ISSN 2520-6303

Economics, Management and Sustainability

journal home page: https://jems.sciview.net

Mayekiso, M., & Moodley, F. (2026). The effect of investor sentiment on returns of JSE size-based indices under changing market conditions: Evidence from a Markov regime-switching model. *Economics, Management and Sustainability, 11*(1), 116-135. doi:10.14254/jems.2026.11-1.6.

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The effect of investor sentiment on returns of JSE size-based indices under changing market conditions: Evidence from a Markov regime-switching model

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OPEN ACCESS

Article history:
Received: December 07, 2025
1st Revision: March 01, 2026
Accepted: April 10, 2026

JEL classification:
G12
G14
G17
G41

DOI:
10.14254/jems.2026.11-1.6

Abstract: *Purpose*: The continuous unresolved debate that arises between traditional finance and behavioural finance frameworks has dominated empirical literature in recent years. Despite this, the limited literature extends the debate to size-based indices, especially in emerging markets like South Africa that are characterised by alternating market conditions and sentiment-induced markets. Consequently, the objective of this study is to examine the effect of market-wide investor sentiment on the Johannesburg Stock Exchange (JSE) size-based indices' returns at bullish/bearish market conditions. *Methodology*: The Markov regime-switching model for the period April 2007 to March 2025 reveals that market-wide investor sentiment has a regime-specific and time-varying effect on JSE size-based indices' returns. In bullish/bearish market conditions, investor sentiment has a positive significant effect on JSE size-based indices' returns. However, the magnitude of such effects seems too great in bearish market conditions. Similarly, the JSE size-based indices' returns are dominated by the bearish market condition, revealing its non-resilient nature to sentiment-induced markets and market fluctuations. *Theoretical contribution*: The study contributes to resolving the debate in literature that arises from the efficient market hypothesis and behavioural finance frameworks, by demonstrating that JSE size-based indices present adaptive behaviour as supported by the adaptive market hypothesis. *Practical implications*: Investors must factor in changing market conditions and sentiment levels in the market when determining whether to invest in JSE sized-based indices as it will contribute positively or negative to prospect returns. Policymakers must devise new policy reforms that

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curb unstable market conditions and noise trading as it contributes directly to alternating market efficiency.

Keywords: investor sentiment, bullish/bearish market conditions, JSE, size-based indices, Markov

Sustainable Development Goals (SDGs): SDG 8: Decent Work and Economic Growth; **SDG 10:** Reduced Inequalities; **SDG 16:** Peace, Justice and Strong Institutions

1. Introduction

In financial markets, market-wide investor sentiment has become an increasingly important factor influencing asset performance. Emerging markets have seen an influx of investors in recent years due to the diverse asset markets and securities available (Moodley *et al*., 2025). Chang *et al*. (2012) refer to investor sentiment as the collective belief and expectations of market participants about future cashflows and investment risks that are not fully justified by the fundamental theory. Essentially, investor sentiment reflects subjective attitudes that are often shaped by market moods, media narratives, and behavioural biases, rather than being centred around data such as earnings, dividends, or macroeconomic fundamentals. On the Johannesburg Stock Exchange (JSE), shifts in sentiment often drive fluctuations across different size-based indices, reflecting how the JSE fledging index, JSE small-cap index and JSE mid-cap index respond differently to market conditions.

First proposed by Banz (1981), size effect refers to the specific relationship between the size of a company and equity market returns, whose research found that the equity market returns, and risk-adjusted returns of large-cap index returns were largely outperformed by small-cap index returns. Chan *et al. (2013*) found that the impact of investor sentiment on size-based returns varies across different sentiment regimes (bull or bear), showing an imbalance and time-dependent effect in Asian economies. Within this context, the research problem emerges from the interaction between investor sentiment and JSE size-based indices' returns under alternating market conditions. Although the size effect highlights structural differences in returns between the JSE fledgling index, JSE small-cap index and JSE mid-cap index, much less is known about how these categories respond whenever sentiment shifts between bullish and bearish phases.

Considering these notions, many studies have highlighted the role of investor sentiment in shaping market outcomes. Mbanga *et al*. (2018) found that investor sentiment tends to influence equity market returns as investors do not monitor the economic fundamentals, which allows sentiment to drive market movements. Globally, Salur and Ekinci (2023) found that investor sentiment is linked to several market anomalies across Europe, causing returns to change over time. Coherent with this, Thirumala *et al*. (2023) demonstrated the importance of considering investor sentiment in order to understand equity market behaviour and predicting market movements. Similarly, Pham *et al*. (2025) illustrated that investor sentiment plays a significant role in determining equity market outcomes. Although these studies collectively highlight the importance of sentiment in shaping equity market returns, there are gaps that remain untouched.

Accordingly, the majority of studies, both domestically and internationally, limit their analyses to the linear effect of market-wide investor sentiment on size-based indices returns. They fail to consider the nonlinear propositions of the adaptive market hypothesis. These limitations possess serious concerns for investors and policymakers, especially in South Africa, where fluctuating market conditions are persistent. That being said, investors are exposed to added portfolio losses and risk as they are not able to conduct portfolio rebalancing when JSE size-based indices are incorporated in a portfolio. This is due to no direct evidence related to the nonlinear effect between investor sentiment and JSE size-based indices' returns during bullish/bearish market conditions. Moreover, financial stability in the equity market becomes compromised as policymakers are not able to generate resilient policies to mitigate sentiment-induced markets, causing unstable and volatile financial markets. To mitigate these issues, the study examines the effect of market-wide investor sentiment on JSE size-based indices' returns under bullish/bearish market conditions.

The remainder of the paper is outlined as follows: Section 2 provides the literature review, which is isolated to the theoretical foundation and empirical review. Section 3 highlights the methodology in relation to the data and empirical model used. Section 4 presents the empirical results; section 5 provides the discussion of results, whereas section 6 concludes the research paper.

2. Literature review

2.1. Theoretical foundations

The efficient market hypothesis (EM), coined by Fama (1965), posits that all available information regarding an asset is fully reflected in its pricing. Therefore, the use of technical and fundamental analysis in determining mispricing will not generate excess returns. This notion is supported by the rationality consensus of EMH, which argues that when asset prices deviate from their fundamental value (causing mispricing), rational investors will not partake in the mispricing, resulting in asset prices reaching its equilibrium value. This is owing to the fact that all investors are rational, making financial markets efficient. Consequently, EMH refutes the proposition of irrationality, which is fundamental to investor sentiment, suggesting that investor sentiment should have no direct influence JSE size-based indices' returns.

