

STOCK MARKET VOLATILITY OF LISTED BANKS ON  
THE GHANA STOCK EXCHANGE

KNUST

By

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## DECLARATION

I hereby declare that this submission is my own work towards the Master of Business Administration (Finance) and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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## DEDICATION

Special dedication goes to my dear parents Mr. and Mrs. Appiah – Sam in whose hands God Almighty has placed my care and guidance on earth.

This project is also dedicated to my wife Mrs. Elizabeth Asemiah and my lovely children...Bella and Peggy and the entire Appaiah – Sam family.



## ABSTRACT

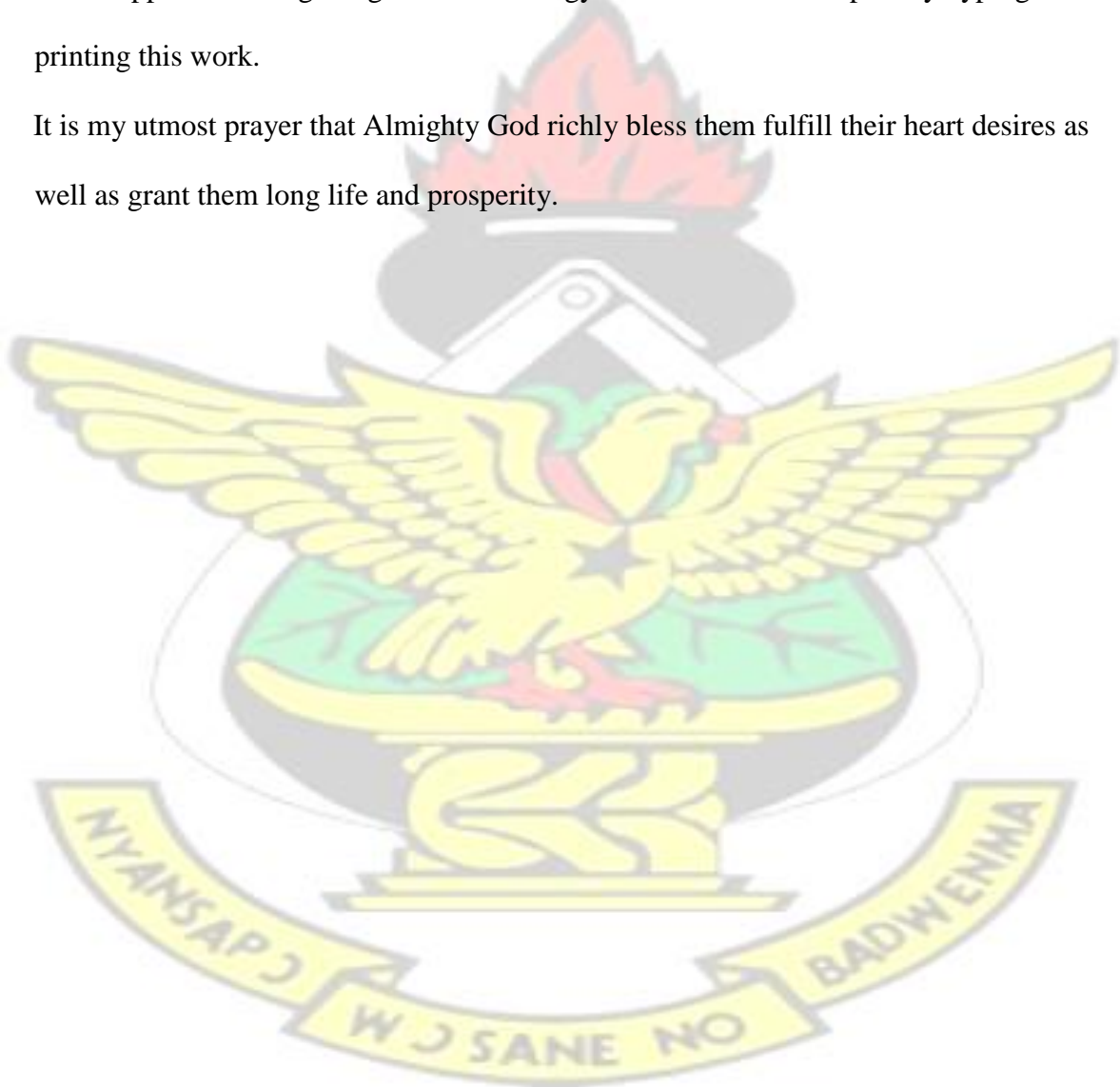
This study focuses on stock market volatility of listed banks on the Ghana Stock Exchange and aims to apply Exponentially Weighted Moving Average models to determine the share price volatility of these banks. The study uses daily time series data spanning from 1<sup>st</sup> January, 2015 to 31<sup>st</sup> December, 2015 which represents 246 daily observations of nine banks listed on the Ghana stock exchange. The results indicate that, the share prices of Ghana Commercial Bank, CAL Bank, Ecobank Ghana, Societe Generale-Social Security Bank, and Standard Chartered Bank were fairly stable over the 12-months period. However, the share price volatility of HFC, Unique Trust Bank, Ecobank Transnational Incorporation and Trust Bank Limited were the most volatile among all the nine commercial Banks share price volatility studied. To increase the value of their share prices, management of HFC, Unique Trust Bank, Ecobank Transnational Incorporation and Trust Bank Limited should advance in technological novelty. This, in effect, can lead to strong profit growth and eventually will improve their share prices. The study also indicated that, there was a correlation between the banks listed on the Ghana Stock exchange. When the share price of one bank increases, there is a corresponding increases of share price of another. With this, investors are advised not change their asset allocation in their shares of banks listed in Ghana. In order to increase the value of shareholders, management of banks listed on Ghana stock exchange should try as much as possible to expand into areas of which they have competitive advantage.

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It is my utmost prayer that Almighty God richly bless them fulfill their heart desires as well as grant them long life and prosperity.



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## TABLE OF ABBREVIATION

CAL	CAL Bank
GCB	Ghana Commercial Bank
EBG	Ecobank Ghana
HFC	HFC Bank
SCB	Standard Chartered Bank
SG-SSB	Societe General-social Security Bank
UTB	Unique Trust Bank
TBL	Trust Bank Limited
ETI	Ecobank Transnational Incorporation
EWMA	Exponentially Weighted Moving Averages

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of Study

Stock market volatility is a well-researched issue in academia and has key factor for investor's decision making, thus has considerable influence on investor department in the market. Stock market volatility is the market risk confronted by investors and financial specialists who hold a business sector portfolio. With technological amendments, financial markets have become macrocosmic and facilely reached to whole world for investment. This led to interdependence among worldwide stock markets. Such interdependence has implicative insinuations for international diversification and even more during ecumenical volatility. Ineluctably volatility in international capital markets has additionally become the key issue for international investment strategy.

Behaviour of stock market is skeptical, volatile and probabilistic in spite of the fact that it is connected with the major macroeconomic pointers of the economy. The dependability of the stock market needs the solid capital market with high macro fundamentals. In the globalization age, the international trade surmises a key part in transmuting stock market efficiency in the regions of banking and finance. The extreme volatility in the stock market engenders instability in the capital market, destabilize the value of currency, and in integration hampers ecumenical trade and finance. Indeed, the development and the portion trading system instability are contrarily cognate where causality was found. A developed stock market ought to be on a very rudimental level more competitive with any other international stock markets in which floating exchange rate mechanism is resolute. The monetary and trade policy of a nation critically avail in discovering variables of stock market

volatility to work opportunely in spite of the fact that the examples of conduct of financial specialists and preservers of the partners are obscure where the political super structure and procedure of the economy are given. Be that as it may, the political variables may change parametrically. In spite of the fact that the reasons for stock market volatility are not surely kened, some engenderers recommend that hoisted stock market volatility may diminish future monetary action. Schwert (1989a) argues that stock market volatility, by reflecting skepticism about future cash flows and discount rates, provides paramount information about future economic activity. Campbell et al. (2001), citing work by Lilien (1982), reason that stock market volatility is cognate to structural transmutation in the economy

The conception of volatility in the stock market is characterized as a quantification for the size and the recurrence of fluctuations of the underlying asset's price for a duration (Maris, Pantou, Nikolopoulos, Pagourtzi and Assimakopoulos, 2004). According to Alexander (2001), implicatively insinuated volatility is the volatility forecast over the life of an option or future that equates an observed market price with the model price of an option while statistical volatility depends on the cull of statistical model, such as GARCH models, that is applied to historical asset returns data. In this way, the dubiousness about future stock value developments is quantified by the capriciousness. Subsequently, the desideratum to estimate and forecast volatility is one of the greatest issues for financial markets.

## **1.2 Statement of the Problem**

One of the primary issues of the stock market is the risk connected with high fluctuations in stock prices which are much past the plausible transmutations in the companies representing the stock. Variances in the Ghana Stock Exchange (GSE)

throughout the years have prompted diminished speculator confidence in the quota trading system. A hedging technique, for example, portfolio insurance is straightforwardly influenced by volatility level. This is because the prices of indemnification increase with volatility. Volatility makes investing in stocks more precarious. Volatility makes putting resources into stocks unsafe. The stock market (share trading system) is among the most volatile financial institution in business. On the off chance that one can presage the course of mazuma markets, the financial specialist has an astute thought of what's in store of the economy. According to Hamadu (2010), volatility modeling and forecasting have attracted much attention in recent years in emerging stock markets. However, modeling volatility and forecasting has not attracted much attention in some West African countries like Nigeria for the simple reason that the stock market is largely under developed Hamadu, (2010). Ghana shares a kindred condition.

### **1.3 Objectives of the study**

The main objective of the study is to use the Exponentially Weighted Moving Average (EWMA) to analyze daily data on banks listed on the Ghana Stock Exchange.

The specific objectives of the study are:

1. To analyze the volatility of share prices of banks listed on the Ghana Stock Exchange using EWMA models.
2. To determine the nature of volatility of share prices of banks listed on the Ghana stock Exchange
3. To analyze the correlation between these banks on the Ghana Stock Exchange.

## **1.4 Methodology**

Time series data of daily stock closing prices for sundry financial companies listed on the Ghana Stock Exchange market expanding from period, January 2015 to December 2015 will be used in the analysis. This time series will be used to calculate for the variance, mean return and the covariance. Other supplemental information shall be obtained from websites and journals on finance as deemed compulsory.

Due to the non-symmetric property of arithmetic mean of returns, geometric mean will be utilized in calculating the daily mean returns because it is symmetric as it takes into account the effect of perpetual compounding. As a consequence just like so many other studies calculating the portion price volatility in short run, we will utilize the standard measure daily prices/rate of change of indexes perpetually compounded.

Descriptive statistics will be utilized for comparative study and to underline the fundamental features of index daily logarithmic return series.

## **1.5 Significance of the Study**

The study will provide an insight into the stock performance of listed banks and additionally apprise policy makers on the issue of listing the rest of public banks on the Ghana stock exchange. It might likewise be subsidiary to policy makers, stock brokers and financial specialists in valuing, fortifying and portfolio administration. It will control forthcoming speculators on the decision of listed banks to invest in predicated on past stock market performance.

It might likewise be of much substance to approach policy makers, financial analysts, applied economists, business analysts, researchers and management teams

of companies in quest for corporate objectives to model volatility and precisely prognosticate it, in avail of concrete budgetary cuts to prepare for unexpected future events.

The study may likewise integrate to the literature on volatility of quotas of banks listed on the Ghana stock exchange. At last, this research work may offer an accumulation of information which can be tapped for future research works into comparative areas of studies.

### **1. 6. Organization of the Study**

The study will be divided into five chapters. Chapter one will comprise background of the study, Statement of the Problem, Objectives of the Study, Research Questions, and Significance of the Study. In chapter two presents theoretical and empirical literature for the study. Chapter three also will deal with the various methods that will be employed in carrying out the study. Chapter four will present data collection, analysis and discussion of findings. Finally, Chapter five gives summary of the major findings, conclusion, recommendations.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0 Introduction

The purpose of this chapter is to present the relevant theoretical and empirical literature on the volatility of share price of banks listed on the Ghana Stock Exchange. The reason is to provide theoretical basis for the study as well as the empirical measure for discussing the findings of the study. The chapter has two sections. The first section present theoretical issues on volatility, stock markets across the globe, and the financial market in Ghana (Financial Development system), the Ghana Stock Exchange and the profile of the bank sector. The final section presents the empirical literature relevant for the study.

#### 2.1 Volatility Modeling

A volatility model should be able to forecast volatility. Virtually all the financial utilizations of volatility models entail forecasting aspects of future returns. Typically, a volatility model is utilized to forecast the absolute magnitude of returns, but it may withal be habituated to presage quantiles or, in fact, the entire density. Such forecasts are utilized in risk management, derivative pricing and hedging, market making, market timing, portfolio cull and many other financial activities. In each, it is the predictability of volatility that is required. A peril manager must ken today the likelihood that his portfolio will decline in the future. An option trader will optate to ken the volatility that can be expected over the future life of the contract. To hedge this contract he will additionally want to ken how volatile is this forecast volatility. A portfolio manager may want to sell a stock or a portfolio afore it becomes too volatile. A market maker may want to set the bid–ask spread wider when the future is believed to be more volatile.

Much research has been devoted to modeling and forecasting the volatility of financial returns, and yet few theoretical models expound how volatility comes to subsist in the first place.

Roll (1984) shows that volatility is affected by market microstructure. Glosten and Milgrom (1985) shows that at least one source of volatility can be expounded by the liquidity provision process. When market makers infer the possibility of adverse cull, they adjust their trading ranges, which in turn increases the band of price oscillation. Investors care about volatility for the following reasons: The wider the swings in an investment's price, the harder emotionally it is to not worry;

1. Price volatility of a trading instrument can define position sizing in a portfolio;
2. When certain cash flows from selling a security are needed at a specific future date, higher volatility means a greater chance of a shortfall;
3. Higher volatility of returns while saving for retirement results in a wider distribution of possible final portfolio values;
4. Higher volatility of return when retired gives withdrawals a larger permanent impact on the portfolio's value;
5. Price volatility presents opportunities to buy assets cheaply and sell when overpriced.
6. Volatility affects pricing of options, being a parameter of the Black–Scholes model

## **2.2 Financial Market**

According to Mensah, (1997), financial market is an expansive term depicting any emporium where buyers and sellers take part in the trade of assets, for example, equities, bonds, currencies and derivatives. Financial markets are commonly

characterized by having transparent pricing, essential controls on exchanging, expenses and charges and market strengths deciding the costs of securities that exchange. Some financial markets just sanction participants that meet certain criteria, which can be factors like the amount of money held, the investor's geographical location, knowledge of the markets or the vocation of the participant. The types of financial markets are:

1. Capital markets which to comprise of Stock markets, which give financing through the issuance of shares or money stock, and empower the resulting exchanging thereof and Bond markets, which give financing through the issuance of securities, and empower the subsequent trading thereof.
2. Commodity markets, which smoothen the trading of commodities.
3. Money markets, which supply short term debt financing and investment.
4. Futures markets, which supply normalized forward contracts for trading products at some expected date; see also forward market.
5. Derivatives markets, which supply instruments for the administration of financial risk.
6. Foreign exchange markets, which smoothen the trading of foreign exchange.
7. Insurance markets, which smoothen the redistribution of different risks.
8. Spot market
9. Interbanks market

The capital markets may likewise be dissevered into primary markets and secondary markets. Recently composed (issued) securities are purchased or sold in primary markets, for example, during initial public offerings. Secondary markets sanction financial specialists to purchase and offer subsisting securities. The exchanges in

essential markets subsist amongst issuers and investors, while secondary market transactions subsist among speculators.

Liquidity is a consequential part of securities that are traded in secondary markets.

Liquidity alludes to the simplicity with which a security can be sold without lost worth. Securities with an active secondary market implicatively insinuate that there are numerous purchasers and venders at a given point in time. Investors benefit from liquid securities since they can offer their benefits at whatever point they require; an illiquid security may constrain the dealer to dispose of their benefit at a prodigious markdown.

