THE DYNAMICS OF STOCK MARKET RETURNS VOLATILITY AND GROWTH RATE OF LISTED COMPANIES IN KENYA

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMETRICS AND STATISTICS IN THE SCHOOL OF BUSINESS, ECONOMICS AND TOURISM IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ECONOMICS (ECONOMETRICS) OF KENYATTA UNIVERSITY

JUNE, 2025

DECLARATION

This research project is my original work and has not been presented for a degree in any other university or for any other award.

Signature ………………………………. Date………………………

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K102/21780/2020

I confirm that the work reported in this project was carried out by the candidate under my supervision

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DEDICATION

This research project is dedicated to my parents Willy Ndumbi Kimani and Hannah Wanjiku for their immense inspiration, encouragement, and dedicated support.

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ABBREVIATIONS AND ACRONYMS

ARCH: Autoregressive Conditional Heteroscedasticity

CMA: Capital Market Authority

EMH: Efficient Market Hypothesis

GMM: Generalized Method of Moment

NSE 20: Nairobi Securities Exchange 20 share index

NSE: Nairobi Securities Exchange

IPO: Initial Public Offer

T+3: 3 days after the transaction date of a security for settlement of payments

T+4: 4 days after the transaction date of a security for settlement of payments

OPERATIONAL DEFINITION OF TERMS

Growth rate - It is the percentage change in the level of an economic value over a given period

Listed companies - Public companies that trade shares in the country's recognized stock exchange markets.

Shares - Units of stock issued by a company as units of ownership.

Stock - A financial instrument representing ownership of a fraction of a company.

Stock returns - The change in the price of a stock over the trading period.

Volatility – A measure of the rate of fluctuations in a security's returns over time.

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ABSTRACT

Stock returns behavior affects the growth of firms' assets and hence their growth rates. Over time, companies listed under the Nairobi Securities Exchange have experienced an inconsistent trend in growth rates. Some companies keep issuing profit warnings to investors, and others result in delisting. In addition, the market has had a low number of new listings over the past 25 years. This raises some concerns about whether the listed companies are more exposed to risks associated with the stock market in Kenya. Based on the stock market environment, volatility of stock returns is among the motivators for companies to get high or low returns, and to get listed or get delisted. This study sought to determine the relationship between the volatility of stock returns and the growth rate of companies in Kenya. It outlined two specific objectives; to analyze the stock returns volatility's long-term behavior and determine their effect on the overall growth rate of total assets of listed companies in Kenya. The study used the maximum likelihood estimation method to analyze stock returns behavior, with the volatility models of the exponential generalized autoregressive heteroskedasticity and the generalized autoregressive heteroskedasticity. It then used the generalized method of moments to determine how the volatility of stock returns affects the growth rate of total assets. The stock returns data comprised 2,999 observations of daily stock returns, and the panel data comprised 1368 observations, from 19 listed companies between 2010 and 2023. Stock data was collected from the Wall Street Journal, while panel data was collected from the Wall Street Journal, and Africa Financials from companies' statements of financial positions. For the models' validity, the study did the normality and ARCH-LM test on stock returns series and pooled ordinary least squares, fixed effects, and generalized method of moment models for the panel data, which helped to validate the use of a two-step generalized method of moment. Diagnostic tests were also conducted to avoid reporting spurious results: the auto-correlation test, Hansen's test, and the joint significant test. The study found that stock returns over the study period were characterized by volatility clustering, persistence, and mean reversion behaviors but were not asymmetric. It also found that the volatility of stock returns adversely affected the growth rate of listed companies. The study therefore recommended that the government and other policymakers intervene in the stock market, with measures to attain significant asymmetric behavior. This will encourage investors and hence stock liquidity payout. This would give the listed companies easier access to more finance, reducing their financial risks in their attempt to grow their asset base.

CHAPTER ONE

INTRODUCTION

1.1 Background

The growth of firms has helped countries address economic growth globally, especially in low-income economies that are yet to be industrialized (Lee et al., 2013), as well as addressing general economic development (Tambunan, 2019). During the Industrial Revolution from around 1760 to 1830 and 1840s, private investment in cottage industries due to innovation and inventions was a key driver of economic growth and development in Europe and the United States of America. It improved people's lifestyles, though it was not as evident as in the 19^{th} and 20^{th} centuries (Steil et al., 2002).

Firms play a significant role in economic growth and development. World Bank (2020) reported that formal small and medium-sized enterprises constituted about 90 percent of global businesses. In emerging economies, they contributed to 40 percent of gross domestic product (GDP) and more than 50 percent of employment worldwide. From economic literature, economic growth is affected by openness to trade, political environment, government spending, institutional framework, foreign direct investments, and public and private investments among others (Mose, 2021).

There is a strong link between stock prices and overall economic activities in three ways: future economic activities may be reflected by the current stock prices, owing to the hypothesis that stock prices are signals of economic performance. The next link is in the sense that changes in discount rates affect stock prices and consequently investment. Lastly, stock price changes change wealth, which affects consumption and investments. Financial liberalization and integration have helped local financial markets to integrate well with international financial markets. For example, emerging

Asian markets benefited from allocation efficiency and risk diversification because of financial integration (Park & Lee, 2011).

The stock market, therefore, has been an important subject of study over the years, as well as how it impacts investments in companies and the general economic growth of countries. Marques et al., (2013) found a bidirectional causality between economic growth and stock market development. Using various financial instruments like domestic savings, savers can diversify their portfolios, acting as capital for investment. Investors can therefore diversify risk and increase the marginal productivity of capital. The stock market, hence, is perceived to impact economic performance, thus, it reflects how firms in those economies perform. Good performance of firms in the stock market has the potential to attract more capital for investment through the sale of stock (Novitasari & Dewi, 2021). When a firm performs well, such as by higher profitability and/or an increase in assets, it indicates the company's good prospects, which could trigger investors' demand for stock.

Firms, however, have to list themselves in the stock market to get direct benefits from stock returns, which includes increasing the probability of raising external finance. However, some firms do not always get the benefits they anticipate from listing and end up delisting. Among the major reasons is when they do not get benefits from listing. Other examples include: when they are not able to raise equity, low profitability, and low growth opportunities, some of which are attributed to low stock returns. In some cases, firms list themselves in the stock market to rebalance their leverage rather than to finance their growth opportunities (Pour & Lasfer, 2013).

Despite the positive contribution of the stock market on the growth and performance of firms by various researchers over time, companies in the stock market face challenges that make them get low returns on stock and some of them end up delisting. Factors that influence stock market prices and returns include share index, diaspora remittance, market liquidity (Nyasha & Odhiambo, 2014), consumer sentiments, policy decisions by governments, and volatility of stock returns and volatility of stock returns' spillover (Kumar, Sarangi & Verma, 2020). Stock returns volatility measures the rate of fluctuations of securities returns over time. Stock returns, hence, can be low or high at different times (Oliveira, Cortez & Areal, 2017).

Investors are assumed to be rational in efficient markets (Fama, 1970). Therefore, high stock returns volatility discourages them from buying stock. When stock returns are highly volatile, investors shy away from trading or acquiring new stock. Prolonged periods of high volatility of stock returns could erode investors' confidence consequently posing a risk of solvency. This is because, as investors shy away from buying stock, companies face a higher financial risk, hindering them from acquiring more assets. On the other hand, low stock returns volatility becomes attractive to traders, as it implies low risk over the holding period, and hence the subsequent asset levels of companies rise.

Cooper, Gulen & Schill (2008) found a negative correlation between activities associated with the expansion of assets in firms and subsequent abnormal stock returns. Hence, if the stock returns volatility is high, it negatively affects companies' asset levels as they get fewer investments from selling new shares. Some companies end up delisting as they get more exposed to high and prolonged volatility of stock returns implying that they do not realize the benefits from listing in the stock market.

Financial assets' volatility such as stocks display three dominant behaviors. These behaviors are persistent, asymmetry, and clustering (Abdalla & Winker, 2012). The levels of each behavior differ in various stock markets. These behaviors affect investors' response to the stock market as they are indicators of future stock market returns behavior. In an efficient market, stock returns' volatility is assumed to be systematic (Fama, 1970). However, investors' sentiments make them irrational, leading to mispricing of stocks (Altuwaijri, 2016). Stocks are mispriced during high sentiment periods when the market is considered distressed (Avramov et al., 2019). Stock returns consequently end up becoming more volatile as panic trading heightens.

1.1.1 The Kenyan Stock Market and its Stock Returns Volatility Trend

A stock market is where investors can trade their securities, and industry and the government can raise long-term capital (Arnold, 2004). The Kenyan stock market is called the Nairobi Securities Exchange. It was established as the Nairobi Stock Exchange in 1954, however, it changed its name to Nairobi Securities Exchange (NSE) in 2011. It initially acted as a voluntary association of stockbrokers. However, it was registered as a limited company in 1991. NSE is responsible for developing and regulating trading activities in the Stock Market. In 2000, the Capital Market Authority (CMA) Act was amended, which mandated NSE to promote, regulate, and facilitate NSE’s development. The main functions of the NSE are price discovery and provision of liquidity to corporations by providing companies with the means of issuing shares through Initial Public Offers (IPOs).

NSE has created a favorable trading environment for securities trading through several policies. It introduced the Nairobi All Share Index in 2008 to complement the existing NSE 20 share index (NSE 20) following a recommendation by the International Finance Corporation. NSE 20 tracks the performance of the 20 best-performing companies based on weighted market performance. The performance is based on the number of shares traded, deals/liquidity, respective company's market capitalization, and its turnover for 12 months. The main aim of the Nairobi All Share Index is to ensure comprehensive stock market information dissemination to investors.

Another policy that enhanced the NSE was the introduction of an equity settlement cycle. It allowed investors to receive payment three days after the sale of shares (T+3) instead of four days (T+4). In 2018, NSE introduced the Ibuka program to support companies' growth through various stages. It comprised a panel of advisors and consultants based on incubation and acceleration programs. Companies benefit from capital market access easily and visibility opportunities through exposure to media, analysts, and stakeholders. Other benefits included expert advice, value discovery, and business sustainability. In 2023, there were 65 listed companies in Kenya (NSE, 2022). The number of listings, however, has remained poor over the past 25 years and below the NSE target of 10 newly listed companies per year. In other cases, companies have been delisted, as illustrated in Figure 1.1. This study included 19 listed companies[1] under the NSE 20 as per the last quarter of 2022.

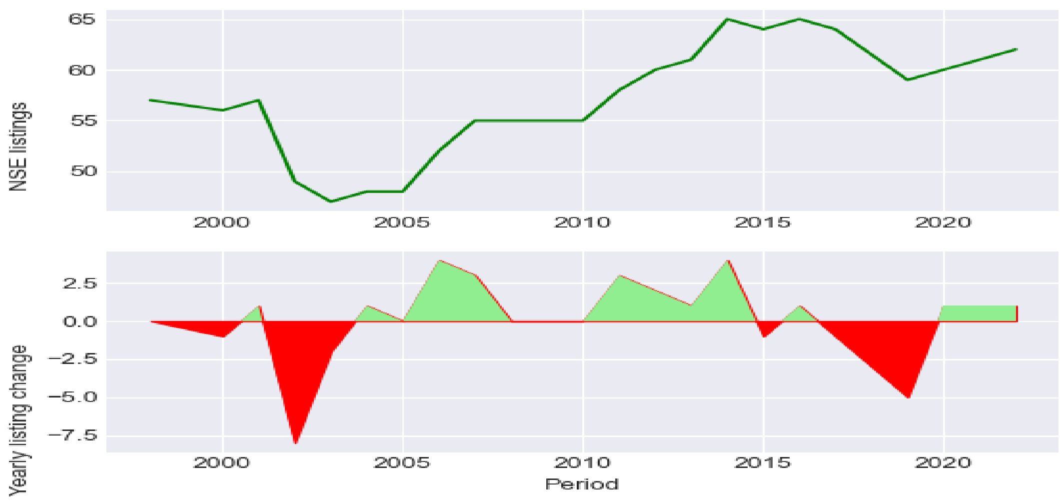

Figure 1.1: NSE listing and delisting trend from 1998 to 2022

Source of data: World Bank online database (2023).

[1] Safaricom Limited (SAF), East African Breweries Limited (EABL), I&M Holding (IMH), Kenya Power and Lighting Company PLC (KPLC), Equity Bank (Equity), Kenya Commercial Bank Group (KCB), Diamond Trust Bank (DTB), British American Tobacco Kenya PLC (BAT), Co-operative Bank of Kenya Limited (COOP), Centum Investment Company PLC (Centum), Bamburi Cement PLC (Bamburi), Kenya Reinsurance Corporation Limited (KNRE), Stanbic Bank Kenya Limited (STANBIC), Nation Media Group (NMG), SCAN Group Limited (SCAN_G), Standard Chartered Bank (STDC), ABSA Bank Kenya PLC (ABSA), Britam Holdings (BRITAM), and KENGEN (NSE, 2022).

Figure 1.1 shows the listing and delisting trends in NSE from 1998 to 2022. The number of listings is below the NSE target of 10 new listings per year and has been persistent over the past 25 years. The highest listing was in 2006 and 2014, with 4 newly listed companies, and in 2002, NSE recorded the highest number of 8 companies delisting.

Stock market returns are volatile if they keep reaching new highs and lows. In developed stock markets, various indices are used to determine the level of stock returns relative to the broader market. An example of such indices is the beta index. Beta compares a given stock's volatility against the volatility of the broader market. In the Kenyan case, however, there is no established volatility index. Nonetheless, the beta for a specific company can be calculated using historical stock prices, using the NSE 20 as the broader market. A beta of 1 means that the risk associated with the stock equals the broader market risk. A beta below 1 means that the risk associated with the stock is below the broader market risk. A beta value greater than 1 means that the risk associated with the stock is more than the broader market risk. Finally, a negative beta indicates that the risk associated with the stock and the broader market risk moves in the opposite direction.

Figure 1.2 shows the stocks' beta for individual listed companies from 2011 to 2022. All listed companies have a beta below 1. British American Tobacco is the most volatile stock, with a beta of 0.8, while Stanbic Bank Kenya Limited has the lowest beta of -0.0012. Compared to the broader market, the stocks of companies listed under the NSE 20 share index do not expose investors to more than the market risk. However, the risk associated with the stock of Stanbic Bank Kenya Limited and Kenya Reinsurance Corporation Limited and the broader market is moving in the opposite direction.

