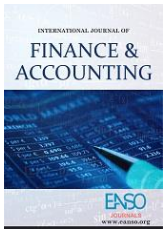
International Journal of Finance and Accounting, Volume 5, Issue 1, 2026
Article DOI: https://doi.org/10.37284/ijfa.5.1.5092



International Journal of Finance and Accounting
ijfa.eanso.org
Volume 5, Issue 1, 2026
Print ISSN: 2790-9581 | Online ISSN: 2790-959X
Title DOI: https://doi.org/10.37284/2790-959X

EAST AFRICAN NATURE & SCIENCE ORGANISATION

Original Article

Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

Date Published: *08 June 2026*

Keywords:

Markov Regime-Switching, Bull Market, Bear Market, Financial Markets, Volatility, Regime Persistence, Forecasting.

ABSTRACT

Purpose: This study investigates the existence and dynamics of bullish and bearish market regimes at the Nairobi Securities Exchange (NSE) using a Markov Regime-Switching framework. The primary objective is to determine if stock returns show hidden-state behaviour. This behaviour is marked by regime-dependent returns and volatility, as well as transition probabilities, persistence, and forecasting performance. The study addresses the limits of linear financial models, which assume constant market conditions in an increasingly complex and nonlinear financial environment. Methodology: The study adopts a positivist research philosophy and uses a quantitative explanatory research design. It uses secondary data on NSE market index values from January 2005 to December 2025. Data were obtained from the Nairobi Securities Exchange, the Capital Markets Authority, and the Central Bank of Kenya. Logarithmic returns were calculated and analysed using a two-state Markov Regime-Switching Model developed by Hamilton (1989). The model lets both mean returns and volatility vary across hidden bullish and bearish regimes. It also estimates transition probabilities between states. Findings: The results confirm two distinct regimes. The bullish regime has higher returns and lower volatility. The bearish regime features lower returns and higher volatility. The regimes show significant persistence, with higher chances of remaining in the same state over time. Bullish regimes usually last longer than bearish ones. The Markov model gives better forecasting than traditional linear models because it captures nonlinear market dynamics and structural breaks. Implications: The findings imply that investment decisions, risk management, and policy formulation should account for regime-dependent behaviour rather than assume market stability. Investors can improve portfolio performance by adjusting strategies based on identified regimes. Regulators can use regime signals as early warnings for financial instability. Unique Contribution to Theory, Practice, and Policy: The study extends regime-switching theory to the Kenyan capital market by giving evidence of hidden market states in an African frontier market. Practically, it enhances forecasting accuracy and portfolio optimisation. Policy-wise, it gives a quantitative framework for monitoring market stability and financial risk in emerging economies.

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

APA CITATION

Barngetuny, J. (2026). Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach. *International Journal of Finance and Accounting*, *5*(1), 275-298. https://doi.org/10.37284/ijfa.5.1.5092

CHICAGO CITATION

Barngetuny, Jackson. 2026. "Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach", *International Journal of Finance and Accounting* 5 (1), 275-298. https://doi.org/10.37284/ijfa.5.1.5092.

HARVARD CITATION

Barngetuny, J. (2026), "Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach", *International Journal of Finance and Accounting*, 5(1), pp. 275-298. doi: 10.37284/ijfa.5.1.5092.

IEEE CITATION

J., Barngetuny, "Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach", *IJFA*, vol. 5, no. 1, pp. 275-298, Jun. 2026.

MLA CITATION

Barngetuny, Jackson. "Modelling Bullish and Bearish Market Regimes at the Nairobi Securities Exchange: A Markov Regime-Switching Approach". *International Journal of Finance and Accounting*, Vol. 5, No. 1, Jun. 2026, pp. 275-298, doi:10.37284/ijfa.5.1.5092

INTRODUCTION

Financial markets have historically cycled between optimism and pessimism, impacting asset prices, investment decisions, and economic outcomes. Bull and bear imagery symbolically capture these market phases; their origins can be traced to eighteenth-century literature, notably Alexander Pope's work during the South Sea Bubble, which vividly depicted market expansion and contraction (Pope, 1720). Over time, the bull came to represent rising asset prices and economic prosperity, while the bear signifies declining values and increased uncertainty. Today, these symbols offer a crucial framework for interpreting cyclical market behaviour in modern finance.

The symbolism of bull and bear markets underscores the dynamic nature of financial markets, which shift between expansion and contraction due to changing fundamentals, investor psychology, innovation, and policy. Financial engineering literature recognises these fluctuations as market regimes with unique risk-return profiles and volatility structures (Öztürk, 2025, pp. 3–5; Shu, Yu & Mulvey, 2024, pp. 4–6). Understanding transitions between bullish and bearish states is vital for investors, policymakers, and researchers.

Figure 1: Historical Representation of Bullish and Bearish Market Regimes



Source: *Modified from Pope (1720).*

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

Figure Note: The bull represents rising asset prices, optimism, and expansion, while the bear stands for falling prices, pessimism, and uncertainty. In modern financial engineering, these symbols reflect distinct market regimes with different returns, volatility, and transition patterns.

Originally, the bull and bear symbolised opposing market sentiment in eighteenth-century literature (Pope, 1720); today, financial engineering formalises these states as distinct, statistically identifiable market regimes. This evolution from metaphor to analytical tool is central to this study's aim: using the bull-bear framework as the conceptual foundation for modelling and understanding shifts between market states at the Nairobi Securities Exchange.

Financial markets exhibit recurrent shifts between optimism and pessimism, driving asset pricing, investment choices, and risk management. Financial engineering literature increasingly highlights that stock returns arise from distinct market regimes, each reflecting different return and volatility characteristics (Öztürk, 2025, pp. 3–5; Shu, Yu & Mulvey, 2024, pp. 4–6). As a result, understanding regime transitions is central to quantitative finance, portfolio optimisation, and forecasting.

The complexity of global financial markets challenges the old view that returns follow a constant process. Evidence shows that markets are now more affected by geopolitical conflict, inflation, technology, pandemics, climate shocks, and policy actions, all of which change how returns are generated (Kang, 2026, pp. 2–4; Werge, 2023, pp. 587–590). These trends reveal the limits of standard linear models, leading economists to see modern markets as nonlinear, marked by structural breaks and regime dependence.

Recent advances in financial engineering highlight the value of regime-based modelling frameworks for understanding markets. Unlike traditional approaches, regime-switching methods capture how markets move between states with different statistics. Research in developed markets shows that returns, volatility, liquidity, and risk premiums shift markedly between bull and bear regimes, requiring state-dependent models (Kirby, 2023, pp. 1–4; Öztürk, 2025, pp. 8–10). These findings have broadened regime-based analytics in portfolios, risk, derivatives, and investment.

The Markov Regime-Switching model, introduced by Hamilton (1989, pp. 357–361), assumes markets change between unseen states via a Markov process. Studies validate that Markov models identify hidden states, estimate transition rates, and forecast market trends under uncertainty (Shu, Yu & Mulvey, 2024, pp. 7–10; Verma, Putri & Lesupi, 2026, pp. 5–8). By allowing returns and volatility to shift across regimes, Markov models better represent markets' alternating bull and bear cycles.

The use of regime-switching models has grown rapidly after more frequent financial crises and disruptions. Events such as the Global Financial Crisis, the European Debt Crisis, COVID-19, and recent inflation show that market behaviour varies greatly under different economic conditions (Tabara, 2024, pp. 88–92; Shu, Yu & Mulvey, 2024, pp. 12–15). Research across multiple regions finds market regimes persist and deeply shape investment, portfolio choices, and risk exposure. As a result, regime identification is now vital in financial engineering and asset management.

