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Analysis of the effect of efficiency on liquidity in Kenya's next derivatives market moderated by market innovation.

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ANALYSIS OF THE EFFECT OF EFFICIENCY ON LIQUIDITY IN KENYA'S NEXT DERIVATIVES MARKET MODERATED BY MARKET INNOVATION

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A THESIS SUBMITTED TO STRATHMORE UNIVERSITY BUSINESS SCHOOL IN PARTIAL FULFILMENT FOR THE AWARD OF A MASTER OF COMMERCE IN FINANCE SPECIALIZATION

APRIL 2025

DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this university or any other university. To the best of my knowledge and belief, the proposal contains no material previously published or written by another person except where due reference is made within the proposal.

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ABSTRACT

Liquid and efficient derivatives markets are essential for financial resilience, effective risk management, and capital market development. This study examines how efficiency influences liquidity in Kenya's NEXT derivatives market, and by assessing the effect of operational efficiency on liquidity, analyzes the dynamics between liquidity and market efficiency; and evaluates the moderating role of market innovation on the relationship between efficiency and liquidity. Anchored in market microstructure and efficiency theories, the study adopted a positivist research philosophy within a quantitative descriptive research design. The study population included all Futures contracts and their underlying asset prices, with a census sampling technique used to select and collect secondary data from January 2021 to December 2024 in the Nairobi Securities Exchange (NSE). Data analysis combined descriptive and econometric methods. Descriptive statistics were applied to calculate means, standard deviations for each variable. Econometric techniques, including panel regression, vector autoregressive, and Granger causality, were applied. A Market Innovation Index was constructed using principal component analysis to test moderation effects, reflecting a dimensionality reduction technique of eight standardized innovation-related related. STATA and EViews were used for data processing. The findings indicated that trading volume and order books enhance liquidity, while high transaction costs and exchange rate volatility had adverse effects. Price discovery is more efficient in futures contracts, though asymmetry volatility reveals inefficiencies in price adjustment. Innovation was found to significantly moderate the effect of trading volume on liquidity but not the impact of transaction costs. Granger causality tests identified a unidirectional relationship from efficiency to liquidity. These findings suggest that regulatory and technological improvements are crucial for strengthening Kenya's derivatives market. The study provides a data-driven foundation for reforms and comparative analysis in other emerging derivatives markets.

Keywords: *Liquidity, Efficiency, Operational Efficiency, Market Efficiency, Market Innovation.*

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To my beloved parents, Jean-Pierre Nsale and Jeanne Kenfuni, your sacrifices, prayers, and unwavering belief in me have been the foundation of all my achievements. To my siblings and cousins, thank you for your love, support, and inspiration, which have motivated me to preserve and strive for excellence.

To my friends and classmates, your camaraderie and the experiences we have shared made this academic journey truly enriching. This accomplishment would not have been possible without the collective support, encouragement, and prayers. I am deeply grateful to each of you for being a part of this milestone.

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LIST OF ABBREVIATIONS AND ACRONYMS

APAC: Asia-Pacific region

CAGR: Compound Annual Growth Rate

CBK: Central Bank of Kenya

CMA: Capital Markets Authority

EMEA: Europe, Middle East, and Africa region

EMH: Efficient Market Hypothesis

ETD: Exchange-traded

HIS: Hasbrouck's Information Share (IS-method)

IMF: International Monetary Funds

JSE: Johannesburg Stock Exchange (South Africa)

KNBS: Kenya National Bureau of Statistics

NEXT: Nairobi Securities Exchange Derivatives Segment

NGX: Nigerian Exchange Limited

NSE: Nairobi Securities Exchange

OTC: Over-the-counter

SSF: Single Stock Futures

VAR: Vector Autoregressive

VECM: Vector Error Corrector Model

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DEFINITION OF TERMS

Derivatives Market: A financial market where derivatives contracts, such as forwards, futures, options, and swaps, are traded, enabling market participants to hedge, speculate on price movements, and enhance price discovery (Hull, 2015).

Liquidity: The ease with which derivative contracts can be bought or sold without significantly impacting their price (Maddaloni, 2015; Ametefe et al., 2020; Liu et al., 2023).

Efficiency: Efficiency in financial markets, particularly in the derivatives market, refers to the ability of the market to allocate resources effectively, ensure accurate pricing, and facilitate seamless transactions (Bruel, 2024). Efficiency in derivatives markets is a dual concept:

- **Operational Efficiency** focuses on optimizing processes, technology, and workflows to reduce costs, errors, and delays, enabling smooth transaction execution and stability (Njoroge et al., 2013; Bruel, 2024).
- **Market Efficiency** ensures that derivatives prices reflect all relevant and available information accurately and promptly, ensuring fair valuation and effective risk transfer (Fama, 1970). The price discovery efficiency model is commonly used to measure it.

Innovation: The process of developing and implementing new ideas, methods, technologies, or products to improve efficiency, effectiveness, or competitive advantage in a given domain (Al-Razgan, et al., 2021).

Market Innovation: The introduction of regulatory reforms, technological advancements, new financial products, and infrastructure improvements that enhance market functionality, efficiency, and liquidity. In the derivatives market, market innovation fosters greater participation, price discovery, and operational efficiency, ultimately influencing liquidity (Shanmugam, 2011; Mohapatra & Mishra, 2020; Bruel, 2025).

Emerging Market: A financial market within a developing economy that exhibits rapid growth, increasing integration into the global economy, and evolving regulatory frameworks (Somanathan & Nageswaran, 2015; CGD, 2019).

Emerging Derivatives Market: A developing financial market where derivative instruments are newly introduced or in the early stages of adoption (Upper & Valli, 2016).

CHAPTER ONE

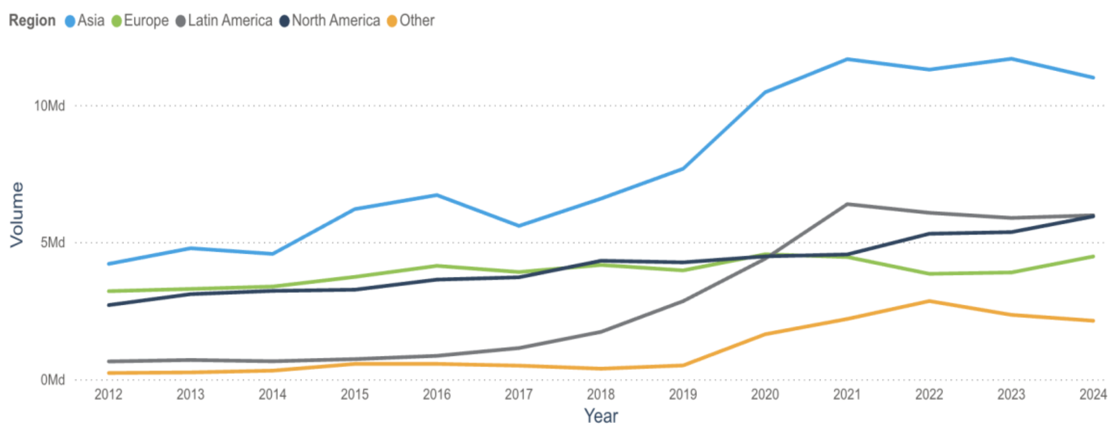
INTRODUCTION

1.1. Background to the Study

Over the past few decades, financial markets have experienced significant transformations driven by globalization, technological advancements, and financial integration (Al-Jaifi, 2017; Alhassan & Naka, 2020). Derivatives markets have been central to this evolution, offering instruments for risk hedging, speculation, and price discovery (Sánchez-Verdasco, 2018; WFE, 2018). These contracts derive value from underlying assets such as commodities, equities, or bonds (Hull, 2015) and are traded either on exchange-traded platforms (ETD) or over-the-counter (OTC) markets. ETDs, such as futures and options exchanges, offer standardized contracts and transparent trading environments, while OTC derivatives allow for customized, bilaterally negotiated contracts (Hourani & Zarai, 2014; Vo, et al., 2020; Huang & Yao, 2021).

The increase in financial system complexity has amplified the role of derivatives in enhancing market liquidity, facilitating efficient risk transfer, and promoting price discovery (Violi & Camerini, 2018; Mohapatra & Mishra, 2020). Automation, financial innovation, and regulatory advancements have propelled derivatives market activity to unprecedented levels (Shruthi & Suresh, 2022). For instance, as shown in Figure 1, global futures trading volumes have consistently increased between 2012 and 2024, indicating sustained global demand for derivatives instruments.

Figure 1. Global Derivatives Activity (ETD) – Futures Trading Volumes (2012-2024)



Source: *From the FIA ETD Tracker*

The global derivatives market has experienced remarkable growth in recent years (Aluko & Opoku, 2022; Bruel, 2024), with its size reaching $30.57 billion in 2024 and projected to expand to $64.24 billion by 2033 at a compound annual growth rate (CAGR) of 8.6% (Business Research Insights, 2025). The Asia-Pacific region dominates trading volume (74%), while the Americas and Europe, Middle East, and Africa (EMEA) regions experienced declines (WFE, 2021). Table 1 below further illustrates the historical performance and forecast evolution of the global derivatives market.

Table 1. Evolution of Global Derivatives Market Size (2018-2033)

Year	Market Size (USD Billion)	Key developments
2018	18.5	Rise in automated trading Systems
2020	22.3	Increased retail participation
2022	26.8	Regulatory frameworks strengtened
2024	30.6	Asia-Pacific dominationce; innovation accelerates
2027 (F)*	45.2	Blockchain and AI integration
2030 (F)*	55.8	Standardization and global interoperability
2033 (F)*	64.2	Full digitalization and wider institutional use

(*) Forecasting.

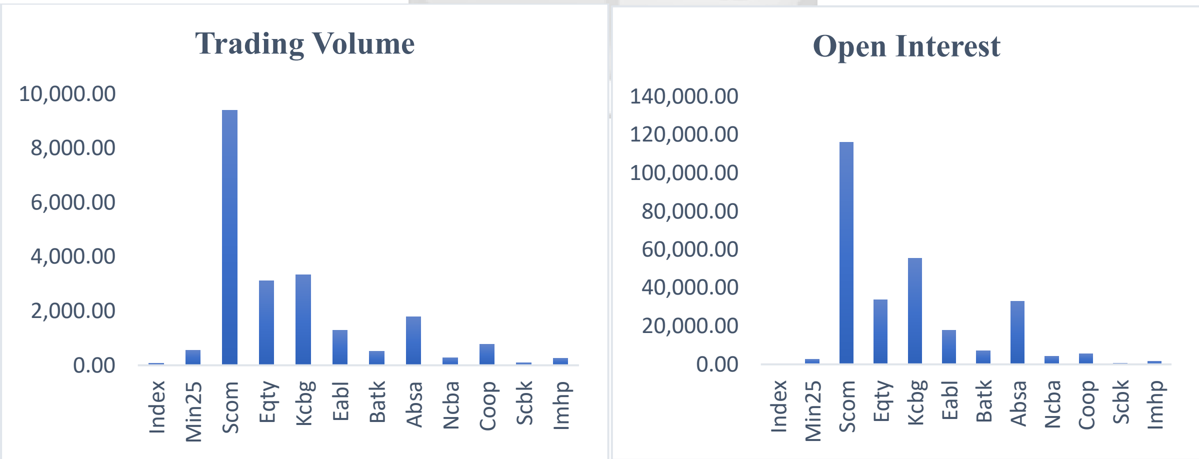
Source: *Market Growth Reports (2024); Business Research Insights (2025); DataHorizzon Research (2025); Global Growth Insights (2025).*

Despite the significant growth of global derivatives markets, there is a clear contrast between the established markets in developed economies and the nascent markets of emerging markets. In developed markets, derivatives benefit from robust liquidity, diverse product offerings, and advanced market infrastructure. Conversely, emerging derivatives markets, high transaction costs, and structural inefficiencies (Mihaljek & Packer, 2010; Goebel, 2023). Despite these challenges, emerging economies recognize the crucial role derivatives play in enhancing financial resilience, attracting foreign investment, and fostering broader economic development (Somanathan & Nageswaran, 2015; CGD, 2019). As a result, many of these countries have embraced the development of derivatives markets as a strategy to bolster their financial infrastructure and integrate more effectively into the global economy (Kiriakopoulos & Koulis, 2014; Jin et al., 2020).

Countries such as India, Brazil, and South Africa exemplify successful derivatives market development through strategic reforms, technological investments, and broader investor participation (Goebel, 2023). India, for instance, has witnessed extraordinary growth in its derivatives market with a monthly turnover of approximately $113.6 trillion in 2024, driven by a significant increase in retail investor participation, which surged from 2% in 2018 to 41% by 2024 (Hazeley, 2024; Times of India, 2024). South Africa's Johannesburg Stock Exchange (JSE) has similarly evolved, with derivatives trading volumes rising from 15 million contracts in 2005 to over 2.65 million contracts by 2018, positioning it as a leading derivatives market in Africa (WFE, 2019).

In contrast, Kenya's Nairobi Securities Exchange Derivatives Market (NEXT), launched in 2019, reflects the aspirations and the challenges inherent to emerging derivatives markets (Imhanzenobe, 2023; NSE, 2024). Despite its aim to enhance liquidity, market depth, and risk management, NEXT's trading volumes and open interest remain modest compared to peers like the JSE, as shown in Figure 2 below.

Figure 2. NEXT's Trading Volume & Open Interest (2021 -2024)

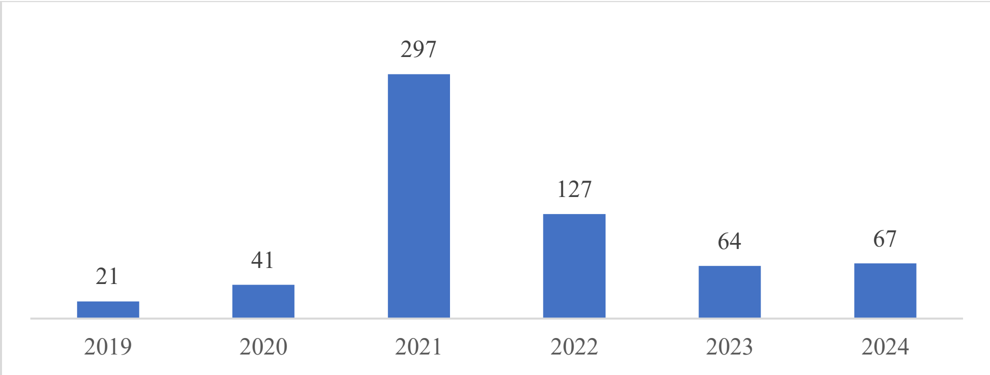


Source: *NEXT (2025)*

In 2024, NEXT remains constrained by high transaction costs, a narrow range of products, and limited market participation (NSE, 2024). Despite the introduction of more accessible contracts, such as the Mini NSE Index Futures in 2021, the market remains heavily reliant on the ten Single Stock Futures (SSF), which accounted for 83% of the market activity.

Furthermore, the trading value has experienced a decline from KES 297 million during the pandemic of COVID-19, with 7,585 contracts in 2021, to 127 million in 2022 and volumes to 4,165 contracts, exacerbating concerns about the sustainability of the market's growth (NSE-NEXT, 2024).

Figure 3. Market Journey – NEXT (Turnover in Millions KES)



Sourc*e: NEXT (2024), with data up to May 2024.*

Persistent challenges, including volatile trading patterns, limited institutional participation, and regulatory bottlenecks, continue to hamper NEXT's ambition to become a regional derivatives hub (Onsongo et al., 2020).

Understanding liquidity and its intricate relationship with efficiency thus becomes indispensable. Liquidity in derivatives markets is not merely a function of trading volume but is influenced by factors such as institutional quality, market structure, macroeconomic conditions, and regulatory effectiveness (Holden et al., 2014; Kyle & Obizhaeva, 2018).

For Kenya, liquidity constraints have cascading effects: they increase price volatility, impede the efficient incorporation of information into prices, and widen bid-ask spreads, ultimately weakening the risk management and price discovery roles of the market (Bekaert et al., 2007; Chordia et al., 2008; Khuntia & Pattanayak, 2019).

1.1.1. Liquidity in Derivatives Markets

Liquidity is a fundamental aspect of market efficiency, ensuring that assets can be bought and sold with minimal price impact and low transaction costs (Chakraborty, 2018). The determinants of liquidity in derivatives markets are diverse and multifaceted, encompassing market-specific factors such as trading volume, investor behavior, and market depth, as well as structures elements like regulatory frameworks and market infrastructure (Holden et al., 2014).

Theoretical and empirical studies highlight that liquidity in derivatives markets is not solely dictated by the actions of market participants but is also influenced by broader economic and institutional conditions (Kyle & Obizhaeva, 2018). In particular, the interplay between liquidit, volatility, and efficiency critically shapes derivatives market performance in emerging economies (Bekaert et al., 2007; Khuntia & Pattanayak, 2019).

Liquidity is a cornerstone of efficient derivatives markets, influencing price stability, trade execution, and overall market resilience (Bagnara & Jappelli, 2022). It refers to the ability of a market or asset to accommodate transactions without causing significant price fluctuations (Ametefe et al., 2020). A liquid derivatives market is characterized by tight bid-ask spreads, low price impact of large trades, and high trading volumes (Maddaloni, 2015; Liu et al., 2023).

However, emerging derivatives markets face unique liquidity challenges. Macroeconomic volatility, limited investor participation, and an underdeveloped financial infrastructure (Cavanaugh & Penick, 2013) hinder liquidity by increasing transaction costs and reducing trade execution efficiency (Kim & Waweru, 2015; Samarasinghea & Uylangco, 2022). Structural barriers such as inefficient clearing and settlement systems, regulatory gaps, and limited capital mobility further exacerbate these constraints (Dugast, 2019). The absence of robust market-making mechanisms amplifies price volatility and discourages institutional participation, necessitating policy interventions to enhance market depth and resilience (Ma et al., 2018).

Without robust market-making mechanisms, price volatility is amplified, and institutional participation remains low, necessitating policy interventions to enhance market depth and resilience (Ma et al., 2019).

1.1.2. Efficiency in Derivatives Markets

Efficiency in derivatives markets broadly encompasses operational efficiency and market efficiency, both of which significantly impact market liquidity and price discovery (Mohapatra & Mishra, 2020; Nguyen & Dao, 2022). Operational efficiency refers to the seamless execution, clearing, and settlement of trades at minimal costs and delays while ensuring price accuracy and stability (Bruel, 2024). Transaction costs, execution speed, market depth, and technological integration are key determinants of operational efficiency (Njoroge et al., 2013; Delcey, 2019; Jia et al., 2020).

Market (informational) efficiency focuses on the degree to which prices fully incorporate all available information, minimizing arbitrage opportunities and enhancing price discovery (Fama, 1970). Highly efficient derivatives markets feature advanced clearing mechanisms that reduce counterparty risk and optimize trade execution (Kozarevic et al., 2014). Developed markets such as the Chicago Mercantile Exchange (CME), Indian National Stock Exchange, and Johannesburg Stock Exchange (JSE) have leveraged these advancements to drive liquidity and improve market resilience.

However, in emerging derivatives markets, inefficiencies persist. Outdated trading infrastructure, fragmented regulatory frameworks, and limited technological adoption collectively hinder liquidity and market development (Chikalipah & Makina, 2019; Jin et al., 2020; Xiong et al., 2023). The Efficient Market Hypothesis (EMH) asserts that asset prices fully reflect available information, leaving no room for systematic arbitrage (Fama, 1970).

Price discovery, a key element of market efficiency, is often evaluated using models such as the Hasbrouck information Share (Hasbrouck, 1995; Lien et al., 2022). Futures prices should ideally anticipate spot price movements; however, persistent inefficiencies such as asymmetric information, speculative trading, and inconsistent regulation create pricing anomalies and hinder effective risk allocation (Violi & Camerini, 2018; Shruthi & Suresh, 2022).

In the context of Kenya's NEXT market, operational and market efficiency challenges have constrained liquidity. Despite the intended role of NEXT in enhancing liquidity, the market faces issues such as high margin requirements, limited technological automation, and fragmented market infrastructure (Koskei, 2024). Comparative studies emphasize how the JSE leveraged algorithmic trading and robust risk management systems to deepen liquidity, whereas NEXT continues to struggle with slow trade execution, high transaction costs, and limited market participation (Adelegan, 2009; Vo, et al., 2020).

Moreover, market efficiency within NEXT remains underdeveloped. Information asymmetry, low investor participation, and inconsistent regulatory practices hinder derivatives prices from fully reflecting market information (Nguyen & Dao, 2022). Inefficiencies persist in price discovery led to arbitrage opportunities, mispriced contracts, and reduced liquidity (NSE-

NEXT, 2024), highlighting the urgent need for regulatory reforms, technological innovations, and improved risk management frameworks.

1.1.3. Moderating Role of Market Innovation

Innovation, defined as the creation of new products, services, or processes that offer consumer value (Taques et al., 2021), plays a transformative role in financial markets. In derivatives markets, innovation often takes the form of new financial products, trading technology, and regulatory frameworks (Shanmugam, 2011; Jia et al., 2020).

Global derivatives markets have leveraged innovations such as algorithmic trading, high-frequency trading (HFT), and blockchain-based clearing mechanisms to enhance liquidity, market depth, and price discovery (Dugast, 2019; Titova et al., 2020). In mature markets, these innovations have driven efficiency improvements and expanded market participation.

In emerging derivatives markets, the adoption of digital trading platforms, automated clearing and settlement systems, and real-time analytics is critical to overcoming liquidity challenges (Mohapatra & Mishra, 2020; Liu et al., 2023). However, the impact of innovation depends heavily on regulatory adaptability, investor education, and technological infrastructure readiness.

India's derivatives market provides a successful example of innovation-driven liquidity improvements, whereas NEXT continues to face fragmented automation and regulatory inefficiencies (Young & Auret, 2018). Despite the introduction of products such as Single Stock Futures and the NSE 25 Index Futures, NEXT faces persistent liquidity challenges due to slow adoption of algorithmic trading, limited product diversity, and regulatory bottlenecks (Koskei, 2024).

Emerging innovations, including centralized clearing, margin financing, and automated trading, hold the potential to address these constraints. Yet their effectiveness hinges on the readiness of market participants and the regulatory frameworks (Di Castri & Plaitakis, 2018).

A critical question remains: To what extent can market innovation moderate the relationship between liquidity and efficiency in the Kenyan derivatives market? Addressing this question is essential for informing regulatory strategies, fostering technological adoption, and promoting a resilient, efficient, and liquid derivatives market in Kenya.

1.2. Problem Statement

The evolution of derivatives markets has become central in strengthening global financial systems, enhancing price discovery, enabling risk management, and promoting liquidity (Mohapatra & Mishra, 2020; Jia et al., 2020). In developed economies, the success of derivatives markets is anchored in advanced infrastructures, robust regulatory frameworks, diversified product offerings, and deep, resilient liquidity pools (Sandra, 2021; Dungore et al., 2022). Conversely, derivatives markets in emerging economies often face structural inefficiencies driven by underdeveloped infrastructures, limited market participation, and high transaction costs (Muriithi et al., 2016; Sime et al., 2020).

Across regions such as Africa, Asia, and Latin America, derivatives markets have been promoted as mechanisms to stimulate financial market development and attract foreign investment (Uddin et al., 2018). Nevertheless, many of these markets remain characterized by low trading volumes, wide bid-ask spreads (Shillington & Frasse, 2023; Lai et al., 2024). These inefficiencies deter investor confidence, particularly among institutional and international players (Funga & Tsai, 2021).

In Kenya, the NEXT launched in 2019, offering Single Stock Futures and Index Futures on select equities. Despite regulatory support and initial optimism, the derivatives market remains deeply illiquid. For instance, in 2023, NEXT recorded a total turnover of KES 64.28 million, a sharp 49% decline from KES 127 million in 2022. The number of contracts also fell from around 4,092 to 2,941, while deals dropped from 1,517 to 1,091 (NSE, 2024).

These figures contrast starkly with South Africa's Johannesburg Stock Exchange (JSE), which recorded over 100 million derivatives contracts traded in 2023 with diversified product offerings, or India's National Stock Exchange (NSE), which processed over 75 billion derivative contracts in the same period, with an important portion in options (BusinessWire, 2024). Even in smaller emerging markets such as Pakistan, the Pakistan Mercantile Exchange reported a turnover of PKR 2.9 trillion (approximately KES 1.5 trillion) in 2023. This comparison highlights the marginal scale and limited depth of Kenya's derivatives market, underscoring persistent liquidity challenges.

A key yet underexplored dimension in the Kenyan context is the relationship between efficiency and liquidity. Efficiency encompasses operational constraints, such as high transaction costs, inadequate market-making, clearing, and settlement limitations, is widely acknowledged barriers to liquidity in frontier derivatives markets (Gabrielsen et al., 2011; Kimani et al., 2014; Ondiba et al., 2018); informational inefficiencies, where asset prices fail to reflect available market information, compromise the effectiveness of derivatives in transmitting price signals (Delcey, 2019; Lien et al, 2022). These prior studies broadly support the idea that greater efficiency enhances liquidity, but most focus on developed markets or do not disentangle the effects of operational versus market (informational) efficiency. They also typically overlook the influence of contextual moderators such as market structure, innovation, and regulation.

Market innovation, including technological, regulatory, and product innovation, has been shown to influence liquidity globally (Chowdry et al., 2017; Shurthi & Suresh, 2022). Yet, innovation without adequate governance may increase systematic risk or introduce complexity (Mizrach & Neely, 2006). In Kenya, innovation initiatives such as the rollout of upgraded trading platforms, risk-based margining, and quarterly contract reforms remain largely anecdotal and under-evaluated empirically.

Therefore, to the best of the research's knowledge, there is a clear gap in understanding not only how operational and market (informational) efficiency influence liquidity in the Kenyan derivatives market but also how the strength and direction of this relationship is moderated by the degree of innovation.

1.3. General Objective

The general objective of this study was to analyze the relationship between efficiency and liquidity in the Kenyan derivatives market, with market innovation as the moderating variable.

1.3.1. Specific Objectives

i. To assess the effect of operational efficiency on liquidity in the Kenyan derivatives market.
ii. To analyze the effect of market efficiency on liquidity in the Kenyan derivatives market.
iii. To determine the moderating effect of market innovation on the relationship between liquidity and efficiency in the Kenyan derivatives market.

