

**PORTFOLIO RISK AND RETURN THROUGH INTER-
SECTORAL DIVERSIFICATION**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,
LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR
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DECLARATION

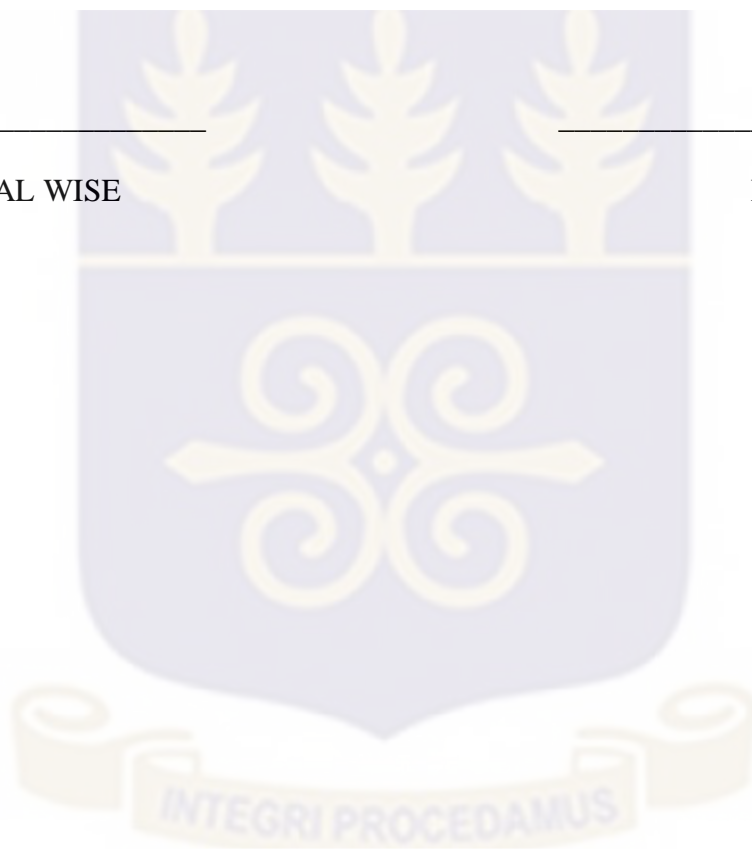
I do hereby declare that this work is the result of my own research and has not been presented by anyone for any academic award in this or any other University. All references used in the work have been duly acknowledged.

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CERTIFICATION

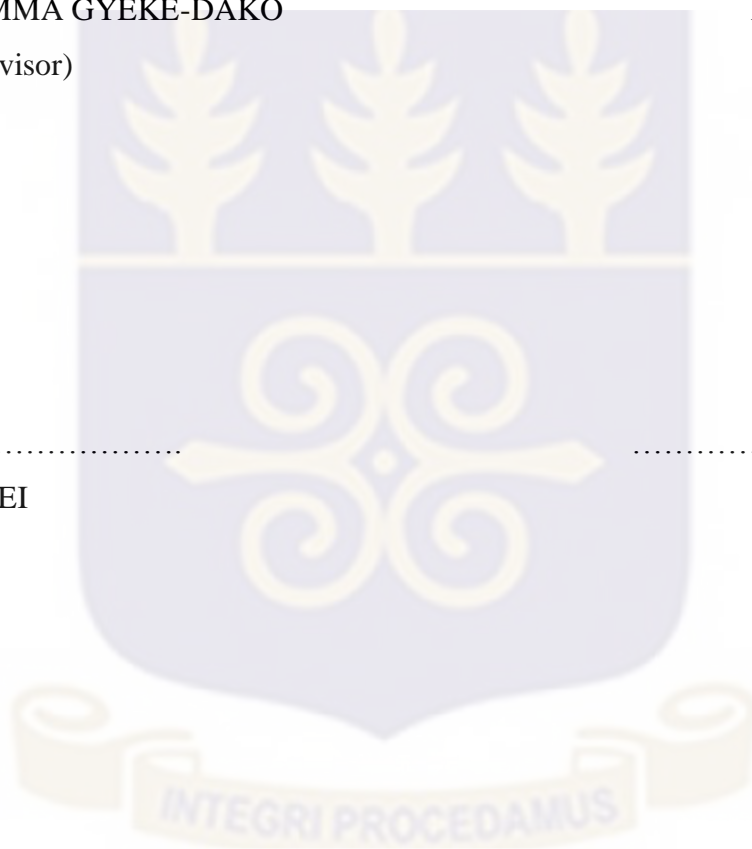
I hereby certify that this dissertation is supervised in accordance with the procedures laid down by the University.