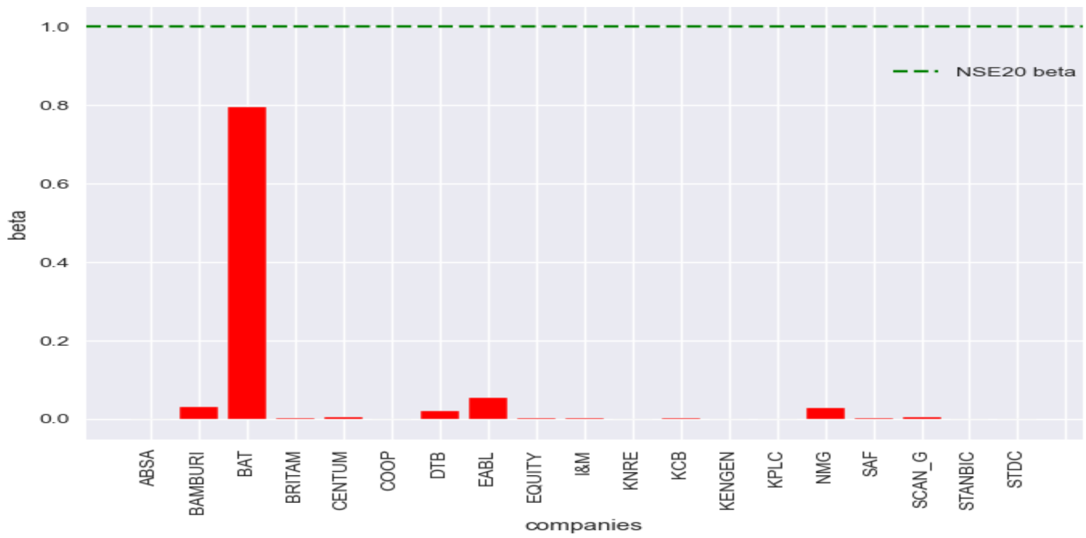

Figure 1.2: Beta volatility index for companies listed on the NSE 20 share index.

Source of data: Wall Street Journal (2023).

1.1.2 The Kenyan Capital Market and Assets Growth Rate of Listed Companies in Kenya

Capital markets connect the financial sector with non-financial sectors. Demirguc & Levine (1996) found a positive relationship between economic growth and long-term capital. A well-functioning capital market, therefore, helps to increase efficiency in economic growth in terms of investment. Capital markets help to reduce transaction costs, price discovery, liquidity provision, and risk transfer. Nonetheless, companies continue to seek finance from financial institutions such as banks, which cripple capital market development. As in other capital markets, the Kenyan capital market faces challenges in its development such as low investors' confidence, lack of awareness and competitive pressure, low liquidity level, and vulnerability to market shocks (Nyasha & Odhiambo, 2014).

In Kenya, as shown in Figure 1.3 the stock returns series for the NSE 20 have been volatile over time. Investors shy away from buying new stock when the stock market returns are volatile and as a result, companies get lesser investments in terms of sale volume of new shares. Consequently, they lose the ability to acquire more assets, especially if the purchase is to be done through equity financing. This points out that periods of high returns (meaning that the stock returns volatility is high) precede periods of decline in assets, and periods of low stock returns precede high asset growth rates. Therefore, there is a negative correlation between activities that are associated with asset expansion and subsequent abnormal returns of stock (Cooper, Gulen & Schill, 2008).

However, during the actual trading period, given that a company financed its assets through equity financing, there is increased financial risk, which contributes to higher stock returns volatility (Lashgari & Ahmadi, 2014; Gharbi, Sahut & Teulon, 2014). In addition, the dispersion in assets' growth rate has a very strong predictive power of average idiosyncratic returns volatility both in time series and in cross-sectional data (Song, 2016). Given a bidirectional causality between stock returns volatility and asset growth rate, it implies that high stock returns volatility has a positive contribution to the asset growth rate.

In Kenya, listed companies on the NSE 20 share index demonstrate inconsistent growth rate trends over the years. In addition, concerning the stock returns volatility trend over the years, the simultaneous trend in the growth rates of total assets is not consistent with the expected relationship between growth rates of total assets as shown in Figure 1.3. The average growth rate of companies listed on the NSE 20 share index shows an inconsistent trend over time. The highest and the lowest growth rates were experienced in 2014 and 2018, respectively. The annual volatility, on the other hand, ranged between 20.17 percent and 8.05 percent and kept reaching new highs and lows from 2011 to 2022. This shows that the broader market has been volatile over time. In addition, the stock returns volatility and the assets' growth rate for most periods move in the opposite direction, deviating from the expected relationship.

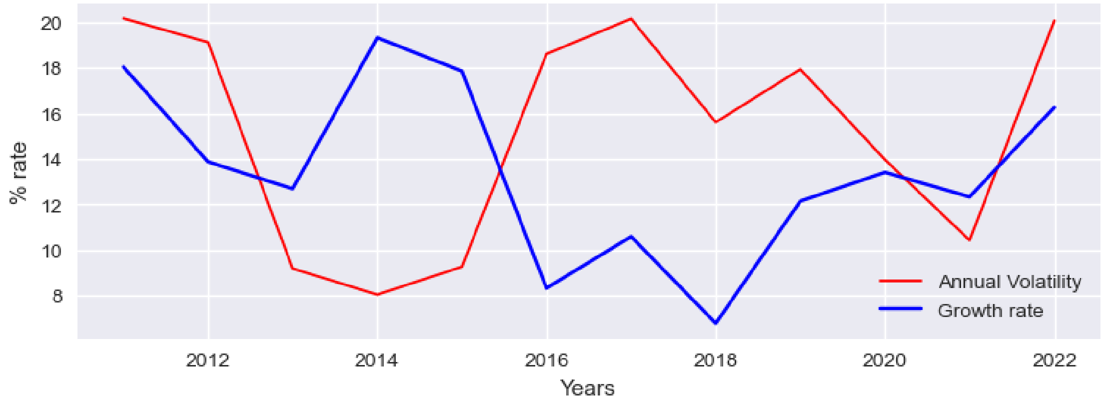

Figure 1.3: Annual trends in the total assets' growth rate and stock returns volatility of the listed companies in Kenya.

Source of data: The Wall Street Journal (2023) and African Financials (2023).

1.2 Statement of the Problem

A well-established capital market enhances an economy's financial development and growth, given that the relationship between economic growth and long-term capital is positive (Demirguc & Levine, 1996). Kenya has established the Nairobi Securities Exchange, where local and international companies trade their securities. Several policies have been put in place to enhance its development. Some include the amendment of the Capital Market Authority in 2000, establishing the Nairobi Securities Exchange 20 share index and the Nairobi All Share Index, reducing the equity settlement cycle, and allowing for international financial integration (NSE, 2021). However, the stock market has been volatile over the years, and few new companies list themselves in the market, while some end up delisting. In addition, NSE has not achieved its target of 10 new listings per year since 1998 (NSE, 2022).

On the other hand, the average growth rate of companies listed on the NSE 20 has experienced an inconsistent trend over the years. The simultaneous trend in stock returns volatility depicts a deviation from the expectations of a similar trend in asset growth rate, despite investors experiencing a very low beta. Moreover, the stock returns' volatility trend in most cases does not precede the behavior of the asset's growth rate.

In Kenya, several studies have been done on the volatility of factors affecting various macroeconomic variables that are important to economic growth. Some are on the effects of volatility in financial markets (Ochieng et al., 2019), on global oil prices volatility and foreign direct investment inflows (Amboko, 2021), and systematic risks and stock market volatility in Kenya (Ngugi & Jagongo, 2021). However, there is very little literature on how stock market returns volatility relates to the growth rate of assets of listed companies. In this regard, the current study focused on filling the aforementioned gap and studied the dynamics of stock market returns volatility and the growth rate of assets of listed companies on the NSE 20.

1.3 Research Questions

i. What is the long-term volatility behavior of the stock returns of companies listed on the NSE 20?

ii. What is the effect of the stock returns' volatility on the growth rate of the total assets of companies listed on the NSE 20?

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of this study was to determine the relationship between stock market returns volatility and the average growth rate of listed companies in Kenya.

1.4.2 Specific Objectives

i. To analyze the long-term volatility behavior of the stock returns of companies listed on the NSE 20.

ii. To determine the effect of the stock returns' volatility on the growth rate of the total assets of companies listed on the NSE 20.

1.5 Significance of the Study

This study will significantly benefit investors, policymakers, the public, and the body of knowledge. It is instrumental to investors by helping them to base their investment decisions on empirical knowledge, as far as stock selection is concerned. Companies willing to take part in listing their companies also have a guide on growth prospects depending on the behavior of stock returns, and can therefore take control. Policymakers, on the other hand, can understand how their policies are affected by stock returns volatility. Lastly, with the limited literature on this subject matter available, the study adds a new literature to the body of knowledge, thus helping those willing to undertake similar research.

1.6 Scope and Limitations of the Study

This study covered the period from 2011 to 2022 for actively listed companies in the NSE that have not delisted at any trading period. It used stock returns and total assets data of respective companies to determine the relationship between Kenya's stock market returns volatility and the growth rate of listed companies.

1.7 Organization of the Study

This study is organized into five chapters: Chapter One introduces the study, the second chapter reviews the literature, Chapter Three provides the study's methodology, and the fourth chapter presents the results from the conducted empirical analysis and their interpretation. Finally, Chapter Five gives the study's summary, conclusion, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides the relevant literature that guided this study. First, it covers the theoretical literature guiding firms' growth, and second, it discusses stock market returns. It then reviews the empirical literature and gives an overview of both.

2.2 Theoretical Literature

2.2.1 Gibrat's Rule of Proportionate Growth

Gibrat (1931) explained in stochastic terms the growth of a firm. Gibrat's Rule of Proportionate, also referred to as Gibrat's Law, mainly assumes that the proportionate growth rate of a firm and a firm's absolute size are independent. It also assumes that factors affecting the growth of a firm are randomly distributed across firms in the same industry. The law also assumes that firms grow following a random phenomenon, and this is not affected by firm size. These factors include managerial capacities, organizational structures, demand growth, innovation, and luck. Hence, the law concludes that regardless of a firm's size, its growth follows a random phenomenon, with each firm's probability of growth being equal to that of others in the industry during the same period. Furthermore, a firm's past growth does not influence its current growth.

Past studies have criticized Gibrat's Law since they found that the firm's age and size relate to growth (Audretsch et al., 2004). Other evidence from micro, small, and medium firms in Greece's manufacturing sector on the firm's growth and its initial size showed an inverse relationship (Fotopoulos and Giotopoulos, 2010). In spite of small firms defying the law, they were found to face difficulties in keeping up with the pace of growth as they grew bigger (Parker et al., 2010). In other scenarios, such as studies by Leitner & Guldenberg (2010), the law has been criticized on the grounds that, even if it appears to hold, the observed results may stem from measurement errors or omitted variable bias. Nonetheless, the law remains relevant as seen from past studies. It was found to apply to the 500 largest industrial corporations in the United States of America (Simon & Bonini, 1958) and 811 Dutch companies (Lensink, van Steen & Sterken, 2005).

2.2.2 Growth Maximization Theory

Marris (1964) postulated the growth maximization theory, attempting to develop a dynamic balanced growth maximizing model of firms (companies and cooperatives). The main proposition was that modern firms managed by managers and shareholders needed to strike a balance between each party’s utility, i.e., managers aiming to maximize the firm’s growth rate while shareholders aiming to maximize market share prices and dividends. Managers, hence, need to determine a growth rate in sales, profits, and assets’ growth. A preference for higher growth of a firm would lead to increased research and development costs and advertisement costs. Consequently, a firm realizes lower profits for shareholders and a fall in share prices. Shareholders (owners), therefore, desire a balanced level of growth, as it is the only way to ensure they get fair returns on capital. The theory assumes that production cost is given, factor prices are constant, firms grow through diversification, and all variables increase at a constant rate (sales, profits, and costs).

Marris modeled the growth-profit relationship to have a negative relationship at a low level of growth and a positive relationship at a higher level of growth. An increase in diversification, meaning getting new products to supply from more research and development, helps a firm to grow. This however has a limited capacity since an increase in research and development calls for an increase in management resources, hence higher expenditure. Therefore, beyond a certain limit, where marginal profit is zero, profit starts declining. On the other hand, higher levels of profits provide more funds for reinvestment and attract more funding from the capital market through investments by shareholders. The determinant of capital supply to a firm is now only constrained by the profit retention ratio, i.e., the ratio of retained profit to total profits. A low retention ratio implies low funds for the growth of a firm and a large retained profit ratio implies more funds to spur a firm's growth.

The theory brought the firm in the light of ownership by the public, unlike in the theory of a firm, where a firm is solely owned. Even if this theory is applicable in some firms' settings, it is criticized since a firm's growth and shareholders' security are competing objectives of a firm. Shareholders' interests demand conservative financial policies, for example, excess liquidity, and firms' growth needs managers to undertake relatively risky investments and risky methods of obtaining more capital (Curwen, 1976).

2.2.3 Jovanovic's Learning Theory

Jovanovic (1982), attempted to explain how firms grow using a learning model of a firm. His approach was referred to as the 'noisy selection' model, based on the "lifecycle learning theory". In this theory, which was a deviation from Gibrat's Rule of Proportionate Return, firms differ in size because they have different efficiency in learning rates as they age. This way, efficient firms will grow, while inefficient firms will decline and/or fail. Efficiency includes a firm's ways of gaining from flexibility to the industry's dynamics and true costs. Thus, initially, a firm does not know its real efficiency level but keeps on learning and updating itself. This theory includes a firm's age (learning time of a firm) as a determinant of growth, unlike Gibrat's theory.

Critics argue that the theory assumes no technological progress. Including technological progress as a factor is crucial in capturing some but not all factors of growth (Ericson and Pakes, 1995). Also, the theory does not account for any past knowledge, as it assumes all is newly learned, whereas workers in a firm could have experience in the industry. Nonetheless, Javanovic's Theory remains relevant in explaining an important aspect (age) of a firm's growth path.