In recent years, the notions of EMH have been challenged by the behavioural finance (BF) theory developed by Kahneman and Tversky (1974). According to BF, investors do not act rationally; rather, they are irrational as they use their cognitive biases to determine future perspectives, where past experiences shape current decisions. To this extent, when mispricing occurs in the financial market, irrational investors will enter the market to take part in the mispricing, causing asset prices to not reach its fundamental value. Therefore, markets are considered to be inefficient, revealing that investor sentiment should have a linear effect on JSE size-based indices. Given the two notions presented by EMH and BF, the empirical debate regarding rationality and inefficiency has plagued literature with no direct reconciliation.

Until recently, Lo (2004) attempted to reconcile both EMH and BF to assist in settling the long-lasting empirical debate by introducing the adaptive market hypothesis (AMH). According to AMH, financial markets comprise rational and irrational investors, causing markets to be efficient or inefficient, in what is known as alternating efficiency. That being said, changing market conditions, such as bull and bear periods, cause financial markets to contain alternating efficiency as market conditions derive irrational investors that cause sentiment-induced trading, resulting in a nonlinear effect. Therefore, investor sentiment will have an alternating effect on JSE size-based indices' returns, where the effect will vary under a bull and bear market condition. Consequently, AMH posits that sentiment does exist, but its influence on JSE size-based returns is not uniform under each market condition but varies making it asymmetrical and regime-dependent.

2.2. Empirical review

2.2.1. Linear effect of investor sentiment in emerging markets

Li (2021) examined the effect of investor sentiment on sovereign bonds using monthly data on local currency and United States dollar (USD) denominated sovereign debt from 30 emerging countries, which covered the period from January 1998 to October 2018. The findings revealed that sentiment has a negative and a linear relationship with future sovereign bond returns across emerging market countries. As investor sentiment increases, emerging market bonds' returns decrease. This is an indication of investor sentiment having a linear relationship with assets. This study aligns with that of Vuong and Suzuki (2022), where they examined the return predictability of investor sentiment in 12 Asian and European markets for the period 2004 to 2016. They employed a composite sentiment index and found a strong negative relationship between investor sentiment and returns. In this study, the beta from the volatility premium was positive and statistically significant. This means that, as investor sentiment increased, the returns also increased in a proportional way.

These studies align with the findings of Henchiri and Mounica (2022), where the aim was to test the relationship between investor sentiment and the profitability of stocks listed on the Moroccan and the Tunisian markets. In this study, there was a positive and significant relationship between investor sentiment and profitability. Furthermore, in a study conducted by Andleeb and Hasssan (2023), the authors' aim was to investigate investor sentiment on returns of selected emerging equity markets in the following settings: Brazil, India, China, Indonesia, and Pakistan over the short- and long-term horizon. A positive link was found between investor sentiment and returns in the short-term, where the linear relationship was identified in China and Pakistan.

2.2.2. Non-linear effect of investor sentiment in emerging markets

Xu and Green (2013) analysed the impact of investor sentiment on stock returns in China, using a benchmark, namely the Fama-French three-factor model and furthermore distinguished between normal and positive sentiment. The study uses monthly data from the Shanghai and Shenzhen stock markets from January 1997 to December 2007. The findings revealed that sentiment affects both the times series and cross-sectional patterns of asset returns. That being said, positive sentiment affects the market differently. Moreover, sentiment appears to be an important factor for smaller companies. Collectively, investor sentiment tends to be a conditional determinant of asset pricing, and this mispricing explains how investor sentiment has a non-linear effect on the Chinese stock market. These findings were further supported by Dash (2016), who found a non-linear effect between investor sentiment and stock-return behaviour in the Indian stock market.

In a similar study, Bouteska *et al. (*2023a) proposed developing a sentiment index to apply to the Korea composite stock price index and examine the significance of sentiment-based factors to explain equity deviations in asset pricing. They furthermore employ the methodology of Huang *et al*. (2015) to estimate the sentiment index and they employ the partial least squares method to overcome the drawbacks of the investor sentiment index by Baker and Wurgler (2006). Their findings indicated that there was a non-linear relationship between investor sentiment and stock returns. There is therefore evidence of a non-linear relationship in emerging markets; it is important, however, to further examine whether similar dynamics are present in developed markets.

2.2.3. Non-linear effect in developed markets

Ma *et al*. (2018) studied investor sentiment and its ability to predict stock returns using a quantile regression approach. The study employs the principal component from Baker and Wurgler (2006:2007), where they constructed an index of investor sentiment that aggregates information from six proxies. The data spans from July 1965 to December 2014. The findings found a non-linear relationship between investor sentiment and stock returns from the US stock market. These findings were further supported by Sakariyahu *et al.* (2023), where they explored the inclusion of sentiment matters as a risk factor in asset pricing. This study analysed volatility in the United Kingdom (UK) stock market and analysed the relationship between investor sentiment and asset pricing. The findings revealed a non-linear relationship between investor sentiment and UK stock returns, even though it spanned from January 1993 to December 2020. In a similar study, by Brady (2025), the relationship between investor sentiment and the S&P500 index was analysed. The study used the Bai and Perron (1998, 2003) method to identify multiple structural breaks in investor sentiment and S&P 500 data using a time series model that incorporates structural breaks. With data spanning from July 1987 to January 2023, the study demonstrated the nonlinear relationship between market returns and investor sentiment. However, the predictive power of sentiment was more consistent in determining volatility than returns were.

While these studies indicate strong evidence of a non-linear sentiment effect in developed markets, research in emerging markets, particularly in Africa, remains non-existent. Limited attention has been given to how investor sentiment affects size-based indices in emerging economies, despite emerging economies being highly sensitive due to lower liquidity and higher volatility. Most studies furthermore employ linear frameworks and traditional proxies of sentiment, neglecting the exploration of more advanced sentiment measures within contexts such as South Africa.

3. Methodology

3.1. Data

The objective of the study is to examine the effect of market-wide investor sentiment on JSE size-based index returns under changing market conditions. To this extent, the study employs monthly data for the period April 2007 to March 2025. The choice of data frequency and sample period is dictated by the availability of the investor sentiment proxies, such that they are only available in monthly frequency and the South African Volatility Index (SAVI) is available from March 2007. Despite this, the sample period is robust as it captures important historical market events such as the 2007/2008 global financial crises and the COIVD-19 pandemic. The dependent variable comprises the JSE fledgling index, JSE small-cap index and the JSE mid-cap index. The selection of the three indices follows studies by Lawrence *et al.* (2024) and Moodley (2025). Similarly, the independent variable comprises the constructed market-wide investor sentiment index of Moodley *et al.* (2024:2025), as presented in Appendix A. The index is augmented for the sample period and is

considered appropriate as it is the most recent market-wide investor sentiment index developed for the South African financial market, which captures recent events. To ensure the robustness of the findings, the study isolates the effect of market-wide investor sentiment by including macroeconomic control variables. The control variables include the inflation rate (CPI), money supply rate (M2), GDP rate and real effective exchange rate (REER). The choice of these variables follows that of Moodley (2022), who found that these variables had a significant effect on South African stock market returns under changing market conditions.