1.3.2. Research Questions

The following research questions will address the identified gaps in the liquidity and efficiency of the Kenyan derivatives market, focusing on the moderating role of market innovation.

i. What is the effect of operational efficiency on liquidity in the Kenyan derivatives market?
ii. How does market efficiency impact liquidity in the Kenyan derivatives markets?
iii. To what extent does market innovation moderate the relationship between efficiency and liquidity in the Kenyan derivatives market?

1.4. Scope of the Study

This study focuses exclusively on the Nairobi Securities Exchange Derivatives Market (NEXT), covering the period from January 4^{th,} 2021, to December 31^{st,} 2024. The analysis will examine and capture liquidity determinants, operational development trajectory, performance, and key market innovations.

1.5. Significance of the Study

This study is significant as it fills a key knowledge gap on the liquidity-efficiency dynamics of Kenya's underdeveloped derivatives market, where issues like low liquidity and weak price discovery persist. Existing research has largely overlooked these concerns, particularly in sub-Saharan Africa. By analyzing the moderating role of market innovation and applying advanced econometric methods, this research offers timely empirical insights to guide policy and market development.

1.5.1. Policymakers and Regulators

The findings will provide valuable insights into regulatory barriers and potential reforms to enhance market liquidity and efficiency of the Kenyan derivatives market. This can guide institutions such as the Capital Markets Authority (CMA) and the Nairobi Securities Exchange (NSE) in formulating policies that foster market growth.

1.5.2. Market Participants

For institutional and retail investors, this study will highlight the practical implications of liquidity and efficiency on trading costs, risk management, and investment decision-making.

Understanding these dynamics can help participants better navigate the market, optimize their trading strategies, and anticipate market behaviors under varying conditions of liquidity and volatility.

1.5.3. Academicians

By addressing the gap in empirical research on liquidity and efficiency in emerging derivatives markets, particularly in Kenya, this study will contribute to the broader academic discourse on financial market development. It will offer a foundational framework for future studies examining similar markets in Africa and other emerging economies.

1.6. Chapter Summary

This Chapter introduces the study on liquidity and efficiency in the Kenyan derivatives market, focusing on the NEXT. It outlines the challenges the market faces, including liquidity constraints, operational inefficiencies, and the impact of market innovations such as regulatory reforms and product diversification. It provides the foundation for the study, establishing its objectives, scope, and relevance to stakeholders, and framing the Kenyan derivatives market's liquidity-efficiency dynamics for further empirical analysis.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter provides an in-depth and comprehensive review of the existing literature on liquidity and efficiency encompassing operational efficiency and market efficiency in financial markets. Exploring relevant theoretical frameworks and empirical studies will help establish a solid foundation for addressing the research objectives outlined in Chapter One. By examining relevant theories and prior research, this chapter will identify key concepts, prevailing theories, and gaps in the current body of knowledge, ultimately guiding the analysis of subsequent sections of this study.

2.2. Theoretical Framework

This section will comprehensively review the theoretical foundation that underpins liquidity, operational efficiency, and market efficiency. Given the complexity of the derivatives markets, the following theories capture our attention: market microstructure, liquidity preference theory, efficient market hypothesis, and innovation diffusion.

2.2.1. Market Microstructure Theory (MMT)

Market Microstructure Theory, primarily used by O'Hara in 1995 and deriving from Glosten and Milgrom in 1985, provides a framework for understanding the mechanisms through which financial markets facilitate order execution, price discovery, and liquidity provision (Çetın, 2018). Unlike classical finance theories that assume efficient and friction costs, this concept acknowledges the role of market frictions, in shaping trading dynamics and influencing overall market efficiency (O'Hara, 1995). These frictions are particularly pronounced in emerging derivatives markets, where liquidity constraints and regulatory inefficiencies often hinder market development (Vega & Miller, 2009).

A central aspect of this theory is the role of market makers, who are instrumental in providing liquidity through bid-ask spreads, which are fundamental measures of transaction costs and indirectly affect indicators of market efficiency. Early theoretical contributions by Garman (1976), Stoll (1978), Glosten, and Milgrom (1985) established the foundational understanding of inventory management, order processing costs, and information asymmetry in determining bid-ask spreads. Garman (1976) analyzed how market makers balance their inventory to maintain, while Stoll (1978) further examined the implications of inventory holding costs on spreads. Glosten and Milgrom (1985) contributed significantly by exploring the concept of information asymmetry between informed traders and market makers, demonstrating that this asymmetry could lead to wider bid-ask spreads due to the risks faced by market makers in trading with informed participants. Kyle (1985) further expanded this framework by modeling the strategic interactions between informed traders, noise traders, and liquidity providers, highlighting the relationship between order flows, price adjustments, and market depth.

These theoretical foundations underscore the importance of operational efficiency in enhancing market liquidity. Order flow dynamics, transaction costs, and the speed of order execution directly impact liquidity levels, determining how effectively trades can be executed without significant price distortions.

However, the evolution of market microstructure has introduced new complexities. The advent of algorithmic and high-frequency trading (HFT) has transformed traditional liquidity provision mechanisms (Çetın, 2018). While Abergel et al. (2014) argue that such technological innovations have improved price efficiency and reduced spreads, they also highlight concerns regarding market stability, increased volatility, and the risk of systemic disruptions, such as flash crashes. These developments necessitate a continuous reinforcement of this theory (MMT), particularly in emerging derivatives markets, where the integration of advanced trading mechanisms remains uneven and regulatory oversight is still evolving.

In the context of the NEXT, MMT provides a critical analytical framework for assessing the impact of operational efficiency on liquidity dynamics. Research by Wenjuan (2017) and Varghese & Jose (2020) emphasizes the significance of market structure, regulatory interventions, and information dissemination in shaping derivatives market liquidity. Emerging derivatives markets, including NEXT, often face structural inefficiencies, such as high transaction costs, limited market participation, and inadequate risk management frameworks, all of which act as barriers to liquidity enhancement.

2.2.2. Liquidity Preference Theory (LPT)

Liquidity preference theory (LPT), developed by John Maynard Keynes in 1936, explains that investors prefer holding liquid assets to manage uncertainty about future interest rates, asset prices and market conditions, demanding a premium for less liquid assets (Keynes, 1936;

Marglin, 2020). Keynes identified three motives for holding money: transactional (daily expenses), precautionary (unexpected needs), and speculative (hedging against interest rate changes), with the speculative motive highlighting the preference for liquidity in volatile markets (Keynes, 2018; D'Acunto et al., 2020). This preference influences asset pricing and trading activity, especially in markets with liquidity constraints like Kenya's NEXT derivatives market.

This concept of liquidity preference challenges the Efficient Market Hypothesis by arguing that liquidity is an independent factor affecting pricing and returns. Highly liquid markets have lower transaction costs and more efficient price discovery, while illiquid markets (Fama, 1970; Perobelli et al., 2016). NEXT, characterized by low trading volumes, high costs, and few participants, exemplifies these challenges, where operational inefficiencies further dampen liquidity and market efficiency (IMF, 2015; Chistopher, et al., 2021).

Operational efficiency, minimizing transaction costs and improving order execution speed, enhances liquidity and market depth, crucial for NEXT's development, optimizes price discovery (Kyle & Obizhaeva, 2018; Schwartz, 2016; Chang, 2018). Empirical measures like Amihud's Illiquidity Ratio and turnover ratios demonstrate how market structure barriers, regulatory constraints, and information asymmetries exacerbate liquidity problems in emerging markets, leading to inefficiencies (Amihud, 2002; Pástor & Stambaugh, 2003). Additionally, liquidity crisis can arise from coordination failures where uncertainty prompts investors to exit illiquid markets, deepening inefficiencies as described by Diamon-Dybvig model (Brunnermeier & Pedersen, 2009).

Emerging derivatives markets often face structural regulatory barriers that limit liquidity and efficiency (Almeida et al., 2014). The NEXT, constrained by limited market participants, high margin requirements, and price distortions, reflects these challenges. Vayanos and Wang (2012) argue that trading frictions, asymmetric information, and search costs exacerbate liquidity constraints, leading to inefficiencies.

The relevance of liquidity preference theory provides a solid theoretical foundation for understanding how investor behavior, liquidity constraints, and operational efficiency interact in shaping market dynamics. In the NEXT, where liquidity remains a critical challenge, operational efficiency improvements could enhance liquidity, leading to greater market efficiency.

2.2.3. Efficient Market Hypothesis (EMH)

The efficient market hypothesis (EMH), introduced by Eugene Fama (1970) and initially developed by Paul Samuelson (1965), posits that asset prices fully reflect all available information, making it impossible for investors to consistently achieve returns that outperform the market (Țițan, 2015; Delcey, 2019). EMH classifies market efficiency into three forms: weak, semi-strong, and strong, each reflecting the degree to which information is integrated into asset prices (Fama, 1970). While this hypothesis has been foundational in finance theory, its applicability to emerging derivatives markets, including the nascent Kenya's derivatives market (NEXT), remains subject to scrutiny due to factors such as liquidity constraints, market structure inefficiencies, and regulatory limitations (Kumar & Jawa, 2017; Delcey, 2019).

Market efficiency is contingent upon liquidity conditions, trading frictions, and market structure, which affect price formation (Alderighi & Gurrola-Perez, 2021). Liquidity, defined as the ease of trading without significantly impacting its price, plays a critical role; illiquid markets show delayed price adjustments and higher costs, reducing efficiency (Liu et al., 2023; Garrison et al., 2019). Operational efficiency, through improved trading mechanisms and lower costs, enhances liquidity and supports market efficiency by enabling faster price adjustments transaction processing in minimizing costs and maximizing execution speed (Njoroge et al., 2013; Çetın, 2018; Chen et al., 2024).

Empirical tools like the Hasbrouck Information Share model and variance ratio tests assess price discovery and randomness in prices, key indicators of market efficiency (Hasbrouck, 1995; N'Dri, 2015). Studies of emerging markets reveal persistent inefficiencies due to regulatory limits, low participation, and volatility (Magnusson & Wydick, 2002; Bouattour & Martinez, 2019). In Kenya, liquidity constraints and information asymmetry hinder efficient price discovery (Muragu, 1990; Magnusson & Wydick, 2002). Furthermore, volatility and external shocks impact efficiency, macroeconomics policies playing a stabilizing role (Chowdhury et al., 2018; Arshad et al., 2019)

The concept of market efficiency remains a complex and evolving area of study, with various factors influencing the degree of efficiency observed across markets. In the context of this study, the Efficient Market Hypothesis (EMH) provides a theoretical framework for understanding how liquidity, influenced by operational efficiency factors, contributes to market efficiency in NEXT.

2.2.4. Innovation Diffusion Theory (IDT)

Everett Rogers's (2003) innovation diffusion theory offers a comprehensive framework for understanding the dissemination of new ideas, technologies, or practices within a social system (Al-Razgan, et al., 2021). This theory is particularly relevant to financial markets, where technological advancements, new financial instruments, and regulatory reforms significantly influence market structures and participant behavior, ultimately affecting liquidity and efficiency (Sahin, 2006; Frame & White, 2012).

In the NEXT, market innovation is crucial in moderating the relationship between operational efficiency and liquidity. Innovations such as algorithmic trading, high-frequency trading (HFT), and smart order routing have transformed financial markets by reducing transaction costs, enhancing price discovery, and increasing trading volume, thereby improving liquidity (Çetın, 2018; Lagos & Zhang, 2020). These technological advancements, which increase operational efficiency and encompass depth and resilience in trading activity, tend to foster greater liquidity in the market. However, the effective diffusion of these innovations depends on various factors, including the perceived benefits by market participants, compatibility with existing systems, complexity, trialability, and observability (Ramos-Requena et al., 2020).

Additionally, regulatory innovations, such as implementing central clearing and standardized contract specifications, enhance market participant transparency and reduce counterparty risk, thereby fostering greater liquidity and market stability (Jonker & Riva, 2022). Regulatory reforms aimed at promoting competition and reducing barriers to entry can also encourage new market participants, further contributing to liquidity and market efficiency (Mele & Sangiorgi, 2021). For instance, the introduction of new trading platforms or the relaxation of trading restrictions can attract additional liquidity providers, thereby deepening the market.

Market participants are more likely to adopt innovations that offer clear advantages, such as reduced transaction costs, faster execution speeds, or improved risk management capabilities. Thus, the theory helps in understanding the market dynamics of trading and how to manage market microstructure (Jiang et al., 2022). In derivatives markets, innovations such as new derivatives products, electronic trading platforms, and regulatory changes are essential for enhancing operational and liquidity.

The Innovation diffusion theory distinguishes five categories of adopters: Innovations, early adopters, early majority, late majority, and laggards which provides a useful lens through which to analyze how the adoption of new technologies and regulatory frameworks can facilitate the relationship between operational efficiency and market liquidity in NEXT.

2.3. Empirical Review

This section provides an empirical examination of existing literature analyzing the interlinkages between operational efficiency, market efficiency, innovation, and liquidity within derivatives markets. It draws upon findings from both developed and emerging markets to contextualize the determinants and dynamics shaping liquidity and efficiency in nascent markets such as Kenya's NEXT derivatives market.

2.3.1. The Effect of Operational Efficiency on Liquidity in Derivatives Markets

Operational efficiency, often manifested through factors such as trading volume, market depth, bid-ask spreads, transaction costs, clearing and settlement systems, and regulatory frameworks, plays a fundamental role in shaping liquidity dynamics in derivatives markets (Njoroge et al., 2013; Bruel, 2024). Liquidity, defined as the ease with which assets or contracts can be traded without significantly impacting their price, is highly sensitive to the microstructural features of financial markets (Gabrielsen et al., 2011; Narayan & Reddy, 2017).

Empirical studies have consistently shown that trading activity and market are core indicators of operational efficiency and strong predictors of liquidity (Gabrielsen et al., 2011; Jia et al., 2020). High trading volume facilitates narrower bid-ask spreads, reduce price volatility, and improve execution efficiency, contributing to robust markets, where investor participation (Houben & Snyers, 2018). Conversely, in emerging markets, where investor participation is often limited, thin order books and infrequent trading exacerbate illiquidity (Ergun et al., 2020).

A considerable body of research has demonstrated that transaction costs, encompassing brokerage fees, taxes, and implicit trading frictions, act as a deterrent to active trading, thus stifling market illiquidity (Marshall et al., 2014). This relationship is particularly pronounced in emerging derivatives markets, where infrastructure inefficiencies, such as delayed settlement systems, further inhibit operational performance (Beck, et al., 2010). For instance, studies in Kenya, Nigeria, and Pakistan indicate that inefficient settlement mechanisms and regulatory inertia contribute to low turnover and reduced market attractiveness (Kimani et al., 2014; Ondiba et al., 2018).

Moreover, the role of regulatory frameworks as an enabler of operational efficiency has been underscored in both developed and emerging contexts. Strong regulatory oversight enhances market transparency and mitigates systemic risks, thereby encouraging investor confidence and participation (Ondigo & Moronya, 2018). However, when regulatory structures are weak or misaligned with market realities, as observed in several Sub-Saharan African financial markets, they may inadvertently create bottlenecks that hinder liquidity (Ondiba et al., 2018).

Advanced econometric studies further support the influence of operational factors on liquidity. Ndigwa and Muriu (2016), utilizing GARCH models, illustrated the extent to which volatility. In Kenya's equity markets is exacerbated by insufficient operational infrastructure, reinforcing the need for regulatory and structural reform. Similarly, Were (2020) used a vector autoregressive (VAR) framework to examine spillovers within East African financial markets, highlighting how operational inefficiencies can transmit liquidity shocks across borders.

Collectively, these findings suggest that achieving operational efficiency is a precondition for sustainable liquidity development in derivatives markets, particularly in frontier economies. For the Nairobi Securities Exchange Derivatives Market (NEXT), a holistic approach incorporating infrastructural investment, reduced transaction frictions, and strategic regulatory support is essential for enhancing liquidity outcomes.

2.3.2. The Effect of Market Efficiency on Liquidity in Derivatives Markets

Market efficiency, defined as the extent to which asset prices reflect all available information, is intrinsically linked to market liquidity (Delcey, 2019). The Efficient Market Hypothesis (EMH), articulated by Fama (1970), posits that in an efficient market, arbitrage opportunities are minimized, and prices quickly incorporate new information. However, the realization od such efficiency is contingent upon sufficient liquidity, which facilitates the seamless adjustment of prices to new information (Ma et al., 2018; Alhassan & Naka, 2020).

In liquid markets, the mechanisms of price discovery operate efficiently, enabling rational valuation of derivatives and their underlying assets. Empirical evidence from developed markets demonstrates that high liquidity is associated with reduced transaction costs, lower volatility, and minimal pricing errors, conditions conductive to strong market efficiency (Chung & Hrazdil, 2010; Liu et al., 2023). Conversely, illiquid markets often exhibit delayed information assimilation, larger pricing deviations, and increased arbitrage potential, all of which undermine efficiency (Smith, 2022).

In derivative markets, the informational efficiency of futures relative to spot markets is often measured using cointegration frameworks and price discovery models (Hasbrouck, 1995; Hansen, 2022). The Hasbrouck Information Share (IS) model, for instance, quantifies the extent to which each market contributes to the efficient price (Lien et al. 2022). Empirical studies using IS models have shown that in mature markets, such as the U.S. or India, derivatives often lead spot markets in price discovery due to their higher liquidity and lower transaction costs (Adämmer et al., 2015). However, in markets like Kenya's NEXT, efficiency is undermined by low liquidity, regulatory frictions, and limited investor base, resulting in persistent mispricing (Malafeyev et al., 2019).

Moreover, the relationship between liquidity and efficiency is further influenced by volatility dynamics. As noted by Kulikova & Kulikov (2023), high liquidity tends to dampen excessive volatility by facilitating continuous trading and mitigating price gaps. In contrast, markets characterized by low liquidity are more prone to volatility spikers and inefficient pricing behavior, phenomena that have been repeatedly observed in emerging African derivatives markets (Malafeyev et al., 2019).

The empirical literature thus confirms that market liquidity and market efficiency share a bidirectional, reinforcing relationship. Efficient price discovery mechanisms rely on sufficient liquidity, while the presence of informational efficiency tends to attract higher tradingactivity challenges is crucial for realizing the efficiency goals envioend under financial market development strategies.

2.3.3. Moderating Role of Market Innovation on Efficiency and Liquidity

In recent years, attention has increasingly shifted toward the role of market innovation as a crucial catalyst for both liquidity and efficiency in derivatives markets (Di Castri & Plaitakis, 2018; Young & Auret, 2018; Mohapatra & Mishra, 2020). Innovation, encompassing financial products, technological platforms, regulatory reforms, and market infrastructure enhancements, has the potential to transform market dynamics by improving access, reducing information asymmetry, and attracting broader participation (Tufano, 2003; Biais et al., 2015).

Empirical evidence underscores the transformative role of financial innovation in enhancing market outcomes (Çetın, 2018; Lagos & Zhang, 2020). For instance, introducing electronic trading platforms and algorithmic trading systems in developed markets has significantly increased liquidity and reduced bid-ask spreads (Pagano & Roell, 1996; Menkveld, 2016). In emerging markets, innovations such as the introduction of new derivatives contracts, reforms to managing systems, and implementation of central counterparty clearing have shown measurable improvements in market activity and pricing efficiency (Perera et al., 2020).

However, the effectiveness of financial innovation is contingent upon the maturity of market structures and the adaptability of regulatory frameworks. Khuntia and Pattanayak (2019) argue that innovation must be sequenced with institutional readiness, as premature or poorly implemented reforms can increase complexity without delivering proportional improvements in liquidity or efficiency. Were (2020) emphasizes the need for regional coordination to prevent fragmented liquidity pools and redundant infrastructure, which can dilute the benefits of market modernization.

Focusing on Kenya, the Nairobi Securities Exchange (NSE) has introduced a series of innovations in its derivatives segment since the launch of the NEXT market in 2019. These include the rollout of NSE 25 Index Futures and Single Stock Futures, periodic margining policies, and digitalization of clearing operations (NSE, 2024). Despite these efforts, the empirical impact of such innovations on liquidity and efficiency remains underexplored, party to limited historical data, and modest levels of daily trading activity relative to more mature markets. Initial studies suggest that while innovation has the potential to enhance liquidity by attracting diverse investor classes and improving execution speeds, its effect is conditional upon market readiness and supportive policy environments (Feyen et al., 2021; Abbas, 2024).

Importantly, financial innovation may also play a moderating role in the relationship between liquidity and efficiency. In environments where innovation uptake is high, the adverse effects of low liquidity on efficiency can be mitigated through improved transparency, advanced trading systems, and the development of derivative instruments tailored to local risk profiles (Avgouleas & Kiayias, 2019). Conversely, when innovations are implemented in the absence of regulatory coherence or adequate investor education, it may deepen existing inefficiencies and distort market signals (Song & Zhao, 2024).

Moreover, the interaction between innovation and operational infrastructure is crucial. Even the most transformative innovations may fail to yield tangibility gains if not supported by adequate technological systems, investor engagement, and enforcement mechanisms. In the Kenyan context, innovations in market microstructure have yet to translate into sustained trading momentum. Despite the presence of structured derivative products, average daily remains low, raising questions about the depth of market participants, system readiness, and the effectiveness of ongoing regulatory oversight.

Table 2 below summarizes prior studies, their findings, and the methodology used.

Table 2. Summary of Literature

Author (s)	Study Objective	Methodology Used	Findings
Elsayed et al. (2024)	Examine volatility spillovers in emerging derivatives markets	VAR models on High-frequency data	High liquidity mitigates excessive volatility, enhancing stability
Sahoo & Kumar (2024)	Assess the role of liquidity in market efficiency across derivatives markets	GARCH models & HIS methodology	Higher liquidity leads to improve price discovery and efficiency
Liu et al. (2023)	Investigate liquidity and efficiency dynamics in Asian derivatives markets	Panel regression with efficiency metrics	Liquid markets exhibit lower volatility and enhanced information flow
Deng & Zhou (2023)	To analysze liquidity, volatility, and market microstructure noise in emerging markets	Analysis of high-frequency data	Identifies the distinct relationship between types of volatility and liquidity.
Fayen et al. (2021)	Evaluate innovation's impact on liquidity and efficiency in emerging markets	Cross-country empirical analysis	Innovation boost liquidity and efficiency but only with adequate policy and infrastructure support.
Rösch (2021)	Examine arbitrage efficiency in derivatives markets	Empirical asset pricing models	Arbitrage improves pricing efficiency, but market frictions reduce effectiveness in illiquid markets
Alhassan & Naka (2020)	Assess liquidity's impact on market efficiency in emerging economies	Time-series econometrics, event study methodology	Efficient markets require stable liquidity for optimal price adjustments
Ergun et al. (2020)	Investigate transaction costs and liquidity constraints	Microstructure analysis with bid-ask spread data	High transaction costs deter participation, limiting liquidity and efficiency

Khunia & Pattanyak (2019)	Assess liquidity-efficiency dynamics in derivatives markets	High-frequency data analysis with liquidity proxies	Strong liquidity correlates with reduced mispricing and volatility
Malafeyev et al. (2019)	To assess global financial crises' impact on market efficiency in China and India	GARCH and econometric models	Global financial crises lead to persistent inefficiencies in emerging markets
Saeed & Hassan (2018)	Study liquidity as a multidimensional construct	Sectorial liquidity analysis with regression models	Liquidity determinates vary across asset classes, requiring tailored regulatory interventions
Perveen et al. (2018)	To examine the impact of economic instability on Pakistan's derivatives markets	Case study analysis	Economic instability in derivatives can destabilize markets; calls for regulatory reform.
Ochenge & Muriu (2016)	Examine liquidity challenges in Kenya's derivatives market	Empirical case study of NSE derivatives trading	Limited investor participation and high costs hinder liquidity growth
Holden et al. (2014)	Assess structural elements affecting liquidity	Empirical analysis of market depth and transaction costs	Market infrastructure significantly influences liquidity and trading costs

Source: Author

2.4. Research Gap

Despite growing global literature on market liquidity and efficiency, empirical research on derivatives markets within Sub-Saharan Africa, particularly Kenya, remains limited. Most studies focus on equities or banking sectors, overlooking the Nairobi Securities Exchange Derivatives Segment (NEXT), which, since its 2019 launch, has faced persistent liquidity and efficiency challenges.

Existing frameworks, largely based on mature markets, emphasize drivers such as trading volume, macroeconomic stability, and investor behavior (Poufinas & Pappas, 2021; Jain et al., 2023; Paddrik & Tompaidis, 2023). However, these may not reflect the realities of Kenya's nascent derivatives market, where limited depth, infrastructure gaps, and regulatory evolution play a more central role.

Moreover, while the link between operational efficiency and liquidity has been extensively examined in equity markets (Njoroge et al., 2013; Kimani et al., 2014; Maina, 2019), little research explores how this relationship operates within derivative trading. Key attributes, such as transaction costs, contract design, counterparty risk, and leverage, require a distinct analytical lens. The application of price discovery models like Hasbrouck's Information Share (1995) is also rare in local contexts.

Market volatility, a known determinant of both liquidity efficiency (Naik et al., 2020; Kulikova & Kulikov, 2023), has not been significantly analyzed in Kenya's derivatives segment, where its impact may be amplified by thin trading and low investor participation. Likewise, the influence of regulatory reforms, technological innovation, and trading infrastructure remains underexplored, despite their significance in shaping market performance in emerging economies (Shruthi & Suresh, 2022).

Furthermore, regulatory frameworks and financial innovation, which are widely acknowledged as pivotal supporting market development (Di Castri & Plaitakis, 2018; Shruthi & Suresh, 2022), have not been rigorously examined within the Kenyan derivatives market. While scholars like Mugo (2017) and Odingo & Moronya (2018) address broader financial regulation in Kenya, they fall short of analyzing policy measures and innovations tailored specifically to derivatives, such as automated trading infrastructure, central clearing mandates, and investor protections, that may drive liquidity and efficiency outcomes.