2.2.4 Efficient Market Hypothesis

Fama (1970), floated the Efficient Market Hypothesis (EMH), which is an investment theory that attempted to explain how efficient financial markets work. An efficient financial market is a market with transparency of information (no information asymmetry). The theory posited that in the long run, an investor cannot realistically achieve substantially higher returns on investment than the market average, even if he gets lucky in the short run. Hence, an investor can't outperform the market in the long run. This is because, as to its assumptions, the market value of stock reflects all relevant information and is available to all investors who act rationally, therefore, there is no possibility of buying an undervalued stock or selling an overvalued stock. The theory presented three variations, that is, the weak form, the semi-strong form, and the strong form EMH.

The weak form assumes no information asymmetry on all past information, but new information is yet to be publicly released to the stock market. In addition, it assumes all past information to be independent of new information, hence technical trading strategies are flawed in predicting future prices. The weak form however gives superior fundamental analysis a possible chance of predicting future prices. The semi-strong form expands on the weak form by adding an extra assumption that prices adjust very quickly on the arrival of new information. Lastly, the strong form assumes that stock prices will reflect all the public and private information, which includes past prices and any other information including insider information only known by the company's executives. From the three forms of the EMH, all information cannot leak to the market to give investors an edge in predicting stock prices even with superior fundamental trading techniques.

Various criticisms of EMH have claimed that EMH assumes market prices are fair, but there are cases where market prices have risen and fallen beyond their fair market value. Such cases of speculative bubbles and market crashes make markets to be inefficient (Malkiel, 2003). Market anomalies also have been seen to cause stock prices to deviate from the established market price. Market anomalies may arise at any time with no specific reason, such as in the case of irrational pricing (Ball, 1978). Nonetheless, the hypothesis remains relevant in explaining the unpredictable movement of stock prices and hence stock returns in stock markets.

2.2.5 The Random Walk Hypothesis

Malkiel (1973), in his book "*A Random Walk Down Wall Street,*" attempted to explain the nature of prices in the stock market. In this hypothesis, prices follow a random walk. This hypothesis was an improvement of the weak form EMH (Fama, 1970). The theory hypothesizes that in efficient markets, the use of technical and fundamental techniques to predict market prices would be futile since historical information cannot be used to predict market prices. Therefore, for an investor to benefit from the stock market, it can only be through luck. The theory assumes that investors act rationally in the stock market since they have equal access to information in the stock market. It also assumes that each security price follows a random walk and that the movement of one security price is independent of another security price. From this theory, therefore, investors cannot outperform the stock market in the long run without taking additional risks. Investing in a portfolio that resembles the total stock market was the best strategy for investors. This means investing in a security whose price movement reflects perfectly the movement of every security in the stock market.

Random walk theory has been criticized about prices of securities and its idea of luck as the only way to benefit from the stock market. Studies have shown that by arbitrage, investors can benefit from the stock market (Hamid et al., 2017). Prices of securities are affected by very many factors, and it could be hard to determine the pattern it follows, but just because that pattern is not observed does not mean it does not exist. In addition, the large numbers of investors in the market do not spend an exact amount of time trading. Therefore, it is possible that a trend could emerge in the short run and one can outperform the market at this time given that not all stock prices follow a random walk at all times (Shaik & Maheswaran, 2017).

2.3 Empirical Literature

Zakaria, Muhammad and Zulkifli (2012) conducted a study in Malaysia aiming to determine how a firm's dividend policy affects the volatility of stock prices. The study used data from 77 listed Malaysian construction and Material companies from 2005 to 2010. It applied the least square regression technique for analysis. It found investment growth, dividend yield, leverage, dividend payout, firm size, and earning volatility payout ratio to explain 43.43 percent of changes in share price. Thus, it established that between the dividends payout ratio and firms' share price volatility, there is a significant positive relationship. Nonetheless, their study was limited to 6 years. This study covered 11 years and expanded on all the sectors of the NSE-20.

Gharbi, Sahut & Teulon (2014), studied research and development (R&D) investments of firms in the high-tech sector in France. The study aimed to determine if R&D intensity is positively related to total stock returns and idiosyncratic volatility. It used panel data from 162 French high-tech firms' expenses from 2002 to 2011 which were electrical and electronic equipment, information technology, and telecommunication firms using the fixed effect model. The study found that firms investing in research and development (R&D) activities had a positive relationship with total stock returns and idiosyncratic volatility. R&D increases information asymmetry about firms' prospects and profits, making the stock more volatile. This study used firms that had the advantage of exhibiting similar stock trading characteristics in R&D behaviors. The current study explored more heterogeneity absent in their study and included other sectors, as well as bridging the geographical gap by focusing on Kenyan firms.

Lashgari & Ahmadi (2014), conducted a study in the Tehran stock market in Iran to determine what impact the dividend policy had on stock price volatility. Their study used panel data from 51 companies trading between 2007 and 2012 and used a fixed effect model for analysis. The study found that the dividend payout ratio had a negative impact on the volatility of the share price. Assets' growth rate had a positive effect on stock price volatility. However, aspects of variables like company size, leverage, and earning volatility had no significant effect on stock price volatility contradicting a study by Zakaria, Muhammad and Zulkifli (2012).

Mori (2016), investigated the effects of share price volatility on the performance of the NSE starting from 2006 to 2015 in Kenya. It analyzed data from 20 companies listed on the NSE 20 using a descriptive study design and a multiple linear regression model. The study found that interest rates and share price volatility negatively affect NSE performance. However, it was limited to the NSE 20 where 20 companies were assumed to be representative of all sectors in the market.

Ngugi (2017), investigated the factors that influenced the share price volatility of firms in the NSE market from 2010 to 2016 in Kenya. The study used secondary data of 61 listed companies from reports by the Capital Market Authority Library. The data comprised stock prices, trading volume, inflation, GDP, and dividend policy data. The study used regression analysis and found that all variables affected share price volatility with positive coefficients: GDP at 0.852, inflation at 0.654, dividend policy at 0.231, and trading volume at 0.489. They all explained the total variation of share price volatility of listed firms by 80.7 percent. The study was limited to a time frame where it considered data for 5 years to be an adequate period. However, a longer period for analysis could give more precise results, as used in this study.

Mawardi (2018), studied the determinants of stock market volatility in Indonesia, attempting to analyze the influence of sales growth, debt-to-equity ratio, returns on equity, firm size, dividend payout ratio, and cash ratio on stock price volatility. The study used a sample of all 8 listed firms in the manufacturing sector from 2011 to 2015. It used the panel data and panel data regression technique, which was adjusted using the GARCH model for analysis. Only sales growth had a significant effect on stock price volatility. All factors investigated only contributed 4.84% of stock price volatility, while the remaining 95.16 percent was explained outside the variables of the research. The study recommended that investors should invest in companies with low sales growth if they are risk-averse, and invest in companies with high sales growth if they are risk-takers.

Alarussi & Alhadheri (2018), conducted a study in Malaysia to investigate factors affecting the profitability of listed firms between 2012 and 2014 using data from 120 listed companies using secondary data from companies' annual reports. The data was analyzed using fixed effects and pooled ordinary least square regression. Company efficiency, working capital, and firm size were found to have a strong positive relationship with profitability. Leverage was found to have a significant negative relationship with profitability. However, liquidity had no significant relationship with profitability. The limitation of the study is based on the period of 2 years, which is considered small.

Kathandi (2019) did a study intending to establish the influence of financial leverage on the financial performance of the energy and petroleum sectors of the listed companies in Kenya. It used secondary data from 5 companies from 2012 to 2016 and ran a multiple linear regression for analysis. It found that financial performance and financial leverage had a negative relationship. The financial ratios of debt, interest coverage, and debt-equity had a negative relationship with financial performance.

Hosain (2020), studied factors affecting the share price volatility. The study was done on Bangladesh's private banks to determine the existing association between share price and factors such as asset growth, bank size, capital-risk weighted ratio, earning per share, non-performing loans, and non-performing loans to total loans. The study used panel data from 18 listed commercial banks from 2014 to 2018. The study used Driscoll-Kraay's standard errors and a fixed effect model to test its hypothesis. It found that assets' growth and capital-risk weighted asset ratio in the Dhaka Stock Exchange had no significant effect on share price volatility. Bank size, non-performing loans to total loans, and earning per share significantly affected share price volatility. However, the study was limited to a small sample size which could not be generalized to the whole banking industry.

Al-shabbar (2020), studied on determinants of stock price volatility for the listed industrial firms in Jordan from 2010 to 2018 using a panel data from 40 industrial firms as the sample of analysis in the Amman Stock Exchange. The study applied a random effect regression to examine internal and external factors determining stock market price volatility. The study found that growth in assets, dividend yield, and financial leverage had a positive significant relationship, but inflation rate, dividend payout ratio, and firm size negatively affected the volatility of stock prices. Lastly, interest rate and GDP had no relationship with stock price volatility. The study was limited to only one industrial sector and could not as well give a generalization of other sectors.

Kerubo (2020), investigated the effects of financial risk on the performance of commercial and services companies listed in the NSE in Kenya. The study used panel data from 14 commercial and service companies from 2013 to 2019 and a fixed effect model technique based on the outcomes of the Hausman test. It found that operational risk and credit positively affected return on equity, though it was insignificant. The operational cost had a significant positive effect on asset returns. Liquidity risk negatively affected returns on equity. However, firm size had an insignificant moderating effect. Returns on equity were affected by the current ratio, although the cost-income ratio had the highest effect on the returns on assets. The study, however, was limited to the use of an unbalanced panel where data for all 14 companies was not available, which could have led to spurious results.

Höhler & Lasink (2021), conducted a study to determine the impact of the COVID-19 pandemic on stock prices and profits in the food supply chain. The study aimed to examine the impact of the COVID-19 pandemic on the stock price volatility and profits of listed companies. It covered companies dealing with food and supply chains in Japan, Europe, and the United States. It used a regression technique to analyze data from 71 major companies from these countries from 2019 to 2020. The study covered 11 sub-sectors: agricultural products, agricultural and farm machinery, brewers, tobacco, hypermarkets and supercenters, fertilizer and agricultural chemicals, food retail, packaged food and meat, soft drinks, and distillers and vintners. The study found that stock markets reacted to an increase in price volatility. Compared to other sub-sectors, producers of packaged food and food retailers experienced low volatility. On the other hand, profits were realized in distillers and vintners, food and retail, tobacco, agricultural products, packaged foods and meals, hypermarkets, and soft drinks compared to the period before the pandemic. Fertilizer and agrochemicals, agricultural and farm machinery, brewers, and food distributions, however, recorded a negative profit. The study limited itself to 2 years, demonstrating better the different reactions of firms' stock price volatility behavior in times of crisis. This study included analysis across this period, which is important in the analysis of the dynamics of stock returns.

Samuel (2022), conducted a study to establish the effect of financial structure and financial growth in the NSE in Kenya. It used panel data from 2010 to 2017 from 21 financial firms. It found a significant relationship between financial growth and share capital, short-term debt, and retained earnings. However, long-term debt and financial growth had a negative and insignificant effect. Lastly, it found that firm size is a significant moderator of the financial structure and financial growth. This study, however, constrained itself to only 5 variables and owing to the extensive variables that affect the financial sector, further studies are recommended that need to include more variables.

2.4 Overview of Literature

The theoretical literature review shows how firms grow based on various factors. Stock market returns behavior is also found to be volatile. From the reviewed theories, there is no consensus on which theory best fits the growth of firms or stock market returns behavior. Nonetheless, each theory lays strong hypotheses to support its validity. Gibrat (1931) explains the growth in stochastic terms, Jovanovic (1981) hypothesized it as a learning model, and Marris (1964) argues that there should be a balance between a firm's growth interest and shareholders' interests.

The empirical literature on its side has shown differences in factors affecting firms' growth and the volatility of stock prices and returns. Various studies use different measures of firms' growth, methodologies, and periods. For example, firms' growth: using assets, revenue, sales volume, size, profitability, and efficiency of staff and managers. There are also differences in types of data and data analysis techniques, such as multiple linear regression (Zakaria, Muhammad and Zulkifli; 2012, Lashgari & Ahmadi; 2014, Wafula; 2016) and panel data regression (Samuel; 2022, Kerubo; 2020). Despite these differences, there is a connection between stock returns volatility and the growth of firms. However, a study on the relationship between the stock returns' volatility and the growth rate of companies in Kenya is missing. Apart from filling the literature gap, this study provides updated results on stock returns volatility behavior, as it covered a recent period, between 2010 and 2023. This period is also longer than other reviewed empirical studies. Increasing the study period and hence the number of observations helped to better discover the dynamics of the stock returns' volatility

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the research design, the theoretical framework, and model specifications employed in the study. It also outlines the definitions and measurements of variables, data types, data sources, and data collection methods. Finally, it presents the analytical methods used to achieve the study objectives.

3.2 Research Design

This study used a non-experimental research design using sourced secondary data from the Nairobi Securities Exchange, the Wall Street Journal, African Financials, the World Bank, and companies' annual statements of financial position.

3.3 Theoretical Framework

3.3.1 The Expected Stock Returns.

The analysis of the long-term volatility behavior of stock returns was guided by the efficient market hypothesis (Fama, 1970) and the random walk hypothesis (Malkiel, 1973). The Random Walk hypothesis is a weak form of the EMH. It explains how efficient markets behave given the availability of all information in the stock market for a stock price determination. It postulates that there are no chances of investors making substantially high returns on investment in the long run. The weak form of the efficient market hypothesis must hold if the random walk hypothesis holds (Ko & Lee, 1991) but not vice versa. A simple random walk process for stock returns can be expressed as follows:

$$r_t = r_{t-1} + \varepsilon_t, \qquad (3.1)$$

Where r_t is the stock returns at period t, r_{t-1} is the stock returns at period $t-1$, and ε_t is the error term at the time t.

3.3.2 Growth Rate of Assets

The growth rate of assets of listed companies' model was guided by the growth maximization theory (Marris, 1964). The theory states that the balanced growth of a firm is based on shareholders' and managers' utilities. The utility function of the shareholders comprises variables such as public image, size of market share, profit, capital, and output. Managers are concerned, on the other hand, with powers, job security, salaries, and status. However, Marris (1964) claimed that the difference between the two agents is not so wide. He cited the existence of a very strong correlation between the size of the firm and variables appearing in both functions.