The dependent, independent and control variables were converted to returns and growth rates, respectively. The formula used to convert the JSE size-based indices' closing prices to returns is given by:

$$\mathrm{R_t} = 100 \times \mathrm{In}\left(\frac{RP_t}{RP_{t-1}}\right) \tag{1}$$

$\mathrm{R_t}$ is the JSE size-based returns, RP_t is the current month's JSE size-based index closing price while RP_{t-1} is the previous month's JSE size-based index closing price, *In* is the natural log and t was given to be the time.

Similarly, the augmented market-wide investor sentiment index and macroeconomic variables are given in percentages, which were converted to growth rates to ensure it meets the stationary properties of the empirical model. This was done using the following equation:

$$RG_r = \left(\frac{RM_t - RM_{t-1}}{RM_{t-1}}\right) \times 100 \tag{2}$$

RG_r is the percentage growth rate, RM_t is given to be the current month's macroeconomic/investor sentiment percentage, while RM_{t-1} is the previous month's macroeconomic/investor sentiment percentage and t is given to be the time.

3.2. Empirical model

3.2.1. Markov regime-switching model

To achieve the study's objective, a nonlinear modelling approach capable of distinguishing between bull and bear market phases is required. Accordingly, this study employs the Markov regime-switching model. The choice of this model is motivated by its ability to incorporate regime changes driven by an unobserved state variable that evolves according to a first-order Markov process (Hamilton, 1989). As a result, the model accommodates regime shifts that occur at irregular time intervals, unlike many alternative nonlinear models that rely on exogenous structural changes occurring at fixed periods. The Markov regime-switching model is specified as follows:

$$\Delta \mathrm{I}_t = \mu_{ct} + \alpha_{0ict}\Delta SENT + \varphi_{0ict}\Delta\mathrm{CPI} + \varphi_{1ict}\Delta\mathrm{M2} + \varphi_{2ict}\Delta\mathrm{GDP} + \varphi_{3ict}\Delta\mathrm{REER} + \varepsilon_{c_{t,}} \tag{4}$$

$\Delta \mathrm{I}_t$ is the JSE size-based index returns, and the average returns under each market condition are given by the state-dependent mean μ_{ct}. The model considers two market conditions ($\mathrm{C_t}$,), i.e. bull (1) and bear (2) market conditions. $\Delta SENT$ is the state-dependent explanatory variable (α_{0ict}) that reflects the market-wide investor sentiment index of Moodley (2024:2025). The state dependent control variables (φ_{0-3ict}) include inflation growth rate (ΔCPI), money supply growth rate (ΔM2), GDP growth rate (ΔGDP) and real effective exchange growth rate (ΔREER). ε_{c_t} is the variance associated with state-dependent mean.

Market conditions are assumed to evolve according to a first-order Markov process, governed by a constant transition probability matrix. Consequently, the likelihood of transitioning between bull and bear market regimes is expressed as follows:

$$Prob = \begin{bmatrix} Prob(C_t = 1/C_{t-1} = 1) & Prob(C_t = 2/C_{t-1} = 1) \\ Prob(C_t = 2/C_{t-1} = 2) & Prob(C_t = 1/C_{t-1} = 2) \end{bmatrix} = \begin{bmatrix} Prob_{11} & Prob_{21} \\ Prob_{22} & Prob_{12} \end{bmatrix} \tag{5}$$

Where $Prob_{11}$ is the probability that the JSE size-based index return is in a bullish state and will not move, $Prob_{21}$ is the probability that the returns are in a bullish state and will move to a bearish state. $Prob_{22}$ is the probability that the returns are in a bear regime and will not move, $Prob_{12}$ is the probability that the returns are in a bearish regime and it will move to a bullish state (Brooks, 2019).

4. Empirical results

4.1. Preliminary results

4.1.1. Summary statistics

Table 1 provides a statistical overview of the following variables: the three size-based returns (JSE fledgling index, JSE small-cap index and JSE mid-cap index), investor sentiment (SENT), and macroeconomic control variables (CPI, M2, GDP, REER). The average monthly returns for all the JSE size-based indices are positive, suggesting that all the JSE size-based indices delivered modest gains with 0.28%, 0.45% and 0.47%, respectively. Although the JSE sized-based indices are negatively skewed, the median values are also positive and close to the mean, indicating a consistent performance across distributions. In contrast, the market-wide investor sentiment index mean is closer to zero, suggesting that sentiment averages are neutral over time, with lower dispersions. The inflation growth rate attained a negative average rate of -0.61, indicating that inflation pressures eased more often than they increased. Similarly, the money supply average growth rate was more negative with a value of -3.43, demonstrating limited liquidity in the economy as the circulation of money was restrictive as opposed to expansive. Gross domestic product growth rate attained a positive value of 0.08, which is close to zero, suggesting that the economy was quite stagnant over the sample period. The real effective exchange growth rate also had a positive value of 0,03, which points to a slight strengthening of the rand against trading partners' currencies. In conclusion, inflation was easing, money supply was tightening, economic growth was flat, and the rand gained a little strength on average.

The JSE size-based indices' returns express moderate volatility levels with the JSE fledgling index, JSE small-cap index and JSE mid-cap, attaining values of 3.61%, 4.51% and 4.26%, respectively. Of the three indices, the JSE mid-cap index return attains the highest standard deviation, suggesting that there were greater dispersions from the mean as it attained the highest minimum values and lowest maximum values as compared to other JSE size-based indices' returns. The market-wide investor sentiment index standard deviation figure is 1.89%, which is relatively low compared to the JSE size-based indices' returns. These low figures underscore the stable nature of the index, despite it capturing both positive and negative sentiments in the market, as supported by the positive minimum value and the negative minimum value. Similarly, of the macroeconomic control variables, inflation growth rate and money supply growth rate have the highest volatility, indicating that there are large swings in both variables.

The JSE sized-based indices are negatively skewed, meaning returns are tilted toward losses (left-skewed). This is common in equity market returns, indicating higher downside risk. All variables, besides the market-wide investor sentiment index, express a kurtosis greater than 3, confirming fat tails and a higher likelihood of extreme events. The Jarque-Bera statistics are significant at all levels of significance, which calls for the rejection of the null hypothesis of normally distributed variables. Therefore, the JSE size-based indices' returns, market-wide investor sentiment index and macroeconomic control variables are not normally distributed. Moreover, the Brock-Dechert-Scheinkman (BDS) test statistics are significant for all JSE size-based index returns, indicating nonlinear dependence, justifying the use of non-linear models such as the Markov regime-switching model instead of linear regressions.