The market infrastructure dimension, including the robustness of trading platforms, clearinghouses, and settlement processes, has also received insufficient empirical attention. International studies (Carmona & Webster, 2012) highlight the essential role of infrastructure in shaping trading efficiency, yet Kenya-specific evidence on how the structure and performance of the NEXT infrastructure influence market participation and execution quality remains anecdotal or descriptive at best.

Lastly, the role of investor composition, particularly institutional and foreign participation (Ochenge & Muriu, 2016), has minimal on how different participant typologies interact with derivatives contracts, though comparative studies in Brazil, India, and South Africa (Afful et al., 2017) show that diversified participation enhances derivatives market performance, a hypothesis to be tested in Kenya.

While existing studies provide a foundational understanding of Kenya's financial markets, they do not sufficiently capture the complexity of the NEXT ecosystem. The absence of rigorous empirical models addressing operational efficiency, regulatory innovation, volatility transmission, market infrastructure, and participant heterogeneity presents a critical gap. This study aims to fill these voids by empirically analyzing how these elements jointly and interactively affect liquidity and efficiency in Kenya's derivatives market. Addressing these gaps is essential for informing both scholarly discourse and policy interventions aimed at fostering a resilient and liquid derivatives ecosystem in Kenya.

Table 3 below maps these thematic to the study's objectives and methodological approach.

Table 3. Identified Research Gaps in Liquidity and Efficiency Studies on Kenya's Derivatives Market (NEXT)

Thematic Area	Existing Evidence	Identified Research Gap	Implication for current study
Liquidity Determinants in derivatives Markets	Empirical studies from mature markets (Poufinas & Pappas, 2021; Jain et al., 2023) emphasize macroeconomic variables and trading metrics	Limited empirical evidence on how microstructure and macroeconomic factors affect liquidity in Kenya's derivatives market	The study empirically investigates liquidity drivers in NEXT using localized market-specific indicators.
Market Efficiency in Derivatives markets	Most literature (Hasbrouck, 1995l Lien et al., 2022) focuses on developed markets or spot markets in emerging markets.	Scarcity of research assessing informational efficiency and price discovery in Kenya's derivatives trading.	The study applies Hasbrouck information Share and other models to evaluate price discovery and market efficiency in NEXT.
Impact of Operational Efficiency on Liquidity	Evidence from equity and banking markets in Kenya (Kimani et al., 2014; Njuguna, 2016).	Lack of empirical focus on how transaction mechanisms, and infrastructure influence liquidity in derivatives trading	The study explores the role of operational efficiency in shaping liquidity in NEXT.
Volatility's Role in liquidity and Efficiency	Global studies highlight volatility as a key liquidity driver (Naik et al., 2020), but focus is on cash markets.	Limited analysis of how derivatives-specific volatility affects liquidity and efficiency in Kenya.	The study incorporates volatility measures to assess their impact on both liquidity and efficiency in NEXT.
Influence of Market Innovation	Studies in India and Brazil (Chowdhry et al., 2017), Shruthi & Suresh, 2022) show strong links between reforms and liquidity.	Kenyan research has not isolated the impact of derivatives-specific reforms or innovations on market performance.	The study evaluates innovation variable as moderators of liquidity-efficiency dynamic

Source: Author

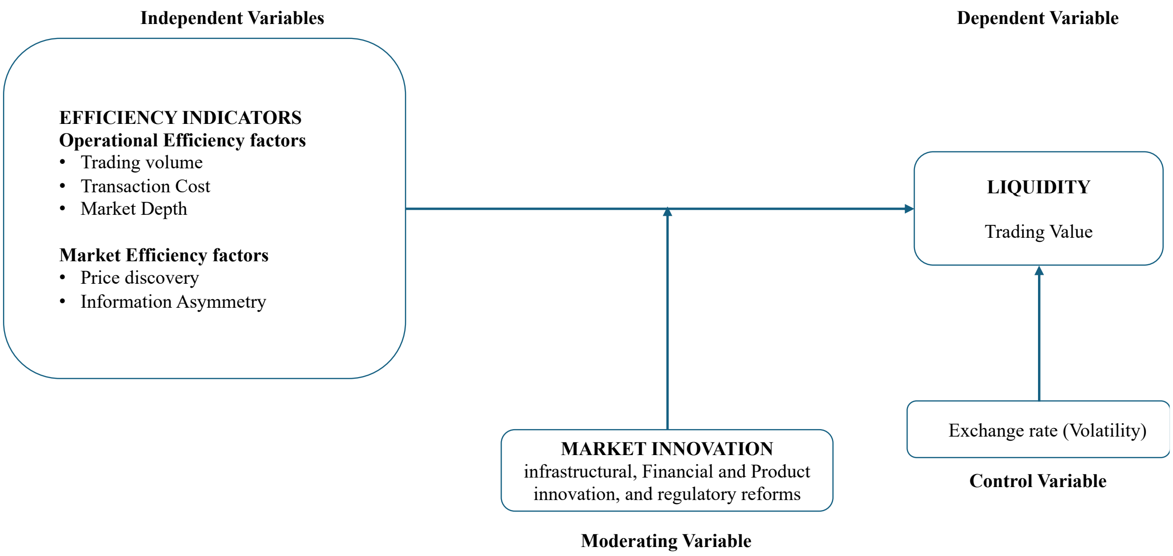
2.5. Conceptual Framework

A conceptual framework serves as a foundational structure that guides research by illustrating the hypothesized relationships among key variables (DeCuir-Gunby & McCoy, 2023). In Kenya's derivatives market (NEXT) context, this study investigates liquidity as the primary dependent variable, shaped by a combination of operational efficiency, market efficiency, and external market dynamics.

Figure 4 below presents a conceptual model that delineates these interactions, highlighting the role of operational efficiency factors (trading volume, transaction cost, and market depth) and market efficiency factors (price discovery efficiency and information asymmetry) as key determinants of liquidity. Additionally, exchange rate fluctuations are introduced as a control variable serving as a proxy for international market shocks that may influence liquidity.

Furthermore, market innovation, which encompasses regulatory reforms, technological advancements, introduction of new products, margin requirements updates, and infrastructure improvements, is integrated as a moderating variable. The moderating effects suggest that the impact of operational and market efficiency on liquidity may vary depending on the level of innovation within the derivatives market.

Figure 4. Conceptual Framework



Source: Author

2.6. Operationalization and Measurement of Variables

The important variables for the analysis are identified and operationalized in this subsection.

Table 4. Operationalization of Variables

Variable	Variable Definition	Measurement	Supporting Literature	Supporting Theories	Data Source
Dependent Variable					
Liquidity (*LIQ*)	The ease with which derivatives contracts can be traded without significantly impacting their price.	Trading value as proxy of liquidity. It is the total monetary value of all contracts traded in a session. It reflects Market Turnover. $\boldsymbol{Trading\ Value\ (LIQ) = Total\ Contracts\ Traded * VWAP * Nominal\ Contrat\ Size}$	Chordia, Roll, and Subrahmanyam (2000), Kyle (1985)	Liquidity Preference Theory, Market Microstructure Theory	NEXT daily reports
Operational Efficiency Factors					
Trading Volume *(TV)*	The total number of derivatives contracts exchanged in each period, indicating market activity.	The number of contracts traded.	Kyle (1985) – continuous trading model	Liquidity Preference Theory	NEXT daily reports
Transaction Cost (TC)	Cost associated with executing derivatives trades. Standard deviation	Standard deviation of price returns	Stoll (1989) Transaction Costs, Kyle (1985).	Market Microstructure Theory	NEXT daily reports

Market Depth (MD)	The availability of buy and sell orders at different price levels, reflecting market resilience.	Proxy for the number of orders per unit of traded volume.	Chang (2018); Ma et al. (2018).	Market Microstructure Theory	NEXT daily reports
Market Efficiency Factors					
Price Discovery Efficiency (EFF or IS)	The degree to which market prices reflect all available information.	Hasbrouck information share (IS) proxy of Market Efficiency.	Fama (1970); Hasbrouck (1995) – Information Shares in Prices Discovery: IS-Spot vs Futures market,	Efficient Market Hypothesis	NSE - NEXT daily reports
Information Asymmetry (IA)	The extent to which one party in a financial transaction process more or better information than the other.	Leverage effect from returns volatility (EGARCH)	Kyle (1985) – continuous trading model; Glosten & Milgrom (1985)	Market Microstructure Theory and Efficient Market Hypothesis	NSE - NEXT daily reports
Moderating Factor					
Market Innovation (*MI*)	The introduction of new products, services, or processes that significantly change the way a market operates.	Technology innovations; Market share of innovative products; Regulatory reforms. Measured by Market Innovation Index.	Glosten & Milgrom (1985), O'Hara (1995)	Market Microstructure Theory and Innovation Diffusion Theory	NEXT daily reports and CMA

Control Variable					
Exchange Rate *(EXCH)*	The effect of currency fluctuations due to global financial shocks on the derivatives market.	Exchange rate in KES/USD; Exchange rate volatility:	Khuntia & Pattanayak (2019), (Chowdhury et al., 2018)	Market Microstructure Theory	CBK & IMF

Source: Author

2.7. Chapter Summary

The chapter reviews the theoretical and empirical literature on liquidity, efficiency encompassing operational and market efficiency, and market innovation in derivatives markets, focusing on the Nairobi Securities Exchange derivatives Segment (NEXT). It integrates Market Microstructure Theory, Liquidity Preference Theory, Efficiency Market Hypothesis, and Innovation Diffusion Theory to explain liquidity dynamics.

Key determinants of liquidity, including trading volume, transaction costs, market depth, price discovery efficiency, price volatility, market participation, and exchange rate fluctuations, are analyzed. The chapter also explores the moderating role of market innovation on the relationship between efficiency and liquidity, encompassing regulatory reforms, technological advancements, and new product introductions.

The conceptual framework hypothesizes these relationships, providing a complex but structured approach for analysis. Additionally, the operationalization of variables ensures empirical rigor, defining key constructs and their proxies. This establishes a solid foundation for hypothesis development and the methodological design in the next chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter outlines the methodological framework employed in analyzing the impact of efficiency, which encompasses operational and market efficiency, on liquidity in the Nairobi Securities Exchange Derivatives Segment (NEXT), while also considering the moderating role of market innovation. It details the research design, data collection methods, and analytical techniques employed in the study. The chapter is structured to first discuss the research philosophy and design, followed by an exploration of the population, sampling approach, data collection procedures, and analytical methods. It concludes with an overview of the research quality and ethical considerations.

3.2. Research Philosophy

The research philosophy adopted for this study was rooted in the positivist paradigm, which posits that financial market phenomena can be objectively measured and analyzed through empirical methods (Creswell & Poth, 2018; Alam, 2019). Given the study's quantitative nature, this approach was used to assess causal relationships between efficiency, liquidity, and market innovation in the derivatives market (Phoenix et al., 2013; Park et al., 2019). A deductive approach was applied, with hypotheses derived from established theories such as the Liquidity Preference Theory (Keynes, 1936) and the Efficient Market Hypothesis (Fama, 1970). This framework ensured rigor in testing theoretical assumptions against observed market data.

3.3. Research Design

The research employed a quantitative descriptive research design. The descriptive design was appropriate for presenting a structured analysis of liquidity patterns, efficiency metrics, and market innovation across the NEXT, offering a clear and measurable account of market behavior (Cote, 2021). Quantitative methods facilitated objective measurement and statistical testing using financial data, aligning with the study's goal to empirically assess market dynamics (Phoenix, et al., 2013; Kotronoulas, et al., 2023).

This methodological approach ensured that the study not only presented an overview of market performance but also explained the structural factors influencing liquidity in the Kenyan derivatives market.

3.4. Population and Sampling

3.4.1. Population and Sampling Procedure

The study employed a census sampling approach, encompassing all derivatives contracts traded on the Nairobi Securities Exchange Derivatives Market (NEXT) between January 4th, 2021, and December 31st, 2024. This included ten (10) Single Stock Futures (SSFs), the NSE 25 Index Future, and the Mini Index 25 Futures. Daily trading data and contract-specific information were sourced directly from official NSE trading bulletins and the NEXT segment's historical data archive. (NSE, 2024) Supplementary macroeconomic data, such as daily exchange rates from the Central Bank of Kenya (CBK) validated by the Kenya National Bureau of Statistics (KNBS). Additionally, market reports and policy documents from the Nairobi Securities Exchange (NSE-NEXT) and Capital Market Authority (CMA) were analyzed to contextualize trends in liquidity, efficiency, and market innovation.

3.5. Data Collection Methods

3.5.1. Quantitative Data

Secondary data were collected from institutional sources, including NSE, CMA, CBK, and KNBS. Key indicators analyzed included trading value, trading volume, contract prices, open interest, and exchange rates as a proxy for external shocks.

3.5.2. Document Analysis

Documentary evidence from the NSE and CMA was critically analyzed to identify regulatory or institutional innovations. Following Bowen (2009) and Dalglish et al. (2020), document analysis is a systematic procedure for reviewing or evaluating documents, printed and electronic material. This was complemented by reviewing policy documents and reports to provide supplementary insights into market innovations and their impact on market stability and development (Ragab & Arisha, 2018). Innovations were codified using dummy variables (0 = No innovation/No change; 1= innovation/change) and documented in Appendix 2.

3.5.3. Data Cleaning and Preparation

Data cleaning involves the process of identifying and removing errors and inconsistencies from the raw data collected, ensuring data quality and reliability. Data were subjected to rigorous cleaning processes to ensure completeness, accuracy, and consistency. Although initial data collection spanned the full inception of NEXT (2019), the analysis was refined to include only the complete daily dataset from January 4th, 2021, and December 31st, 2024. The quality of trading data was prioritized, and incomplete 2020 data was noted in Appendix 1. All trading data is quantitative and numeric.

3.6. Data Analysis Techniques

This study applied both descriptive and econometric techniques to analyze the interrelationships among liquidity, efficiency, and market innovation within the Kenyan derivatives market. Descriptive statistics such as mean and standard deviation were used to summarize the dataset. The core analytical framework includes panel regression models, time-series econometrics, Vector Autoregressive (VAR) modeling, and interaction-based regression models to examine moderating effects.

Given the divergence in analytical scope and methodological requirements, the empirical strategies for the three objectives were treated distinctly.

3.6.1. Operational Efficiency

To capture heterogeneity in operational efficiency factors, a cross-sectional or panel regression model focused on operational sector-level determinants of liquidity. To account for variations across contracts and over time, the model was specified as a panel regression (Zulfikar & Mayvita, 2017).

$$LIQ_{it} = \beta_0 + \beta_1 TV_{it} + \beta_2 TC_{it} + \beta_3 MD_{it} + \beta_4 EXCH_t + \epsilon_{it} \quad (3.1)$$

Where:

- ***LIQ_{it}***: Liquidity measured by trading value for contract "i" at time t. It represents the total monetary value of all shares or contracts traded within a specific period.
- ***TV_{it}*****:** Trading volume refers to the product of the number of shares traded (volume) and the weighted average price at which each share was traded (NSE, 2024).
- ***MD_{it}****:* Market depth (proxy for the number of orders per unit of traded volume). It is the ratio of open interest to trading calculated as follows:

$$MD_t = \frac{OI_t}{TV_t} \quad (3.1.1.)$$

Where: **OI** is the Open Interest at time t, and **TV** is Trading Volume at time t.

- ***TC****$_{it}$*: Transaction cost (standard deviation of the returns over a short moving window).

$$TRC_t = \sigma(R_t) \quad (3.1.2.)$$

- *$EXCH_t$:* Exchange rate fluctuations
- *ε_{it}:* Error term

The panel regression model was estimated using either Fixed Effects (FE) or Random Effects (RE) frameworks, based on the outcome of the Hausman specification test. Pre-estimation diagnostics included unit root tests, multicollinearity checks, and stationarity analysis.

3.6.2. Market (Informational) Efficiency

To capture the dynamic relationship between market efficiency and liquidity, the Vector Autoregressive (VAR) framework was employed, complemented by Granger causality tests. The VAR model identified whether past values of market efficiency help predict current liquidity, acknowledging potential bidirectional effects. The VAR equation (3.3) is specified in the following equation:

We derived the VAR system of equations specified as:

$$Y_t = A_0 + \sum_{i=1}^{p} A_i Y_{t-i} + \varepsilon_t \quad (3.2)$$

Where Y_t is the vector of endogenous variables: liquidity, market efficiency (EFF) extracted from the Hasbrouck Information Share analysis through VECM, and Information asymmetry (IA) estimated via the EGARCH (1,1) model. The steps for extraction are as follows:

Step 1: Preparation for extracting information asymmetry (IA)

<u>*Mean Equation*</u>**:** $$r_t = \alpha + \gamma_1 * \epsilon_t;\ \epsilon_t = \sigma_t z_t \quad (3.2.1)$$

Where: $\mathbf{r_t}$ is the average derivative market price return.

<u>*Variance Equation*</u>**:** The EGARCH model, developed by Nelson (1991), uses the logarithm of the conditional variance, allowing it to model the variance to ensure it is always positive. The variance equation is expressed as:

$$ln(\sigma_t^2) = \boldsymbol{\omega} + \sum_{i=1}^{p} \boldsymbol{\alpha_i} \frac{|\epsilon_{t-1}|}{\sigma_{t-1}} + \sum_{j=1}^{q} \boldsymbol{\beta_j}\, l\,n\left(\sigma_{t-j}^2\right) + \boldsymbol{\gamma}\, \frac{\epsilon_{t-1}}{\sigma_{t-i}} \quad (3.2.2)$$

This formulation captures the asymmetry ($\boldsymbol{\gamma}$) in the response of volatility to positive and negative shocks.

Where:

- $\boldsymbol{\omega}$ is the constant term.
- $\boldsymbol{\alpha_i}$ measures the impact of past shocks on current volatility, as the coefficient of the ARCH terms.
- $\boldsymbol{\beta_j}$ measures the persistence of volatility over time, as the coefficient of the GARCH terms.
- $\boldsymbol{\gamma}$ is the key asymmetry parameter, as the coefficient of the EGARCH terms

A significant, positive $\boldsymbol{\gamma}$ implies a stronger market response to negative shocks, indicating high information asymmetry.

For **price discovery efficiency** (EFF), the link between future and spot prices, Hasbrouck's Information Share (IS) model (Hasbrouck, 1995), which estimates the proportion of information from market relative to the underlying cash market (Lien et al. 2022).

This gives the percentage of price discovery attributed to the futures market, using the Variance-Covariance Matrix, as follows:

$$\Sigma = \begin{bmatrix} Var(\epsilon_{t,F}) & Cov(\epsilon_{t,F}, \epsilon_{t,S}) \\ Cov(\epsilon_{t,F}, \epsilon_{t,S}) & Var(\epsilon_{t,S}) \end{bmatrix} \qquad (3.2.3.)$$

The Hasbrouck Information Share (IS) will use the following formula from the Variance-Covariance Matrix:

$$EFF = IS_f = \frac{(e_f' \Sigma e_t)}{e_f' \Sigma e_t + e_s' \Sigma e_s} \qquad (3.2.3.)$$

Where $\boldsymbol{e_f}$ and $\boldsymbol{e_s}$ are the error terms (innovations) for the futures and spot markets, respectively.

Step 2: Preparation for extracting price discovery efficiency (EFF)

In this study, Hasbrouck Information Share (IS) was assessed as a proxy of informational efficiency using the Vector Error Correction Models (VECM) of Engle & Granger (1987) and was evaluated to decompose the contributions of the futures and spot markets.

$$Price_{t,Futures} = \alpha + \beta_1 P_{t,Spot} + \mu_t \quad (3.2.4.)$$

Here $\boldsymbol{\mu_t}$ is the cointegration residual representing deviations from long-term equilibrium.

$$\Delta Price_{t,F} = \beta_0 + \sum_{i=1}^{p-1} \beta_1 \Delta Price_{t-i,F} + \sum_{i=1}^{p-1} \beta_2 \Delta Price_{t-i,S} + \phi(\mu_{t-1}) + \epsilon_{t,F} \quad (3.2.4.1.)$$

$$\Delta Price_{t,S} = \lambda_0 + \sum_{i=1}^{p-1} \lambda_1 \Delta Price_{t-i,F} + \sum_{i=1}^{p-1} \lambda_2 \Delta Price_{t-i,S} + \psi(\mu_{t-1}) + \epsilon_{t,S} \quad (3.2.4.2.)$$

Where:

- $\boldsymbol{\mu_{t-1}}$, is the lagged cointegration, representing the deviation from equilibrium at time $\boldsymbol{t-1}$.
- $\boldsymbol{\phi}$ and $\boldsymbol{\psi}$ are the error correction terms' coefficients, indicating the adjustment speed toward equilibrium.
- $\boldsymbol{\beta}$ and $\boldsymbol{\lambda}$ are short-term coefficients $\epsilon_{t,s}$ and $\epsilon_{t,f,}$ error terms.

Following the requirements of the Vector Error Correction Model (VECM), the variables included must exhibit integration of one order, I (1).

3.6.3. Moderating role and Interactions Terms

To capture the moderating role of innovation, interaction terms were incorporated into the regression model (Mize, 2019), allowing the study to assess how various innovations affect the efficiency-liquidity relationship. The model (3.3) further accounts for market-level variables to comprehensively capture innovation's modeling role.

The regression model will also capture the moderating effect of market innovation on liquidity and efficiency, including market variables. The analysis will involve a two-step approach, outlined as follows:

Step 1: Pre-moderation Model:

The baseline equation for the interaction regression model:

$$LIQ_t = \beta_0 + \beta_1 TV_t + \beta_2 TC_t + \beta_3 MD_t + \beta_4 EFF_t + \beta_5 IA_t + \beta_6 EXCH_t + \epsilon_t \quad (3.3)$$

Step 2: Moderation Model:

To test for moderation by market innovation (MII), interaction terms are included:

$$(3.4) \quad LIQ_t = \beta_0 + \beta_1 TV_t + \beta_2 TC_t + \beta_3 MD_t + \beta_4 EFF_t + \beta_5 IA_t + \beta_6 EXCH_t + \beta_8 MII_t + \delta_1(TV_t * MII_t) + \delta_2(TC_t * MII_t) + \delta_3(MD_t * MII_t) + \delta_4(EFF_t * MII_t) + \epsilon_t$$

The interaction terms allow examination of how market innovation influences the effect of each determinant on liquidity (Frost, 2018; Mize, 2019).

To construct a robust and data-driven Market Innovation Index (MII_t). This applies Principal Component Analysis (PCA) to a set of binary variables representing specific reforms and innovation events within the Nairobi Securities Exchange Derivatives Market (NEXT) listed in Appendix 2. These include the introduction of new derivative products (PI), financial reforms (FI), technological innovations (TI), and infrastructure improvements (II), as well as regulatory upgrades (RR).

PCA is a dimensionality reduction technique that transforms correlated variables into a smaller set of uncorrelated components, principal components (Jolliffe & Cadima, 2016). Mathematically, the first principal component maximizes the variance captured in the data and is given by the linear combination:

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p \qquad (3.4.1.)$$

Where $x_{1,}x_2, \dots, x_p$, are the original binary innovation variables a_{1j} are the corresponding component loadings. In this study, the first component is adopted as the Market Innovation Index ($MII_{t)}$, representing the most dominant underlying pattern of innovation activity across time. This continuous index captures both the intensity and the diversity of innovation and serve as the moderator in the regression framework.

3.7. Analytical Tools and Software

Quantitative analyses were performed using software such as EViews (versions 9 and 12) and STATA (version 18), depending on the specific requirements of each model. Microsoft Excel was used for initial data organization. The use of multiple software platforms ensured robustness and flexibility in model testing and visualization.

3.8. Research Quality – Validity, Reliability, and Objectivity

3.8.1. Validity

Validity was ensured by using multiple data sources and triangulation of findings (Low et al., 2018). The use of objective quantitative data and established diagnostic tests further supported statistical internal and external validity.

Internal validity was reinforced by employing well-established quantitative methods, such as panel regression with Hausman tests, VAR and Granger causality analysis, and interaction-based moderation models, ensuring that the relationships tested were causally meaningful and free from endogeneity. External validity was enhanced using a comprehensive daily dataset from January 2021 to December 2024 covering key features on NEXT. Statistical and construct validity were confirmed through unit root test (ADF), heteroskedasticity and autocorrelation diagnostics, and application of VECM and EGARCH models to capture long-run dynamics and asymmetric volatility patterns.

3.8.2. Reliability

Reliability was achieved through standardized data collection procedures, clear operational definitions of variables, and unbiased interpretation of data (Cooper & Schindler, 2019). Robustness checks, including alternative model specifications and Newey-West standard errors, ensured result consistency. The use of PCA for index construction and first differencing of non-stationary variables further reinforced the reliability and reproducibility of the findings.

3.9. Ethical Considerations

Ethical compliance was strictly maintained throughout the study. Since only secondary data were used, informed consent was not required. However, all data sources were properly acknowledged, and confidentiality was preserved by excluding any proprietary or sensitive information. The research complied with the ethical guidelines of Strathmore University Business School and adhered to relevant Kenyan regulatory standards. The APA reference style was used consistently, with neutrality and transparency, and data were securely stored under data protection laws.

3.10. Chapter Summary

This chapter provides a comprehensive overview of the research methodology, grounded in the positivist paradigm and a deductive approach. It details the research design, sampling strategy, data collection, and analytical techniques used to examine the determinants of liquidity in the NEXT, with market innovation as a moderating factor. A census of all Single Stock Futures and NSE 25 Index Futures is conducted. The empirical strategy integrates panel data regression, Granger causality, and vector autoregressive (VAR) models to capture both cross-sectional and dynamic aspects of liquidity. A VECM and the EGARCH were utilized to extract price discovery and information asymmetry, respectively. Principal Component Analysis (PCA) is applied to derive a composite index for market innovation. Emphasis is placed on ensuring data reliability and ethical compliance, establishing a rigorous and contextually appropriate foundation for analyzing Kenya’s emerging derivatives market.

CHAPTER FOUR

PRESENTATION AND RESEARCH FINDINGS

4.1. Introduction

This chapter presents the analysis of the data collected and the subsequent results obtained from the study of the relationship between liquidity and efficiency in the Kenyan derivatives market, called NEXT, as well as investigates the impact of market innovations such as regulatory reforms, technological advancements, the introduction of new products, margin requirements updates and infrastructure improvements from the period between January 4th, 2021, and December 31st, 2024. The chapter is organized into several sections, each addressing specific aspects of the research questions and hypotheses.