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DEDICATION

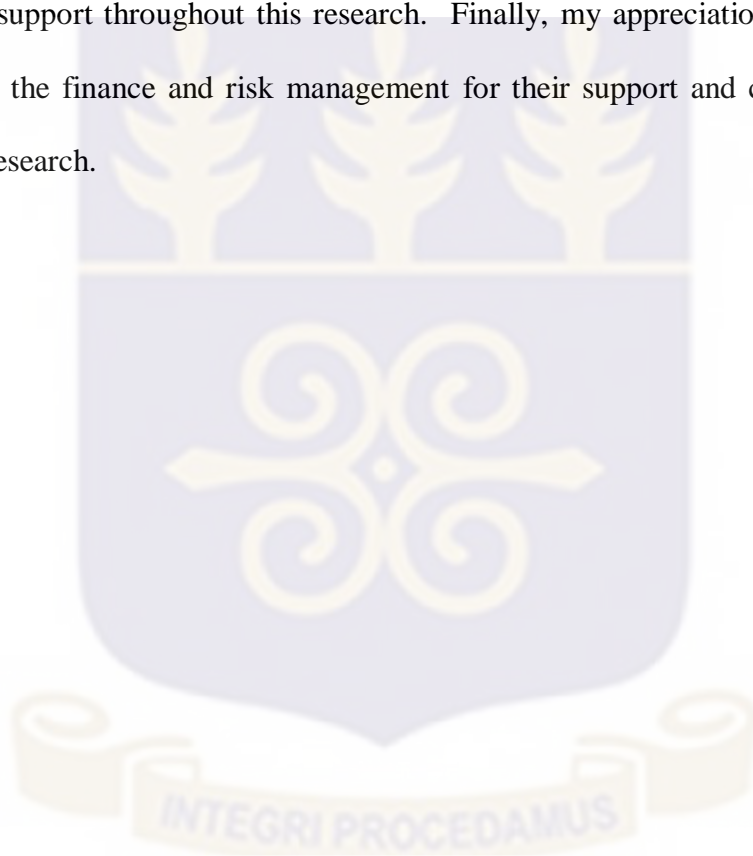
This work is dedicated to God Almighty for His persistent care and protection and to my parent who believed that to be successful one must be educated.



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My greatest gratitude goes to the Lord Almighty for His love and protection for seeing me through my postgraduate studies and the completion of this work. I am highly indebted to my supervisors, Dr. Agyapomaa Gyeke-Dako and Prof. K.A. Osei for their support, patience, encouragement and supervision of this work.

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ABSTRACT

Sectoral diversification is identified to be of a reduced risk, enjoying the sector-wise investment offers exposure to less risky investment than expected by an individual stock. This sectoral investment breeds growth among segments, diversify portfolio and manage risks that are involved in individual stock. Considering all the advantages of sectoral investment, this area in the field of research has received little attention. In this study we examined how investors would be able to reduce risks through suitable portfolio diversification and selection among the sectors.

Using data from the Ghana Stock Exchange (GSE), investors have been provided with several opportunities that identify and evaluate the various sectors to invest into, in order to reduce portfolio risk. Five out of eight sectors have been used to build asset mix that minimizes risk, maximizes returns and provide optimal portfolios of which an investor can diversify. Using the Markowitz model, the study has developed portfolios that are on the global minimum variance, that is on the tangency and those that are on the efficient frontier. These techniques have provided an asset mix that maximizes overall investor returns, minimized overall investor risk and also constitutes an optimal portfolio. Investor therefore can choose asset mix of portfolio to invest based on their risk characteristics.