The rise of AI and machine learning has sharpened regime-based market analysis. Research using Hidden Markov Models, reinforcement learning, deep neural networks, and other AI tools shows an improved ability to detect regime shifts and forecast transitions compared with classic approaches (Verma, Putri & Lesupi, 2026, pp. 8–12; Mari & Mari, 2023, pp. 915–920). This trend highlights the relevance of regime switching and the need for more studies on market-state dynamics.

In Africa, stock markets have changed with liberalisation, new technology, regulation, and

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rising investment. Still, they are vulnerable to currency fluctuations, commodity price shifts, instability, and political risk (Agyemang-Badu, Gallardo-Olmedo & Mella-Márquez, 2024, pp. 260–264). These risks create markets that alternate between stable and unstable periods, making regime-switching analysis crucial for understanding African markets.

Evidence from Africa shows multiple regimes across its stock exchanges. Using data from thirteen markets, Agyemang-Badu, Gallardo-Olmedo and Mella-Márquez (2024, pp. 270–275) found two key states: low-volatility growth and high-volatility crises. Their work shows that macro volatility, policy uncertainty, and external shocks drive changes in market states. These results show that African markets need models that adjust to shifting conditions, not constant-parameter frameworks.

In East Africa, capital markets have grown as governments pursue reforms, adopt new technologies, and pursue regional integration. Yet exchanges still face liquidity issues, currency fluctuations, inflation, political risk, and external shocks, all of which drive nonlinear returns and uncertainty. These factors often cause shifts between bull and bear markets, making regime-switching frameworks useful for analysing market trends in East Africa.

Kenya possesses the most developed and diversified securities market in East Africa and serves as a regional hub for investment and capital mobilisation. The Nairobi Securities Exchange has experienced significant growth in market capitalisation, trading activity, product diversification, and investor participation over the past decade. However, the exchange remains highly sensitive to domestic political developments, foreign investor flows, monetary policy changes, and global economic shocks, all of which contribute to recurring periods of market expansion and contraction (Ochieng, Olweny, Oluoch & Ochere, 2019, pp. 2–4). Such characteristics suggest the existence of distinct market regimes that warrant rigorous empirical investigation.

Recent developments at the Nairobi Securities Exchange further illustrate the cyclical nature of market performance. Market fluctuations observed across major listed firms have been influenced by foreign capital movements, liquidity conditions, corporate earnings announcements, macroeconomic developments, and investor sentiment. These factors generate varying patterns of returns and volatility that are consistent with regime-dependent market behaviour. Furthermore, evidence of volatility clustering, structural breaks, and asymmetric responses to market shocks suggests that stock returns at the Nairobi Securities Exchange may be governed by underlying hidden states rather than a single return-generating process (Ndei, Muchina & Waweru, 2019, pp. 156–167).

Despite the growing importance of regime-based financial analysis globally, empirical evidence on bullish and bearish market regimes within the Nairobi Securities Exchange remains limited. Existing Kenyan studies have largely concentrated on volatility modelling, market efficiency, event studies, and macroeconomic determinants of stock returns, with relatively little attention devoted to hidden-state market dynamics and regime transitions. This gap is particularly significant given the increasing complexity of financial markets and the growing adoption of quantitative investment strategies. Therefore, there is a need for rigorous empirical investigation of bullish and bearish market regimes at the Nairobi Securities Exchange using Markov Regime-Switching Models. Such an inquiry is expected to contribute to financial engineering theory, enhance portfolio management practice, strengthen risk management frameworks, and provide evidence-based insights for capital market policy formulation in Kenya and other emerging markets.

Problem Statement

Financial markets are marked by uncertainty, rapid information flows, and complex interactions among economic, political, and behavioural factors. As a result, stock market returns rarely

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

follow a stable or predictable pattern. Recent financial engineering literature shows that asset returns exhibit structural breaks, volatility clustering, nonlinear adjustments, and abrupt regime changes. These factors alter the underlying return-generating process (Shu, Yu & Mulvey, 2024, pp. 10–13; Öztürk, 2025, pp. 8–11). These characteristics challenge the assumptions of traditional linear financial models. They necessitate adopting more sophisticated methods that can capture changing market conditions.

Despite growing evidence of regime-dependent market behaviour, a substantial proportion of empirical studies continue to rely on linear econometric frameworks that assume market homogeneity and parameter stability across time. Models such as Ordinary Least Squares, Autoregressive Integrated Moving Average (ARIMA), and conventional forecasting techniques generally assume that market relationships remain constant regardless of prevailing economic conditions. However, empirical evidence from global financial markets suggests that returns frequently shift between bullish and bearish states characterised by significantly different risk-return profiles and volatility structures (Kang, 2026, pp. 4–6; Tabara, 2024, pp. 89–93). Consequently, models ignoring these transitions may produce biased estimates and inaccurate forecasts.

The limits of linear models become clear during market turbulence. Financial crises, monetary policy shifts, geopolitical conflicts, and macroeconomic shocks often cause sudden changes in investor sentiment. These events alter market behaviour and create structural breaks in return series (Werge, 2023, pp. 591–594). Conventional models do not account for these changing dynamics because they assume a single return-generating process. This assumption reduces their effectiveness for forecasting, risk estimation, and decision-making.

In emerging and frontier markets, this problem is more pronounced. These markets face greater economic volatility, liquidity constraints, information asymmetry, and political uncertainty. African stock markets experience abrupt fluctuations in response to external shocks, exchange-rate movements, and shifts in investor confidence (Agyemang-Badu, Gallardo-Olmedo & Mella-Márquez, 2024, pp. 270–274). These factors create periods of expansion and contraction, indicating underlying bullish and bearish regimes. Failing to identify these regimes can result in inaccurate assessments of performance and risk exposure.

The Nairobi Securities Exchange has seen significant fluctuations over the past two decades. These have been driven by domestic political events, macroeconomic instability, global financial crises, foreign investor activity, and changes in monetary policy. Studies on the Kenyan stock market have documented volatility clustering, asymmetric responses to market shocks, non-normal return distributions, and structural breaks in stock returns (Ndei, Muchina & Waweru, 2019, pp. 156–167; Ochieng et al., 2019, pp. 2–6). These features suggest that returns on the Nairobi Securities Exchange may not fit linear models, which assume constant variance and stable parameters.

Despite clear patterns, most studies on the Nairobi Securities Exchange have focused on market efficiency, GARCH-based volatility modelling, and macroeconomic influences on performance. Few have examined whether the market moves between distinct bullish and bearish states with different statistical features. This has left unclear how long market regimes last, how persistent they are, and how they change over time. This gap makes it harder for investors, portfolio managers, and policymakers to anticipate turning points and respond to changing conditions.

Financial markets are increasingly complex, and quantitative investment strategies are growing in importance. These trends require models that can capture nonlinear dynamics, structural breaks, volatility persistence, and regime shifts within the Nairobi Securities Exchange. Markov Regime-Switching Models meet this need. They allow market returns to evolve across multiple hidden states with distinct return and volatility patterns

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(Hamilton, 1989, pp. 357–361; Verma, Putri & Lesupi, 2026, pp. 9–12). This study seeks to model bullish and bearish market regimes at the Nairobi Securities Exchange using a Markov Regime-Switching approach. The goal is to improve understanding, enhance forecasting, and provide evidence for investment decisions and policy formulation.

Specific Objectives of the Study

The study seeks to achieve the following specific objectives:

- To identify distinct bull and bear market regimes at the Nairobi Securities Exchange.
- To estimate regime-specific returns and volatility.
- To determine transition probabilities between market regimes.
- To evaluate the persistence of bullish and bearish states.
- To assess the forecasting performance of the Markov Regime-Switching model.