Financial markets bolster capital arrangement by providing investors with chances to rapidly change over their investments to mazuma. Ghana's mazuma cognate framework has advanced throughout the year's privilege from the pilgrim time through the auxiliary changes time frame through to the bulwarked periods. The prompt post-liberation period was described by Import Licensing: An exhaustive arrangement of import sanctioning was organized in November 1961, this administration of import sanctioning kept going until trade controls came in.

The Exchange Control Act of 1961 came in with control that prompted confinements on financing costs. The sharp crumbling in Ghana's economy in the 1970s put earnest weights on the mazuma cognate framework. There were solid designations of extreme mazuma cognate suppression (McKinnon 1973 referred to in Mensah, 1997). Inside this same period, the non-bank budgetary part was generally undeveloped. The State Indemnification Corporation (SIC) was set up in 1962 and given an imposing business model over the administration division. The National Trust Holding Company (NTHC) was built up by authoritative instrument in 1976 to work as a national prevalent asset. The targets were to utilize NTHC to bolster the administration's indigenization program. NTHC procured the quotas of

outside organizations and sold them to Ghanaians in what was rudimentally an over-the-counter market, the first and final one of its kind in Ghana at the time.

By the tardy 1980s, the World Bank and the Ghana Regime had concurred that a vicissitude and reconstituting of the cash cognate framework was essential to a fruitful financial recuperation program. With specialized and budgetary avail from the IDA, the legislature set out upon a Financial Sector Reform Program in 1988. While endeavoring to spare the circumstance by reconstituting the preserving cash division, energize the development of non-bank budgetary organizations and to transmute showcases, the Financial Sector Adjustment Program (FINSAP) in 1988 initiated.

The goals of the project were: To endeavor the reconstituting of fiscally upset banks; to upgrade the soundness of the managing an account framework through an enhanced administrative and supervisory structure; to enhance the preparation and allotment of monetary assets – including the amelioration of cash and capital markets.

These advancements prompted the establishment of various non-bank financial institutions in the nation. An immensely colossal region of progress has been the expeditious development of the non-bank cash cognate organizations with the auxiliary conformity and liberalization of the economy. Since 1987, 39 non bank financial institutions have been sanctioned as takes after: Discount houses, Finance houses, Leasing and Hire buy organizations, Venture Capital Funds, Mortgage account organizations, Savings and Loans organizations, Stock Exchange and Stock Brokerage organizations.

In 1993, the Financial Institutions (Non-Banking) Law was passed to give a lawful system to a radical incipient arrangement of mazuma cognate organizations that were being built up. The development of the non bank financial sector was given

an immensely colossal avail in 1995, when the Regime of Ghana, with the backing of a \$25 million IDA credit built up a project to ameliorate the inhibition of the non bank mazuma financial sector. The Non-Bank Financial Institutions Assistance Credit addresses gaps in the immensely colossal formal sector non-bank Financial Sector:

1. Capital Market Institutions (Ghana Stock Exchange, Securities Regulatory Commission and the Bank of Ghana NBFID Department)
2. The Contractual Savings Industry (National Insurance Commission, State Insurance Company, Ghana Reinsurance Organization, Social Security and National Insurance Trust)
3. Associated Financial Infrastructure (Domestic payments system, School of Administration of the University of Ghana, Institute of Chartered Accountants of Ghana and Home Finance Company).

The reform measures instituted culminated in augmenting the banking sector balanced sheet. Private sector credit to GDP expanded altruistically amid the period of financial sector liberalization. The proportion of 2.70 % in 1983 registered appreciable boost to 14.20% in 2000 and 26.70% afore the cessation of 2010 (Bank of Ghana, 2011). A rudimentary audit of the financial deepening designators demonstrated that the Ghanaian monetary framework proximately collapsed somewhere around 1982 and 1987 preceding the World Bank availed reform commenced. The monetary part has enhanced colossally since 1987 to date. The deposits to GDP ratio which grew from 7.80% in 1983 to 16.90% in 2000 perpetuated to register vigorous magnification and was 45.60% in 2010 (Bank of Ghana, 2011).

### 2.3 Stock Markets

Stock market is the market in which quotas of openly held companies are issued and exchanged either through exchanges or over-the-counter markets. Otherwise called the equity market, the stock market is a standout amongst the most essential segments of a free-market economy, as it gives organizations access to capital in reciprocation for giving investors a cut of possession in the organization. The stock market makes it conceivable to develop initial sums of cash into vast ones, and to wind up affluent without going out on a limb of beginning a business or making the penances that customarily go with a lucrative profession.

The stock markets gives investors a chance to take an interest in the monetary accomplishments of the organizations whose shares they hold. At the point when organizations are productive, stock market investor's profit through the dividends the organizations pay out and by offering appreciated stocks at a benefit called a capital gain. The drawback is that investors can lose cash if the organizations whose stocks they hold lose cash, the stocks' costs goes down and the investor sells the stocks in a state of disorientation. The stock market system can be divided into two fundamental areas: the primary market and the secondary market. The primary market is the place incipient issues are first sold through beginning open offerings. Institutional investors customarily buy a sizably voluminous portion of these portions from investment banks. All consequent exchanging goes ahead in the secondary market where members incorporate both institutional and individual financial investors.

Stocks can be arranged in different ways. One mundane way is by the nation where the organization is domiciled. For instance, CAL Bank and Standard Chartered Bank Ghana are domiciled in Ghana, so they might be considered as a feature of

the Ghana securities exchange. At the terminus of 2012, the extent of the world securities exchange (all out business sector capitalization) was about US\$55 trillion.

By nation, the most sizably voluminous business sector was the Cumulated States (around 34%), trailed by Japan (around 6%) and the United Kingdom (around 6%). This went up adscititious in 2013.

#### **2.4 The Ghana Stock Exchange Market**

In 1969, the Commonwealth Development Finance Company Ltd. suggested the substructure of a securities exchange within 2 years in its Pearl Report. In 1971, the Accra Stock Exchange Act was passed and the Accra Stock Exchange Company was enlisted but it never got to be operational. In 1989, the procedure to establish the Ghana Stock Exchange (GSE) was commenced culminating in the initiation of exchanging 1990 and its official dispatch the next year.

Since its commencement, the GSE's postings have been incorporated into the main index, the GSE All-Share Index. In 1993, the GSE was the 6th best index performing emerging stock market, with a capital valuation for 116%. In 1994 it was the best record performing securities exchange among all developing markets, incrementing 124.3% in its list level. 1995's record development was a frustrating 6.3%, incompletely as a result of high expansion and loan fees. Development of the list for 1997 was 42%, and toward the cessation of 1998 it was 868.35 (optically discern the 1998 Review for more data). As of October 2006 the business sector capitalization of the Ghana Stock Exchange was around 111,500 billion cedis (\$11.5 billion).

From January to July 2013, the GSE Composite Index remains at 61.39%, as against 6.06% for the entire of 2012. The GSE Financial Stock Index similarly remains at 61.66%, as against 0.53% for the whole 2012. Consummate business sector

capitalisation of the bank for the period under survey remains at GH¢55.78 billion as against GH¢54.95 billion in 2012 with household capitalization multiplying from GH¢5.57 billion to GH¢10.57 billion. Consummate volume of exchange is similarly on the ascent. At the terminus of business on July 31, 2015, absolute exchange remained at GH¢209.16 million as against GH¢218.13 million, for the entire of a year ago. As far as quality, aggregate exchange remains at GH¢230.51 million, as against GH¢102.2 million for the entire of 2015. Looking into the business sector, Bloomberg and other macrocosmic news wire administration depicted the business sector as "best performing market in Sub-Saharan Africa". Recorded organizations likewise recorded immensely colossal cost increments amid the main half year. Out of the 34 organizations, CAL drove the gainers with 194 for every penny took after by EGL with 191 for each penny, BOPP, 150 for each penny, GCB, 134 for each penny, and PZC, 122 for every penny.

The assembling and brewing sectors have subjugate the exchange. A distant third is the Banking industries while other listed organizations fall into the indemnification, mining and petroleum sectors. The majority of the listed organizations on the GSE are Ghanaian, however there are some multinationals additionally.

In spite of the fact that non-resident investors can bargain in securities recorded on the trade without getting earlier trade control sanction, there are a few inhibitions on portfolio investors not denizen in Ghana. The current limits on all types of nondenizen investor holdings (be they institutional or individual) are as per the following: a single investor (i.e. one who is not a Ghanaian and who lives outside the nation) is sanctioned to hold up to 10% of equity. Besides, for all equity, peregrine investors may hold up to an aggregate of 74% (in exceptional circumstances, this point of confinement might be waived). The circumscriptions

additionally omit trade in Ashanti Goldfields shares. These restrictions were nullified by the Peregrine Exchange Act, 2006 (Act 723).

There is an 8% withholding tax on dividend income for all investors. Capital gains on securities listed on the exchange will remain exempt from tax until 2015. The exemption of capital gains applies to all investors on the exchange. There are no exchange control regulations on the remittance of pristine investment capital, capital gains, interest payments, dividends, returns and other cognate earnings.

Potential changes at the exchange include the exordium of automated trading and the listing of some state banks. The Bank of Ghana plans the development of mutual fund unit trusts and municipal bonds at a subsequent date. These transmutations are aimed at making the exchange more pertinent, efficient and efficacious. The exchange was additionally involved in preparing the draft law on collective investment conveyances.

## **2.5 Ghana Stock Exchange Composite Index and Financial Stock Index**

Ghana Stock Exchange Composite Index, GSE-CI is a major stock market index which tracks the execution of all organizations traded in the Ghana Stock Exchange. The computation of the GSE Composite Index (GSE-CI) depends on the volume weighted average closing price of all listed stocks. All standard shares recorded on GSE are incorporated into the GSE-CI at total market capitalization, except for those of listed organizations that have shares listed on different markets. The GSECI is a market capitalization weighted index, i.e. every constituent is given weight as per its market capitalization. The base date for the GSE-CI is December 31, 2010 and the base index value is 1000.

The GSE-CI had a consequential increase of 0.27% (4.8 points) on Friday May 20 as from the antecedent trading session. GSE-CI Index lost 561.6 points or 24.02 percent during the last 12 months from 2,338.63 points in May of 2015. Generally, the Ghana Stock Exchange Composite Index, GSE-CI achieved an unsurpassed high of 2440.80 in February of 2014 and a record low of 940.04 in December of 2011.

The GSE Financial Stocks Index (GSE-FSI) has its constituents as listed stocks from the financial sector including banking and indemnification sector stocks. All customary portions of the financial stocks recorded on GSE are incorporated into the GSE-FSI at total market capitalization, with the exception of those stocks which are recorded on different markets. The base date of GSE-FSI is withal December 31, 2010 and the base index value is 1000.

## **2.6 Structure of Ghana Stock Exchange**

The GSE is presided by a Council (Board of Directors) with supervisory task that sets its plans. It is comprised of presentation from Licensed Dealing Members, Listed Companies, the banks, Indemnification Companies, Mazuma Market and the general public. An ex-officio part accommodates as the Managing Director of the Exchange and heads the administration staff whose obligation is the everyday administration of the GSE, availed by the Deputy Managing Director. Different obligations of this administration staff are sanctioning postings, counteracting misrepresentation and misbehaviors, keeping up great request among individuals and managing securities exchange business.

Enrollments to GES are either corporate bodies or people assembled into relegations. They are the Licensed Dealing Members(LDM), Associate Members and Regime Securities Dealers (PDs). A LDM is a corporate body sanctioned by

the Exchange to bargain in all securities. An Associate part is an individual or corporate body which has consummated the Exchange's enrollment pre-requisites yet is not sanctioned to bargain in securities. A PD is a corporate body, which is affirmed by the Bank of Ghana and enlisted by the Exchange to bargain only in regime securities.

## **2.7 Automation of Ghana Stock Exchange Activities**

Official trading activities on the GSE transpires each working day. Official uninterrupted trading transpires between the hours of 10:00am and 15:00pm every working day of the week aside from Saturdays, Sundays and occasions promulgated by the trade ahead of time. The trade however has pre-market sessions from 9:30am to 10:00am.

GSE utilizes an electronic exchanging stage called the GSE Automated Trading System (GATS). Exchanging is done on the Floor of the Exchange each working day. Some organizations, akin to the Ashanti Goldfields Company sanction over the counter exchanging.

The closing prices of equities listed on the stock market are computed utilizing the volume weighted average price of each single equity for each given trading day since January 4, 2011. An electronic online application is utilized in the settlement of exchanges. Settlement transpires 3 business days (T+3) after the exchange date. The framework takes into account mundane settlement of exchange on T+0 or T+1 premise. On settlement dates shares are moved naturally to customer's records in the store framework and the agents settlement account charged.

### **2.1.0. Performance Evaluators/Indices**

The GSE performance indices are the GSE ALL Share Index and the Databank Stock Index (DSI). The Strategic African Securities Constrained has recently published three incipient indices, namely the SAS Index (SASI), SAS Manufacturing Index (SAS-MI) and SAS Financial Index (SAS-FI).

The performance of market, quantified by the all Share Index perpetuated to fluctuate in reciprocations just like all other exchanges.

### **2.8 Regulations**

The Securities Industry Law (S.I.L.), P.N.D.C.L. 333, of 1993 is by far the most consequential legislation in this sector of the economy partly due to its intended scope of coverage and its regulations in the securities. As umbrella legislation, it covers all facets of the securities industry. Companies who need to operate under the Companies Code, 1963(Act 179) and those operating on the GSE under the enacted trading regulations. Other than these groups of people and their regulations, trading was unregulated until the exordium of the S.I.L.

The Securities and Exchange Commission otherwise kenneed as the Securities Regulatory Commission (S.R.C.) accommodates as the pivotal regulatory body in the securities market. This is according to the S.I.L. In order to ascertain orderly, fair and equitable dealing in securities, they are to maintain surveillance over the securities business. They are additionally to bulwark the integrity of the securities markets against any abuses arising from the practice of insider trading. They withal register, license, sanction or regulate the Stock Exchange, investment advisors, unit trusts, mutual funds and securities dealers.

### **2.1.2 Banks Listed on the Ghana Stock Exchange**

The advancements that described the financial system amid periods 1960s to 1980s prepared the way for listing of banks on the GSE and as at end December 2010, six (6) banks were recorded on the GSE. Regime has shares in 14 of the ecumenical banks and shareholding of 50% in 5 banks as betokened by Amediku, 2013. Security Exchange Commission (SEC) gives observation over the securities market through sanctioning and control of unit trust, mutual fund, securities dealers, and investment advisers. Right now, GSE has nine (9) listed banks with the adscititious listing of Agricultural Development Bank circumscribed.

### **2.1.3 Empirical Literature**

Literature on volatility is broad, as volatility is the principle thought for individual, institutional and additionally international investors to settle on any investment cull. Du and Budescu, (2007) while investigating the investor conduct with veneration to volatility designated out less certainty to high volatility and past volatility as a jeopardy measure, so volatility analysis can give insights of cognizance to investors as volatility in the stock market quantitatively measures the peril which is key determinant in the appraisal of cost of capital, investment and leverage decision Chukwuogor & Freidan, (2007)

Ahmed and Suliman (2011) utilizes the Generalized Autoregressive Conditional Heteroscedastic models to estimate volatility (conditional variance) in the circadian returns of the main stock exchange of Sudan namely, Khartoum Stock Exchange (KSE) over the period from January 2006 to November 2010. The models incorporate both symmetric and assymmetric models that capture the most widely apperceived stylized facts about index returns such as volatility clustering and leverage effect. The observational results demonstrate that the conditional variance

process is exceptionally sedulous (explosive process), and give proof on the presence of peril premium for the KSE index return series which bolster the positive correlation hypothesis amongst volatility and the expected stock returns. Their findings supplementally revealed that the asymmetric models give preferred fit over the symmetric models, which affirms the presence of leverage effect. These outcomes, by and immensely colossal, demystify that high volatility of index return series is available in Sudanese stock exchange over the sample time frame.

In their print, Diebold and Yilmaz (2007) gave a rudimental and instinctive measure of relationship of asset returns and/or volatilities. Categorically, we formulate and analyze exact and isolate measures of return spillovers and volatility spillovers. Our system emboldens investigation of both non-crisis and crisis episodes, including trends and bursts in spillovers, and both end up being precisely essential.