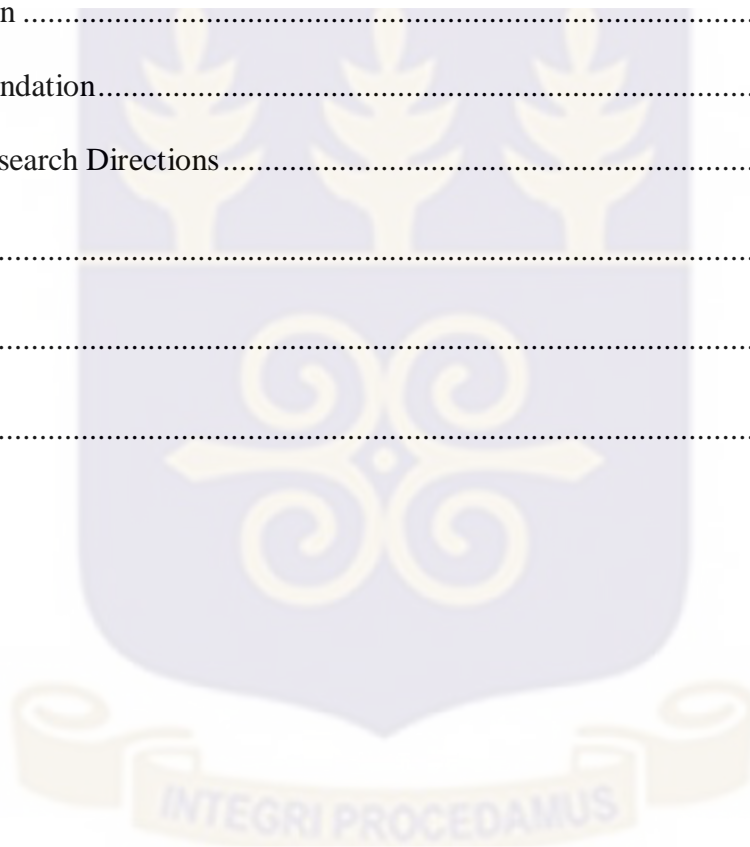
The study recommends that the investors should analyse their risk and returns characteristics before they choose a portfolio that best suit them and invest so that they will not be at a loss.

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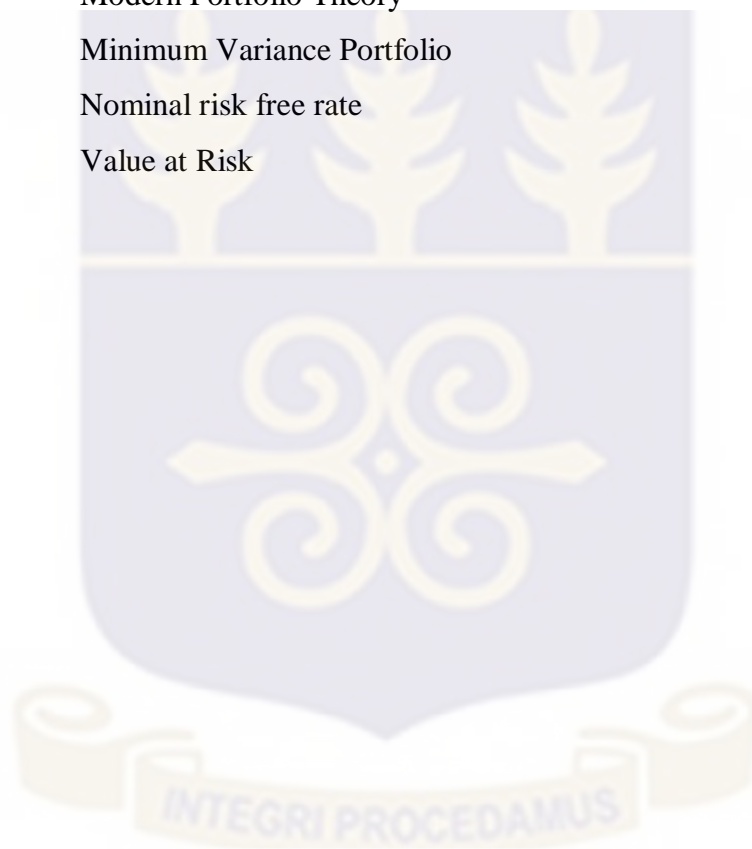
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LIST OF ABBREVIATIONS

CAPM	Capital Asset Pricing Model
GCB	Ghana Commercial Bank
GDP	Gross Domestic Product
GMVP	Global Minimum Variance Portfolio
GSE	Ghana Stock Exchange
GSE-CI	GSE Composite Index
GSE-FSI	GSE Financial Stock Index
ISM	Institute of Supply Management
MPT	Modern Portfolio Theory
MVP	Minimum Variance Portfolio
NRFR	Nominal risk free rate
VaR	Value at Risk



CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Risk Management by financial specialists usually includes the identification, appraisal or assessment, prioritization of risk, and then followed by coordinating and economical utilization of assets to minimize, screen and control the likelihood or effect of deplorable events (Gakure et al., 2012). The source of risk and the degree of its impact depends on the type of investment (Connor et al., 2010). However, Bloomberg (2011) indicated that “portfolio’s performance also depends on your ability to manage complexity and consistently out-think the market which will help develop insightful portfolio and risk strategies”. The most common source of investment risk is financial exposure to changes in interest rates, equity market, inflation, foreign exchange rates, credit quality and commodity prices. However, investors need to plan on how to reduce this risk and increase returns. One way that investor’s risk can be reduced is through the use of optimal portfolio selection diversification.

