

**THE EFFECT OF AUTOMATION ON STOCK MARKET TRADE  
VOLUME AT THE NAIROBI SECURITIES EXCHANGE.**



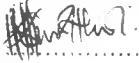
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**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT  
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## DECLARATION

This research project is my original work and it has not been presented for any academic award in any university or institution of higher learning.

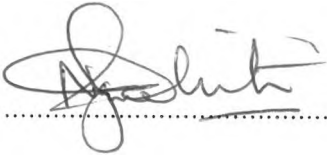
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## DEDICATION

To my family who have been infinitely supportive

## ABSTRACT

This study investigated the effect of automation on stock market trade volume at the Nairobi Security Exchange (NSE). Two study periods were considered, pre-automation (January 2002 to June 2006) and post-automation periods (July 2008 to December 2012). This study provides empirical analysis of stock volume before and after automation at NSE. The study was a quantitative case study and considered data on monthly accumulated stock volume on 31 NSE listed companies from January 2002 to December 2012. Secondary data was used in this analysis. Descriptive statistics was used for analysis together with a t-test was used to test the significance. The results indicate that the introduction of the ATS had no statistically significant effect on stock volume at the NSE. However, few companies showed that there was an effect on the companies' stock volumes traded after automation, which may have been caused by other factors which were not considered in this research, including either organizational, macro or micro economic and therefore unrelated to the system introduced. The study is important as it appreciates and underscores the effect of continued change in technology is having on the mobilization of resources in stock and securities exchanges in Kenya and around the world.

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## ABBREVIATIONS

NSE	-	Nairobi Securities Exchange
ATS	-	Automated Trading System
ETF	-	Exchange-Traded Funds
CMA	-	Capital Markets Authority
HFT	-	High-Frequency Trading
CDS	-	Central Depository System
CDSC	-	Depository and Settlement Corporation
RWH	-	Random Walk Hypothesis
NYSE	-	New York Securities Exchange
ICT	-	Information Communication Technology
SEM	-	Stock Exchange of Mauritius
WAN	-	Wide Area Network



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# CHAPTER ONE: INTRODUCTION

## 1.1 Background to the Study

Automated stock trading is a burgeoning research area with important practical applications. The advent of the Internet has radically transformed the nature of stock trading in most stock exchanges. Traders can now readily purchase and sell stock from a remote site using Internet-based order submission protocols. Additionally, traders can monitor the contents of buy and sell order books in real time using a Web-based interface. The electronic nature of the transactions and the availability of up-to-date order-book data make autonomous stock-trading applications a promising alternative to immediate human involvement.

The issue of market-trading systems has gained increasing attention in recent years, especially for emerging markets where a need exists to build a financial infrastructure. Advances in technology have led to the development of highly sophisticated computerized trading systems, which can both improve liquidity and reduce trading costs. These technological advances, such as electronic trading, have trickled down from exchanges in developed countries to stock exchanges in emerging markets, where major efforts to improve microstructure and liquidity have been undertaken. Some of these markets—Singapore in 1989 (Amihud et al., 1997), Israel in 1991 (Naidu and Rozeff, 1994) and Morocco in 1998 (Derrabi, 1998)—implemented electronic trading systems.

Automation of the trading system usually either precedes or is preceded by the adoption of a Central Depository System (CDS) (Yartey and Adjasi, 2007). Capital markets automation

does not only benefit one of the players of the financial trading game, but also all the players in the sector gain from such technological breakthrough. After the automation, investors were not entitled to go and deal directly with stock exchanges; they did not have to go to a stock broker's office or deal with the hassles of calling him/her on the phone. Initially, investors had to compete for the broker's time through regular and continuous access. The application of information technology allowed the investor to reach the information he/she requires any time anywhere.

The volume traded in a stock exchange is as a result of its performance in the economy and is of interest to various parties including investors, capital markets, the stock exchange and government among others. There is evidence that stock markets promote economic growth in Africa (Yartey and Adjasi, 2007). They find that stock markets contribute to financing corporate investments and growth of listed firms in Africa i.e. stock markets impact aggregate economic performance through corporate financing. The implementation of the Automated Trading System (ATS) was a key to achieving enhanced operational efficiency, transparency, reduced cost of doing business, and enhanced market integrity and investor confidence (Capital Markets Authority, 2007). The automation of the Nairobi Securities Exchange was premised on the belief that it would as one of its objectives to improve the efficiency (both operational and informational) of the market. Thus after years of implementation of the automation of the exchange, the question that beckons is whether the automation of the exchange has improved the efficiency of the Nairobi Securities exchange. The purpose of this study is thus, to examine the effects of automation on stock trade volume at Nairobi Securities Exchange taking into consideration the role of automation of the exchange.

Using data from the Nairobi Securities exchange (NSE), this paper examines the effects automation on the market trade volume. In 2006, the Nairobi Securities exchange became an automated exchange.

### **1.1.1 Market Trade Volume**

Volume is a measure of the quantity of shares that change owners for a given security. According to Oranika (2010), trading volume refers to the quantity of stocks of a given institution traded at specified period of time. Trading volume indicates the trading actions of public buyers and sellers hence it provides information about the activities of the stock traders (Harris, 2003).

The amount of daily volume on a security can fluctuate on any given day depending on the amount of new information available about the company, whether options contracts are set to expire soon, whether the trading day is a full or half day, and many other possible factors. Of the many different elements affecting trading volume, the one which correlates the most to the fundamental valuation of the security is the new information provided. This information can be a press release or a regular earnings announcement provided by the company, or it can be a third party communication, such as a court ruling or a release by a regulatory agency pertaining to the company.

Any empirical analysis of trading activity in the market must start with a proper measure of volume. The literature on trading activity in financial markets is extensive and a number of measures of volume have been proposed and studied. Some studies of aggregate trading

activity use the total number of shares traded as a measure of volume (Epps and Epps (1976), Gallant, Rossi, and Tauchen (1992), Hiemstra and Jones (1994), and Ying (1966)).

Other studies use aggregate turnover the total number of shares traded divided by the total number of shares outstanding as a measure of volume (Campbell, Grossman, Wang (1993), LeBaron (1992), Smidt (1990), and the 1996 NYSE Fact Book). Individual share volume is often used in the analysis of price/volume and volatility/volume relations (Andersen (1996), Epps and Epps (1976), and Lamoureux and Lastrapes (1990, 1994)). Studies focusing on the impact of information events on trading activity use individual turnover as a measure of volume (Bamber (1986, 1987), Lakonishok and Smidt (1986), Morse (1980), Richardson, Sefcik, Thompson (1986), Stickel and Verrecchia (1994)). Alternatively, Tkac (1996) considers individual dollar volume normalized by aggregate market dollar-volume. And even the total number of trades (Conrad, Hameed, and Niden (1994)) and the number of trading days per year (James and Edmister (1983)) have been used as measures of trading activity.

### **1.1.2 Automated Trading System**

Automated trading, for the purposes of this paper, refers to a subset of electronic trading that relies on computer algorithms for decision-making and execution of order submissions. Automated trading represents a diverse set of strategies, differing both in complexity and the degree of reliance on speed, but tends to thrive in electronic markets with a central limit order book, robust IT infrastructure, and real-time data feeds. While execution algorithms—or those designed to carry out a given transaction—are typically considered to be low frequency, market-making algorithms are typically considered higher frequency. Indeed, high-frequency trading (HFT) is a subset of automated trading in which the trading opportunities are identified and acted upon algorithmically and often executed via low-latency technology and

with high message rates (orders, modifications, and cancellations). Such HFT strategies generally rely on high-speed communications and robust trading systems, with the submission of orders often accomplished through dedicated high-speed computers

Security markets/exchanges in the world individually and collectively play a critical role in the most national economies. The main aim of a security exchange/market is to provide facilities for trade of company stocks and other financial instruments. Security exchanges have always been found in central locations for ease record of transactions. Nowadays, modern exchange stock markets are electronic networks with the evolution of information and communication technology infrastructures, which gives them speedy and less costly transactions (Helen, Hawkins and Sato, 1997).