Categorically, in an analysis of sixteen ecumenical equity markets from the mid 1990s to the present, we discover striking corroboration of divergent demeanor in the dynamics of return spillovers vs. volatility spillovers: Return spillovers show a delicately expanding trend but no bursts, whereas volatility spillovers exhibit no trend but clear bursts.

Omari-Sasu, Frempong, Boateng and Boadi (2015) inspected and modeled stock market volatility of financial return series for three listed equities on the Ghana Stock Exchange (GSE). A historical data from 25th June 2007 to 31st October 2014 was considered for the examination. The arrangement for each of the three values was tested for stationarity utilizing the KPSS test. Series observed to be nonstationary were transmuted to be stationary. The study fitted a GARCH (p, q) model for instability. GARCH (1, 1), GARCH (1, 2), GARCH (2, 1) and the GARCH (2, 2) models were fitted to residual series of approximately three values.

Results unearthed the presence of volatilities in all three equities and additionally showed that volatility though present was not assiduous in the three equities. For each of the organizations under study, the GARCH (1, 1) model was found to outflank the other three models taking into account the correlation of the AICc for every model.

The study prescribed the utilization and correlation of different variations of the GARCH model in estimation of volatility.

At the 12th National Convention on Statistics at the Philippines, Crisostmo et al. (2013) unearthed that the Philippine stock market is one of the earliest exchanges established in Asia and has an affluent history of events that have contributed to its development. It is additionally considered as an indicator of future economic performance, and for a considerable length of time has accommodated its essential elements of inspiring the double part of capital raising for organizations and exchanging of shares by investors. The paper investigates an in-depth visually examine available historical data since the accumulation of the past two stock trades. The time series data gives bits of erudition on the advancement of cash markets, and how some of its qualities persevere while some are experiencing perpetual changes. At last, the paper inspects a few studies that propose the portion trading system's relationship to financial development and presents cross-country stock market development ratios that can accommodate as hop off focuses for further examination and study.

According to Hamadu (2010), volatility modelling and forecasting have magnetized much attention in recent years in emerging stock markets. However, modelling volatility and forecasting has not magnetized much attention in some West African

countries like Nigeria for the simple reason that the stock market is largely under developed (Hamadu, 2010). Ghana shares a homogeneous condition.

Chen, Roll, & Ross (1986) attempted to expound stock price volatility by referring only to the vicissitudes in economic data. Their study investigated the reaction of the stock market to innovations in some macroeconomic variables. Then, Schwert (1989) analyzed the cognition of stock volatility with authentic and nominal macroeconomic volatility, economic activity, financial leverage, and stock trading activity to evaluate why the stock market volatility changes over time.

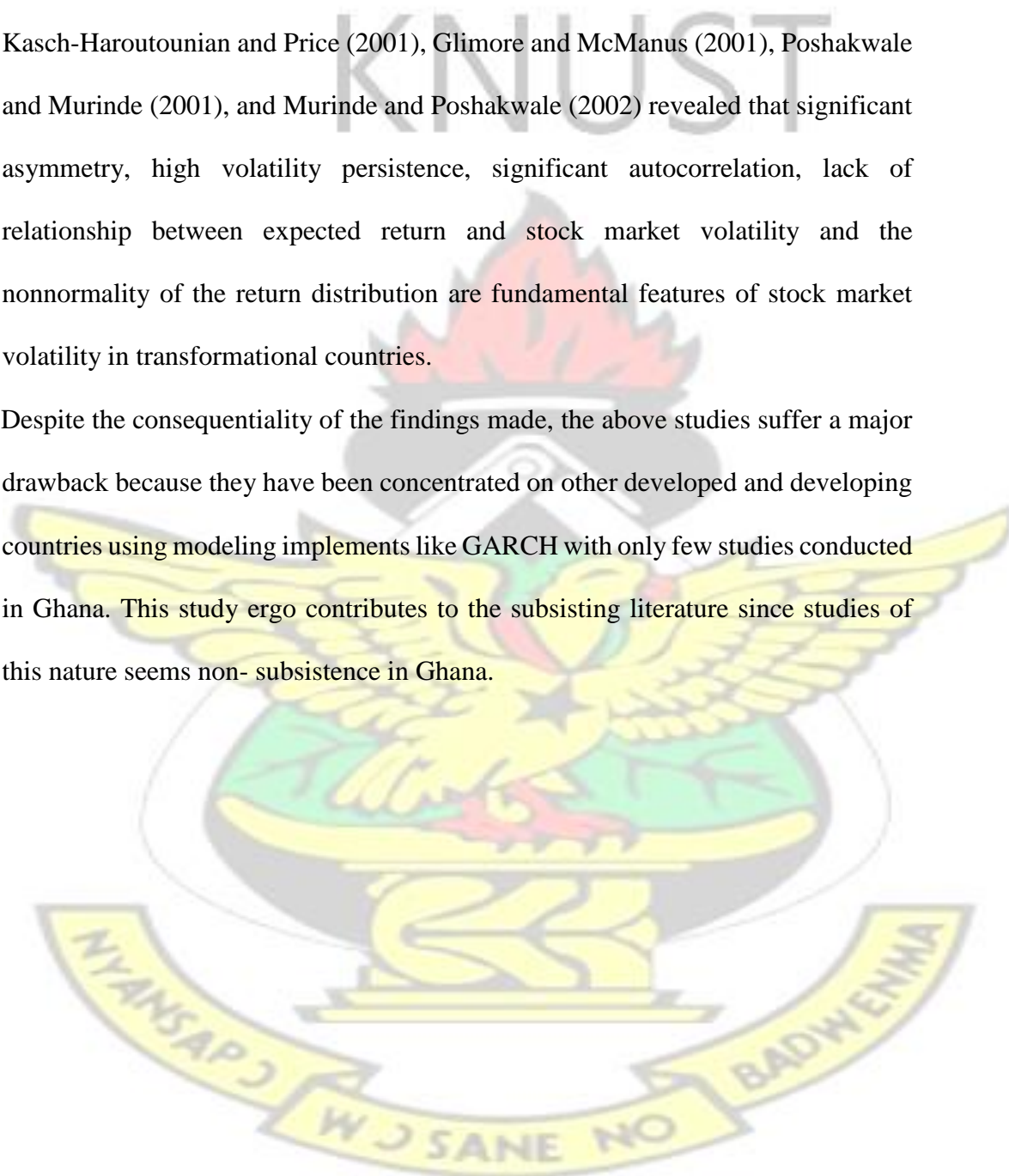
Harvey (1995a) described the high volatility of returns by: high risk exposures to volatile economic factors, lack of diversification in the country index, and timevariation in the jeopardy exposures and/or incomplete integration into world capital market.

Harvey (1995b) revealed that the serial correlation in emerging markets returns are much more vigorous than that described in developed markets. Harvey described this feature as a lack of diversification and with the fact that trading depth persuades fictitiously unauthentic serial correlation. There are emerging markets not entirely integrated into the world capital market. Factors that play a component in market integration are free access by domestic investors to international capital markets and free access by foreigners to domestic capital markets and. Potential barriers to integration come in the form of: access, taxes, and information.

Balaban, Bayar, and Faff (2003) prognosticated stock market volatility of fourteen stock markets. They used eleven models, symmetric and asymmetric loss functions to assess the performance of these models. From the symmetric loss functions utilized, it is the exponential smoothing model that gives the best forecast. Nevertheless, when asymmetric loss functions are implemented, the ARCH-type models give the optimal forecast.

Harvey (1995b) revealed that the serial correlation in emerging markets returns are much stronger than that noticed in developed markets. Harvey described this feature as a lack of diversification and with the fact that Recently, a number of authors have researched into the volatility of Central and Eastern European stock markets. Kasch-Haroutounian and Price (2001), Glimore and McManus (2001), Poshakwale and Murinde (2001), and Murinde and Poshakwale (2002) revealed that significant asymmetry, high volatility persistence, significant autocorrelation, lack of relationship between expected return and stock market volatility and the nonnormality of the return distribution are fundamental features of stock market volatility in transformational countries.

Despite the consequentiality of the findings made, the above studies suffer a major drawback because they have been concentrated on other developed and developing countries using modeling implements like GARCH with only few studies conducted in Ghana. This study ergo contributes to the subsisting literature since studies of this nature seems non- subsistence in Ghana.



## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.0 Introduction**

Financial time series have the tendency to volatility clustering. This means periods of high and low market uncertainty. This section presents the research design, population, data source, EWMA Model used for the study.

#### **3.1 Profile of banking sector of the Ghana Stock Exchange**

The financial sector on the Ghana stock exchange includes banking and nonbanking stocks. For the purport of our analysis and the time frame for our data, nine (9) banks on the Ghana stock exchange were utilized and this banks operate in the country. These banks includes CAL Bank (CAL), Ecobank Ghana (EBG), Ghana Commercial Bank (GCB), Ecobank Transnational Incorporation (ETI), Trust Bank Inhibited(TBL), HFC Bank (HFC), Standard Chartered Bank (SCB), “SocieteGenerale-Convivial Security Bank,” (SG-SSB) and UT Bank (UTB). Cal Bank commenced operations in July 1990 providing world class financial solutions to the Ghanaian banking sector. Cal Bank received its ecumenical banking license in 2004 and anon commenced providing specialized retail banking accommodations. It is one of the commercial bank licensed by the Bank of Ghana. Ecobank of Ghana is a member of the Pan-African Ecobank chain which operates in thirty-two (32) countries. The bank was composed in 1990. Ghana commercial bank was founded in 1953, with 27 employees, as the bank of Gold Coast. Initially, it fixated on accommodating Ghanaian traders, farmers and business people who could not obtain financial support from the expatriate banks. On September 17,

1996, HFC issued the first corporate bank (HFC Housebank) on the Ghana stock exchange with a shelf registration of 36 million US dollars to finance peregrine currency mortgages. Standard Chartered Bank Constrained is a banking and financial accommodations company in Ghana; it is an 80% subsidiary of Standard Chartered Bank; it is the fourth most immensely colossal bank in Ghana. The bank stock is listed on the Ghana Stock Exchange and is traded under the symbol: SGSSB.UT financial accommodations were a non- bank financial accommodation provider (NBFI). In Ghana, this was incorporated in 1977. Overtime, the NBFI acquired subsidiaries and was listed on the Ghana Stock Exchange under its holding company, UT Holdings Constrained. In 2008, UT holdings Inhibited acquired majority. UT Bank Ghana Constrained commonly kened as UT Bank (UTB) is a commercial bank in Ghana. As of February 2011, the bank is one of the commercial banks licensed by Bank of Ghana.

### **3.2 Research Design**

The approach to this study is visually examined from the inductive perspective. Inductive research commences with an observation of a phenomenon in an environment, then data is accumulated upon which a theory is developed or generalization is made. Time series data is utilized for this study. A basic assumption of classical time series analysis is that successive values in the data represent consecutive quantifications taken at equally spaced time intervals.

The technique of time series analysis was the main implement utilized in the identification and understanding of an already subsisting pattern or structure embedded in the data.

### 3.3 Population

The data and population for this study consists of daily share prices of all the banks listed on the Ghana Stock Exchange (GSE).

### 3.4 Data source

Data for all variables are daily observations with spanning time period from January 2015 to December 2015, making a total of 246 observations obtained from Ghana Stock Exchange. The focus of the study was on individual banks level analysis, in which share prices for CAL Bank (CAL), Ecobank Ghana (EBG), Ghana Commercial Bank (GCB), Ecobank Transnational Incorporation (ETI), Trust Bank Limited (TBL), HFC Bank (HFC), Standard Chartered Bank (SCB), “SocieteGenerale-Social Security Bank,” (SG-SSB) and UT Bank (UTB). were examined separately. The study also conducted sector level analysis.

### 3.5 Volatility

The most widely accepted approach to risk in financial markets fixates on the quantification of volatility in certain return distributions. The volatility of portfolio returns depends on the variances and covariances between the jeopardy factors of the portfolio, sensitivities are withal quantified by variances and covariances.

Volatility is customarily quoted as an annualized percentage standard deviation:

$$\text{volatility at time } t = (100 \sigma_t \sqrt{B})\%$$

where B denotes the number of observations per year. We do this so that volatilities of different maturities may be compared on the same scale – as the variance increases with the holding period, so the annualizing factor decreases. In this way volatilities are standardized.

### 3.6 Correlation

It is more facile to describe the co-movement of two assets as a correlation rather than covariance. Correlation summarizes the relationship of one asset to other assets. A correlation between assets can be positively correlated, negatively correlated or may have no correlation between them. The peril is greatest when the correlation coefficient is 1. We consider a portfolio of two assets and write the variance  $\sigma_p^2$  of our portfolio as a function of weights ( $w_1, w_2$ ).

$$\sigma_p^2 = (\sigma_1 w_1)^2 + (\sigma_2 w_2)^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2$$

( $w_1, w_2$ ) is subject to constraints:

$$\square w_1 + w_2 = 1$$

$$\square \forall_i, w_i \geq 0$$

We replace  $w_2$  by  $(1 - w_1)$ , giving us the following expressions of  $\sigma_p$ :

$$\sigma_p^2 = (\sigma_1 w_1)^2 + (\sigma_2 (1 - w_1))^2 + 2w_1 (1 - w_1) \rho_{12} \sigma_1 \sigma_2$$

Perfect Correlation between assets, ( $\rho_{ij} = +1$ )

$$\sigma_p^2 = (\sigma_1 w_1)^2 + (\sigma_2 (1 - w_1))^2 + 2w_1 (1 - w_1) \sigma_1 \sigma_2$$

which factorizes into:

$$\sigma_p^2 = (\sigma_1 w_1 + \sigma_2 (1 - w_1))^2 = \sum_{i=1}^n \sigma_i w_i$$

In this special case, the Portfolio standard deviation is the weighted average of asset standard deviations. Hence the maximal portfolio standard deviation is the simple weighted average of component standard deviations when  $\rho=1$ . In simple terms, the variance of a portfolio is greatest when  $\rho_{ij} = +1$ . So for any other  $\rho$  there will be a lower  $\sigma_p^2$

No Correlation between assets, ( $\rho_{ij} = 0$ )

$$\sigma_p^2 = (\sigma_1 w_1 + \sigma_2(1 - w_1))^2 = \sum_{i=1}^n \sigma_i^2 w_i^2$$

A correlation coefficient of zero means that there is no linear relationship between the two stocks' returns.

Perfect Anti-Correlation between assets, ( $\rho_{ij} = -1$ )

$$\sigma_p^2 = (\sigma_1 w_1)^2 + (\sigma_2(1 - w_1))^2 - 2w_1(1 - w_1)\sigma_1\sigma_2$$

$$\sigma_p^2 = (\sigma_1 w_1 - \sigma_2(1 - w_1))^2$$

$$\sigma_p^2 = |(\sigma_1 w_1 - \sigma_2(1 - w_1))|$$

If we choose  $w_1 = \frac{\sigma_2}{\sigma_1 + \sigma_2}$ ;

$$\sigma_p = \frac{\sigma_2}{\sigma_1 + \sigma_2} \sigma_1 - \left(1 - \frac{\sigma_2}{\sigma_1 + \sigma_2}\right) \sigma_2$$

$$\sigma_p = \frac{\sigma_1 \sigma_2 - \sigma_2^2 - \sigma_1 \sigma_2 + \sigma_2^2}{\sigma_1 + \sigma_2}$$

$$\sigma_p = 0$$

This implicatively insinuates that if assets are impeccably negatively correlated, the portfolio has zero variance.

Volatilities and correlations are just standardized forms of the variances and covariances between returns, so the information obligatory to quantify portfolio risk is customarily summarized in a covariance matrix.

### 3.7 Asset Prices and Return

There are many approaches to make money and even more ways to lose it. You can wager on horse races and play soccer. Our concentration will be making money on the financial market. Financial market is a general term. There subsist markets for

stocks, bonds, for money, oil, wheat, indemnification, the weather. If an investor has enough money, he or she will always find a financial institution ready to take the other side of your bet.