Portfolio diversification has long been advocated as a means of enhancing return whilst reducing risk by diversifying into other organizational sectors in the stock market. Lane, Salk and Lyles (2001) observed in a study that, most investors do not hold stock in isolation, but rather, they choose to hold a portfolio of several stocks. When this is the case, a portion of an individual stock’s risk can be eliminated, i.e. diversified away. Portfolio diversification as indicated by Fragkiskos (2015) is a process of providing a sensitive benefits of measure to the choice of risk, analyzing a large and common number of securities provides a return variance of a portfolio lower than the average variance of an individual security. In lieu of this, investors hold more of their asset in a number of securities than an individual security, thereby

managing the risk that is highly associated with an individual security and spreading across a number of securities.

The Portfolio theory gives a better understanding of the interactions of risk and reward. It has significantly impacted the way institutional portfolios are overseen, and inspired what is known as "passive management" investment techniques. The arithmetic of portfolio theory is generally utilized as a part of Financial Risk Management and is a theoretical predecessor for more recent risk measures. Disregarding the important debate on whether the theoretical assumptions that the father of Modern Portfolio Theory (MPT) holds is real or not, recent research has shown that other practical problems can kill the gains promised by optimal portfolio choice. DeMiguel, Garlappi and Uppal (2007) for instance, showed that there is an error, explicit of the most common model parameter estimates that can offset the gains from optimal diversification. They show this by demonstrating how a naively diversified portfolio with equal weights in every asset, can out-perform out-of-sample on a risk adjusted basis (Sharpe-ratio in this case) an "optimally" diversified portfolio.

1.2 Statement of the problem

One of the most useful theories in assessing risk is the Modern Portfolio Theory, which is simply known as the portfolio theory. The theory was introduced by Harry Markowitz in 1952. The theory has become a broad theory for portfolio selection. Markowitz's (1952) presented that the assessment of the risks and rewards of portfolios was carried out through the analysis of individual securities independently. The author further added that "investors should focus on selecting portfolios based on their joint risk-reward features instead of merely compiling individually attractive securities regardless of their relation to the other assets on their portfolios" (Markowitz's, 1952).

Several studies have indicated the benefit of diversification in portfolio selection (e.g. Chen, Silvapulle & Silvapulle, 2014; Guidolin & Hyde, 2012; Horneff et al., 2009; Driessen & Laevan, 2007; Ledoit & Wolf, 2004; De Roon & Nijman, 2001; Huberman & Kandel, 1987). However, most of these studies have shown that investors tend to limit themselves to local investments (within a country) (Driessen & Laevan, 2007). This is because most countries have placed some constraints on diversifying overseas, although diversifying internationally is very beneficial to investors, most especially those from developing economies (De Roon & Nijman, 2001). Due to this, most studies usually focus on investment portfolios in one economy. For example, Guidolin and Hyde (2012) conducted a study to investigate if VAR models can capture regime shifts in asset returns in the United States. Similarly, Horneff et al. (2009) also investigated on asset allocation and location over the life cycle with investment-linked survival-contingent payouts in the United States. In Kenya, Jagongo and Mutswenje (2014) explore studies on factors influencing investment decisions on individual investors listed on the Nairobi Stock Exchange. Mensah, Avuglah, and Dedu (2013) conducted some studies in Ghana.

