2010). The property sector's relationship with the central bank is accentuated by various influences that monetary policy decision has on property sector prices.

Central banks around the world have adopted forward-looking communications as a means of alluding to future interest rate changes (Frydman et al., 2020). The sale and rental prices of properties are directly linked to interest rate levels (Yan, 2019). The property sector is also impacted by the general outlook of the economy. The demand for housing and property in an economy is related to macroeconomic factors (Ligocká et al., 2016).

The central bank's communication, which takes the form of formal statements, presents the bank's estimation of the health of the economy, which affects market sentiment. This applies to the property sector, too.

## **2.22 Real Estate Investment Trusts in the Property Sector**

REITs are part of equity markets. They are the companies that own, operate or finance income-generating real estate (Bredin, O'Reilly, & Stevenson, 2011). These entities provide an opportunity for investors to earn dividends from estate investments without having to buy physical property assets. The financialisation of the property sector creates



opportunities for foreign investment as well as more liberalisation in the market (Wimschulte, 2008).

The REIT sector was introduced to South Africa in 2009, to increase the competitiveness of the property sector by amending the restrictive regulations that applied to the real-estate vehicles that were listed at the time (Kola & Kodongo, 2017). In the South African market, investment in REIT shares has been incentivised through exemption from capital gain tax.

In general, macroeconomic conditions have been shown to affect the pricing of REIT shares, although variances have been noted between different markets (Liow et al., 2006). The listed REIT companies also provide a measure of the commercial and residential development activities taking place in an economy.

Research indicates that changes in monetary policies significantly affect the returns of listed REIT companies (Kola & Kodongo, 2017; Laopodis, 2009). Market participants try to make sense of future policy changes using the statements by the MPC. Bennani et al. (2020) demonstrate that the sentiment level in a central bank's narrative can be linked to the perceived performance of the economy by the central bank and may precede interest rate changes. The sentiment in the MPC narrative can influence changes in the share prices of REIT companies, as it reflects the level of the SARB's confidence in the economy, which may influence future policy decisions.

In the past, the South African REIT sector performed in a manner that was countercyclical to macroeconomic conditions. Researchers have noted that there is a need for empirical research to develop a better understanding of the effects of macroeconomic variables on South African REIT companies (Cohen & Burinskas, 2020). As mentioned previously, the real estate sector is susceptible to boom and bust cycles. It is important to understand the effectiveness of the SARB's communication in managing investor sentiment in the South African REIT sector, as it is significant for the overall health of the economy.

## Chapter 3: Research Hypotheses

### 3.1 Introduction to the Research Hypotheses

The aim of the research hypotheses is to establish whether there is a correlation between the direction and size of the SARB narrative sentiment and changes in the share prices of selected JSE-listed REIT companies. In addition, the study aims to establish if there is a precedence between the direction and size of the narrative and the changes in the share prices. Finally, the research tests the effects of including information about interest rate changes in the SARB MPC narrative on the correlation and precedence with changes in the share prices of the selected companies.

In order to capture the changes in share prices, the CSPs of the chosen companies one day **after** the release of the MPC statement (d+1) will be compared with the CSPs of the same companies one day **before** the release of the statement (d-1). The MPC statement is released at 3 PM. The researcher will calculate the changes in share prices over two days. This will ensure a more comprehensive assessment of the immediate market reaction than if the researcher were only to account for price changes on the day that the MPC statement is released. The Spearman's rank correlation test (SCT), Pearson's correlation test (PCT) and the Granger causality test (GCT) will be employed to analyse the validity of the hypotheses.

### 3.2 Hypothesis 1

H0: The null hypothesis states that there is an insignificant correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

H1: The alternative hypothesis states that there is a significant correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

### **3.3 Hypothesis 2**

H0: The null hypothesis states that there is an insignificant correlation between the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

H1: The null hypothesis states that there is a significant correlation between the narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

### **3.4 Hypothesis 3**

H0: The null hypothesis states that there is no Granger causality between the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

H1: The null hypothesis states that there is a Granger causality between the MPC narrative sentiment and changes in CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

### **3.5 Hypothesis 4**

H0: The null hypothesis states that there is no Granger causality between the MPC narrative sentiment when the narrative includes information about interest rate changes, and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

H1: The null hypothesis states that there is a Granger causality between the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

## **Chapter 4: Choice of Methodology**

### **4.1 Introduction to the Choice of Methodology**

A quantitative methodology was employed in the research, to determine whether there was a correlation and Granger causality between the SARB MPC narrative sentiment and changes in the share prices of the selected JSE-listed REIT entities. Shiller (2017) stresses the importance of quantitative analysis in understanding the effects of narratives on the economics systems. Quantitative methods rely on large amounts of data, which are used to analyse trends and thereby predict changes in economic systems (Emerson, Kennedy, O'Shea , & O'Brien, 2019).

A secondary research method was used to obtain relevant information from authentic sources, thus facilitating an understanding of the relationship between the variables in the study. The researcher noted that a secondary research process has been used in studies of a similar nature. He aimed to use a significant amount of secondary data to test the research hypotheses. The datasets that were collected through the secondary research process were used in statistical analysis to determine the existence and strength of the correlation and Granger causality between the chosen constructs.

In addition to the above, a deductive research approach was used to test the theories that were being investigated and to present specific findings for a broader review of the topic in question(Casula et al., 2021). This means that each hypothesis was tested using appropriately selected analysis techniques and that the findings were synthesised. It was important for the researcher to link the goal of the research with the methodology to ensure that only purposeful research was carried out (Zyphur & Pierides, 2017). Statistical methods were applied during the analysis phase to establish the correlation and Granger causality between the sentiment in the MPC narrative and changes in the REIT share prices.

The purpose of the research is to be explanatory. Benitez, Henseler, Castillo and Schuberth (2020) established the suitability of explanatory research in a number of scenarios in which the correlations between variables were being determined. Explanatory research is used to explain the reason behind a prevailing set of circumstances. This type of research is linked to the hypothesis-testing process in that it uses deductive reasoning to answer the questions posed in the study.

As part of the study, it was necessary to quantify and measure the sentiment in the SARB MPC narrative. Therefore, the research philosophy emphasised the collection of quantifiable observations. When a positivist philosophy is adopted in a study, the researcher relies on quantifiable observations (Kock, Avison, & Malaurent, 2017), as was the case with this research. A positivist philosophy advocates working with an observable reality in the environment under observation and then using the observations to produce generalisations. In addition, a positivist philosophy focuses on facts instead of being influenced by subjective information (Alharahsheh & Pius, 2020).

As mentioned previously, the aim behind this study was to assist researchers in measuring the effects of the SARB sentiment on changes in the share prices of various JSE-listed REIT companies. According to a positivist philosophy, it is possible to observe, quantify and study the interactions between different agents in an environment. A positivist philosophy also tasks the researcher with maintaining an objective viewpoint and viewing the world as external and factual (Kock et al., 2017).

The four research hypotheses of the study were based on a narrative economics theory, which argues that narratives have an important role in the onset of market events (Shiller, 2017). The researcher tested the broad link between the SARB sentiment level and the change in share prices of the REIT entities against the data obtained during the research process.

In addition to the above, it is important to note that a mono method (namely, the collection of secondary data) was used to conduct the research. This was necessary because of the nature of the study – researchers have long used the collection of secondary data to research the effects of communication by the central banks on the financial markets (Ligocká et al., 2016; Tang, 2019).

The data collected for the study were archival in nature. A sizeable dataset was required to ensure a meaningful analysis of the relationship between the variables. An archival form of secondary research is useful when many samples are required to reach a valid inference (Heng, Wagner, Barnes, & Guarana, 2018).

The time horizon for the research was cross-sectional. The researcher studied the selected variables over a defined period of time. A cross-sectional study allows the researcher to observe one independent variable (in this case, the MPC narrative sentiment) and various dependent variables (in this case, changes in the CSPs of selected JSE-listed REIT companies). The time frame for this research was from January 2010 to December 2019. According to Ward and Muller (2010), it can be useful to study variables over a period of time to determine the effects of external factors on changes in stock market share prices.

## **4.2 Population**

The study population constituted the SARB and five JSE-listed REIT companies. The five companies were singled out from those on the JSE REIT index. They are Growthpoint, Redefine, Resilient, Vukile and SA Corporate.

## **4.3 Unit of Analysis**

For the purposes of this research, the first unit of analysis was the SARB's MPC narrative. The second unit of analysis was changes in the share prices of the selected JSE-listed REIT entities, after the release of the MPC report.

## **4.4 Sampling Method and Size**

A convenience sampling method was used in the research. Convenience sampling is a non-probability sampling technique; the researcher selects samples from the population because they are conveniently available to him/her (Andrade, 2021). As part of this research, all the SARB quarterly bulletins from January 2010 to December 2019 were collected. The JSE-listed REIT entities were selected based on their presence in the market during the study period. It was important that they were present during the **entire** study period.

The researcher selected companies that had variances in their market capitalisation. Research indicates that fund size can affect performance (Pillay, Muller, & Ward, 2010). Researchers have also noted that it is important to ensure that the research design is relevant to the sample population (Aguinis, Gottfredson, & Joo, 2013). The selected

entities had different levels of market capitalisation, which helped to foster a clearer understanding of the effects of the SARB sentiment level on the target population.

The companies in the sample population were assigned codes for ease of referencing in the document. They were categorised as follows, based on their market capitalisation:

High: Growthpoint (H1), Redefine (H2)

Medium: Resilient (M1), Vukile (M2)

Low: SA Corporate (L1)

## **4.5 Measurement Instrument Used**

The research measured the level of the SARB sentiment and analysed its effects with regard to changes in the share prices of the chosen REIT entities. The independent variable in the research was the measurement of sentiment in the SARB narrative.

Dictionary based sentiment analysis techniques have been widely employed by researchers to understand sentiment in central bank communications (Born, Ehrmann, & Ehrmann, 2014; Tuckett, 2020). Loughran and McDonald (2011) developed a finance-specific dictionary, referred to as the LM dictionary. This context-aware dictionary has proven to analyse sentiment better than general English-based dictionary methods. Frydman et al. (2020) used the LM dictionary when measuring the sentiment of financial reports in order to forecast share price returns. Appendix 1 provides a glossary of words used in the study, as classified by Loughran and McDonald (2011). This was obtained from <https://sraf.nd.edu/textual-analysis/resources>.

The researcher relied on the Python programming language to implement a script that automates the sentiment-gathering process using the LM dictionary (Chopra, England, & Alaudeen, 2019). Scripts are sequences of instructions that are incorporated into a programming language to automate tasks (Van Vliet, 2020). The textual analysis used RE, which is a text manipulation programming library developed for the Python language (Chopra et al., 2019). The programming library has pre-defined codes for particular programming languages, which can be used to increase the pace of software development.

For the purposes of the research, each MPC statement was analysed separately using the script that was developed for sentiment analysis. The script uses the FindAll method, from the RE library, to retrieve all of the words contained in the MPC statements (Chopra et al., 2019). The method is defined as an independent code in programming language that is used to complete a specific task.

The selection of words takes place using regular expressions. Regular expressions are defined as sequences of characters that specify a search pattern (Taboada et al., 2011). The method tokenises the text in the statement into individual words, which are then stored in an array in the order that they appear in the text. An array is a structure in programming language that stores a collection of items, such as words. The words stored in an array can be referenced using the positioning in the array.

The script checked each word from the statement to determine whether it was defined as positive or negative according to the LM dictionary. Loughran & McDonald (2011) argue that the presence of negative words within three words before a positive word changes the meaning of the positive word. The researcher incorporated this principle while assigning a positive or negative score to a word. If a word was determined to be positive, then the three preceding words were checked for words that could cause a negation. The negation word list in the LM dictionary has been augmented with words that exhibit negation signals. This word list was compiled by Liu (2013).

If any of the three preceding words were part of the negation word list, then the polarity of the positive word was inversed and stored in the array of negative words. After processing all of the words in the MPC statement, the number of words stored in the positive and negative arrays were differenced in order to calculate the overall polarity of the statement.

The researcher noted that the statements from the MPC vary in length. Because of the disparity in sentiment scores between the statements, the sum of positive and negative words in each statement were divided by the total number of words in the text. The accumulative score for the MPC statement was calculated using the difference between positively and negatively classified words. The Python script that was used for this analysis can be found in Appendix 1.



The change in interest rate information in the MPC narrative was used as a moderator variable. The MPC statements that include announcements about changes in the interest rate were categorised as such.

The sentiment measurement instrument used in this research assigned the sentiment score on a continuous scale. The sentiment was measured to two decimal places. Changes in the share prices of the selected JSE-listed REIT companies between d+1 and d-1 were measured. The share prices for the following days were extracted relative to the historical releases of the MPC statements: the close-of-day share prices of the selected entities at d-1 (one day before the release of the SARB report) and the close-of-day share prices of the selected entities at d+1 (one day after the release of the SARB report).

#### **4.6 Data-Gathering Process**

The sources of secondary data for the research were the SARB MPC statements and the JSE stock price database. The SARB hosts archives of its MPC statements on its website. These can be accessed at: <https://www.resbank.co.za/en/home/publications>. The statements are published every two months. The researcher downloaded the statements for January 2010 to December 2019. The measured sentiment data was stored in a comma-separated values (CSV) file.

The daily closing share price of the selected companies were retrieved using IRESS Expert, which is available on the GIBS Electronic Database for researchers. The researcher also used the GOOGLFINANCE function in Google Sheets to retrieve and cross-check the data. The share price data was stored in a CSV file for each of the companies referenced in the research.