Initially, the chapter provides an overview of the data collected, including its sources and characteristics. The data analysis process involves several stages, beginning with data cleaning and preparation, followed by descriptive statistical analysis, time series analysis, and robustness checks. The findings are presented in the form of tables, figures, and narratives, providing a comprehensive overview of the empirical evidence.

4.2. Descriptive Statistics

Descriptive statistics, such as means and standard deviations, are presented according to the variables (dependent and independent) and objectives to provide an overview of the characteristics of the variables after transformation. It provides key insights into the dynamics of Kenya's derivatives market[1], particularly across futures prices, spot prices, trading value, and trading volume of various underlying assets.

4.2.1. Operational Efficiency in Kenya's NEXT

Operational efficiency within the Kenyan derivatives market has been proxied by three key variables: trading volume, transaction costs, and market depth. These proxies provide a composite view that actively and cost-effectively market participants can execute trades, and the extent to which the market can absorb large orders without significant price disruption.

[1] IINDEX (Index 25); MIN25 (MINI 25 Index); SCOM (Safaricom Plc); EQTY (Equity Bank Group holding), KCBG (Kenya Commercial bank Group); EABL (East Africa Breweries Ltd); BATK (British American TobaccoKenya); ABSA (Absa Kenya) NCBA (Ncba Kenya) Coop (Co-operative Bank of Kenya Ltd) Scbk (Standard Chartered Bank Kenya Ltd); IMPH (I&M Group Plc); and EXCH (Exchange Rate KES/USD)

4.2.1.1. Trading Volume

As reflected in Table 5, trading volume (TV) remains highly skewed across instruments, with a notable concentration in a few actively traded contracts. SCOM futures show the highest mean trading volume (9.511), followed by EQTY (3.158) and KCB Group (KCB, 3,371), suggesting higher investor participation and turnover in these contracts. In stark contrast, contracts such as IMHP, SCBK, and NCBA show mean volumes below 0.3, indicating minimal trading activity and a lack of consistent investor interest.

Table 5. Individual Stock Futures – Trading Volume (2021-2024)

Trading Volume	Index	Min25	Scom	Eqty	Kcbg	Eabl
Mean	0.077	0.567	9.511	3.158	3.371	1.298
Standard Deviation	0.630	8.451	32.746	7.674	9.099	6.731
Kurtosis	187.906	517.420	160.699	20.969	35.259	404.741
Skewness	12.514	22.118	11.407	3.978	5.225	17.208
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	12.000	216.000	504.000	79.000	100.000	170.000
Sum	76.000	560.000	9,397.000	3,107.000	3,331.000	1,282.000

Trading Volume	Batk	Absa	Ncba	Coop	Scbk	Imhp
Mean	0.532	1.808	0.285	0.781	0.089	0.271
Standard Deviation	2.293	6.163	1.636	6.471	0.727	4.498
Kurtosis	47.075	48.006	144.683	204.268	152.829	479.828
Skewness	6.361	6.038	10.436	13.688	11.497	21.807
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	24.000	76.000	30.000	109.000	12.000	100.000
Sum	526.000	1,786.000	282.000	772.000	88.000	268.000

***Source**: Author's computation using Excel*

The extreme kurtosis and skewness values, such as 160.7 for SCOM and 4798.9 for IMHP, suggest a distribution characterized by a high frequency of zero-trading days, punctuated by occasional spikes, reinforcing the episodic and shallow nature of market activity.

4.2.1.2. Transaction costs

Transaction costs (TC), proxied by the five-day rolling standard deviation of price returns (Table 6), reveal moderate variability across contracts. Most instruments exhibit relatively low mean transaction cost values (between 0.006 and 0.016), indicating that while costs may not be prohibitively high, they remain non-trivial, especially in less liquid contracts like IMHP and

COOP, which display higher standard deviations and skewness. The elevated kurtosis of some contracts, such as IMHP (76.263) and BATK (25.909), suggests the presence of sudden transaction cost spikes, likely during periods of low liquidity or market stress.

Table 6. Individual Stock Futures – Transaction Costs (2021-2024)

Transaction costs	Index	Min25	Scom	Eqty	Kcbg	Eabl
Mean	0.007	0.006	0.016	0.014	0.013	0.016
Standard Error	0.000	0.000	0.000	0.000	0.000	0.000
Standard Deviation	0.004	0.004	0.012	0.009	0.010	0.012
Kurtosis	3.803	3.184	10.134	5.275	8.370	5.225
Skewness	1.526	1.283	2.497	1.741	2.277	1.932

	Batk	Absa	Ncba	Coop	Scbk	Imhp
Mean	0.012	0.011	0.012	0.008	0.007	0.011
Standard Error	0.000	0.000	0.000	0.000	0.000	0.001
Standard Deviation	0.011	0.008	0.013	0.009	0.009	0.021
Kurtosis	25.909	4.626	0.589	2.805	6.282	76.263
Skewness	3.719	1.759	1.026	1.489	2.198	7.369

Source*: Author's computation using Excel*

These findings imply that transaction costs still deter trading, particularly in less liquid instruments, thereby constraining overall market efficiency.

4.2.1.3. Market Depth

Market depth (MD) statistics in Table 7 further illustrate disparities in operational efficiency across instruments. SCOM, EQTY, and KCB again dominate, with average market depth values of 21.986, 5.640, and 8.632, respectively, indicative of robust order book activity in these contracts. Conversely, instruments such as SCBK (mean=0.045) and IMHP (mean=0.143) reveal a near-absence of depth, reinforcing across most contracts, especially IMHP (Skewness = 31.03, Kurtosis = 970.82), underscore the presence of sporadic order placement rather than continuous depth, again highlighting the immaturity and inefficiency of the market microstructure.

Table 7. Individual Stock Futures – Transaction Costs (2021-2024)

Market Depth	**Index**	**Min25**	**Scom**	**Eqty**	**Kcbg**	**Eabl**
Mean	0.030	0.141	21.986	5.640	8.632	1.687
Standard Deviation	0.186	0.744	58.567	12.998	20.568	5.496
Kurtosis	55.813	52.500	38.446	14.605	29.325	18.090
Skewness	7.101	6.796	5.494	3.427	4.539	4.092
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	2.000	9.000	574.000	99.000	214.000	47.000
Sum	29.583	139.742	21,722.429	5,571.955	8,528.237	1,666.442

	Batk	**Absa**	**Ncba**	**Coop**	**Scbk**	**Imhp**
Mean	0.378	4.872	0.488	0.511	0.045	0.143
Standard Deviation	1.669	14.784	3.614	5.142	0.363	3.194
Kurtosis	55.481	22.341	117.037	375.872	151.294	970.818
Skewness	6.661	4.374	10.480	18.610	11.475	31.031
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	22.000	113.000	44.000	109.000	6.000	100.000
Sum	372.998	4,813.641	482.477	504.973	44.200	141.083

***Source**: Author's computation using Excel*

Table 8 combines all three proxies to provide a summary of overall operational efficiency at the market level.

Table 8. Individual Stock Futures – Operational Efficiency (2021-2024)

	Market (TV)	**Market (TC)**	**(MD)**
Mean	21.736	0.011	3.727
Standard Error	1.467	0.000	0.200
Standard Deviation	46.100	0.005	6.292
Kurtosis	76.213	2.985	25.279
Skewness	7.567	1.276	4.271
Sum	21,475.000	-	2,389.731

***Source**: Author's computation using Excel*

The market-wide average trading volume is 21.736, with a high standard deviation of 46.100, reflecting the lopsided participation across instruments and time. Average transaction costs remain moderate (mean=0.011), but again, volatility exists. The mean market depth stands at 3.727, a relatively low figure considering the role of derivatives in ensuring market stability and hedging opportunities. The excessive kurtosis and Skewness across all proxies (Kurtosis for TV = 76.213; for MD = 25.279) further emphasize the episodic and unstable nature of liquidity provision in the NEXT.

The operational indicators reveal a market marked by uneven participation, sporadic depth, and cost asymmetries. While a few contracts exhibit healthy trading volumes and depth, the broader market remains underdeveloped and operationally inefficient.

4.2.2. Market Efficiency in Kenya's NEXT Market

Market efficiency in this study is assessed through two core indicators: price discovery efficiency (EFF) and information asymmetry (IA), as summarized in Table 9. These measures provide insights into how effectively market prices reflect available information and how equitably that information is distributed among participants.

Table 9. Individual Stock Futures – Market Efficiency (2021-2024)

Market Efficiency	**Price discovery Efficiency (EFF)**	**Information Asymmetry (IA)**
Mean	0.808	0.000
Standard Error	0.009	0.000
Standard Deviation	0.285	0.008
Kurtosis	2.497	8.369
Skewness	1.267	0.393

Source*: Author's computation using Excel*

The mean value of EFF stands at 0.808, indicating that, on average 80% of price formation occurs in the derivatives market relative to the underlying spot market. However, the relatively high standard deviation (0.285) and positive skewness (1.267) signal significant variability across periods, implying that efficiency is inconsistent, and likely influenced by liquidity constraints and contract-specific trading intensity.

Conversely, while the mean IA value is effectively zero, its elevated kurtosis (8.369) reveals irregular but extreme order imbalances, indicative of occasional high information asymmetry. This suggests that the market occasionally experiences sharp disparities in information access, potentially due to thin trading, limited transparency, or insider advantages.

4.2.3. Liquidity in Kenya's NEXT Market

Tables 10 and 11 present the descriptive statistics of trading value, used in this study as a proxy for market liquidity in Kenya's derivatives market. The statistics reveal significant disparities in liquidity levels across contracts.

Table 5 below captures the trading activity of individual Single Stock Futures (SSFs) and the NSE 25 Index Futures on the NSE derivatives market (NEXT).

Table 10. Liquidity for Each Futures Stock (2021-2024)

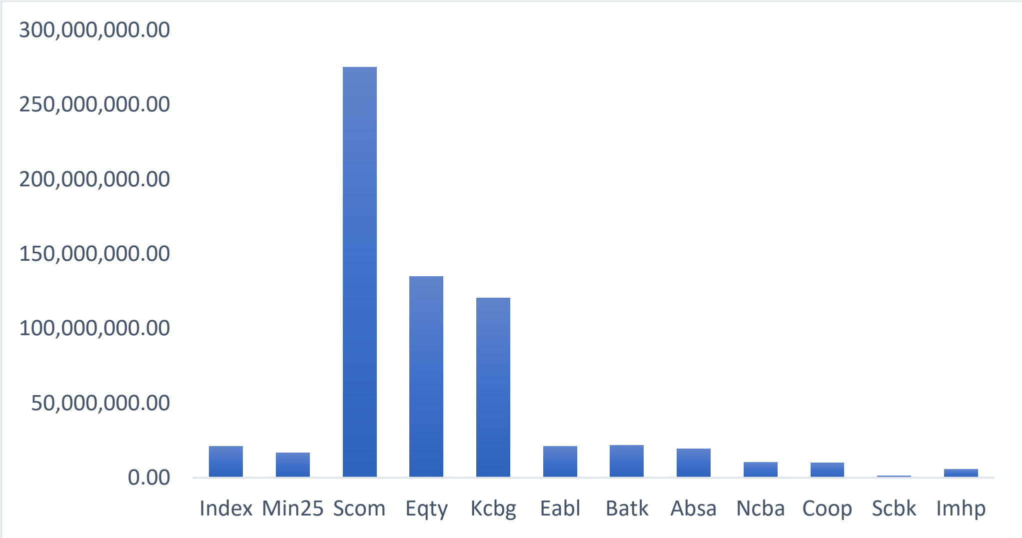
Trading Value	Index	Min25	Scom	Eqty	Kcbg	Eabl
Mean	21,254.858	16,815.091	278,612.996	136,552.186	122,024.747	21,190.703
Standard Error	6,411.286	7,474.576	39,857.960	10,557.940	10,447.133	3,517.171
Standard Deviation	201,522.523	234,944.368	1,252,834.032	331,862.110	328,379.171	110,553.374
Kurtosis	286.797	517.148	242.845	19.704	35.245	438.985
Skewness	15.779	21.992	14.638	3.938	5.210	18.078
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	4,341,000.000	6,037,200.000	22,296,860.000	3,184,110.000	3,735,000.000	2,850,900.000
Sum	20,999,800.000	16,613,310.000	275,269,640.000	134,913,560.000	120,560,450.000	20,936,415.000

Trading Value	Batk	Absa	Ncba	Coop	Scbk	Imhp
Mean	21,818.897	19,688.593	10,352.298	9,971.903	1,367.692	5,822.986
Standard Error	2,966.515	2,132.133	1,846.850	2,700.384	356.022	3,057.065
Standard Deviation	93,244.878	67,018.206	58,051.043	84,879.744	11,190.658	96,091.111
Kurtosis	49.403	58.387	110.547	218.752	148.447	479.061
Skewness	6.421	6.447	9.262	14.136	11.395	21.779
Minimum	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	1,053,000.000	934,800.000	972,000.000	1,545,600.000	177,300.000	2,152,560.000
Sum	21,557,070.000	19,452,330.000	10,228,070.000	9,852,240.000	1,351,280.000	5,753,110.000

***Source**: Author's computation using EViews and Excel*

From Table 10, it is evident that trading activity is slightly contracted among few instruments. Notably, Safaricom (SCOM), Equity Bank (EQTY), and KCB Group (KCBG) futures exhibit the highest average daily trading values, KES 278,612.996, KES 136,552.186, and KES 122,024.747 respectively, indicating relatively higher investor interest and turnover. In contrast, contracts such as Standard Charted (SBCK) and I&M Holdings (IMHP) show consistently low averages (below KES 6,000), in Figure 5 below, suggesting limited market participation and potentially poor price discovery in these instruments.

Figure 5. Individual Stock Futures – Trading Value (2021-2024)



***Source**: Author's computation using Excel*

The high standard deviations, particularly for SCOM (KES 1.25 million) and EQTY (KES 331,862), reflect substantial volatility in trading volumes, reinforcing the episodic nature of liquidity in the market. The presence of extreme skewness and Kurtosis across all contracts, most notably for IMPH (Sk: 21.799); Ku: 479.061), further indicates that while most trading days register minimal activity (Min = 0), there are occasional, abrupt surges in volume. This pattern aligns with characteristics of illiquid or nascent markets, where market depth is insufficient, and trading is driven more by sporadic institutional activity or speculative behavior than by consistent investor engagement.

The overall market liquidity, presented in Table 11 below, aggregates the trading value across all derivatives. The mean trading value at the market level is KES 665,472.950, with a standard deviation of KES 1.57 million, reflecting the overall inconsistency in daily liquidity. The aggregate skewness (9.871) and Kurtosis (126.672) similarly reveal a market prone to infrequent but intense trading sessions, consistent with findings at the individual contract level. These stylized facts support that the NEXT remains shallow and fragmented, with liquidity driven by a narrow investor base and limited product uptake.

Table 11. Overall Market Liquidity (2021-2024)

Trading Value	***Market Liquidity (LIQ)***
Mean	665,472.950
Standard Error	50,097.571
Standard Deviation	1,574,690.259
Kurtosis	126.672
Skewness	9.817
Minimum	0.000
Maximum	49,280,330.000
Sum	657,487,275.000

***Source**: Author's computation using Excel*

Collectively, the descriptive statistics underscore a critical challenge: while the introduction of derivatives was aimed at enhancing liquidity and market depth, the current trading patterns reveal persistent inefficiencies, the concentration of activity in a few instruments, and a high prevalence of zero trading days.

4.3. Inferential Results and Econometrics Analysis

This section presents the empirical findings derived from econometric modeling to evaluate the key determinants of liquidity in the Nairobi Securities Exchange derivatives segment/market (NEXT), specifically focusing on operational efficiency, market efficiency, and the moderating effect of market innovation.

4.3.1. Effect of Operational Efficiency on Liquidity in the NEXT Market

Using a balanced panel regression technique, Model 1 estimates the influence of operational efficiency, proxied by trading volume transaction cost, and market depth, on derivatives market liquidity in Table 8. The Hausman specification test guides the choice between Fixed Effects (FE) and Random Effects (RE) estimators.

Equation (3.2): $LIQ_{it} = \beta_0 + \beta_1 TV_{it} + \beta_2 TC_{it} + \beta_3 MD_{it} + \beta_4 EXCH_t + \epsilon_{it}$

Table 12. Panel Regression- Fixed Effects Results

Periods included: 988
Cross-sections included: 12
Total panel (balanced) observations: 11856

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TV	34153.12	121.5601	280.9566	0.0000
TC	-416849.0	120934.6	-3.446897	0.0006
MD	162.2920	69.92710	2.320875	0.0203
EXCH	-10408.03	3371.311	-3.087236	0.0020
C	-152.9289	2016.768	-0.075829	0.9396

***Source**: Author's computation using EViews*

The results from the Fixed Effects model, which accounts for time unobserved heterogeneity at the cross-sectional level, indicate significant relationships between operational efficiency factors and liquidity. Specifically, trading volume (TV) has a positive and highly significant effect on liquidity, with a coefficient of 34,153.12 (p-value = 0.000). this finding suggests that higher trading volumes lead to increased liquidity. Conversely, transaction costs (TC) have a negative and statistically significant impact on liquidity, with a coefficient of -416,849 (p-value = 0.0006), indicating that higher transaction costs reduce liquidity. Market depth (MD) is positively associated with liquidity, with a coefficient of 162.29 (p-value = 0.0203), suggesting that greater market depth enhances liquidity. Exchange rate fluctuations (EXCH) are found to negatively affect liquidity, with a coefficient of -10,408.03 (p-value = 0.0020), implying that exchange rate volatility hinders market liquidity.

To determine the most appropriate model, a Hausman test was conducted and presented in Table 13 below.

Table 13. Hausman test –Random Effects Result

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	4	1.0000

* Cross-section test variance is invalid. Hausman statistic set to zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
TV	34153.12...	34143.635...	38.071836	0.1242
TC	-416849.0...	-423962.65...	54644669....	0.3359
MD	162.292050	154.609863	22.898170	0.1084
EXCH	-10408.03...	-10397.788...	192.416254	0.4601

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-152.9289	2016.768	-0.075829	0.9396
TV	34153.12	121.5601	280.9566	0.0000
TC	-416849.0	120934.6	-3.446897	0.0006
MD	162.2920	69.92710	2.320875	0.0203
EXCH	-10408.03	3371.311	-3.087236	0.0020

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.874769	Mean dependent var	55456.08
Adjusted R-squared	0.874610	S.D. dependent var	408602.7
S.E. of regression	144688.0	Akaike info criterion	26.60390
Sum squared resid	2.48E+14	Schwarz criterion	26.61386
Log likelihood	-157691.9	Hannan-Quinn criter.	26.60724
F-statistic	5513.671	Durbin-Watson stat	1.823551
Prob(F-statistic)	0.000000		

Source: *Author's computation using EViews and Excel*

Table 13 shows that the Hausman test statistic is 0.0000, with a p-value of 1.000, which indicates that the Random Effects model is preferred. The high p-value fails to reject the null hypothesis, suggesting that unobserved individual effects are uncorrelated with the regressors, thus supporting the use of the Random Effects model.

Table 14. Panel Regression –Random Effects Result

Periods included: 988
Cross-sections included: 12
Total panel (balanced) observations: 11856
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TV	34143.64	121.4034	281.2411	0.0000
TC	-423962.7	120708.5	-3.512286	0.0004
MD	154.6099	69.76318	2.216210	0.0267
EXCH	-10397.79	3371.283	-3.084223	0.0020
C	-30.62449	6675.165	-0.004588	0.9963

Source: *Author's computation using EViews*

The Random Effects model yields the following estimated equation (3.2), elucidating the multifaceted operational efficiency determinant of derivatives market liquidity:

$$LIQ_{it} = -30.62 + 34{,}143.64\ TV_{it} - 42{,}3962.7\ TC_{it} + 154.61\ MD_{it} - 10397.79\ \beta_4 EXCH_t + \epsilon_{it}$$

(0.9963) (0.0000) (0.0004) (0.0267) (0.0020)

The adjusted R-squared value of 0.8746 indicates that approximately 87% of the variance in derivatives market liquidity is explained by including independent variables (trading volume, transaction costs, market depth, and exchange rate fluctuation), suggesting a strong overall fit of the model to the data.

The positive and statistically significant coefficient associated with trading underscores a direct relationship with liquidity, implying that heightened trading activity fosters a more liquid market environment by increasing the ease of executing trades. Conversely, the negative and significant coefficient for transaction costs (TC) indicates an inverse relationship, suggesting that elevated costs impede liquidity by discouraging participation. Market depth (MD), characterized by a positive and significant coefficient, enhances liquidity by providing greater order book resilience to large trades. Finally, the negative and significant coefficient of exchange rate fluctuations (EXCH) suggests that increased currency volatility detracts from market liquidity, likely due to heightened uncertainty and risk aversion among traders.

Additionally, the Durbin-Watson statistic, for both models, was calculated as 1.82 (~2), indicating no significant autocorrelation in the residuals. This value suggests that the models are well-specified and that the regression results are not biased due to autocorrelation issues.

4.3.2. Effect of Market Efficiency on Liquidity in the NEXT Market

To evaluate the impact of market efficiency on liquidity within the Kenyan derivatives market, this study employed a Vector Autoregressive (VAR) modeling framework. The choice of VAR is motivated by its capacity to capture dynamic interdependencies and potential bidirectional relationships between key market variables, specifically, liquidity (LIQ) and market efficiency (EFF) extracted from the Hasbrouck Information share (VECM), and the information asymmetry (IA) extracted from the EGARCH (1,1) model.

4.3.2.1. Information Asymmetry via EGARCH (1,1)

The EGARCH model was employed to measure the persistence and asymmetry of volatility shocks across individual derivatives instruments, with a focus on determining the existence of information asymmetry embedded in the NEXT.

Table 15. EGARCH (1,1) Estimates by Futures Contract – ARCH, GARCH & Asymmetry

Stocks	Constant (ω)	ARCH (α) *	GARCH (β)*	EGARCH (γ)	P-value
INDEX*	-12.212	15.483	0.893	0.093	0.000
MIN25**	-0.504	0.465	0.976	-0.085	0.059
SCOM*	-0.754	0.333	0.935	-0.077	0.000
EQTY	-2.591	0.708	0.079	-0.013	0.871
EABL	-2.071	0.963	0.748	-0.163	0.202
KCBG	-1.467	0.036	0.850	0.012	0.551
BAT	-0.563	1.224	0.939	-0.029	0.812
ABSA	-2.913	0.593	0.697	-0.078	0.193
NCBA	-7.055	2.740	0.191	-0.049	0.640
COOP	-7.324	2.685	0.194	-0.128	0.375
SCBK	-7.902	2.612	0.184	0.045	0.622
IMHP	-7.037	2.562	0.184	-1.089	0.540

(*) Significant at 5%; (**) Significant at 10%

***Source**: Author's computation using EViews and Excel*

As reported in Table 15, significant EGARCH coefficients (**γ**) were observed in the INDEX ($\gamma = 0.093$, $p < 0.01$), SCOM single stock futures ($\gamma = 0.077$, $p < 0.01$), and MIN25 index ($\gamma = 0.085$, $p < 0.01$). The signs of asymmetry coefficients reflect the direction of leverage effects: for instance, the positive **γ** in the INDEX futures suggests that negative shocks (bad news) have a greater impact on volatility, indicating greater information asymmetry. Conversely, the negative **γ** values for SCOM and MIN25 futures imply that positive shocks are more influential, suggesting more efficient information assimilation in those contracts.

The persistence of volatility captured by the GARCH parameter (**β**) remained high across contracts (e.g, $\beta = 0.893$ for INDEX and $\beta = 976$ for MIN25), underscoring the long memory nature of market volatility, a potential risk factor for liquidity, as prolonged uncertainty can deter market participants.

Give most of the leverage effect captured through the Information Asymmetry (γ) in the EGARCH model from futures price returns are not significant (Table 15), thus the use of average market-level **γ** coefficient, as presented in Table 16 below.

Table 16. EGARCH (1,1) Average Futures Market – Level Estimates IA Dynamics

Sample: 1/04/2021 12/31/2024
Included observations: 988
Convergence achieved after 34 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)
*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000814	0.000372	2.191278	0.0284
AR(1)	0.665186	0.082849	8.028916	0.0000
MA(1)	-0.424831	0.098906	-4.295285	0.0000
Variance Equation				
C(4)	-2.042559	0.277698	-7.355327	0.0000
C(5)	0.304621	0.038688	7.873762	0.0000
C(6)	0.061139	0.023611	2.589428	0.0096
C(7)	0.814139	0.026398	30.84111	0.0000

***Source**: Author's computation using EViews*

The average market-level $\boldsymbol{\gamma}$ coefficient from the EGARCH (1,1) in the simplified equation (3.1.3.1) with all coefficients statistically significant at the 1% level. The positive and significant asymmetry term (p = 0.0096) indicates the presence of information asymmetry, where shocks exert asymmetry effects on volatility.

$$ln(\sigma_t^2) = -2.042 + \mathbf{0.305} * \text{ARCH} + \mathbf{0.814}\ GARCH + \mathbf{0.061} * EGARCH$$

(0.0000) **(0.0000)** **(0.0000)** **(0.0096)**

In Appendix 3, the pre-estimation ARCH effect (p = 0.0002) validated the use of EGARCH, while post-estimation diagnostics, including an insignificant ARCH LEM test (p = 0.9755), residual Q-statistics (p> 0.05) combined with a Durbin Watson value of 2, and a log-likelihood value of 34080, support strong model fit and predictive capacity.

From the equation (3.1.3.1) the time series from the EGARCH (1,1) innovation (residual) was extracted and used as Information asymmetry in the VAR equation (3.3.).

4.3.2.2. Price Discovery Efficiency via Hasbrouck Information Share

To complement the above, this study also extracted the price discovery component from spot and futures market using the Hasbrouck Information Share methodology based on VECM results confirmed the existence of long-run cointegrations between spot and futures prices for several contracts, including INDEX, SCOM, KCBG, and EABL, as evidenced by significant negative error correction terms presented in Table 18 below.