### 3.7.1 Stocks

When an investor buys a stock, the investor buys diminutive part of the firm that issued the stock. If Adinkra Automobile Company issues 1000 shares and an investor buys 10 of those portions for 1000 Cedis, the investor would be the rightful owner of 1% of Adinkra Automobile Company. Depending on the kind of stock, the investor will have a 1% stake in the voting rights and are entitled to 1% of future returns.

Adinkra Automobile Company might expand wildly, transmute its brand denomination, get an incipient brand logo and make the investor opulent. Or perhaps people will stop purchasing Adinkra Conveyances and take up Toyota cars instead, in which case you might as well have bought 10 shares. More likely, the outcome will be somewhere in between. If Adinkra Automobile operates well, and the investor's quota of the profits for the year is 100 cedis, then the investor made a 10% return on his/her investment. Is this amount of return worth the investment?

You took the jeopardy of visually perceiving Adinkra's go insolvent and lose all your mazuma. You could additionally have become an owner of automobiles. And both settings might still come true in future years. So the value of the investor's investment depends on the construal of the future, the automobile industries and your take on Toyota cars. Now if the investor wants to sell his/her stock, he/she has to find a buyer who concurs to his/her price. This may not generally be simple.

Others may have an alternate thought on Adinkra's automobile or Toyota cars. The investor might not find a buyer, or he/she might find a buyer who accedes to a reduced price. If the investor has to sell and there is only a buyer, he/she will have to accede and he/she is liable to lose money. This is called liquidity risk. Financial markets decrease this risk, by bringing buyers and sellers together, with hopes of incrementing the amount of trading done and making it more frugal to do so.

### 3.7.2 Prices and returns

While Adinkra Automobile is not quoted on any major exchanges that we know of, Ghana Commercial Bank (GCB) is. We shall use GCB stock to define the terms we will be using throughout this book.

#### Prices

We shall refer to the price of an asset at time  $t$  as  $P_t$ . The closing prices are always taken either at the terminus of the day, the terminus of the week or the cessation of the month. We will periodically refer to logprices, which we define as:

$$\log p_t = \log(p_t)$$

Asset prices have a propensity to shift a considerable measure in a day, less on a week after week premise. The less customarily you sample prices, the smoother your price curve gets. One method for saying this is there is a plethora of noise in the market and that you can smooth this out by taking more extensive time periods.

#### Returns

The return of an asset is the relative change in its worth after some time, whether the price of an asset has expanded (positive return) or diminished (negative return).

The return of an asset in applications of finance is normally controlled on the thought of the Estimated Return.

The return on a stock at time,  $t$  is defined mathematically from time  $t - 1$  to  $t$  as:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Where  $P_t$  is the price at time,  $t$  and  $P_{t-1}$  is the price at time  $t - 1$ . Suppose, the dividend of the stock portfolio is given by  $Div_t$ , then

$$R_t = \frac{P_t - P_{t-1} + Div_t}{P_{t-1}}$$

### Log Returns

For a small change in price at time,  $t$  of  $P_t$ , we have  $P_t \approx P_{t-1}$  and the return at time,  $t$  is very small:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - \frac{P_{t-1}}{P_{t-1}}$$
$$R_t = \frac{P_t}{P_{t-1}} - 1 \approx 0$$

For a small  $x$ , the following first order approximation:

$$\log(1 + x) \approx x$$

Alternatively, for small price variations, it can also be written:

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

## 3.8 Methods for Data Analysis

This section presents the methods used for the data analysis and other methods that can also be used to model volatility of share prices.

### 3.8.1 Moving Averages

The moving average may be the most universal of all technical analysis indicators. While it is tempting to dismiss the moving average as antiquated its staying power is testament to its utility.

Initially, the only type of moving average was a simple arithmetic average, easy to understand and quick to calculate. This made it a standout in a world of technical analysis that predated computers. With the evolution of computerized technical analysis, a variety of additional averaging formulas have entered the mainstream.

All moving averages use a historical data series and the current price in the calculation. Since the goal is to forecast future price direction, would it be more effective to give greater weight to the more recent data points in the price series? This Analysis Concepts paper attempts to address the three most common moving average formulas: simple, weighted and exponential.

We begin with a comparison of the calculations of a simple arithmetic average, a weighted average and an exponential average. This includes an understanding of the impact that each data point has in the calculation since that is at the logical and mathematical heart of these averages.

A moving average is calculated by averaging price values from a specified number of bars. Specifically, there are two parameters (inputs) for a moving average formula:

Price, a single price value from each bar to be used in calculating the average.

Traditionally, the price value used is the closing price of each bar.

Length, the specified number of bars, counting backwards from the current, or most recent, bar from which to draw the data points.

The “moving” part of a moving average is not actually in any of the formulas. As each new bar is built, the oldest data point is dropped from the series (or its impact is reduced) and the price value from the new bar is added to the series.

There are some common values for the length of a moving average but the choice is generally both subjective and relative. That is, some traders may choose a length based on their own experience or the number of bars in a day or week. Traders who use multiple moving averages will set the lengths relative to each other so that one is a shorter length and therefore more sensitive to recent price movement, and another is longer and therefore smoother.

The items above are common to all moving averages. The difference between simple, weighted and exponential averages comes from the weights, if any, that are assigned to each of the price values in the data series. This is not a minor point, either mathematically or analytically.

### **3.8.2 Equally Weighted Moving Average**

We describe how volatility and correlation are estimated and forecast by applying equal weights to certain historical time series data. The Equally Weighted Moving Average models should be used as an indication of the possible range for long-term volatility and correlation. The Equally Weighted Moving Average models are of

dubious validity for short-term volatility and correlation forecasting. In the following, for simplicity, we assume that the mean return is zero and that returns are measured at the daily frequency, unless specifically stated otherwise. A zero mean return is a standard assumption for risk assessments based on time series of daily data, but if returns are measured over longer intervals it may not be very realistic. Then the equally weighted estimate of the variance of returns is the average of the squared returns and the corresponding volatility estimate is the square root of this expressed as an annual percentage. The equally weighted estimate of the covariance of two returns is the average of the cross products of returns and the equally weighted estimate of their correlation is the ratio of the covariance to the square root of the product of the two variances. Equal weighting of historical data was the first widely accepted statistical method for forecasting volatility and correlation of financial asset returns. For many years, it was the market standard to forecast average volatility over the next  $h$  days by taking an equally weighted average of squared returns over the previous  $h$  days. This method was called the historical volatility forecast. Nowadays, many different statistical forecasting techniques can be applied to historical time series data so it is confusing to call this equally weighted method the historical method. However, this rather confusing terminology remains standard. Perceived changes in volatility and correlation have important consequences for all types of risk management decisions, whether to do with capitalization, resource allocation or hedging strategies. Indeed, it is these parameters of the returns distributions that are the fundamental building blocks of market risk assessment models. It is therefore essential to understand what type of variability in returns the model has measured. The model assumes that an independently and identically distributed process generates returns. That is, both volatility and correlation are constant and the

“square root of time rule” applies. This assumption has important ramifications.

### 3.9 Exponentially Weighted Moving Averages

An exponentially weighted moving average (EWMA) eschews the pitfalls expounded in the precedent section because it puts more weight on the more recent observations. Thus as extreme returns move further into the past as the data window slides along, they become less consequential in the average.

The Exponentially Weighted Moving Average (EWMA) model was derived by JP Morgan in 1989 for their Risk Metrics framework from a Gaussian distribution. The EWMA method of calculating volatility laid more accentuation on more recent returns. The reason behind is that recent price changes is the best presager of future movement. This was an amelioration to the simple volatility method.

#### 3.9.1 Statistical Methodology

An exponentially weighted moving average can be defined on any time series of data. Say that on date  $t$  we have recorded data up to time  $t - 1$ , so we have observations  $(x_{t-1}, \dots, x_1)$ . The exponentially weighted average of these observations is defined as:

$$EWMA(x_{t-1}, \dots, x_1) = \frac{x_{t-1} + \lambda x_{t-2} + \lambda^2 x_{t-3} + \dots + \lambda^{t-2} x_1}{1 + \lambda + \lambda^2 + \dots + \lambda^{t-2}}$$

where  $\lambda$  is a constant,  $0 < \lambda < 1$ , called the smoothing decay constant. Since  $\lambda^T \rightarrow 0$  as  $T \rightarrow \infty$  the exponentially weighted average places negligible weight on observations far in the past. And since  $1 + \lambda + \lambda^2 + \dots = (1 - \lambda)^{-1}$ , we have, for large  $t$ ,

$$EWMA(x_{t-1}, \dots, x_1) = \frac{x_{t-1} + \lambda x_{t-2} + \lambda^2 x_{t-3} + \dots}{1 + \lambda + \lambda^2 + \dots}$$

This is the formula that is used to calculate exponentially weighted moving average

(EWMA) estimates of variance (with  $x$  being the squared return) and covariance (with  $x$  being the cross product of the two returns). As with equally weighted moving averages, it is standard to use squared daily returns and cross products of daily returns, not in mean deviation form. That is:

$$\sigma_t^2 = (1 - \lambda)r_{t-1}^2 + \lambda\sigma_{t-1}^2 \quad \dots \dots \dots (1)$$

$$\sigma_{12,t} = (1 - \lambda)r_{1,t-1}r_{2,t-1} + \lambda\sigma_{12,t-1} \quad \dots \dots \dots (2)$$

### 3.9.2 Interpretation of $\lambda$

There are two terms on the right hand side of equation 1. The first term  $(1 - \lambda)r_{t-1}^2$  determines the intensity of reaction of volatility to market events: the more minuscule is  $\lambda$  the more the volatility reacts to the market information in yesterday's return. The second term  $\lambda\sigma_{t-1}^2$  determines the sedulousness in volatility:

Irrespective of what transpires in the market, if volatility was high yesterday it will be still be high today. The more proximate that  $\lambda$  is to 1, the more assiduous is volatility following a market shock. Thus, a high  $\lambda$  gives little reaction to genuine market events but great assiduousness in volatility, and a low  $\lambda$  gives highly reactive volatilities that expeditiously die away. A hapless restriction of exponentially weighted moving average models is that the reaction and assiduousness parameters are not independent: the strength of reaction to market events is resolute by  $(1-\lambda)$ , whilst the sedulousness of shocks is tenacious by  $\lambda$ . But this postulation is not empirically justified except perhaps in a few markets (e.g., major U.S. dollar exchange rates). The effect of utilizing a different value of  $\lambda$  in EWMA volatility forecasts can be quite substantial.

### 3.9.3 Properties of the Estimates

A EWMA volatility estimate will react immediately following an unwontedly immensely colossal return then the effect of this return on the EWMA volatility estimate gradually diminishes over time. The reaction of EWMA volatility estimates to market events ergo persists over time, and with a vigor that is resolute by the smoothing constant  $\lambda$ . The larger the value of  $\lambda$ , the more weight is placed on observations in the past and so the smoother the series becomes. One of the disadvantages of using EWMA to estimate and forecast covariance matrices is that the same value of  $\lambda$  is utilized for all the variances and covariances in the matrix. For instance, in an immensely colossal matrix covering several asset classes, the same  $\lambda$  applies to all equity indices, peregrine exchange rates, interest rates, and/or commodities in the matrix. But why should all these risk factors have kindred reaction and sedulousness to shocks? This constraint is commonly applied merely because it assures that the matrix will be positive semi-definite.

### 3.9.4 The EWMA Forecasting Model

The exponentially weighted average variance estimate or in its equipollent form or in its equivalent form. That is, it gives a variance estimate at any point in time but there is no 'model' as such, that explicates the behaviour of the variance of returns,  $\sigma_t^2$  at each time  $t$ . In this sense, we have to distinguish EWMA from a GARCH model, which commences with an opportune designation of the dynamics of  $\sigma_t^2$  and then proceeds to estimate the parameters of this model. Without an opportune model, it is not pellucid how we should turn our current estimate of variance into a forecast of variance over some future horizon.

### **3.10 Hypotheses**

The hypotheses will be tested at a confidence level using EWMA model to evaluate the research questions for the study.

H<sub>0</sub>: The share prices of banks listed on the Ghana Stock Exchange are neither volatile nor correlated using EWMA model.

H<sub>1</sub>: The share prices of banks listed on the Ghana Stock Exchange are volatile using EWMA model.

H<sub>2</sub>: The share prices of bank listed on the Ghana Stock Exchange are correlated.

## **CHAPTER FOUR**

### **DATA PRESENTATION AND ANALYSIS**

#### **4.0 Introduction**

This chapter is in two sections. The first section has to do with analyzing share price returns and volatility of share prices of banks listed on the Ghana stock Exchange Using EWMA models. The second section analyzes the correlation between these banks on the Ghana stock Exchange. It deals with the presentation and analysis of 246 daily observations from January 2015 to December 2015 on banks listed on the Ghana Stock Exchange. The results are presented in the form of tables and graphs.

#### **4.1 Cal Bank share price**

Figure 4.1: Share Price Return of CAL

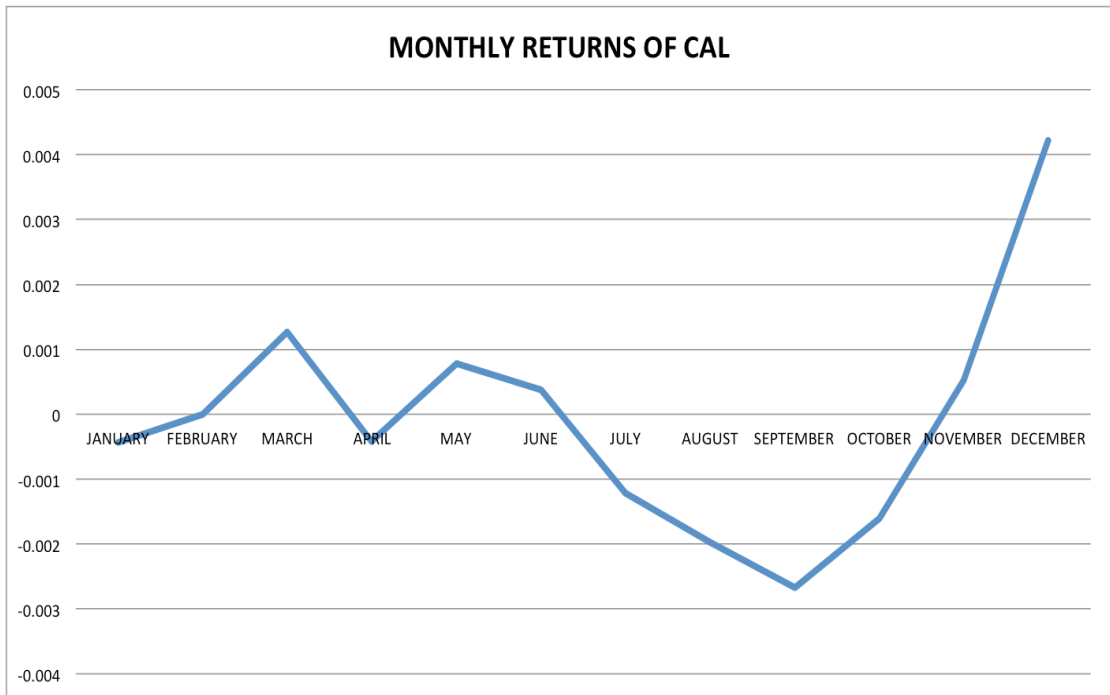
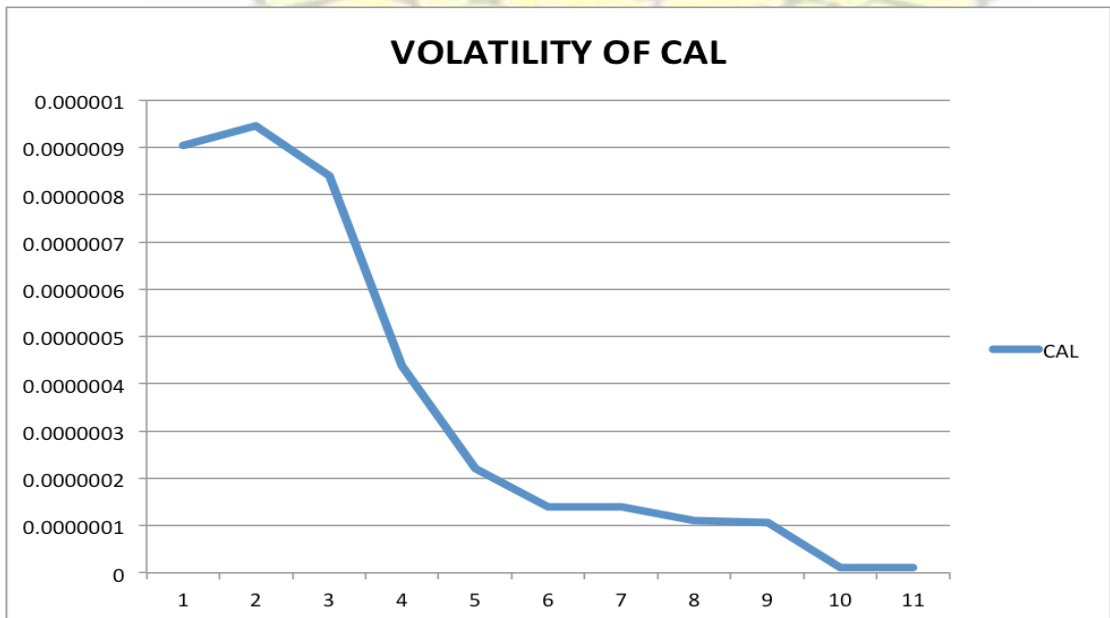


Figure 4.1 above shows, the returns of Cal Bank stock ranges from -0.003 to 0.005.