The role played by stock exchanges has remarkably transformed over the last couple of decades due to the increasing and effective role information and communication technology platforms play. Emerging markets improved their microstructures by adopting electronic trading in order to take advantage of existing technology such as Tunisia in 1996 and Jordan in 2000 (Sioud and Hamied, 2003). Introduction of fully automated electronic trading systems, is one of the of six capital market-specific and related reforms among them stock market liberalization, enforcement of insider trading laws, privatization programs, structural pension reform, and institutional reform (de la Torre, Gozzi, and Schmukler, 2006). Security exchange automation started in the early 1970s and the transaction of securities became electronically traded through the support of information and communication technology (Jain, 2005).

Automation of the trading system usually either precedes or is preceded by the adoption of a Central Depository System (CDS) (Yartey and Adjasi, 2007). Capital markets automation does not only benefit one of the players of the financial trading game, but also all the players in the sector gain from such technological breakthrough. After the automation, investors were not entitled to go and deal directly with stock exchanges; they did not have to go to a stock broker's office or deal with the hassles of calling him/her on the phone.

Initially, investors had to compete for the broker's time through regular and continuous access. The application of information technology allowed the investor to reach the information he/she requires any time anywhere. NSE automation was preceded by the establishment of the Central Depository and Settlement Corporation (CDSC) in 2002 after a Shareholder Agreement was reached and subsequent installation of the central depository system (CDS) in 2004. The automation of the NSE was three fold i.e. installation of the CDS in 2004, the Automated Trading System (ATS) in 2006.

### **1.1.3 Automation and Stock Volume**

Advocates of automation suggested that execution of trades was faster and less costly under computerized trading systems. Traders have access to broader information including bid and ask prices, trades sizes and volume, at lower costs, due to the existence of a limit order book than under systems that restrict access to information about standing orders above and below the market. That would attract more investors and improve volume and liquidity and generate better price discovery. However, critics of automation argue that electronic trading could lead to less efficient prices since judgmental aspects of trade execution are lost with automation, which could be particularly important in times of fast market movements. Volatility is likely

to increase when automation speeds up the dissemination of prices especially when information is hitting the market.

## **1.2 The Research Problem**

Stock market volume could be influenced by several economy-wide factors which may have a positive impact, negative or no effect on its performance. African stock markets low turnover performance and specifically Kenya has been partly attributable to the existence of manual systems. Automation has been touted as one of the policies on how to promote the development of African stock markets. Automation is expected to reduce the costs and inefficiencies associated with manual systems increases trading activity, improving market transparency, liquidity and turnover in the stock markets by speeding up operations

The study assumes that the stock exchanges in Africa face the same challenges. Policy options have been discussed for promoting the development of the stock markets in Africa. To address the challenges of stock exchanges in Africa, they recommended robust electronic trading systems and central depository systems as being very crucial. The performance Stock markets are influenced by a number of factors notably the activities of governments and the general performance of the economy. Evidence shows that there is a direct correlation between the level of development of a nation's capital market and her overall social and economic development. There is therefore, the need for a fast growing capital market, through technological innovation so as to facilitate the speedy growth and development of an economy. However after implementing some of the recommendations, a study should be undertaken to articulate whether the desired results has been achieved or there was no effect as a result of the new technology. As there is yet to be a study to add to the body of



knowledge this study seeks to bring into the light some of the effects that the market has experienced and especially on stock volume.

The introduction of the Central Depository System (CDS) in 2004, the Automated Trading System (ATS) in 2006 and the implementation of Wide Area Network (WAN) in 2007, was the onset for Automation to revolutionize security trading in Kenya. As a result of the automation, the NSE experienced an increase in liquidity while the number of days for settlement and cases of fraud reduced in stock trading as fixed-income traders and investors flocked to the Automated Trading System (ATS). Kariuki (2012) observes that the automation of stock market has enabled investors to see a positive real return on their investments. Cases of fraud have also reduced thereby leading to an increase in investors' confidence.

Automation of the trading system usually either precedes or is preceded by the adoption of a Central Depository System (CDS) (Yartey and Adjasi, 2007). Capital markets automation does not only benefit one of the players of the financial trading game, but also all the players in the sector gain from such technological breakthrough. According to Debysingh and Watson (2009), the aim of automating stock trading is to improve both operational and informational efficiency of an exchange. Automated markets provide more efficient discovery of prices because of the lower trading cost, faster execution of trade and better capture of information thereby enhancing efficiency. Brailsford et al (2000) emphasize that automated stock trading system offers greater transparency and dissemination in regard to the quotes and prices of securities. Automated stock trading system exhibit higher feedback on stock trading and provide greater lead time over returns on the securities traded.

Studies have also been carried on the impact of automated systems on efficiency and effectiveness of firms listed. Nonetheless, it is not clear as to whether the automation has an effect on trading volume and market size. For instance, Kariuki (2012) carried out a study on the impact of automated trading systems (ATS) on Share trading in the Nairobi Stock Exchange while Mailafia (2011) did a study to determine the effect of automation of the trading system in the Nigerian Stock Exchange both emphasising more on the efficiency of the market. While these studies shade some light on the impact of automated system, they do not specifically deal with the effect of automated trade system on the stock market trade volume, rather they give a lot of emphasis on market efficiency, prices and cost of trading. The effect of automation on stock market trade volume is an essential area that requires more attention from researchers since this is expected to spur the stock trading activities. As a result, this study seeks to establish whether the automation of stock market had an effect on the stock market performance in regard to trading volumes and market size.

Gworo (2012) examined the price-volume movements in the NSE for the 14 companies continuously forming the NSE 20-share index between the periods January 2007 to December 2011. The study used Karl Pearson's correlation coefficient model for the purpose of analysis to determine whether there exists a relationship between the variables and concluded that major variations of price were explained by other variables other than changes in traded volumes, implying a weak correlation between trading volume and share price volatility. Achieng (2013) carried out a similar study for all the 58 firms listed at the NSE by December 31, 2012 covering the period January 2008 to December 2012, using a regression model proposed by Lee and Rui (2002). The results indicated that major variations of stock prices and trading volume were explained by other factors as opposed to the relationship

between the two variables. Kamuti (2013) examined the relationship for companies quoted under NSE- 20 share index for the period from January 2008 to June 2012. The study found that there was a significant positive relationship between price and volume in the NSE, indicating that rising market goes with rising volume.

While a fair amount of empirical evidence on the volatility and volume relationship exists for developed countries, very few empirical studies have been reported from emerging markets and specifically from NSE. In contrast, some authors find that automated trading can have a negative effect on liquidity when transactions are based on human interactions. Biais et al. (1997) suggest that automation decreases liquidity because for important transactions traders cannot negotiate directly and so have no control on trading conditions. Given the mixed empirical results between price, returns and trading volume especially in emerging markets context, more empirical research from other emerging financial markets is needed to better understand the volume – volatility relationship.

This study aimed at examining the effect of automation on stock market trade volume in Nairobi securities exchange. Therefore, the research question in this study was: what was the effect of automation on stock market trade volume?

### **1.3 Research Objectives**

To determine the effect of automation on the stock market trade volume at the Nairobi Securities Exchange.

#### 1.4 Significance of the Study

The study is significant as all over the world investments in securities are making an unprecedented growth. With the advent of computerisation complimented by the advent of the internet and online trading becoming a reality, it has become relevant to study the extent of impact created by the process of automation in the stock exchanges and to articulate whether automation had any effect on the volume of stocks traded.

The study aims to highlight the effect of automation on the stock market trade volume at the Nairobi Securities Exchange (NSE). This study is useful to the investment community, system developers, organisations that are already trading and those intending to raise their capital through NSE, share brokers and investment analysts in planning, analyzing and making capital and other related decisions.

The study would also leave further inroads for future researchers in other disciplines of finance, economics and management regarding the progressive growth of Stock Market in Kenya.



## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter reviews literature on the Effect of Automation on stock Market volume. It highlights the trends in this study relating to the research topic. It includes research areas, methodology, theoretical approaches and findings. It shows sources of where the information is coming from such as countries or other areas. The review also outlines some of the gaps identified, it deals with the historic and current state of research in the field.

### **2.2 Theoretical Review**

Although people often talk as if theory and practice are different things, as in “that is only theoretical,” nothing is more practical than a good theory. Theory helps make sense of complex situations by directing attention to key issues and by guiding methods of analysis. Kummerow (2000).

In the study, there are several theories that attempt to explain stock volume movement and some of the factor that influence stock volumes. These theories includes efficient market hypothesis, Random walk hypothesis and Theory of stock market co-movement.