Table 17. VECM results - Hasbrouck Information Share

	FUTURES		CAUSALITY F VS S	
Stock futures	**ECT**	**P-value**	**CointEq**	**P-value**
INDEX	-0.0679	0.0241	-0.9038	0.0155
MIN25*	-0.0098	0.0036	-1.6480	6.3672
SCOM	-0.0276	0.0271	-0.9739	0.0153
EQTY	-0.0228	0.0183	-0.9255	0.0773
EABL	-0.0124	0.0385	-0.9211	0.0290
KCBG	-0.0353	0.0258	-0.9878	0.0157
BAT*	-0.0264	0.0000	-0.7069	0.1203
ABSA*	-0.0115	0.0151	-1.0533	0.1779
NCBA*	-0.0029	0.0041	-6.6701	1.6258
COOP*	-0.0014	0.0019	-12.0032	15.7841
SCBK*	-0.0026	0.0022	1.3500	5.5287
IMHP*	-0.0025	0.0026	3.6156	1.3809

(*) Long-run equilibrium, but no statistical cointegration due to variable specificities or recent introduction in the market.

***Source**: Author's computation using EViews and Excel*

These results imply that price adjustments occur in response to deviations from equilibrium, indicating well-functioning arbitrage mechanisms in select instruments.

The Hasbrouck Information Share (IS) estimates reinforced the role of futures markets in leading price discovery. For most contract, such as MIN (IS = 0.99), KCBG (IS =0.946), COP (0.972) and NCBA (IS = 0.968), the futures market contributed significantly more to information assimilation than the spot market. These IS values presented in Table 18, are indicative of strong informational efficiency in futures pricing, reflecting investors' reliance on derivatives instruments to price in new information more quickly. Conversely, instruments such as EABL (IS= 0.478) and NCBA (IS = 0.506) displayed relatively balanced IS scores, suggesting a more symmetric flow of information between the spot and futures markets.

Table 18. Hasbrouck Information Share-Results

Hasbrouck Information Share (IS)			
Stocks	**Futures**	**Spot**	**Prob.***
INDEX	0.513	0.487	1.000
MIN25	0.999	0.001	1.000
SCOM	0.536	0.464	1.000
EQTY	0.561	0.439	1.000
EABL	0.478	0.522	1.000
KCBG	0.946	0.054	1.000
BAT	0.574	0.426	1.000
ABSA	0.506	0.494	1.000
NCBA	0.968	0.032	1.000
COOP	0.972	0.028	1.000
SCBK	0.994	0.006	1.000
IMHP	0.846	0.154	1.000

***Source**: Author's computation using EViews and Excel*

(*) prob of futures +Spot market =1

However, weaker IS value or insignificant VECM cointegration for certain securities (e.g., SCBK, IMHP) is attributed to their illiquidity, limited trading activity, or recent introduction to the NEXT. These market-specific frictions dilute the efficacy of the price discovery process and, by extension, affect overall liquidity.

4.3.2.3. Dynamic effect of EFF and IA on Liquidity in the NEXT Market

The interplay between information asymmetry and price discovery efficiency carries important implications for liquidity. Therefore, the choice of the VAR model, motivated by its capacity to capture dynamic interdependencies and potential bidirectional relationships between key market variables, specifically, liquidity (LIQ) and market efficiency (EFF) extracted from the Hasbrouck Information share (VECM), and the information asymmetry (IA) extracted from the EGARCH (1,1) model.

This VAR model specification was further supported by the application of Granger causality tests to ascertain directional predictability among these constructs.

Prior to estimating the VAR model, it was necessary to assess the stationarity properties of the underlying time series variables. Augmented Dickey-Fuller (ADF) tests were performed for the logarithm of liquidity (LNLIQ), price discovery efficiency (EFF), and information asymmetry (IA), with four lag lengths based.

4.3.2.3.1. Stationarity Test

The results, presented in Appendix 6, reject the null hypothesis of unit root at the 1% significance level for EFF, IA, and LNLIQ, confirming that the series were stationary in levels.

4.3.2.3.2. VAR Lag Length Selection

Optimal lag length was determined using the VAR lag order selection criteria. Based on the lowest values of Akaike Information Criterion (AIC), Hannan-Quinn Information Criteria (HQIC), and Schwarz Bayesian Information Criterion (SBIC), a lag structure of 3 was selected for VAR model. This lag length balances model fit and parsimony, ensuring a comprehensive capture of dynamic interactions across periods while minimizing the risk of overfitting

Table 19. VAR Lag Length Selection

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	3984.66				8.3e-07	-5.49194	-5.48786	-5.48102
1	7245.77	6522.2	9	0.000	9.3e-09	-9.97762	-9.96132	-9.93393
2	7346.99	202.44	9	0.000	8.2e-09	-10.1048	-10.0763*	-10.0284*
3	7360.91	27.837	9	0.001	8.2e-09*	-10.1116*	-10.0708	-10.0024
4	7362.33	2.843	9	0.970	8.2e-09	-10.1012	-10.0482	-9.95916
5	7364.92	5.1763	9	0.819	8.3e-09	-10.0923	-10.0271	-9.91754
6	7371.06	12.285	9	0.198	8.3e-09	-10.0884	-10.0109	-9.88083
7	7387.6	33.074*	9	0.000	8.3e-09	-10.0988	-10.0091	-9.85846
8	7396.05	16.894	9	0.050	8.3e-09	-10.098	-9.9961	-9.82493

* optimal lag
Endogenous: **lnliq eff ia**
Exogenous: **_cons**

***Source**: Author's computation using STATA*

4.3.2.3.3. VAR Estimation Results

The VAR (3) model was estimated using daily data from January 2021 to December 2024. The vector of endogenous variables included LINLIQ, EFF, and IA. Table 20 summarizes the estimation output for the liquidity equation (cf. Appendix 8).

Table 20. VAR Estimation - Liquidity Equation

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
lnliq						
lnliq						
L1.	.6879437	.0264882	25.97	0.000	.6360279	.7398596
L2.	.1756371	.0318832	5.51	0.000	.1131472	.238127
L3.	.046931	.0264159	1.78	0.076	-.0048431	.0987052
eff						
L1.	.0070598	.0804011	0.09	0.930	-.1505234	.1646429
L2.	.0567213	.1270024	0.45	0.655	-.1921988	.3056414
L3.	-.0004367	.0804046	-0.01	0.996	-.1580269	.1571535
ia						
L1.	.8858579	.797937	1.11	0.267	-.6780699	2.449786
L2.	.0678061	.8530565	0.08	0.937	-1.604154	1.739766
L3.	.2489429	.7960742	0.31	0.754	-1.311334	1.80922
_cons	-.1246052	.0209222	-5.96	0.000	-.1656119	-.0835984

Source: *Author's computation using STATA*

The results point to a pronounced autoregressive structure in liquidity. Specifically, the first lags of LNLIQ (β = 0.6879, p < 0.01) and the second lag (β = 0.1756, p<0.01) are both highly statistically significant, reinforcing the persistence of liquidity shocks over time. This inertia, where current liquidity levels are heavily influenced by past values, is characteristic of thin or developing markets, such as Kenya's nascent derivative market, where order flow, transaction volume, and market-making activities adjust more sluggishly due to limited depth and participant heterogeneity.

Conversely, the coefficient, associated with price discovery efficiency (EFF) and information asymmetry (IA) across all lag lengths are statistically insignificant (p> 0.3). for example, EFF at lag 1 (β =0.0077, p = 0.342) and IA at lag 1 (β = -0.0859, p = 0.914) fail to show meaningful explanatory power. While this may initially suggest the limited immediate or short-term influence of these variables on liquidity, the interpretation should be approached cautiously. Notably, the coefficient on IA at lag 3 (β = 0.2489) is relatively large in magnitude, though statistically insignificant (p = 0.754), potentially indicating the presence of delayed or nonlinear effects not adequately captured within the linear VAR framework.

This subtlety points to a broader concern: the interaction of efficiency and asymmetry with liquidity may be contingent on structural features of the market, such as institutional, investor behavior, regularly interventions, or stage of innovation adoption.

4.3.2.4. Granger Causality Test Results

To assess directional predictability liquidity (LNLIQ), price discovery efficiency (EFF, the Granger causality Wald test was conducted within the VAR framework. Table 21 summarizes the test statistics, degrees of freedom, and associated p-values for each pairwise exclusion test.

Table 21. Granger Causality Wald Test Results

Equation	Excluded	chi2	df	Prob > chi2
lnliq	eff	10.97	3	0.012
lnliq	ia	1.8034	3	0.614
lnliq	ALL	13.022	6	0.043
eff	lnliq	3.5731	3	0.311
eff	ia	3.3172	3	0.345
eff	ALL	6.9198	6	0.328
ia	lnliq	4.4073	3	0.221
ia	eff	4.425	3	0.219
ia	ALL	8.7406	6	0.189

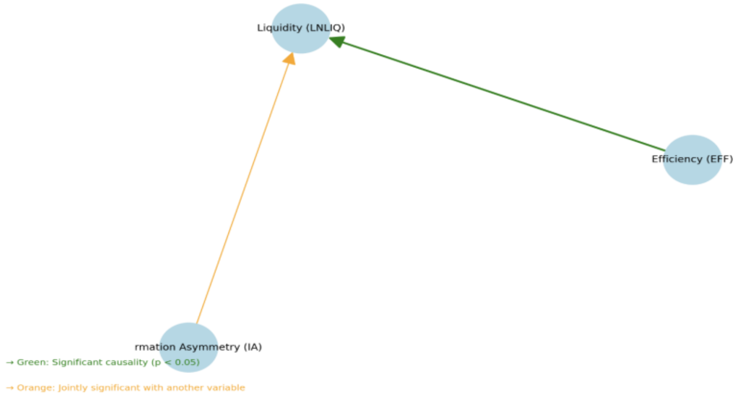
Source*: Author's computation using STATA*

The results reveal a unidirectional Granger causality from price discovery efficiency (EFF) to liquidity (LNLIQ), statistically significance at the 5% level (χ^2 = 10.97, p = 0.012). This implies that the informational primacy of price efficiency in influencing liquidity conditions. In practical terms, improvements in how quickly and accurately asset prices reflect new information foster trading activity by reducing uncertainty and adverse selection risks, core determinants of market liquidity.

Furthermore, the joint exclusion of both EFF and IA from the liquidity equation yields a significant (χ^2 = 13.62, p = 0.043), suggesting that while IA alone does not exert a statistically discernible impact (p = 0.614), its presence in tandem with EFF strengthens the explanatory model. This finding points to a complementary effect between informational quality and frictions from asymmetric information, consistent with microstructure theories of liquidity provision.

On the other hand, no evidence of reverse causality was detected: liquidity does not have Granger-cause EFF (p = 0.311) or IA (p = 0.220), and IA similarly does not predict the other variables (p > 0.18 for all cases). This asymmetry in causality flows supports the notion that in low-depth or developing markets, informational quality is a leading driver of trading dynamics, rather than being shaped by them. Such a structure reflects a market still maturing in terms of participant diversity and feedback mechanisms, where volume-based signals have limited predictive feedback into efficiency or asymmetry.

Figure 6. Unidirectional Flow Diagram - Granger Causality

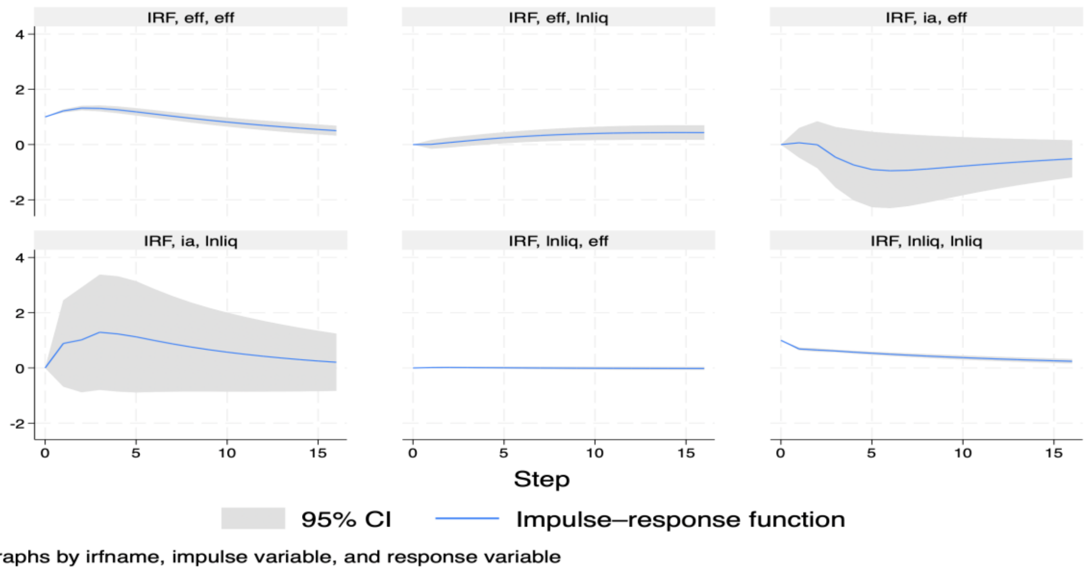


***Source**: Author's computation*

4.3.2.5. Impulse Response Function (IRF) Analysis

To better understand the dynamic interactions among the variables, impulse response functions (IRFS) were computed for a 16-period horizon. The IRFS trace the effect of a one-standard deviation shock to one variable on the current and future values of all variables in the VAR system. Figure 7 displays selected IRFs along with 95% confidence intervals.

Figure 7. IRF - Liquidity, Efficiency, and Information Asymmetry



***Source**: Author's computation using STATA*

The IRF analysis is in Figure 7. Reveals that a one-standard-deviation shock to market efficiency produces only a modest and statistically insignificant increase in liquidity, with the effect quickly dissipating. The confidence bands consistently encompass zero, indicating no meaningful transmission of efficiency shocks into liquidity. Similarly, while a shock to information asymmetry initially raises liquidity, this effect is short-lived and statistically fragile, as evidenced by the wide confidence intervals.

Conversely, liquidity shocks have no discernible impact on informational efficiency. The response remains flat with tight confidence bands, underscoring the absence of dynamic feedback from liquidity to efficiency. Notably, liquidity exhibits strong autoregressive behavior, with shocks to liquidity showing a high degree of persistence over time. This indicates that liquidity conditions in the derivatives market are primarily self-driven rather than significantly influenced by innovations in efficiency or information asymmetry. This limited transmission may be attributed to structural market deficiencies, including underdeveloped trading infrastructure, low institutional participation, and limited market depth.

4.3.2.6. Diagnostic Tests

To validate the adequacy of the estimated VAR (3) model, diagnostic tests were conducted to assess both stability and residual autocorrelation in Table 22 below.

Table 22. Diagnostic Tests - Stability & LM

Eigenvalue stability condition

Eigenvalue	Modulus
.9299662 + .01997366*i*	.930181
.9299662 − .01997366*i*	.930181
.4496857	.449686
.370478 + .2355248*i*	.439006
.370478 − .2355248*i*	.439006
−.3356858	.335686
−.1155759 + .2000281*i*	.231017
−.1155759 − .2000281*i*	.231017
−.1959377	.195938

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	14.0616	9	0.12015
2	12.5103	9	0.18604

H0: no autocorrelation at lag order

***Source**: Author's computation using STATA*

The stability condition of the model was satisfied, with eigenvalues falling within the unit circle (<1), confirming that the VAR process is dynamically stable and suitable for inference. Additionally, the Lagrange Multiplier (LM) tests for residual autocorrelation up to lag 3 returned p-values above 0.05, indicating the absence of serial correlation in the residuals. These results affirm that the model is well-specified, and the impulse responses derived are reliable for interpretation.

4.3.3. Moderating Role of Market Innovations on Liquidity-Efficiency in the NEXT

This subsection presents the results of the analysis examining the moderated role of market innovation on liquidity and efficiency within the Kenyan derivatives market (NEXT). To address this objective with analytical rigor, Principal Component Analysis (PCA) was employed as a dimensionality reduction technique to derive a robust and parsimonious Market Innovation Index (MII). The index was subsequently integrated as a moderator variable in ensuring econometric models, facilitating a nuanced examination of how market-level innovations modulate the interplay between liquidity and efficiency.

4.3.3.1. Principal Component Analysis and Index Construction

The application of PCA to the initial set of eight standardized innovation-related variables pertinent to the NEXT, as described in Appendix 2. The variable launch was excluded from the PCA due to its lack of variability. The objective of the PCA was to reduce the dimensionality of the innovation variables and create a composite index that encapsulates the various dimensions of market innovation.

Table 23. PCA - Results

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.72773	2.36313	0.4660	0.4660
Comp2	1.3646	.386417	0.1706	0.6365
Comp3	.97818	.272992	0.1223	0.7588
Comp4	.705189	.0982991	0.0881	0.8470
Comp5	.60689	.177543	0.0759	0.9228
Comp6	.429347	.243954	0.0537	0.9765
Comp7	.185393	.182717	0.0232	0.9997
Comp8	.00267564	.	0.0003	1.0000

Source: *Author's computation using STATA*

The results of the PCA, presented in Table 23, reveal that the first three principal components collectively account for a substantial 75.89% of the total variance inherent in the innovation variables (cumulative). The dominance of the first component (Comp1), which explained 46.40% (0.4660) of the variance (proportion), signifies the presence of a salient underlying factor driving a significant portion of the observed market innovation. As elucidated and further supported by the component loadings detailed in Table 24, Comp1 appears to encapsulate a broad spectrum of market-level transformations, encompassing financial products and regulatory changes under the period of the study. This suggests that a significant thrust of innovation within the NEXT has been concentrated in these overarching areas. While the subsequent components (Comp2 and Comp3) capture additional frictions of the variance (17.06% and 12.23%, respectively), their interpretation based on the loadings in Table 24, likely pertains to more granular aspects of market infrastructure and specific regulatory adjustments.

Table 24. Principal Components (Eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Unexplained
liborrr	0.4890	-0.0938	0.0294	0.1209	-0.0077	-0.4046	0.2729	0.7059	0
survcomprr	0.3919	0.0661	-0.0507	-0.5528	-0.2592	0.5592	0.3926	-0.0000	0
newminpi	0.3635	-0.1074	0.0377	0.5877	0.4066	0.5821	-0.0731	-0.0019	0
newssfpi	0.4668	-0.0335	0.0069	-0.2280	-0.1803	-0.0466	-0.8332	0.0044	0
srinvstfi	0.4893	-0.0934	0.0295	0.1174	-0.0098	-0.4052	0.2670	-0.7083	0
adjinmarfi	0.0571	0.6888	-0.1120	0.4412	-0.5596	0.0443	0.0013	-0.0000	0
opintpi	0.1205	0.6539	-0.2327	-0.2629	0.6463	-0.1281	-0.0214	-0.0000	0
margrefi	0.0089	0.2518	0.9631	-0.0700	0.0633	0.0060	0.0079	0.0002	0

Source: *Author's computation using STATA*

Following the eigenvalue criterion presented in Table 24, which often implicitly set above 1, through the rational for retaining only Comp1 based solely on its dominant eigenvalue metrics further explicit justification, the study elected to retain only the first principal component (Comp1) for the construction of the Market Innovation Index (MII), the computational details of which are provided in Appendix 9. This MII was subsequently generated using PCA scores of Comp1, effectively representing the primary axis of innovation within the market. The strategic utilization of this MII as a moderating variable in subsequent econometric models is designed to rigorously explore the conditional effects of market innovations on the dynamic relationship between liquidity and efficiency, thereby offering a deeper understanding of how these innovations shape the fundamental characteristics of the derivatives market.

4.3.3.2. The Interaction Effect of Market Innovation on Efficiency and Liquidity

Building upon the Granger causality founding from Objective Two, which indicated a significant joint effect of both price discovery efficiency (EFF) and information asymmetry (IA) on liquidity, as presented in Table 21, the baseline model (Equation 3.2.) was modified.

Recognizing potential collinearity and aiming for more parsimonious model specification for the moderation analysis, the EFF and IA were dropped from the model variables to create a combined variable potential omitted variable bias and the potential loss of nuanced information regarding the individual impacts of market depth, efficiency and information asymmetry. The revisited equations 3.3. and 3.4, employing logarithmic transformation for the dependent variable (liquidity) and incorporating the MII as the moderator, are presented as follows for pre- and post-moderation analyses, respectively:

(3.3.rev) $$LNLIQ_t = \beta_0 + \beta_1 LNTV_t + \beta_2 LNTC_t + \beta_3 LNMEF_t + \beta_4 LNEXCH_t + \epsilon_t$$

(3.4.rev) $$LNLIQ_t = \beta_0 + \beta_1 LNTV_t + \beta_2 TC_t + \beta_3 LNMEF_t + \beta_4 LNEXCH_t + \delta_1 MII_t + \delta_2(LNTV_t * MII_t) + \delta_2(LNTC_t * MII_t) + +\epsilon_t$$

4.3.3.3. Moderating Effect-Results

To investigate the moderating effect of market innovation (MII) on the relationship between market efficiency drivers and market liquidity, a mean-centering approach was applied to minimize multicollinearity, from the combined effect of the equations (3.3.rev and 3.4.rev). The variables for trading volume (LNTV), transaction costs (LNTC), and market innovations (MII) were centered around their respective means: 2.1123, -4.5863, and 0.0148 (Appendix 9). These were used to generate centered variables and interaction terms (miilntv_c and miilntc_c).

Table 25. Regression Model Pre-Moderation

```
reg lnliq lntv_c lntc_c lnmef lnexch
```

Source	SS	df	MS			
Model	15356.1075	4	3839.02688	Number of obs	=	1,458
Residual	9503.90819	1,453	6.54088658	F(4, 1453)	=	586.93
				Prob > F	=	0.0000
				R-squared	=	0.6177
				Adj R-squared	=	0.6167
Total	24860.0157	1,457	17.0624679	Root MSE	=	2.5575

lnliq	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lntv_c	2.476684	.0526049	47.08	0.000	2.373495	2.579874
lntc_c	-.0025349	.143327	-0.02	0.986	-.2836849	.2786152
lnmef	-15.21761	7.878883	-1.93	0.054	-30.67282	.2375864
lnexch	-.2832571	.0685096	-4.13	0.000	-.4176453	-.1488689
_cons	11.83955	.7216297	16.41	0.000	10.42401	13.2551

***Source**: Author's computation using STATA*

The baseline equation (3.3.rev):

$$LNLIQ_t = \mathbf{11.8396} + \mathbf{2.47667}\, LNTV_t - \mathbf{0.0025}\, LNTC_t - \mathbf{15.2176}\, LNMEF_t - \mathbf{0.2933}\, LNEXCH_t + \epsilon_t$$

The baseline regression (Table 25) indicated that trading volume (LNTV) significantly and positively affects market liquidity (β = 2.477, $p < 0.01$), while transaction costs (LNTC) had no statistically significant effect. Market efficiency (LNMEF) was negatively associated with liquidity at the 5%% level (β = 15.218, $p = 0.054$), and exchange rate volatility (LNEXCH) was negatively significant ($p < 0.01$).

In the moderated model (Table 25), after introducing MII and the interaction terms, several key findings emerged. First, the direct effect of MII on liquidity was significantly and statistically significant (β = 0.140, $p < 0.01$), suggesting that innovation in isolation may not directly improve liquidity outcomes. Second, the interaction between MII and trading volume (MIILNTV_C) was positive and highly significant (β = 0.165, $p < 0.01$), indicating that market innovation strengthens the positive impact of trading volume on liquidity. However, the interaction between MII and transaction costs (MIILNTC_C) was statistically insignificant, implying no moderating effect in that dimension.

Table 26. Regression Model Outcome Post-Moderation

Source	SS	df	MS			
Model	15598.4457	7	2228.34938	Number of obs	=	1,458
Residual	9261.57007	1,450	6.3872897	F(7, 1450)	=	348.87
Total	24860.0157	1,457	17.0624679	Prob > F	=	0.0000
				R-squared	=	0.6275
				Adj R-squared	=	0.6257
				Root MSE	=	2.5273

lnliq	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lntv_c	2.409737	.0542275	44.44	0.000	2.303364	2.51611
lntc_c	.0008274	.1726365	0.00	0.996	-.3378166	.3394714
lnmef	-8.694326	8.15791	-1.07	0.287	-24.69689	7.30824
lnexch	-.2212779	.0701264	-3.16	0.002	-.358838	-.0837179
mii_c	-.1399068	.0448257	-3.12	0.002	-.2278369	-.0519766
miilntv_c	.1645181	.0285269	5.77	0.000	.1085597	.2204764
miilntc_c	-.0785293	.064365	-1.22	0.223	-.2047877	.0477291
_cons	11.53711	.7300886	15.80	0.000	10.10497	12.96926

***Source**: Author's computation using STATA*

The inclusion of MII and interaction terms marginally improved the model's explanatory power, with the adjusted R-squared increasing from 0.6177 to 0.6275. Variance inflation factor (VIF) values were all below 2 (Mean VIF =1.39), indicating no multicollinearity concerns (Appendix 10).

Diagnostic tests indicated a violation of the normality and homoskedasticity assumptions. Both the Breusch-Pagan test ($\chi^2 = 762.79$, $p < 0.001$) and White's test ($\chi^2 = 1128.78$, $p < 0.001$) rejected the null hypothesis of constant variance. Similarly, the joint test for normality was significant ($\chi^2 = 1810.19$, $p < 0.001$), prompting the application of Newey-West standard errors in Table 27 below.