Table 1: Descriptive statistics results

	JSE_FLD	JSE_MID_CAP	JSE_SML_CAP	ΔSENT	ΔCPI	ΔM2	ΔGDP	ΔREER
Mean	0.277691	0.446640	0.473785	2.69E-16	-0.611969	-3.433435	0.080697	0.033679
Median	0.313973	0.570318	0.806370	0.366435	0.000000	-1.631831	0.102184	0.297340
Maximum	13.05865	9.535955	14.32507	3.628098	20.00000	717.1429	41.58004	9.863370
Minimum	-16.44495	-27.72292	-24.89995	-3.537230	-88.76923	-720.0000	-48.50107	-11.80298
Std. dev.	3.605136	4.506420	4.262985	1.885334	7.756743	81.66384	5.217634	2.926660
Skewness	-0.860718	-1.507884	-1.293846	-0.116968	-6.800817	-0.479060	-1.045056	-0.332851
Kurtosis	6.859863	9.797126	9.426475	1.781185	79.02924	58.16712	55.86507	4.821476
Jarque-Bera	160.7570	497.6620	431.9615	13.86213	53689.05	27398.96	25191.76	33.84839
Probability	0.000000	0.000000	0.000000	0.000977	0.000000	0.000000	0.000000	0.000000
Observations	216	216	216	216	216	216	216	216
BDS	0.040832***	0.013955***	0.027318***	-	-	-	-	-

Notes: 1. ***, ** and * indicate a 1%, 5% and 10% significance level, respectively; 2. The BDS test is estimated using two dimensions

Source: Authors' own estimation (2025)

4.1.2. Stationarity and unit root tests

In Table 2, the augmented Dickey-Fuller (ADF) unit root test, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test and ADF breakpoint test are presented. The ADF test presents statistically significant values for the JSE size-based index returns, market-wide investor sentiment index and macroeconomic control variables. Therefore, the null hypothesis of a unit root is rejected in favour of the alternative hypothesis that the variables are stationary in levels. These findings are confirmed by the KPSS test as the statistics are less than the critical values, resulting in a failure to reject the null hypothesis of stationarity in levels. The ADF breakpoint test confirms that all variables are stationary in the presence of structural breaks as the test statistic is more negative than the associated critical values at all levels of significance. Accordingly, the null hypothesis of the variables expressing stationarity properties in the presence of structural breaks cannot be rejected. Collectively, the JSE size-based index returns, market-wide investor sentiment index and macroeconomic control variables are stationary in levels and in the presence of structural breaks, which permits the estimation of the Markov regime-switching model.

Table 2: Stationarity and unit root results

	JSE_FLD	JSE_MID_CAP	JSE_SML_CAP	ΔSENT	ΔCPI	ΔM2	ΔGDP	ΔREER
ADF	-9.071051***	-14.45216***	-12.42507***	-15.13202***	-14.52106***	-6.678495***	-13.84899***	-12.76941
KPSS	0.086286	0.078311	0.092156	0.565539	0.186372	0.184845	0.064801	0.038070
ADF-Break	-10.29656***	-17.16286***	-14.92204***	-19.00723***	-23.11700***	-13.30678***	-21.34508***	-13.40658***

Notes: 1. The critical values for the KPSS test is 0.7390, 0.4630 and 0.3470, respectively; 2. *, **, *** indicates a 10%, 5% and 1% significance level, respectively
Source: Authors' own estimation (2025)

4.1.3. Variance inflation factor test

The variance inflation factor (VIF) test results are presented in Table 3. The test is estimated to confirm whether the explanatory and macroeconomic control variables are not collinear. It is evident that the centred VIF figures for the market-wide investor sentiment index and macroeconomic control variables are close to 1, which suggests that there is no colinear relationship between the explanatory and control variables. Consequently, there is no need to omit any of the variables as they meet the properties for the estimation of the Markov regime-switching model.

Table 3: Variance inflation factor results

	Coefficient	Uncentred	Centred
Variable	**Variance**	**VIF**	**VIF**
C	0.059536	1.044073	NA
ΔSENT	0.001306	1.037713	1.006970
ΔCPI	0.000942	1.015133	1.005630
ΔM2	8.24E-06	1.008183	1.006503
ΔGDP	0.002057	1.029551	1.028865
ΔREER	0.006713	1.034921	1.034878

Notes: Authors' own estimation (2025)

4.1.4. Unconditional correlation tests

The unconditional correlation results associated with the JSE size-based index returns, market-wide investor sentiment index and macroeconomic control variables are presented in Table 4. It is evident that the market-wide investor sentiment is positively correlated with the JSE fledgling index and the JSE small-cap index. However, the correlation is very low and close to 0 as opposed to 1, indicating that an increase in investor sentiment will cause the return of both JSE size-based indices to increase overtime. Similarly, inflation growth rate and money supply growth rate are negatively correlated with the JSE size-based indices' returns. Despite this, the correlations are very low and close to 0, suggesting that when inflation or money supply increases, the JSE size-based indices' returns will decrease but the decrease is not substantial. Gross domestic product depicts a positive low correlation with the JSE fledgling index and a negative low correlation with the JSE small-cap index. On the contrary, real effective exchange growth rate expresses all positive low correlations with the JSE size-based indices. Collectively, it is evident that market-wide investor sentiment and macroeconomic control variables have a direct influence on JSE size-based index returns, thereby suggesting that there exists a linear association. However, it does not provide

consensus on the nonlinear effects, which requires the estimation of the Markov regime-switching model.

Table 4: Unconditional correlation results

	JSE_FLD	JSE_SML_CAP	JSE_MID_CAP
ΔSENT	0.086214**	0.116662*	0.113292
	(0.0202)	(0.0966)	(0.1067)
ΔCPI	-0.000965*	-0.029592*	-0.007719**
	(0.0891)	(0.0744)	(0.0128)
ΔM2	-0.002759*	-0.004618	-0.007114**
	(0.0688)	(0.9477)	(0.0196)
ΔGDP	0.104835**	-0.035464*	-0.033621
	(0.0356)	(0.0146)	(0.6331)
ΔREER	0.378505***	0.411247***	0.358295***
	(0.0000)	(0.0000)	(0.0000)

Notes: 1. The p-values are given in parenthesis; 2. *, **, *** indicates a 10%, 5% and 1% significance level, respectively
Source: Authors' own estimation (2025)

4.2. Empirical model results

4.2.1. Regime classification

A key classification that is needed prior to interpreting the Markov regime-switching results is to ensure that regime 1 and regime 2 are correctly identified according to the bullish/bearish conditions. The study follows the approach of Mandondo and Kunjal (2025), Jaffar et al. (2025), and Moodley and Lawrence (2026), who used the standard deviation of each regime, and the lowest/highest value of the associated regimes will be the bullish/bear market condition. In this light, Table 5 provides the associated classification results of regime 1 and regime 2. The standard deviation values of the JSE fledgling index and JSE mid-cap index in regime 1 are 0.93 and 1.09, respectively, whereas in regime 2, they are 1.28 and 1.14, respectively. Consequently, regime 1 is classified as the bullish market condition, as it is the lowest and regime 2 is classified as the bearish market condition, as it is the highest. Contrarily, the standard deviation figure in regime 1 for the JSE small-cap index is 1.27, and in regime 2 it is 0.98. Therefore, regime 1 is classified as the bearish market condition, and regime 2 is classified as the bullish market condition.