#### **2.2.1 Efficient Market Hypothesis**

According to Edwards at el (2000), the efficient market hypothesis states that asset prices in financial markets should reflect all available information. Consequently, prices should always

be consistent with the existing conditions and information in the market. Efficient Stock Markets provide the opportunities for mobilizing savings and investment. They provide opportunities to investors to diversify their portfolios across a variety of assets. In general, ideal market is the one in which prices provide accurate signals for resource allocation so that firms can make productive investment decision and investors can choose among the securities under the assumption that securities prices at any time fully reflect all available information.

The Efficient market Hypothesis identifies three forms of efficiency; weak-form efficiency, semi-strong efficiency and strong-form efficiency. The works of Fama (1970), Samuel and Wilkes (1980), Weston and Copeland (1988), Osaze (2003), Horne (1997) and Scott-Quinn and Deyber (2009) all affirm this position. One medium through which information could be effectively disseminated is the use of computer. Modern technological innovations coupled with globalization have altered the modus operandi of global stock markets. Alile and Anao (1986) argue that a Stock Exchange market flourishes in an environment where the telephone, fax and telex work efficiently. Therefore, a stock exchange will attain a desirable level of efficiency if it is highly automated.

In Scholes' (1972) study of the price effects of secondary offerings, he examines stock price movements when the seller may be in possession of non-public information. On average, share prices fall by an amount that reflects the value of this information. The impact of a secondary distribution on the stock price is largely unaffected by the volume of the transaction, which confirms the depth of the market and the substitutability of one security for another.

### 2.2.2 Random Walk Hypothesis (RWH)

To begin with, we need to know how the market sets the stock prices. Stock prices are driven by the demand and supply factors initiated by a large amount of willing buyers and willing sellers. The buying and selling of a particular stock or through the price discovery mechanism, will eventually settle on a price equilibrium. This in turn may have an effect on the stock volume in a securities market.

The RWH finds its origin in the early works of Bachelier (1900). Extended and translated into English by Cootner (1964) this theory submits that stocks at the end of a certain time period largely show future prices. These seem to be generated by a random process and show independent (Gaussian or normal standard) distributions. Other chartist theories however share the common assumption that history repeats itself and therefore historical stock price behaviours can be used to predict a share's price (Fama 1965). Bachelier (1900) and later Osborne (1959) inductively transferred botanic observations like the Brownian motion to build a mathematical model to explain price fluctuations on the stock market. Even though both tried to justify this theory empirically, they felt short as they only used cross-sectional data. Moore (1962), analysing only eight shares from the U.S. Stock market (NYSE), and Kendall (1953), examining 19 British industrial indices, deductively proved that successive stock prices cannot be predicted by adjusting historical prices. They observed an approximately normal distribution; however they acknowledged that most of the distributions were leptokurtic which weakens their findings.

To provide more reliable facts, Fama (1965) analysed the whole Dow-Jones Industrial Average index (30 stocks). He was also able to explain the "fat tails" within his sample by

using the findings of Mandelbrot (1963), who states that distributions show a stable Paretian (Levy 1925) shape with characteristic exponents smaller than 2.

### **2.2.3 Theory of Stock Market Co-Movements**

Until 1987 the stock market co-movements were not in the center of interest of academicians, researchers, and financial analysts. If they were studied, it was for the purpose of portfolio diversification. Nevertheless, what happened in 1987 could not be explained by contemporary knowledge and theories. The crash began on the 19th October 1987 in Hong Kong, spread throughout Europe and finally hit the United States. The stock markets around the world (e.g. Australia, New Zealand, Spain, United Kingdom, Germany, Japan and Canada) fell by tens of per cent by the end of October. More interestingly, the reasons for such enormous downturns were mysterious. Information technology or market psychology was to blame. Reasons why crash in one market can influence the whole world attracted attention of politicians as well as academicians and they started to investigate them.

The recent technological developments, the facilities of communication, the liberalization activities in terms of economies, the augmentation of international trade, the committed free trade agreements and trading blocks, concisely the fact of globalization, have made economies more integrated among countries. Certainly, some advantages and disadvantages occur with financial integration. For instance, emerging economies have become more attractive places for portfolio investors and portfolio capital. This has impacted on the stock markets being influenced by other stock markets movement and so the trade volumes.

The innovations in ICT enabled or at least enhanced the growing importance of the other causes. Beginning of substantial innovations can be dated back to 1980s and the trend



continues till today. Access to enormous amount of information with speed of light accelerates all processes in business and finance.

The trade linkages increase interdependence of individual firms or sectors.

Another possible cause of stock market co-movements is herd behavior and general loss of confidence. Herd behavior arises from information asymmetry and need not be necessarily irrational. Small and middle investors face higher costs of getting relevant information in comparison to large banks and multinational investment companies (especially when investing in distant emerging markets). Therefore they rely on big players and try to emulate their actions. If a big player leaves some region or withdraw his funds from there, uninformed investors may follow him, thus causing co-movements.

Investors may also lose confidence in institutions (rating agencies, media, analysts, etc.), sell risky stocks and invest in the safest and most liquid assets (e.g. fixed income instruments). Stock markets then fall together. This actually happened in the recent global financial crisis.

The two groups of theoretical causes of stock market co-movements (fundamental and behavioral) have opposite implications for contagion. The fundamental causes explain interdependence of markets where co-movements occur. There is no reason for contagion during turbulent times; the slump in various markets is a logical result of interconnections. On the other hand, the behavioral causes reflect behavior of investors which is different in turbulent and tranquil times. Prevailing behavioral causes would justify contagion.

The trend of globalization would suggest that the correlations among international stock markets have grown over time. The question is, however, whether there are still some isolated markets and how the recent crisis has influenced them. For example Forbes & Chinn

(2004) studied world markets after the burst of the internet bubble in the first half of 2002 and reported that some markets are still relatively isolated (namely: South Africa, South Korea, and Iceland). Moreover, Brooks & Negro (2004) conclude that the reported increasing co-movements are temporary results of the IT bubble.

### **2.3 Empirical Review**

Advocates of automation suggested that execution of trades was faster and less costly under computerized trading systems. Traders have access to broader information including bid and ask prices, trades sizes and volume, at lower costs, due to the existence of a limit order book than under systems that restrict access to information about standing orders above and below the market. That would attract more investors and improve volume and liquidity and generate better price discovery. However, critics of automation argue that electronic trading could lead to less efficient prices since judgmental aspects of trade execution are lost with automation, which could be particularly important in times of fast market movements. Further, it can be argued that price efficiency remains unchanged after automation.

According to this viewpoint, liquidity and efficiency on a stock market depend on rules on handling and execution of trades. If these rules do not change, then liquidity and efficiency are not expected to change. Market efficiency is an important hallmark of a sophisticated market. A market microstructure (stock market automation) is premised on the belief that it would improve the efficiency (both operational and informational) of the market.

Freund and Pagano (2000) discuss the mechanics of automated trading systems and the benefits and disadvantages of implementing such systems and the effects of automation on

volume and price efficiency. They examine price efficiency before and after automation on the NYSE and the TSE. Although they find that automation is associated with an improvement in market efficiency on the TSE relative to the NYSE, they do not detect any changes in the nonrandom patterns in returns before and after automation, which leads them to conclude that automation has not changed price efficiency on the TSE. However they point out that their results should be interpreted with caution since they rely on a relatively short sample.

Naidu and Rozeff (1994) in their study they find out reduced autocorrelations of returns, which leads them to conclude that market efficiency improves after automation at the Singapore Stock Exchange. Anderson and Vahid (2001) investigate the impact of electronic trading on price efficiency on the London and Australian stock markets.

In recent comparable studies on African stock markets the low turnover performance in African stock markets and specifically Kenya has been partly attributable to the existence of manual systems. Automation has been touted as one of the policies on how to promote the development of African stock markets. Automation is expected to reduce the costs and inefficiencies associated with manual systems increases trading activity, improving market transparency and liquidity in the stock markets by speeding up operations (Capital Markets Authority, 2010). Benimadhu (2003) indicates that exchange specific issues affecting stock markets in Africa are low level of liquidity, few listed companies and the small size of the exchange as well as efficiency. The study assumed that the stock exchanges in Africa face the same challenges. Policy options for promoting the development of the stock markets in Africa have been discussed (Yartey and Adjasi, 2007). To address the challenges of stock exchanges in Africa, they recommended robust electronic trading systems and central

depository systems as being very crucial. The performance Stock markets are influenced by a number of factors notably the activities of governments and the general performance of the economy. There is a direct correlation between the level of development of a nation's capital market and her overall social and economic development (Okereke-Onyiuke, 2000).