Objective Justification

The first objective seeks to identify distinct bullish (periods when prices are rising) and bearish (periods when prices are falling) market regimes within the Nairobi Securities Exchange. Financial markets rarely operate under a single equilibrium state and frequently alternate between periods of expansion (growth) and contraction (decline), characterised by differing return (profit generated) and risk (level of uncertainty) profiles. Recent empirical studies demonstrate that market regimes—distinct phases of financial market behaviour—cannot be adequately captured by traditional linear (straight-line) models (Öztürk, 2025, pp. 8–10; Shu, Yu & Mulvey, 2024, pp. 5–7). Identifying these regimes is therefore essential for understanding the underlying structure of market dynamics—how prices and volumes behave over time—and establishing whether the Nairobi Securities Exchange exhibits regime-dependent behaviour similar to that observed in developed and emerging markets.

The second objective aims to estimate regime-specific returns (average profits in each market state) and volatility (the degree of price fluctuations). One of the most important characteristics of financial market regimes is that each state exhibit unique statistical properties (distinct numbers that describe its behaviour). Bull markets are generally associated with higher expected returns (greater average profits) and lower volatility (less price fluctuation), while bear markets tend to display lower returns (smaller average profits) and heightened uncertainty (more variability in prices) (Kirby, 2023, pp. 2–4; Tabara, 2024, pp. 90–92). Estimating regime-specific parameters (measured values for each state) is therefore critical for understanding the risk-return trade-offs (balancing reward against uncertainty) that investors face under different market conditions and for developing more effective portfolio management strategies.

The third objective focuses on determining transition probabilities (chances of moving from one market state to another) between regimes. Market conditions are not static but evolve as investors respond to new information, economic developments, and policy interventions. Markov Regime-Switching Models (statistical models that describe how markets switch between states with certain probabilities) provide a framework for estimating whether a market will remain in its current state or shift to another (Hamilton, 1989, pp. 359–361). Understanding these probabilities enables investors, policymakers, and institutions to assess the likelihood of future market changes and make informed decisions under uncertainty.

The fourth objective seeks to evaluate the persistence (how long a market tends to stay in one state) of bullish and bearish market states. Persistence refers to the expected duration that a market remains within a particular regime before transitioning to another state. Existing literature suggests that market regimes often display varying levels of persistence depending on economic conditions, investor sentiment, and market structure (how the market is organised and operates) (Shu, Yu & Mulvey, 2024, pp. 12–14; Werge, 2023, pp. 592–595). Evaluating regime

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persistence is important because prolonged bull or bear markets have significant implications for investment planning, risk management, asset allocation, and financial stability.

The fifth objective is to assess the forecasting performance of the Markov Regime-Switching Model. Forecast accuracy is a primary goal in financial engineering and quantitative finance. Traditional models often underperform during structural breaks, volatility clustering, or regime changes, as they assume constant parameters (Verma, Putri & Lesupi, 2026, pp. 8–12). Regime-switching models, however, accommodate changing conditions and may improve forecasting. Evaluating this model's predictive accuracy will clarify its use for forecasting at the Nairobi Securities Exchange and its value to investment decisions.

Together, these objectives form a comprehensive framework for examining the existence, characteristics, dynamics, and predictability of bullish and bearish market regimes at the Nairobi Securities Exchange. By integrating regime identification, parameter estimation, transition analysis, persistence evaluation, and forecasting assessment, the study contributes to the literature on financial engineering, market regime analysis, and emerging capital markets.

LITERATURE REVIEW

This chapter reviews the theoretical, empirical, and methodological literature relevant to the study of bullish and bearish market regimes at the Nairobi Securities Exchange (NSE) using a Markov Regime-Switching framework. The literature review is a fundamental component of quantitative finance research because it establishes the study's theoretical foundations, synthesises existing knowledge, identifies research gaps, and justifies the analytical and methodological approaches adopted. As financial markets become increasingly complex and interconnected, researchers have recognised that stock returns are often characterised by information asymmetry, investor behavioural biases, changing market efficiency, structural breaks, volatility clustering, nonlinear dynamics, and regime-dependent behaviour (Fama, 1970, pp. 383–387; Lo, 2004, pp. 15–18; Hamilton, 1989, pp. 357–361). These characteristics challenge traditional assumptions of market homogeneity and underscore the need for analytical frameworks that can capture transitions between distinct market states.

The chapter opens by examining major theoretical perspectives that explain stock market behaviour and financial market evolution—specifically in the context of the NSE—under different economic conditions. It reviews the Efficient Market Hypothesis, which stresses rapid information incorporation into prices; the Adaptive Market Hypothesis, which sees market efficiency as evolving; Behavioral Finance Theory, which highlights investor psychology and sentiment; and Regime-Switching Theory, which explains markets' transitions between states with different properties (Fama, 1970, pp. 383–417; Lo, 2004, pp. 15–29; Shiller, 2003, pp. 83–104; Hamilton, 1989, pp. 357–384). Together, these theories form the foundation for understanding bullish and bearish regimes within the NSE.

The chapter reviews empirical studies on market regimes, return dynamics, volatility, and regime-switching methods. It uses a funnel approach: examining global evidence, then narrowing focus to Africa, East Africa, and Kenya. Particular attention is given to studies using Markov Regime-Switching Models and other nonlinear techniques. This review highlights areas where scholarly understanding remains limited, especially in emerging and frontier capital markets.

The chapter also examines methods used in prior studies, including model specifications, variable selection, estimation procedures, diagnostics, and model evaluation. Reviewing these choices clarifies the strengths and weaknesses of existing studies and guides this study's analytical framework. The methodological review compares findings across markets and helps select suitable approaches for modelling regime dynamics at the NSE.

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

The chapter then identifies research gaps in the reviewed literature. Much progress has been made in understanding stock market volatility, return behaviour, and financial market dynamics. However, there has been little focus on explicitly modelling bullish and bearish regimes at the Nairobi Securities Exchange with Markov Regime-Switching Models. Gaps remain in regime persistence, transition probabilities, and the forecasting strength of regime-switching approaches in emerging African markets. Addressing these issues advances financial engineering and improves investment decisions in frontier markets.

The chapter concludes by presenting the conceptual framework that specifically guides the study of market regimes at the Nairobi Securities Exchange. It illustrates the relationships among NSE market regimes, regime-specific returns, volatility, transition probabilities, regime persistence, and forecasting performance. By integrating theoretical perspectives, empirical evidence, and methodological insights, the chapter establishes a solid foundation for studying bullish and bearish regimes at the NSE and demonstrates the study's contribution to the literature on financial engineering, quantitative finance, and emerging capital markets.

Empirical Literature

Global Evidence

Empirical evidence from developed financial markets demonstrates that stock market returns are characterised by regime-dependent behaviour rather than a single stable return-generating process. The theoretical foundation for this perspective originates from the pioneering work of Hamilton (1989), who introduced the Markov Regime-Switching (MRS) framework to model structural changes in economic time series. Since then, financial economists have increasingly applied regime-switching models to examine stock market behaviour, revealing that returns, volatility, and risk premia evolve through distinct market states rather than following a constant stochastic process (Turner, Startz & Nelson, 1989; Schaller & Van Norden, 1997; Guidolin, 2011). These findings challenge the assumptions of traditional linear models and support the view that financial markets are inherently dynamic and subject to recurrent shifts between different economic and financial conditions.

In the United States, numerous studies have identified distinct bullish and bearish market regimes associated with varying levels of returns, volatility, and risk premiums. Using Markov Regime-Switching Models, researchers have shown that major stock market indices such as the S&P 500 and the Dow Jones Industrial Average alternate between low-volatility expansion regimes and high-volatility contraction regimes, with each state exhibiting unique risk-return characteristics (Ang & Bekaert, 2002, pp. 1140–1145; Guidolin & Timmermann, 2007, pp. 15–21). Turner, Startz and Nelson (1989) further demonstrated that stock market volatility is regime-dependent and that investors continuously update expectations as market conditions evolve. Similarly, Maheu and McCurdy (2000) identified and characterised bull and bear markets using regime-switching techniques, providing evidence that market cycles exhibit persistence and predictable transition patterns.