This theory explains a firm's growth where it grows balancing the supply side of growth and the demand side of growth. Marris (1964) used the rate of successful diversification brought by research and development and the level of advertising as a measure of the growth of the demand side of a firm. Meanwhile, debt ratio, liquidity ratio, and retained profit ratio were the determinants of the supply side of growth. The balanced growth equation is expressed as follows:

$$BG_r = G_d = G_s, \qquad (3.2)$$

Where BG_r is the balanced growth of a firm, G_d is the demand side's growth, and G_s is the supply side's growth.

The equation of the demand side of growth is expressed as follows:

$$G_d = f(R\&D, A), \qquad (3.3)$$

Where G_d is the growth of the demand side, $R\&D$ is the rate of successful research and development, and A is the advertising rate.

On the other hand, the supply side of the growth equation is expressed as follows:

$$Gs = f\ (Drt, Lrt, Rrt), \qquad (3.4)$$

Where G_s is the growth of the supply side, Drt is the debt ratio, Lrt is the liquidity ratio, and Rrt is the firm's retention ratio.

This study used the supply side of growth to analyze the total assets' average growth rate in listed companies since the factors affecting the growth rate of a listed company from the stock market are inclined to the supply side of growth brought about by the supply of capital from the stock market. For this reason, the study modified Equation (3.4) to get Equation (3.5) for analysis to include variables of age and volatility of stock returns to be specified as follows:

$$Gs = f\ (Drt, Lrt, Rrt, age, volatility\ of\ stock\ returns), \qquad (3.5)$$

Where G_s is the supply side's growth rate, Drt, Lrt, and Rrt represent the debt ratio, the liquidity ratio, and the retention ratio, respectively.

3.4 Model Specification

3.4.1 The GARCH Family Models

After buying a stock at period t and willing to sell it at period t plus 1, a stockholder is interested in the rate of stock return and its variance over the holding period. A stockholder's primary interest, therefore, lies in predicting the volatility of stock returns at time $t + 1$. However, modeling this volatility is complicated by the behavior of financial assets, which typically exhibit non-constant variance. High periods of stock returns volatility could hence be followed by periods of high volatility, or low stock returns volatility periods could be followed by periods of low volatility (Ender, 2015).

Although there are many types of returns, the study concentrated on log returns due to their applicability and wide use in finance. Also, it ensures non-negativity in returns. This, in addition, makes interpretation easier in percentage points rather than a unit change, and it means they are easier to use in long-term predictions, such as growth prospects. From this point onwards, stock returns for all the models in this study at period t were expressed as:

$$r_t = \Delta \ln(P_t) = \ln(P_t) - \ln(P_{t-1}), \quad (3.6)$$

Where r_t and ΔlnP_t is the first difference in the log of stock price, P_t is the price of a stock at time t, P_{t-1} is the price of a stock at time $t-1$, and ln is the natural logarithm.

A random walk process with neither a trend nor a deterministic trend, as in Equation (3.1), is non-stationary. It has a mean of zero, but its variance is heteroskedastic, meaning it changes over time. Engle (1982) introduced a model to overcome the challenge of heteroscedasticity in stock returns modeling using an autoregressive conditional heteroscedasticity (ARCH (p)) model. The ARCH model in this study was based on the variance of the error term, where it was modeled with changing mean and variance simultaneously as an autoregressive process. ARCH models are second-level models, implying that there must be a mean equation. The mean equation for stock returns was expressed as follows:

$$r_t = \mu + \varepsilon_t, \quad (3.7)$$

Where r_t is the log returns, μ is the conditional expected log returns (given the information set (I_{t-1})) and ε_t are the log returns innovations.

From the mean Equation (3.7) the conditional variance equation for the ARCH (p) model can now be expressed as follows:

$$\varepsilon_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \cdots + \alpha_p \varepsilon_{t-p}^2 + v_t, \quad (3.8)$$

Where ε_t^2 is the conditional variance, α_0 is the constant of the ARCH model, α_1, α_2, …, α_p are the coefficients of lags of conditional variances ε_{t-1}^2, ε_{t-2}^2, …, ε_{t-p}^2, and p is the lag length, and v_t is an error term (having a zero mean and a constant variance).

In this study, however, ARCH models have been seen to have limitations of being extremely general and weak in empirical estimations. Therefore, the study used its generalized form called the generalized ARCH model. Bollerslev (1986) improved the ARCH (p) model such that the heteroskedastic variance could be modeled using both the autoregressive part represented by p and the moving average part represented by q using the generalized autoregressive conditional heteroscedasticity (p, q) model. The conditional variance in the GARCH (p, q) is parameterized as a distributed lag of the square of past innovations and conditional variances. The lag order (1, 1) or GARCH (1, 1) is enough to capture the volatility clustering present in a data series (Brook and Burke, 2003). The model can capture the volatility clustering behavior efficiently.

However, since financial market data has been observed to have substantial kurtosis (Baillie et al., 1990), it is appropriate to model the volatility of stock returns following a conditional t density. The study found the stock returns series leptokurtic, and the specification of the GARCH (p, q) model was modeled to follow a t-distribution. Equation (3.9) represents the GARCH (p, q) model used in this study.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta \sigma_{t-1}^2, \qquad (3.9)$$

Where σ_t^2 is the conditional variance, μ_t is the rational value of the expected log returns at time $t-1$, α_0, α_1 and β are parameters of the model.

Although the GARCH (p, q) model efficiently captures the symmetric behavior of volatility, it does not allow for asymmetric effects in the evolution of the volatility process. This means that both positive and negative news have equal effects on the volatility of financial returns (Duraj & Ludwicka, 2019). The Exponential GARCH (EGARCH) model by Nelson (1991) was used to capture any asymmetric or leverage effects in the evolution of the volatility process. The EGARCH model has the advantage of capturing the leverage effects and guarantees that the parameters are positive since it works with the log of variances. Also, there are no restrictions on the parameters ω_0, α, and Υ in the EGARCH model as specified in Equation (3.9). However, it was necessary to maintain stationarity. This is ensured by β being positive and less than one. The EGARCH model for conditional variance in this study was specified as follows:

$$ln(\sigma^2) = \omega_0 + \alpha \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + \beta_1(\sigma_{t-1}^2) + \Upsilon \frac{\varepsilon_{t-1}}{\sigma_{t-1}}, \qquad (3.10)$$

Where $ln(\sigma^2)$ is the log of variance of the series, ω_0 is the coefficient of the EGARCH model, α is the coefficient of the ARCH effects, β_1 measures asymmetry or leverage effects, and Υ is the coefficient of the GARCH effects.

The coefficients in Equations (3.9) and (3.10) show the long-run characteristics of the stock returns' volatility in the NSE 20 and answer the study's first objective. From Equation (3.10), a significant α and β values show the presence of volatility clustering and persistence behaviors in the stock returns series, respectively. From Equation (3.10), the study seeks evidence of the asymmetric behavior, which is not captured by Equation (3.9). A significant β_1 value implies evidence of the asymmetric behavior.

3.4.2 The Dynamic Panel Data Model

The study used a dynamic panel data model for analysis to achieve its second objective. According to Davison et al., (2005), the growth of a firm can be measured using various methods, but it needs to be assessed as its size changes over time, preferably in a concurrent longitudinal design. The size of a firm was measured using the company's total assets. To analyze the average growth rate of assets of listed companies, the empirical model was based on the supply side of growth, of the growth maximization theory. One key guide to the empirical model is the nature of the growth of assets, where the current period's total assets growth is correlated with the assets growth in the past periods.

From economic literature, even in cases where the dynamics in a variable are not of direct interest, it may be crucial to allow for their dynamics in the underlying process to get consistent estimates of other parameters (Bond, 2002). This behavior calls for a dynamic panel data model for analysis. This model incorporates both within and between variations in the determining model coefficients. This way, it captures individual and time-specific effects more efficiently (Piper, 2014).

Consider the following model for a static panel data model guided by Blundell and Bond (2001):

$$Grw_{it} = \alpha_i + X'_{it}\beta + \mu_{it}, \qquad (3.11)$$

For i = 1, 2, ..., N and t = 1, 2, ..., T

Where Grw_{it} is the growth rate of assets of the i^{th} individual company in t^{th} period, X'_{it} represents the vector of the explanatory variables, α_i represents the unobserved individual-specific heterogeneity effect, β represents the vector of unknown parameters, and μ_{it} is the unobserved error term.

To introduce dynamism to the model in Equation (3.11), $Grw_{it-1,}$ which is the first lag of the growth rate of assets, was introduced as follows:

$$Grw_{it} = \beta_0 Grw_{it-1} + X'_{it}\beta + v_{it} \qquad (3.12)$$

Where Grw_{it} represents the growth rate of assets, X'_{it} represents the vector of explanatory variables, β represents the vector of unknown parameters, and $v_{it} = \alpha_i + \mu_{it}$ is the composite error term.

X'_{it} in Equation (3.12) comprises debt, liquidity, and retention ratios.

Marris (1964) model used only debt ratio, liquidity ratio, and retention ratio to model the supply side of the growth of a firm. However, the supply side of the growth model in Equation (3.4) in this study was enriched with additional variables from literature with potential impacts on the growth of listed companies. They were the age of a listed company and the respective stock returns volatility. The importance of including the age of a listed company in the stock market was emphasized by Jovanovic's learning theory (Jovanovic, 1982). Jovanovic (1982) argued that firms differ in size because they have different efficiency in learning rates as they age. On the other hand, stock returns and asset growth have been found to have a cross-sectional relationship (Wantanabe et al., 2013). In addition, stock returns volatility was found to be a leading indicator of the business cycle's state, hence useful in forecasting the direction of economic activity (Hamilton & Lin, 1996).

The main assumption from Equation (3.12) is that $E(v_{it}|Grw_{it-1}, X_{it}, \alpha_i) = 0$. The strict exogeneity assumption for the explanatory variables in this model is relaxed, allowing for feedback from lagged values of Grw to the current value of the explanatory variables. In addition, it implies a lack of autocorrelation in v_{it} (Benito et al., 2017). Arellano & Bond (1991) cite that the assumption in Equation (3.12) ensures consistency of the Generalized Method of Moments estimator. In the estimation of dynamic panel data, the two models mostly used are the difference Generalized Method of Moments estimator (Arellano & Bond, 1991) and the system Generalized Method of Moment estimator (Arellano & Bover, 1995).

The system Generalized Method of Moment approach has the advantage of allowing for more instruments and dramatically improving efficiency. It does not also expunge the fixed effects (Roodman, 2009). The Generalized Method of Moment estimators unlike pooled OLS, fixed effect, and random effects models do not require distributional assumptions for example normality. The estimators can also allow for heteroscedasticity of unknown form (Greene, 2002). The above advantages, however, need to be decided based on results from the test on downward bias (Bond, 2001). The econometric model in Equation (3.13) hence needed to be estimated using pooled OLS (β_{0ls} estimated is assumed to be upward biased), then with a fixed effect approach (estimated β_{fixed} is assumed to be downwards biased). System GMM was chosen since the difference GMM estimated coefficient of lag of growth rate was less than the fixed effects estimated coefficient of lag of growth rate than the coefficients of pooled OLS

$$Grw_{it} = \beta_0 Grw_{it-1} + \beta_1 Drt_{it} + \beta_2 Lrt_{it} + \beta_3 Rrt_{it} + \beta_4 Age_{it} + \beta_5 Vsr_{it} + \alpha_i + \mu_{it}, \quad (3.13)$$

Where Grw_{it} is the growth rate of assets, Drt_{it} is debt ratio, Lrt_{it} is the liquidity ratio, Rrt_{it} is the retention ratio, Age_{it} is the age of the company since its listing in the NSE, Vsr_{it} is the annual volatility of stock returns, α_i is the unobserved individual-specific heterogeneity effect, β_0, β_1, β_2, β_3, $\beta_4$and β_5 are unknown parameters, and μ_{it} is the random error.

3.5 Definition and Measurements of Variables

Table 3.1 shows the model variables used to achieve this study's objectives, variable definitions, and their respective units of measurement.

Table 3.1: Model Variables

Variables	**Definition**	**Measurements**
Stock returns	It is the difference between the closing prices of stocks of listed companies between different trading periods.	Measured daily in Kenyan shillings
Stock returns volatility (Vsr)	It is a measure of the dispersion of stock returns.	Measured annually using the standard deviation of stock returns.

Growth rate of total assets (Grw)	It is the percentage change in the value of a company's total assets in a financial year.	Measured annually in percentages.
Debt ratio (Drt)	It is a measure of the amount of assets a company has bought using debt.	Measured annually using debt ratio.
Retention ratio (Rrt)	It is a measure of the percentage of total earnings that is credited back to a company after paying dividends to shareholders in a given financial year.	Measured annually using retention ratio.
Liquidity ratio (Lrt)	It is the measure of a company's ability to pay off its current liabilities (payable within one year) with its total current assets.	Measured annually using the current ratio.
Age	The number of years since a company was listed.	Measured in years

3.6 Data Types and Sources

The study used secondary data. It comprised the yearly number of listed companies, daily closing stock prices, and annual data on the growth rate of total assets, debt ratio, retention ratio, and liquidity ratio. The first objective used time series data in daily frequency with 2,999 observations. On the other hand, the panel data comprised annual data on the growth rate of total assets, debt ratio, retention ratio, liquidity ratio, and stock returns volatility variables of listed companies. The data was collected for 12 years, with a total number of 1,368 observations. Datasets on stock prices and the number of listings were sourced from the Wall Street Journal and the World Bank online database, respectively. Datasets on total assets, liquidity ratio, debt ratio, and retention ratio between 2010 and 2023 were obtained from African Financials and annual reports of statements of financial position of companies.

3.7 Data Analysis

The first objective involves an analysis of the long-term behavior of the volatility of stock returns in the companies listed in the NSE 20 from 2011 to 2023. To achieve this objective, the study estimated Equations (3.9) and (3.10) using the maximum likelihood estimation method. It then estimated Equation (3.13) using a two-step system GMM method to achieve its second objective.

3.8 Model Diagnostics

This study conducted diagnostic tests after the estimation of the models. For models in Equations (3.8), (3.9), and (3.10), it conducted a residual-based test to test for normality, autocorrelation, and remaining ARCH effects. The model in Equation (3.13), tested for over-identification restrictions using Hansen's test and test for zero autocorrelation using the Arellano Bond (AR (2)) test.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents the study's data analysis and model estimation results. It starts with the summary statistics of the variables used and then discusses the estimated models' results. Finally, it gives diagnostic test results for the estimated models' validity.