In addition to the standard deviation figures presented in Table 5, the average returns for the associated JSE size-based indices are also presented for the bullish/bearish market conditions. In the bullish market condition, the JSE fledgling index return, and the JSE mid-cap index returns are positive and significant, whereas in the bearish market condition, they are negative and significant. However, the JSE small-cap average return is positive and significant in a bearish market condition. These findings align with the broadly accepted facts of regime-switching models originally established by Hamilton (1989) and furthermore supported by Ang and Bekaert (2002), who demonstrate that financial markets exhibit asymmetric behaviour across bullish/bearish market conditions. These findings were confirmed by Moodley *et al.* (2025), who found that equity market returns are significantly higher in expansionary phases (bullish conditions) and deteriorate in contractionary conditions (bearish conditions) due to shifts in investor confidence and macroeconomic instability. These findings further reveal that the JSE fledgling index and JSE mid-cap index benefit from bullish market conditions as they remain positive and increase over time. This implies that the two indices are good investments during bullish market conditions as they will yield positive returns for investors.

In the bear regime, the pattern reverses for some indices. The JSE fledgling index and the JSE mid-cap index exhibit negative and significant returns, confirming that these segments are more negatively affected by pessimistic sentiment and declining market confidence. The JSE small-cap index returns are positive and significant in a bearish market condition. This suggests relative resilience, potentially due to defensive investors seeking undervalued or small-cap stocks during downturns as they are perceived to offer higher future growth potential and may be less exposed to macroeconomic shocks compared to larger, more cyclical firms. These findings align with foundational sentiment research by Baker and Wurgler (2003), who demonstrated that when

sentiment is low, returns are high on small-cap indices, a pattern replicated in South African markets by Dalika *et al*. (2014)

Table 5: Regime classification results

Variables	Regime 1			Regime 2		
	Std. dev.	Average Return	Classification	Std. dev.	Average Return	Classification
JSE_FLD	0.933392*** (13.84203)	0.666347*** (3.303386)	Bull regime	1.284016*** (11.16490)	-2.286904* (-1.886340)	Bear regime
JSE_SML	1.266761*** (11.60213)	0.805175*** (3.412439)	Bear regime	0.983675*** (14.48239)	-1.448759 (-1.241261)	Bull regime
JSE_MID	1.094507*** (20.02786)	0.863030*** (3.236554)	Bull regime	1.136848*** (7.469228)	-4.381728*** (-4.060505)	Bear regime

4.2.2. Markov regime switching model

Having considered the appropriate market conditions for each JSE size-based index and interpreted the average returns and overall volatility, the study now turns to the Markov regime-switching model results. More specifically, it looks at the effect of market-wide investor sentiment and macroeconomic control variables on JSE size-based indices' returns. In Table 6, it is evident that market-wide investor sentiment plays a statistically significant and economically meaningful role across regimes and size categories. In the bullish condition, market-wide investor sentiment exerts a positive and significant influence on the JSE fledgling index returns, JSE small-cap returns and JSE mid-cap returns. This suggests that optimism among investors amplifies returns during expansionary phases, as rising sentiment leads to increased demand for risky assets, as confirmed by Moodley *et al*. (2025).

In the bearish market condition, the effects remain positive, but it reveals varying levels of significance. That being said, market-wide investor sentiment has a positive and significant effect on the JSE fledgling index returns and JSE small-cap index returns, implying that even during pessimistic phases, changes in sentiment can influence returns. However, for the JSE mid-cap index returns, it is not statistically significantly affected by market-wide investor sentiment, indicating that larger, more established mid-cap index firms are less sentiment-driven in bearish market conditions. These findings align with Smales (2017), who also found that market-wide investor sentiment influences are stronger during high uncertainty or transitional phases.

If one turns to the macroeconomic control variables, it is seen that macroeconomic variables have a time-varying and regime-specific effect on the JSE size-based indices' returns. This suggests that changes in the JSE size-based indices' returns are explained by fluctuating macroeconomic variables, highlighting the importance of controlling for these factors. Inflation growth rate has a significant and negative effect on the JSE fledgling index returns and the JSE mid-cap returns in a bullish market condition, with the effect being the same only for the JSE small-cap index returns and JSE mid-cap index returns in a bearish market condition. Contrary to this, money supply growth rate has a positive and significant effect on the JSE mid-cap index returns in a bullish market condition but a negative and significant effect on the JSE small-cap index returns and JSE mid-cap index returns in a bearish market condition. Gross domestic product growth rate has a positive and significant effect on the JSE fledgling index returns and a negative and significant effect on the JSE small-cap index returns in a bullish market condition. These findings were further evident in the bearish market conditions for the JSE small-cap index returns and the JSE mid-cap index returns. Lastly, the real effective exchange growth rate has a positive and significant effect on all JSE size-based indices' returns in a bullish market condition, but in a bearish market condition, the effect is only positive and significant for the JSE fledgling index returns and the JSE small-cap index returns.

Muzindutsi *et al*. (2021) and Magubane (2025) found similar findings that macroeconomic shocks and financial cycle dynamics have a significant influence on the performance of equity market returns. This reaffirms the importance of controlling for macroeconomic variables. Collectively, these findings further support the view that equity return behaviour is shaped jointly by sentiment-driven and fundamental factors, consistent with recent evidence from Moodley *et al*. (2025).

The diagnostic tests in Panel C confirm the reliability of the model estimates. The Durbin Watson (DW) statistics for JSE size-based indices are close to 2, indicating that the model errors are likely not affected by first-order autocorrelation. There is therefore no significant autocorrelation in the residuals. The Breusch-Pagan-Godfrey test statistics are insignificant across the JSE fledgling index returns, JSE small-cap index returns and JSE mid-cap index returns, suggesting

homoscedasticity and the absence of heteroskedasticity issues. Collectively, the diagnostic results indicate that the model is well-specified.