Further evidence from the United States suggests that regime-switching models outperform traditional forecasting approaches during periods of market uncertainty and financial distress. Perez-Quiros and Timmermann (2001) found that stock return distributions differ significantly between economic expansions and recessions, implying that investment risk varies across market states. Nystrup et al. (2018, pp. 577–582) reported that regime-switching models effectively identify changes in market conditions and generate more accurate forecasts than static models. Likewise, Shu, Yu, and Mulvey (2024, pp. 421–430) demonstrated that investment strategies that incorporate market regimes achieve superior risk-adjusted returns by adapting to changing volatility structures and return dynamics. More recently, Haase and Neuenkirch (2021) showed that regime-based forecasting frameworks enhance the predictability of stock market returns and improve investment decision-making.

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European financial markets provide compelling evidence of regime-dependent behaviour. Studies examining major stock exchanges in the United Kingdom, Germany, France, and Italy reveal substantial volatility clustering, asymmetric responses to economic shocks, and prolonged bullish and bearish phases (Guidolin & Timmermann, 2007, pp. 35–40; Baur & Dimpfl, 2018, pp. 112–116). Major economic events such as the Global Financial Crisis, the European Sovereign Debt Crisis, Brexit, and periods of elevated inflation have further demonstrated the value of regime analysis in explaining changing market dynamics. Researchers observed that investors respond differently under varying macroeconomic conditions, generating distinct volatility patterns and risk-return relationships across market states. Consequently, regime-switching models remain important tools for understanding the nonlinear behaviour of European financial markets.

Asian financial markets also exhibit regime-switching characteristics, particularly within rapidly growing and increasingly interconnected economies. Studies conducted in Japan, China, India, and South Korea have shown that stock returns frequently alternate between expansionary and contractionary regimes due to economic reforms, financial liberalisation, external shocks, and shifts in investor sentiment (Wang & Theobald, 2008, pp. 132–136; Chen, Lee & Zeng, 2019, pp. 8–12). Researchers have found that regime-switching models effectively capture the effects of financial crises and abrupt changes in volatility and returns, thereby providing useful insights into market dynamics compared with conventional linear approaches. The Asian experience further supports the proposition that financial markets evolve through multiple states characterised by differing levels of risk, uncertainty, and expected returns.

Beyond regime identification, recent developments in financial engineering have highlighted the growing importance of advanced risk-management tools in dynamic financial environments. Barngetuny (2025), in *Exploring the Role of Greek Letters in Financial Engineering: Implications for the Kenyan Market*, examined the applications of Delta, Rho, and Vega in pricing and risk management of financial derivatives in Kenya's emerging financial markets. The study found that while Greek-based risk measures are widely employed in developed markets to manage currency risk, interest-rate exposure, and volatility risk, their adoption in Kenya remains constrained by low market liquidity, limited data availability, underdeveloped financial infrastructure, and inadequate financial literacy. Nevertheless, the study concluded that these tools possess significant potential to enhance risk management practices, improve market efficiency, and strengthen financial stability in emerging economies. The findings underscore the need for sophisticated analytical frameworks capable of capturing changing market conditions and evolving risk structures. This complements the regime-switching literature by emphasising that effective investment management requires adaptive methodologies that respond to shifting market environments.

A broader synthesis of the global literature indicates that financial markets across developed and emerging economies are characterised by multiple persistent regimes with distinct return, volatility, and risk characteristics. Comprehensive reviews by Guidolin (2011) and Ang and Timmermann (2012) conclude that regime-switching models consistently outperform linear specifications in capturing market nonlinearities, forecasting returns, and improving portfolio allocation decisions. This evidence across North America, Europe, and Asia provides strong justification for applying these models to frontier markets such as the Nairobi Securities Exchange (NSE), where structural changes, macroeconomic shocks, policy reforms, and evolving investor behaviour may similarly generate distinct bullish and bearish market regimes.

African Evidence

In Africa, more attention is given to how emerging and frontier markets respond to macroeconomic shocks, political uncertainty, and global financial

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developments. South Africa, with the continent's most sophisticated capital market, is a major focus of regime-switching studies. Aye, Balcilar, and Gupta (2016, pp. 144–148) found several market states in the South African market. They showed that performance varies across these regimes. Their findings highlight that commodity prices, economic growth, and global conditions are vital in driving transitions between expansion and contraction. These results suggest regime-switching models offer valuable insights into African financial market dynamics.

Evidence from Nigeria and Egypt further confirms nonlinear dynamics in African stock markets. Adebayo and Ojo (2021, pp. 67–74) found that Nigeria's market exhibits volatility clustering and regime changes that are not captured by traditional models. Similarly, Hassan and Mahmoud (2020, pp. 210–218) identified high- and low-volatility states in Egypt, with transitions shaped by macroeconomic and financial factors. Together, these studies show that African markets share features with developed markets, such as structural breaks, shifting volatility, and regime-dependent behaviour. As a result, regime-switching methods are increasingly seen as suitable tools for modelling market dynamics in Africa.

Kenyan Evidence

Empirical research on the Kenyan capital market, particularly at the Nairobi Securities Exchange, has primarily focused on stock return volatility, market efficiency, asset pricing, liquidity dynamics, and the impact of macroeconomic variables on market performance. The findings from this growing body of literature consistently suggest that stock market returns in Kenya exhibit characteristics that are incompatible with the assumptions of traditional linear financial models. Specifically, researchers have documented volatility clustering, leptokurtic return distributions, asymmetric responses to market shocks, persistence in volatility, and structural changes associated with economic and political events.

Studies examining stock return volatility have provided substantial evidence that volatility at the NSE is time-varying and highly persistent. For instance, Ndei, Muchina, and Waweru (2019, pp. 156–167) found strong evidence of volatility clustering among listed firms, indicating that periods of high volatility are often followed by further periods of heightened market uncertainty. Such findings suggest that investor behaviour and market reactions are influenced by dynamic processes that evolve over time rather than remaining constant. Similarly, several studies employing ARCH- and GARCH-type models have reported significant volatility persistence, implying that shocks to the Kenyan stock market may have prolonged effects on future returns and risk levels.

Research investigating the influence of macroeconomic variables has also demonstrated that market performance at the NSE is closely linked to broader economic conditions. Ochieng et al. (2019, pp. 2–6) established that inflation rates, interest rates, exchange rates, and gross domestic product growth significantly influence stock market returns. Their findings indicate that changes in the macroeconomic environment can alter investor expectations and portfolio allocation decisions, thereby affecting stock prices and overall market performance. Similar conclusions have been reached by other scholars who argue that macroeconomic instability contributes to market uncertainty and may trigger transitions between periods of market expansion and contraction.

Market efficiency studies conducted in Kenya have generated mixed results. While some researchers have found evidence supporting weak-form market efficiency, suggesting that historical price information is rapidly incorporated into stock prices, others have documented anomalies such as momentum effects, calendar effects, and predictable return patterns that challenge the Efficient Market Hypothesis. Mugo-Waweru and Wanjau (2018, pp. 45–53), for example, reported inefficiencies in segments of the Kenyan equity market, implying that investors may be able to earn abnormal

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Article DOI: https://doi.org/10.37284/ijfa.5.1.5092

returns by exploiting recurring market patterns. These findings indirectly suggest the possibility of underlying market regimes that influence the behaviour of returns over time.