It is also evidenced from the literature that much work on portfolio diversification has been conducted in developed countries as compared to developing countries. For example, authors like Aslanidis and Casas (2013), Guidolin and Hyde (2012), Chu (2011) have all focused on developed economies. A study by Driessen and Laevan (2007) who conducted a cross country study with a sample of 52 countries considered only 18 developing countries, of which 6 were African countries. This indicates that developing countries lack adequate studies on portfolio diversification. Despite the fact that there are some studies on portfolio risk and return through diversification in both developed and developing countries, it seems most of these studies turn not to look at inter-sectoral diversification. For instance, Mensah, Aboagye and Akosa (2013)

conducted a study looking at monetary policy regimes and asset allocation on the Ghana Stock Exchange (GSE). The authors followed the GSE industrial classification to select the following sectors; Financials, Distribution, Food and Beverages, ICT, Mining, Agriculture and Manufacturing. However, the studies did not specify the number of stocks (companies) within each sector and how each of these stocks contributes to the sector. To the best of my knowledge, a few studies such as Ayentimi, Mensah and Naa-Idar (2013) have tried to bridge this gap by performing some studies on inter-sectoral diversification. However, the authors only look at stocks within the financial sector, which this current study look beyond the financial sector. There is therefore the need for more inter-sectoral studies to provide a better picture of the merits of local diversification in portfolio selection and to understand how each selected stock in a sector has an impact on portfolio selection. It seems only a few researchers like Harvey (1995) and Mensah et al. (2013) have considered country specific optimized portfolio choice in Africa, and specifically Ghana. It is important for more insights on investment portfolios in developing economies, especially Africa.

It is also shown that several studies have given alternatives to improve some parameters of Markowitz's mean-variance model. An example of these studies is the paper by Sharpe (1963) where he uses the market portfolio in order to improve the estimations of the expected return and covariance matrix. Other examples are in Elton and Gruber (1973) and Ledoit and Wolf (2004) where they find that "imposing" a structure of the covariance matrix as opposed to its sample estimator, can improve the output of optimally constructed portfolios. Even though this recent research gives some hope for the mean-variance approach, the fact that there is not a well-known robust estimate of the expected return of most assets, evidence the situation that the benefits promised by portfolio optimization in its conception are still not fully achieved, and hence further research has to be done in this sense. Markowitz theory has not confirmed

the number of securities needed to appropriately reduce risk. Another interesting issue that has received little attention is the diversification of risk not using single-asset (example, stocks), but rather different sectors. This study, therefore, seeks to examine how investors would be able to reduce risk through suitable portfolio diversification and selection among the sectors on the Ghana Stock market.

1.3 Objectives of the study

The general objective of the research is to identify assets combination that minimizes investor's overall risk and increase their return. To better address the issues of this study, the study divided the general objective into specific objectives, which are as follows:

1. To find out sectoral assets mix that constitutes a global minimum variance.
2. To identify the sectoral assets-mix that constitutes an optimal portfolio (Tangency).

1.4 Research Questions

1. What are the sectoral assets mix that constitutes a global minimum variance?
2. What are the sectoral assets-mix that constitutes an optimal portfolio (Tangency)?

1.5 Significance of the study

This study is very important because it measures how portfolio risk can be reduced through diversification. With the completion of this study, investors would be able to identify and evaluate the various sectors to invest in, in order to reduce portfolio risk. The study also adds to theories on how to construct a portfolio using instruments of similar kinds. It also outlines the various sectors on the Ghana stock exchange and the need for inter-sectoral diversification. The study is also particularly significant because it adds to the empirical literature on market portfolio risk reduction through diversification. In sum, this work clarifies

the mystic beliefs of equity management and retool the investment know how of the Ghanaian populace, thereby attracting more people into the investment bracket for general economic development and growth.

1.6 Scope and limitation

The scope of this study is identifying how investors on the Ghana stock market can reduce portfolio risk through sectoral diversification. The study simply relied on only secondary data without including primary data. The accuracy of secondary data is however beyond the control of the researcher. In addition, the study relies on the Ghana Stock exchange as a case study; therefore, this limits my ability to generalize findings.

1.7 Organization of the Study

The study comprises five chapters:

Chapter one deals with the general background and introduction to the study, the problem statement, the objectives of the study as well as the scope and limitations of the study.

Chapter two present literature review of key relevance to the study. These include various definitions and concepts of portfolio risk and return, stock market and investment decisions, role of the stock market, types of risks, institutional profile of the Ghana Stock Exchange, and review of empirical works on portfolio risk management.

Chapter three grapples with the methodology employed in the study. This consists of the description of research design and research instrument. The tools of data analysis are also outlined.

Chapter four encapsulates the analysis and discussion of results.

Lastly, chapter five presents a summary of the study, its conclusions and recommendations as well as implications for areas of further research.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the concepts of portfolio risk and returns on trading securities critically focusing on the theoretical underpinnings of the study. It provides a summary of the relevant literature used in the study and states the theoretical framework within which the study was put into perspective. In this regard, the concepts, theories and principles relevant to the study are reviewed.