Table 27. Newey-West standard errors

```
Regression with Newey-West standard errors      Number of obs     =      1,458
Maximum lag = 3                                 F(  7,       1450) =     116.29
                                                Prob > F          =     0.0000
```

lnliq	Coefficient	Newey-West std. err.	t	P>|t|	[95% conf.	interval]
lntv	2.401609	.1008056	23.82	0.000	2.203869	2.59935
lntc	.1966834	.1713391	1.15	0.251	-.1394156	.5327825
lnmef	-11.24662	11.68078	-0.96	0.336	-34.15965	11.66641
lnexch	-.2049329	.0858015	-2.39	0.017	-.3732412	-.0366246
mii	-.3488029	.2021566	-1.73	0.085	-.7453535	.0477477
miilntv	.1663738	.0534113	3.11	0.002	.061602	.2711455
miilntc	-18.02781	12.33003	-1.46	0.144	-42.21441	6.158783
_cons	7.689429	.9787041	7.86	0.000	5.769602	9.609257

***Source**: Author's computation using STATA*

The post-moderation equation (3.4.rev):

$$LNLIQ_t = \mathbf{7.6894} + \mathbf{2.5016}\, LNTV_t + \mathbf{0.1968}\, LNTC_t - \mathbf{11.22466}\, LNMEF_t - \mathbf{0.2049}\, LNEXCH_t - \mathbf{0.3488}\, MII_t + \mathbf{0.1664}\, (LNTV_t * MII_t) - \mathbf{18.0278}\, (LNTC_t * MII_t) + \epsilon_t$$

The Newey-West adjusted regression confirmed the robustness of the moderating effect of market innovation. The interaction term MIILNTV remained positive and statistically significant (δ = 0.1664, p = 0.0002), reinforcing the earlier finding that innovation enhances the volume liquidity relationship. The coefficient for MIILNTC was negative but not statistically significant.

These results underscore the role of innovation as a positive moderator in the link between trading activity and liquidity but suggest that innovation does not mitigate the adverse effects of transaction costs.

4.4. Chapter Summary

In this Chapter, the study presented the empirical analysis results from the secondary data collected from the Nairobi Securities Exchange derivatives segment (NEXT). Speciffically, it began with the descriptive statistics of variables, followed by the results from the analysis and their specific diagnostic tests Using daily data from January 2021 to December 2024, the study employed a range of econometric techniques, including panel regression, VAR, Granger causality, VECM, EGARCH, and PCA, to capture both direct and structural market dynamics.

The analysis underscores the critical role of market innovation in strengthening the relationship between trading volume and liquidity in the Kenyan derivatives market. While market innovation enhances liquidity through increased trading activity, it does not alleviate the adverse effects of transaction costs.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.0. Introduction

The chapter outlines a critical discussion of the empirical detailed in Chapter Four. The central objective of this study was to examine the relationship between liquidity and efficiency in the NEXT while assessing the moderating role of market innovation. By integrating econometric analyses with theoretical and empirical literature reviewed in Chapter Two, this chapter contextualizes the results and evaluates their implications.

The discussion is structured into key sections, corresponding to the study's specific objectives: (i) assessing the effect of operational efficiency (trading volume, transaction costs, and market depth) on liquidity; (ii) analyzing the dynamics between liquidity and market efficiency; and (iii) evaluating the moderating role of market innovation. The chapter concludes with implications, recommendations, limitations, and future research directions.

5.1. Summary of the Study Findings

This study examined how operational and market efficiency, as two perspectives of efficiency, influence liquidity in Kenya's NEXT derivatives market, with market innovation as moderating factor, using data from 2021 to 2024 and employing panel regression, VAR and interation models.

Results show that operational efficiency, proxied by trading volume, transaction costs, and market depth, significantly affects liquidity, while elevated transaction costs and exchange rate volatility reduce it. Market efficiency, measured by price discovery and information asymmetry, Granger-caused liquidity but limited short-run impact, indicating weak transmission effects.

Market innovation significantly strengthened the positive relationship between trading volume and liquidity but failed to mitigate the adverse effect of transaction costs. The innovation liquidity interaction remained robust, through innovation's influence on cost-based inefficiencies was statistically significant.

Importantly, these findings highlight that market innovation enhances liquidity primarily by ampliflying the effect of trading activity, rather than through cost mitigation. Furthermore efficiency improvements, while causally related to liquidity, exhibit limited short-term dynamism in the Kenyan context.

5.2. Discussion

5.2.1. The Effect of Operational Efficiency on Liquidity in Kenya's NEXT Market

The panel regression model indicated that trading volume exerts a statistically significant and positive influence on liquidity, supporting the foundational argument of market microstructure theory. High trading volume reduces price impact, enhances order book resilience, and tightens bid-ask spreads, thereby fostering improved liquidity conditions (Aitken & Winn, 1997; Madhavan, 2000). These findings are consistent with empirical studies in mature and emerging markets, including those by Rösch et al. (2016) and Vidović (2019), which echo Adelegan's (2009) assertion that trading activity is the primary determinant of liquidity in the South African derivatives market. The evidence reinforces the centrality of volume as an operational efficiency proxy within developing derivatives ecosystems.

Conversely, transaction costs were found to significantly and negatively influence liquidity, supporting the theoretical position advanced in transaction costs theory by Demsetz (1968) and further explained by Glosten and Milgrom (1985). High explicit and implicit costs, such as brokerage fees, margin funding charges, and bid-ask spreads, deter market participation and discourage liquidity provision. This relationship was particularly salient for less frequently traded futures contracts such as IMHP and SCBK in the current study, where wider spreads and thinner order books exacerbated illiquidity. The findings align with the argument that elevated transaction costs heighten adverse selection risks, leading to market withdrawal and reduced depth.

The positive association between market depth and liquidity corroborates the insights of Goyenko et al. (2009), emphasizing the importance of order book elasticity in absorbing large trades without significant price disruptions. However, in the context of NEXT, the magnitude of this influence remains modest. This subdued effect likely stems from the limited number of active participants and the relatively shallow pool of liquidity providers in the Kenyan derivatives market (NSE, 2022). While market depth is directionally aligned with liquidity, its full potential appears constrained by infrastructural and institutional immaturity.

Consistently, exchange rate volatility, presented as external shocks to the market, had a significant negative effect on liquidity. This finding echoes those of Muriithi et al. (2016), who observed that macroeconomic uncertainty in emerging markets disrupts investor confidence and diminishes transaction volumes. In the Kenyan context, currency volatility poses an additional layer of uncertainty that compounds the challenges associated with leveraged derivatives, particularly for foreign and institutional participants seeking stability.

5.2.2. The Influence of Market Efficiency on Liquidity in Kenya's NEXT Market

To evaluate the dynamic relationship between liquidity and efficiency, the study employed a suite of time series techniques, VAR, Granger causality, and impulse response functions, supplemented by VECM and EGARCH volatility modeling. The analysis revealed a unidirectional causality from efficiency (proxied by price discovery measures) to liquidity, although this relationship exhibited weak short-term predictive power. This outcome partially supports the findings of Hasbrouck (1995), who argued that Informational efficiency precedes and often leads to market liquidity, though the strength and persistence of this effect vary across market structures.

The short-lived and weak liquidity responses to efficiency shocks, as observed through the IRFs, reflect structural rigidities in the Kenyan derivatives market. This finding mirrors the conclusions of Ujumwa & Modebe (2012) and Njoroge et al. (2013), who observed that institutional weaknesses, such as limited product offerings, asymmetrical access to market information, and suboptimal regulatory oversight, dampen the transmission of information into liquidity, enhancing behaviors. As such, the efficiency-liquidity feedback loop remains fragile in thin and illiquid market environments.

Moreover, while information asymmetry was statistically significant in volatility modeling EGARCH (1,1), particularly for INDEX and SCOM futures, its direct impact on liquidity was negligible. This result may be attributed to the low informational heterogeneity among market participants and the relatively homogeneous nature of trading strategies. The limited sophistication of participants reduces the strategic advantage of private information, thus muting the expected adverse selection dynamics (Kyle & Obizhaeva, 2018). These findings underscore the importance of investor diversity and transparency in catalysing the full efficiency-liquidity linkage.

The evidence points to a weak and asymmetric relationship between liquidity and efficiency in the NEXT. While futures prices exhibit informational leadership, as confirmed by VECM cointegration, their influence on actual market liquidity is conditional on structural and behavioural factors that limit efficient price formation. This insight resonates with the observations of Jin et al. (2020), who caution that efficiency mechanisms in nascent markets are frequently undermined by infrastructural fragility, fragmented market participant, and regulatory lag.

5.2.3. The Moderating Role of Market Innovation on Liquidity and Efficiency in Kenya's NEXT Market

A key contribution of this study lies in its incorporation of market innovation as a moderating variable in the liquidity-efficiency nexus. Using a Principal Component Analysis (PCA), derived innovation index, the findings suggested that market innovation significantly strengthens the positive relationship between trading volume and liquidity. This result is consistent with the theoretical propositions by Tufano (2003) and Violi & Camerini (2018), who contend that market innovations, technological, financial, and regulatory, can enhance market participation, reduce frictions, and increase investor confidence.

The Significant interaction effect ($\delta = 0.1664$, $p < 0.01$) confirms that innovations implemented between 2021-2024, including system upgrades, revisions in margin requirements, and introduction of new products, have amplified the liquidity benefits of trading activity.

These developments appear to have attracted new participants, improved execution speed, streamlined clearing and settlement processes, thereby enhancing overall market functionality. The experience aligns with reform trajectories observed in other emerging derivatives markets, such as those in India and South Africa (Rösch D. , 2015; Hazeley, 2024).

However, the analysis also reveals that innovation did not mitigate the adverse impact of transaction costs on liquidity. The asymmetry suggests that while innovation improves accessibility and transparency, it does not address underlying cost structures that continue to hinder participation. These finding aligns with Mohapatra & Mishra (2020), who emphasize that without targeted cost rationalization, the full benefits of innovation on liquidity cannot be realized. Therefore, innovation must be complemented by regulatory reforms aimed at cost efficiency, including fee restructuring, tax incentives, and risk-based margining systems.

In essence, the moderating role of innovation highlights its enabling effect but also underlines its limitations in compensating for broader structural inefficiencies. This partial efficacy suggests that innovation alone cannot substitute for deeper policy reforms, echoing sentiments by Xion et al (2023).

5.3. Conclusions

This study examined the relationship between the dual perspective of efficiency, operational and informational efficiency, on liquidity in Kenya's derivatives market (NEXT), emphasizing the moderating role of market innovation. Grounded in the Market Microstructure Theory (MMT), the Efficient Market Hypothesis (EMH), the Preference Theory of Liquidity (PTL), and the Innovation Diffusion Theory (IDT), the findings offer a nuenced understanding of market dynamics in an emerging derivatives environment.

The first objective was validated. The results affirm that trading volume and market depth, as proxies for operational efficiency, exert a statistically significant and positive influence on market liquidity. This supports the central tenets of MMT, which posit that market structure elements such as trading activity and order flow directly affect price formation and liquidity. However, high transaction costs, an operational friction, continued to exhibit a negative effect, reinforcing the notion that structural innefficiencies remain an impediment to full market functionality.

The second objective examined the influence of market efficiency on liquidity. Long-run cointegration between spot and futures prices, as established through VECM-Hasbroubck framework, indicates the presence of informational efficiency consistent with the semi strong form of the EMH. Nonetheless, the weak short-run causal relationship between price discovery and liquidity suggests that information is not immediately or fully incorporated into trading activity, therby revealing partial inefficienies characteristic of nascent markets. Therefore a partial validation of EMH while highlighting temporal asymmetries in the transmission of information into liquidity.

The third objective was supported, despite being conditionally. Innovation was found to enhance the positive relationship between trading volume and liqudity, confirming its catlytic role in improving market accessibility, technology adoption, and efficiency, consistent with the IDT. However, innovation did not significantly attenuate the adverse effects of transaction costs suggesting that technological progress alone is insufficient to overcome embedded structural barriees, highlighting the limitations of technological and regulatory advancements without broader structural reforms.

In light of these findings, the Preference Theory of Liquidity is only partially validated. While innovation and efficiency gains reduced some liquidity constraints, persistent macroeconomic volatility and transaction costs continue to drive precautionary and speculative liquidity preferences. Consequently, full market liquidity in uncertain market environments.

Importantly, the study confirms the relevance of MMT and IDT and lends partial support to EMH and PTL within the Kenyan derivatives market. Additionally, the research demonstrates that while market and operational efficiency are essential to liquidity development, their effectiveness is contigent upon structural and isntitutional quality. Finally, innovation, though impactful, cannot compensate for systemic inneficiencies without comprehensive policy and regulatory reforms.

5.4. Recommendations

Drawing from the empirical findings and broader thematic analysis, this study proposes a series of policy and market-oriented recommendations aimed at enhancing the liquidity and efficiency of the Kenyan derivatives market. These recommendations are structured to target policymakers, regulators, market participants, and academicians.

To improve operational efficiency, regulatory reforms are critical. The Capital Markets Authority (CMA) should revise transaction-related costs (lower brokerage and clearing costs) and ease licensing requirements to promote broader participation. Modernizing the Capital Markets Act to accommodate evolving instruments and technologies will support market accessibility and innovation.

Addressing market efficiency, the Nairobi Securities Exchange (NSE) should invest in advanced infrastructure, such as algorithmic trading, real-time analytics, and AI tools, to improve price discovery and reduce execution delays. Additionally, digital investor education platforms should be developed to strengthen market awareness and informed trading.

Given innovation's moderating effect on liquidity, product diversification is essential. Expanding derivatives to include interest rate, exchange rate, and commodity futures, alongside

OTC trading for currency and rates, would deepen market participation. Relaxing listing conditions for Single Stock Futures (SSFs) would further boost market depth.

Investor education and capacity building remain vital. Integrating derivatives training into academic curricula and offering targeted programs for investors, brokersm and regulators will build a more informed participant base.

Finally, macroeconomic stability and regional integration are key. Coordinated policies to stabilize exchange rates and harmonize regulations across East African markets would promote confidence and liquidity. Lessons from more advanced markets such as India and South Africa could guide strategic reforms.

5.5. Limitations of the Study

Despite offering valuable insights into the interplay between liquidity and efficiency in Kenya's derivatives market, this study is subject to several limitations. First, data constraints notably affected variable availability. Incomplete data for open interest in 2020 and limited access to daily participation rates necessitated a revised study period (2021-2024), limiting longitudinal analysis from the market's inception in 2019.

Second, the exclusive focus on exchange-traded derivatives instead of over-the-counter (OTC) markets, which are integral components of derivative trading ecosystems in emerging economies. The focus on the exchange-traded (EDT) only may narrow the comprehensiveness of liquidity and efficiency assessments.

Third, the construction of the Market Innovation index through binary proxies, while pragmatic, may have oversimplified the complex, multifaceted nature of innovation. This approach may understate qualitative shifts in market practices and participant behavior that are not immediately quantifiable.

Ultimately, although the study employed robust econometric techniques such as VAR and Granger causality tests, potential endogeneity issues remain, possibly affecting causal inferences. More advanced econometric strategies could further strengthen the validity of the conclusions drawn.

5.6. Areas for Future Research

Future studies should seek to extend the observation period to capture long-term trends as the Kenyan derivatives market matures. A longitudinal analysis would better reflect the progressive evolution of liquidity, efficiency, and innovation dynamics.

Broadening the data scope to include OTC derivatives markets and improving the granularity of key variables, such as participation rates, transaction costs, and open interest, would provide a more comprehensive evaluation of market behavior. In addition, refining innovation measurement through weighted composite indices or expert-informed scoring could better reflect the heterogeneity and impact of innovation on market outcomes.

Methodologically, future studies could apply structural equation modelling (SEM), Instrumental Variable (IV), Time-Varying parameter VAR (TVP-VAR) models. These methods would help address endogeneity concerns and better capture dynamic relationships within the derivatives ecosystem.

Finally, cross-country comparative analyses across emerging and frontier markets would illuminate how regulatory, institutional, and macroeconomic differences shape the liquidity-efficiency nexus. Investigating innovation's interaction with systemic shocks, such as macroeconomic volatility or regulatory shifts, would also provide timely insights for policy and market resilience strategies.

REFERENCES

Aawaar, G., Boamah, A. N., & Akotey, J. O. (2020). Investor herd behavior in Africa's emerging and frontier markets. *International Journal of Economics and Financial Issues, 6*, 194–205.

Abbas, J., Balsalobre-Lorente, D., Amjid, M. A., Al-Sulaiti, K., Al-Sulaiti, I., & Aldereai, O. (2024). Financial innovation and digitalization promote business growth: The interplay of green technology innovation, product market competition, and firm performance. *Innovation and Green Development, 3*(1).

Abergel, F., Lehalle, C.-A., & Rosenbaum, M. (2014). Understanding the stakes of high-frequency trading. *The Journal of Trading, 9*(4), 49-73.

Acharya, V. V., & Pedersen, L. H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics, 77*, 375–410.

Adelegan, O. J. (2009). The derivatives market in South Africa: Lessons for sub-Saharan African countries. *International Monetary Fund, Monetary and Capital Markets Department*.

Afful, K. B., Okeahalam, C. C., & Ayogu, M. (2017). Sub-Saharan Africa's infrastructure gap: A failure of financial markets? *Developing Country Studies, 7*(7), 28-42.

Aitken, D. (2018). The derivatives market in emerging economies. *The Economic Review*. Retrieved October 2024, from https://theeconreview.com/2018/02/27/the-derivatives-market-in-emerging-economies/

Aitken, M., & Winn, R. (1997). *What Is This Thing Called Liquidity?* Securities Industry Research Centre of Asia-Pacific. Securities Industry Research Centre of Asia-Pacific.

Al-Jaifi, H. A. (2017). Ownership concentration, earnings management and stock market liquidity: Evidence from Malaysia. *Corporate Governance, 17*(3), 490-510.

Alam, B. (2019). Qualitative research framework: Integrating philosophical and methodological assumptions. *Journal of Philosophy, Culture and Religion, 40*, 1-3.

Alderighi, S., & Gurrola-Perez, P. (2021). Investor types, liquidity, and price formation: Evidence from the Stock Exchange of Thailand. Retrieved February 2025, from World

Exchanges Organization: https://www.world-exchanges.org/storage/app/media/Investor%20types%20and%20liquidity%20formation%20SET%20w%20cover.pdf

Alhassan, A., & Naka, A. (2020). Corporate future investments and stock liquidity: Evidence from emerging markets. *International Review of Economics & Finance, 65*, 69-83.

Almeida, H., Campello, M., Cunha, I., & Weisbach, M. S. (2014). Corporate liquidity management: A conceptual framework and survey. *Annual Review of Financial Economics, 6*, 135–162.

Aluko, O. A., & Opoku, E. E. (2022). The financial development impact of financial globalization revisited: A focus on OECD countries. *International Economics, 169*, 13-29.

Aman, A., Khan, M. A., Haider, A., Oláh, J., & Fenyves, V. (2023). Role of institutions in promoting finance in emerging markets: A panel data analysis. *PLOS ONE*.

Ametefe, F., Devaney, S., & Marcato, G. (2020). Liquidity: A review of dimensions, causes, measures, and empirical applications in real estate markets. *Journal of Real Estate Literature, 24*(1), 1-29.

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets, 5*(1), 31-56.

Arshad, S., Haroon, O., & Rizvi, S. A. (2019). Understanding Asian emerging stock markets. *Bulletin of Monetary Economics and Banking, 21*(12), 495-510.

Atenya, M. K. (2019). The status quo of East African stock markets: Integration and volatility. *African Journal of Business Management, 13*(5), 176-187.

Atilgan, Y., Demirtas, K. O., & Simsek, K. D. (2016). Derivative markets in emerging economies: A survey. *International Review of Economics & Finance, 42*, 88-102.

Atta-Mensah, J., & Ibrahim, M. (2020). Explaining Africa's debt: The journey so far and the arithmetic of the policymaker. *Theoretical Economics Letters, 10*(2), 409-441.

Avgouleas, E., & Kiayias, A. (2019, February). The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the 'Holy Grail' of Systemic Risk Containment. *European Business Organization, 20*, 81–110.

Awrey, D. (2016). The mechanisms of derivatives market efficiency. *New York University Law Review, 9*(15), 1104-1182.

Bagnara, M., & Jappelli, R. (2022). Liquidity derivatives. Retrieved November 2024, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4216669

Banerjee, R., De, A., & Bandyopadhyay, G. (2018). Momentum effect, value effect, risk premium, and predictability of stock returns: A study on the Indian market. *Asian Economic and Financial Review, 8*(5), 669–681.

Batten, J. A., & Vo, X. V. (2014). Liquidity and return relationships in an emerging market. *Emerging Markets Finance and Trade, 50*(1), 5-21.

Beck, T. H., Cull, R., Fuchs, M., Getenga, J., Gatere, P. R., & Trandafir, M. (2010). Banking sector stability, efficiency, and outreach in Kenya. Retrieved October 2024, from https://documents.worldbank.org/en/publication/documents-reports/documents

Bekaert, G., Harvey, C. R., & Lundblad, C. (2007). Liquidity and expected returns: Lessons from emerging markets. *The Review of Financial Studies, 20*(6), 1783–1831.

Bekale, A. N., Alagidede, I., & Odei-Mensah, J. (2023). The impact of derivatives use on systemic risk of Africa's banking system. *Journal of African Business, 25*, 486-508.

Bella, F. I., Chalid, F. I., & Rusgianto, S. (2021). What drives return of Sukuk in the long and short terms: Evidence from Indonesia. *An-Nisbah: Jurnal Ekonomi Syariah, 8*(2), 489-514.

Biais, B., Foucault, T., & Moinas, S. (2015, Nay). Equilibrium fast trading. *Journal of Financial Economics, 116*(2), 292-313.

Bibow, J. (2021). Evolving international monetary and financial architecture and the development challenge. In B. Bonizzi, A. Kaltenbrunner, & R. A. Ramos (Eds.), *Emerging economies and the global financial system*. Routledge.

Bongaerts, D., & Achter, M. V. (2020, April). Competition among liquidity providers with access to high-frequency trading technology. *Journal of Financial Economics, 140*(1), 220-249.

Bongaerts, D., Jong, F. D., & Driessen, J. (2011). Derivative pricing with liquidity risk: Theory and evidence from the credit default swap market. *The Journal of Finance, 66*(1), 203-240.

Bouattour, M., & Martinez, I. (2019). Efficient market hypothesis: An experimental study with uncertainty and asymmetric information. *Finance Contrôle Stratégie, 22*(4).

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *The Review of Financial Studies, 22*(6), 2201–2238.

Bruel, S. (2024, March). *Derivatives Market Structure 2024: Focusing on Capital and Workflow Efficiency.* Retrieved April, 2025 from greenwich.com: https://www.greenwich.com/market-structure-technology/derivatives-market-structure-2024-focusing-capital-and-workflow

Bruel, S. (2025). *Drivers of derivatives markets growth in the year ahead.* Crisil, Coalition Greenwich. Crisil.

Business Research Insights. (2025, April 7). *Derivatives Market Repport Overview*. Retrieved April, 2025 from https://www.businessresearchinsights.com/market-reports/derivatives-market-100600

Caporin, M., & Costola, M. (2022). Time-varying Granger causality tests in the energy markets: A study on the DCC-MGARCH Hong test. *Energy Economics, 111.*

Carmona, R., & Webster, K. (2012). High frequency market making. *arXiv preprint*. Retrieved October 2024, from https://arxiv.org/abs/1210.5781

Cavanaugh, G., & Penick, M. (2013). The lifecycle of exchange-traded derivatives. Presentation at the *Agricultural & Applied Economics Association's 2013 AAEA Annual Meeting*. Washington, DC.

Çetın, U. (2018). Mathematics of market microstructure under asymmetric information. *arXiv preprint*. Retrieved July 2024, from https://arxiv.org/abs/1809.03885v1

Chang, B. (2018, January). Adverse selection and liquidity distortion. *The Review of Economic Studies, 85*(1), 275-306.

Chen, J., Haboub, A., & Khan, A. (2024). Limits of arbitrage and their impact on market efficiency: Evidence from China. *Global Finance Journal, 59*.

Chowdhry, A., Uddin, M., & C, K. A. (2018). Liquidity and macroeconomic management in emerging markets. *Emerging Markets Review, 34*, 1-24.

CGD. (2019). *Making Basel III Work for Emerging Markets and Developing Economies.* Center for Global Development (CDG). Washington, DC: Center for Global Development.

Christopher, F. M., Njuguna, A., & Kiriri, P. (2021). Accelerators of depth in nascent derivative markets: Case of Nairobi Securities Exchange. *Kabarak Journal of Research & Innovation, 11*(1), 34-42.

Chung, D. Y., & Hrazdil, K. (2010). Liquidity and market efficiency: Analysis of NASDAQ firms. *Global Finance Journal, 21*(3), 262-274.

Cote, C. (2021). *What Is Descriptive Analytics? 5 Examples*. (Harvard Business School Online) Retrieved March 2025 from https://online.hbs.edu/blog/post/descriptive-analytics#:~:text=Descriptive%20analytics%20is%20the%20process,but%20doesn't%20dig%20deeper.

DataHorizzon Research. (2025, March 2). *Derivatives Market: Futures, Options, Swaps, And Forwards - Global Market Size, Share, Growth, Trends, Statistics Analysis Report, By Region, And Forecast 2024-2033*. (DataHorizzon Research) Retrieved April, 2025 from http://datahorizzonresearch.com/derivatives-market-43623

D'Acunto, F., Rauter, T., Scheuch, C. K., & Weber, M. (2020, March). Perceived precautionary savings motives: Evidence from FinTech. Retrieved October 2024.

Demsetz, H. (1968, February). The Cost of Transacting. *The Quarterly Journal of Economics, 82*(1), 33-53.

Deng, Q., & Zhou, Z.-G. (2023). Liquidity premium, liquidity-adjusted return and volatility, and extreme liquidity. Retrieved October 2024, from arXiv.org: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4493342

Deuskar, P., Gupta, A., & Subrahmanyam, M. G. (2007, March). Liquidity effects in interest rate options markets: Premium or discount? Retrieved October 2024, from archive.nyu.edu: http://hdl.handle.net/2451/26307

Di Castri, S., & Plaitakis, A. (2018). Getting financial inclusion policies right in the digital era: Focus on competition and innovation as policy objectives.

Diamond, D. W. (2007). Banks and liquidity creation: A simple exposition of the Diamond-Dybvig model. *Economic Quarterly, 93*(2), 189–200.

Eganza, M. R. (2016). Factors that inhibit the development of financial derivatives in the Kenyan financial sector (master's thesis). United States International University-Africa, Chandaria School of Business. Retrieved from USIU Africa Digital Repository.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25*(2), 383-417.