#### **4.7 Approach to Data Analysis**

The approach to data analysis depends on the type of data collected. The sentiment score assigned to the MPC narrative is continuous in nature. The sentiment analysis technique that was employed in this research was based on the word count strategy. The resultant accumulative sentiment score was represented on a continuous scale.

The purpose of this research was to analyse the effect of the MPC narrative sentiment on the asset market. The approach was to check for correlation and Granger causality between the SARB sentiment and changes in the selected JSE-listed REIT companies' share prices. The research analysed how the share price fluctuated with changes in the sentiment level and how it reacted to announcements about interest rate changes, which were included in the MPC statement.

The nature of the research dataset and the required analysis necessitated the use of the Spearman correlation test (SCT), the Pearson correlation test (PCT) and the Granger causality test (GCT). The PCT measures the statistical relationship, or association, between two continuous variables. More specifically, the method tests for the association between variables by checking the measure of covariance between them. This test was used in the research to determine the magnitude and direction of the relationship. Certain prerequisites must be met before PCTs can be applied to the data. The test can be used when variables are distributed normally, when they are continuous and when there is a linear relationship between them.

The researcher used the Shapiro–Wilk and Kolmogorov–Smirnov tests to check that the data met the condition of normality. The evaluation of linearity between the variables was carried out using scatter plots. The researcher used the PCT to check the correlation between the variables that passed the test – for both normality and linearity.

The variable pairs that did not meet the criteria of the PCT were checked for suitability for the SCT. The SCT helps researchers to establish whether there is a significant relationship between the variables chosen. It also assists in measuring the strength of the relationship.

An SCT does not require a linear relationship between the variables in the research. The SCT checks for the strength and direction of the monotonic relationship between the chosen variables. A relationship between two variables is said to be monotonic when the value of one variable increases as the value of the other variable increases. The SCT compares the rank values of two variables. The strength and direction of correlation between the two variables is assigned a value between -1 and +1.

The GCT can be used to establish precedence between two variables. Researchers have explored the use of GCT in determining precedence between weather factors and stock prices (Kathiravan, Selvam, Venkateswar, & Balakrishnan, 2021). As part of the research, more evidence was sought to explain the nature of the relationship between the chosen constructs using the GCT method applied by Kathiravan et al. (2021). The GCT helped the researcher to examine the link between the sentiment level in the MPC narrative and changes in the share prices of the JSE-listed REIT entities during the study period.

The effect of the moderator variable was gauged using the difference in the relative strength of the relationship measured through statistical tests.

## **4.8 Data Storage**

Data collected during the study were stored as follows: the SARB MPC statement was downloaded in a PDF format, and the sentiment score assigned to each MPC statement was listed in a CSV file. (The CSV file has two columns – one for the MPC release date and one for the assigned sentiment score.) The share price information was stored in a CSV format. All files used in the research were compressed using Microsoft ZIP file software.

## **4.9 Quality Controls**

The aim behind the data-gathering process was to ensure that it was as exhaustive as possible within the available timeframe to ensure that the hypotheses were tested effectively. The purpose of quantitative research is to solve real-world problems (Zyphur & Pierides, 2017).

### **4.9.1 Linearity**

Correlation tests were employed to measure the relationship between the chosen variables. Testing for linearity is one of the requirements of statistical tests, like the PCT.

Pallant (2020) demonstrated the use of scatter plots in determining linearity between independent and dependent variables. A scatter plot representation can be used to identify the nature of the relationship between the variables under study. The shape of the scatter plot shows the strength and direction of the relationship between the variables. The results of the linearity test were used to determine what statistical test was needed to check the correlation.

#### **4.9.2 Normality**

This research utilised statistical tests to check for the normal distribution of data. The sample size in the dataset was 60 for hypotheses 1 and 2. This was assumed to be enough to avoid significant statistical problems (Ghasemi & Zahediasl, 2012). The sample size for hypotheses 3 and 4 was 14, which could have caused statistical issues if the criteria of normality were not met. Statistical tests were applied to the dataset to check for normality in the complete dataset.

Testing for normality is a precondition for tests that check for correlation of variables through parametric testing. According to the central limit theorem (CLT), normality is not a significant problem when the data sample size is greater than 100. In this research, the sample size was smaller than 100; therefore, it was important to check for the normal distribution of data. Two main methods were used to check normality, namely the graphical method and the numerical method.

The research employed two types of tests to check for normality in the data. The numerical tests for normality were the Kolmogorov–Smirnov test and the Shapiro–Wilk test. The Kolmogorov–Smirnov test is suitable for a sample size that is greater than 50, while the Shapiro–Wilk test is appropriate for a sample size that is less than 50.

For hypotheses 1 and 3, the sample size is greater than 50. The Kolmogorov–Smirnov test was therefore used to test normality for this population. For hypotheses 2 and 4, the sample size was less than 50. The Shapiro–Wilk test was therefore used to test normality for this population.

### **4.9.3 Stationarity**

Stationarity is related to how the statistical properties of a variable change when assessing the variable over a period of time. A data series that has even distribution around the mean is known to be stationary. Stationarity is an important consideration when using statistical analysis to study time series data (Bistacchi et al., 2020). The use of non-stationary data can result in unreliable results (Kapetanios, 2009).

An Augmented Dickey-Fuller (ADF) test was used to check for stationarity. The ADF test was carried out using SPSS software. In addition, the differencing method was applied to the time series data to induce stationarity in the dataset. Using logarithms to transform data can help to induce stationarity in the data. The STATSMODEL library in the Python programming language was used to induce stationarity to the time series data (Fandango, 2017).

### **4.9.4 Outliers**

An outlier is an observation in a sample that has a highly unusual value (Clermont & Schaefer, 2019). The existence of outliers in variables can impact the validity of a statistical analysis. The researcher employed a z-test to check for outliers.

## **4.10 Limitations**

Four limitations were identified in the study. Firstly, only the REIT entities were considered in the research. The results are not indicative of the effect that the SARB sentiment level has on the equity markets as a whole. Secondly, the study period was limited to 10 years, namely from the 1<sup>st</sup> of January 2010 to the 31<sup>st</sup> of December 2019. Thirdly, all of the limitations associated with the statistical tools that were used were also applicable to this study. The sentiment analysis is done using the dictionary method. Although the dictionary technique employed is finance domain specific (Loughran & McDonald, 2011) researchers have shown that techniques using machine learning analysis may prove more effective in domain specific sentiment analysis than dictionary-based methods (Kazmaier & van Vuuren, 2020).

## **Chapter 5: Results**

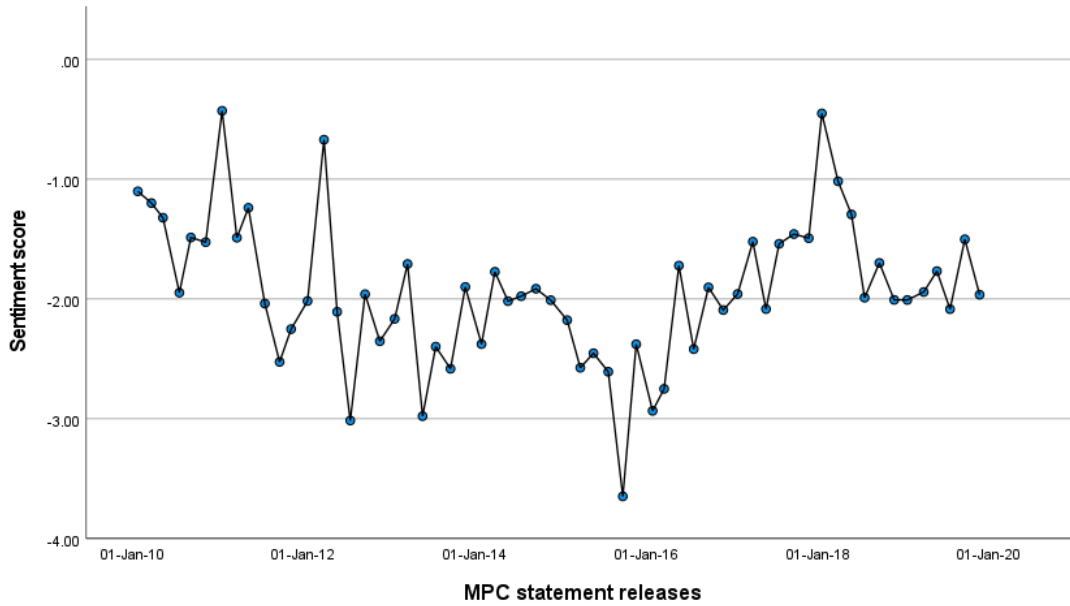
### **5.1 Introduction**

This chapter provides an overview of the results obtained from the study. It includes a graphical representation of changes in each of the company's share prices and the sentiment level, along with statistical data about the relevant population. The chapter also presents the details of the validity tests that were applied to the dataset to ascertain the suitability of the statistical analysis used. In addition, the results of the statistical analysis are presented.

As noted previously, the LM dictionary method was used to measure the MPC narrative sentiment. The moderator variable in the study was the announcement about the change in the interest rate, which was included in the MPC narrative. The hypotheses presented in Chapter 3 addressed the question of correlation and the Granger causality between the chosen variables. The SCT, PCT and GCT were used to address the hypotheses described in the chapter.

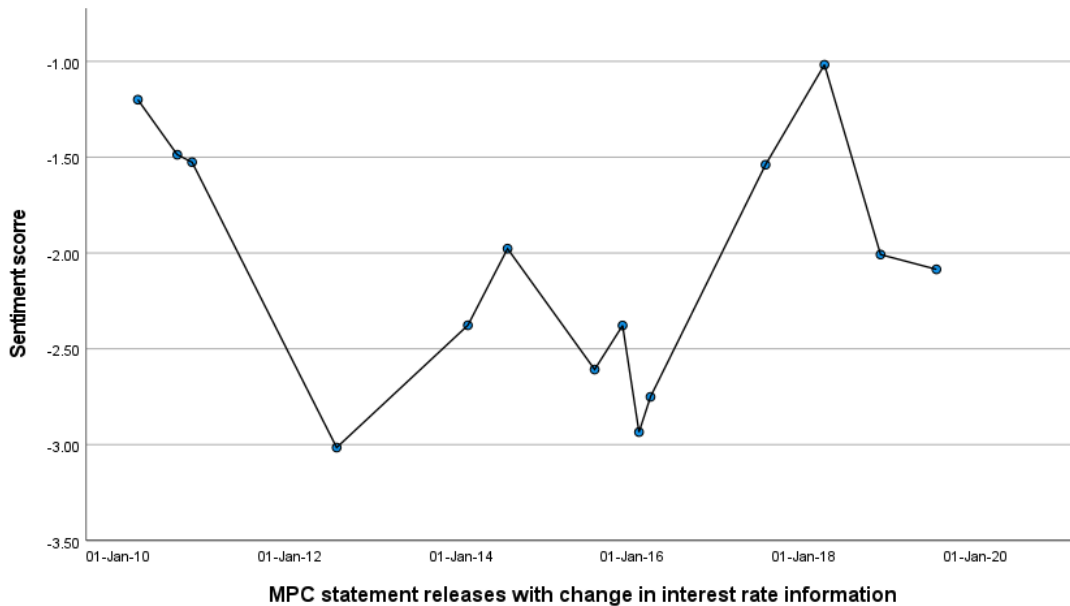
### **5.2 Graphical Representation of the Sample Data**

The scope of the research was limited to the release of MPC statements from January 2010 to December 2019. The SARB releases a report every two months, and there were 60 releases for the study period. As explained in Chapter 3, hypotheses 1 and 3 focus on all of the statements released during the study period. Hypotheses 2 and 4 are concerned with the MPC statements that contain information about interest rate changes. For the latter two, an investigation of 14 data points was required. Figure 2 shows the sentiment score assigned to each of the MPC statement releases during the 2010 – 2019 time period.



**Figure 2: Sentiment score assigned to MPC statement releases for 2010 – 2019 time period**

Figure 3 shows the sentiment score assigned to each of the MPC statement releases that contained information about interest rate changes during the 2010 – 2019 time period.



**Figure 3: Sentiment score assigned to MPC statements containing information about interest rate changes during the 2010 – 2019 time period**

### 5.3 Hypothesis 1

For Hypothesis 1, the researcher sought to determine whether there was a significant correlation between the MPC narrative sentiment and changes in the share prices of the selected JSE-listed REIT companies. The null hypothesis states that there is an insignificant correlation between the direction and size of the MPC narrative and changes in the CSPs of the JSE-listed REIT entities one day after the release of the MPC statement, compared to one day before the release of the statement. The alternative hypothesis states that there is a significant correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the JSE-listed REIT entities one day after the release of the MPC statement, compared to one day before the release of the statement.

#### 5.3.1 Descriptive Statistics

As noted in Chapter 4, the changes in the CSPs of the selected companies were measured between one day after and one day before the release of the MPC statement. Figure 4 is a graphical representation of changes in the CSPs during the study period, relative to the release of the MPC statements for the selected companies.