Table 6: Markov regime-switching results

	JSE_FLD	JSE_SML_CAP	JSE_MID_CAP
Panel A: Bull regime			
ΔSENT	0.012049**	0.006538*	0.052252**
	(2.347846)	(1.985296)	(2.560103)
ΔCPI	-0.015422**	0.027361	-0.001933*
	(-1.939153)	(1.043238)	(-1.935614)
ΔM2	0.001794	0.002781	0.002149*
	(0.849216)	(1.196994)	(1.736670)
ΔGDP	0.022100*	-0.154889***	-0.022172
	(1.858017)	(-3.847679)	(-0.333082)
ΔREER	0.302989***	0.407678***	0.467760***
	(3.864807)	(4.127623)	(4.367861)
Panel B: Bear regime			
ΔSENT	0.300200***	0.132073*	0.109998
	(3.599111)	(1.993505)	(0.597977)
ΔCPI	-0.044456	-0.332902*	-0.112442**
	(-0.717203)	(-1.803017)	(-2.424199)
ΔM2	-0.145148	-0.223989***	-0.508874***
	(-2.087087)	(-2.979569)	(7.572085)
ΔGDP	0.001556	0.416662**	-0.362783***
	(0.009360)	(2.050084)	(-4.227258)
ΔREER	0.486852*	0.585901**	-0.095154
	(1.938283)	(2.525132)	(-0.476680)
Panel C: Diagnostic tests			
DW-Stat	1.970625	1.837122	2.100015
Breusch-Pagan-Godfrey	0.405192	1.558541	1.816597
	(0.8449)	(0.1735)	(0.1176)

Notes: 1. The z-statistics are given in parentheses; 2. *, **, *** indicate a 10%, 5% and 1% significance level, respectively

Source: Authors' own estimation (2025)

Panel A (bull regime) and Panel B (bear regime) report constant terms (C), representing the average returns for each size-based index under different market conditions.

4.1.3. Transition probabilities and duration tests

Table 7 displays the transition probabilities and expected regime durations for the JSE size-based indices, namely the JSE fledgling index returns, the JSE small-cap and the JSE mid-cap index returns estimated under the Markov regime-switching framework. The transition probabilities P11 and P22 indicate the likelihood that the JSE size-based indices' returns will remain in a bull or bear regime, respectively, while D11 and D22 represent the expected number of months the JSE size-based indices' returns will remain in a bullish/bearish market condition,

The JSE fledgling index returns' probability of remaining in a bull regime (P11=0.98) is relatively high, suggesting that the bullish market condition is highly persistent. The expected duration (D11=41.99 months) confirms this stability, indicating that the JSE fledgling index returns tend to remain in expansionary periods for extended intervals. In the bearish market condition, the probability (P22 =0.84) and the duration (D22 =6.30 months) imply that downturns are shorter and less persistent. This result aligns with Moodley *et al.* (2025), who found that South African equity market returns typically experience longer bullish cycles than bearish cycles, reflecting investor confidence in established firms during bullish market conditions.

The JSE small-cap index returns reveal an even stronger persistence in the bearish market condition (P11 = 0.99) with a longer expected duration of approximately 66, 75 months, compared to a much shorter bullish market duration of 6.70 months. This indicates that the JSE small-cap index returns experience extended bearish phases, potentially driven by speculative investment and higher risk premiums during pessimistic market sentiment. However, while downturns are more persistent, their impact may be severe, as smaller firms are more sensitive to liquidity and macroeconomic shocks.

In contrast, the JSE mid-cap index returns demonstrate a distinct pattern. The bullish market condition probability (P11=0.69) is relatively low, with a short average duration of 3.17 months, suggesting that the bullish market condition is short-lived. The bearish market condition probability

(P22=0.94) is highly persistent, with an average duration of 15.89 months, implying that the JSE mid-caps index returns tend to remain in contractionary phases for extended periods. These findings suggest that the JSE mid-caps index returns, which are positioned between established JSE-listed large firms and JSE-listed small firms, may be more vulnerable to prolonged economic uncertainty and sentiment-driven volatility.

Table 7: Constant transition probabilities and duration results

	Bull regime	Bear regime
	JSE_FLD	
P11 and P22	0.976182	0.841366
D1 and D22	41.98519	6.303811
	JSE_SML_CAP	
P11 and P22	0.850713	0.985020
D1 and D22	6.698486	66.75380
	JSE_MID_CAP	
P11 and P22	0.684818	0.937060
D1 and D22	3.172765	15.88825

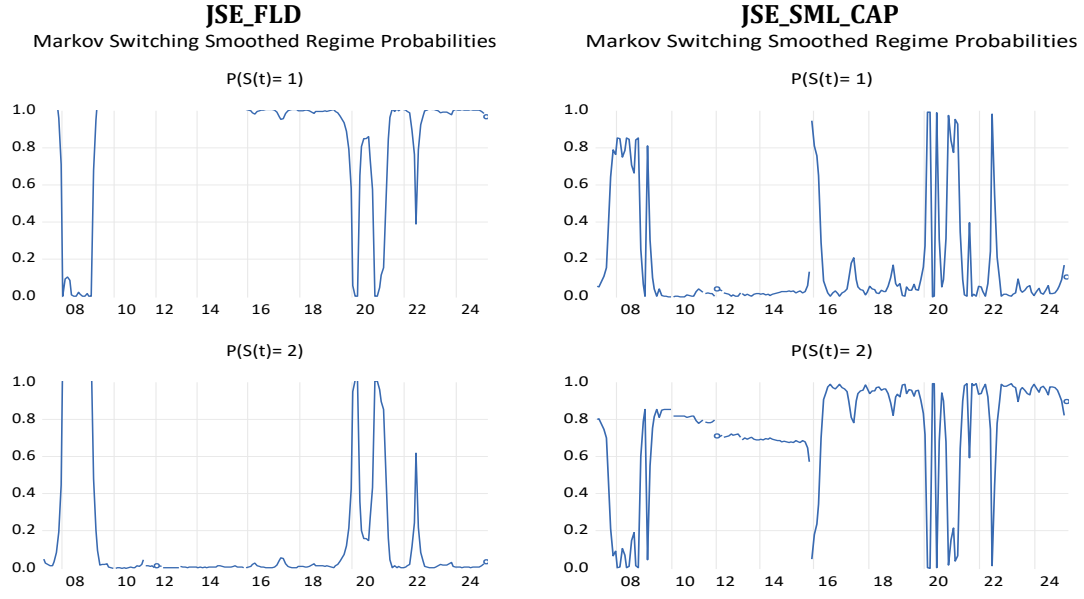
Notes: P11 and P22 are the transition probabilities in a bull and bear regime, respectively; D11 and D22 are the duration of a bull and bear regime, respectively
Source: Authors' own estimation (2025)