It recorded the worst negative return in the month of September. The month of December recorded the highest return, which was followed by March.

Figure 4.2: Volatility of CAL



The volatility of Cal was sharply decreased from January to May. It however decreased slowly from May through to October. It then remains averagely at a constant rate from November to December.

## 4.2 Ecobank Ghana share price

The stock of Ecobank Ghana is listed on the Ghana stock exchange where its shares are traded under the symbol EBG. The bank is a fully networked commercial bank in Ghana with branches in almost all regions in Ghana. The diagram in Figure 4.3 below shows the share price returns of Ecobank of Ghana.

Figure 4.3: Share Price Return of EBG

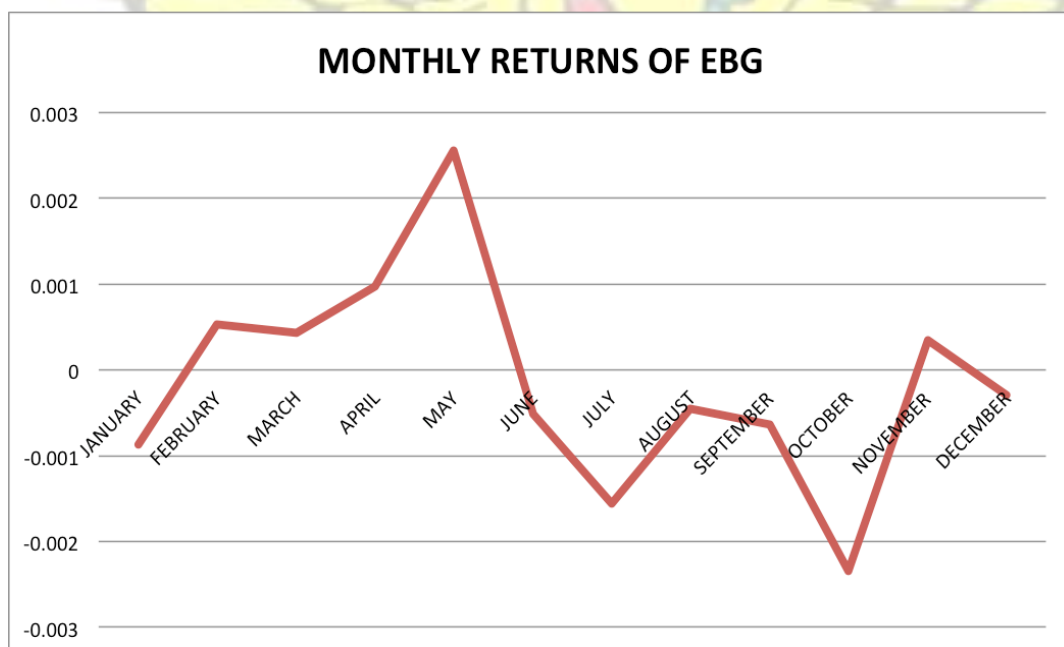
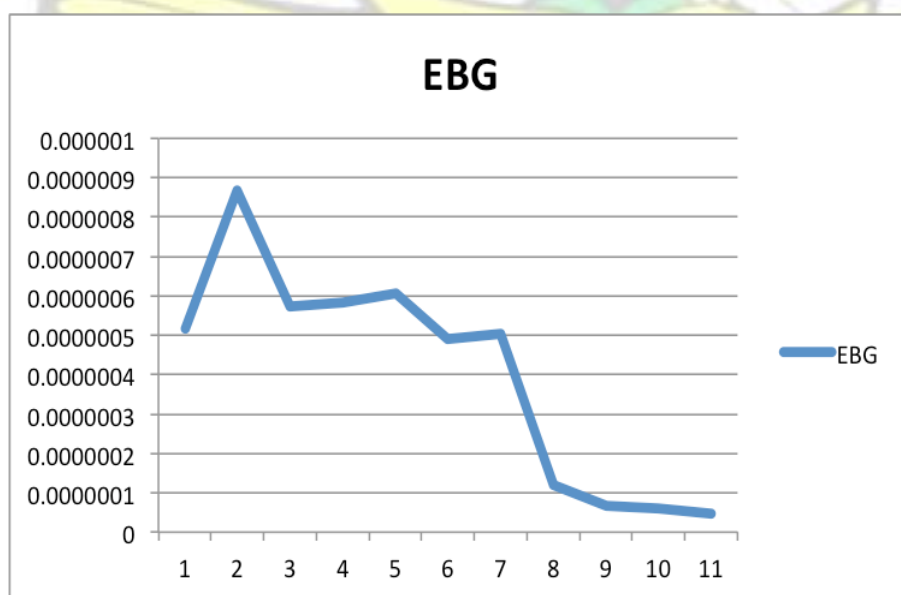


Figure 4.3 above shows that the share price returns of Ecobank Ghana does not follow any regular pattern and cannot be easily predicted. Hence the share price will

be difficult to predict. This stock therefore needs a detailed analysis before a stock broker can recommend to an investor. The share price returns increased from January through to May. It however slowed down to June and later remained at a negative return.

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Figure 4.4 Volatility of EBG

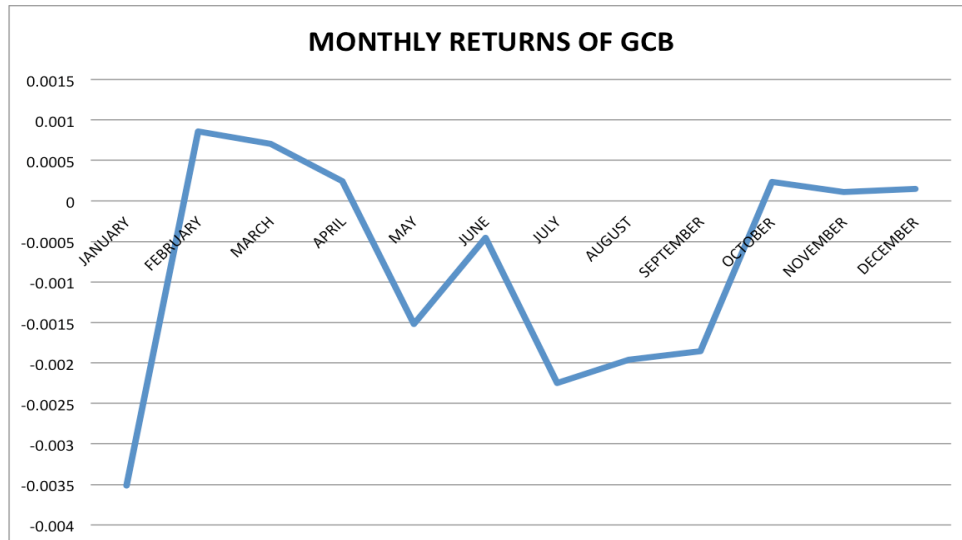


### 4.3 Ghana Commercial Bank share price

The shares of stock of Ghana Commercial bank are listed on the Ghana Stock Exchange. As of December 2015, the bank's total assets were valued at about 148 billion US dollars with stakeholders' equity of approximately 99 million US dollars.

The share price of Ghana commercial bank is shown in Figure 4.5 below.

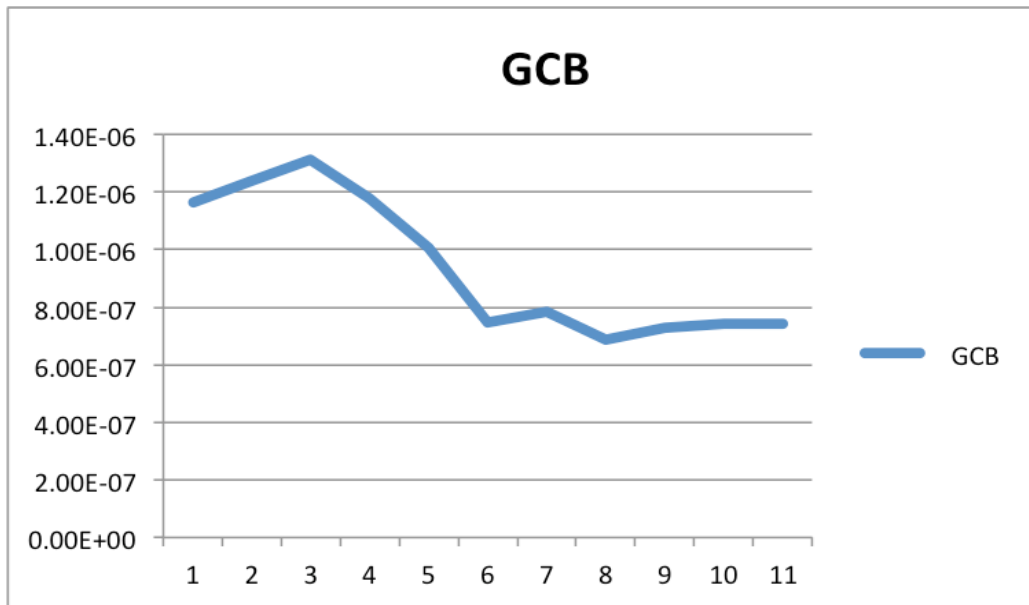
Figure 4.5: Share Price Return of GCB



The month of January recorded the highest negative return in Share price followed by the month of July. There was a fairly stationary share price returns from the month of October to December. Nonetheless, the month of February recorded the highest return of 0.000860102. Averagely, the share price return of Ghana Commercial Bank was negative, -0.000770707. It was the second lowest average share price among the entire nine commercial Banks average share price.

The average volatility of Ghana Commercial Bank was  $9.38264E-07$ . This volatility was the lowest among all the nine commercial banks. However, there was a constant decline of the volatility of Ghana Commercial Bank from March September. The volatility remained uniform from September to December. The highest and lowest volatility was recorded in the month of October and July with a value of  $1.31E-06$  and  $7.83E-07$  respectively

Figure 4.6 Volatility of GCC



#### 4.4 HFC Bank share price

HFC Bank Ghana limited formerly Home Finance Company was licensed as a mortgage financial institution to implement the IDA/SSNIT pilot Housing Finance program in Ghana. Figure 4.7 shows the share price of HFC Ghana.

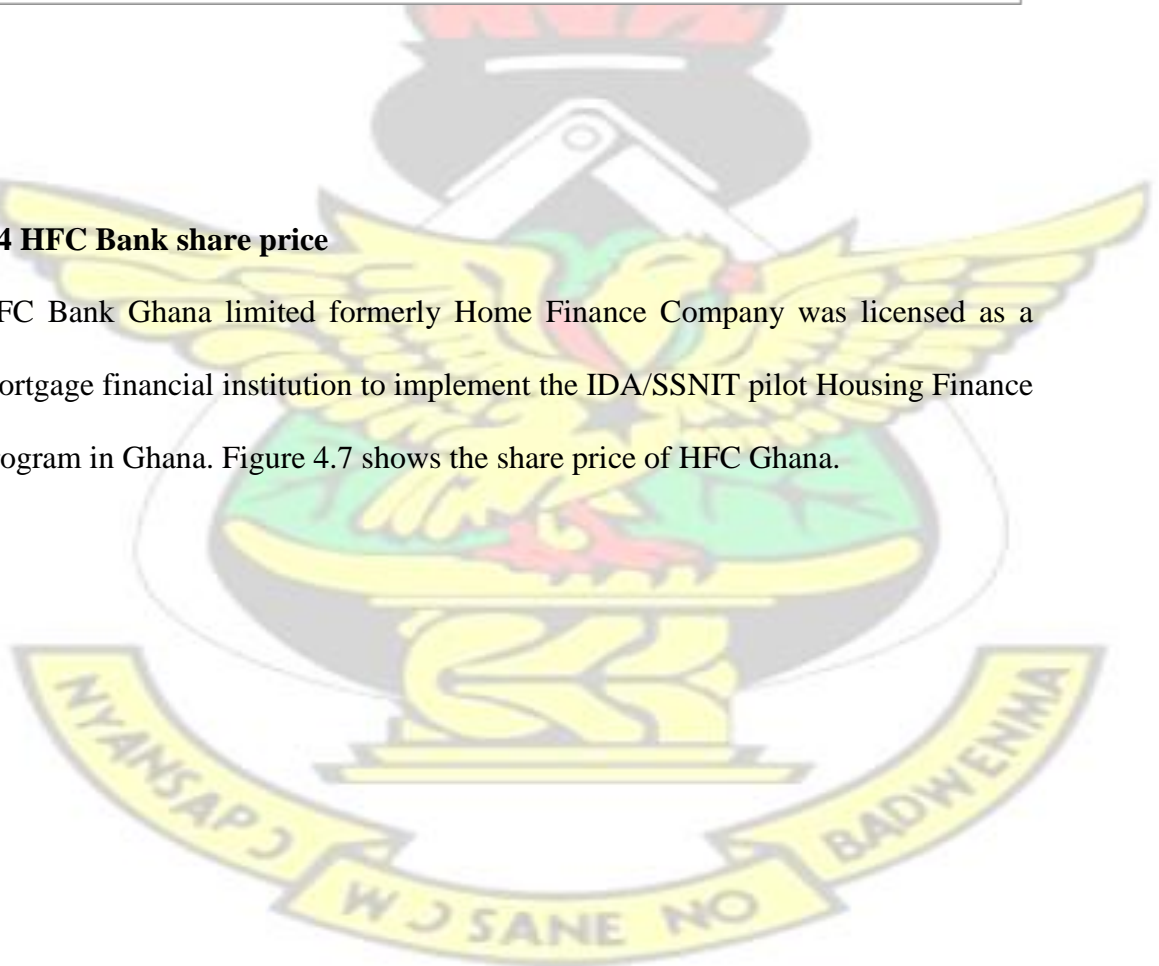
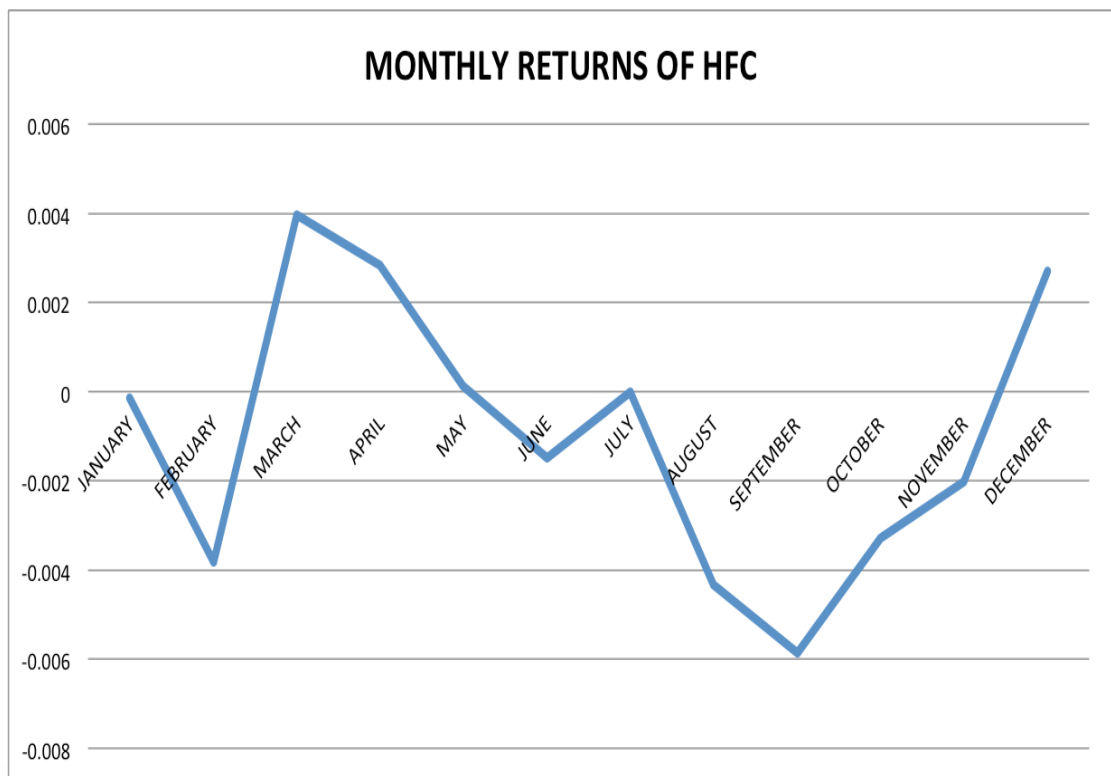