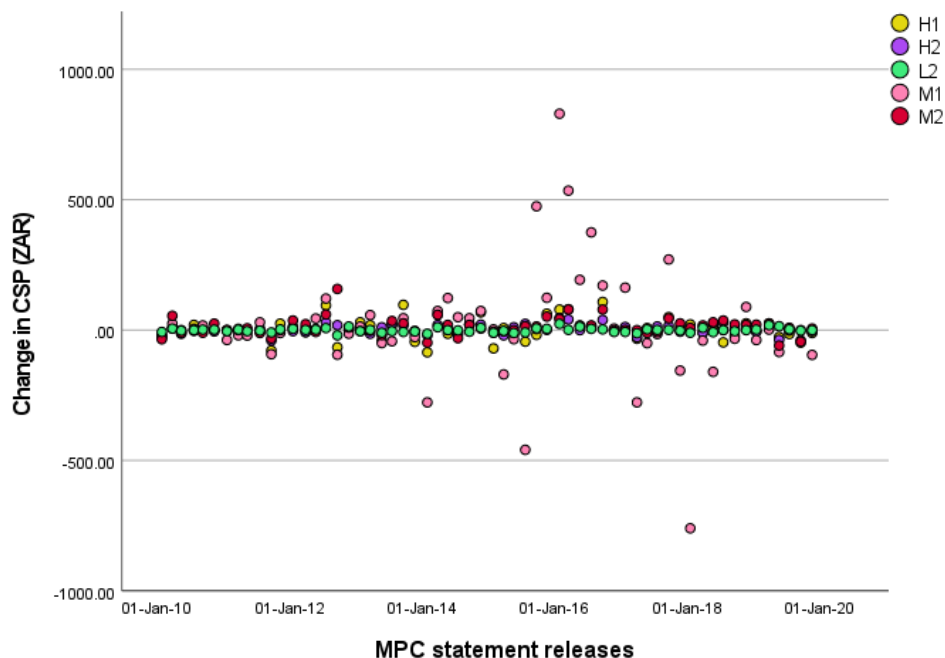


Figure 4: Changes in CSPs between d+1 and d-1



Table 1 shows the descriptive statistics for changes in the CSPs of the selected companies between d+1 and d-1. The standard deviations are presented, along with their minimum, maximum and mean values

**Table 1: Descriptive statistics for the CSP changes (ZAR) for selected companies between d+1 and d-1**

Descriptive Statistics							
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
H1	60	-85.00	108.00	4.27	41.10	.38	.31
H2	60	-40.00	46.00	3.08	16.89	.12	.31
M1	60	-760.00	830.00	14.82	211.75	.40	.31
M2	60	-59.00	158.00	13.02	33.88	1.29	.31
L1	60	-19.92	24.00	-.11	8.06	.47	.31
SENT_SCORE	60	-3.65	-.43	-1.93	.60	.09	.31
Valid N (listwise)	60						

### 5.3.2 Testing for Outliers

The presence of outliers in the variables can have a negative impact on the results of the statistical analysis. The identification of outliers was important, in this case, as the sample size was relatively small. The research employed a z-test to check for the outliers, that is, to check how far the value was from the mean of the data. The z-score was calculated for each of the variables under study. The presence of outliers was deemed to occur when the values were greater than three standard deviations from the mean. Table 2 presents the outliers identified for the variables under study.

**Table 2: Outliers in Hypothesis 1**

Sentiment Score	0
H1	0
H2	3
M1	2
M2	1
L1	0

### 5.3.3 The Kolmogorov–Smirnov Normality Test

In order to select the appropriate correlation tests, it was necessary to check the data for normality. The Kolmogorov–Smirnov test was used to test for normality of the sample distribution, given that the sample size for Hypothesis 1 was greater than 50. This test requires the value of significance (Sig.) to be larger than 0.05, based on the 95% confidence level, for the sample data to be normally distributed.

Table 3 demonstrates the Kolmogorov–Smirnov normality test results for the CSP changes between one day after and one day before the release of the MPC statements during the study period.

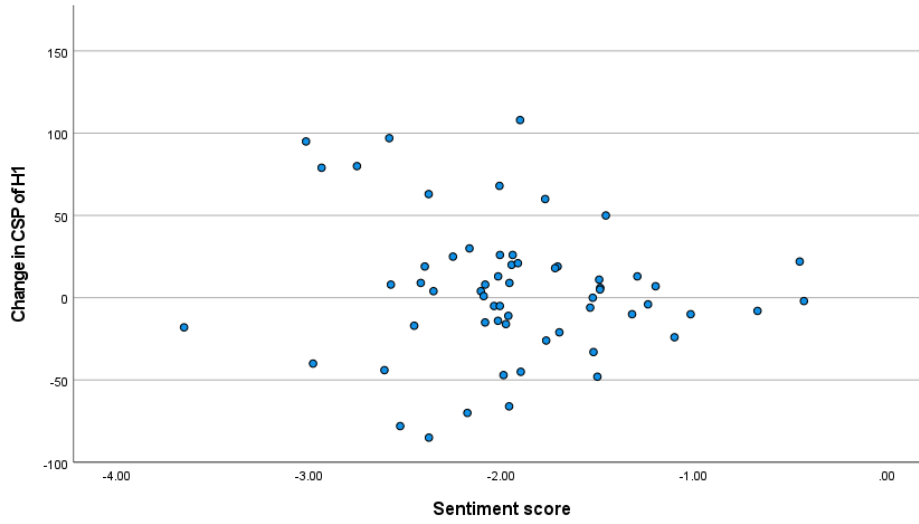
**Table 3: Kolmogorov–Smirnov test results for Hypothesis 1**

	Kolmogorov–Smirnov <sup>a</sup>		
	Statistic	df	Sig.
H1	.132	60	.011
H2	.116	60	.044
M1	.196	60	.000
M2	.134	60	.009
L2	.116	60	.042

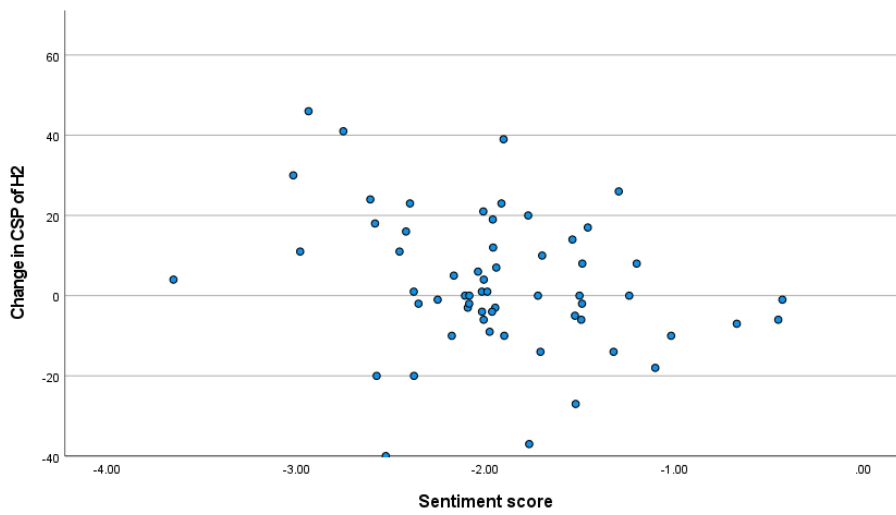
a. Lilliefors Significance Correction

### 5.3.4 Testing for Linearity

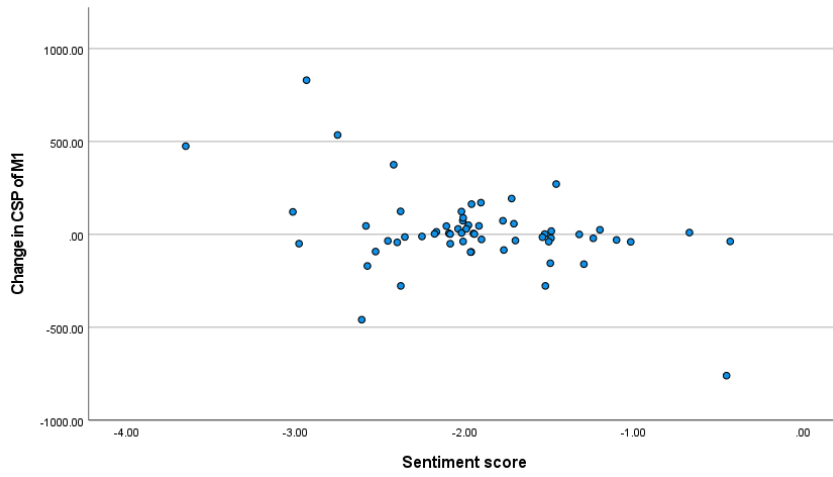
The researcher used a scatter plot to establish the presence of a linear relationship between the independent and dependent variables. Figures 5 – 9 use scatter plots to show the linear relationship between the independent variable sentiment score and the dependent variable changes in the CSPs of the selected companies between d+1 and d-1.



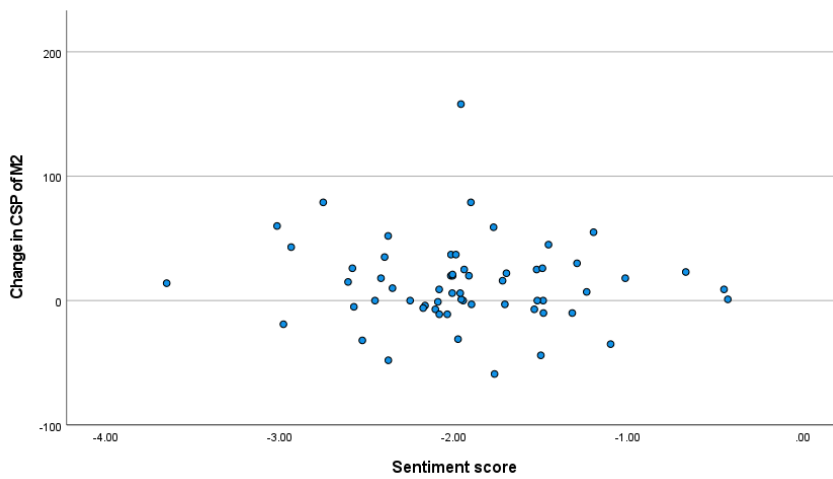
**Figure 5: Scatter plot representation of sentiment score and H1**



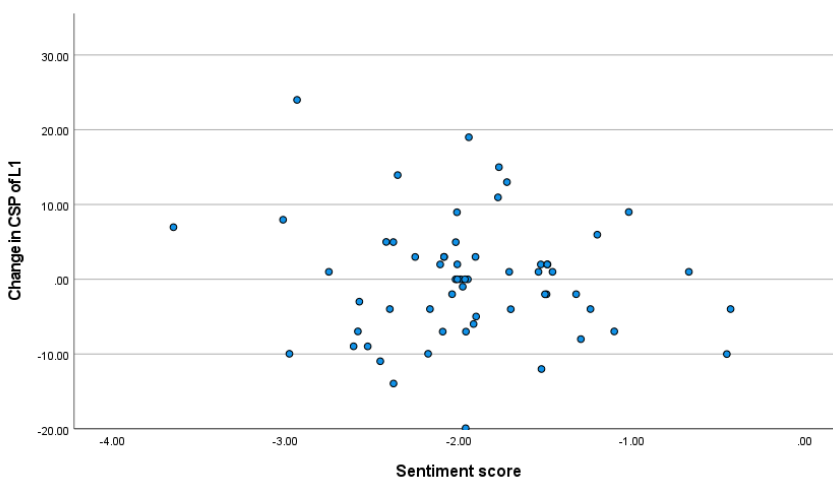
**Figure 6: Linear relationship between sentiment score and H2**



**Figure 7: Linear relationship between sentiment score and M1**



**Figure 8: Linear relationship between sentiment score and M2**



**Figure 9: Linear relationship between sentiment score and L1**

The scatter plots of the data shows that there is no linear relationship between the MPC narrative sentiment score and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

### 5.3.5 The Spearman Correlation Test

Sections 5.5.3 and 5.5.4 show that the sample data for Hypothesis 1 do not meet the criteria for the PCT. The SCT was selected to check the correlation between the variables in Hypothesis 1. The SCT tests for the degree of monotonicity between the variables.

**Table 4: CSP changes between d+1 and d-1**

		Sentiment Score	Rank of H1	Rank of H2	Rank of M1	Rank of M2	Rank of L1
Rank of Sentiment Score	Correlation Coefficient	1.000	-0.071	-.275*	-0.203	-0.020	-0.020
	Sig. (2-tailed)		0.591	0.034	0.120	0.882	0.880
	N	60	60	60	60	60	60

The test results presented in Table 4 show that there is a weak negative correlation between the sentiment score and companies H1, H2, M1, M2 and L1, with a correlation coefficient level that is less than 0. The confidence level for companies H1, M1, M2 and L1 is above 0.05, which is statistically insignificant. The confidence level for L2 is statistically significant at 0.034. The test results reject the alternative hypothesis that there is a strong correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1.

## 5.4 Hypothesis 2

Hypothesis 2 was concerned with determining whether there is a significant correlation between the MPC narrative sentiment when information was presented about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1. The null hypothesis states that there is an insignificant correlation between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the JSE-listed REIT entities one day after the release of the MPC statement, compared to one day before the release of the statement. The alternative hypothesis states that there is a significant

correlation between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the JSE-listed REIT entities one day after the release of the MPC statement, compared to the one day before the release of the statement.