Fernando, J. (2025, January 23). Understanding derivatives: A comprehensive guide to their uses and benefits. *Investopedia.* Retrieved February 2025, from https://www.investopedia.com/terms/d/derivative.asp

Feyen, E., Frost, J., Gambacorta, L., Natarajan, H., & Saal, M. (2021). *Fintech and the digital transformation of financial services: implications for market structure and public policy.* Bank for International Settlements (BIS), Monetary and Economic Department. The Bank for International Settlements and the World Bank Group.

Filis, G. N. (2004). Options in emerging markets: Evidence from the Greek derivative market. Retrieved October 2024, from https://eprints.bournemouth.ac.uk/340/

Fisher, I. (1930). *The theory of interest.* Journal of the Royal Statistical Society, *93*(3), 450-452.

Frame, W. S., & White, L. J. (2012). Technological change, financial innovation, and diffusion in banking. In A. N. Berger, P. Molyneux, & J. O. Wilson (Eds.), *The Oxford Handbook of Banking* (pp. 486–507). Oxford Academic.

Gabrielsen, A., Marzo, M., & Zagaglia, P. (2011). Measuring market liquidity: An introductory survey. *Quaderni - Working Paper DSE No. 802.*

Garrison, R., Jain, P., & Paddrik, M. (2019). Cross-asset market order flow, liquidity, and price discovery. *Office of Financial Research, 19*(4).

Global Growth Insights, (2025, April 7), *Derivatives Market Size, Share, Growth, and Industry Analysis, By Types (Financial, Commodity), By Applications Covered (Hedging, Speculative Arbitrage), Regional Insights and Forecast to 2033*. (Global Growth Insights) Retrieved April, 2025 from https://www.globalgrowthinsights.com/market-reports/derivatives-market-102850

Guidi, F., Gupta, R., & Maheshwari, S. (2010). Weak-form market efficiency and calendar anomalies for Eastern Europe equity markets. *Journal of Emerging Market Finance, 10*(3).

Goyenko, R. Y., Holden, C. W., & Trzcinka, C. A. (2009, May). Do liquidity measures measure liquidity? *Journal of Financial Economics, 92*(2), 153-181.

Hansen, B. E. (2022). *Econometrics*. Princeton University Press.

Hasbrouck, J. (1995). One security, many markets: Determining the contributions to price discovery. *Journal of Finance, 50*, 1175–1199.

Helbing, D., & Kirman, A. (2013). Rethinking economics using complexity theory. *Real-World Economics Review, 64*.

Henriques, C., & Neves, E. (2021). Exploring the trade-off between liquidity, risk, and return under sectoral diversification across distinct economic settings. *Journal of Risk Finance, 22*(2), 130-152.

Hull, J. C. (2015). *Options, futures, and other derivatives* (9th ed.). Pearson Education.

International Monetary Fund (IMF). (2012). *The role of financial derivatives in emerging markets*. Retrieved October 2024, from https://www.elibrary.imf.org/downloadpdf/display/book/9781589062917/ch04.pdf

International Monetary Fund. (2015). Market liquidity: Resilient or fleeting. *Global Financial Stability Report: Vulnerabilities, Legacies, and Policy Challenges: Risks Rotating to Emerging Markets.*

International Swaps and Derivatives Association (ISDA). (2022, June 27). *Policy framework for safe and efficient derivatives activity in emerging and developing markets*. Making Finance Work for Africa. Retrieved October, 2024, from https://www.mfw4a.org/publication/policy-framework-safe-and-efficient-derivatives-activity-emerging-and-developing

Jameel, K., & Hasan, S. S. (2018). Financial environment for derivatives: Growth and new dimensions for financial derivative market in Pakistan; A case study. *Research Journal of Finance and Accounting, 9*(9), 58-67.

Jolliffe, I. T., & Cadima, J. (2016). Principal component analysis: a review and recent developments. *Philosophical transactions of the royal society A: Mathematical, Physical and Engineering Sciences*, *374*(2065), 20150202.

Jonker, J., & Riva, A. (2022). Stock exchange price currents, financial information, and market transparency: An introduction. *Financial History Review, 29*, 271–286.

Karagozoglu, A. (2006). Financial derivatives in emerging markets: Experience of Korea and Turkey. Retrieved February 2025, from Hofstra University: https://www.hofstra.edu/pdf/ORSP_Horizons_Karagozoglu_spr06.pdf

Keynes, J. M. (1936). *The general theory of employment, interest and money.* Palgrave Macmillan.

Keynes, J. M. (2018). The psychological and business incentives to liquidity. In *The general theory of employment, interest, and money*. Palgrave Macmillan.

Khuntia, S., & Pattanayak, J. K. (2019). Evolving efficiency of exchange rate movement: Evidence from the Indian foreign exchange market. *Global Business Review, 21*(4).

Kimani, J. G., Nyangáu, B. O., Karungu, R. M., & Kirui, K. (2014). What are the implications of working capital management on liquidity risk? A case of listed commercial banks in Kenya. *Research Journal of Finance and Accounting, 5*(10), 34-50.

Kulikova, M. V., & Kulikov, G. Y. (2023, September). On derivative-free extended Kalman filtering and its Matlab-oriented square-root implementations for state estimation in continuous-discrete nonlinear stochastic systems. *European Journal of Control, 73.*

Kumar, H., & Jawa, R. (2017). Efficient market hypothesis and calendar effects: Empirical evidence from the Indian stock markets. *Business Analyst, 37*(2), 145-160.

Kyle, A. S., & Obizhaeva, A. A. (2018, August 30). Adverse selection and liquidity: From theory to practice. Retrieved November 2024, from SSRN: https://ssrn.com/abstract=3236030 or http://dx.doi.org/10.2139/ssrn.3236030

Lagos, R., & Zhang, S. (2020). Turnover liquidity and the transmission of monetary policy. *American Economic Review, 110*(6), 1635–1672.

Li, Y., & Kim, S. (2011). The effect of market inefficiency on the value relevance of earnings. *24th Australasian Finance and Banking Conference 2011 Paper*. SSRN. Retrieved from https://ssrn.com/abstract=1914852

Liu, G., Li, J., Gregoriou, A., & Bo, A. Y. (2023). Which market enhances market efficiency from liquidity? Evidence of stock liquidity in relation to market value. *Asian Economic Papers, 22*(1), 33–61.

Louhichi, W., Saghi, N., Srour, Z., & Viviani, J.-L. (2022). The effect of liquidity creation on systemic risk: Evidence from the European banking sector. *Annals of Operations Research, 334*, 357–389.

Lu, D. (2015). Overview of derivatives trading. In D. Lu, *The XVA of financial derivatives: CVA, DVA and FVA explained* (pp. 5-21). Palgrave Macmillan.

Ma, R., Anderson, H. D., & Marshall, B. R. (2018). Market volatility, liquidity shocks, and stock returns: Worldwide evidence. *Pacific-Basin Finance Journal, 49*, 164-199.

Maddaloni, G. (2015). Liquidity risk and policy options. *Journal of Banking & Finance, 50*, 514-527.

Madhavan, A. (2000, August). Market microstructure: A survey. *Journal of Financial Markets, 3*(3), 205-258.

Magnusson, M. A., & Wydick, B. (2002). How efficient are Africa's emerging stock markets? *The Journal of Development Studies, 38*(4), 141-156.

Malafeyev, O., Awasthi, A., Kambekar, K. S., & Kupinskaya, A. (2019). Random walks and market efficiency in Chinese and Indian equity markets. *Statistics, Optimization & Information Computing, 7*(1), 1-25.

Malkiel, B. G. (2003). The efficient market hypothesis and its critics. *Journal of Economic Perspectives, 17*(1), 59–82.

Mandimika, N. (2010). Volatility and the risk-return relationship on the South African equity market. *[Unpublished manuscript]*. Retrieved October 2024, from https://www.semanticscholar.org/paper/Volatility-and-the-risk-return-relationship-on-the-Mandimika/0baa060aa4d41c0b45e0d4b9f

Manzoor, R., Ahmed, V., & Maken, A. M. (2019). Pakistan-China financial market integration: Challenge to financial market integration. *JSTOR, 165*, 7-11.

Marangu, P. K. (2013). Product diversification as a strategic approach by youth funding organisations in Kenya (MBA project). University of Nairobi, School of Business.

Marcuzzo, M. C., Repapis, C., & Toporowski, J. (2024). Victoria Chick (1936–2023), a restless challenger to mainstream economics: An appreciation.

Market Growth Reports. (2024, April 24). *Derivatives Market Size, Share, Growth, and Industry Analysis, By Type (Financial,Commodity), By Application (Hedging,Speculative Arbitrage), Regional Insights and Forecast to 2116*. (MG, Producer, & Market Growth Reports) Retrieved April, 2025 from marketgrowthreports.com: https://www.marketgrowthreports.com/market-reports/derivatives-market-104112

Marglin, S. A. (2020). *Raising Keynes: A twenty-first-century general theory.* Harvard University Press.

Marshall, B. R., Nguyen, N. H., & Visaltanachoti, N. (2014, October 21). *Transaction Costs in an Illiquid Order-Driven Market.* Retrieved April, 2025 from ssrn.com: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2512924

Martens, W., Yapa, P., Safari, M., & Watts, S. (2021). The influence of earnings management on bank efficiency: The case of frontier markets. *Heliyon, 7*(10), 1-14.

Menkveld, A. J. (2016, September). The Economics of High-Frequency Trading: Taking Stock. *Annual Review of Financial Economics, 8*, 1-24.

Mihaljek, D., & Packer, F. (2010). Derivatives in emerging markets. *BIS Quarterly Review*, 43–58.

Mizrach, B., & Neely, C. (2006). *The transition to electronic communications networks in the secondary treasury market.* Review, Federal Reserve Bank of St. Louis , Economics Departments, Institutes and Research Centers in the World .

Mize, T. (2019). Best practices for estimating, interpreting, and presenting nonlinear interaction effects. *Sociological Science, 6*, 81–117.

Mohapatra, S., & Mishra, A. K. (2020). The evolving financial landscape in emerging markets and developing economies. In *The financial landscape of emerging economies* (pp. 1-14). Springer.

Mpapalika, J. (2020). Alternative financing instruments for African economies. *Journal of Mathematical Finance, 10*(1).

Mriithi, J. G., Muturi, W., & Waweru, K. (2016). The effect of market risk on financial performance of commercial banks in Kenya. *Journal of Finance and Accounting, 4*(4), 225-233.

Muchiri, M. S., Kyalo, M. J., & Kibera, W. A. (2021). Copula models for equity portfolio risk estimation: A case study of Nairobi Securities Exchange. *International Journal of Statistical Distributions and Applications, 7*(3).

Muneeb, D., Khong, K. W., Ennew, C., & Avvari, M. (2020). Conceptualizing and validating resource recombination in the context of higher educational institution competitiveness. *International Journal of Organizational Analysis, 28*(4).

Muragu, K. (1990). Stock market efficiency in developing countries: A case study of Nairobi Stock Exchange. *[Unpublished manuscript].* Retrieved October 2024, from https://core.ac.uk/reader/281390

Muthanga, N. W. (2022). *The impact of derivatives trading on the liquidity of stocks at the Nairobi Securities Exchange*. [Master's thesis, Strathmore University Business School].

N'Dri, K. L. (2015). Variance ratio tests of the random walk in the BRVM. *Applied Economics and Finance, 2*(2).

Nairobi Securities Exchange (NSE). (2024). *History of NSE*. Retrieved from https://www.nse.co.ke/our-story/

Naik, G., Chitre, C., Bhalla, M., & Rajan, J. (2020, March). Impact of use of technology on student learning outcomes: Evidence from a large-scale experiment in India. *World Development, 127*.

Narayan, P., & Reddy, Y. V. (2017). Exploring the causal relationship between stock returns, volume, and turnover across sectoral indices in the Indian stock market. *Metamorphosis: A Journal of Management Research, 16*(2).

Ndwiga, D., & Muriu, P. W. (2021). Stock returns and volatility in an emerging equity market: Evidence from Kenya. *European Scientific Journal, 12*(4), 80-98.

Nesbitt, J. (2016). Exponential general autoregressive conditional heteroskedastic (EGARCH) model. *NumXL Help Center.* Retrieved October 2024, from https://support.numxl.com/hc/en-us/articles/214502046-Exponential-General-Autoregressive-Conditional-Heteroskedastic-EGARCH-Model

Nguyen, N. P., & Dao, T. T. (2022). Liquidity, corporate governance, and firm performance: A meta-analysis. *Accounting, Corporate Governance & Business Ethics, 9*, 1-26.

Njenga, G., Machagua, J., & Gachanja, S. (2022). Capital markets in sub-Saharan Africa. *[Working paper]*. Retrieved from https://www.wider.unu.edu/sites/default/files/Publications/Working-paper/PDF/wp2022-112-capital-markets-sub-Saharan-Africa.pdf

Njoroge, N. N., Matumo, N. G., & Maina, K. E. (2013). Factors influencing the development of financial derivatives markets: A survey of listed companies in Kenya. *Global Advanced Research Journal of Management and Business Studies, 2*(5).

Njuguna, J. (2016). Testing the efficient market hypothesis on the Nairobi Securities Exchange. *Investment Management and Financial Innovations, 13*(3), 75-83.

NSE-NEXT. (2024). *Derivatives market rapport.* Nairobi Securities Exchange (NSE).

NSE. (2022). Introduction of new single stock futures on the NSE derivatives market. *Nairobi Securities Exchange.* Retrieved September 2024, from https://www.nse.co.ke/wp-content/uploads/Press-Release-INTRODUCTION-OF-NEW-SINGLE-STOCK-FUTURES-ON-THE-NSE-DERIVATIVES-MARKET.pdf

NSE. (2024). *Daily statistics – NSE.* Nairobi Securities Exchange (NSE).

Ntim, C. G., Opong, K. K., Danbolt, J., & Dewotor, F. (2008). Can emerging African stock markets improve their informational efficiency by formally harmonizing and integrating their operations? Retrieved October 2024, from https://ideas.repec.org/p/pra/mp

Ochenge, R. O., & Muriu, P. W. (2016). Stock returns and volatility in an emerging equity market: Evidence from Kenya. *European Scientific Journal, 12*(4), 79-98.

Ochenge, R. O., Ngugi, R., & Muriu, P. (2020). Foreign equity flows and stock market liquidity in Kenya. *Cogent Economics & Finance, 8*(1), 1-29.

Omwono, G., & Atieno, E. (2020). Effect of working capital management practices on liquidity risk of insurance firms listed at the Nairobi Securities Exchange (NSE), Kenya. *Sumerianz Journal of Business Management and Marketing*.

Ondigo, H., & Moronya, D. C. (2018). The relationship between financial liberalization and economic growth in Kenya. *African Journal of Business and Management, 4*(3), 53-79.

Onsongo, S. K., Muathe, S. M., & Mwangi, L. W. (2020). Financial risk and financial performance: Evidence and insights from commercial and services listed companies in Nairobi Securities Exchange, Kenya. *International Journal of Financial Studies, 8*(3), 51.

Paddrik, M., & Tompaidis, S. (2023). Intermediation networks and derivative market liquidity: Evidence from CDS markets. Retrieved from https://www.financialresearch.gov/working-papers/files/OFRwp-24-01-intermediation-networks-and-derivative-market-liquidity.pdf

Pagliari, M. S., & Hannan, S. A. (2017). The volatility of capital flows in emerging markets: Measures and determinants. *IMF Working Papers*. Retrieved from https://www.imf.org/en/Publications/WP/Issues/2017/03/07/The-Volatility-of-Capital-Flows-in-Emerging-Markets-Measures-and-Determinants-44725

Pagano, M., & Roell, A. (1996). Transparency and Liquidity: A Comparison of Auction and Dealer Markets with Informed Trading. *Journal of Finance, 51*(2), 579-611.

Pan, J. (2024). Emerging markets conclude 2023 on a better note than developed markets. *S&P Global Market Intelligence*. Retrieved from https://www.spglobal.com/marketintelligence/en/mi/research-analysis/emerging-markets

Park, Y. S., Konge, L., & Artino, A. R. (2019). The positivism paradigm of research. *Academic Medicine, 95*(5), 1.

Pástor, L., & Stambaugh, R. F. (2003). Liquidity risk and expected stock returns. *Journal of Political Economy, 111*(3), 642-685.

Perera, S., Nanayakkara, S., Rodrigo, M., Senaratne, S., & Weinand, R. (2020, March). Blockchain technology: Is it hype or real in the construction industry? *Journal of Industrial Information Integration, 17*.

Perobelli, F. F., Famá, R., & Sacramento, L. C. (2016). Return and liquidity relationships on market and accounting levels in Brazil. *Revista Contabilidade & Finanças, 27*(71), 259–272.

Perveen, S., Ahmed, M., & Begum, R. (2018). A review on economic instability and the derivative market of Pakistan. *European Scientific Journal, 14*(22), 13-24.

Peters, O., & Adamou, A. (2011). Stochastic market efficiency. *Quantitative Finance*.

Peterson, P. E., & Leuthold, R. M. (1982). Using mechanical trading systems to evaluate the weak-form efficiency of futures markets. *Research and Development/Tech Change/Emerging Technologies, 14*(1), 147–151.

Phoenix, C., Osborne, N. J., Redshaw, C., Moran, R., Stahl-Timmins, W., Depledge, M. H., & Wheeler, B. W. (2013). Paradigmatic approaches to studying environment and human health: (Forgotten) implications for interdisciplinary research. *Environmental Science & Policy, 25*, 218-228.

Piesse, J., & Hearn, B. (2005). Regional integration of equity markets in sub-Saharan Africa. *South African Journal of Economics, 73*(1), 36-52.

Polsky, D., & Baiocchi, M. (2014). Observational studies in economic evaluation. *Encyclopedia of Health Economics*, 399-408.

Poufinas, T., & Pappas, K. (2021). Determinants of option markets liquidity: An empirical analysis on European markets. *Theoretical Economics Letters, 11*(4), 824-857.

Ragab, M. A., & Arisha, A. (2018). Research methodology in business: A starter's guide. *Management and Organizational Studies, 5*(1), 1-14.

Rath, P. K. (2022). Nexus between Indian financial markets and macroeconomic shocks: A VAR approach. *Asia-Pacific Financial Markets, 30*, 131–164.

Rösch, D. (2015). Market efficiency and liquidity. Retrieved from https://repub.eur.nl/pub/79121/Dissertations-Rosch-Dominik.pdf

Rösch, D. M., Subrahmanyam, A., & Dijk, M. A. (2016). The dynamics of market efficiency. *The Review of Financial Studies, 30*(4), 1151-1187.

Roy, B. N., Roy, H., Rahman, K. S., Mahmud, F., Bhuiyan, M. H., Bhuiyan, A.-A. K., & Islam, M. S. (2024). Principal component analysis incorporated water quality index modeling for Dhaka-based rivers. *City and Environment Interactions, 23.*

Saeed, S., & Hassan, A. (2018). Inter-linkages between liquidity and stock returns: An empirical investigation through panel cointegration. *Pakistan Journal of Commerce and Social Sciences, 12*(2), 617-637.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *The Turkish Online Journal of Educational Technology, 5*(2).

Sahoo, A., & Sahoo, S. (2020). What drives derivatives: An Indian perspective. *Journal of Risk and Financial Management, 13*(6), 134.

Samarasinghea, A., & Uylangco, K. (2022). Stock market liquidity and traditional sources of bank business. *Accounting & Finance, 13*, 3107–3145.

Sánchez-Verdasco, J. (2018). The use of derivatives to hedge market risk in corporate financing. *SSRN Working Paper*. Retrieved October, 2024, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3230485

Saunders, M. N., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). United Kingdom.

Schwartz, R. A. (2016). A challenge for equity markets on both sides of the Atlantic: Can liquidity be augmented, volatility better controlled, and price discovery sharpened? *Zeitschrift für Bankrecht und Bankwirtschaft, 28*(6).

Shanmugam, V. P. (2011). Derivatives market: Innovations and its effects. *Financial Derivatives: Market & Application, 3*, 8387–482.

Smith, K. (2022). Risk information, investor learning, and informational feedback. *Review of Accounting Studies, 29*, 237–275.

Somanathan, T. V., & Nageswaran, V. A. (2015). The economics of derivatives. In T. V. Somanathan & V. A. Nageswaran (Eds.), *Derivatives and emerging markets* (pp. 134-164). Cambridge University Press.

Somanathan, T. V., & Nageswaran, V. A. (2015). *The economics of derivatives*. Cambridge University Press.

Song, W., & Zhao, K. (2024, August). Navigating the innovation policy dilemma: How subnational governments balance expenditure competition pressures and long-term innovation goals. *Heliyon, 10*(15).

Spyrou, S. I. (1997, February). On the functioning and the efficiency of the emerging markets. Retrieved October 2024, from https://core.ac.uk/download/337924.pdf

Țițan, A. G. (2015). The efficient market hypothesis: Review of specialized literature and empirical research. *Procedia Economics and Finance, 32*, 442–449.

Titova, Y., Penikas, H., & Gomayun, N. (2020). The impact of hedging and trading derivatives on value, performance, and risk of European banks. *Empirical Economics, 58*(2), 535–565. https://doi.org/10.1007/s00181-019-01691-4

Tufano, P. (2003). Chapter 6 - Financial Innovation. In P. Tufano, *Handbook of the Economics of Finance* (Vol. 1, pp. 307-335). Boston, Boston: Elsevier.

Uddin, R., Reza, S. M., & Sana, A. K. (2018). Liquidity risk and performance: A study on the banking sector of Bangladesh. *A Journal of Business Administration Discipline, 11*(1-2), 35-42.

Ujunwa, A., & Modebe, N. J. (2012). Adopting strategic management approach in the capital market development: The Nigerian case. *International Journal of Economics and Finance, 4*(1), 223-228.

Upper, C., & Valli, M. (2016, December 11). Emerging derivatives markets? *Bank for International Settlements (BIS)*. https://www.bis.org/publ/qtrpdf/r_qt1612g.htm

Varghese, J., & Jose, B. (2020). Is Indian equity options market suitable for hedging when the options payoff structure changes? *Global Journal of Management and Business Research, 20*(B4), 21–32.

Vayanos, D., & Wang, J. (2011). Theories of liquidity. *Foundations and Trends in Finance, 6*(4), 221–317.

Vayanos, D., & Wang, J. (2012). Liquidity and asset return under asymmetric information and imperfect competition. *The Review of Financial Studies, 25*(5), 1339-1365.

Vd M. Smit, E., & Louw, M. W. (1996). The relationship between volatility, volume and open interest: some evidence from the South African futures market. *South African Journal of Business Management*, *27*(4), 113-121.

Vega, C., & Miller, C. S. (2009). Market microstructure. In R. A. Meyers (Ed.), *Encyclopedia of Complexity and Systems Science* (pp. 5392–5404). Springer.

Vidović, J. (2019, December 6). Turnover Based Illiquidity Measurement as Investment Strategy on Zagreb Stock Exchange. *American Journal of Operations Research, 10*(1).

Violi, R., & Camerini, E. (2018, March). Emerging market portfolio strategies, investment performance, transaction cost, and liquidity risk. *SSRN*. https://doi.org/10.2139/ssrn.3127422

Vo, H., Nguyen, D., Nguyen, P., Vo, H., Nguyen, A., & Thang, N. (2020). Derivatives market and economic growth nexus: Policy implications for emerging markets. *The North American Journal of Economics and Finance, 5*(C).

Wang, G., Hamad, R., & White, J. S. (2024). Advances in difference-in-differences methods for policy evaluation research. *Epidemiology, 35*(5), 628-637.

Wenjuan, W. (2017). Study on the duration of market microstructure theory. *International Journal of Business and Management, 12*(10), 252-256.

Were, J. O. (2020). Analysis of volatility spillover from market to market in the East Africa capital markets. *Unpublished manuscript.*

World Federation of Exchanges (WFE). (2018). What attracts international investors to emerging markets? *World Federation of Exchanges.* https://www.world-exchanges.org/

World Federation of Exchanges (WFE). (2019). Derivatives market survey—2018 report. *World Federation of Exchanges.* https://www.world-exchanges.org/

World Federation of Exchanges (WFE). (2021, May 19). Annual derivatives market analysis. *World Federation of Exchanges.* https://www.world-exchanges.org/news/articles/wfe-publishes-annual-derivatives-market-analysis

Wu, X., & Jiang, Z. (2023). Time-varying asymmetric volatility spillovers among China's carbon markets, new energy market, and stock market under the shocks of major events. *Energy Economics, 126.*

Xiong, X., Wang, Z., Cui, T., Knottenbelt, W., & Huth, M. (2023). Market misconduct in decentralized finance (DeFi): Analysis, regulatory challenges, and policy implications. *arXiv.* https://arxiv.org/abs/2311.17715

Yadav, Y., & Turing, D. (2015). The extra-territorial regulation of clearinghouses. *Journal of Financial Regulation, 1*(2), 149-183.

Yakubu, Z., Loganathan, N., Mursitama, T. N., Mardani, A., Khan, S. A., & Hassan, A. A. (2020). Financial liberalization, political stability, and economic determinants of real economic growth in Kenya. *Energy, 13*(13), 3426.

Yeh, I.-C., & Liu, Y.-C. (2020). Discovering optimal weights in weighted-scoring stock-picking models: A mixture design approach. *Financial Innovation, 6*(1), 1–28.

Young, N., & Auret, C. (2018). Liquidity and the convergence to market efficiency. *Investment Analysts Journal, 47*(3), 209-228.

Zhang, Y.-C. (2001). Why financial markets will remain marginally inefficient. *arXiv.* https://arxiv.org/abs/cond-mat/0105373

Zheng, C., Chen, S., & Dong, Z. (2021). Economic fluctuation, local government bond risk, and risk-taking of city commercial banks. *Sustainability, 13*(9871).

Ziliotto, A., & Serati, M. (2015). The semi-strong efficiency debate: In search of a new testing framework. *Research in International Business and Finance, 34*, 412-438.

Zulfikar, R., & Mayvita, P. A. (2017). The effects of political events against abnormal return and total volume sharia shares activity that listed in Jakarta Islamic Index (JII). *JEMA: Jurnal Ilmiah Bidang Akuntansi dan Manajemen*, *14*(2), 157-168.