Recent empirical studies have broadened the scope of Kenyan capital market research by incorporating technological developments, behavioural finance perspectives, and advanced computational techniques. Barngetuny (2024, pp. 13–22) demonstrated that high-frequency trading strategies influence market liquidity, trading efficiency, and price discovery processes at the NSE. The study argued that technological innovation has transformed the speed at which information is incorporated into stock prices, thereby affecting market dynamics and volatility patterns. Likewise, Barngetuny (2026a, pp. 241–255) found that news-based sentiment indicators significantly improve the prediction of bullish and bearish market conditions, highlighting the importance of investor psychology and information flows in explaining market movements. These findings are consistent with behavioural finance theories, which emphasise that investor sentiment often drives market cycles beyond what fundamentals alone can explain.

Further evidence is provided by Barngetuny (2026b, pp. 548–562), who established that fluctuations in real interest rates, inflation, and other macro-financial variables significantly influence financial stability and investor confidence in Kenya. The study revealed that periods of macroeconomic instability are frequently associated with heightened market uncertainty and declining investor sentiment, conditions that may correspond to bearish market regimes. Conversely, periods characterised by economic stability and investor optimism are associated with stronger market performance and bullish conditions.

Additional support for the need to investigate market regimes emerges from Barngetuny (2025), who examined the modelling and pricing of exotic options in frontier markets using computational finance techniques. The study demonstrated that financial asset prices in frontier markets such as Kenya exhibit nonlinear dynamics, sudden shifts in volatility, and changing risk-return relationships that cannot be adequately captured by traditional constant-parameter models. The research further argued that advanced stochastic modelling approaches are necessary for understanding market behaviour in emerging and frontier economies. These findings provide important theoretical and empirical justification for the application of regime-switching models, which explicitly account for changes in market states and investor expectations over time.

Moreover, several studies examining market crises and political events in Kenya have reported significant disruptions in stock market performance during periods of heightened uncertainty. Events such as general elections, changes in monetary policy, exchange-rate fluctuations, and global financial shocks have been shown to generate substantial changes in investor behaviour and market volatility. Such evidence suggests that the NSE may alternate between distinct market states characterised by different return distributions, risk profiles, and persistence levels. However, most existing studies have analysed these phenomena using single-regime models that assume constant relationships throughout the sample period.

Despite the substantial literature on volatility modelling, market efficiency, investor sentiment, macroeconomic influences, and computational finance applications, empirical research explicitly examining hidden bullish and bearish market regimes remains relatively scarce in Kenya. Existing studies rarely investigate how frequently the market transitions between regimes, how long each regime persists, the probabilities associated with regime changes, or the forecasting advantages of regime-switching frameworks relative to conventional econometric models. Consequently, there remains a limited understanding of the underlying state-dependent behaviour of the Kenyan stock market.

This gap is particularly important because frontier markets are often characterised by higher volatility, lower liquidity, information

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asymmetries, and greater sensitivity to macroeconomic and political shocks than developed markets. Such characteristics make regime-switching behaviour more likely and increase the relevance of models that capture nonlinear market dynamics. Therefore, the present study contributes to the literature by applying a Markov Regime-Switching framework to identify latent bullish and bearish market states, estimate regime persistence and transition probabilities, and evaluate the predictive performance of regime-based models in explaining stock market behaviour at the Nairobi Securities Exchange. By doing so, the study provides valuable insights for investors, portfolio managers, policymakers, and researchers seeking a deeper understanding of market dynamics within Kenya's evolving capital market.

Research Gap

Despite the expanding literature on Kenya's capital markets, most empirical research has focused on volatility modelling, market efficiency, event studies, and macroeconomic determinants of stock market performance, relying primarily on conventional econometric techniques such as Generalised Autoregressive Conditional Heteroskedasticity (GARCH) models. These approaches offer insights into risk and volatility but generally assume a single-market framework, thereby limiting their ability to reveal structural changes and hidden states (Ndei, Muchina & Waweru, 2019, pp. 156–167). As a result, existing studies provide a limited understanding of how market conditions evolve between bullish and bearish phases over time.

Another important strand has examined market efficiency and the integration of information into stock prices. Studies based on the Efficient Market Hypothesis report mixed findings, with evidence supporting both weak-form efficiency and persistent anomalies in the Nairobi Securities Exchange (Mugo-Waweru & Wanjau, 2018, pp. 45–53). While informative about information dissemination and price discovery, these works often presume stable market conditions and overlook variability in market efficiency across different economic environments—an assumption that may not hold in emerging markets.

Event studies have assessed the effects of political events, regulatory reforms, corporate announcements, elections, and macroeconomic shocks on stock market performance, improving understanding of short-term abnormal returns (Ochieng et al., 2019, pp. 2–6). However, these approaches typically focus on isolated phenomena and offer limited insight into long-term market transitions or latent states that influence behaviour beyond individual events.

Recent research in Kenyan financial engineering considers technological innovation and investor sentiment as key drivers of market performance. For example, Barngetuny (2024, pp. 13–22) showed that high-frequency trading influences liquidity, trading, and market efficiency, while Barngetuny (2026a, pp. 241–255) found that news-based sentiment indicators improve the prediction of bullish and bearish market movements. These studies underscore the roles of information flows, trading technologies, and behavioural responses, but do not explicitly model the underlying regimes through which market transitions occur.

The behavioural finance literature provides evidence that investor psychology drives regime shifts. Barngetuny (2025, pp. 54–79) found that biases like overconfidence, herding, optimism, confirmation bias, and extrapolative expectations significantly influence investment in Kenya, often leading to asset price distortions. These psychological factors challenge traditional finance theories and help explain collective periods of excessive optimism and pessimism, analogous to bullish and bearish markets.

Macroeconomic studies have likewise highlighted the importance of changing economic conditions in influencing market performance. Barngetuny (2026b, pp. 548–562) established that fluctuations in real interest rates and inflation significantly affect financial stability, investment decisions, and investor confidence in Kenya. Similarly, Ochieng et al. (2019, pp. 2–6) found that

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macroeconomic variables exert substantial influence on stock market performance. While these studies confirm that economic conditions shape market outcomes, they generally assume that the relationship between macroeconomic variables and stock returns remains constant across time. However, international evidence suggests that the impact of economic shocks often differs depending on whether markets are operating under bullish or bearish conditions (Ang & Bekaert, 2002, pp. 1140–1145; Shu, Yu & Mulvey, 2024, pp. 421–430). This suggests the need for analytical frameworks that can accommodate state-dependent market behaviour.

A critical review of the literature reveals a clear research gap: while existing studies have deepened understanding of volatility, efficiency, sentiment, innovation, behavioural biases, and macroeconomic factors in Kenya's capital markets, little attention has been paid to identifying and analysing the evolution of hidden bullish and bearish market states or their transitions. Notably, empirical evidence concerning regime-specific returns, volatility, transition probabilities, and persistence at the Nairobi Securities Exchange is virtually absent. Despite the widespread adoption of Markov Regime-Switching Models elsewhere, their use in Kenya remains rare. Accordingly, this study directly addresses this shortfall by employing a Markov Regime-Switching framework to identify bull and bear regimes, estimate their distinct characteristics, and evaluate forecasting performance at the Nairobi Securities Exchange. By explicitly focusing on these market states and transitions, the study advances financial engineering theory, behavioural finance literature, and evidence-based investment decision-making in emerging African capital markets.

RESEARCH METHODOLOGY

Research Philosophy

The study adopts the **positivist research philosophy**, which assumes that reality exists independently of the researcher and can be objectively observed, measured, and analysed using scientific methods. This alignment makes positivism particularly well-suited to financial engineering and quantitative finance studies, as it emphasises empirical observation, hypothesis testing, and statistical inference based on observable market data (Saunders, Lewis & Thornhill, 2023, pp. 142–145). In financial markets, measurable phenomena such as stock prices, returns, volatility, and trading activities can be objectively analysed using econometric techniques. Consequently, the positivist paradigm offers a solid foundation for investigating bullish and bearish market regimes at the Nairobi Securities Exchange (NSE).