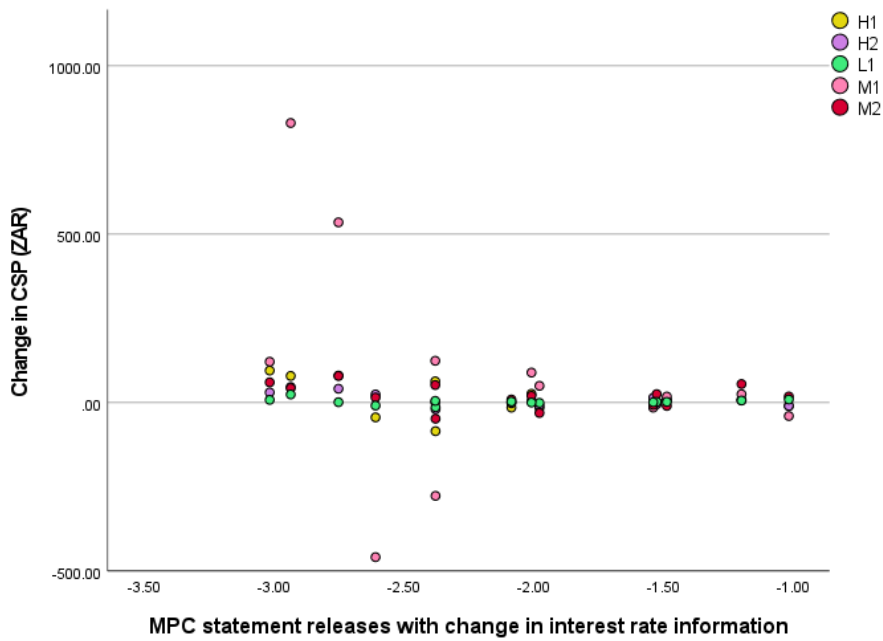
#### 5.4.1 Descriptive Statistics

As mentioned in Chapter 4, the changes in the CSPs of the selected companies were measured between one day after and one day before the release of the MPC statements that contained information about changes in the interest rates. Table 5 shows the descriptive statistics for changes in the CSPs of the selected companies between d+1 and d-1, with “d” being the day on which the MPC statement was released (with information about interest rate changes) during the 2010 – 2019 time period. The standard deviation is presented, along with their minimum, maximum, mean and skewness values.

**Table 5: Descriptive statistics for population that received information about interest rates changes**

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness	
						Statistic	Std. Error
Sentiment Score	14	-3.02	-1.02	-2.06	.64	.08	.60
H1	14	-85.00	95.00	12.86	51.04	.06	.60
H2	14	-20.00	46.00	9.29	19.64	.59	.60
M1	14	-459.00	830.00	71.74	308.06	1.05	.60
M2	14	-48.00	79.00	20.00	36.04	-.26	.60
L1	14	-13.94	24.00	2.64	8.67	.55	.60
Valid N (listwise)	14						

Figure 10 is a graphical representation of changes in the CSPs between the days of interest for the selected companies during the 2010 – 2019 time period.



**Figure 10: Changes in CSPs between d+1 and d-1**

#### 5.4.2 Testing for Outliers

The presence of outliers in the variables can have a negative impact on the results of the statistical analysis. The identification of outliers was important, in this case, as the sample size was relatively small. This research employed a z-test to check for the outliers, that is, to check how far the value was from the mean of the data. The z-score was calculated for each of the variables under study. The existence of outliers was deemed to occur when the values were greater than three standard deviations from the mean. Table 6 presents the outliers identified for the variables under study.

**Table 6: Outliers identified for the population that received information about interest rates changes**

Sentiment Score	0
H1	0
H2	0
M1	0
M2	0
L1	0

### 5.4.3 The Shapiro–Wilk Normality Test

The application of the SCT requires the variables to be normally distributed. The Shapiro–Wilk test was used to test for normality of the sample distribution. This test requires the value of significance (Sig.) to be larger than 0.05, based on a 95% confidence level, in order for the sample data to be normally distributed. Table 7 presents the Shapiro–Wilk normality test results for the CSP changes between one day after and one day before the release of the MPC statements that contained information about interest rate changes during the study period.

**Table 7: Shapiro–Wilk test results**

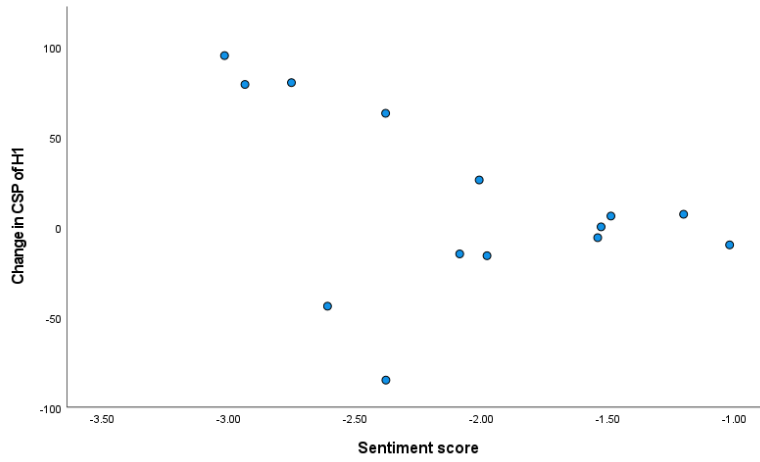
	Shapiro–Wilk		
	Statistic	df	Sig.
H1	.942	14	.449
H2	.949	14	.538
M1	.853	14	.024
M2	.978	14	.959
L1	.908	14	.149

The results showed that the datasets met the criteria of significance for the Shapiro–Wilk test. The null hypothesis for the Shapiro–Wilk test, namely that the dataset is normally distributed, was accepted. The test showed that parametric tests can be applied to measure correlation between the data.

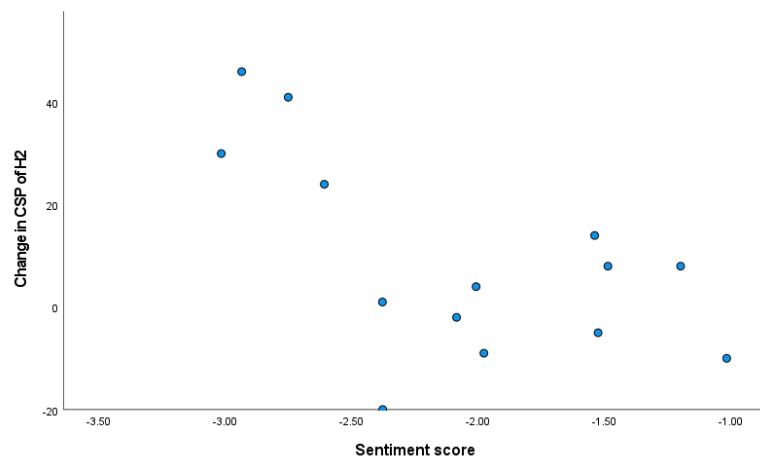
### 5.4.4 Testing for Linearity

Figures 11 – 15 use scatter plots to show the linear relationship between the independent variable sentiment score, when information about interest rate changes was presented, with the dependent variable of changes in the CSPs of the selected companies between d+1 and d-1.

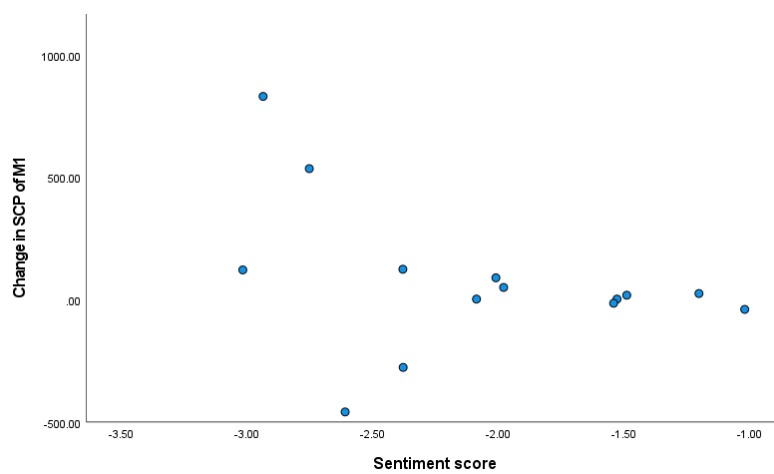




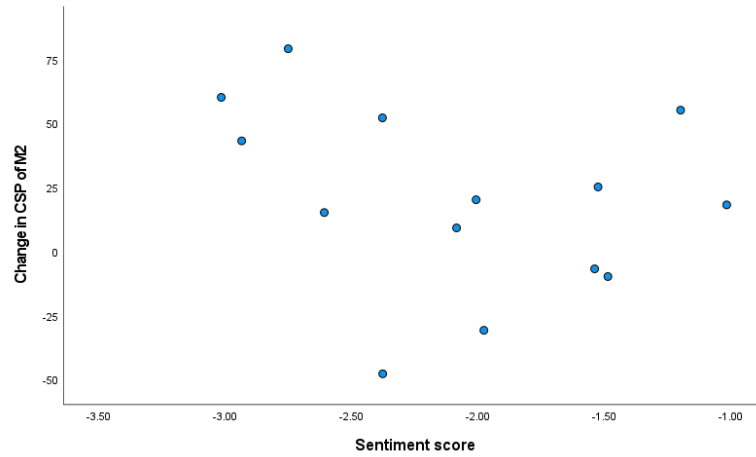
**Figure 11: Linear relationship between sentiment score and H1**



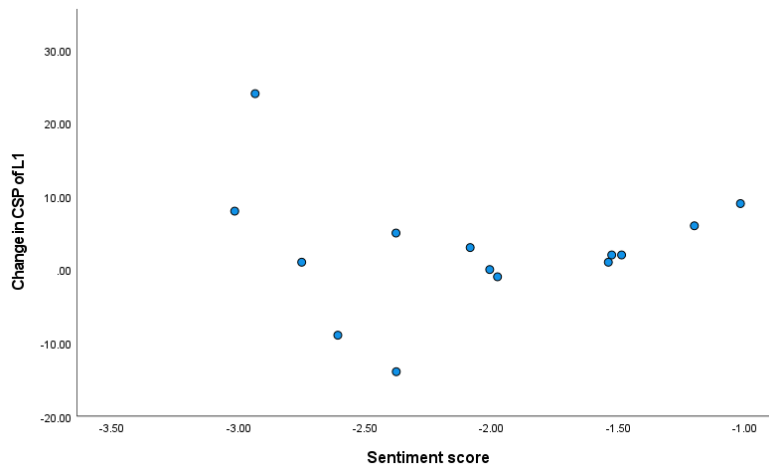
**Figure 12: Linear relationship between sentiment score and H2**



**Figure 13: Linear relationship between sentiment score and M1**



**Figure 14: Linear relationship between sentiment score and M2**



**Figure 15: Linear relationship between sentiment score and M2**

### 5.4.5 Pearson Correlation Test

As Section 5.1 shows, the following SS and H1, H2, M2 and L1 variable pairs passed the normality test and were suitable for parametric correlation testing. As noted in Section 4.7, the PCT is suitable when there is a linear relationship between the variables. Tables 8 – 10 show the results of a PCT between variables that met both of these conditions.

**Table 8: PCT between SS and H1**

		SS	H1
SS	Pearson Correlation	1	-.438
	Sig. (2-tailed)		.117
	N	14	14
H1	Pearson Correlation	-.438	1
	Sig. (2-tailed)	.117	
	N	14	14

**Table 9: PCT between SS and H2**

		SS	H2
SS	Pearson Correlation	1	-.600*
	Sig. (2-tailed)		.023
	N	14	14
H2	Pearson Correlation	-.600*	1
	Sig. (2-tailed)	.023	
	N	14	14

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

**Table 10: PCT between SS and M1**

		SS	M1
SS	Pearson Correlation	1	-.355
	Sig. (2-tailed)		.213
	N	14	14
M1	Pearson Correlation	-.355	1
	Sig. (2-tailed)	.213	
	N	14	14

#### 5.4.6 Spearman Correlation Test

As explained in Section 4.7 the variable pairs in the data that did not meet the conditions of linearity were not suitable for the PCT, and the SCT was used to check for correlation in such instances. The SCT tests for the degree of monotonicity between these variables. Table 11 shows the results of an SCT between the MPC narrative sentiment score, based on MPC statements that information about interest rates, and changes in the CSPs of the chosen companies between d+1 and d-1.