4.2 Descriptive Statistics

The descriptive statistics results in this study are divided into two sections: The first section is the descriptive statistics of the average stock returns data in the NSE 20, and the second section provides the summary statistics for the variables in panel data form.

4.2.1 The NSE 20 Stock Returns Series

The summary statistics of the log of NSE 20 stock returns of the number of observations, minimum, maximum, mean, standard deviation, skewness, and kurtosis are presented in Table 4.1.

Table 4.1: Descriptive Statistics of the Averaged NSE 20 Log Returns Series

Statistics	**value**
Number of observations	2996
Minimum (%)	-4.71
Maximum (%)	4.98
Mean (%)	-0.0004
Standard deviation	0.0086
Skewness	0.0847
Kurtosis	5.2976
Excess Kurtosis	2.2976

Source: Author's computation

The summary statistics in Table 4.1 illustrate the fundamental characteristics of the NSE 20 stock returns series. As shown, it comprised 2996 observations. The average stock returns' minimum value was -4.71%. Its maximum value was 4.98% while it had a mean of -0.0004% with a standard deviation of 0.01. Additional summary statistics reported are: skewness, kurtosis, and excess kurtosis. This is because they give a crucial spotlight for further analysis. The series had a skewness of 0.08 and a Kurtosis of 5.30. The kurtosis is far from normally distributed data, as shown by the excess kurtosis value of 2.306, implying that the series was leptokurtic.

4.2.2 Panel Data Variables Descriptive Statistics

This section presents a summary of descriptive statistics of the variables of the panel data, which are provided in Table 4.2. Each variable's statistics comprise the number of observations, the minimum, the maximum, the mean, and the standard deviation values.

Table 4.2: Panel Data Variables Descriptive Statistics

Variable/ Statistics	Number of observations	Minimum	Maximum	Mean	Standard Deviation
Growth rate (%)	228	-31.7210	144.0479	12.2824	15.7829
Liquidity ratio (%)	228	0.00003	518.9961	146.272	77.0108
Debt ratio (%)	228	13.1959	113.734	62.7116	22.97988
Retention Ratio (%)	228	-859.22	100	46.2803	0.93.9269
Age (Years)	228	0	68	27.4079	18.4855

Volatility (%)	228	12.7841	78.9881	29.872	9.2401

Source: Authors' Computation

From Table 4.2, all the panel data variables comprised a cross-section of observations from 19 firms observed across 12 years, which gave 228 observations per variable. The minimum value of the growth rate of firms was -31.72 percent, which was recorded by the WPP-Scangroup in 2020. The maximum growth rate was 144.04 percent, achieved by Centum Investment Company PLC in 2015. The growth rate had a mean of 12.28 percent. Its standard deviation was 15.78. The liquidity ratio's minimum value was approximately 0 percent. Its maximum value was 519.0 percent, having a mean was 146.27 percent and a standard deviation of 77.01.

The debt ratio's minimum value was 13.2 percent and a maximum value of 113.73 percent. Its mean value was 62.71 percent. Lastly, it had a standard deviation of 22.98. Conversely, the retention ratio had a minimum value of -859.22 percent and a maximum value of 1 percent. Its mean value was 46.28 percent and a standard deviation of 93.93. Age had a minimum of 0 years. In this case, the company was listed in 2011. On the other hand, the recorded maximum age was 68 years. The mean age was 27.41 years with a standard deviation of 18. 49.

The last variable in this analysis was the volatility of stock returns (volatility). It was measured annually and had to have a minimum value of 12.78 percent. This was recorded by the Standard Chartered Bank in 2021. In the same year, the highest volatility of 78.98 percent was observed in the WPP-Scangroup. Notably, 2019 and 2021 were years during the rise of the COVID-19 pandemic. Meanwhile, volatility's mean value was 29.87 percent while the standard deviation was 9.24 percent.

4.3 Diagnostic Tests

4.3.1 The ARCH LM Test

This study conducted the ARCH-LM test to test for the appropriateness of using the volatility models. This test shows the extent of ARCH effects. ARCH effects show the extent of autocorrelation in the squared residuals of the returns series. The results in Table 4.3 showed strong evidence of ARCH effects. This is illustrated by a significant p-value, leading to the rejection of the null hypothesis and concluding that there was the presence of ARCH effects in the residual series.

Table 4.3: ARCH LM Test

ARCH LM Statistics	**P-Value**	**Conclusion**
62.2184	0.0000***	Presence of arch effects

Note: *** denotes statistical significance at a 1% confidence level

Source: Author's computation

4.3.2 Test for Normality

The study tested the distributional properties of the residual series using the Shapiro-Wilk test. As shown by the significant p-value illustrated in Table 4.4, the study rejected the null hypothesis, that is, the residual series was generated from a normal distribution.

Table 4.4: Shapiro-Wilk Test Statistics

Test Statistics	P-Value
0.9125	0.0000***

Note: *** denotes statistical significance at a 1% confidence level

Source: Author's computation

4.3.3 Check for the Skewness of the NSE 20 Stock Returns Series

The study checked for the skewness of the returns series to confirm whether the distributional assumptions of normality needed an extra assumption in the model building. The skewness from the descriptive statistics was 0.08, which is close to zero. This led to the conclusion that the model building did not require skewness assumption in its distributional assumptions. Figure 4.1 illustrates the skewness characteristics of the NSE 20 stock returns series.

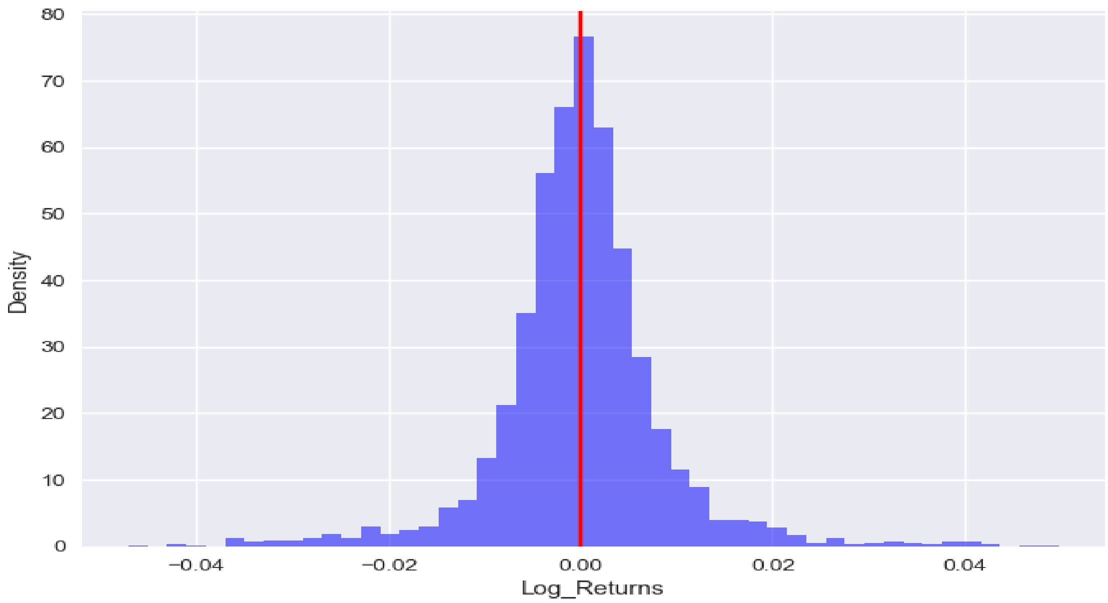

Figure 4.1: NSE 20 Stock Returns Series' Skewness

Source: Author's computation

4.4 Model Estimation

This section gives the results of the estimated models in the study that were used to achieve its research objectives. It first estimated the GARCH (1, 1) model using Equation (3.8) and then the EGARCH (1, 1) model using Equation (3.9) to show the long-run behaviors of the NSE 20 stock returns series. The second model estimated was the system GMM model in Equation (3.13) to show the effect of stock returns volatility on the average growth rate of total assets of listed companies in Kenya.

4.4.1 The Long-run Behavior of NSE Stock Returns

The stock returns volatility is a dominant behavior in the stock returns series. Various stock returns in different stock markets are affected by different factors such as dividend yield (Caner & Önder, 2005), macroeconomic factors (Pinjaman & Aralas, 2015), and sentiment (Musembi et al. 2020; Haritha & Rishad, 2021). In the Kenyan case, stock return volatility is affected by periods around general elections (Lusinde, 2011) and macroeconomic variables (Muriithi, 2018) among other factors. The long-run behavior was discovered by estimating two volatility models in Equations (3.8) and (3.9).

The results of the ARCH-LM test validates the use of GARCH and EGARCH models since there is evidence of ARCH effects in the residual series. The normality test showed evidence against normality. In addition, from the descriptive statistics, the stock returns series has an excess kurtosis of 2.30. This implies that the estimated ARCH family models needed to follow a more dispersed distribution. This study chose the Student's t-distribution, which is more dispersed compared to the normal distribution. Given that the series skewness was very close to zero, the study did not impose the skewness property to estimate its models. For both models, the study used the maximum likelihood estimation.

4.4.1.1 GARCH Model Estimation Results

The results of the analysis as shown in Table 4.5 showed that the best model was GARCH (1, 1). The model was estimated considering that the NSE 20 stock returns had excess kurtosis. It therefore used the student's t-distribution.

Table 4.5: GARCH (1, 1) Results of the Estimated Model

Statistics	Coefficient	Standard Error	T-Statistics	P-Value
omega	7.5662e-06	8.627e-06	0.877	0.380
alpha	0.2820	2.359e-02	11.952	6.347e-33***
beta	0.6265	3.173e-02	19.742	9.378e-87***

Note: *** denotes statistical significance at 1% level

Source: Author's computation

The P-value results for GARCH (1, 1) in Table 4.4 show that the ARCH term (α) and the GARCH term (β) coefficients are statistically significant. This means that the lagged conditional variance has strong explanatory power on the current volatility with a magnitude of 0.30 and lagged squared disturbance with a magnitude of 0.63. The statistical significance of α showed the presence of volatility clustering behavior. The significant β value showed persistence behavior in the stock returns series. The sum of the ARCH and the GARCH coefficients is 0.91, which is very close to 1. This meant that past shocks were quickly absorbed, and the market reverted to its average long-run returns, referred to as mean reversion behavior. However, the constant term is not statistically significant. In this study, the sample period was characterized by crucial events like the COVID-19 pandemic which ensued distress increasing the volatility of stock returns, as it reflected the uncertainty of the financial market. The empirical results therefore showed that the stock market returns behavior in Kenya continued to exhibit volatility clustering and persistence even in the most recent times. The results agreed with the findings of Ombaba (2015), Ndei et al., (2019), and Kalovwe et al., (2021), who used an earlier period for analysis.

4.4.1.2 EGARCH Model Estimation Results

The GARCH (1, 1) model captured the persistence and volatility clustering behaviors of the NSE 20 stock returns series. However, it could not capture the effects of news or the leverage effects. This means that positive and negative news have equal effects on the volatility behavior of the stock returns series, implying symmetric behavior. However, positive and negative news has been found to have different effects on the stock returns behavior in various markets (Basuony, et al., 2021). For this reason, the study employed the EGARCH modeling, intending to capture significant asymmetric behaviors. The findings showed that in the NSE 20 series, news did not have a statistically significant contribution to the stock returns volatility behavior. Table 4.6 presents the EGARCH (1, 1) results.

Table 4.6: EGARCH (1, 1) Results of the Estimated Model

Coefficient	**Value**	**Std. errors**	**t-value**	**P-value**
omega	-0.5359	0.202	-2.650	8.044e03*
alpha	0.2935	5.078e-02	5.780	7.458e09*
gamma	0.0290	2.087e-02	1.392	0.164
beta	0.9423	2.119e-02	44.461	0.000*

Note: *** denotes statistical significance at 1% level.

Source: Author's computation

To ensure the robustness of the lack of asymmetric behavior in the NSE 20 stock returns series, the study estimated the Threshold GARCH. This model can also capture the asymmetric behavior by introducing a threshold effect in the conditional variance equation, which allows the model to differentiate between the positive and the negative shocks. The estimated TGARCH (1, 1) results summary is presented in Appendix A. The coefficient value of gamma is statistically insignificant, further supporting

EGARCH (1, 1) results. Therefore, the EGARCH and TGARCH models provided no evidence of the asymmetric behavior of NSE 20 stock returns volatility. The empirical finding on the absence of leverage supports the conclusion of Kalovwe et al. (2021) and Kengere (2023).

4.4.2 The Effect of Stock Returns Volatility on the Average Growth Rate of the Total Assets of Listed Companies

After understanding the stock returns volatility behavior, this study sought to determine the effects of the aforementioned volatility on the average growth rate of the total assets of Kenya's listed companies on the NSE 20. Accompanied by other important variables in the determination of assets growth rate i.e., Liquidity ratio, debt ratio, retention ratio, and age, the study determined the contribution of stock returns volatility on the growth rate of total assets in Kenyan listed companies. To achieve this, it employed dynamic panel data analysis using the two-step GMM model.

The system GMM estimation method as in Equation (3.13) was developed by Arellano & Bond (1991) and it was improved later by Arellano & Bover (1995). To help increase the number of sample size and for the asymptotic properties, the study used one lag of growth rate. The study estimated 4 models: the pooled ordinary least square (pooled OLS) (Appendix B), the fixed effect (Appendix B), the GMM (Appendix B), and the system GMM models.

The first three models were used as benchmarks for the validity of using the system GMM model. The first three models' results showed that using a two-step system GMM model was valid. This is because the coefficient of the lagged dependent variable of the one-step difference GMM was lower than the fixed effect model's estimated coefficient than that of the pooled OLS. Hence, the study chose the two-step system GMM as to the Bond (2001) model selection criteria. The results summary is presented in Table 4.7

Table 4.7: Lagged Dependent Variable Coefficients for Pooled OLS, Fixed Effect, and One-step GMM Models

Estimation Method	Coefficient	P-Value
Pooled OLS	0.4638	0.001***
Fixed Effect Model	0.4947	0.000***
Difference GMM	0.4473	0.000***

Note: statistically significant at the ***1% level.