APPENDIX

Appendix 0. Administrative Documentation

Strathmore UNIVERSITY

2nd April 2025

Mr Nsale Chanel,
chanel.nsale@strathmore.edu

Dear Mr Nsale,

RE: Analyzing the Impact of Efficiency on Liquidity in the Nairobi Securities Exchange Derivatives Segment (NEXT): Moderated by Market Innovation

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** proposal. Your application reference number is **SU-ISERC2772/25.** The approval period is from **2nd April 2025 to 1st April 2026.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 72 hours.
v. Clearance for the export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days of completion of the study to SU-ISERC.

Before commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

Mr Ambrose Rachier,
Chairperson; SU-ISERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

Research Proposals Review <ethicsr... Wed, Apr 2, 12:23 PM (13 days ago)
to me

Dear Mr Nsale,

I am pleased to inform you that your proposal: **" Analyzing the Impact of Efficiency on Liquidity in the Nairobi Securities Exchange Derivatives Segment (NEXT): Moderated by Market Innovation "** has been approved.

Please find attached your **approval letter.**

You **MUST** obtain a mandatory research permit **(if dealing with primary data**) from the National Commission for Science and Technology and Innovation (NACOSTI) before the commencement of the study.

The application process is made online through the NACOSTI portal (https://research-portal.nacosti.go.ke/).

Sincerely,

Mwango Chanda
Secretariat | SU-ISERC

Strathmore UNIVERSITY

Direct Line: +254 (0) 703 034418 **Ext:** 2418
Enquiries: +254 (0) 703-034000/200/300 OR +254 (0) 730-734000/200/300
Email: mchanda@strathmore.edu
Address: Strathmore University, Ole Sangale Road, Madaraka Estate, Nairobi, Kenya
Visit Our Website

Appendix 0.1. NSE Data Services

to me, NSE

Good afternoon Chanel,

Thank you for reaching out to us regarding your data inquiry.

Your data request amounts to **Kes.52,290.00** payable through our pay bill number: **733333.**

Once the amount is paid, kindly share the M-PESA message here which will allow us to populate your data request.

BR,

Sammy Mukhule
Officer, Data Analytics & Operations
Nairobi Securities Exchange - The EXchange, 55 Westlands Road
☎ : (Office) (020) 2831000
www.nse.co.ke

Our Vision: To be a leading securities exchange in Africa, with a global reach

Appendix 0.2. Research Study Budget

Category	Items	Cost (Kshs.)
Data Acquisition Fees	Payment to NSE-NEXT for financial data (2021-2024)	52,290.00
Software for Data Analysis	EViews, STATA or other statistical software license/subscription	-
Printing & Photocopying	Hard copies of research documents for review and submission	-
Binding	Final thesis binding for submission	-
	TOTAL AMOUNT	**52,290.00**

Appendix 1: Raw Data Collected Pre-transformation

Variable	Description	Period of the Study	Sources
Future Prices[2]	For the all the stock futures traded in the derivatives markets	From Jul. 4th, 2019, to Dec. 31, 2019, and from Jan. 4th, 2021, to Dec. 31st, 2024, and incomplete for all 2020.	NEXT
Trading Volume	For the all the stock futures traded in the derivatives markets	From Jul. 4th, 2019, to Dec. 31, 2019, and from Jan. 4th, 2021, to Dec. 31st, 2024, and incomplete for all 2020.	NEXT
Trading Value	For the all the stock futures traded in the derivatives markets	From Jul. 4th, 2019, to Dec. 31, 2019, and from Jan. 4th, 2021, to Dec. 31st, 2024, and incomplete for all 2020.	NEXT
Open Interest (OI) [3]	For the all the stock futures traded in the derivatives markets	From Jul. 4th, 2019, to Dec. 31, 2019, and from Jan. 4th, 2021, to Dec. 31st, 2024, and incomplete for all 2020.	NEXT
Spot Prices	For all the underlying asset (in the spot/cash market) corresponding to the futures stock	from Jul. 4th, 2019, to Dec. 2024.	NSE
Exchange Rate	Exchange rate in KES/USD	from Jul. 4th, 2019, to Dec. 2024.	CBK & KNBS
Innovations/ Reforms/ Improvements	Financial, product, regulatory, technological, infrastructure and margin requirements	from Jul. 4th, 2019, to Dec. 2024.	NSE, NEXT & CMA

Source: Author

[2] Nominal: SSF-1000 below Kes.100; SSF-100 above Kes.100; INDEX-100; MINI-INDEX – 10

[3] Open interest: total number of long or short positions that remain outstanding at the end of a particular trading day.

Appendix 2. Innovations in the NEXT

Date	Innovation Type	Abbr.	Description	Institution of Approval
2016 (amended post-2019)	Regulatory Reform	RR	Introduction of Capital Markets (Derivatives Markets) Regulations, Legal Notice 37 of 2016	CMA
Jul-19	Product Innovation	PI	Launch of Single Stock Futures and Index Futures under the NEXT derivatives market	NSE
2019–2024 (ongoing)	Financial Innovation	FI	Development of margining regime and daily mark-to-market practices	CMA & NSE
Oct-19	Technological Innovation	TI	Upgrade of Automated Trading System (ATS) for enhanced speed and reliability	NSE
Oct-19	Market Infrastructure Innovation	MII	China-Kenya Capital Market Service Initiative with SZSE to promote cross-border investments	NSE & SZSE
Oct-19	Market Infrastructure Innovation	MII	Expansion of Ibuka-V-Next Connect partnership linking SMEs to Chinese investors	NSE &SZSE
2020	Market Infrastructure Innovation	MII	Establishment of Derivatives Settlement Guarantee and Investor Protection Funds	NSE
2021	Regulatory Reform	RR	Transition from LIBOR to Risk-Free Rates (RFR) benchmarks	CMA & CBK
2021–2024	Regulatory Reform	RR	Enhanced surveillance and compliance for derivatives brokers	CMA
Jun-21	Product Innovation	PI	Introduction of Mini NSE 25 Share Index Futures	NSE
May 13, 2022	Product Innovation	PI	Availability of expanded Single Stock Futures (NCBA, COOP, SCBK, IMHP)	NSE
May 16, 2022	Product Innovation	PI	Trading commencement of expanded Single Stock Futures	NSE
2022–2024	Financial Innovation	FI	Surge in retail investor participation via education and simplified platforms	NSE
2023–2024	Technological Innovation	FI	Deployment of advanced risk management and trade surveillance systems	NSE Clear
2024	Technological Innovation	TI	Integration of cash-settled derivatives contracts via NSE Clear infrastructure	NSE Clear
2024 (planned)	Product Innovation	PI	Proposed expansion to interest rate and commodity-linked derivatives	NSE & CMA
Oct. 25, 2024	Product Innovation	PI	Approval of Options Derivatives trading on existing futures	CMA
Dec. 20, 2024	Financial Innovation	FI	Adjustment of Initial Margin Requirements for Equity Futures	NSE

Source: CBK, CMA, NSE, NEXT & SZSE

Appendix 3: EGARCH – Outcome for the Market, SCOM, MIN25, and EQTY

Dependent Variable: RET_MIN25
Method: ML ARCH - Student's t distribution (Marquardt / EViews legacy)
Date: 04/05/25 Time: 06:41
Sample: 1/04/2021 12/31/2024
Included observations: 988
Convergence achieved after 11 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.38E-07	4.50E-08	-3.055744	0.0022
AR(1)	0.863834	0.035851	24.09545	0.0000
MA(1)	-0.637646	0.051133	-12.47035	0.0000
Variance Equation				
C(4)	-0.503853	0.044273	-11.38072	0.0000
C(5)	0.465210	0.056934	8.171104	0.0000
C(6)	-0.085456	0.045193	-1.890895	0.0586
C(7)	0.976231	0.002033	480.1061	0.0000

Dependent Variable: RET_EQTY
Method: ML ARCH - Student's t distribution (Marquardt / EViews legacy)
Date: 04/05/25 Time: 06:57
Sample: 1/04/2021 12/31/2024
Included observations: 988
Convergence achieved after 22 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.67E-05	0.000420	0.063523	0.9493
AR(1)	0.621755	0.230695	2.695137	0.0070
MA(1)	-0.562538	0.246816	-2.279183	0.0227
Variance Equation				
C(4)	-2.590858	0.583086	-4.443355	0.0000
C(5)	0.707795	0.245929	2.878053	0.0040
C(6)	-0.012888	0.079074	-0.162990	0.8705
C(7)	0.698275	0.073463	9.505184	0.0000

Heteroskedasticity Test: ARCH

F-statistic	0.000943	Prob. F(1,985)	0.9755
Obs*R-squared	0.000944	Prob. Chi-Square(1)	0.9755

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 04/28/25 Time: 02:53
Sample (adjusted): 1/05/2021 12/31/2024
Included observations: 987 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.998948	0.111042	8.996124	0.0000
WGT_RESID^2(-1)	0.000978	0.031862	0.030701	0.9755

Dependent Variable: RET_SCOM
Method: ML ARCH - Normal distribution (Marquardt / EViews legacy)
Date: 04/05/25 Time: 06:53
Sample: 1/04/2021 12/31/2024
Included observations: 988
Convergence achieved after 56 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	-0.114921	0.306548	-0.374887	0.7077
MA(1)	0.223628	0.311096	0.718838	0.4722
Variance Equation				
C(3)	-0.753560	0.090624	-8.315252	0.0000
C(4)	0.332629	0.033509	9.926620	0.0000
C(5)	-0.077462	0.014475	-5.351582	0.0000
C(6)	0.935321	0.010704	87.38118	0.0000

Heteroskedasticity Test: ARCH

F-statistic	14.29747	Prob. F(1,984)	0.0002
Obs*R-squared	14.12135	Prob. Chi-Square(1)	0.0002

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/28/25 Time: 03:00
Sample (adjusted): 1/06/2021 12/31/2024
Included observations: 986 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.04E-05	6.02E-06	8.371128	0.0000
RESID^2(-1)	0.119674	0.031650	3.781200	0.0002

R-squared	0.014322	Mean dependent var	5.72E-05
Adjusted R-squared	0.013320	S.D. dependent var	0.000181
S.E. of regression	0.000180	Akaike info criterion	-14.40254
Sum squared resid	3.20E-05	Schwarz criterion	-14.39262
Log likelihood	7102.453	Hannan-Quinn criter.	-14.39877
F-statistic	14.29747	Durbin-Watson stat	2.010179
Prob(F-statistic)	0.000165		

Source: Author (from Eviews)

Appendix 4: Augmented Dickey-Fuller (ADF) test for VECM – IS (EViews- Excel)

	Before Stationarity				After Stationarity			
Secutity	**ADF Values***	**Prob****	**Decision**	**Method**	**ADF Values**	**Prob****	**Decision**	**I(d)*****
lindex_f	-1.329	0.618	Non-Stationary	DS	-23.310	0.000	Stationary	I(1)
lindex_s	-1.191	0.680	Non-Stationary	DS	-22.190	0.000	Stationary	I(1)
lmin25_f	-2.792	0.060	Non-Stationary	DS	-31.387	0.000	Stationary	I(1)
lmin25_f	-1.191	0.680	Non-Stationary	DS	-22.190	0.000	Stationary	I(1)
lscom_f	-1.015	0.750	Non-Stationary	DS	-26.290	0.000	Stationary	I(1)
lscom_s	-0.998	0.756	Non-Stationary	DS	-24.114	0.000	Stationary	I(1)
leqty_f	-2.518	0.112	Non-Stationary	DS	-31.539	0.000	Stationary	I(1)
leqty_s	-2.750	0.066	Non-Stationary	DS	-25.405	0.000	Stationary	I(1)
leabl_f	-2.156	0.2228	Non-Stationary	DS	-30.713	0.000	Stationary	I(1)
leabl_s	-1.928	0.3197	Non-Stationary	DS	-32.677	0.000	Stationary	I(1)
lkcbg_f	-1.681	0.441	Non-Stationary	DS	-20.593	0.000	Stationary	I(1)
lkcbg_s	-1.351	0.608	Non-Stationary	DS	-23.471	0.000	Stationary	I(1)
lbat_f	-2.694	0.075	Non-Stationary	DS	-26.317	0.000	Stationary	I(1)
lbat_s	-2.406	0.140	Non-Stationary	DS	-33.437	0.000	Stationary	I(1)
labsa_f	-0.671	0.852	Non-Stationary	DS	-19.169	0.000	Stationary	I(1)
labsa_s	-0.847	0.804	Non-Stationary	DS	-19.047	0.000	Stationary	I(1)
lncba_f	-1.255	0.652	Non-Stationary	DS	-31.646	0.000	Stationary	I(1)
lncba_s	-0.928	0.780	Non-Stationary	DS	-34.095	0.000	Stationary	I(1)
lcoop_f	-1.283	0.639	Non-Stationary	DS	-31.318	0.000	Stationary	I(1)
lcoop_s	-1.933	0.317	Non-Stationary	DS	-30.667	0.000	Stationary	I(1)
lscbk_f	-1.250	0.654	Non-Stationary	DS	-31.442	0.000	Stationary	I(1)
lscbk_s	1.483	0.999	Non-Stationary	DS	-28.761	0.000	Stationary	I(1)
limhp_f	-1.175	0.687	Non-Stationary	DS	-31.376	0.000	Stationary	I(1)
limhp_s	-1.630	0.467	Non-Stationary	DS	-32.375	0.000	Stationary	I(1)

(*) Augmented Dickey-Fuller test statistic
(**) Test critical values at a 5% level (-2.864)
(***) Order of integration or difference after stationarity.

Appendix 5: Panel (balanced) – Unit Root Tests (Eviews)

Panel unit root test: Summary
Series: LIQ
Date: 04/08/25 Time: 12:31
Sample: 1/04/2021 12/31/2024
Exogenous variables: Individual effects
User-specified lags: 4
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-38.4545	0.0000	12	11796
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-42.0994	0.0000	12	11796
ADF - Fisher Chi-square	1334.18	0.0000	12	11796
PP - Fisher Chi-square	1828.43	0.0000	12	11844

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: TV
Date: 04/08/25 Time: 12:32
Sample: 1/04/2021 12/31/2024
Exogenous variables: Individual effects
User-specified lags: 4
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-35.8903	0.0000	12	11796
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-42.1665	0.0000	12	11796
ADF - Fisher Chi-square	1336.12	0.0000	12	11796
PP - Fisher Chi-square	1832.27	0.0000	12	11844

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: TC
Date: 04/08/25 Time: 12:33
Sample: 1/04/2021 12/31/2024
Exogenous variables: Individual effects
User-specified lags: 4
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-38.3719	0.0000	12	11796
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-35.2080	0.0000	12	11796
ADF - Fisher Chi-square	1054.61	0.0000	12	11796
PP - Fisher Chi-square	689.967	0.0000	12	11844

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: MD
Date: 04/08/25 Time: 12:32
Sample: 1/04/2021 12/31/2024
Exogenous variables: Individual effects
User-specified lags: 4
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-20.4445	0.0000	12	11796
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-36.0228	0.0000	12	11796
ADF - Fisher Chi-square	1085.44	0.0000	12	11796
PP - Fisher Chi-square	1836.06	0.0000	12	11844

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: EXCH
Date: 04/08/25 Time: 12:32
Sample: 1/04/2021 12/31/2024
Exogenous variables: Individual effects
User-specified lags: 4
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-24.1894	0.0000	12	11796
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-23.0520	0.0000	12	11796
ADF - Fisher Chi-square	562.260	0.0000	12	11796
PP - Fisher Chi-square	457.805	0.0000	12	11844

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 6: VAR Model – Unit Root test (STATA)

```
. dfuller lnliq, lags(4)

Augmented Dickey-Fuller test for unit root

Variable: lnliq                        Number of obs  = 1,453
                                       Number of lags =     4

H0: Random walk without drift, d = 0

                                       Dickey-Fuller
                   Test          ———— critical value ————
              statistic            1%           5%          10%
----------------------------------------------------------------
 Z(t)            -6.251        -3.430       -2.860       -2.570
----------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.
```

```
. dfuller eff, lags(4)

Augmented Dickey-Fuller test for unit root

Variable: eff                          Number of obs  = 1,453
                                       Number of lags =     4

H0: Random walk without drift, d = 0

                                       Dickey-Fuller
                   Test          ———— critical value ————
              statistic            1%           5%          10%
----------------------------------------------------------------
 Z(t)            -6.313        -3.430       -2.860       -2.570
----------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.
```

```
. dfuller ia, lags(4)

Augmented Dickey-Fuller test for unit root

Variable: ia                           Number of obs  = 1,453
                                       Number of lags =     4

H0: Random walk without drift, d = 0

                                       Dickey-Fuller
                   Test          ———— critical value ————
              statistic            1%           5%          10%
----------------------------------------------------------------
 Z(t)           -16.491        -3.430       -2.860       -2.570
----------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.
```

Appendix 7: VAR Model – Lag Length Selection (STATA)

Lag-order selection criteria

Sample: **12jan2021** thru **31dec2024** Number of obs = **1,450**

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	3984.66				8.3e-07	-5.49194	-5.48786	-5.48102
1	7245.77	6522.2	9	0.000	9.3e-09	-9.97762	-9.96132	-9.93393
2	7346.99	202.44	9	0.000	8.2e-09	-10.1048	-10.0763*	-10.0284*
3	7360.91	27.837	9	0.001	8.2e-09*	-10.1116*	-10.0708	-10.0024
4	7362.33	2.843	9	0.970	8.2e-09	-10.1012	-10.0482	-9.95916
5	7364.92	5.1763	9	0.819	8.3e-09	-10.0923	-10.0271	-9.91754
6	7371.06	12.285	9	0.198	8.3e-09	-10.0884	-10.0109	-9.88083
7	7387.6	33.074*	9	0.000	8.3e-09	-10.0988	-10.0091	-9.85846
8	7396.05	16.894	9	0.050	8.3e-09	-10.098	-9.9961	-9.82493

* optimal lag
Endogenous: **lnliq eff ia**
Exogenous: **_cons**

Appendix 8: VAR Model – Output (STATA)

```
. var lnliq eff ia, lags(1/3)
```

Vector autoregression

Sample: 07jan2021 thru 31dec2024			Number of obs	=	1,455
Log likelihood	=	7353.047	AIC	=	-10.06604
FPE	=	8.53e-09	HQIC	=	-10.0254
Det(Sigma_ml)	=	8.19e-09	SBIC	=	-9.957121

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lnliq	10	.201077	0.8106	6228.846	0.0000
eff	10	.069088	0.9397	22673.31	0.0000
ia	10	.006599	0.1562	269.3791	0.0000

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
lnliq						
lnliq						
L1.	.6879437	.0264882	25.97	0.000	.6360279	.7398596
L2.	.1756371	.0318832	5.51	0.000	.1131472	.238127
L3.	.046931	.0264159	1.78	0.076	-.0048431	.0987052
eff						
L1.	.0070598	.0804011	0.09	0.930	-.1505234	.1646429
L2.	.0567213	.1270024	0.45	0.655	-.1921988	.3056414
L3.	-.0004367	.0804046	-0.01	0.996	-.1580269	.1571535
ia						
L1.	.8858579	.797937	1.11	0.267	-.6780699	2.449786
L2.	.0678061	.8530565	0.08	0.937	-1.604154	1.739766
L3.	.2489429	.7960742	0.31	0.754	-1.311334	1.80922
_cons	-.1246052	.0209222	-5.96	0.000	-.1656119	-.0835984
eff						
lnliq						
L1.	.0151464	.0091011	1.66	0.096	-.0026915	.0329843
L2.	-.0121568	.0109548	-1.11	0.267	-.0336278	.0093142
L3.	-.00531	.0090763	-0.59	0.559	-.0230992	.0124792
eff						
L1.	1.217717	.0276252	44.08	0.000	1.163572	1.271861
L2.	-.1636472	.043637	-3.75	0.000	-.2491742	-.0781202
L3.	-.0991996	.0276264	-3.59	0.000	-.1533463	-.0450528
ia						
L1.	.0636988	.2741648	0.23	0.816	-.4736544	.601052
L2.	-.1215979	.2931034	-0.41	0.678	-.6960701	.4528743
L3.	-.4109121	.2735248	-1.50	0.133	-.9470108	.1251866
_cons	.034621	.0071887	4.82	0.000	.0205314	.0487106
ia						
lnliq						
L1.	.0007073	.0008693	0.81	0.416	-.0009966	.0024112
L2.	-.0016342	.0010464	-1.56	0.118	-.0036852	.0004167
L3.	.0013968	.000867	1.61	0.107	-.0003025	.003096
eff						
L1.	.0036374	.0026388	1.38	0.168	-.0015345	.0088093
L2.	-.0006144	.0041682	-0.15	0.883	-.008784	.0075552
L3.	-.0026162	.0026389	-0.99	0.321	-.0077883	.002556
ia						
L1.	.3821385	.0261884	14.59	0.000	.3308102	.4334667
L2.	.0321937	.0279974	1.15	0.250	-.0226802	.0870676
L3.	-.0591415	.0261272	-2.26	0.024	-.11035	-.0079331
_cons	-.0001304	.0006867	-0.19	0.849	-.0014762	.0012155

Appendix 9: Principal Component Analysis (PCA) - STATA

summarize

Variable	Obs	Mean	Std. dev.	Min	Max
date	0				
launch	988	1	0	1	1
liborrr	988	.7489879	.4338151	0	1
survcomprr	988	.5020243	.5002491	0	1
newminpi	988	.8856275	.3184243	0	1
newssfpi	988	.6578947	.4746549	0	1
srinvstfi	988	.7479757	.434395	0	1
adjinmarfi	988	.0060729	.077731	0	1
opintpi	988	.0445344	.2063836	0	1
margrefi	988	.0172065	.1301059	0	1
daily	988	23009.96	422.268	22284	23741

Correlation Matix

```
. correlate launch liborrr survcomprr newminpi newssfpi srinvstfi adjinmarfi opintpi margrefi
(obs=988)
```

	launch	liborrr	survco~r	newminpi	newssfpi	srinvs~i	adjinm~i	opintpi	margrefi
launch	.								
liborrr	.	1.0000							
survcomprr	.	0.5813	1.0000						
newminpi	.	0.6208	0.3608	1.0000					
newssfpi	.	0.8028	0.7240	0.4983	1.0000				
srinvstfi	.	0.9973	0.5828	0.6191	0.8050	1.0000			
adjinmarfi	.	0.0453	0.0779	0.0281	0.0564	0.0454	1.0000		
opintpi	.	0.1250	0.2150	0.0776	0.1557	0.1253	0.3621	1.0000	
margrefi	.	0.0048	0.0072	-0.0014	0.0134	0.0051	0.0898	0.0469	1.0000

.

Varimax Matrix

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8
Comp1	0.4890	0.0571	0.0089	0.3635	0.1205	0.4668	0.3919	0.4893
Comp2	-0.0938	0.6888	0.2518	-0.1074	0.6539	-0.0335	0.0661	-0.0934
Comp3	0.0294	-0.1120	0.9631	0.0377	-0.2327	0.0069	-0.0507	0.0295
Comp4	0.1209	0.4412	-0.0700	0.5877	-0.2629	-0.2280	-0.5528	0.1174
Comp5	-0.0077	-0.5596	0.0633	0.4066	0.6463	-0.1803	-0.2592	-0.0098
Comp6	-0.4046	0.0443	0.0060	0.5821	-0.1281	-0.0466	0.5592	-0.4052
Comp7	0.2729	0.0013	0.0079	-0.0731	-0.0214	-0.8332	0.3926	0.2670
Comp8	0.7059	-0.0000	0.0002	-0.0019	-0.0000	0.0044	-0.0000	-0.7083

Index creation (MII)

date	launch	liborrr	survco...	newminpi	newssfpi	srinvstfi	adjinmarfi	opintpi	margrefi	daily	MII
2021-01-04	Yes	No	No	No	No	No	No	No	No	04jan2021	-1.726516
2021-01-05	Yes	No	No	No	No	No	No	No	No	05jan2021	-1.726516
2021-01-06	Yes	No	No	No	No	No	No	No	No	06jan2021	-1.726516
2021-01-07	Yes	No	No	No	No	No	No	No	No	07jan2021	-1.726516
2021-01-08	Yes	No	No	No	No	No	No	No	No	08jan2021	-1.726516
2021-01-11	Yes	No	No	No	No	No	No	No	No	11jan2021	-1.726516
2021-01-12	Yes	No	No	No	No	No	No	No	No	12jan2021	-1.726516
2021-01-13	Yes	No	No	No	No	No	No	No	No	13jan2021	-1.726516
2021-01-14	Yes	No	No	No	No	No	No	No	No	14jan2021	-1.726516
2021-01-15	Yes	No	No	No	No	No	No	No	No	15jan2021	-1.726516

Appendix 10. Other Moderation Regression Outcome -STATA

Mean Centred

Mean estimation   Number of obs = 1,458

	Mean	Std. err.	[95% conf. interval]	
lntv	2.112265	.0340371	2.045498	2.179032

Mean estimation   Number of obs = 1,458

	Mean	Std. err.	[95% conf. interval]	
lntc	-4.586316	.0137271	-4.613242	-4.559389

Mean estimation   Number of obs = 1,458

	Mean	Std. err.	[95% conf. interval]	
mii	.0147572	.0504313	-.0841684	.1136828

Diagnostic: Residual Tests

Variable	VIF	1/VIF
lntc_c	1.87	0.535398
mii_c	1.70	0.588364
miilntc_c	1.53	0.653184
lnexch	1.27	0.788960
lnmef	1.14	0.877305
lntv_c	1.13	0.882580
miilntv_c	1.12	0.892574
Mean VIF	1.39	

Source	chi2	df	p
Heteroskedasticity	1128.78	32	0.0000
Skewness	653.56	7	0.0000
Kurtosis	27.85	1	0.0000
Total	1810.19	40	0.0000

```
Breusch–Pagan/Cook–Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of lnliq

H0: Constant variance

    chi2(1) = 762.79
Prob > chi2 = 0.0000

. estat imtest, white

White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

   chi2(32) = 1128.78
Prob > chi2 =  0.0000
```

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