2.2 Portfolio Risk and Return

Several definitions have been given to the term risk. Among the earliest is the one given by Knight (1921) who defined risk as measurable uncertainty. Holton (2004) makes an attempt to summarize the most relevant definitions and gives a more general concept of risk: the exposure to a proposition of which one is uncertain. Other definitions address the concept in a Finance relevant context, such as Jorion (2000), who defines it as the volatility of the expected results on the value of assets and liabilities of interest. Depending on the type of the factors that produce it, for firms, the risk is group into four categories: Market Risk, Credit Risk, Strategic or Business Risk and Operational Risk. Another definition of risk in a portfolio management context that we consider more appropriate is the one given by Cool (1999) who defines risk as the absolute value of probable loss.

Elton and Gruder (1977) define portfolio as “a collection of financial assets involving investment tools such as bonds, foreign exchange, stocks, gold, asset-backed securities, real estate certificates and bank deposits which are held simultaneously by one person or a group of persons”. However, if you own a home and household furnishings and a savings account

you already have a portfolio. Risk is the probability of the losses one incurred in portfolio investment and the return is the profit or benefit one derives from portfolio investment. Investment is the net worth of long term financial assets such as bonds, shares and mutual funds. The investment risk is most properly understood when it is expressed in statistical terms that consider the entire range of an investment's possible return.

Markowitz's (1952) indicated that the expected return (mean) and variance or standard deviation (risk) of return of the portfolio is the whole criteria for portfolio selection and construction. These parameters can be used as a possible maxim for how investors need to act. It is interesting to note that, the whole model is based on an economic fact of "Expected Utility". The concept of utility here is based on the fact that different investors have different investment goals and can be satisfied in different ways.

Consequently, every investor seeks to maximize their utility (satisfaction) by maximizing expected return and minimizing risk (variance). Prior to Markowitz article in 1952, Hicks (1935) mentioned the necessity of improvement on theory of money in 1935. He introduced risk in his analysis and stated that "risk -factor" comes into our problem in two ways: First, as affecting the expected period of investment and second as affecting the expected net yield on investment. On his work Sharpe (1964) and Lintner (1965) almost simultaneously developed a model to price capital asset, popularly known as the Capital Asset Pricing Model (CAPM).

Later studies by Sharpe (1964) and Lintner (1965) on portfolio construction further investigated the trend of prices in cases where all savers invest in financial assets and particularly in share certificates in accordance with modern portfolio theory. Although, it is no secret that Markowitz mean-variance model has empirical setbacks or challenges, it is

undisputable fact that it is the most widely used model in academic and real world application. Anderson (1974) conducted a study on yielding rate of oil paintings as well as elements contributing to the price movement. He constructed hedonic price indices from 1780 to 1960; and further estimates a nominal annual return rate of 3.3%. However, Anderson (1974) noticed in his studies that variables such as time and size have significant influence on price. He then again controlled the quality difference in the time period between 1653 and 1970; and performs repeat-sales regression and estimates a nominal annual return rate of 4.9%. Finally, he found that those lower price paintings tend to achieve a higher return than those expensive ones. Similarly, Baumol (1986) constructs a data set of transaction prices of the best known art works from 1652 to 1961 in London. Using repeat-sales regression, the result shows an annual return of 0.55% in real terms with high risk. Statistics also reveal that art price fluctuates and floats rather aimlessly. Therefore, the author concludes that there is little evidence showing that art investment generates profit for investors in the future.

Stein (1977) also conducted a study and develops geometric mean price indices on auction records. The author estimates the annual nominal return rate of 10.47% on the US market and 10.38% of the UK market during the time period 1946-1968. After comparing the financial asset, artwork investment again yields a lower return. Mei and Moses (2002) construct a completely new data set by assembling sales records in the New York Public Library and Watson Library at the Metropolitan Museum of Art in the period of 1875-1999. Adopting repeat-sales regression, the authors develop general price indices as well as 4 school indices. For the entire period, an annual real return rate of 4.9% is estimated which is outperforming certain fixed-return securities while underperformed stocks.

2.3 Portfolio Diversification

Diversification is seen as one of the fundamental principle in finance, which aims at minimizing the risk investors are faced with (Gaudecker, 2015; Amenc & Martellini, 2011).

Diversification is the method of lessening the risk by putting resources into various sorts of assets. It is usually, a procedure for risk management that checks a wide choice of investments in a portfolio. This is done by investing in different assets, asset classes and markets that have low, negative or possibly no correlations between their returns, thereby reducing the risk investors are subjected to (Flavin, 2004).