The Stock Exchange of Mauritius (SEM) (2004) identified the operational advantages derivable from automation and the application of the automated trading system (ATS) as; electronic matching of orders, internet trading facilities, enhancing internationalization of the stock market' multiple prices for an order, quick order execution prices and volume levels available in real time. Automation also improved market data or information, online report of prices, higher volume of trade and index, online corporate reporting, transparency of dealings and fairness in establishing order priority. Conceptually, an automated stock market will ensure automatic monitor and a user friendly stock market. All this operational advantages of automation were to translate into improved market efficiency.

The performance of a stock market of an economy is of interest to various parties including investors, capital markets, the stock exchange and government among others. There is evidence that stock markets promote economic growth in Africa (Yartey and Adjasi, 2007). They find that stock markets contribute to financing corporate investments and growth of listed firms in Africa i.e. stock markets impact aggregate economic performance through corporate financing. The implementation of the Automated Trading System (ATS) was a key to achieving enhanced operational efficiency, transparency, reduced cost of doing business, and enhanced market integrity and investor confidence (Capital Markets Authority, 2007). The automation of the Nairobi Securities Exchange was premised on the belief that it would as one of its objectives to improve the efficiency (both operational and informational) of the

market. Thus after years of implementation of the automation of the exchange, the question that beckons is whether the automation of the exchange has improved the efficiency of the Nairobi Securities exchange. The purpose of this study is thus, to examine the efficiency of Nairobi Securities Exchange taking into consideration the role of automation of the exchange.

The discussion of the effect of automation on security markets efficiency is very scanty in the literature, particularly in sub-Saharan Africa. Evidence emanating from this study is hoped to advance knowledge in the literature on the effect of automation on security markets efficiency.

### **2.3.1 Automation Trends in Africa**

Automation of stock exchanges is on the increase in Africa. Since the automation of the Johannesburg stock exchange in mid 1990s and movement of the Egyptian Stock Exchange to an automated order-driven system in 1992 there have been continued efforts towards automation. The Stock exchanges in Sub-Saharan African stock exchanges have gradually adapted to electronic systems, but many of them still use manual trading systems as well as manual clearing and settlement systems. The most recent stock exchange to automate its trading system is the Botswana Stock Exchange in August 2012 with Uganda, Rwanda and Zimbabwe being in advanced stages of implementing the same

### **2.4 Automation and Stock Market**

According to Debysingh and Watson (2009), the aim of automating stock trading is to improve both operational and informational efficiency of an exchange. Automated markets provide more efficient discovery of prices because of the lower trading cost, faster execution of trade and better capture of information thereby enhancing efficiency. Brailsford et al. (2000) emphasize that automated stock trading system offers greater transparency and dissemination in regard to the quotes and prices of securities. Automated stock trading system exhibit higher feedback on stock trading and provide greater lead time over returns on the securities traded.

Since the main objective of automation is to create a well-functioning stock market, automation can have positive effects on market microstructure-related characteristics of volume and volatility. Pirrong (1996) showed that automated exchanges can be deeper and more liquid than open floor exchanges. Naidu and Rozeff (1994) noted an increase in liquidity and an improvement in efficiency, but volatility increased following the automation of the Singapore stock exchange. Derrabi (1998) studied the effect of automation on the Moroccan exchange, which uses both call and continuous markets. A permanent stock-price increase was observed for securities transferred, but volatility and efficiency improved only for securities transferred to the call-based trading system. In contrast, some authors find that automated trading can have a negative effect on liquidity when transactions are based on human interactions. Biais et al. (1997) suggest that automation decreases liquidity because for important transactions traders cannot negotiate directly and so have no control on trading conditions.

Some authors affirm that automated trading can have a negative effect on stock volume when transactions are often the result of human interactions. Biais et al. (1997) suggest that

automation can lead stock volume to decrease because it doesn't allow a direct negotiation between traders for important transactions and doesn't allow them therefore to preserve a certain control on trading conditions.

In contrast, Pirrong (1996) has shown that automated exchanges can be deeper and more liquid than open floor exchanges.

Naidu & Rozeff (1994) note an increase of volatility and liquidity as well as an improvement in efficiency following the automation of the Singapore stock exchange. They advance that automation speeds up the dissemination of prices, making it likely that volatility will increase, especially when information is hitting the market. The increased speed with which prices and trading volume are available incites investors likely to trade to exploit the published information, which is likely to improve market efficiency.

Derrabi (1998) was interested in the change of the Moroccan market microstructure. The automated trading by fixing produced a significant and permanent increase of prices. The fixing system also permits efficiency improvement and lower volatility but no significant impact has been noted for stocks traded in continuous.

## **2.5 Summary**

Kenya has one stock exchange, where the trading of stocks takes place. This is known as the Nairobi Securities Exchange, formerly known as the Nairobi Stock Exchange. Although Kenya's stock market is one of the largest stock markets in Africa, it is still young and developing by the standards of advanced economies. In order to foster stock market

development in the country, a number of reforms targeting the stock market have been implemented over the years. These include the formation of a regulatory body (the CMA), marking a shift from the self-regulatory system to the statutory regulatory system; the replacement of the "Call-Over" trading system, in favour of the floor-based "Open-Floor System", the reduction of listing costs, the relaxation of the exchange control for locally controlled companies, and the repeal of the Exchange Control Act, Automation, dematerialization and demutualization of NSE. This paper seeks to establish whether all these reforms especially the automation has had any significant effect on the volume of the stocks traded.

The introduction of the Central Depository System (CDS) in 2004, the Automated Trading System (ATS) in 2006 and the implementation of Wide Area Network (WAN) in 2007, was the onset for Automation to revolutionize security trading in Kenya. As a result of the automation, the NSE experienced an increase in liquidity while the number of days for settlement and cases of fraud reduced in stock trading as fixed-income traders and investors flocked to the Automated Trading System (ATS). Kariuki (2012) observes that the automation of stock market has enabled investors to see a positive real return on their investments. Cases of fraud have also reduced thereby leading to an increase in investors' confidence. Nonetheless, it is not clear as to whether the automation has an effect on trading volume and market size.

With various studies having been undertaken in the past relating to automation of the NSE none of them have addressed the issue on whether there was any effect on the stock volume after automation which is a critical part in a security market. All the stake holders in the stock market are concerned on the movement of stock and this study is be of much interest to each



one of them in helping to organize and plan for the future. It also helps them to strategize and be prepared for the effects of technological changes on future.

The stock market in Kenya is vulnerable to market shocks, as the method of determining share prices may result in the market capitalisation of a counter being heavily affected by a small lot deal. People and businesses have low confidence in the performance of capital markets. They also have a perception of low standards of corporate governance, since neither the NSE nor the brokers publish their corporate governance report (Capital Markets Authority et al., 2011). As a result, players in such a market are limited; and any efforts to innovate the market are not well-cultivated, thereby leading to another challenge, which is the slow pace of innovation and the flexibility and limited access to capital. Deep markets are constantly developing products, such as securities, derivatives and options – for both funding and risk management. The capital markets in Kenya have been slow in developing products; and they have left companies to depend on the short-term money markets (Nairobi Stock Exchange, 2002).

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This chapter outlines the methods and procedures used in this research. The chapter covers the research design, population, sampling method, data collection methods and data analysis technique.

### **3.2 Research Design**

This refers to the nature and outlook of the type of research applied. The overall objective was to find out the effects of automation on stock market volume. A descriptive research design was used to obtain information concerning the current status of the problem. It describes what exists in a situation (Key, 1997). Quantitative techniques was used since the study focuses on statistical and quantitative assessment of volumes in NSE.

### **3.3 Population**

The target population comprised of all listed companies at the NSE and only includes those firms listed at the NSE by 1st January 2002. Only firms with data spanning the study period were considered i.e. firms that had changed names, been taken over, been suspended/delisted/had merged/with stock split were not included in the study. See appendix – list of listed companies (adapted from NSE)

### **3.4 Data Collection Methods**

Secondary data was collected from NSE Excel worksheets. Data on monthly closing index values and monthly closing stock prices was obtained from the daily price list at NSE. The data included monthly returns and closing prices from January 2002 to June 2006 (pre-automation period), July 2008 to August 2012 (post-automation period). The data was considered reliable since the data was collected by them and are institutions charged with the responsibility.