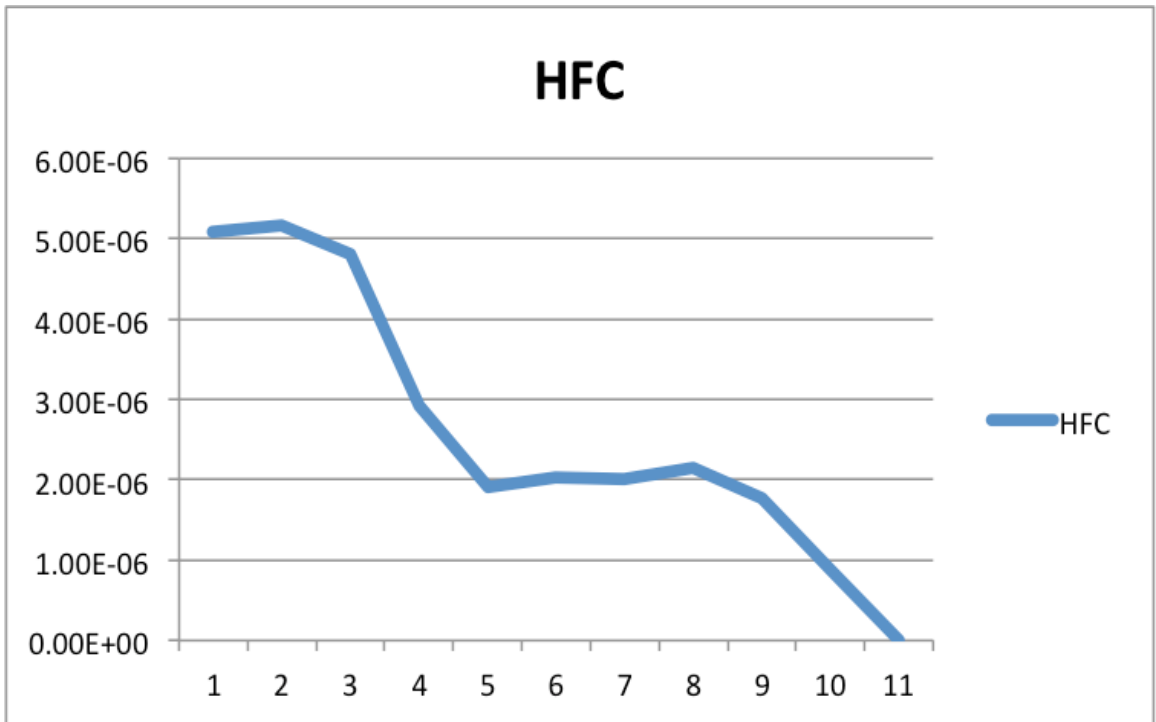
Figure 4.7 Share Price Return of HFC



HFC recorded a negative average share price return of -0.000936354. This indicated that most of the monthly share price returns of HFC was negative. March, April, May and December was the only months with positive returns. The share price returns of HFC decreased slowly from March to September. Withal, there was an increase in share price return from September to December.

The lowest volatility of HFC was 1.27E-09, which was recorded in the month of February. There was a gentle increase in volatility from February through to May. Volatility remained stable from May through to August. Regardless of the stability from May through to August, there was a sharp increase from August to October. There was a significant decrease in volatility of from November to December.

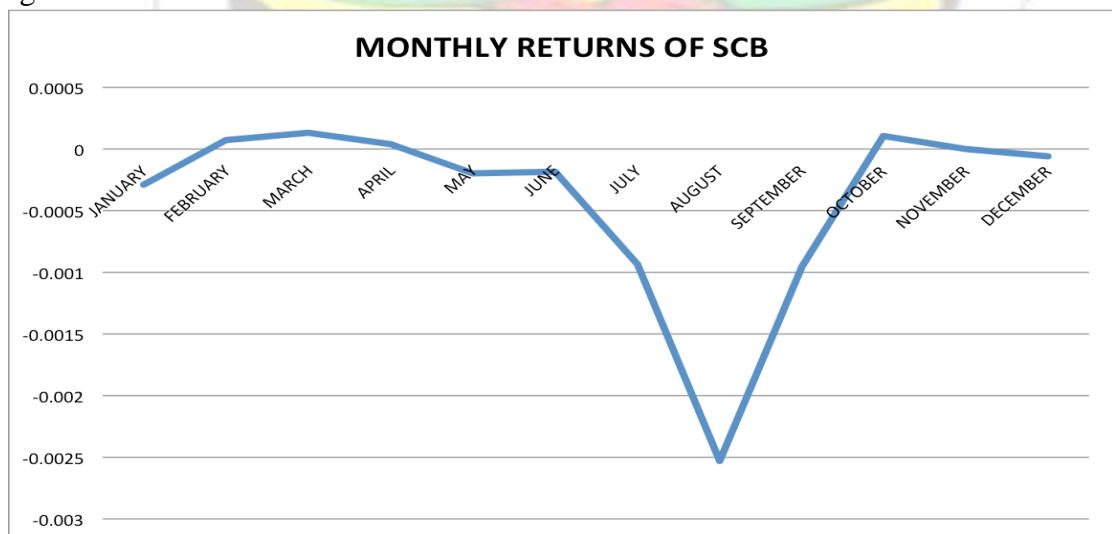
Figure 4.8 Volatility of HFC



#### 4.5 Standard Chartered Bank share price

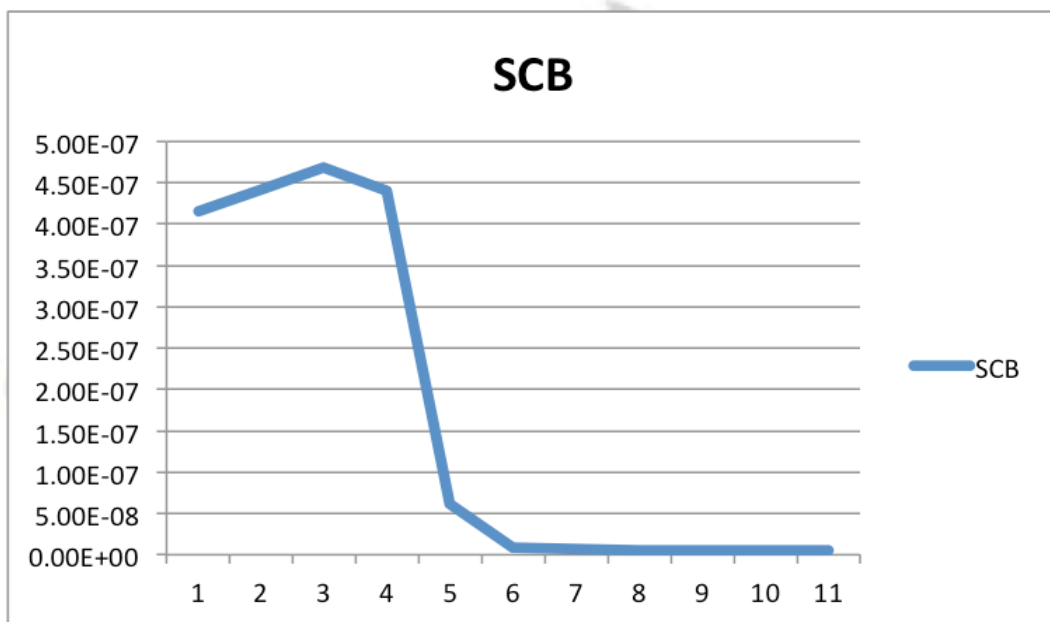
Standard chartered bank was listed on the stock index of the Ghana Stock Exchange, the GSE All Share Index operating since 1896. It is one of the oldest companies in Ghana. It is the successor to the Bank of British West Africa in Ghana. Figure 4.9 shows the share price of Standard Chartered Bank.

Figure 4.9 Share Price Returns of SCB



The average share price return of Standard Chartered Bank was  $-0.000394443$ , indicating a negative overall return. It recorded a highly negative return of  $-0.002529222$  in the month of August, which is the worst return comparative to all the other share price returns of all the commercial Banks studied. However, there was a small perturbation of returns from January to May.

Figure 4.10 Volatility of SCB



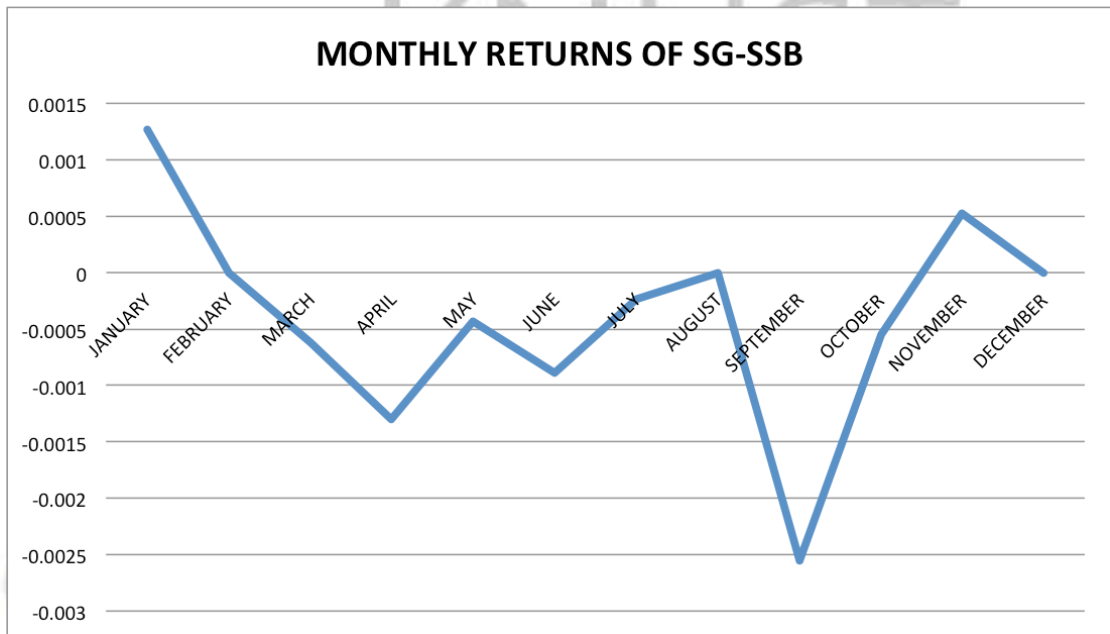
Standard Chartered Bank recorded a very stable volatility from February through to July. There was a sharp increase in volatility from  $7.48E-09$  in July to  $4.41E-07$  in October. The volatility declined slowly from October to December. The average volatility of Standard Chartered Bank share price for the 2015 year was  $1.6965E-07$ .

#### 4.6 Societe Generale-Social Security Bank (SG-SSB) Returns

The name “SG-SSB” is a short form of “SocieteGenerale-Social Security Bank”. SG-SSB began in 1975 as “Security Guarantee Trust Limited” or “SSB”. In 1994,

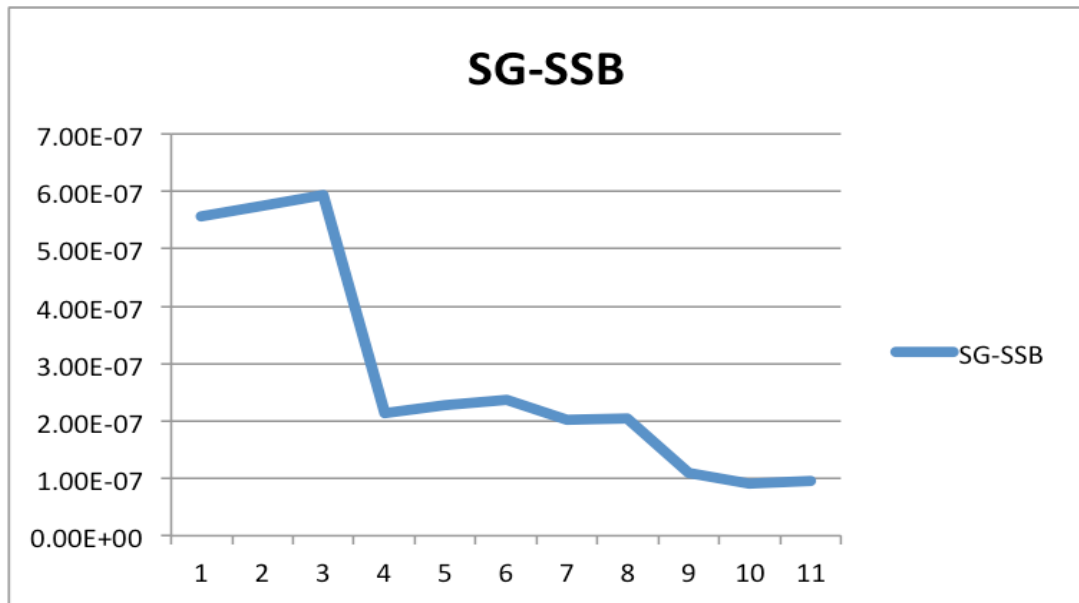
SSB and the “National Savings and Credit Bank” merged under a World Bank program. Figure 4.11 below shows the share price of SG-SSB.

Figure 4.11: Share Price Return of SCB



Clearly, the yearly share price return of SocieteGenerale-Social Security Bank is averagely negative with a value of -0.000402455. This is evident because nearly all the monthly share price was negative with the exception of January, February, November and December. The lowest share price return within the year was -0.002557626, recorded in the month of September.