Portfolio diversification is vital during the time for portfolio risk management, since it empowers the financial investors to significantly decrease their portfolio hazard without trading off their portfolio return. A portfolio that is differentiated or diversified will have less risk in contrast with the weighted normal assets when the value of the assets does not fluctuate in perfect synchrony (Gurrib & Alshahrani, 2012; Gerlach et al., 2015).

Gurrib and Alshahrani (2012) indicated that that there are two styles of diversification; one vertical diversification and the other horizontal diversification. On account of horizontal diversification, an investor invests his capital in different types of a particular asset group. This mode of diversification is commonly observed in case of shares, where investors invest in shares of companies across industries and regions so as to reduce the sector-specific perils. According to Gurrib and Alshahrani (2012), in vertical diversification, an investor invests his money among different categories of assets such as stocks, bonds, cash, property and derivatives among others. These asset categories are anticipated to behave unlike each other and produce dissimilar returns with respect to the changes in the economic scenario. Thus, the

negative or not so good performances of certain assets are compensated by the superior performance of other asset groups.

This contention by Gurrub and Alshahrani (2012) is of key relevance to the present study. In particular, the former views of portfolio espoused by the scholars, Kisaka et al.(2015) inform my choice sampling units in the study. Despite, the benefits of diversification to minimize risk, extreme diversification could result in the reduction of the expected return of a portfolio (Kisaka et al., 2015). This is so, because the risks and expected returns of a portfolio are usually positively related (Gerlach et al., 2015). Hence the lesser the risk, the lesser the expected return on the portfolio.

2.4 Stock Market and Investments Decisions

Stock trades or exchange, essentially serves as primary markets where organizations, other consolidated bodies and governments can raise capital by diverting funds of the investors into productive ventures. According to Drake (1985), the stock market has a positive contribution to economic development, however, exchange rate, interest rate and the rate of inflation can be singled out to affect stock market activity as they impinge directly on the state of corporate activity in the country (Drake, 1985). Identifying the effect on the stock market, Pilbeam (1992) also established that an increase in government borrowing through the issuance of treasury bills affects the stock market through investors' re-adjustment of portfolio balances. In that, it is indicated that the impact of Treasury bill rate also affects stock market performance in the same way as interest on demand and savings deposit impinge stock market.

Stock market development leads to economic growth (Watson, 2009). Levine and Zervos (1996) studied the relationship between economic growth and stock market development found out that there is a correlation between the stock market development and long-run economic growth after controlling the initial level of per capita GDP. Kyereboah-Coleman and Agyire-Tettey (2008) defined stock market index as a listing of stocks and a statistic reflecting the composite value of its components on the Ghana Stock Market primary stock exchange in Ghana which was incorporated in July 1989 and started its trading in 1990 with twelve listed companies and government (Ayentimi, Mensah & Naa-Idar, 2013). It is used as a tool to represent the characteristics of its component stocks, all of which bear some commonality such as trading on the same stock market exchange, belonging to the same industry or having similar market capitalization.

A study conducted by Statman and Sepe (1989) found positive stock market reaction to project termination announcements. The authors further added that because a project termination decision signals a firm's willingness to cut losses, the stock market responds positively to such an announcement. Contrary, Gombola and Tsetsekos (1992) found negative stock market reactions to announcements of plant closing decisions. Their arguments were that the negative market reaction to plant closing announcements may be caused either by the negative information conveyed by the announcement about the firm's future investment opportunities, or by the market's belief that managers are making poor abandonment decisions. Alui, Ramirez and Yung (1991) find a significant positive abnormal return for 112 announcements of corporate headquarters relocation. They argue that the market should respond positively to the announcement if it believes that the relocation decision is a positive NPV project.

2.5 Factors Influencing Investment Decision

Some researchers have also investigated some factors that influence investors and investment decision (eg. Jagongo & Mutswenje, 2014; Hussein, 2007; Dimitrios, 2007; Kadiyala & Rau, 2004; Phau & Poon, 2000; Nagy & Obenberger, 1994; Kiran & Rao, 2005; Bennet et al., 2011; Lodhi, 2014; Geetha & Vimala, 2014; Shanmughama & Ramyab, 2012; Obamuyi, 2013).