To differentiate between the performance in the pre and post automation periods, estimations were done for the pre-automation and post automation periods. Since the automation process took some time before it was finally implemented as a result of some institutional and implementation challenges at the exchange, the periods of implementation was excluded. Therefore the pre-automation period was taken as the 54 months from 1st January 2002 to 30th June 2006, while the post automation period was taken as the 54 months from 31st July 2006 to 31st December, 2012. Thus, the period starting from 1st July 2006 to 30th June 2008 was excluded from the analysis since during this period the NSE was operating under both manual listing and automated listing and coping with the challenges of initial implementation.

### **3.5 Data Analysis Technique**

The primary objectives of the paper are, as mentioned earlier, to find out the effect of the automation on the stock market trade volume. In order to attain those objectives, the present

study postulates two hypotheses. One of them was the null hypothesis that two mean values of trade volume for the two time periods are the same which can be expressed in the following mathematical notation:

$$H_0: \mu_1 - \mu_2 = 0,$$

Where  $\mu_1$  is the mean of trade volume in the period of January 2002 to June 2006 and  $\mu_2$  is the mean of the same in the period of July 2008 to June 2015 in the data.

In tests of two means of the two periods the alternative hypothesis is set as:

$$H_1: \mu_1 - \mu_2 < 0.$$

Where;-

$H_0$ : Means of the two periods are significantly the same that is the automation had no effect on the volume of stocks traded.

$H_1$ : Means of the two periods are significantly not the same. That is the mean of stocks volume differs significantly after automation with the mean of stocks volume before automation.

A standard t-test for difference of means was conducted on the data to establish the significance of the differences between the measures of stock market volume before and after automation. For equal sized samples the t-value was given by:

$$t = \frac{x_1 - x_2}{\sqrt{\left[\frac{s_1 - s_2}{n}\right]}}$$

Where;-

$X_1$  is the mean of stock volume for the period Jan 2002 to Jun 2006

$X_2$  is the mean of stock volume for the period Jul 2008 to Dec 2012

$S_1$  is the variance of stock volume for the period Jan 2002 to Jun 2006

$S_2$  is the variance of stock volume for the period Jul 2008 to Dec 2012

$N$  is the sample size

The degrees of freedom for the test was given by  $2n-2$

For the two independent periods with a normally distributed population.

$$\bar{X} = (X_1 + \dots + X_n) / n,$$

$$S^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2.$$

Where;-

$\bar{X}$  is the volume mean,

$S^2$  is the volume variance.

## CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

### 4.1 Introduction

This chapter presents the data findings on effect of automation on stock volume at Nairobi securities exchange by analysing how the automation impacted on the stock volumes of the listed companies. The data was collected from the NSE reports between 2002 and 2012 and analysed using Excel. The data obtained from the NSE gave information on the listed companies from which 31 were selected which had had a consistent presence and trading at the market and whose total daily volumes of equities traded by each company in the periods were used in the analysis.

### 4.2 Descriptive Analysis

The tables below give longitudinal view of the changes in volumes traded over the years in each sector per company. The tables reflects observed movement in stock volumes per sector.

**Table 1: Percentage Changes in Stocks Volume in Agricultural Sector**

	Kakuzi Ord.5.00	Rea Vipingo Plantations Ltd Ord 5.00
Pre Automation		
2002	1,306,741.00	1,237,674.00
2003	1,683,329.00	6,922,006.00
2004	2,951,897.00	6,542,401.00
2005	1,879,169.00	14,553,862.00
2006	899,657.00	5,832,483.00
Aggregate	8,720,793.00	35,088,426.00
Post Automation		
2008	440,320.00	2,639,197.00
2009	674,935.00	870,176.00
2010	4,270,100.00	10,104,200.00
2011	1,289,700.00	5,258,700.00

2012	3,372,981.00	5,743,115.95
Aggregate	10,048,036.00	24,615,388.95
% Change	15.22%	-29.85%

Source: Nairobi Securities Exchange, 2015

The analysis exhibited a mixed move in both companies listed under agriculture. Kakuzi showed an increase in stock volume from around 8.7 Million shares to around 10 Million shares representing 15.22% while Rea Vipingo Ltd showed a decrease in stock volumes by 29.85% from around 10.1 Million shares to around 24.6 million share.

**Table 2: Percentage Changes in Stocks Volume in Commercial and Services Sector**

COMMERCIAL AND SERVICES				
	Car & General (K) Ltd Ord 5.00	Hutchings Biemer Ltd Ord 5.00	Kenya Airways Ltd Ord 5.00	Marshalls (E.A.) Ltd Ord 5.00
Pre Automation				
2002	9,799	10,468	19,863,119	4,795
2003	37,222	1,267,037	24,220,362	34,245,799
2004	66,086	1,069,764	58,513,991	12,955,626
2005	226,811	-	67,757,300	594,314
2006	1,369,747	-	48,275,802	224,696
Aggregate	1,709,665	2,347,269	218,630,574	48,025,230
Post Automation				
2008	2,354,788	2,276,894	11,137,360	879,180
2009	669,690	399,300	20,503,502	29,350
2010	2,220,700	-	71,850,100	1,893,500
2011	1,034,700	-	50,599,400	807,700
2012	299,129	242,100	45,182,615	8,818,200
Aggregate	6,579,007	2,918,294	199,272,977	12,427,930
% Change	284.81%	24.33%	-8.85%	-74.12%

Source: Nairobi Securities Exchange, 2015

The trend was similar to the agriculture sector with some companies registering huge stock movements after automation especially at the end of the period of study. Car & General (k) Ltd registered the hugest movement in stock volumes from around 1.7 million shares to around 6.5 million shares representing 284.81% increase in stock trade volume. Hutching Biemer Ltd recorded a small increase in volumes of about 24.33% while Kenya Airways and Marshalls (E.A.) Ltd recorded a decrease of 8.85% and 74.12% respectively.

**Table 3: Percentage Changes in Stocks Volume in Finance and Investment Sector**

	Diamond Trust Bank Kenya Ltd Ord 4.00	Housing Finance Co Ltd Ord 5.00	Jubilee Insurance Co. Ltd Ord 5.00	National Bank of Kenya Ltd Ord 5.00	NIC Bank Ltd Ord 5.00	Pan Africa Insurance Ltd Ord 5.00	Standard Chartered Bank Ltd Ord 5.00
Pre Automation							
2 0 0 2	1,317,437	7,686,681	1,578,373	2,212,950	8,193,731	929,677	2,343,740
2 0 0 3	2,966,620	10,281,349	2,516,622	19,643,909	14,851,329	5,875,510	8,579,994
2 0 0 4	8,517,383	5,899,781	9,452,849	10,967,835	5,194,046	4,749,752	2,417,800
2 0 0 5	22,191,414	3,349,834	22,789,084	9,076,927	6,773,458	6,831,004	1,625,858
2 0 0 6	11,148,956	32,300,643	612,650	19,704,743	4,234,979	1,471,000	2,502,598
Aggregate	46,141,810	59,518,288	36,949,578	61,606,364	39,247,543	19,856,943	17,469,990
Post Automation							
2 0 0 8	9,651,371	16,160,195	1,578,756	8,806,845	5,632,881	1,313,358	1,627,053
2 0 0 9	4,453,987	13,134,739	812,268	5,101,180	11,750,595	726,000	5,010,340
2 0 1 0	13,949,800	41,885,800	3,896,900	20,676,300	27,272,200	2,442,000	4,957,200
2 0 1 1	113,348,900	16,613,000	122,971,900	11,346,700	11,064,300	4,400,000	94,012,000
2 0 1 2	148,427,900	117,746,916	67,489,880	11,282,421	19,351,336	24,445,027	51,608,070
Aggregate	289,831,958	205,540,650	196,749,704	57,213,446	75,071,312	33,326,385	157,214,663
% Change	528.13%	245.34%	432.48%	-7.13%	91.28%	67.83%	799.91%