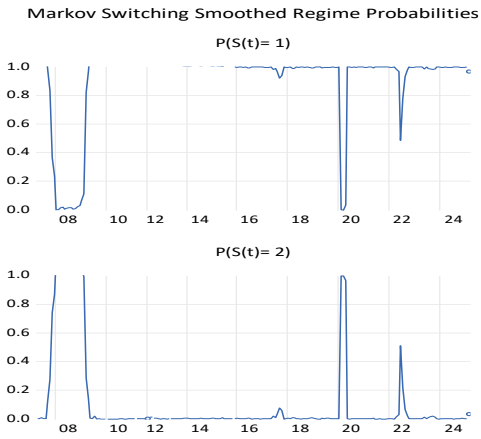
4.3. Robustness tests

4.3.1. Fitted regime probability graphs

Figure 1 displays a visual representation of the smooth regime probabilities associated with regime 1 and regime 2 of the empirical model. For the JSE fledgling index return, the smoothed probabilities indicate extended periods where $P(S_t=1)$ remains close to 1, indicating that the JSE fledgling index return predominantly operated in a bull market condition for much of the sample period. Similarly, it is evident that short-lived downward shifts in probability correspond to temporary bear phases, most visibly around 2008-2009, which is a representation of the global financial crisis, and in 2020/2023, which represents the COVID-19 pandemic. The rapid reversion of probabilities back to 1 suggests that the JSE fledgling index returns are resilient to shocks and quickly recover to expansionary states. This aligns with the high transition probability (P11 =0.98) and long bull regime duration observed in Table 7. The JSE small-cap index returns exhibit strong bearish dominance, as shown by $P(S_t=2)$ probabilities over multiple prolonged intervals. However, compared to the JSE fledgling index returns, the JSE small-cap index returns show more frequent short-term switching, indicating that while the JSE small-caps indices tend to experience long bearish phases (supported by D22=66.75 months), they are not resilient to heightened market-wide sentiment. Collectively, these findings confirm the observations in section 4.1.3, revealing robust findings.

Figure 1: JSE size-based regime probability results





JSE_MID_CAP

Notes: Authors' own estimation (2025)

5. Discussion of results

This discussion of results does not focus on correlating the findings with previous studies, but rather on examining their theoretical and economic implications. This is due to the existence of limited literature on JSE size-based indices. The section also highlights the economic implications of investor sentiment and macroeconomic fundamentals for South African financial markets.

The findings provide strong evidence that market-wide investor sentiment and macroeconomic fundamentals jointly drive the JSE size-based index returns. Their effects vary significantly across market regimes and index sizes, aligning with Moodley *et al*. (2025), Moodley (2025), and Shenjere *et al*. (2025). The positive and significant sentiment coefficients across the JSE size-based indices during bullish/bearish market conditions support the view of Baker and Wurgler (2006) that optimism boosts returns when market confidence is high. Similarly, the heightened impact of sentiment during bearish market conditions indicates that behavioural forces tend to dominate when fundamentals weaken. These findings are consistent with Bouteska and Mili (2023), and Birru and Young (2023).

The findings of the study align with the AMH, which suggests that markets evolve and adapt to changing conditions, allowing behavioural factors to occasionally influence prices. This is observed in the results when the sensitivity of the JSE size-based indices' returns differ across regimes, as supported by Kumari and Mahkud (2015), and Moodley *et al*. (2025). Collectively, the results challenge the EMH's weak and semi-strong forms by demonstrating that sentiment provides predictive power over JSE size-based returns, indicating that markets are not perfectly efficient, but contain alternating efficiency.

The macroeconomic variables further reinforce these behavioural dynamics. That being said, the real effective exchange growth rate is consistently positive and significant across bullish/bearish market conditions, as seen in studies by Chkili and Nguyen (2014) and Korley and Giouvris (2021). Conversely, the inflation growth rate often carries negative coefficients, especially for the JSE fledgling index returns and the JSE mid-cap index returns in bull markets, aligning closely with Chiang (2023). The gross domestic product growth rate and money supply growth rate display mixed effects across regimes, reinforcing findings by Bahrami (2019), Mishra *et al*. (2020) and Sharif (2025).

6. Conclusion and implications

The aim of the study was to examine the effect of market-wide investor sentiment on JSE size-based indices' returns under changing market conditions. To this extent, the study applied monthly data for the period April 2007 to March 2025, where the dependent variables consisted of the JSE fledgling index, JSE small-cap index and JSE mid-cap index. The independent variable comprised a market-wide investor sentiment index tailored for the South African financial market. To isolate the effect of the explanatory variable, control variables were employed, namely inflation growth rate, money supply growth rate, GDP growth rate and real effective exchange growth rate. The findings of the Markov regime-switching model revealed that market-wide investor sentiment has a regime-specific effect on JSE size-based indices' returns, such that the effect varies in magnitude among bullish/bearish market conditions. For example, market-wide investor sentiment has a positive and significant effect on all JSE size-based indices' returns in a bullish market condition, but in a bearish market condition, only the JSE fledgling index returns and the JSE small-cap index returns were

significant. Moreover, the magnitude of the effect was higher in the bearish market conditions as opposed to the bullish market conditions, highlighting the regime-specific and time-varying effects. Similarly, it was found that the bearish market conditions dominated the JSE size-based indices' returns as it stayed the longest in such a market condition, revealing less resilient characteristics to shifting market sentiment and adverse market conditions.

The results of this study show that investor sentiment plays an important role in how South African equity markets behave, especially during periods of market stress. For regulators like the South African Reserve Bank (SARB) and the JSE, new policy reforms must be developed and applied to the South African equity market to eradicate noise traders, as such traders enhance sentiment-induced markets that negatively affect return generation. For investors, the findings highlight that market-wide investor sentiment is not constant as it changes with market conditions. For instance, all JSE size-based indices' returns are more sensitive to sentiment during downturns, which negatively affect returns. Accordingly, investors should conduct portfolio rebalancing if JSE size-based indices form a part of their portfolio, as it will enhance portfolio volatility and reduce portfolio return, exposing investors to excess losses. For portfolio managers, this suggests that one-size-fits-all strategies are less effective. Instead, portfolios should be adjusted based on both market regimes (bull or bear phases) and company size. Using tools like regime switching models can help investors with portfolio rebalancing and improve overall performance. The key takeaway is that combining economic fundamentals with sentiment indicators offers a stronger approach to managing risk and making investment decisions in South African equity markets.