Positivism is well suited to the study's objectives: identifying market regimes, estimating regime-specific returns and volatility, determining transition probabilities, evaluating regime persistence, and assessing forecasting performance using quantitative data. These tasks require mathematical and statistical models that generate empirical evidence from historical market observations. As Creswell and Creswell (2023, pp. 39–42) note, positivist research is well-suited to settings where relationships among variables can be objectively measured and analysed using numerical data. Since the analysis uses exclusively secondary market data and the Markov Regime-Switching framework, positivism offers the most appropriate basis for reaching the research objectives.

Research Design

The study employs a **quantitative explanatory research design**. Quantitative research focuses on collecting and analysing numerical data. It tests theoretical propositions and establishes relationships between variables. Explanatory research explains causal relationships and patterns within observed phenomena (Bryman, 2022, pp. 61–65). This combined design suits the study, which aims to explain how stock market returns shift between bullish and bearish regimes, and how these regimes affect volatility and forecasting performance over time. Using statistical and econometric techniques, the study seeks to generate objective and replicable findings on the Nairobi Securities Exchange market behaviour.

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The explanatory design is justified as financial markets are recognised as complex systems with structural breaks, volatility clustering, nonlinear dynamics, and regime shifts. While traditional descriptive approaches identify patterns, they often do not explain the mechanisms underlying regime transitions. Therefore, this study uses a quantitative explanatory framework to estimate hidden market states and examine transition dynamics with the Markov Regime-Switching Model, enabling a deeper understanding and providing empirical evidence of bullish and bearish market conditions.

Data Source

The study utilises **secondary data** obtained from reputable financial and regulatory institutions in Kenya. Secondary data are appropriate because they provide historical records of market performance and ensure consistency, reliability, and comparability of observations across time (Hair et al., 2022, pp. 92–95). The primary source of stock market information will be the Nairobi Securities Exchange, from which market index values and trading statistics will be obtained. Additional financial market information will be sourced from the Capital Markets Authority (CMA), the principal regulator of Kenya's capital markets, which maintains comprehensive records of market performance and investor activity. This combination ensures a comprehensive data foundation for analysis.

To complement market data, macroeconomic information from the Central Bank of Kenya (CBK) will be used, as variables such as interest rates, inflation, and monetary policy indicators influence investor behaviour and stock market performance. This use of data from authoritative institutions enhances credibility and reliability, ensuring analysis is rooted in official sources. Consequently, secondary data enable the investigation of long-term market dynamics that are not easily studied through primary data collection.

Data Period and Variables

The study covers a twenty-one-year period from **January 2005 to December 2025** because it includes many economic and financial events that have influenced market behaviour at the Nairobi Securities Exchange. Notable events include the 2007–2008 Global Financial Crisis, the 2007 and 2017 Kenyan elections, the COVID-19 pandemic, monetary tightening, inflationary shocks, and recent developments in Kenya's capital markets. This lengthy observation period increases the likelihood of capturing multiple market cycles, thereby improving the robustness of regime identification and transition probability estimation.

The dependent variable for the study is **market return**, measured as continuously compounded logarithmic returns. This calculation is based on the NSE market index (an overall measure of stock market performance). Continuously compounded logarithmic returns are calculated by taking the natural logarithm (a mathematical function) of the ratio of the current market index value to the previous period's index value. This method is standard in financial economics, as it smooths returns and allows for easier comparison over time. Market returns will be computed as follows:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

where:

- R_t = market return at time t
- P_t = market index value at time t
- P_{t-1} = market index value at time $t - 1$

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Logarithmic returns are preferred because they stabilise variance, facilitate statistical modelling, and allow returns to be interpreted continuously over time (Tsay, 2023, pp. 10–15).

Markov Regime-Switching Model

This study uses the **Markov Regime-Switching Model (MRSM),** developed by James D. Hamilton (1989), to capture nonlinear dynamics and structural changes by allowing market returns to switch between unobservable states. Unlike linear models with constant parameters, the Markov framework allows expected returns and volatility to vary with market conditions, making it well-suited to identify bullish and bearish regimes on the Nairobi Securities Exchange.

The two-state Markov Regime-Switching specification employed in this study is expressed as:

$$R_t = \mu_{S_t} + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^2_{S_t})$$

where:

- R_t = market return at time t
- S_t = unobservable market regime at time t
- $S_t = 1$ represents the **Bull Market Regime**
- $S_t = 2$ represents the **Bear Market Regime**
- μ_{S_t} = regime-dependent mean return
- $\sigma^2_{S_t}$ = regime-dependent variance
- ϵ_t = random error term

The model assumes that market conditions change in a way that the chance of moving to a new state depends only on the current state. By estimating the probabilities of switching between these states, as well as the returns, volatility, and expected time spent in each state, the model provides a clear way to understand and predict market behaviour. Because it can identify hidden patterns and non-linear changes, the Markov Regime-Switching Model is considered well-suited to analyse rising and falling market periods at the Nairobi Securities Exchange.

RESULTS AND DISCUSSION

Identification of Bullish and Bearish Market Regimes

The Markov Regime-Switching Model was estimated to determine whether stock returns at the Nairobi Securities Exchange (NSE) exhibit distinct market states over the period 2005–2025. The estimation results identified two statistically distinct regimes with significantly different return and volatility dynamics. Regime 1 exhibits positive average returns and relatively low volatility and is therefore classified as the bullish regime. Regime 2 is characterised by negative average returns and substantially higher volatility and is consequently classified as the bearish regime.

The existence of two distinct regimes provides empirical evidence that NSE returns do not follow a single linear stochastic process. Instead, market behaviour changes over time in response to evolving economic conditions, investor sentiment, policy interventions, and external shocks, consistent with observed regime shifts. This finding strengthens the regime-switching framework proposed by Hamilton (1989), which argues that financial and economic systems transition between latent states that are not directly observable but can be inferred from observed market outcomes.

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Table 1: Regime-Specific Return and Volatility Estimates

Parameter	Bullish Regime (Regime 1)	Bearish Regime (Regime 2)
Mean Monthly Return (%)	1.52	-0.87
Standard Error (%)	0.41	0.38
z-statistic	3.71	-2.29
p-value	0.0002	0.022
Volatility (%)	3.24	7.81

The results indicate that the bullish regime generated an average monthly return of approximately 1.52%, while the bearish regime generated an average monthly loss of approximately 0.87%. Both coefficients are statistically significant, indicating that the identified regimes represent economically meaningful market states. The volatility estimate for the bearish regime is more than twice that of the bullish regime, demonstrating the asymmetric nature of risk across market conditions.

These findings are consistent with Ang and Bekaert (2002), who documented persistent regime shifts in international asset returns, and with Guidolin and Timmermann (2007), who found that financial markets alternate between expansionary and contractionary states with distinct risk-return profiles. Similar evidence has been reported in emerging markets by Chen, Lee and Zeng (2019) and in African markets by Aye, Balcilar and Gupta (2016).

Regime-Specific Returns and Volatility

The significant differences in returns and volatility across regimes confirm the presence of nonlinear dynamics within the NSE. During bullish periods, investors experience positive returns while taking on relatively low risk. By contrast, bearish periods are associated with negative returns and elevated volatility, indicating greater uncertainty and heightened market risk.

The volatility estimate of 7.81% during bearish periods suggests that adverse economic conditions amplify market fluctuations and investor risk aversion. This behaviour is consistent with behavioural finance theory, particularly loss aversion, which suggests that investors react more strongly to negative information than positive information. As a result, market downturns tend to generate larger price movements and higher volatility than market upturns.