Source: Nairobi Securities Exchange, 2015

In this finance and investment sector the statistics indicated a positive movement with a very high increase in volume being registered. Standard chartered bank ltd registered the most increase in stock volume from 17 million before automation to over 157 million shares after automation representing 799.91% increase while National Bank of Kenya ltd registered a negative movement in stock of 7.13% from around 61 million shares before automation to around 57 million shares after automation. Diamond Trust bank, Housing Finance and Jubilee insurance each registered a more than double increase in stock traded volumes during the two periods of 528.13%, 245.34 and 432.48% respectively while NIC Bank Ltd and Pan African Insurance Ltd registered a slight increase in stocks traded in the two periods of 91.28% and 67.83%



**Table 4: Percentage Changes in Stocks Volume in Industrial and Allied Sector**

	INDUSTRIAL AND ALLIED								
	B.O.C Kenya Ltd Ord 5.00	Bamburi Cement Ltd Ord 5.00	British American Tobacco Kenya Ltd Ord 10.00	Carbacid Investments Ltd Ord 5.00	Crown Berger Ltd Ord 5.00	E.A.Portland Cement Ltd Ord 5.00	Mumias Sugar Co. Ltd Ord 2.00	Total Kenya Ltd Ord 5.00	Unga Group Ltd Ord 5.00
<b>Pre Automation</b>									
2002	1,045,854	5,314,141	2,726,392	795,506	2,705,505	48,815	4,148,122	1,165,647	3,421,332
2003	8,338,137	6,936,722	9,447,718	5,687,177	3,563,383	1,796,744	43,190,017	28,136,002	6,292,008
2004	4,101,918	6,188,027	1,467,740	2,220,335	1,982,086	9,327,977	110,879,542	18,361,594	2,658,376
2005	5,537,219	5,453,821	1,391,105	3,060,803	4,062,414	37,527,596	62,324,784	11,114,084	2,218,228
2006	-	2,892,954	3,199,569	-	2,035,464	5,354,584	123,379,846	11,141,218	8,413,748
Aggregate	19,023,128	26,785,665	18,232,524	11,763,821	14,348,852	54,055,716	343,922,311	69,918,545	23,003,692
<b>Post Automation</b>									
2008	1,875,321	468,872	868,972	924,224	882,141	1,904,070	71,710,051	3,554,754	1,909,206
2009	91,200	4,174,815	7,036,451	679,900	1,273,207	337,200	164,642,261	4,962,363	1,394,432
2010	1,588,200	13,374,700	9,640,800	2,439,200	2,218,500	2,134,500	488,291,500	11,768,000	5,563,100
2011	590,100	5,648,500	5,724,000	7,964,900	2,320,500	4,142,100	134,794,000	3,378,600	4,064,500
2012	400,110	13,964,545	7,250,334	5,238,406	4,690,226	4,535,060	136,500,906	43,528,217	115,096,612
Aggregate	4,544,931	37,631,432	30,520,557	17,246,630	11,384,574	13,052,930	995,938,718	67,191,934	128,027,850
% Change	-76.11%	40.49%	67.40%	46.61%	-20.66%	-75.85%	189.58%	-3.90%	456.55%

Source: Nairobi Securities Exchange, 2015

The trend is the same for this sector with some companies showing an increase in stock trade volume and others showing decline. Most Companies showed an increase in stock volumes after automation as compared to pre-automation period like Unga Group Ltd 456.55%, Mumias Sugar Ltd 189.58%, British American Tobacco 67.4%, Carbacid Investments Ltd 46.61% and Bamburi Cement Ltd 40.49%. B.O.C Kenya Ltd showed a decrease of 76.11% of stocks volumes as well as E.A. Portland Cement Ltd -75.85% and Crown Berger Ltd -20.66%.

**Table 5: Percentage Changes in Stocks Volume in Alternative Investment Market Segment**

ALTERNATIVE INVESTMENT MARKET SEGMENT									
	A.Baumann & Co.Ltd Ord 5.00	City Trust Ltd Ord 5.00	Eaagads Ltd Ord 1.25	Express Ltd Ord 5.00	Williams on Tea Kenya Ltd Ord 5.00	Kapchorua Tea Co. Ltd Ord 5.00	Kenya Orchards Ltd Ord 5.00	Limuru Tea Co. Ltd Ord 20.00	Standard Newspapers Group Ord 5.00
Pre Automation									
2002	91,736	24,693	12,950	4,800	225,448	-	210,744	-	265,489
2003	220,760	105,744	28,062	48,805	234,170	14,130	213,413	32,130	2,619,894
2004	624,020	234,234	2,197,958	2,323,030	5,361,922	279,502	4,820	830,738	868,322
2005	960,165	289,688	13,782,189	1,675,630	65,094	69,714	51,237	1,622,970	327,410
2006	166,449	1,016,422	6,778,745	250,507	2,557,138	85,713	8,220	606,081	-
Aggregate	2,063,130	1,670,781	22,799,904	4,302,772	8,443,772	449,059	488,434	3,091,919	4,081,115
Post Automation									
2008	-	17,400	15,100	907,484	427,916	22,100	17,400	300	2,011,799
2009	-	9,000	41,500	788,720	424,660	170,100	200	1,300	340,166
2010	-	69,700	1,222,200	1,079,900	1,335,400	682,800	30,300	401,500	2,308,600
2011	177,300	212,900	147,800	1,072,400	105,256,500	390,800	5,079,400	49,200	666,300
2012	450,500	15,291,200	162,100	1,384,604	1,013,165	163,620	11,626,900	48,510	9,687,522
Aggregate	627,800	15,600,200	1,588,700	5,233,108	108,457,641	1,429,420	16,754,200	500,810	15,014,387
% Change	-69.57%	833.71%	-93.03%	21.62%	1184.47%	218.31%	3330.19%	-83.80%	267.90%

Source: Nairobi Securities Exchange, 2015

In this segment most of the companies registered a higher increase on volume in the automated system as compared to the open floor system with only Limuru tea Co. Ltd - 83.80%, A. Baumann & Co. Ltd -69.57% and Eaagard ltd -93.03% registering a negative movement in stock volumes. Kenya Orchards Ltd and Williamson Tea Ltd recorded a huge increment in volumes from around 488 thousand shares to around 16 million shares and around 8 Million shares to around 108 Million shares representing 1184.47% respectively. Others also registered a big increase in stock volumes with City trust Ltd 833.71%, Standard Newspapers Ltd 267.9%, Kapchorua Tea Co. Ltd 218.31% and Express Ltd 21.62% in respect to the two periods.

### 4.3 t-Test Statistics

**Table 6: t-Statistic from Companies in the Agricultural Sector**

	Pair	t value	Sig. (2 tailed)
Kakuzi Ord.5.00	Pair 1 Before Automation - After Automation	0.3076	0.07607
Rea Vipingo Plantations Ltd Ord 5.00	Pair 2 Before Automation - After Automation	0.483	0.6328

Source: Nairobi Securities Exchange, 2015

From the calculates p values, Rea Vipingo Plantations Ltd showed a little change in volumes traded with a p value of 0.6328 while kakuzi showed a significant differences represented by a p values of about 0.076 meaning that there was a change in the volumes traded after the installation of the automated system.

**Table 7: t-Statistic from Commercial and Services**

	Pair	t value	Sig. (2 tailed)
Car & General (K) Ltd Ord 5.00	Pair 1 Before Automation - After Automation	0.5622	0.5794
Hutchings Biemer Ltd Ord 5.00	Pair 2 Before Automation - After Automation	0.9593	0.3494
Kenya Airways Ltd Ord 5.00	Pair 3 Before Automation - After Automation	0.0433	0.9657
Marshalls (E.A.) Ltd Ord 5.00	Pair 4 Before Automation - After Automation	0.4366	0.665

Source: Nairobi Securities Exchange, 2015

From the commercial and services, Hutching Biermer Ltd showed a significant change in stock mean represented by a p value of 0.349, while all the rest showed a p values above the significant point of 0.5 meaning that the difference in means was not significant after the automation from open floor system.