Source: Author's Computation

The estimated method used in this study is called the two-step system GMM. Its results summary is presented in Table 4.8.

Table 4.8: Two-Step System GMM Results Summary

Variable Name	Coefficient	Std. Errors (Robust)	T-statistic	P-Value
Constant	7.6810	3.3957	2.26	0.036**
Lagged growth $(t-1)$	0.4439	0.0185	23.98	0.000**
Liquidity ratio	2.8043	1.3912	2.02	0.059*
Debt ratio	7.6765	5.5538	1.38	0.184
Retention Ratio	3.4027	1.1222	3.03	0.007**
Age	-0.0426	.0648	-0.66	0.519
Volatility	-16.6088	9.5518	-1.74	0.099*

Note: ** and * denote the 5% and 10% significance level, respectively.

Source: Author's Computation

As illustrated in Table 4.8, the lagged dependent variable of the growth rate of total assets is 0.44. It has a p-value of 0.00, implying that it is significant at a 1 percent level of significance. This showed a high persistence of growth rate, further justifying a dynamic model. It also confirms that the growth rate adjusts to its optimal levels through a dynamic adjustment process. The lagged dependent variable's coefficient has a positive sign indicating that one lag of the growth rate positively affects the current growth rate.

Based on the financial ratios, the liquidity ratio had a positive coefficient of 2.80 and was significant at the 10 percent level. The retention ratios' coefficient was 3.40 and was highly significant at a 1 percent significance level. Conversely, the debt ratio with a coefficient of 7.68 had a statistically insignificant contribution to the growth rate.

Age and assets growth rate had a negative relationship. However, its coefficient was statistically insignificant. The constant term coefficient was 7.68 with a significant p-value. Lastly, volatility had a negative coefficient of -16.61. Its p-value was significant at a 10 percent significant level. The study hence rejected the null hypothesis that the stock returns volatility has insignificant effects on the average growth rate of the total assets of listed companies in Kenya.

4.5 Models Diagnostic Tests

4.5.1 GARCH (1, 1) Models Diagnostic Tests

The study conducted the Ljung-Box test, as a post-estimation test of any autocorrelation in the NSE 20 returns series using the standardized residuals for the GARCH (1, 1) model. The test results rejected the null hypothesis of the presence of autocorrelation of any order in the residual series. This was decided upon an insignificant p-value at a 1 percent confidence level, as shown in Table 4.9. It meant that the model captured all available time series dynamics as far as autocorrelation was concerned.

Table 4.9: GARCH (1, 1) Models Diagnostic Tests

Model	LJung-Box Test statistics	P-value
GARCH (1, 1)	0.0144	1

Source: Author's computation

4.5.2 Two-step GMM Model Diagnostic Tests

To ascertain the use of the estimated results in the two-step system GMM model, the study tested for model adequacy. The two tests conducted were Hansen's test for over-identifying restrictions and the second-order serial autocorrelation (AR2) test using the Arellano and Bond test. Lastly, it tested for the overall significance of the model using the F-statistics. Table 4.10 illustrates the summary of these tests.

Table 4.10: The Two-step GMM Model Diagnostic Tests Summary

Test Name	Test statistics	P-value
Hansen's test	13.78	0.183
Arellano and Bonds test (AR (2))	57.55	0.126
F-statistics	367.41	0.000**

Note: ** denotes a statistical significance level of 1%

Source: Author's Computation

Hansen's test checked for the instruments' validity in the system GMM estimated model. If the instruments used are valid, the p-value should exceed the significance level chosen by a researcher. Hansen's test results in Table 4.10 showed a test statistic of 13.78 and a p-value of 0.183. At a 5% significance level, the study failed to reject the null hypothesis of the validity of the instruments used. Therefore, the first lag of growth rate as an instrument was uncorrelated with the error term and therefore a valid instrument.

Meanwhile, the necessary condition for the GMM estimator is when it is consistent, meaning that there is no second-order serial correlation. The study conducted the AR (2) test to check if the condition was met. It is expected that there exists a first-order serial correlation in the residual, but not in the second-order serial correlation (Arellano & Bond, 1991). As observed from the results summary in Table 4.10, the p-value is statistically insignificant, meaning there is no second-order serial correlation in the residual.

Lastly, to test for the overall significance of the estimated coefficients, the study used F-test. A p-value of F-statistic that is greater than the chosen significance level indicates that all regression coefficients are equal to zero. As shown in Table 4.10 the p-value at 1 percent significance level is 0.00. This led to the rejection of the null hypothesis, that is, all regression coefficients do not jointly explain any variations in the growth rate. The study concludes that the explanatory variables provide statistically significant information to explain the variations in the growth rate.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter first summarizes the study findings and conclusions, and finishes by giving policy recommendations and areas for further research.

5.2 The Summary of the Study

Asset returns volatility is one of the key areas of research in economics and finance. Such assets, like stock of companies, however, have different dynamics over time since various factors affect them. Based on individual or firm characteristics, various levels of returns attract different investors differently. Many investors, however, are risk-averse and prefer low or moderate volatility levels to high. Stock returns affect firms' growth rate since it affects their exposure to financial risks depending on the level of their assets base.

The study used GARCH family models to analyze the behavior of stock returns from 2011 to 2022 in the first objective. The results showed that stock returns were volatile, with the volatility having volatility clustering, persistence, and mean reversion behaviors. In addition, the effect of news on the stock market was not significant, meaning that the volatility behavior was not affected by positive or negative news.

The second objective was to determine the effects of the stock returns volatility on the average growth rate of total assets of listed companies in Kenya. The study used the maximum likelihood estimation method with the two-step GMM model, using 19 out of 20 companies in the NSE 20 for 12 years. The study determined that stock returns volatility negatively affected the asset growth rate of listed companies in Kenya over the study period.

5.3 Conclusion

The study found that stock returns volatility in the NSE 20 is characterized by volatility clustering, persistence, and mean reversion behaviors in its evolution. In addition, the volatility lacked significant asymmetric effects implying that transitory events causing good and bad news have no significant power to influence the evolution of NSE 20 stock returns volatility. The lack of asymmetric effects in the NSE 20 indicates that NSE 20 operates as an efficient market, where all future factors affecting the stock's price are factored in during its price determination.

The current volatility in the NSE 20 was affected by past squared returns and past variances, which is the volatility clustering behavior found. The persistence behavior was highly pronounced by the sum of alpha and beta being 0.91, meaning that in NSE 20, volatility shock has long-lasting effects. Mean reversion was found as well since the sum of alpha and beta was less than 1, implying that any shock in the stock market is quickly absorbed, and the stock returns revert to their long-run average.

The trend in the growth rate for most companies was positive for most of the years. The stock market returns volatility was found to pose a lesser risk to investors in the NSE since it operates as an efficient market. Despite this, the stock returns volatility in the NSE 20 was found to have a significant negative relationship with the total assets' growth rate of the listed companies in Kenya on the NSE 20.

5.4 Policy Recommendations

The study found several areas of policy recommendation as follows: first, from the nature of Kenyan stock returns, investors can benefit from the market since mean reversion behavior of NSE 20 returns is attractive for risk-averse investors, who can invest in the long run. However, due to persistent and lack of leverage effects, it is recommended that policymakers investigate activities such as inside traders that could be leaking private information about stock price determination that continues to make the NSE operate as an efficient market. This is because it disadvantages investors who rely on news to make investment decisions and might shy away from investing in the NSE.

On the other hand, it is recommended that the listed companies increase their liquidity, debt, and retention ratios since they were found to be positively correlated with assets' growth rate. Lastly, the volatility of stock returns had a negative impact on the growth rate of total assets of the listed companies. Based on its long-run behaviors, it is recommended that measures be taken to reduce its persistence, improve the mean reversion, and ensure that asymmetric effects are present in the NSE stock returns volatility. This is because prolonged persistence can lead to prolonged losses, a lack of asymmetric effects makes some investors shy away from investing, and mean reversion will encourage investors who invest in the long run.

5.5 Areas for Further Research

The study investigated the relationship between stock returns volatility and how it affects the growth rate of total assets in listed companies in Kenya. The analysis of stock returns volatility from 2011 to 2022 gave an insight into how stock returns volatility behaved and brought about curiosity about the asymmetric behavior found in Kenya. Future studies could be done to determine the amount of information the NSE 20 gets in its stock price determination. This can help to discover the extent of the efficiency of the NSE 20 in the stock price determination. The second recommendation for future study is a comparative study of various sectors in the NSE, since the current study used most of the companies that are highly regulated by the Central Bank of Kenya. This can help uncover if this study's findings possibly suffered from the problem of generalization.

REFERENCES

Abdalla, S. Z. S., & Winker, P. (2012). Modeling stock market volatility using univariate GARCH models: Evidence from Sudan and Egypt. *International Journal of Economics and Finance*, *4*(8), 161-176.

Alarussi, A.S. and Alhaderi, S.M. (2018), "Factors affecting profitability in Malaysia", *Journal of Economic Studies*, Vol. 45 No. 3, pp. 442-458.

Altuwaijri, B. (2016). Investors' Sentiment and the Stock Market Behavior: An Empirical Analysis of the Saudi Stock Market. *Available at SSRN 2889708.*

Al-Shabbar, O. J. (2020). *Determinants of stock price volatility in Jordanian industrial firms*. Master's thesis, Universiti Utara Malaysia. Retrieved from https://etd.uum.edu.my/id/eprint/10327.

Amboko, J., & Ocharo, K. (2021). *Global Oil Price Volatility and Foreign Direct Investment Inflows in Kenya* (Doctoral dissertation, KENYATTA UNIVERSITY).

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29-51.

Audretsch, D. B., Klomp, L., Santarelli, E., & Thurik, A. R. (2004). Gibrat's Law: Are the services different? *Review of Industrial Organization*, *24*, 301-324.

Avramov, D., Chordia, T., Jostova, G., & Philipov, A. (2019). Bonds, stocks, and sources of mispricing. *George Mason University School of Business Research paper*, (18-5).

Baillie, R. T., & DeGennaro, R. P. (1990). Stock returns and volatility. *Journal of Financial and Quantitative Analysis*, *25*(2), 203-214.

Ball, Ray. 1978. “Anomalies in Relationships Between Securities’ Yields and Yield-Surrogates.” *Journal of Financial Economics. July, 6, pp. 103–26.*

Basuony, M. A., Bouaddi, M., Ali, H., & EmadEldeen, R. (2022). The effect of COVID-19 pandemic on global stock markets: Return, volatility, and bad state probability dynamics. *Journal of Public Affairs*, *22*, e2761.

Pinjaman, S. B., & Aralas, S. B. (2015). The dynamic stock returns volatility and macroeconomic factors in Malaysia: A sectoral study. *South East Asia Journal of Contemporary Business, Economics and Law, 8(3), 33-40*.

Bollerslev, T., & Ghysels, E. (1996). Periodic autoregressive conditional heteroscedasticity. *Journal of Business & Economic Statistics*, *14*(2), 139-151.

Bond, S. R. (2002). Dynamic panel data models: a guide to micro data methods and practice. *Portuguese Economic Journal*, *1*, 141-162.

Brooks, C., Burke, S. P., & Persand, G. (2003). Multivariate GARCH models: software choice and estimation issues. *Journal of Applied Econometrics*, *18*(6), 725-734.

Caner, S., & Önder*, Z. (2005). Sources of volatility in stock returns in emerging markets. Applied Economics, *37*(8), 929-941.

Cooper, M. J., Gulen, H., & Schill, M. J. (2008). Asset growth and the cross-section of stock returns. *the Journal of Finance*, *63*(4), 1609-1651.

Curwen, P. J. (1976). Growth Models. *The Theory of the Firm* (pp. 118-122). London: Palgrave Macmillan UK.

Davidsson, P., Achtenhagen, L., & Naldi, L. (2005). Research on small firm growth: A review. In *35th EISB Conference: Sustaining the Entrepreneurial Spirit over Time: Implications for Young Companies, Family Businesses, and Established Companies* (pp. 1-27). IESE Business School.

Demirgüç-Kunt, A., Levine, R., & Min, H. G. (1998). Opening to foreign banks: Issues of stability, efficiency, and growth. *The implications of globalization of world financial markets*, 83-115.

Dewi, N. L. P. S., & Novitasari, N. L. G. (2022). The Effect of Debt Policy, Dividend Policy, Investment Decisions and Corporate Size on Corporate Value. *International Journal of Accounting & Finance in Asia Pacific (IJAFAP)*, *5*(3), 61-68.

Duraj, A., & Ludwicka, M. (2019). Modeling volatility of time series data containing outliers' observations with arch effect. *Electrical Review*, *95*, 37-40.

Enders, W. (2015). Applied econometric time series (4th ed). New York, NY: John Wiley and Sons Inc.

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the econometric society*, 987-1007.

Ericson, R., & Pakes, A. (1995). Markov-perfect industry dynamics: A framework for empirical work. *The Review of Economic Studies*, *62*(1), 53-82.

Fama, E. F. (1970). Efficient market hypothesis: A review of theory and empirical work. *Journal of Finance*, *25*(2), 28-30.

Fotopoulos, G., & Giotopoulos, I. (2010). Gibrat's law and persistence of growth in Greek manufacturing. *Small business economics*, *35*, 191-202.

Gibrat, R. 1931. *Les Inequalites Economiques*, Paris: Libraire du Recueil Sirey.

Gharbi, S., Sahut, J. M., & Teulon, F. (2014). R&D investments and high-tech firms' stock return volatility. *Technological Forecasting and Social Change*, *88*, 306-312.

Greene, W. (2002) Econometric Analysis, Fifth Edition. Upper Saddle River, New Jersey: Prentice Hall.

Hamid, K. Suleman, M. T., Ali Shah, s. z., & Imdad Akash, R. S. (2017). Testing the weak form of efficient market hypothesis: Empirical evidence from Asia-Pacific markets. *Available at SSRN 291290, 2017.*

Hamilton, J. D., & Lin, G. (1996). Stock market volatility and the business cycle. *Journal of Applied Econometrics*, *11*(5), 573-593.

Heertje, A. (2004). Schumpeter and methodological individualism. *Journal of Evolutionary Economics*, *14*(2).

Höhler, J., & Lansink, A. O. (2021). Measuring the impact of COVID‐19 on stock prices and profits in the food supply chain. *Agribusiness*, *37*(1), 171-186.