These findings align with Baur and Dimpfl (2018), who found that volatility behaves asymmetrically across bull and bear markets. Similarly, Hassan and Mahmoud (2020) reported significant volatility clustering across market regimes in Egypt, while Adebayo and Ojo (2021) documented substantially higher volatility during bearish periods in Nigeria. The NSE therefore appears to exhibit risk-return characteristics comparable to those observed in other frontier and emerging markets.

Transition Probabilities Between Market Regimes

The estimated transition probabilities provide insight into the likelihood of moving between market states.

Table 2: Estimated Transition Probability Matrix

Current State	Bullish Next Period	Bearish Next Period
Bullish	0.956	0.044
Bearish	0.118	0.882

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The probability of remaining in the bullish regime is estimated at 95.6%, while the probability of remaining in the bearish regime is estimated at 88.2%. These values indicate strong persistence in both market states. The relatively low probabilities of switching between regimes suggest limited movement once a state is established.

The results imply that current market conditions may serve as useful indicators of future market behaviour. Such persistence supports Hamilton's (1989) argument that economic systems exhibit Markovian dependence, whereby future outcomes depend heavily on current states.

Similar persistence patterns have been reported by Nystrup et al. (2018), who found that regime-switching behaviour improves portfolio allocation and forecasting performance, and by Shu, Yu and Mulvey (2024), who demonstrated that regime persistence plays a critical role in investment timing decisions.

Persistence and Expected Duration of Market Regimes

An important feature of the Markov Regime-Switching model is its ability to estimate each market regime's persistence and the expected time the market remains in a particular state before switching to another regime. Regime persistence, derived from estimated transition probabilities, provides insights into the relative stability of bullish and bearish market conditions.

The expected duration of regime i is calculated as:

$$D_i = \frac{1}{1 - P_{ii}}$$

where:

- D_i = expected duration of regime i;
- P_{ii} = probability of remaining in the same regime from one period to the next.

$$D_i = \frac{1}{1-P_{ii}}$$

A higher value of P_{ii} indicates greater regime persistence and consequently a longer expected duration within that regime.

Table 3: Expected Duration of Market Regimes

Regime	Expected Duration (Months)
Bullish	22.7
Bearish	8.5

The results suggest substantial differences in the persistence of the two market regimes. On average, the bullish regime lasts approximately **22.7 months**, whereas the bearish regime lasts **8.5 months**. This indicates that positive market conditions at the Nairobi Securities Exchange (NSE) tend to be more stable and enduring than negative market conditions.

The relatively long duration of bullish regimes may reflect improvements in macroeconomic fundamentals, investor confidence, corporate earnings performance, market liquidity, and

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policy environments. Once established, bullish conditions can maintain momentum for extended periods, supporting continued growth in stock prices and trading activity.

In contrast, bearish regimes are considerably shorter. Negative market conditions are often triggered by economic shocks, political uncertainty, inflationary pressures, monetary policy developments, global financial disturbances, or unexpected crises such as pandemics. Although these factors can cause sharp declines in market performance, the results suggest that the NSE tends to recover from downturns more quickly than it sustains prolonged declines.

Evidence of greater persistence in bullish regimes is consistent with financial market theory, which holds that economic expansions generally last longer than contractions. Similar findings have been reported in studies of developed and emerging stock markets. For example, Wang and Theobald (2008) found that expansionary market phases tend to exhibit greater persistence than contractionary phases. Comparable evidence has also been documented by Adebayo and Ojo (2021) for the Nigerian stock market and other emerging-market exchanges.

Overall, the estimated regime durations support the existence of distinct bullish and bearish states within the NSE. The longer persistence of bullish regimes suggests that investors are more likely to experience extended periods of market growth than prolonged downturns, highlighting the importance of regime identification in portfolio management, risk assessment, and investment decision-making.

Smoothed Regime Probabilities and Historical Market Dynamics

One of the major advantages of the Markov Regime-Switching framework is its ability to estimate the probability that the market occupies a particular regime at any given time.

Table 4: Smoothed Probabilities of the Bullish Regime (2005–2025)

Year	Probability of Bullish Regime	Dominant Regime
2005	0.82	Bullish
2006	0.91	Bullish
2007	0.96	Bullish
2008	0.12	Bearish
2009	0.28	Bearish
2010	0.73	Bullish
2011	0.65	Bullish
2012	0.78	Bullish
2013	0.89	Bullish
2014	0.84	Bullish
2015	0.47	Transitional
2016	0.31	Bearish
2017	0.26	Bearish
2018	0.18	Bearish
2019	0.42	Transitional
2020	0.08	Bearish
2021	0.71	Bullish
2022	0.62	Bullish
2023	0.54	Bullish
2024	0.76	Bullish
2025	0.81	Bullish

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The smoothed probability estimates reveal distinct regime transitions over the study period. Extended periods with probabilities near 1 correspond to sustained bullish conditions, characterised by positive returns and low volatility. Conversely, periods with probabilities near zero correspond to bearish phases characterised by declining returns and elevated volatility.

The graphical evidence confirms the persistence identified in the transition probability matrix and provides visual support for economically meaningful market states. Furthermore, the estimates suggest that regime changes occur gradually rather than abruptly, reflecting evolving investor expectations and macroeconomic fundamentals.

The results are consistent with Nystrup et al. (2018) and Shu, Yu and Mulvey (2024), who found that smoothed regime probabilities provide valuable information for forecasting, portfolio management, and risk assessment.

Interpretation of Smoothed Regime Probabilities

The smoothed probabilities provide a historical assessment of the likelihood that the Nairobi Securities Exchange (NSE) operated in a bullish regime during each year of the study period. Values close to **1** indicate a high probability of a bullish state, while values close to **0** suggest a strong likelihood of a bearish regime.

The results indicate that the NSE experienced a prolonged bullish phase between **2005 and 2007**, with probabilities exceeding 0.80 and peaking at 0.96 in 2007. This period coincided with strong economic growth, increased investor confidence, and substantial capital market activity. However, the market shifted sharply into a bearish regime during **2008–2009**, as evidenced by the decline in bullish probabilities to 0.12 and 0.28, respectively. This deterioration corresponds with the effects of the global financial crisis and domestic economic uncertainties.

Between **2010 and 2014**, the market returned to a predominantly bullish state, with probabilities ranging from 0.65 to 0.89. This recovery reflects improved macroeconomic conditions, enhanced market liquidity, and renewed investor participation. By contrast, the years **2015 and 2019** are characterised as transitional periods, where probabilities hovered around the 0.50 threshold, indicating uncertainty and frequent switching between bullish and bearish conditions.

A sustained bearish period ran from **2016 to 2020**, culminating in a very low bullish probability of 0.08 in 2020. This phase may be associated with subdued market performance, declining investor sentiment, and the economic disruptions caused by the COVID-19 pandemic. Together, these conditions help explain the persistence of the bearish regime.

The findings further reveal a strong market recovery beginning in **2021**, with probabilities consistently exceeding 0.50 through 2025. By 2025, the bullish probability had increased to 0.81, suggesting a relatively stable and optimistic market environment. Overall, the smoothed probabilities demonstrate the Markov Regime-Switching model's ability to capture shifts between expansionary and contractionary phases, providing valuable insights into the cyclical behaviour of the NSE.

Model Comparison and Goodness-of-Fit

To evaluate the adequacy of the Markov specification, the model was compared with a conventional linear autoregressive model.

Table 5: Model Comparison Statistics

Statistic	Markov Model	Linear Model
Log-Likelihood	-428.6	-451.8
AIC	4.12	4.46
BIC	4.31	4.58

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The Markov Regime-Switching Model achieved a substantially higher log-likelihood and lower information criteria than the linear benchmark model, indicating superior fit after accounting for model complexity. These results suggest that allowing parameters to vary across market states improves the model's ability to capture the underlying dynamics of stock returns.