**Table 8: t-Statistic from Industrial and Allied**

	Pair	t value	Sig. (2 tailed)
B.O.C Kenya Ltd Ord	Pair 1 Before Automation -	0.1635	0.885

5.00	After Automation		
Bamburi Cement Ltd Ord 5.00	Pair 2 Before Automation - After Automation	0.5116	0.660
British American Tobacco Kenya Ltd Ord 10.00	Pair 3 Before Automation - After Automation	0.2891	0.799
Carbacid Investments Ltd Ord 5.00	Pair 4 Before Automation - After Automation	0.5908	0.614
Crown Berger Ltd Ord 5.00	Pair 5 Before Automation - After Automation	0.5546	0.634
E.A.Portland Cement Ltd Ord 5.00	Pair 6 Before Automation - After Automation	0.2735	0.810
Mumias Sugar Co. Ltd Ord 2.00	Pair 7 Before Automation - After Automation	0.1116	0.921
Total Kenya Ltd Ord 5.00	Pair 8 Before Automation - After Automation	0.3831	0.739
Unga Group Ltd Ord 5.00	Pair 9 Before Automation - After Automation	0.9555	0.440

Source: Nairobi Securities Exchange, 2015

Most of the companies in this industry did not experienced a significant change in stock volumes attributable to automation only Unga Group ltd indicated a significant difference in the stock volumes after trading system change. This implied that the sector was not affected by movement from the open floor system to automated system.

**Table 9: t-Statistic from Alternative Investment Market**

	Pair	t value	Sig. (2 tailed)
A.Baumann & Co.Ltd Ord 5.00	Pair 1 Before Automation - After Automation	1.505	0.207
City Trust Ltd Ord 5.00	Pair 2 Before Automation - After Automation	0.8975	0.420
Eaagads Ltd Ord 1.25	Pair 3 Before Automation - After Automation	1.34	0.189
Express Ltd Ord 5.00	Pair 4 Before Automation - After Automation	0.371	0.712
Williamson Tea Kenya Ltd Ord 5.00	Pair 5 Before Automation - After Automation	0.939	0.401
Kapchorua Tea Co. Ltd Ord 5.00	Pair 6 Before Automation - After Automation	2.714	0.053
Kenya Orchards Ltd Ord 5.00	Pair 7 Before Aut - After Aut	0.347	0.730
Limuru Tea Co. Ltd Ord 20.00	Pair 8 Before Aut - After	1.81	0.143

	Aut		
Standard Newspapers Group Ord 5.00	Pair 9 Before Aut - After Aut	1.0908	0.3367

Source: Nairobi Securities Exchange, 2015

In the alternative investment segment, only Express Kenya ltd and Kenya Orchards ltd exhibited there was no significance in stock volume movement due to system automation. All the others indicated a significant move in share volumes after automation of the systems with Kapchorua tea Co. Ltd showing a big change in volumes.

The data was also manipulated per sector to ascertain if there was any consistency with the data as per company obtained above. Critical examination of the total daily volumes of equities traded by the listed companies for the period in question was carried out. The monthly volumes were then cumulated to give a comparative picture of annual equities traded by the companies. It is important to note that the data corresponds respectively to the time systems used at the floor of Nairobi Securities shifted from open floor to automated trading systems.

**Table 10: Volumes Traded Annually Per Sector for Listed Companies during Open Floor System**

	AGRICULTURAL	COMMERCIAL AND SERVICES	FINANCE AND INVESTMENT	INDUSTRIAL AND ALLIED	ALTERNATIVE INVESTMENT MARKET SEGMENT
2002	2,544,415	19,888,181	24,262,589	21,371,314	835,860
2003	8,605,335	59,770,420	64,715,333	113,387,908	3,517,108
2004	9,494,298	72,605,467	47,199,446	157,187,595	12,724,546
2005	16,433,031	68,578,425	72,637,579	132,690,054	18,844,097
2006	6,732,140	49,870,245	71,975,569	156,417,383	11,469,275

Source: Nairobi Securities Exchange, 2015

Table 10 above shows how each sector was performing in relation to stock volumes traded per year for the selected companies from year 2002 through 2006 period prior to automation.

The period involved open floor dealings only and brokers had to be physically present to negotiate or seal a deal.

**Table 11: Volumes Traded Annually Per Sector for Listed Companies during Automated Trading Systems**

	AGRICULTURAL	COMMERCIAL AND SERVICES	FINANCE AND INVESTMENT	INDUSTRIAL AND ALLIED	ALTERNATIVE INVESTMENT MARKET SEGMENT
2008	3,079,517	16,648,222	44,770,459	84,097,611	3,419,499
2009	1,545,111	21,601,842	40,989,109	184,591,829	1,775,646
2010	14,374,300	75,964,300	115,080,200	537,018,500	7,130,400
2011	6,548,400	52,441,800	373,756,800	168,627,200	113,052,600
2012	9,116,096	54,542,043	440,351,549	331,204,415	39,828,120

Source: Nairobi Securities Exchange, 2015

Table 11 also representing the same companies analysed under table 10 above shows the accumulated stock volume traded per year for five years on automated system.

**Table 12: Total Changes in Stocks Volumes Traded Per Sector during Open Floor and Automated Trading Systems in Percentage**

	AGRICULTURAL	COMMERCIAL AND SERVICES	FINANCE AND INVESTMENT	INDUSTRIAL AND ALLIED	ALTERNATIVE INVESTMENT MARKET SEGMENT
Open floor trading system	43,809,219	270,712,738	280,790,516	581,054,254	47,390,886
Automated Trading System	34,663,425	221,198,207	1,014,948,118	1,305,539,555	165,206,265
% Change	-20.88%	-18.29%	261.46%	124.68%	248.60%

Source: Nairobi Securities Exchange, 2015

A critical analysis of the difference per sector reveals that the agricultural, commercial and services had a negative movement in stock volumes of -20.88% and -18.29% respectively.

This may also be attributed to other factors this research did not capture like entrance of other

players in the sector and general performance of the sector. Finance and investment sectors traded at more than double of open floor trading system at 261.46% as well as Alternative investment segment at 248.6% while industrial and allied sector recorded a less increase in volume at 124% as per table 12.

Over and above, 20 companies in the various sectors listed in the Nairobi Securities Exchange, traded more volumes during the launch of the automatic trading system. There were slight decreases within 11 listed companies in. This findings were consistent with the per company per sector findings earlier with agriculture sector followed by commercial and services showing a negative decrease per sector majorly due to huge decrease in Rea Vipingo Plantations Ltd huge decline in volumes, Kenya Airways Ltd and Marshalls Ltd both in the commercial and services sector recorded a slight decline as well affecting the whole sector performance due to their intensity.

**Table 13: Correlation Statistics**

<b>Paired Samples Statistics</b>				
	Mean	N	Std. Deviation	Std. Error Mean
Total Volumes traded open floor system	494.5	4	254.053	127.027
Total Volumes traded during Automatic Trading system	842.5	4	513.668	256.834

Source: Menge Osero, 2012

It is important to note that since much change after the launch of automated trading system in securities volumes, the null hypotheses tested during the correlation was that no change in volumes traded by the companies occurred. A critical look at the p-values computed indicates that indeed there were changes in the volumes transacted. Note that for all sectors and cumulative annual volumes traded P values > .005 which called for rejection of the null hypothesis.

## **CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Introduction**

This chapter presents the summary of the results of the study and the main conclusions drawn from the analysis of the data in Chapter Four. The chapter is organized as follows. Section 5.2 presents the summary of the findings of the study while section 5.3 is the conclusion. Section 5.4 discusses the policy implications arising from the results of this study. Lastly, section 5.5 presents the recommendations for further research.

### **5.2 Summary of the Findings of the Study**

The development in technology is causing unprecedented changes in the manner trading is done. Although trading systems are complex and expensive and particularly those used in the stock market or exchanges, many countries around the world both in the developed and the emerging markets have adapted automatic trading systems and those that have not, are hastening to create structures and mobilize resources to install them.

Large markets that have installed electronic systems find it easier to trade across the borders integrating markets and extending to bring efficiency and hence leading to high volume trades. From the research there is evidence that the change of systems from the old open floor to Automatic systems have a significant relationship, i.e. after the adaption of the new system volumes of trade in some sectors surges up. Though certain other organizational specific factors affect trading as well as macro and micro economic factors which may lead to low trading for some companies as indicated earlier.



The upsurge in volume after automation was not however experienced across all sectors with especially the industrial and allied sector showing a reduction or insignificant change in stock volumes after automation.

Agriculture sector did not record a significant change in volumes that can be attributed to shift from open floor trading to automated trading system as well as commercial & services and Industrial & Allied sectors. In Commercial & services sector there was recorded a mixed reaction to the change of system with some particular companies recording a huge increase in volume of stocks traded after automation. The trend was a bit different in the alternative investment market where the change in trading system had an impact on the shares traded and a higher volumes were recorded.