Figure 4.12: Volatility of SG-SSB

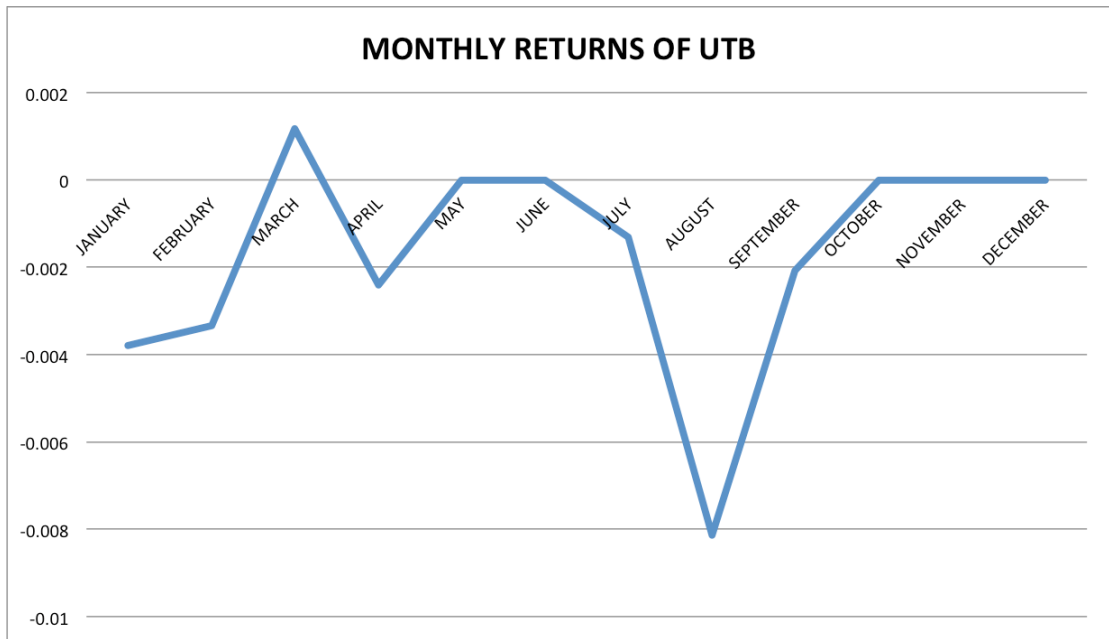


The average volatility of the share price returns of SocieteGenerale-Social Security Bank is 2.82177E-07. There was a gentle increase of volatility from February to July. There was a significant decrease from July to September. However, a sudden sharp increase from September to October, with a highest volatility of 5.93E-07.

#### 4.7 Unique Trust Bank share price Returns

Unique Trust Bank is a medium-sized financial service provider headquartered in Ghana with subsidiaries in West Africa and Western Europe. Figure 4.13 shows the share price of unique trust bank.

Figure 4.13: Share Price Return of UTB



Unique Trust Bank recorded a negative average share price return of -0.001658083.

This is also clearly evident since all the months with the exception of March recorded a negative return. The month of August recorded the lowest return of -0.0082136365. The only positive monthly share price return was in March, with a value of 0.001174055.

The average volatility share price return Unique Trust Bank is 2.80126E-06.

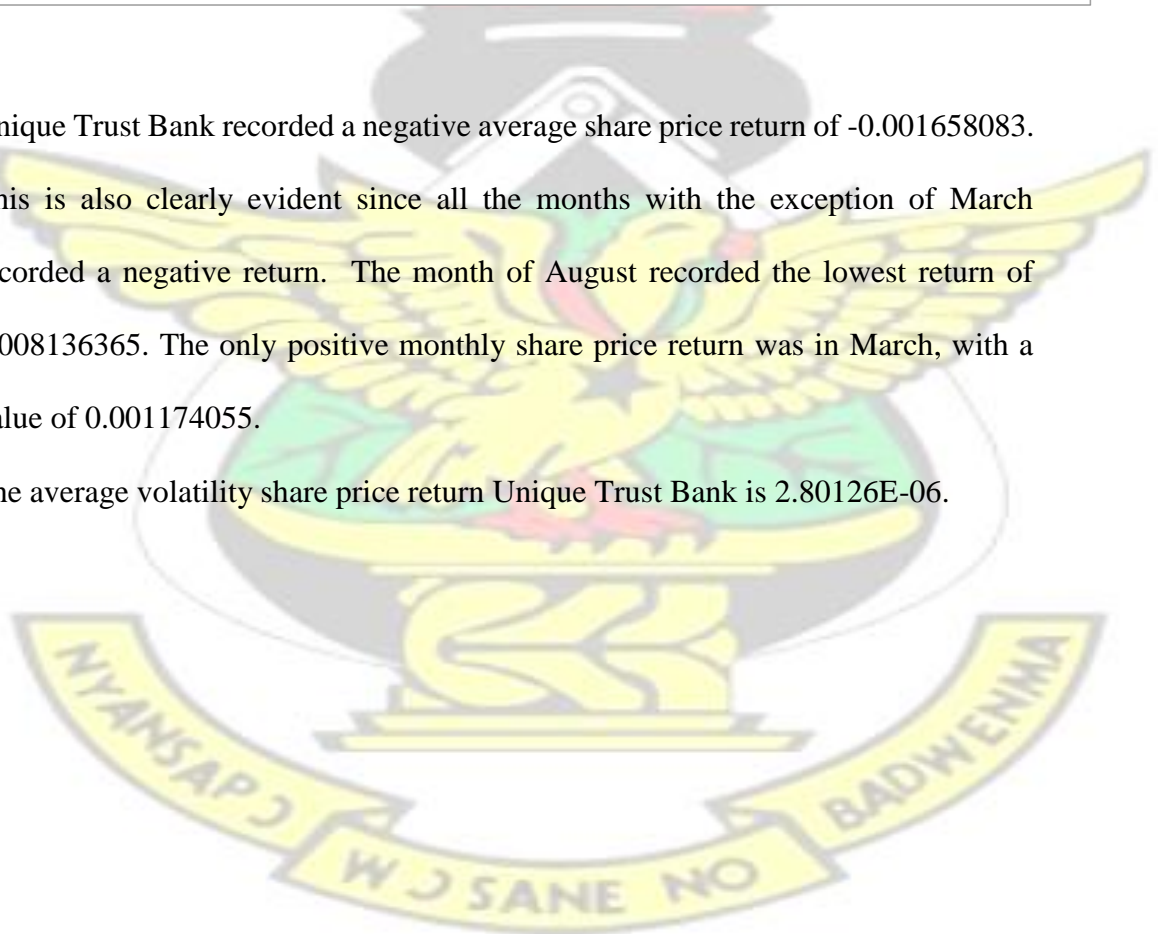
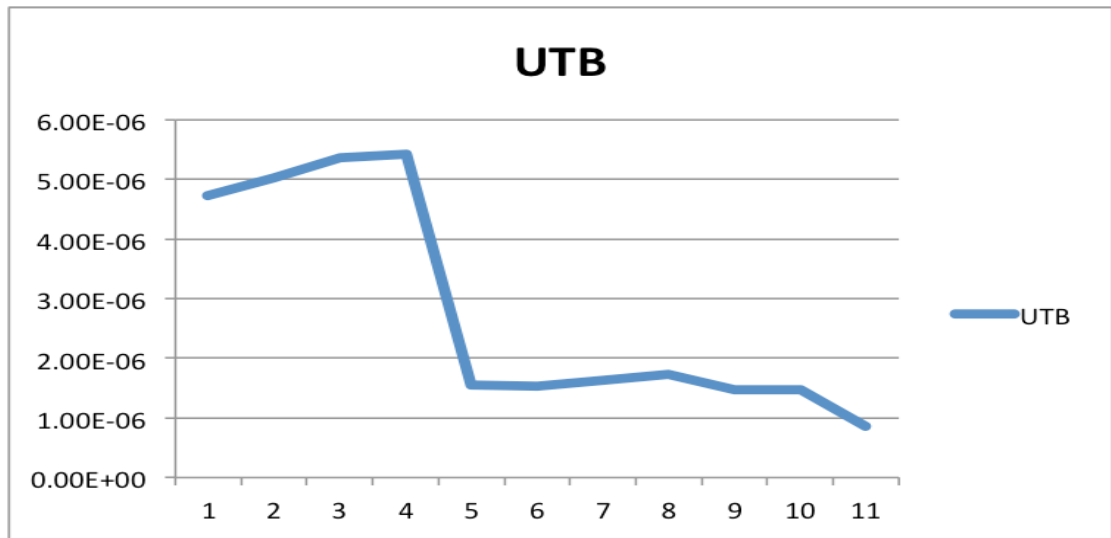


Figure 4.14: Volatility of UTB



#### 4.8 Trust Bank Limited share price Returns

The Trust Bank Limited commonly known as The Trust Bank is a commercial Bank in Ghana. It is one of the 27 Commercial Banks licensed by the Bank of Ghana. The shares of stock of TBL are owned by Ghanaian and International corporate investors.

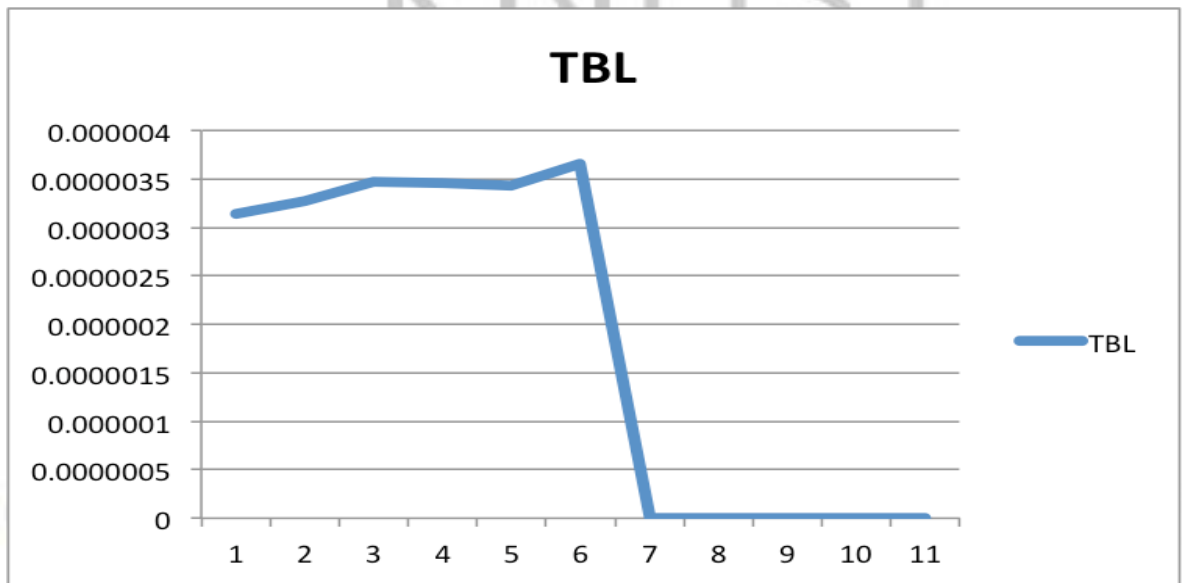
Figure 4.15: Share Price Return of TBL



The share price return of Trust Bank Limited was steady for the period January-

May. Nonetheless, the share price return remained inconsistent from May-December, rising very sharply in the month of May-July. It recorded the highest average share price return of 0.000741641. It is the only positive share price return among all the nine average share price returns calculated.

Figure 4.16: Volatility of TBL

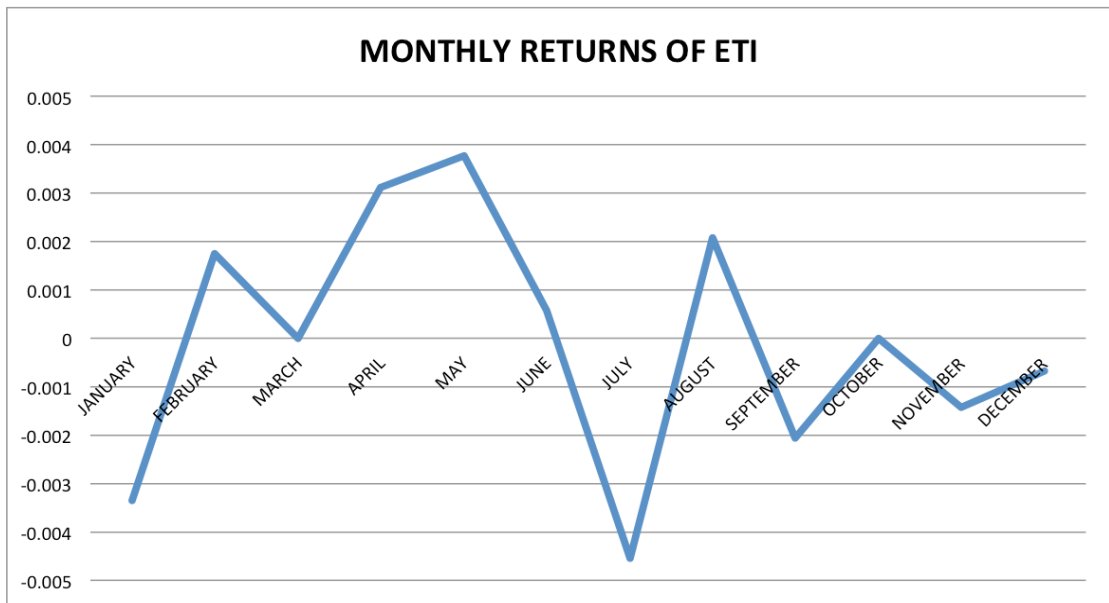


The average share price volatility of Trust Bank Limited is 1.85685E-06. The share price volatility remained stable from January through to June. It however increased sharply to the month of July and slowed down gradually to December. The share price volatility of TBL is unpredictable.

#### 4.9 Ecobank Transnational Incorporated share price Returns

Ecobank Transnational Incorporated (ETI) is a public limited liability company, which was established a bank holding company in 1985 under a private sector initiative spearheaded by the federation of West African Chambers of Commerce industry with the support of the Economic Community of West Africa States (ECOWAS).

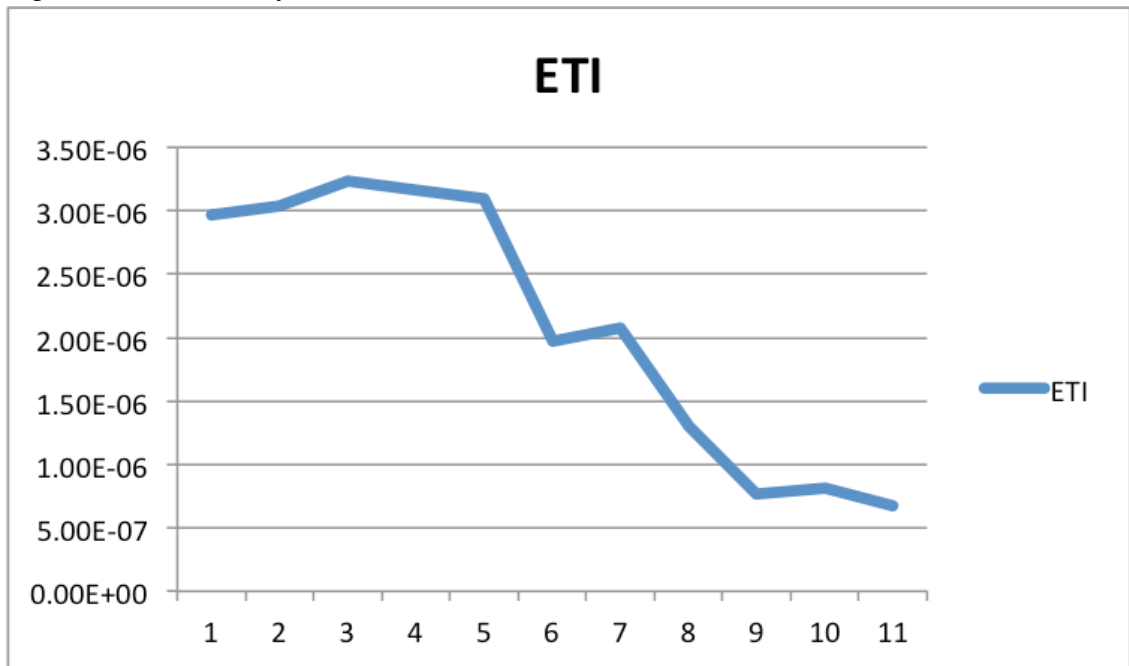
Figure 4.17: Share Price Return of ETI



A fluctuation share price returns is a characteristic feature of Ecobank Transnational Incorporated. The average share price return was  $-6.39474E-05$ . The third highest average share price return among the nine commercial Banks average share price returns.