**Table 11: Spearman correlation test results**

		Sentiment Score	Rank of M2	Rank of L1
Rank of Sentiment Score	Correlation Coefficient	1.000	-0.358	0.033
	Sig. (2-tailed)		0.208	0.911
	N	14	14	14

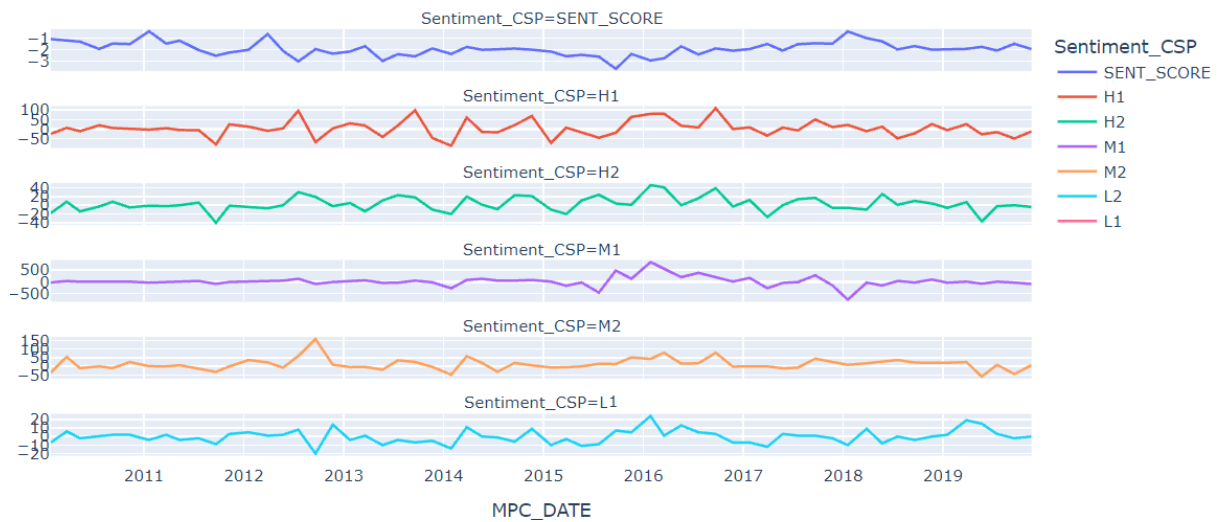
The test results presented in Table 11 show that there was a weak negative correlation between the sentiment score and companies M2 and L1, with an unacceptable confidence level, which was greater than 0.05, signified by the Sig value.

## **5.5 Hypothesis 3**

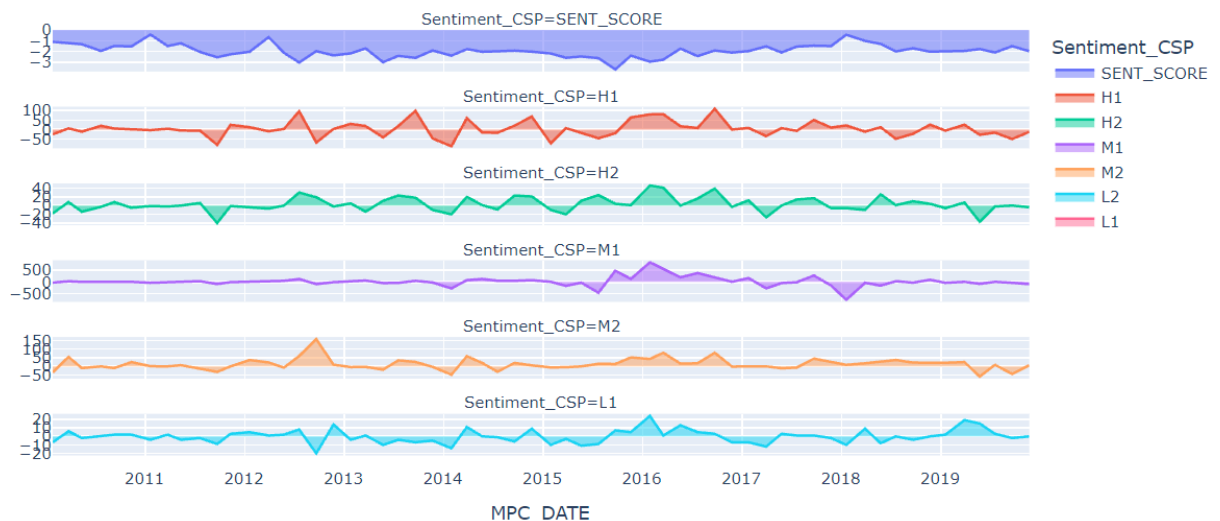
Hypothesis 3 was concerned with determining whether the size and direction of the MPC narrative sentiment Granger-causes changes in the share prices of the selected JSE-listed REIT companies between d+1 and d-1. The null hypothesis states that the direction and size of the MPC narrative does not Granger-cause changes in the CSPs of the JSE-listed REIT companies one day after the release of the statement, compared to one day before the release of the statement. The alternative hypothesis states that the direction and size of the MPC narrative sentiment Granger-causes changes in the closing share prices of the JSE-listed REIT companies between one day after and one day before the release of the MPC statement.

### **5.5.1 Graphical Time Series Representation**

Figures 16 and 17 are a time series representation of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies between one day after and one day before the release of the statement.



**Figure 16: Timeline of changes in MPC narrative sentiment and CSP of companies**



**Figure 17: Timeline of changes in MPC narrative sentiment and CSP of companies**

### 5.5.2 Testing for Stationarity

The researcher analysed time series data while employing the GCT for hypothesis testing. The GCT requires the time series data to be stationary. The test for stationarity was conducted using the ADF test. Table 12 provides a summary of the results. The test shows that the  $p$  values for the variables under study were less than .05 and therefore did not contain a unit root. The test concluded that all of the time series data for variables M1 and M2 were not stationary.

**Table 12: Summary of test for stationarity**

Variable	Trend Detected	$\rho$	<.05	Hypothesis ADF Test	Conclusion
Sentiment Score	No	0.001	TRUE	Reject Ho	Stationary
H1	No	0.002	TRUE	Reject Ho	Stationary
H2	No	0.001	TRUE	Reject Ho	Stationary
M1	No	0.081	FALSE	Reject Ho	Non-Stationary
M2	No	0.987	FALSE	Reject Ho	Non-Stationary
L1	No	0.001	TRUE	Reject Ho	Stationary

### 5.5.3 Applying a Differentiation Method to Achieve Stationarity

Section 5.6.2 explains that the test for stationarity was not passed for all of the time series data used in the GCT. Statistical forecasting assumes that time series data can be rendered approximately stationary through the use of mathematical transformations. Stationarity in time series is a prediction for the GCT.

A differencing method was applied to all of the time series data to achieve stationarity in the dataset. Table 13 outlines the results of the stationarity test after the differencing method was applied to the data.

**Table 13: Summary of test for stationarity after differencing transformation**

Variable	Trend Detected	$\rho$	<.05	Hypothesis ADF Test	Conclusion
Sentiment Score	No	0.00	TRUE	Reject Ho	Stationary
H1	No	0.03	TRUE	Reject Ho	Stationary
H2	No	0.00	TRUE	Reject Ho	Stationary
M1	No	0.00	TRUE	Reject Ho	Stationary
M2	No	0.02	TRUE	Reject Ho	Stationary
L1	No	0.01	TRUE	Reject Ho	Stationary

### 5.5.4 The GCT Results

Table 14 presents the results of the GCT. The test showed that the direction and size of the MPC narrative sentiment did not Granger-cause changes in the CSPs of the selected JSE-listed REIT companies. The significance level required for the test was 0.05, and none of the data points satisfied this condition.

**Table 14: Test results of GCT**

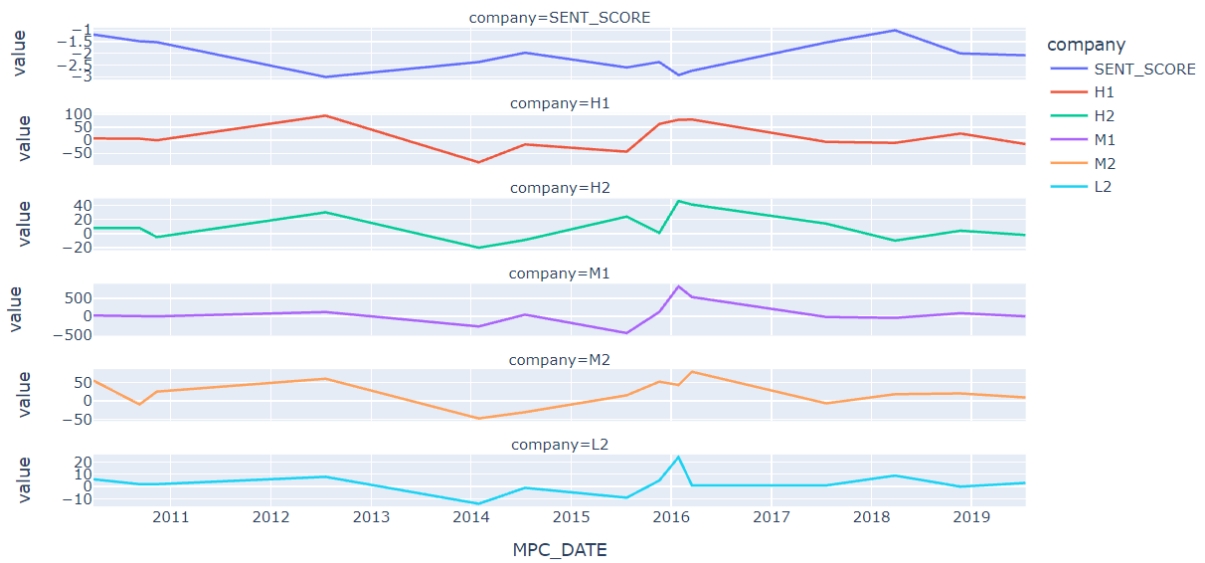
	SENT_SCORE_x	H1_x	H2_x	M1_x	M2_x	L2_x	L1_x
<b>SENT_SCORE_y</b>	1.0000	0.6149	0.7470	0.1374	0.1065	0.1303	0.1306
<b>H1_y</b>	0.1756	1.0000	0.8117	0.4490	0.4731	0.3645	0.0143
<b>H2_y</b>	0.6246	0.0293	1.0000	0.6424	0.0515	0.3284	0.0361
<b>M1_y</b>	0.9082	0.0451	0.4957	1.0000	0.4013	0.0415	0.1675
<b>M2_y</b>	0.3097	0.0077	0.0357	0.1615	1.0000	0.2254	0.8652
<b>L1_y</b>	0.9767	0.3532	0.9422	0.4226	0.2185	1.0000	0.0628

## **5.6 Hypothesis 4**

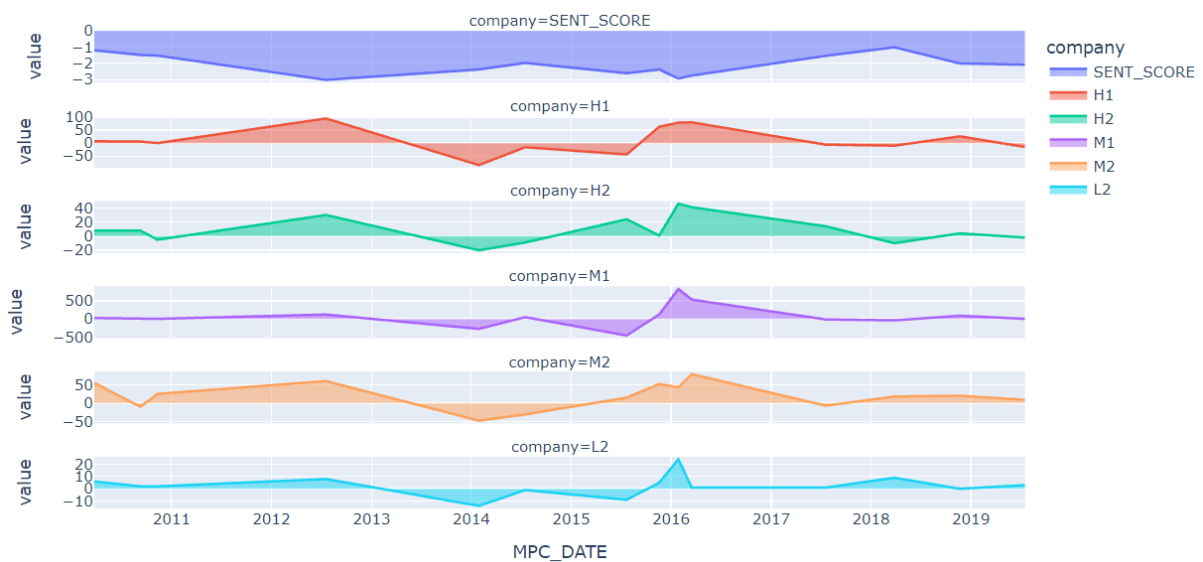
Hypothesis 4 was concerned with determining whether the size and direction of the MPC narrative containing sentiment information Granger-causes changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis states that the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes does not Granger-cause changes in the CSPs of the JSE-listed REIT companies one day after the release of the statement, compared to one day before the release of the statement. The alternative hypothesis states that the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes Granger-causes changes in the CSPs of the JSE-listed REIT companies between one day after and one day before the release of the MPC statement.

### **5.6.1 Graphical Time Series Representation**

Figures 18 and 19 are time series representations of the MPC narrative sentiment for the narrative that contains information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies between one day after and one day before the release of the statement.



**Figure 18: Timeline of changes in MPC narrative sentiment and CSP of companies**



**Figure 19: Timeline of changes in MPC narrative sentiment and CSP of companies**

### 5.6.2 Testing for Stationarity

Time series data were analysed as part of the study, while the GCT was employed for hypothesis testing. The GCT requires the time series data to be stationary. The test for stationarity was conducted using the ADF test. Table 15 presents a summary of the results. The test showed that the  $p$  values for the variables under study were less than .05 and therefore did not contain a unit root. The test concluded that all of the time series data for variables M1 and M2 were not stationary.



**Table 15: Summary of test for stationarity**

Variable	Trend Detected	$p$	<.05	Hypothesis ADF Test	Conclusion
Sentiment Score	No	0.32	FALSE	Reject Ho	Non-Stationary
H1	No	0.11	FALSE	Reject Ho	Non-Stationary
H2	No	0.14	FALSE	Reject Ho	Non-Stationary
M1	No	0.03	TRUE	Reject Ho	Stationary
M2	No	0.41	FALSE	Reject Ho	Non-Stationary
L1	No	0.27	FALSE	Reject Ho	Non-Stationary

### 5.6.3 Applying a Differentiation Method to Achieve Stationarity

In Section 5.7.2, it is noted that, for all of the time series data used in the GCT, the test for stationarity was failed. Statistical forecasting assumes that time series data can be rendered approximately stationary through the use of mathematical transformations. Stationarity in time series data is a condition for prediction in the GCT.