### **5.3 Conclusions**

This paper has discussed the effect of automation on stock market trade volume at the Nairobi Securities Exchange. Kenya has one stock exchange, where the trading of stocks takes place. This is known as the Nairobi Securities Exchange, formerly known as the Nairobi Stock Exchange. Although Kenya's stock market is one of the largest stock markets in Africa, it is still young and developing by the standards of advanced economies. In order to foster stock market development in the country, a number of reforms targeting the stock market have been implemented over the years. These include the formation of a regulatory body (the CMA), marking a shift from the self-regulatory system to the statutory regulatory system; the replacement of the "Call-Over" trading system, in favour of the floor-based "Open-Outcry System", the reduction of listing costs, the relaxation of the exchange control for locally controlled companies, and the repeal of the Exchange Control Act. Following

these reforms, Kenya's stock market has developed significantly in terms of market capitalization, the total value of stocks traded, and the turnover ratio. Although the volume movements may indicate there was an increase in share volumes from sectors of Finance and investments 261.46%, Industrial and Allied 124.68% and Alternative investment market segment of 248.60%, this may not be directly attributed to automation only and therefore the study concludes that automation of the Nairobi Securities Exchange did not significantly affect its stock volumes. On the stocks with an upsurge after automation, this may have been caused by other factors this research did not consider.

#### **5.4 Policy Recommendations**

Since automation has not been fully integrated in the system the NSE should try and harness its operations with the advancement in technology especially enable remote trading.

The government should aid in developing infrastructures which are a major challenge to adopting technologies like helping in developing a reliable and quick server to aid in transactions.

Limited listings have a negative impact on the supply of new equities. The limited supply of new equities in the capital market has restricted the use of the equity market as a source of financing. In view of the past failure to attract new equity NSE should consider increasing the number of medium-sized and large family-owned businesses and state-owned companies operating in Kenya.

NSE also should also consider lowering the bar on LPO so that new entrants can make a cameo on the market.

## **5.5 Limitations of the Study**

There are factors related to delisting of companies that were existing in the beginning of the period of study and listing of new companies in between the study period which may have had an effect on how stake holders traded on the companies under research and who's effect could not be measured.

Elimination of companies with share splits may have affected the deduction as most companies with share splits are the most active in the industry and may have given a clearer depiction of the market.

Change in other economic and political factors may have influenced the investors' behavior thus having an implication on the volumes of stocks traded at the NSE.

## **5.6 Suggestion for Further Research**

Studies should be done on the effect of demutualisation on the efficiency of the NSE. A further study can narrow down on the effects of automation to performance of stock brokers.

Future research may be carried to confirm and assess the determinants of lower liquidity positions in the market after introduction of the automated trading system. Further research could also be conducted into the post-automation efficiency/volatility/liquidity level of the NSE by adopting different estimation techniques as well as extending the sample size and scope so as to ascertain the exact effect of the automation on exchange.

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Table 14: Listed Companies as at 2002 (Source NSE website)  
[www.nse.co.ke/listedcompanies](http://www.nse.co.ke/listedcompanies)

	COMPANY	SYMBOL	ISIN	LISTED	ISSUED SHARES	COMPARTMENT
1	ARM Cement Ltd	ARM	KE0000000034	1997	495,275,000	Main
2	Bamburi Cement Ltd	BAMB	KE0000000059	1970	362,959,275	Main
3	British American Tobacco Kenya Ltd	BAT	KE0000000075	1969	100,000,000	Main
4	A.Baumann & Co Ltd	BAUM	KE0000000018	1948	3,840,066	Main
5	Barclays Bank of Kenya Ltd	BBK	KE0000000067	1986	5,431,536,000	Main
6	Crown Paints Kenya Ltd	BERG	KE0000000141	1992	23,727,000	Main
7	B.O.C Kenya Ltd	BOC	KE0000000042	1969	19,525,446	Main
8	Car & General (K) Ltd	C&G	KE0000000109	1940	33,419,424	Main
9	East African Cables Ltd	CABL	KE0000000174	1973	253,125,000	Main
10	Carbacid Investments Ltd	CARB	KE0000000117	1972	33,980,265	Main
11	CFC Stanbic of Kenya Holdings Ltd	CFC	KE0000000091	1970	395,321,638	Main
12	Liberty Kenya Holdings Ltd	CFCI	KE2000002168	0	515,270,364	Main
13	CIC Insurance Group Ltd	CIC	KE2000002317	2012	2,179,615,440	Main
14	CMC Holdings Ltd	CMC	KE0000000133	1950	582,709,440	Main
15	Co-operative Bank of Kenya Ltd	COOP	KE1000001568	0	4,190,845,080	Main
16	Diamond Trust Bank Kenya Ltd	DTK	KE0000000158	1972	220,100,096	Main
17	East African Breweries Ltd	EABL	KE0000000216	1972	790,774,356	Main
18	Eaagads Ltd	EGAD	KE0000000208	1972	32,157,000	Main
19	Sameer Africa Ltd	FIRE	KE0000000232	1994	278,342,393	Main
20	Hutchings Biemer Ltd	HBL	KE0000000257	0	360,000	Main
21	Housing Finance Co.Kenya Ltd	HFCK	KE0000000240	1992	235,750,000	Main
22	Centum Investment Co Ltd	ICDC	KE0000000265	1967	665,441,775	Main
23	Jubilee Holdings Ltd	JUB	KE0000000273	1984	59,895,000	Main

24	Kapchorua Tea Company Ltd	KAPC	KE0000000229	1972	3,912,000	Main
25	Kenya Commercial Bank Ltd	KCB	KE0000000315	1989	2,984,137,017	Main
26	KenolKobil Ltd	KENO	KE0000000323	0	1,471,761,200	Main
27	Kenya Re Insurance Corporation Ltd	KNRE	KE1000000604	0	700,000,000	Main
28	Kenya Power & Lighting Co Ltd	KPLC	KE0000000349	1972	1,951,467,045	Main
29	Kenya Airways Ltd	KQ	KE0000000307	1996	1,496,469,035	Main
30	Kakuzi Ltd	KUKZ	KE0000000281	1951	19,599,999	Main
31	Limuru Tea Company Ltd	LIMT	KE0000000356	1967	1,200,000	Main
32	Longhorn Kenya Ltd	LKL	KE2000000275	1993	58,500,000	Main
33	Marshalls East Africa Ltd	MASH	KE0000000364	1969	14,393,106	Main
34	Mumias Sugar Co. Ltd	MSC	KE0000000372	2001	1,530,000,000	Main
35	National Bank of Kenya Ltd	NBK	KE0000000398	1994	280,000,000	Main
36	NIC Bank Ltd	NIC	KE0000000406	1971	542,984,148	Main
37	Nation Media Group Ltd	NMG	KE0000000380	1973	188,542,286	Main
38	Olympia Capital Holdings Ltd	OCH	KE0000000166	1974	40,000,000	Main
39	Kenya Orchards Ltd	ORCH	KE0000000331	1959	12,868,124	Main
40	Pan Africa Insurance Holdings Ltd	PAFR	KE0000000414	1963	96,000,000	Main
41	East African Portland Cement Co. Ltd	PORT	KE0000000190	0	90,000,000	Main
42	Rea Vipingo Plantations Ltd	REA	KE0000000422	1996	60,000,000	Main
43	Sasini Ltd	SASN	KE0000000430	1965	228,055,500	Main
44	Standard Chartered Bank Kenya Ltd	SCBK	KE0000000448	1988	309,159,514	Main
45	Standard Group Ltd	SGL	KE0000000455	1954	81,481,478	Main
46	Total Kenya Ltd	TOTL	KE0000000463	1988	175,028,706	Main
47	TPS Eastern Africa Ltd	TPSE	KE0000000539	1997	182,174,108	Main
48	Uchumi Supermarket Ltd	UCHM	KE0000000489	1992	265,426,614	Main



49	Umeme Ltd	UMME	KE2000005815	0	1,623,878,005	Main
50	Unga Group Ltd	UNGA	KE0000000497	1971	75,708,873	Main
51	Williamson Tea Kenya Ltd	WTK	KE0000000505	1972	8,756,320	Main
52	Express Kenya Ltd	XPRS	KE0000000224	1978	35,403,790	Main