The study findings are not without limitations. That being said, from the methodology perspective, the market-wide investor sentiment index is isolated to seven proxies and does not cover a wide array of proxies available to capture market-wide investor sentiment. Moreover, the market-wide investor sentiment index was constructed following the Baker and Wurgler (2004:2006:2007) method by using the principal component analysis, which may ignore other relevant measures such as news sentiment and textual sentiment. Similarly, the authors limit the regime dependency solely to a two-regime model in line with studies by Moodley *et al.* (2024:2025), Jaffer *et al*. (2025), and Mandondo and Kunjal (2025). Therefore, future studies are encouraged to incorporate additional proxies to enhance the market-wide investor sentiment index. Consider different forms of sentiment measures, and extend the regime-dependency to a three-regime model and conduct a comparative analysis of the findings.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare no conflicts of interest. Both authors have no financial or personal relationships with individuals or organizations that could inappropriately influence or bias the content of this manuscript.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used Grammarly (Premium version) to enhance the clarity, grammar, and readability of the English language text. Grammarly was employed solely for language editing purposes, including correction of grammatical errors, improvement of sentence structure, and refinement of word choice.

Citation information

Mayekiso, M., & Moodley, F. (2026). The effect of investor sentiment on returns of JSE size-based indices under changing market conditions: Evidence from a Markov regime-switching model. *Economics, Management and Sustainability, 11*(1), 116-135. doi:10.14254/jems.2026.11-1.6.

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Appendix A

Investor sentiment proxy	Explanation
Share turnover ratio	The share turnover proxy is retained in this study's investor sentiment index, as found in the index of Muguto *et al.* (2019). The proxy is calculated by taking the total volume of shares traded and dividing it by the number of average shares listed in the South African stock market. The variable selection follows that of Baker and Stein (2004), as they argue that noise traders are high when there are short-sale characteristics in the market because the arbitrate of rational investors 21 does not drive noise traders out of the market. This causes stock prices to be overvalued. Studies such as Rupande *et al.* (2019), Muguto *et al.* (2022), and Muzindutsi *et al.* (2023) used the proxy for investor sentiment.
Equity issue ratio	The equity issue ratio is retained in this study's investor sentiment index, as found in the index of Muguto *et al*. (2019). The calculation of the proxy entails taking the number of issued shares of total equity and dividing it by the total issue of debt in South Africa. Baker and Wurgler (2006, 2007) argue that elevated share issues predict low market returns. That being said, companies wanting to expand will issue shares when sentiment in the market is high, making equity overvalued. Therefore, overvaluation is associated with high sentiment periods because sentiment-induced investors underestimate risk and overestimate returns (Baker & Wurgler 2006). Studies by Muguto *et al.* (2019) and Muzindutsi *et al.* (2023) use the proxy to measure market sentiment.
Advance/decline ratio index	The advance/decline ratio index is retained in this study's investor sentiment index, as found in the index of Muguto *et al.* (2019). It is measured by the number of advancing and declining shares, adjusted for their volume (Brown & Cliff 2004). Positive sentiment is indicated by positive market breadth, whereas negative sentiment is indicated by negative market breadth. Consequently, many studies have used it as a measure of market sentiment; these include Muguto *et al.* (2019), Reis and Pinho (2020), and Gong *et al.* (2022).
Rand/dollar bid–ask spread	The bid-ask spreads remain within this study's investor sentiment index, as found in the index of Muguto *et al*. (2019). It is determined by the demand for domestic securities, where negative sentiment attributed to poor economic performance shows a decline in capital inflows. This causes the bid-ask spread to increase as foreign investors omit rand-denominated securities (Hengelbrock *et al*., 2011). Studies by Muguto *et al*. (2019), Rupande *et al.* (2019), and Muguto *et al.* (2022) used it as a proxy for market sentiment.
South African volatility index (SAVI)	The South African volatility index (SAVI) will replace the rand/pound bid-ask spread in the Muguto *et al.* (2019) investor sentiment index. This is done by including both the rand/dollar bid-ask spread and the rand/pound bid-ask spread, as done by Muguto *et al.* (2019), which will enhance high correlation levels. Consequently, adding the SAVI proxy will remove the correlation bias, which contributes significantly to the robustness of the constructed market-wide sentiment index. The SAVI provides the 90-day future level of volatility associated with the entire financial market of South Africa. High levels of volatility indicate fear among investors in the market. Rupande *et al.* (2019) used the index as a proxy for market sentiment.
CNN fear and greed index	The CNN fear and greed index will replace the term structure of interest proxy proposed in the Muguto *et al.* (2019) index. This is done to increase the robustness of the constructed investor sentiment index, as investors participating in the South African financial market are not isolated to domestic investors but also foreign investors (Liu *et al*., 2020). Therefore, to account for foreign investors in the South African financial market, the CNN fear and greed index is used as a proxy in this study. The fear and greed index is a global index that comprises seven different proxies that CNN uses to formulate a market sentiment index for the United States (US) financial market. Against the backdrop of there being no direct proxy for foreign investor sentiment in South Africa, the CNN fear and greed index is selected, as the US is the focal point of the global financial market. Therefore, it constitutes investors from different geographical regions, which provides a better gauge of foreign investors' participation in South Africa. The proxy is unique to this study as previous South African studies (Muguto *et al.*, 2019; Rupande *et al*., 2019; Muzindutsi *et al.*, 2023) have

South African consumer confidence index	not captured the sentiment of foreign investors in the South African financial market. Moreover, Beirne *et al.* (2024) argue that, in any market-wide investor sentiment index, it is essential for foreign market participation to be captured as financial markets are not isolated to domestic investors but also foreign investors. Consequently, Liutvinavicius *et al.* (2017) used the index as a measure of market sentiment. The consumer confidence index (CCI) is added additionally to the study's constructed investor sentiment index. This is done because financial markets consist of investors with different financial statuses, high-end individuals, and lower-end individuals (Junaeni, 2020). Consequently, it is important that the market-wide investor sentiment captures both types of investors and is not isolated to high-end individuals, which distorts the level of sentiment. The CCI provides household consumption and savings prospects based on their financial status (OECD, 2022). Although stock prices do not affect consumers' opinions, the index is highly correlated with sentiment in the financial market (Rahman & Shamsuddin, 2019). This is because market participants' financial status dictates their ability to participate in financial markets; if they do not have income, they will not participate, but the opposite holds if they do have income. Therefore, high-value signs reflect increased consumer confidence in future economic conditions, allowing investors to participate in financial markets. Koy and Akkaya (2017) demonstrate that CCI has evolved as a critical measure for sentiment following the financial crises. Hamurcu (2021) found that the index as a proxy for sentiment influences the Turkish stock market. Therefore, the proxy will contribute to the South African context, as previous studies in South Africa (Muguto *et al.,* 2019; Rupande *et al*., 2019; Muzindutsi *et al*., 2023) did not capture consumer sentiment in their sentiment index, which is a vital flaw given that these domestic consumers also participate in the South African financial market.

Source: Moodley *et al.* (2024)

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