Hossain, M. Z. (2020). Factors of Share Price Volatility: Empirical Evidence from Private Commercial Banks in Bangladesh. *Research Journal of Finance and Accounting*, *11*(4), 110-117.

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica: Journal of the econometric society*, 649-670.

Kalovwe, S. K., Mwaniki, J. I., & Simwa, R. O. (2021). On stock returns volatility and trading volume of the Nairobi securities exchange index. *RMS: Research in Mathematics & Statistics, 8*(1), 1889765.

Kerubo, O. S. (2020). *Financial risk and performance of commercial and services listed companies in Nairobi securities exchange, Kenya* (Doctoral dissertation, Kenyatta University).

Kithandi, C. P. A., & Katua, C. (2019). *Financial Leverage and Financial Performance of the Energy and Petroleum Sector Companies Listed in The Nairobi Securities Exchange* (Doctoral dissertation, Kenyatta University).

Kumar, D., Sarangi, P. K., & Verma, R. (2020). A systematic review of stock market prediction using machine learning and statistical techniques. *Materials Science*, *2214*, 7853.

Lashgari, Z., & Ahmadi, M. (2014). The impact of dividend policy on stock price volatility in the Tehran stock exchange. *Kuwait Chapter of the Arabian Journal of Business and Management Review*, *3*(10), 273.

Lee, K. (2013). *Schumpeterian analysis of economic catch-up: Knowledge, path-creation, and the middle-income trap*. Cambridge University Press.Lensink, R., Steen, P. V., & Sterken, E. (2005). Uncertainty and Growth of the Firm. *Small Business Economics*, *24*, 381-391.

Leitner, K. H., & Güldenberg, S. (2010). Generic strategies and firm performance in SMEs: a longitudinal study of Austrian SMEs. *Small Business Economics*, *35*, 169-189.

Lim, K. P., Vun, M. K. C., & Lee, H. A. (2006). The random walk behavior of Malaysian stock market: Evidence from individual stocks. *International Journal of Management Studies (IJMS)*, *13*(2), 1-40.

Lusinde, M. M. (2012). *Volatility in stock returns of NSE listed companies around general elections in Kenya* (Doctoral dissertation, University of Nairobi).

Malkiel, B. G. (1973). *A random walk down Wall Street [by] Burton G. Malkiel*. Norton.

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

Marris, R. (1964). The Economic Theory of 'Managerial' Capitalism. London: *Macmillan*.

Marques, L. M., Fuinhas, J. A., & Marques, A. C. (2013). Does the stock market cause economic growth? Portuguese evidence of economic regime change. *Economic modeling*, *32*, 316-324.

McKinsey Global Institute. A new look at how corporations impact the economy and households,2021.Retrieved from https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/a-new-look-at-how-corporations-impact-the-economy-and-households

McKinsey Global Institute, Outperformers: Maintaining ASEAN countries' exceptional growth,2018. Retrieved from *https://www.mckinsey.com/*

Marris, R. (1964). The Economic Theory of 'Managerial' Capitalism. London: *Macmillan*.

MAWARDI, W. (2018). Determinants of the stock price volatility in the Indonesian manufacturing sector. *International Research Journal of Business Studies*, *11*(3), 179-193.

Moral-Benito, Enrique and Allison, Paul D. and Williams, Richard A, Dynamic Panel Data Modelling Using Maximum Likelihood: An Alternative to Arellano-Bond (January 25, 2017). Banco de Espana Working Paper No. 1703, Available at SSRN: https://ssrn.com/abstract=2905606 or http://dx.doi.org/10.2139/ssrn.2905606

Mori, M. W. (2016). *The Effect of Share Price Volatility on Stock Market Performance at the Nairobi Securities Exchange* (Doctoral dissertation, University of Nairobi).

Mose, N. (2021). Determinants of regional economic growth in Kenya. *African Journal of Business Management*, *15*(1), 1-12.

Muriithi, L. K. (2018). *The Effect of Financial Performance on Stock Price Volatility of Commercial Banks Listed at Nairobi Securities Exchange* (Doctoral dissertation, university of nairobi).

Musembi, M. M. (2020). Symmetric and asymmetric effect of investor sentiment on performance of equity market in Nairobi Securities Exchange, Kenya. *International Journal of Management and Commerce Innovations,* 8(1), 438-447.

Nelson, D. B., & Cao, C. Q. (1992). Inequality constraints in the univariate GARCH model. *Journal of Business & Economic Statistics*, *10*(2), 229-235.

Ndei, C. M., Muchina, S., & Waweru, K. (2019). Modeling stock market return volatility in the presence of structural breaks: Evidence from Nairobi Securities Exchange, Kenya. *International Journal of Research in Business and Social Science (2147-4478),* 8(5), 156-171.

Ngugi, F. (2017). *Factors Influencing Share Price Volatility of Firms Listed at the Nairobi Securities Exchange* (Doctoral dissertation).

Ngugi, K. D., & Jagongo, A. (2021). Systematic risks and stock market volatility in Kenya. *International Research Journal of Business and Strategic Management*, 3(3), 698-712.

Njeule, M. A. (2013). *The effects of central bank of Kenya prudential regulations on financial performance of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).

NSE 2022. History of NSE. Retrieved from https://www.nse.co.ke

NSE. 2023. Listed Companies. Available online: **https://www.nse.co.ke/listed-companies** (accessed on 18 May 2023).

Nyasha, S., & Odhiambo, N. M. (2014). The dynamics of stock market development in Kenya. *Journal of Applied Business Research (JABR)*, *30*(1), 73-82.

Ochieng, I. L., Olweny, T. O., Oluoch, O. J., & Ochere, G. O. (2019). Effect of foreign equity flows on stock market volatility in Kenya Empirical evidence at Nairobi securities exchange. *Journal of Finance and Investment Analysis*, *8*(3), 1-5.

Oliveira, N., Cortez, P., & Areal, N. (2017). The impact of microblogging data for stock market prediction: Using Twitter to predict returns, volatility, trading volume, and survey sentiment index. *Expert Systems with Applications, 73, 125-144.*

Ombaba, J. (2015). *Dynamics of stock return volatility and leverage effect on share price returns at the Nairobi securities exchange in Kenya* (Doctoral dissertation, University of Nairobi).

Park, C. Y., & Lee, J. W. (2011). Financial integration in emerging Asia: Challenges and prospects. *Asian Economic Policy Review*, *6*(2), 176-198.

Parker, S. C., Storey, D. J., & Van Witteloostuijn, A. (2010). What happens to gazelles? The importance of dynamic management strategy. *Small Business Economics*, *35*, 203-226.

PH, H., & Rishad, A. (2020). An empirical examination of investor sentiment and stock market volatility: evidence from India. *Financial Innovation*, *6*(1), 34.

Piper, A. T. (2014). *The benefits, challenges, and insights of a dynamic panel assessment of life satisfaction.*

Pour, E. K., & Lasfer, M. (2013). Why do companies delist voluntarily from the stock market? *Journal of Banking & Finance*, *37*(12), 4850-4860.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, *9*(1), 86-136.

Samuel, K. W. (2022). *Financial structure and financial growth of financial firms listed at Nairobi securities exchange* (doctoral dissertation, Kenyatta University).

Simon, H. A., & Bonini, C. P. (1958). The size distribution of business firms. *The American Economic Review*, *48*(4), 607-617.

Shaik, M., & Maheswaran, S. (2017). Random Walk in emerging Asian stock markets. *International Journal of Economics and Finance, 9(1), 20-31.*

Song, Z. (2016). Asset growth and idiosyncratic return volatility. *Review of Finance*, *20*(3), 1235-1258.

Steil, B., Victor, D. G., & Nelson, R. R. (Eds.). (2002). *Technological innovation and economic performance*. Princeton University Press.

Tambunan, T. (2019). Recent evidence of the development of micro, small, and medium enterprises in Indonesia. *Journal of Global Entrepreneurship Research, 9(1), 1-15.*

World Bank. 2020. Small and Medium Enterprise Finance. Retrieved from https://www.worldbank.org/en/topic/smefinance

World Bank. 2021. Global Productivity: Trends, Drivers, and Policies - World Bank. Retrieved from Global Productivity: Trends, Drivers, and Policies - World Bank

Watanabe, A., Xu, Y., Yao, T., & Yu, T. (2013). The asset growth effect: Insights from international equity markets. *Journal of Financial Economics*, *108*(2), 529-563

Zakaria, Z., Muhammad, J., & Zulkifli, A. H. (2012). The impact of dividend policy on the share price volatility: Malaysian construction and material companies. *International Journal of Economics and Management Sciences*, *2*(5), 1-8.

APPENDICES

Appendix A: Threshold GARCH (1, 1) Results for NSE 20 Stock Returns Series

Coefficient	value	Standard error	t-value	P-value
omega	0.0101	2.575e-04	39.054	0.000**
alpha	4.8182e-03	1.425e-05	338.089	0.000**
gamma	1.9416	8.025	0.242	0.809
beta	0.0150	2.697e-03	5.564	2.638e-08**

Note: Significant at the **1% level

Source: Author's computation

Appendix B: Panel Data Models Estimated to Determine the Effect of Volatility of Stock Returns on the Growth Rate of Listed Companies in Kenya.

Variables	Pooled OLS	Fixed Effects	One-step GMM
Constant	7.6945 (1.45)	31.8331 **	_
Growth rate(it – 1)	0.4638*** (3.24)	0.4947***	0.4473 *** (23.03)
Liquidity ratio	2.7757 (1.30)	2.0927	2.2816 (1.48)
Debt ratio	7.7046* (1.66)	10.1796	10.3900 (1.44)
Retention ratio	3.3575*** (1.66)	1.5376 ***	1.7021 ***(3.71)
age	-0.0419 (-0.91)	-.9291 **	-.9038** (-2.46)
Volatility	-16.5306** (-2.19)	-13.5106	-13.4716 (-1.57)
F-Statistics (Robust)	30.021***	14.867***	_
F-test for Poolability	_	3.9739***	_

Notes: ***, **, and * denote the 1%, 5%, and 10% level of significance, respectively

2. T-statistics in bracket

Source: Author's computation

Appendix C: Panel Data Used in Model Analysis

Company id	year	growth rate	liquidity ratio	debt ratio	retention ratio	age	volatility
1	2011	0.588483	2.620365	0.278431	0.500602	41	0.2805
1	2012	28.46397	2.348025	0.282936	0.711912	42	0.261546
1	2013	-0.05344	2.681324	0.267488	0.286837	43	0.270212
1	2014	-4.70534	2.296838	0.289625	0.394832	44	0.264763
1	2015	2.534703	2.357078	0.293219	0.510499	45	0.249899
1	2016	-2.90031	2.696565	0.269339	0.554874	46	0.264092
1	2017	15.66244	1.718677	0.248713	0.915868	47	0.246561
1	2018	6.681779	1.320599	0.335485	-0.07122	48	0.253319
1	2019	-2.52596	1.377064	0.34538	-3.25143	49	0.372347
1	2020	0.735459	1.516949	0.31135	0.432517	50	0.540248
1	2021	4.615136	1.872524	0.318493	0.431253	51	0.34663
1	2022	8.426771	1.51715	0.317578	0.937081	52	0.257711
2	2011	23.63862	1.306909	0.388394	0.418934	42	0.184991
2	2012	10.37013	1.177962	0.398819	0.183586	43	0.311415
2	2013	8.025022	1.256178	0.413623	0.12721	44	0.351814
2	2014	11.33983	1.249146	0.393508	0.130499	45	0.389275
2	2015	2.342969	1.45124	0.353334	0.145944	46	0.371641
2	2016	-0.97094	1.413238	0.343029	-0.02046	47	0.445047
2	2017	-3.75254	1.317981	0.369246	-0.2861	48	0.33236
2	2018	-0.40788	1.59108	0.326625	0.36328	49	0.321926

2	2019	23.70388	1.087027	0.471843	0.103933	50	0.300153
2	2020	-14.4468	1.304374	0.440843	0.389895	51	0.497902
2	2021	28.51536	2.563721	0.379142	0.409317	52	0.291839
2	2022	-4.93739	2.162243	0.32995	0.203773	53	0.354203
3	2011	1.093478	5.141715	0.666236	0.952226	0	0.184991
3	2012	39.70835	3.15575	0.651807	0.935514	1	0.311415
3	2013	30.93903	2.449312	0.638937	0.893031	2	0.351814
3	2014	54.46988	4.18745	0.704078	0.921364	3	0.389275
3	2015	7.152481	1.85817	0.772331	0.817343	4	0.371641
3	2016	7.741949	2.407912	0.786262	0.258895	5	0.445047
3	2017	18.39044	2.34678	0.771067	0.695241	6	0.33236
3	2018	4.677083	0.258859	0.768889	0.735003	7	0.321926
3	2019	20.82577	1.510139	0.765442	1	8	0.300153
3	2020	9.356893	0.894296	0.87539	0.945983	9	0.497902
3	2021	12.02144	0.699132	0.875619	0.687174	10	0.291839
3	2022	3.25525	1.688089	0.868442	1	11	0.354203
4	2011	49.00217	0.32738	0.222914	0.99959	44	0.323111
4	2012	-5.9657	0.906404	0.131959	0.99946	45	0.264412
4	2013	63.91807	5.189962	0.280505	0.999211	46	0.402481
4	2014	56.0907	0.568164	0.315043	0.999483	47	0.379793
4	2015	144.0479	1.377047	0.466236	0.999943	48	0.267015
4	2016	8.060414	3.480688	0.445787	0.99991	49	0.289718
4	2017	13.23716	2.148026	0.440246	0.99987	50	0.260924