The average share price volatility of Trust Bank Limited is  $1.85685E-06$ . There was a steady increase in share price volatility from January to June. Share price Volatility of ETI was fairly stable half-way in the year, July-December.

Figure 4.18: Volatility of ETI



#### 4.10 Results of EWMA Model

This section presents the results estimated from the EWMA models. The variables for the study were CAL, EBG, GCB, HFC, SCB, SG\_SSB, UTB and UTB, ETI and TBL which represents differenced share prices of CAL Bank, Ecobank Ghana, Ghana Commercial Bank, Standard Chartered Bank, SocieteGenerale-Social Security Bank, Unique Trust Bank, Ecobank Transnational Bank, and Trust Bank Limited respectively. The Table 4.1 below shows the volatility of share price of banks listed on the Ghana stock exchange.

Table 4.1

December November October September August July June  
 May April March February January

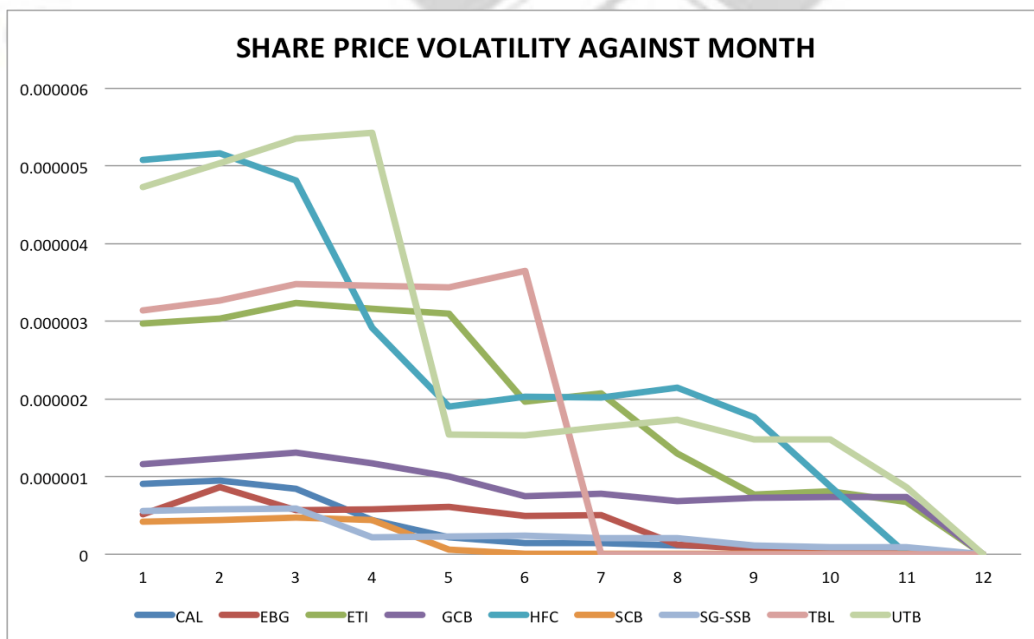
CAL	9.04E-07	9.46E-07	8.41E-07	4.39E-07	2.21E-07					
EBG	1.40E-07	1.40E-07	1.10E-07	1.06E-07	1.04E-08					
ETI	1.11E-08	0	5.18E-07	8.68E-07	5.72E-07					
GCB	5.83E-07	6.07E-07	4.91E-07	5.05E-07	1.20E-07					
HFC	6.75E-08	5.99E-08	4.59E-08	0	2.97E-06					
SCB	3.04E-06	3.23E-06	3.17E-06	3.09E-06	1.97E-06					
SG-SSB	2.07E-06	1.30E-06	7.64E-07	8.13E-07	6.72E-07					
TBL	0	1.16E-06	1.24E-06	1.31E-06	1.18E-06					
UTB	1.01E-06	7.49E-07	7.83E-07	6.87E-07	7.27E-07					
	7.42E-07	7.42E-07	0	5.08E-06	5.17E-06					
	4.81E-06	2.92E-06	1.91E-06	2.03E-06	2.01E-06					
	2.14E-06	1.76E-06	8.74E-07	1.27E-09	0	4.15E-07				
	4.42E-07	4.69E-07	4.41E-07	6.10E-08	9.10E-09					
	7.48E-09	5.54E-09	5.78E-09	5.09E-09	5.05E-09	0				
	5.56E-07	5.76E-07	5.93E-07	2.13E-07	2.27E-07	2.38E-07				
	2.03E-07	2.04E-07	1.08E-07	9.03E-08	9.61E-08	0				
	3.14E-06	3.27E-06	3.47E-06	3.45E-06	3.43E-06	3.65E-06				
	0	0	0	0	0	4.73E-06	5.04E-06			
	5.36E-06	5.43E-06	1.55E-06	1.53E-06	1.63E-06					
	1.74E-06	1.47E-06	1.48E-06	8.60E-07	0					

The analysis began with the estimation of volatility of share price of CAL Bank, Ecobank Ghana, Ghana Commercial Bank, Standard Chartered Bank, SocieteGenerale-Social Security Bank, Unique Trust Bank, Ecobank Transnational Bank, and Trust Bank Limited using the appropriate EWMA model as shown in Table 4.1 above.

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Figure 4.19 share price volatility against month.



The study focused on the volatility of share prices of banks listed on the Ghana stock exchange over the period January 2015 to 31 December 2015 which represents 246 observations. The share price volatility of Standard Chartered Bank is highly stable over the 12-month period. The share price volatility of SocieteGenerale Social Security Bank is stationary though volatility is fairly

persistent. Also the share price volatility of EcobankGahna and Ghana Commercial Bank is stationary, although volatile but is quite persistent. However, that cannot be said for Unique Trust Bank, since its share price volatility can change dramatically over a short period of time in all directions. The same can be said of the share price volatility of HFC since it is very explosive. Although the share price volatility of Trust Bank Limited remained stable over a period. It also turned out to be very explosive over the middle part of the year to the end of the year. Ecobank Transnational Incorporation had a gentle increase in its share price volatility from January to August but somehow remained at a constant volatility from August to December.

Table 4.2: Correlation of Share Price Returns

	CAL	EBG	ETI	GCB	HFC	SCB	SG-SSB	TBL	UTB
CAL	1	0.37385195	0.13351589	0.43001913	0.68969515	0.51519503	0.33689478	0.06328541	0.49923897
EBG	0.373851951	1	0.66760936	0.20751801	0.32384732	0.20990059	-0.0451346	-0.0781256	0.10425444
ETI	0.13351589	0.667609361	1	0.44453753	0.06419742	0.05287019	-0.190851	-0.068608	-0.1195093
GCB	0.43001913	0.20751801	0.44453753	1	0.23971969	0.56970125	-0.1827721	0.09745638	0.45962168
HFC	0.68969515	0.32384732	0.06419742	0.23971969	1	0.46908604	0.19346802	-0.1033457	0.45919636
SCB	0.51519503	0.20990059	0.05287019	0.56970125	0.46908604	1	0.05271179	0.25614435	0.77581718
SG-SSB	0.33689478	-0.0451346	-0.190851	-0.1827721	-0.1790553	0.19346802	0.052711791	-0.3121484	-0.1790553
TBL	0.06328541	-0.0781256	-0.068608	0.09745638	-	0.1033457	0.25614435	-0.31214841	0.39426612

UTB	0.49923897	0.10425444	-0.1195093	0.45962168
	0.45919636	0.77581718	-0.1790553	0.39426612

1

From the correlation table above, there was a negative correlation between Trust Bank Limited and SocieteGenerale- Social Security Bank. The associated value recorded is -0.312148431. This indicates that as the share price of Trust Bank increases, the share price return of SocieteGenerale - Social Security Bank decreases. Though the relationship between them is weak, an investor who wants to diversify his/her wealth can invest in this two stocks since all the two stocks cannot all record a negative return at a time.

However, there was a strong correlation between Standard Chartered Bank and Unique Trust Bank Share Price Returns. This indicates that when the share price of Standard Chartered Bank increases, there is a corresponding increase of share price in Unique Trust Bank and vice versa. This implies that an investor may turn to loose all of his/her wealth or gain much return should he/she invest in this asset. The same analysis can be done to CAL Bank and HFC.

#### 4.11 Tested Research Hypotheses

Ho: From the findings, the share prices of GCB, CAL, EBG, SG-SSB and SCB were fairly stable over the 12 months period whiles the share prices of HFC, TBL, ETI and UTB were the most volatile among the nine banks studied. Likewise, there was a correlation between the banks listed on the Ghana Stock Exchange based on this fact the null hypotheses is rejected.

H<sub>1</sub>:

From the findings, the share prices of GCB, CAL, EBG, SG-SSB and SCB were fairly stable over the 12 months period. While HFC, TBL, ETI and UTB share prices were volatile based on this fact this true hypothesis is rejected.

H<sub>2</sub>:

From the findings, there was a correlation between the banks listed on the Ghana Stock Exchange based on this fact this true hypothesis is accepted.



## CHAPTER FIVE

### SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

#### 5.0 Introduction.

This chapter summarizes the findings of the study, draws conclusion and makes recommendations. The order of presentation is as follows: summary of findings begins, followed by conclusion. We end the presentation with recommendations.

#### 5.1 Summary of Findings

The survey reveals that, the share price volatility of Standard Chartered Bank is highly stable over the 12-months period. The share price volatility of Societe General - Social Security Bank is stationary though volatility is fairly persistent. In addition, the research also shows that, the share price volatility of Ecobank Ghana and Ghana Commercial Bank is stationary, although volatile but is quite persistent. However, that cannot be said for Unique Trust Bank, since its share price volatility can change dramatically over a short period of time in all directions. The same can be said of the share price volatility of HFC since it is very explosive. Although the share price volatility of Trust Bank Limited remained stable over a period. It also turned out to be very explosive over the middle part of the year to the end of the year. The studies also indicated that, Ecobank Transnational Incorporation had a gentle increase in its share price volatility from January to August but somehow remained at a constant volatility from August to December.

The research reveals that there is correlation between banks on the Ghana Stock Exchange. There is a negative correlation between Trust Bank Limited and SocieteGenerale- Social Security Bank. This indicates that as the share price of Trust Bank increases, the share price return of Societe Generale - Social Security Bank increases.

The study shows that, there is a strong correlation between Standard Chartered Bank and Unique Trust Bank Share Price Returns. This indicates that when the share price of Standard Chartered Bank increases, there is a corresponding increase of share price in Unique Trust Bank and vice versa. The same analysis can be done to CAL Bank and HFC.

## **5.2 Conclusion**

This study focuses on stock market volatility of listed banks on the Ghana Stock Exchange over the period January 2015 to 31<sup>st</sup> December, which represents 246 observations. The study uses secondary data from nine listed banks in Ghana. The results indicate that, the share prices of Ghana Commercial Bank, CAL Bank, Ecobank Ghana, SocieteGenerale-Social Security Bank, and Standard Chartered Bank are fairly stable over the 12-months period. However, the share price volatility of HFC, Unique Trust Bank, Ecobank Transnational Incorporation and Trust Bank Limited are the most volatile among all the nine commercial Banks share price volatility studied.

The study also indicates that, there is a correlation between the banks listed on Ghana Stock exchange. When the share price of one bank increases, there is a corresponding increases of share price of another. With this, investors are advised not change their asset allocation in their shares of banks listed in Ghana

## **5.3 Recommendations**

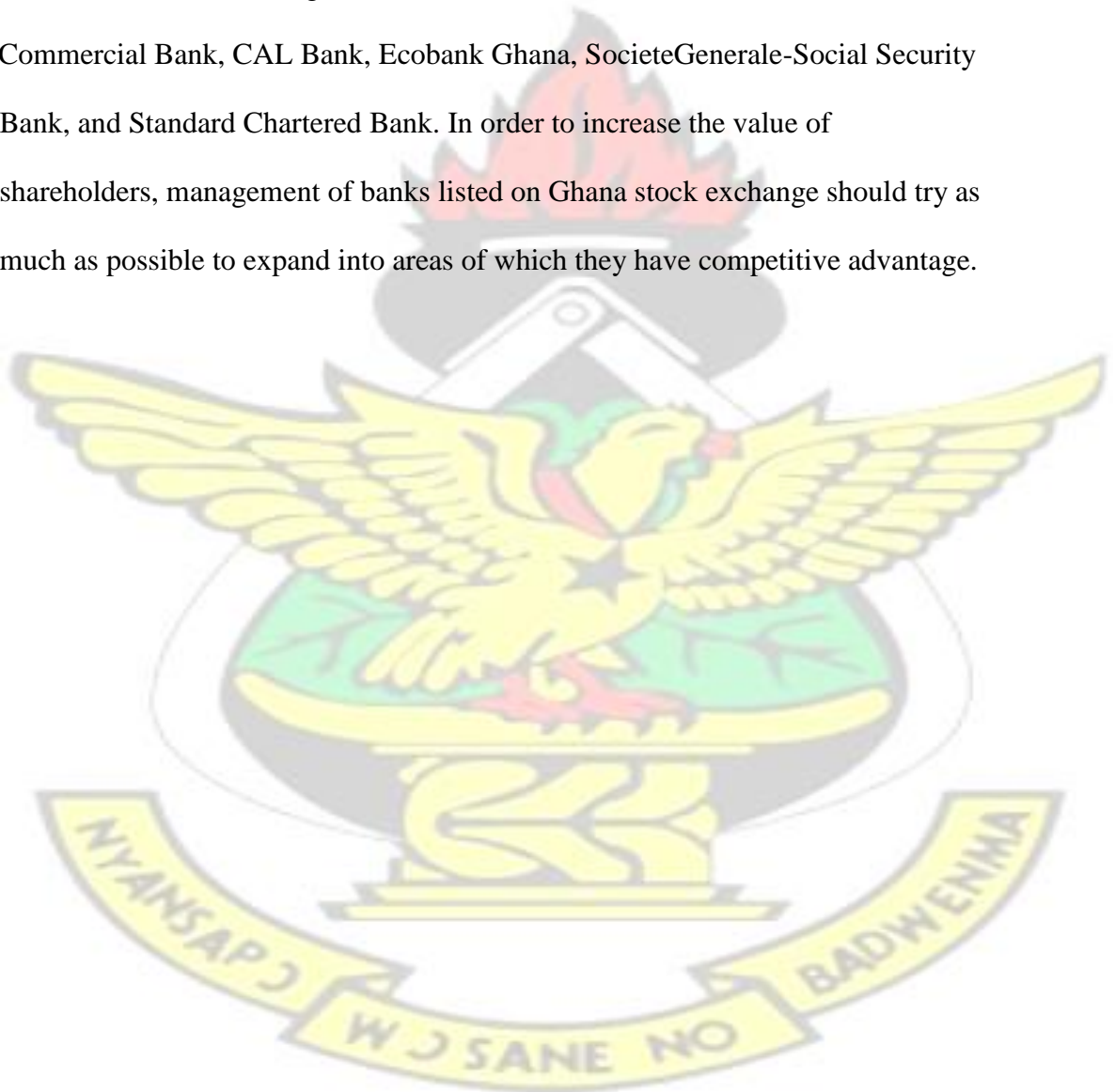
Based on the findings of the study, the following recommendations are made.

There is the need for the managements of HFC, Unique Trust Bank, Ecobank Transnational Incorporation and Trust Bank Limited to be aware that their share prices are highly volatile and therefore should improve their dividend yield and

increase payout ratio so that their share prices do not fall dramatically. To increase the value of their share prices, it is also recommended that management of HFC, Unique Trust Bank, Ecobank Transnational Incorporation and Trust Bank Limited should advance in technological novelty. This, in effect, can lead to strong profit growth and eventually will improve their share prices.

Since there is a correlation between the banks listed on the Ghana stock exchange, investors should not change their asset allocation in the shares of Ghana

Commercial Bank, CAL Bank, Ecobank Ghana, SocieteGenerale-Social Security Bank, and Standard Chartered Bank. In order to increase the value of shareholders, management of banks listed on Ghana stock exchange should try as much as possible to expand into areas of which they have competitive advantage.



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