A differencing method was applied to all of the time series data to achieve stationarity in the dataset. Table 16 outlines the results of the stationarity test after applying a differencing method to the data.

**Table 16: Summary of test for stationarity after differencing transformation**

Variable	Trend Detected	$p$	<.05	Hypothesis ADF Test	Conclusion
SS	No	0.03	TRUE	Reject Ho	Stationary
H1	No	0.00	TRUE	Reject Ho	Stationary
H2	No	0.41	TRUE	Reject Ho	Non-Stationary
M1	No	0.01	TRUE	Reject Ho	Stationary
M2	No	0.00	TRUE	Reject Ho	Stationary
L1	No	0.00	TRUE	Reject Ho	Stationary

Table 16 presents the results after the differentiation method was applied. The results show that the timeline for variables SS, H1, M2, M2 and L1 had stationarity. The timeline for variable H2 did not achieve stationarity with the differentiation method that was used.

#### 5.6.4 Applying a Differentiation Method to Achieve Stationarity

Table 17 presents the results of the GCT. The test showed that the direction and size of the MPC narrative sentiment did not Granger-cause changes in the CSPs of the selected JSE-listed REIT companies. As noted in Section 5.7.3, the time series data for H2 did not satisfy the stationarity requirement after the differentiation, and it was excluded from the GCT.

Table 17 shows the results for the GCT, applied to the time series data of all the variables that passed the test of stationarity. The significance level required for the test was 0.05, and none of the data points satisfied this condition.

**Table 17: Test results of GCT**

	<b>SS_x</b>	<b>H1_x</b>	<b>H2_x</b>	<b>M1_x</b>	<b>M2_x</b>	<b>L1_x</b>
<b>SS_y</b>	1	0.2457	0.1124	0.0876	0.1471	0.0638
<b>H1_y</b>	0.6373	1	0.835	0.5001	0.239	0.3196
<b>M1_y</b>	0.4567	0.0054	0.0565	1	0.1746	0.0003
<b>M2_y</b>	0.3574	0.7065	0.7402	0.5718	1	0.1981
<b>L1_y</b>	0.0487	0.6081	0.0096	0.0281	0.4752	1

## **Chapter 6: Discussion of Results**

### **6.1 Introduction to the Discussion of Results**

The objective of the current chapter is to assess the results of the research, outlined in Chapter 5, within the context of the objectives of the research, as set out in Chapter 1. Consideration will be given to the current body of knowledge and how the results can be interpreted in relationship to this.

The chapter starts with a discussion of how the SARB MPC presented its narratives during the study period. Thereafter, the chapter explains the results of the analysis that was carried out to determine the effects of the MPC narrative on changes in the CSPs of the selected JSE-listed REIT sector companies.

### **6.2 The SARB MPC Narrative Sentiment in the Study Period**

The study period is from January 2010. The research focused on the MPC statements to observe the narrative disseminated by the SARB. As indicated in previous chapters, the MPC releases its statements every two months. In this section, a summary of the investigation into these narratives will be presented for each of the years that were studied. The results of the sentiment score assigned to the MPC narrative can be found in Appendix 2.

#### **6.2.1 2010**

In the first year of study, the narrative in the MPC statements was dominated by the effects of the GFC on the global economy as well as the South African economy. The SARB's inflation-targeting monetary policy was central to the SARB narrative, and inflation was explained from different angles. The narrative explained that domestic expenditure was severely strained by unemployment and high personal debt levels. The inflation levels remained low domestically, with electricity and insurance the main contributors to inflation throughout the year. The researcher noted that the January MPC narrative linked uncertainty about electricity price decisions with future expectations that would impact inflation. According to Eusepi and Preston (2010), when managing uncertainty around expectations through communication, it is necessary to explain the factors that are causing the uncertainty and their role in policy making.

The researcher noted that events related to the worsening euro crisis increased the size of the negative sentiment in the MPC narrative for the year in question. In March of 2010, the MPC announced a 0.5% decrease in interest rates, followed by another 0.5% decrease of 0.5% in September and November. Positive sentiment in the narrative increased towards the end of the year, with some measure of satisfaction displayed towards the improved domestic economic performance and meeting of inflation targets, despite the decrease in interest rates.

### **6.2.2 2011**

In 2011, the MPC narratives mentioned an improvement in domestic growth but noted that the economic recovery had not translated into lower unemployment numbers in the country. The narrative explained the continued effects of the European sovereign debt crisis and geopolitical situation, which were hampering economic growth. Domestic inflation remained within the target range.

In the beginning of the year, the narratives reflected confidence due to improvement in economic growth but mentioned that a negative sentiment prevailed in the construction sector. The narratives indicated a depressed demand for housing. It was noted that the inflow of capital, which had increased during the preceding year, had now decreased. The researcher also noted that, in line with the sentiment analysis deployed in the research, the MPC narrative sentiment reflected increased negativity towards the successive statements of 2011.

### **6.2.3 2012**

The researcher noted that the MPC narrative sentiment in 2012 continued to be dominated by negative trends emanating from the local and international environment. The MPC narrative highlighted the inflation dangers faced by the local economy, which were compounded by higher oil prices globally. The MPC sentiment explained that depressed local demand continued to suppress local demands.

The researcher noted that the MPC statement from March mentioned improvements in the domestic and global economic outlook. This was evident in the relatively positive sentiment score that was assigned to the narrative for this month. This relatively positive sentiment was weakened by a negative sentiment, resulting from the successive MPC

statements in May and July. This was evident in the sentiment score assigned by the sentiment analysis.

In addition, the researcher observed that the negative sentiment in the MPC narrative resulted in an announcement that interest rates would be lowered by 0.5% in July. There was a relatively positive sentiment towards the MPC in September, which was reflected in the sentiment score assigned by the sentiment analysis. The MPC narrative in November of 2012 again revealed an increase in negativity, as captured by the sentiment analysis, with widespread labour market instability having a significant impact.

#### **6.2.4 2013**

At the start of the year, the narrative in the MPC statement highlighted ongoing labour problems and uncertainty around global economic recovery. The narrative sentiment in the March statement was buoyed by positive news about recovery of the Asian markets and the improved performance of the mining sector, as reflected in the sentiment score that was assigned during the sentiment analysis.

During the rest of the year, the MPC narrative sentiment was affected by a weakening currency and a volatile global environment. The researcher noted that, from July, the MPC narrative addressed the effects of the forward guidance policy of the Federal Reserve (FED) of the United States, causing capital outflows from the emerging markets. This, in turn, weakened the rand and caused upward pressure on inflation. This coincides with the information in the Literature Review section of this research, which highlights how forward guidance in the central banks' narratives change market expectations (Johnson & Tuckett, 2021).

The manufacturing sector's difficulties with labour and increased inflationary pressure, due to high oil prices, continued to produce downward pressure on the MPC narrative sentiment. This was the case throughout the remainder of the year, until the last MPC statement was released in November.

### **6.2.5 2014**

In 2014, the MPC narrative explained the effects of reduction when the FED eased monetary policy on emerging markets and, in particular, when the rand weakened. The narrative linked the weakening currency with the rise in inflation and implemented an increase in the interest rate in its January statement, which was in line with its inflation targeting policy. (The MPC announced an interest rate increase of 0.5%.)

The narrative sentiment was negatively impacted by the problems in the labour market as well as expected electricity shortages. The researcher noted that sustained negativity in the narrative, due to inflation pressure, resulted in an increase in interest rates in two of the 2014 MPC announcements, namely in January and July. (The MPC announced an interest rate increase of 0.25% in July.)

### **6.2.6 2015**

At the start of 2015, the MPC narrative spoke favourably of the positive effects of low oil prices on inflation. According to the narrative, the rand had been under pressure due to domestic economic performance and outflows of capital from the country.

The local economy was impacted by problems in the platinum mining sector. The narrative in the May MPC statement revealed a negative sentiment because the decrease in global oil prices were reversed. This had a negative effect on inflation. The researcher noted that the MPC narrative in May hinted at an increase in the interest rate, which was implemented in the July MPC statement.

In their research, Bennani et al. (2020) demonstrated that when a central bank's communication contains information about its future monetary policy decisions, this fosters a perception of transparency by the bank. The MPC narrative noted the rising pressure of inflation in the economy, and it raised the interest rate by 0.25% in July. Using the LM dictionary method, the researcher noted a marked increase in negative sentiment in September, which was caused by news of contraction in the local economy and depreciation of the rand. The pressure on inflation caused by the weakening rand resulted in a 0.25% interest rate increase in the November MPC statement.

### **6.2.7 2016**

The MPC narrative sentiment that was measured in January of 2016 was mostly negative due to news of the weakening currency. The narrative was also influenced by inflation in food prices as a result of drought.

The MPC raised the interest rate by 50% in January. In March, the MPC narrative sentiment was still dominated by negative news about inflation, which resulted in an announcement of a 25% interest rate increase. The MPC narrative sentiment measured in the statements released during the rest of year showed a relative reduction in negative sentiment, compared to the sentiment present in the January and March statements.

### **6.2.8 2017**

In 2017, the MPC narrative sentiment reflected more positivity than in the preceding year. The January and March statements mentioned improvements in inflation statistics. The narrative in March hinted at a possible reduction in the interest rate, mentioning a possible end to the contractionary monetary policy.

In July, the MPC narrative implemented a 0.25% reduction in the interest rate. The researcher noted that the narrative sentiment, measured using the LM method, was at higher levels than in 2016, as the inflation statistics were in a more acceptable range than in previous MPC statements.

### **6.2.9 2018**

The MPC narrative in January 2018, measured using the LM method, showed a relatively positive upturn due to the sentiment present in the statement, which reflected a favourable domestic, political, and economic climate. A stronger rand and better global economic conditions were reflected in the positive sentiment.

The improvement in inflation statistics resulted in a 0.25% reduction in the interest rate in the March statement. The researcher noted that the positive narrative sentiment declined, as measured by the LM method, as inflation pressure grew. This growth was indicated in the MPC statements that were released later in the year.

### **6.2.10 2019**

The MPC narrative presented a more stable inflation outlook in the January 2019 statement. The researcher noted that the narrative reflected a negative sentiment in the 2019 statements due to uncertainty in the global economic climate. In addition, there was a slight reduction in negative narrative sentiment in March due to the perception of better economic conditions. This was, again, measured using the LM method.

The MPC reduced the interest rate by 0.25% in May and then again by 0.25% in July. The researcher noted that better statistics on inflation resulted in an increase in positive sentiment towards the SARB narrative for the month of November.

## **6.3 Hypothesis 1**

For Hypothesis 1, it was necessary to evaluate the correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis states that there was no significant correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs.

### **6.3.1 Explanation of Descriptive Statistics**

Table 1 presents the descriptive statistics of the target population for Hypothesis 1. Sixty observations were available, based on the release of the MPC statements and the changes measured in the CSPs of the selected JSE-listed REIT companies between d+1 and d-1. The minimum sentiment score assigned to the MPC statements in this sample was -3.61, and the maximum sentiment score was -.43. None of the assigned sentiment scores were greater than zero or within the positive range, as the LM dictionary method works with a word list that contains more negative words than positive words.

An analysis of the minimum and maximum values for the companies showed that the difference between the two was greatest for M1, followed by M2, H1, H2 and L1. The standard deviation statistic for the variables in the population for Hypothesis 1 showed that the spread of values for changes in the CSPs of the chosen companies was more distributed, compared to the spread of values for the sentiment score assigned to the MPC narrative. The skewness statistics of the data showed that the skewness was significant for M2.



### **6.3.2 Explanation of the Outliers**

Table 2 shows the outliers in the population under study for Hypothesis 1. The results show that outliers occurred for values for companies M1 and M2. The researcher analysed the outliers and determined that they were valid observation points.

The share prices of companies are impacted by information that is available in the market. The researcher noted that one of the outliers for company M1, which was measured with reference to the release of the MPC statement on the 28<sup>th</sup> of January 2018, occurred due to a rumour in the market, which was spread via social media. The researcher was able to find the CEO's statement, which explained the abnormal fluctuation in share prices. He did not note any additional outside information impacting the appearance of the rest of the outliers for companies M1 and M2, apart from the information in the released MPC statements.

### **6.3.3 Results for Tests of Normality**

The skewness of the data and outlier results necessitated further investigation, to check for the normal distribution of data. It was necessary to ascertain the degree of normal distribution of data in order to determine the measures of central tendency and the statistical methods for data analysis.

The Kolmogorov–Smirnov test was appropriate for the population in Hypothesis 1. The test is suitable for use where the sample size is greater than 50. The results of the Kolmogorov–Smirnov test, outlined in Table 3, showed that the data was normally distributed for values of companies H1, H2 and L1, with a significance value greater than 0.05. The test results for the values of companies M1 and M2 did not show a significance value greater than 0.05 and were thus not normally distributed.

### **6.3.4 Results of the Tests for Linearity**

Hypothesis 1 utilises the statistical tests to measure correlation between the independent and dependent variables. Figures 4 – 8 present the tests of linearity that use scatter plots.