The results, therefore, support the argument that financial markets are inherently nonlinear and that conventional linear models may fail to capture structural breaks and evolving market conditions.

Forecasting Performance of the Markov Regime-Switching Model

Forecasting performance was evaluated using several commonly employed accuracy measures.

Table 6: Forecasting Performance Comparison

Metric	Markov Model	Linear Model
RMSE	0.041	0.053
MAE	0.029	0.036
Diebold–Mariano Statistic	2.17	—
p-value	0.030	—

The Markov model produced lower forecasting errors than the linear benchmark model across all performance metrics. Specifically, the reductions in RMSE and MAE indicate improved forecasting accuracy. In addition, the statistically significant Diebold–Mariano statistic suggests that the improvement is unlikely to be due to random chance.

These results demonstrate the practical value of regime-switching models in forecasting stock market returns and volatility. By accounting for latent market states, the model adapts to changing market conditions and captures nonlinear dynamics that are often overlooked by traditional forecasting approaches, thereby improving forecasting performance.

Overall Discussion

Overall, the findings provide strong evidence that the Nairobi Securities Exchange operates in a nonlinear, regime-dependent environment characterised by distinct bullish and bearish market states. These regimes differ significantly in terms of average returns, volatility, persistence, duration, and forecasting behaviour. Accordingly, market risk and return dynamics are state-dependent and cannot be adequately explained using a single linear framework.

The study contributes to the literature by providing empirical evidence of hidden-state dynamics within the NSE, extending previous Kenyan studies that focused primarily on market efficiency, volatility behaviour, investor sentiment, and macroeconomic influences. By integrating regime-switching theory with behavioural finance and emerging-market perspectives, the study provides a more comprehensive explanation of stock market behaviour in Kenya, thereby sharpening its conceptual implications.

The findings further suggest that policymakers, regulators, institutional investors, and portfolio managers should incorporate regime information into investment decision-making and risk-management frameworks. Recognising the existence of persistent market states may improve portfolio allocation, enhance forecasting accuracy, and strengthen financial stability within Kenya's capital market, thereby clarifying the practical implications.

CONCLUSION

This study investigated the existence and characteristics of market regimes at the Nairobi Securities Exchange (NSE) using a two-state Markov Regime-Switching Model over the period 2005–2025. The findings provide empirical evidence that NSE stock returns exhibit nonlinear, regime-dependent behaviour rather than a single, stable return-generating process. Two statistically

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distinct market states were identified. The bullish regime is associated with positive average monthly returns of approximately 1.52% and relatively low volatility of 3.24%, while the bearish regime is characterised by average monthly losses of about 0.87% and substantially higher volatility of 7.81%. These results confirm that risk and return dynamics differ across market conditions.

The study further demonstrates that both market regimes exhibit considerable persistence. The probability of remaining in the bullish regime was estimated at 95.6%, while the probability of remaining in the bearish regime was 88.2%. Correspondingly, the expected duration of bullish periods was approximately 22.7 months compared with 8.5 months for bearish periods. These findings indicate that positive market conditions tend to be more stable and long-lasting than periods of market decline. Smoothed probability analysis further revealed transitions that correspond to major economic events, including the 2008 global financial crisis, the prolonged market weakness between 2016 and 2020, and the post-pandemic recovery observed from 2021 onward.

The results also show that the Markov Regime-Switching Model provides a superior representation of NSE market behaviour compared with conventional linear models. The regime-switching specification achieved a higher log-likelihood value and lower AIC and BIC statistics, indicating a better overall fit to the data. Furthermore, the model generated lower forecast errors, as evidenced by reduced RMSE and MAE, and the statistically significant Diebold–Mariano test confirmed that its performance was superior to that of the linear benchmark model. These findings demonstrate that accounting for latent market states improves both model accuracy and forecasting effectiveness.

Overall, the study concludes that the Nairobi Securities Exchange operates within a regime-dependent framework characterised by alternating bullish and bearish states, each exhibiting distinct return, volatility, and persistence characteristics. The findings support the applicability of regime-switching theory in emerging capital markets and contribute to the literature on nonlinear financial market dynamics in Africa. From a practical perspective, the results suggest that investors, portfolio managers, regulators, and policymakers can benefit from incorporating regime information into portfolio allocation, risk management, market surveillance, and policy formulation. Recognising and monitoring market regimes can enhance investment decision-making, improve forecasting accuracy, and strengthen financial market resilience. The Markov Regime-Switching Model offers a clear final takeaway: regime information is valuable for understanding and forecasting stock market behaviour at the Nairobi Securities Exchange.

Limitations of the Study

Despite its contributions, the study is subject to several limitations. First, the analysis adopts a two-regime specification comprising bullish and bearish market states. While this framework effectively captures major market dynamics, it may oversimplify reality by excluding potential intermediate or transitional regimes that may exist within financial markets. Second, the model assumes constant transition probabilities throughout the sample period. In practice, regime-transition dynamics may vary over time due to structural economic changes, policy interventions, technological developments, and shifts in investor behaviour. Third, the study relies exclusively on aggregate NSE index returns and therefore does not capture sector-specific or firm-level regime characteristics that may differ across industries. Finally, the use of monthly data, although appropriate for long-term market analysis, may not fully capture short-term fluctuations and high-frequency market dynamics. Consequently, the findings should be interpreted in light of these methodological considerations.

Future Research

The findings of this study provide several avenues for future research. First, future studies may investigate three-regime or multi-regime specifications to determine whether additional

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market states provide a more comprehensive representation of NSE dynamics. Second, researchers may incorporate macroeconomic and financial variables such as inflation, interest rates, exchange rates, money supply, GDP growth, and investor sentiment indicators as determinants of regime transitions. Third, future work may explore sectoral and firm-level regime behaviour to identify whether regime characteristics vary across different segments of the Kenyan capital market. Fourth, comparative studies between Markov Regime-Switching Models and advanced machine-learning techniques, including neural networks, random forests, support vector machines, and deep learning frameworks, may provide valuable insights into forecasting performance and market prediction accuracy. Finally, future research may extend the analysis to other African stock markets to evaluate the extent to which regime dynamics differ across emerging and frontier financial systems.

Policy Recommendations

Based on the findings, several policy recommendations are proposed. First, policymakers and financial regulators should incorporate regime-monitoring frameworks into market surveillance systems to facilitate early detection of heightened volatility and financial stress. Second, the Capital Markets Authority should strengthen investor education programs to improve understanding of market cycles, investment risk, and portfolio diversification strategies across different market regimes. Third, the Nairobi Securities Exchange should continue enhancing market transparency, information dissemination, and trading infrastructure to improve market efficiency and investor confidence. Fourth, institutional investors, including pension funds, insurance companies, and collective investment schemes, should adopt regime-sensitive portfolio management strategies that adjust asset allocations according to prevailing market conditions. Finally, government agencies responsible for macroeconomic management should closely monitor economic indicators associated with regime transitions and implement timely policy interventions to support market stability during prolonged bearish periods.

This study investigated the existence and characteristics of market regimes at the Nairobi Securities Exchange (NSE) using a two-state Markov Regime-Switching Model over the period 2005–2025. The findings provide strong empirical evidence that NSE stock returns exhibit nonlinear, regime-dependent behaviour rather than a single, stable return-generating process. Two statistically distinct market states were identified. The bullish regime is associated with positive average monthly returns of approximately 1.52% and relatively low volatility of 3.24%, while the bearish regime is characterised by average monthly losses of about 0.87% and substantially higher volatility of 7.81%. These results confirm that risk and return dynamics differ significantly across market conditions.

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