4	2018	6.8762	2.641787	0.478365	0.999829	51	0.332736
4	2019	7.728381	0.267366	0.49318	0.99983	52	0.260466
4	2020	0.098219	2.27342	0.483401	0.999817	53	0.347787
4	2021	7.430134	1.365127	0.570065	0.999451	54	0.289334
4	2022	8.590832	1.171937	0.285138	0.994375	55	0.433283
5	2011	29.38895	0.893357	0.459123	-0.30447	57	0.240724
5	2012	9.800799	0.803147	0.840323	-0.1337	58	0.205481
5	2013	7.276334	0.698809	0.855964	-0.53697	59	0.249283
5	2014	7.360281	0.721292	0.855234	0.252744	60	0.25856
5	2015	6.480194	1.022478	0.800519	0.32732	61	0.202335
5	2016	-7.75858	0.770709	0.824001	-0.01809	62	0.237663
5	2017	7.968274	1.006864	0.820176	0.302381	63	0.179824
5	2018	6.870808	0.834865	0.836455	-2.25254	64	0.211119
5	2019	22.20282	0.879469	0.814453	-0.06684	65	0.219538
5	2020	1.8294	0.836487	0.842166	0.244119	66	0.306293
5	2021	12.92445	0.858704	0.851649	0.979542	67	0.190387
5	2022	10.29761	0.846372	0.760802	0.124053	68	0.320846
6	2011	6.924766	1.735786	0.568811	0.772053	5	0.317321
6	2012	1.336443	1.485776	0.569833	0.555583	6	0.284472
6	2013	15.64769	1.421849	0.607105	0.749627	7	0.405719
6	2014	32.61312	1.096618	0.693413	0.902779	8	0.436022
6	2015	36.89546	0.950578	0.586611	0.995989	9	0.373589
6	2016	7.219666	1.204857	0.52963	0.043913	10	0.385992

6	2017	2.708721	1.475095	0.51441	1	11	0.350897
6	2018	0.571708	1.504447	0.498874	0.637051	12	0.303068
6	2019	5.817601	1.31377	0.514316	0.898797	13	0.297553
6	2020	2.86598	1.995659	0.488243	0.897449	14	0.397097
6	2021	3.083168	2.148458	0.505887	-0.67657	15	0.378608
6	2022	17.94963	1.786998	0.452096	0.963301	16	0.194325
7	2011	51.06131	1.249557	0.619003	0.758125	39	0.24462
7	2012	10.69597	0.897278	1.137347	0.88991	40	0.176868
7	2013	32.07719	0.922605	0.6416	0.860761	41	0.215223
7	2014	24.24483	1.032021	0.668863	0.972132	42	0.234359
7	2015	25.16195	1.64343	0.697043	0.834521	43	0.251214
7	2016	8.003477	0.98496	0.779474	0.866034	44	0.287196
7	2017	14.82514	0.867497	0.795226	0.924495	45	0.29004
7	2018	-1.4629	0.514035	0.809278	0.741284	46	0.326877
7	2019	-2.56947	0.383893	0.828567	0.941474	47	0.362369
7	2020	-0.83461	0.362857	0.831226	0.994942	48	0.419379
7	2021	2.140629	0.427467	0.827909	0.993514	49	0.364339
7	2022	-0.75891	0.495214	0.817477	0.987641	50	0.346332
8	2011	10.54644	2.313446	0.305559	0.357789	38	0.228009
8	2012	21.10976	2.253303	0.678836	0.459277	39	0.210063
8	2013	7.181524	2.520312	0.279688	0.371672	40	0.257394
8	2014	4.369899	2.365071	0.265918	0.2177	41	0.195588
8	2015	6.299239	2.09543	0.294801	0.089614	42	0.318068

8	2016	-4.11603	2.072714	0.28513	-0.15342	43	0.310623
8	2017	-7.01325	2.017551	0.278615	-0.39574	44	0.308543
8	2018	-1.08036	1.953562	0.296517	0.107883	45	0.291352
8	2019	8.02554	1.93413	0.355403	-0.34002	46	0.372518
8	2020	-2.28244	2.040233	0.328883	1	47	0.48876
8	2021	7.045328	1.979419	0.36063	1	48	0.525813
8	2022	-0.0324	2.062748	0.345822	0.39354	49	0.417737
9	2011	9.348667	0.636071	0.406621	0.39205	3	0.273027
9	2012	7.065945	0.563437	0.40868	0.347876	4	0.255084
9	2013	5.706726	0.692957	0.377095	0.498284	5	0.247602
9	2014	4.458296	0.740187	0.322174	0.46128	6	0.19402
9	2015	16.6096	0.624456	0.335639	0.409163	7	0.251845
9	2016	1.41749	0.705418	0.266634	0.327061	8	0.211559
9	2017	19.81527	0.464223	0.284167	-0.19094	9	0.247619
9	2018	-12.2092	0.630948	0.259945	0.297093	10	0.261387
9	2019	14.95291	1.079984	0.240346	0.294762	11	0.207815
9	2020	10.77999	0.864099	0.328971	-0.00298	12	0.277305
9	2021	8.162461	0.74099	0.403218	0.03195	13	0.211349
9	2022	50.37057	0.664795	0.325075	-0.02023	14	0.295397
10	2011	5.999265	2.048291	0.487051	0.776057	5	0.39432
10	2012	1.849519	2.28237	0.43337	0.689519	6	0.336249
10	2013	49.75972	2.463577	0.36278	0.783744	7	0.333808
10	2014	2.582607	2.460166	0.356928	0.732726	8	0.309334

10	2015	-6.13986	2.755744	0.398895	0.490934	9	0.457485
10	2016	8.163939	2.377901	0.34685	0.511474	10	0.483328
10	2017	2.020658	2.281606	0.34841	0.538704	11	0.471717
10	2018	4.842578	2.069875	0.41149	0.424901	12	0.497926
10	2019	-11.2444	1.999905	0.43822	-2.72566	13	0.789881
10	2020	-31.721	2.325657	0.397439	-8.59224	14	0.779648
10	2021	8.040602	2.074198	0.449389	0.050899	15	0.419654
10	2022	-13.0247	2.482732	0.370204	-6.89536	16	0.444369
11	2011	8.703123	1.075313	0.390262	0.878547	22	0.212793
11	2012	19.73757	1.107134	0.851589	0.852574	23	0.179165
11	2013	15.09746	1.122769	0.76191	0.838079	24	0.20188
11	2014	23.43301	1.127964	0.753342	0.849763	25	0.200925
11	2015	20.00859	1.13418	0.722266	0.856049	26	0.20532
11	2016	2.723729	1.17197	0.757213	0.8277	27	0.289877
11	2017	9.956292	1.200206	0.604513	0.811785	28	0.260369
11	2018	6.864426	1.167917	0.631451	0.823502	29	0.200718
11	2019	10.56564	1.168764	0.601677	0.824076	30	0.258372
11	2020	17.49826	1.168749	0.591991	0.766466	31	0.260165
11	2021	7.959266	1.16529	0.633043	0.826948	32	0.206746
11	2022	4.721102	1.18468	0.520126	0.759572	33	0.21038
12	2011	28.90531	1.196153	0.877058	0.915063	39	0.217912
12	2012	25.70067	1.194515	0.862493	0.916698	40	0.355441
12	2013	22.92826	1.436943	0.701623	0.921098	41	0.239099

12	2014	27.03517	1.223886	0.847482	0.911088	42	0.276043
12	2015	28.39621	1.273533	0.858968	0.906021	43	0.187795
12	2016	20.77839	1.131873	0.860151	0.921503	44	0.304097
12	2017	10.74821	1.192027	0.852411	0.896921	45	0.261511
12	2018	3.96801	1.185475	0.84396	0.881889	46	0.26626
12	2019	2.253227	1.194153	0.832961	0.888021	47	0.257072
12	2020	10.052	1.216407	0.839281	0.827289	48	0.364382
12	2021	7.478739	1.214465	0.836808	1	49	0.293535
12	2022	15.35333	1.19744	0.85263	0.790182	50	0.275098
13	2011	37.25126	1.140603	0.825339	0.631432	5	0.242043
13	2012	23.88051	1.319758	0.823514	0.624696	6	0.219028
13	2013	14.21187	1.312371	0.814369	0.581399	7	0.269863
13	2014	24.06771	1.304835	0.814912	0.687539	8	0.276423
13	2015	24.23006	1.285618	0.831482	0.363237	9	0.324065
13	2016	10.66458	1.29322	0.82695	0.56594	10	0.281815
13	2017	10.71366	1.161479	0.822406	0.07091	11	0.287623
13	2018	9.32741	1.141932	0.834392	0.284441	12	0.245824
13	2019	17.49229	1.155955	0.83408	0.384571	13	0.26208
13	2020	50.67836	1.113776	0.86342	1	14	0.3507
13	2021	28.55118	1.117889	0.864979	1	15	0.21518
13	2022	10.88938	1.099759	0.874078	0.467923	16	0.236956
14	2011	31.57271	1.152144	0.865852	0.516657	22	0.247382
14	2012	11.08598	1.176902	0.853951	0.57714	23	0.20632

14	2013	6.389117	1.175852	0.837905	0.561045	24	0.239064
14	2014	25.45384	1.183143	0.845752	0.621576	25	0.208984
14	2015	13.81818	0.966517	0.854409	0.588968	26	0.243001
14	2016	6.655839	1.210045	0.83777	0.694599	27	0.284605
14	2017	8.640034	1.230799	0.836136	0.433873	28	0.271546
14	2018	10.46032	1.19544	0.84088	0.617372	29	0.2014
14	2019	25.79535	1.148982	0.855614	0.495534	30	0.232643
14	2020	9.931091	1.192719	0.855819	0.612213	31	0.313182
14	2021	15.3736	1.162016	0.847757	0.378466	32	0.181855
14	2022	36.35765	1.15034	0.867263	0.80046	33	0.209796
15	2011	24.37964	0.930828	0.859651	0.582936	0	0.31345
15	2012	33.92569	0.509807	0.865842	0.815831	0	0.274532
15	2013	-2.43533	1.008658	0.83231	0.834716	0	0.292004
15	2014	24.97434	1.371097	0.840726	0.802581	1	0.273928
15	2015	-6.59727	1.033725	0.837302	0.769772	2	0.292001
15	2016	27.73878	0.992729	0.812359	0.811583	3	0.363762
15	2017	14.04389	0.947535	0.69458	0.314484	4	0.308531
15	2018	20.16208	1.1979	0.823672	0.782324	5	0.345119
15	2019	9.277844	1.18584	0.806965	0.976108	6	0.427541
15	2020	13.57767	1.193478	0.809932	0.754014	7	0.349917
15	2021	15.93994	1.184446	0.821649	0.740087	8	0.327939
15	2022	5.20925	1.173842	0.813077	0.752983	9	0.185621
16	2011	7.203597	1.174862	0.871286	-0.67867	3	0.387481

16	2012	-4.63396	1.123087	0.809786	0.951952	4	0.313624
16	2013	26.04503	1.201251	0.820367	0.953997	5	0.387544
16	2014	0.269893	1.216009	0.796158	0.820016	6	0.29393
16	2015	15.16745	1.194393	0.815954	0.382276	7	0.337643
16	2016	2.989089	1.184814	0.813022	0.385071	8	0.385838
16	2017	15.8634	1.155762	0.827306	0.600671	9	0.289867
16	2018	12.95106	1.146948	0.876881	0.552481	10	0.246739
16	2019	8.069527	1.125923	0.838502	0.699166	11	0.328256
16	2020	8.223447	1.125788	0.842571	0.540389	12	0.510428
16	2021	0.084907	1.142122	0.828347	0.684745	13	0.406905
16	2022	21.57618	1.127965	0.844439	0.665663	14	0.371014
17	2011	14.92185	0.790877	0.87385	-0.15096	23	0.213595
17	2012	19.08368	0.909556	0.842578	0.609188	24	0.218665
17	2013	12.81703	1.253483	0.835718	0.527441	25	0.207998
17	2014	0.954958	1.12969	0.817263	0.634081	26	0.197853
17	2015	5.154983	1.150143	0.823684	0.361847	27	0.285169
17	2016	7.059398	1.178723	0.821928	0.490677	28	0.293459
17	2017	14.06985	1.13596	0.84018	0.364279	29	0.256903
17	2018	-0.11215	1.076743	0.836583	0.434102	30	0.203301
17	2019	5.863268	1.078539	0.841923	0.659588	31	0.236515
17	2020	7.766981	1.176922	0.843706	0.294415	32	0.291037
17	2021	2.846067	0.931713	0.841092	0.360649	33	0.127841
17	2022	13.85248	0.884002	0.85276	0.422764	34	0.224915

18	2011	10.76225	2.905402	0.396407	0.819423	5	0.316693
18	2012	24.56749	2.720044	0.385691	0.936299	6	0.374971
18	2013	18.64233	2.83403	0.364963	0.920387	7	0.308327
18	2014	14.00178	2.972584	0.378652	0.877124	8	0.300492
18	2015	11.74816	2.329702	0.389977	0.787984	9	0.243007
18	2016	7.065046	2.921902	0.373068	0.813678	10	0.203813
18	2017	11.01035	3.047115	0.363366	0.853479	11	0.331585
18	2018	3.814335	3.05951	0.360429	0.648854	12	0.215882
18	2019	13.52565	2.956469	0.365591	0.916832	13	0.459084
18	2020	5.705805	3.115346	0.353878	0.8903	14	0.479074
18	2021	4.860318	3.168104	0.336495	0.814532	15	0.268296
18	2022	25.61971	2.34805	0.418594	0.918433	16	0.275629
19	2011	-3.12386	2.64E-06	0.825042	-0.42901	25	0.301716
19	2012	10.65444	1.221466	0.839924	0.229815	26	0.216389
19	2013	11.85662	1.148896	0.843416	0.363044	27	0.188088
19	2014	9.24112	1.185954	0.830923	0.681557	28	0.146072
19	2015	6.656365	1.163546	0.835119	0.167135	29	0.180101
19	2016	7.821834	1.170138	0.836792	0.299497	30	0.276898
19	2017	4.564181	1.17448	0.837619	0.222365	31	0.279259
19	2018	19.78886	1.137905	0.864112	0.269732	32	0.220942
19	2019	15.24409	1.116837	0.879465	0.51786	33	0.221311
19	2020	1.210176	1.119966	0.877438	0.200393	34	0.267003
19	2021	12.98779	1.132163	0.868334	1	35	0.182883

19	2022	11.31549	1.131741	0.866705	0.527649	36	0.23766

Sources of Basic Data: World Bank (2023), Wall Street Journal (2023), Africa Financials (2023).

APPENDIX D: National Commission for Science, Technology and Innovation (NACOSTI) Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **740739**

Date of Issue: **01/April/2025**

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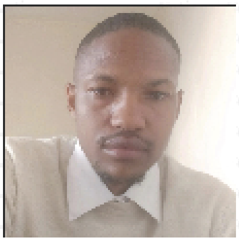

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