The output in figures 4 – 8 show the relationship between the sentiment score of the MPC statements and changes in the CSPs of companies H1, H2, M1, M2 and L1. According to the graphical representation, there appears to be no linear relationship between the two variables.

In the absence of a clear linear relationship between the variables, the SCT was chosen to check the strength and direction of the correlation between the chosen variables.

### **6.3.5 Results of the SCT**

Table 4 presents the SCT test results for the correlation between the independent variables (that is, the sentiment score assigned to the MPC narratives) and the dependent variables, which are the changes in the CSPs of the selected JSE-listed REIT companies, labelled as H1, H2, M1, M2 and L1. The test results showed that the test was applied to the complete sample size, comprising 60 observations between each of the variable pairs. The test results also showed that the direction of the relationship between the independent and dependent variables was negative in nature. Finally, they showed that as the negative sentiment increased in the MPC narrative, changes in the CSPs of the selected companies increased in a positive direction.

The size of the correlation coefficient, *rho*, shown in Table 4 for each of the pairs of independent variables and the dependent variable, was small, which suggests a significant relationship. The results showed that the relative strength of negative correlation was largest for H2, followed by M1, H2, M2 and L1.

The researcher calculated the percentage of variance between the variables under study. This was achieved by multiplying the correlation coefficient by itself. The results showed that the variance percentage between the sentiment scores assigned to the MPC narrative and H2 was 7.5%, which means that the two variables covaried in 7.5% of the population under study. The percentage of variance between the sentiment scores assigned to the MPC narrative and H1, M1, M2 and L2 were 0.5%, 4.1%, 0.04% and 0.04%, respectively. The results showed that there was no strong correlation between the variables.

Table 4 presents the confidence levels assigned to each pair of independent and dependent variables. The results showed that the only acceptable confidence was between the sentiment score and H2, where the  $p$  value was less than 0.05. The confidence level for the rest of the variable pairs was greater than 0.05, which was not an acceptable level.

The test results showed that there was no significant correlation between the variables. The case involving SS and H2 was the only one in which an acceptable confidence level was present, but even in this case, the correlation was not significant.

### **6.3.6 Conclusion for Hypothesis 1**

The hypothesis was tested by applying statistical measures to the sample population. The null hypothesis for Hypothesis 1 is that there is no significant correlation between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies. The test results from the SCT showed that there was no significant correlation between the variables in the research, and, therefore, the null hypothesis is accepted.

## **6.4 Hypothesis 2**

Hypothesis 2 evaluates the correlation between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis states that there is no significant correlation between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected companies.

### **6.4.1 Explanation of Descriptive Statistics**

Table 5 presents the descriptive statistics of the target population for Hypothesis 2. Fourteen observations are available, based on the release of the MPC statements containing information about interest rate changes and the measurement of changes in the CSPs of the selected JSE-listed REIT companies between  $d+1$  and  $d-1$ . The minimum sentiment score assigned to the MPC statements in this sample was -3.01, and the maximum sentiment score was -1.01.

None of the assigned sentiment scores were in the positive range, as the LM dictionary method works with a word list that contains more negative words than positive words. An analysis of the minimum and maximum values for the companies showed that the difference between the two was greatest for M1, followed by M2, H1, H2 and L1.

The standard deviation statistic for the variables in the population for Hypothesis 2 showed that the spread of values for changes in the CSPs of the companies was more distributed, compared to the spread of values for the sentiment score assigned to the MPC narrative. The skewness statistics of the data showed that the skewness was significant for M2.

#### **6.4.2 Explanation of the Outliers**

Table 6 shows the outliers in the population under study for Hypothesis 2. The results show that there were no outliers in this target population.

#### **6.4.3 Results for the Tests of Normality**

It was important to ascertain the degree of normal distribution of data in order to determine the measures of central tendency and the statistical methods for data analysis. The Shapiro–Wilk test was appropriate for the population in Hypothesis 2. The test is suitable for use where the sample size is less than 50. The results of the Shapiro–Wilk test, outlined in Table 7, showed that the data was normally distributed for values of companies H1, H2, M2 and L1, with a significance value greater than 0.05. The test results for the values of company M1 did not show a significance value greater than 0.05 and were thus not normally distributed.

#### **6.4.4 Results of the Tests for Linearity**

Hypothesis 2 also utilises the PCT to measure the correlation between the independent and dependent variables. The application of this test requires the variables to be in a linear relationship. Figures 10 – 14 outline the tests of linearity that use scatter plots.

The output in Figure 10 shows the relationship between the sentiment score of the MPC statements and changes in the CSP of company H1. The output revealed a negative linear relationship between the sentiment score and changes in the CSP of H1. The researcher

also noted that there were two values that did not follow the general trend. This weakened the trend.

The output in Figure 11 shows the relationship between the sentiment score of the MPC statements and changes in the CSP of company H2. The output revealed a negative linear relationship between the sentiment score and changes in the CSP of H2.

The output in Figure 12 shows the relationship between the sentiment score of the MPC statements and changes in the CSP of company M1. The output revealed a negative linear relationship between the sentiment score and changes in the CSP of M1. The researcher noted that there were values that did not follow the general trend. This weakened the trend.

The output in figures 13 and 14 show the relationship between the sentiment score of the MPC statements and changes in the CSPs of companies M2 and L1. The output revealed that there was not a linear relationship between the sentiment score and changes in the CSPs of M2 and L1.

In the graphical tests that were mentioned previously, the researcher observed that there was not a clear linear relationship between the variables. In the absence of a clear linear relationship between the variables, the SCT was selected to check the strength and direction of the correlation between the chosen variables.

#### **6.4.5 Results of the PCT**

Tables 8 – 10 present the results of the PCT conducted on the variable pairs that passed the prerequisite tests for this analysis. The test results showed that the test was applied to the complete sample size, comprising 14 observations for each of the variable pairs.

Table 9 shows the PCT results between the sentiment score and H1. The test results showed that there was a medium negative correlation, represented by an  $r$  value of  $-.438$ , between the two variables, with a statistically insignificant Sig. value of  $.117$ .

Table 10 shows the PCT results between the sentiment score and H2. The test results showed that there was a medium negative correlation, represented by an  $r$  value of  $-.600$ , between the two variables, with a statistically insignificant Sig. value of  $.023$ .

Table 11 shows the PCT results between SS and M1. The test results showed that there was a medium negative correlation, represented by an  $r$  value of  $-.355$ , between the two variables, with a statistically insignificant Sig. value of  $.213$ .

The PCT results revealed that the direction of the relationship between the independent and dependent variables in Hypothesis 2 was negative in nature. They also revealed that as the negative sentiment increased in the MPC narrative, changes in the CSPs of the selected companies increased in a positive direction. The size of the correlation coefficient,  $r$ , shown in Table 7 for the variable pair SS and H2, showed a strong negative correlation, with a value of  $-.600$ . The strength of the correlation between the other two variable pairs, namely SS-H1 and SS-M1 in Hypothesis 2, which were measured through a PCT, showed a weak negative correlation of  $-0.43$  and  $-0.35$ .

The researcher calculated the percentage of variance between the variables under study. This was achieved by multiplying the Pearson correlation coefficient,  $r$ , by itself. The results showed that the variance percentage between the sentiment score assigned to the MPC narrative and H1 was  $19.1\%$ , which means that the two variables covaried in  $19.1\%$  of the population under study. The percentage of variance between the sentiment score assigned to the MPC narrative and H2 was  $36\%$ , while the percentage of variance between the MPC narrative sentiment and M1 was  $12.25\%$ .

#### **6.4.6 Results of the SCT**

In Section 5.5.3, it was noted that the variable pairs SS-M2 and SS-L1 did not pass the criteria for the PCT, as there was no clear linear relationship between the variables for these cases. The SCT was used to check the correlation between these variables.

The test results showed that the test was applied to the sample size, comprising 14 observations between each of the variable pairs. The results also showed that the direction of the relationship between the independent and dependent variables was negative in nature for the variable pair SS-M2, with a Spearman correlation coefficient  $\rho$

value of -0.358. The *rho* value for the variable pair SS-L1 was 0.033, revealing a slight positive correlation.

Table 9 presents the confidence levels assigned to each pair of independent and dependent variables. The test results were statistically insignificant for the variables under study.

#### **6.4.7 Conclusion for Hypothesis 2**

The hypothesis was tested by applying statistical measures to the sample population. The null hypothesis for Hypothesis 2 states that there is no significant correlation between the direction and size of the MPC narrative sentiment when the sentiment includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies.

The researcher applied a PCT and SCT to determine the correlation between the independent and dependent variables in the research. Section 4.7 explains that the precondition for the PCT is a normal distribution in the variables and the presence of a linear relationship. The variable pairs SS-H1, SS-H2 and SS-M1 passed these preconditions, and the PCT was used to test the correlation between these values. The variable pairs SS-M2 and SS-L1 failed these preconditions, and the SCT was used to test the correlation between these variables.

The test results showed that the alternative hypothesis is accepted for only one variable pair, SS-H2. This hypothesis states that there is a significant correlation between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in CSPs of the selected JSE-listed REIT companies. The rest of the variable pairs under study in Hypothesis 2 did not meet the statistical significance criteria for the correlation tests that were applied.

### **6.5 Hypothesis 3**

Hypothesis 3 evaluates the presence of Granger causality between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis states that the direction and size of the MPC narrative

sentiment Granger-causes changes in the CSPs of the selected companies between d+1 and d-1.

### **6.5.1 Explanation of the Outliers**

Table 7 shows the outliers in the population under study for Hypothesis 3. The results showed that there were outliers for values for companies M1 and M2. The researcher analysed the outliers and deemed them to be valid observation points. The share prices of the companies were impacted by information that was available in the market.

The researcher also noted that one of the outliers for company M1, which was measured with reference to the release of the MPC statement on the 28<sup>th</sup> of January 2018, occurred due to a rumour in the market, which was spread through social media. The researcher was able to find the CEO's statement, which explained the abnormal fluctuation in share prices. He did not note any additional outside information impacting the appearance of the remaining outliers for companies M1 and M2, apart from the information in the released MPC statement.

### **6.5.2 Explanation of Time Series Data**

Figures 15 and 16 are time series representations of the variables under study in Hypothesis 3, in the form of line graphs. The time series for the variable SS represented changes in the MPC narrative sentiment during the study period. Observations of the time series data revealed that the sentiment level fluctuated during the study period.

The visual representation of the timeline graph depicts certain the occasional instance where an increased negative sentiment in the MPC narrative caused an increase in the positive changes in the CSPs of the selected JSE-listed REIT companies. However, the relationship between the variables was not clear and requires further testing.

### **6.5.3 Results of the Tests for Stationarity**

As explained in Section 5.6.2, stationarity is an assumption for statistical testing, which is used for inference and forecasting. The ADF test was used to check for stationarity. The results are presented in Table 12. The results showed that the time series representing the MPC narrative sentiment score, assigned by the LM method, was stationary, along



with the variables for companies H1, H2 and L1. The variables M1 and M2 did not pass the criteria for stationarity according to the ADF test.

#### **6.5.4 Applying Differentiation**

As noted in Section 6.5.3, stationarity is a prerequisite when applying statistical tests for forecasting. Section 6.5.2 shows that the time series data for M1 and M2 did not meet the criteria of stationarity.

Section 5.5.3 shows the application of the differentiation method, which was used to induce stabilisation in the variance of the time series that was not exhibiting stationarity. The differencing method helps to stabilise the mean of the time series by removing changes in the level of the time series and reducing the effects of trends and seasonality. Table 13 presents the results of the differencing method, which was applied to the time series, and shows that stationarity was achieved in all of the variables.

#### **6.5.5 The GCT Results**

The GCT shows the cause and effect between the variables being tested. The GCT test is a probabilistic account of causing, as it evaluates the time series to find patterns of correlation. The GCT shows whether one variable in the time series comes before another variable. Table 14 presents the results of the GCT, which showed that none of the variable pairs in Hypothesis 3 required a significance level of 0.05 for this test.

#### **6.5.6 Conclusion for Hypothesis 3**

The hypothesis was tested by applying statistical measures to the sample population. The null hypothesis for Hypothesis 3 states that there is no Granger causality between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies.

The application of the GCT to the time series data that were available for Hypothesis 3 showed that there was no Granger causality between the direction and size of the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis has been accepted.

## **6.6 Hypothesis 4 Results**

Hypothesis 4 evaluates the presence of Granger causality between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis states that the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes Granger-causes changes in the CSPs of the selected companies between  $d+1$  and  $d-1$ .

### **6.6.1 Explanation of the Outliers**

Table 7 presents the outliers in the population under study for Hypothesis 4. The results showed that there were no outliers in the data for this hypothesis.

### **6.6.2 Explanation of Time Series Data**

Figures 17 and 18 are time series representations of the variables under study in Hypothesis 4, in the form of line graphs. The time series for the variable SS represents changes in the MPC narrative sentiment when the narrative contained information about interest rate changes during the study period.

Observation of the time series revealed that the sentiment level fluctuated during the study period. Visual representation of the timeline graph revealed occasions where an increased negative sentiment in the MPC narrative caused an increase in the positive changes in the CSPs of the selected JSE-listed REIT companies. However, the relationship between the variables was not clear and requires further testing.

### **6.6.3 Results for Tests of Stationarity**

As explained in Section 5.7.2, stationarity is an assumption for statistical testing, which is used for inference and forecasting. The ADF test was used to check for stationarity. The results are presented in Table 15. The results showed that the variable SS, representing the MPC narrative sentiment score assigned by the LM method, was not stationary; nor were the variables for the companies H1, H2, M1 and L1. The variable M1 passed the criteria for stationarity according to the ADF test.

#### **6.6.4 Applying Differentiation**

As explained in Section 6.5.3, stationarity is a prerequisite when applying statistical tests for forecasting. In Section 6.5.2, it is clear that the time series SS, H1, H2, M2 and L1 did not meet the criteria of stationarity.

Section 5.7.3 outlines the application of the differentiation method, which was used to induce stabilisation in the variances of the time series that did not show stationarity. The differencing method helps to stabilise the mean of time series by removing changes in the level of a time series and reducing the effects of trends and seasonality. Table 16 presents the results of the differencing method, applied to the time series, and shows that stationarity was achieved in all of the variables.

#### **6.6.5 The GCT Results**

The GCT shows the cause and effect between the variables being tested. The GCT test is a probabilistic account of causing, as it evaluates the time series to find patterns of correlation. The GCT reveals whether one variable in the time series comes before another variable. Table 17 presents the results of the GCT, which show that none of the variable pairs in Hypothesis 3 required a significance level of 0.05 for this test.

#### **6.6.6 Conclusion for Hypothesis 4**

The hypothesis was tested by applying statistical measures to the sample population. The null hypothesis for Hypothesis 4 states that there is no Granger causality between the direction and size of the MPC narrative sentiment when the narrative includes information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies.

The application of the GCT to the time series data that was available for Hypothesis 4 showed that there was no Granger causality between the direction and size of the MPC narrative sentiment when the narrative included information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies. The null hypothesis has been accepted.

## **Chapter 7: Conclusion**

### **7.1 Principal Findings**

The study explained the effects of the direction and size of the SARB MPC narrative sentiment on changes in the CSPs of various JSE-listed REIT companies between d+1 and d-1. The research hypotheses were aimed at determining the association between the variables using correlation and Granger causality tests. The research methodology factored in the announcements about interest rate changes in the MPC narrative. This was the moderator variable.

The research focused on the MPC narrative sentiment as an independent variable. The researcher studied sentiment analysis techniques that were used in previous studies, which included supervised and unsupervised methods that depend on dictionary based techniques as well as machine-learning-based techniques (Fernández-Gavilanes, Álvarez-López, Juncal-Martínez, Costa-Montenegro, & González-Castaño, 2016; Kalamara, Turrell, Redl, Kapetanios, & Kapadia, 2020). In order to gauge the sentiment in the MPC narratives, the researcher selected the LM dictionary, which is a context-aware dictionary that was developed for the finance domain (Loughran & McDonald, 2011).

The researcher studied all of the MPC statements released from January 2010 to December 2019. The SARB has an inflation targeting mandate, and, for this reason, commentary on the inflation statistics feature prominently in the narratives provided by the MPC.

The MPC narratives that were studied explained the inflation phenomenon in South Africa through the lens of consumer price index (CPI) and using the results of surveys from different stakeholders in the economy, including financial analysts and market participants. The MPC narratives also explained the impact that inflation has on the different sectors of the economy, with a distinct focus on food inflation in the country. The researcher noted that the volume of commentary on inflation in the statements weighed heavily on the overall sentiment towards the narrative.

One of the SARB's functions is to align the national economy with the global economy, considering the importance of international linkages to the economy. The MPC narratives that were studied during the research contained consistent commentary on the global

economic climate and its effects on South Africa's economy. The researcher noted that the movement of capital between developed economies and the South African economy was described by the MPC as a consequence of the global economic situation.

MPC narratives also comment on the credit situation in the economy. The narrative explains the debt levels prevalent in the economy as well as the credit being consumed by the economy. Certain businesses, such as those in the REIT sector, rely on credit availability and consumption. The researcher noted that the MPC commented on house mortgages in its narratives, as part of its commentary on the credit market.

According to the MPC narratives, the health of the economy is of paramount importance to the SARB, which carries out monetary measures to support the South African economy's health. In its narratives, the SARB explained that it supports the economy through its expansionary monetary measures while staying within the ambit of its inflation-control mandate. The researcher noted that the MPC narratives explained interest rate changes against a backdrop of the economy's performance and the prevalent and future (expected) inflation statistics.

The MPC narrative sentiment, which was measured using the LM dictionary method, revealed fluctuations in the sentiment based on economic and inflation conditions. During the study period, events of significance, both locally and internationally, caused variance in the measured sentiment.

Hypothesis 1 analysed the effect of the direction and size of the MPC narrative on changes in the CSPs of certain JSE-listed REIT companies by checking the difference in the CSP one day after the release of the statement compared to one day before the release of the statement. The results showed that there was a weak negative correlation between the sentiment score assigned to the MPC narrative and changes in the CSPs of the companies measured between the selected days.

For all of the companies under study, except one, the statistical significance reported by the tests was not acceptable. The results indicated that the sentiment score assigned to the MPC statements, using the LM dictionary method, did not have a strong correlation with changes in the CSPs of the companies in the period being studied.

Hypothesis 2 analysed the effect of the direction and size of the MPC narrative sentiment when the narrative included information about interest rate changes and changes in the CSPs of the selected JSE-listed REIT companies, by checking the difference in the CSPs one day after the release of the statement compared to one day before the release of the statement. The results showed that there was a negative correlation between the sentiment score and changes in the CSPs of the majority of companies that were studied. The researcher noted that with the presence of the moderator variable, the strength of the negative correlation between the variables increased. The test results showed that for company H2, the correlation coefficient of the test conducted indicated a strong correlation with a statistically significant confidence level. The results also showed that with the presence of the moderator variable in the MPC narrative, the strength of negative correlation increased for one company. This was corroborated by a statistically significant confidence level.

The aim behind Hypothesis 3 was to determine whether there is Granger causality between the MPC narrative sentiment and changes in the CSPs of the selected REIT companies. Hypothesis 4 investigated the presence of Granger causality between the MPC narrative sentiment when the narrative included information about interest rate changes and changes in the CSPs of the selected REIT companies. Through the testing carried out on the hypotheses, the researcher found that there was no evidence of Granger causality between the variables under study for both of the hypotheses.

## **7.2 Implications for Stakeholders**

The SARB MPC and the REIT sector equity market participants were considered the primary stakeholders in the study. The research provided insights into a methodology that can be used to measure the sentiment present in MPC narratives. The MPC could adopt a sentiment analysis technique to evaluate the strength and direction of its sentiment, to scientifically modulate the sentiment that the committee exposes to the market.

In their research, Bennani et al. (2020) explain that central banks have an interest in communicating their future policies to the market. Through his research, Tadle (2021) showed that the sentiment present in central bank statements can influence market expectations. This research explored a method by which the SARB can evaluate the sentiment in its narratives to increase its ability to manage future expectations in the

market. Market participants can also refer to the methodology presented in this research to gauge the sentiment in the MPC narrative, which will assist in fostering future expectations.

The research also explored practical implications for the MPC, to improve the way in which it affects future expectations in the market. The study did not find a strong correlation between the MPC narrative sentiment and changes in the CSPs of the selected JSE-listed REIT sector companies.

### **7.3 Limitations of the Research**

The LM dictionary method was used to measure sentiment in the MPC narrative. The dictionary based method of sentiment analysis lacks the precision that is achieved through machine-learning-based sentiment analysis (Gentzkow et al., 2019). The LM dictionary was developed for the financial context; it was not specifically designed for the analysis of the SARB's MPC statements.

This study was limited to five JSE-listed REIT companies. The results do not represent the behaviour of equity markets, in general, or of other companies in the REIT sector.

The research investigated the changes in the CSPs of the selected companies between one day after the release of the MPC statement and one day before the release of the statement. This period was chosen in order to determine the immediate reaction of the market after the release of the statement. The research does not view the market's reaction over a longer period of time to determine the longer-term effects of the MPC narrative sentiment.

### **7.4 Future Research**

The researcher used a dictionary-based sentiment analysis technique to measure the direction and size of the MPC narrative sentiment. Future research into the SARB MPC narrative could explore the use of machine-learning sentiment analysis techniques to measure the sentiment in MPC narratives. Machine-learning sentiment analysis techniques perform better than dictionary based methods in domain-specific analyses (Kazmaier & van Vuuren, 2020).

This research measured the changes in the CSPs of five REIT sector companies between  $d+1$  and  $d-1$ . In future research, the time period of the analysis could be increased to understand how the equity market responds to the MPC narrative over an increased passage of time.

Shiller (2017) suggests that quantitative research on narratives can be improved by using focus groups and social media. Further research on this topic may increase the scale of data being collected to provide a deeper understanding of the narratives emerging in society.



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# Appendix 1

Python sentiment checking script

```
import re
```

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lm_sent = {'Negative': ['abandon', 'abandoned', 'abandoning', 'abandonment', 'abandonments',  
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vader\_negation =  
["no", "none", "non", "nor", "nothing", "neither", "nobody", "doesn't", "never", "nowhere", "not", "n't", "do  
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"cant", "won't", "wont", "didn't", "didnt", "haven't", "havent", "can't", "shan't", "cannot", "couldn  
't", "couldnt", "needn't",

```
"neednt", "wasn't", "wasnt", "isn't", "shant", "weren't", "werent", "daren't", "darent", "hadn't", "hadnt", "hasn't", "isnt",
```

```
"aren't", "arent", "oughtn't", "oughtnt", "wouldn't", "wouldnt", "hasnt", "mightn't", "mightnt", "mustn't", "mustnt", "shouldn't", "shouldnt"]
```

```
def negated(word):
```

```
    """
```

```
    Determine if preceding word is a negation word
```

```
    """
```

```
    if word.lower() in vader_negation:
```

```
        return True
```

```
    else:
```

```
        return False
```

```
def sentiment_check_double_negation(dict, mpc_statement):
```

```
    c_pos = 0
```

```
    c_neg = 0
```

```
    pos_words = []
```

```
    neg_words = []
```

```
    regexp_res = re.findall(r'\b([a-zA-Z]+n\t|[a-zA-Z]+\s|[a-zA-Z]+)\b', mpc_statement.lower())
```

```
    word_count = len(regexp_res)
```

```
    for i in range(0, word_count):
```

```
        if regexp_res[i] in dict['Negative']:
```

```
            c_neg += 1
```

```
            neg_words.append(regexp_res[i])
```

```
        if regexp_res[i] in dict['Positive']:
```

```
            if i >= 3:
```

```
                if negated(regexp_res[i - 1]) or negated(regexp_res[i - 2]) or negated(regexp_res[i - 3]):
```

```
                    c_neg += 1
```

```
                    neg_words.append(regexp_res[i] + ' (negation check)')
```

```
            else:
```

```
                c_pos += 1
```

```
                pos_words.append(regexp_res[i])
```

```
        elif i == 2:
```

```
            if negated(regexp_res[i - 1]) or negated(regexp_res[i - 2]):
```

```
                c_neg += 1
```

```
        neg_words.append(regex_res[i] + ' (negation check)')
    else:
        c_pos += 1
        pos_words.append(regex_res[i])
    elif i == 1:
        if negated(regex_res[i - 1]):
            c_neg += 1
            neg_words.append(regex_res[i] + ' (negation check)')
        else:
            c_pos += 1
            pos_words.append(regex_res[i])
    elif i == 0:
        c_pos += 1
        pos_words.append(regex_res[i])
```

```
results = [word_count, c_pos, c_neg, pos_words, neg_words]
```

```
return results
```

```
sentiment_check_double_negation(lm_sent, mpc_statement)
```



## Appendix 2

MPC Statement Date	Sentiment Score
26-Jan-10	-1.10
25-Mar-10	-1.20
13-May-10	-1.32
22-Jul-10	-1.95
9-Sep-10	-1.49
11-Nov-10	-1.53
20-Jan-11	-0.43
24-Mar-11	-1.49
12-May-11	-1.24
21-Jul-11	-2.04
22-Sep-11	-2.53
10-Nov-11	-2.25
19-Jan-12	-2.02
29-Mar-12	-0.67
24-May-12	-2.11
19-Jul-12	-3.02
20-Sep-12	-1.96
22-Nov-12	-2.35
24-Jan-13	-2.17
20-Mar-13	-1.71
23-May-13	-2.98
18-Jul-13	-2.40
19-Sep-13	-2.58
21-Nov-13	-1.90
29-Jan-14	-2.38
27-Mar-14	-1.77
22-May-14	-2.02
17-Jul-14	-1.98
18-Sep-14	-1.91
20-Nov-14	-2.01
29-Jan-15	-2.18
26-Mar-15	-2.57
21-May-15	-2.45
23-Jul-15	-2.61
23-Sep-15	-3.65
19-Nov-15	-2.38
28-Jan-16	-2.93
17-Mar-16	-2.75
19-May-16	-1.72
21-Jul-16	-2.42
22-Sep-16	-1.90

24-Nov-16	-2.09
24-Jan-17	-1.96
30-Mar-17	-1.52
25-May-17	-2.08
20-Jul-17	-1.54
21-Sep-17	-1.46
23-Nov-17	-1.49
18-Jan-18	-0.45
28-Mar-18	-1.02
24-May-18	-1.29
19-Jul-18	-1.99
20-Sep-18	-1.70
22-Nov-18	-2.01
17-Jan-19	-2.01
28-Mar-19	-1.94
23-May-19	-1.77
18-Jul-19	-2.08
19-Sep-19	-1.50
21-Nov-19	-1.96