Nagy and Obenberger (1994) also examined factors influencing investor behaviour. They further suggested that classical wealth-maximization criteria are important to investors, even though investors employ diverse criteria when choosing stocks. Phau and Poon (2000) also opined that there are a number of factors that influence both in-home and retail shopping methods; such as the internet, telephone and mail order. According to the authors, factors like “socio-economic and demographic factors, product type and distribution methods, perceived purchase risk, personal characteristics and traits as well as shopping or delivery time have a great impact on investors. Kadiyala and Rau (2004) investigated investor reaction to corporate event announcements. They concluded that investors appear to under-react to prior information as well as to information conveyed by the event, leading to different patterns. Kiran and Rao (2005) conducted a study by identifying investor group segments based on demographic and psychographic characteristics. The authors analysed their data using logistic regression and factor analysis. They verified a strong relationship between risk taking attitude and demographic and psychographic variables. A study by Hussein (2007) found that investors consider factors like “expected corporate earnings, get rich quickly, stock marketability, past performance of the firm’s stock, government holdings, and the creation of the organized financial markets”. A study on Investors behaviour conducted by Dimitrios (2007) also found that there are two types of investors, namely; an individual investor and a

professional investor. According to the author, individual investors rely more on newspapers/media and noise in the market when making their investment decisions, while professional investors rely more on fundamental and technical analysis and less on portfolio analysis (Dimitrios, 2007).

Lodhi (2014) examined factors influencing individual's investor behaviour by applying a survey in Karachi, Pakistan. It was found that, financial literacy and accounting information were considered to be significant in lowering information asymmetry and allowing investors to invest in risky instruments. Bennet *et al.* (2011) also conducted a study on factors influencing retail investors' attitude towards investing in equity stocks in Tamil Nadu. The authors found that factors like "investors' tolerance for risk, strength of the Indian economy, media focus on the stock market, political stability and government policy towards business" had a very high influence over retail investors' attitude towards investing in equity stocks.

Then again, Shanmughama and Ramyab (2012) also combined the theory of reasoned action and theory of planned behaviour to investigate the underlying factors that affect investors' behaviour. The authors conducted multiple regression analysis and found that "social factors, namely social interactions and media, influenced the trading behaviour (trading frequency) of individual investors".

Jagongo and Mutswenje (2014) investigated the factors influencing investment decisions at the Nairobi Stock Exchange. The findings of the study depicted that the most important factors that influence individual investment decisions were: reputation of the firm, firm's status in the industry, expected corporate earnings, profit and condition of statement, past performance firms stock and price per share. In a study of Geetha and Vimala (2014)

conducted in China, they found that changes in demographic factors such as income, age, occupation and education had an influence in the investment avenue preference.

Obamuyi (2013) tried to reveal the socioeconomic factors influencing investment decisions of investors in the Nigerian capital. By using several analytical tools like independent t-test, analysis of variance and post-hoc tests, he found that past performance of the company's stock, expected stock split/ bonus, dividend policy, expected corporate earnings and get-rich quick were found to be the most influential factors on investment decisions of investors in Nigeria.

2.6 Theoretical Review

This section provides a brief understanding of some theories, principles and model underlying portfolio optimization and as well as asset allocation. The portfolio theories include, static and dynamic models and as well as the separation theorem.

2.6.1 Portfolio Theory

The Portfolio theory was developed by Markowitz in 1952. The theory relates to the basic asset allocation problem (the choice between the level of the risk and return) an investor is faced when selecting a portfolio (Gratcheva & Falk, 2003). Kisaka, Mbithi and Kitur (2015) indicated that there are five basic assumptions that underpin the portfolio theory. First, the risk investors are exposed to be within a myopic time period (single time period). Second, investors have diminishing marginal utility curves and aim at maximizing their utility. Third, investment choices made by investors depend on their expected return and risk preferences. This is as a result of the assumption underlying the mean-variance approach, that stocks' returns are normally distributed. Hence the mean (first moment) and variance (second moment) are sufficient in the construction and selection of a portfolio. Fourth, for given levels

of risk, investors tend to maximize their expected returns. Conversely, for given levels of expected returns, investors minimize their risk. That is, the mean-variance criterion aims at selecting efficient portfolios for investors. Fifth, portfolio risks are computed based on variations in expected returns.

This theory also assumes that investors are rational, hence they will seek to invest in securities with higher levels of expected returns (Gennaioli, Shleifer, & Vishny, 2015). However, these higher returns come with higher risks, thus, the risks and expected returns are positively related (Gennaioli et al., 2015). In view of these principles, the efficient frontier which enables investors to choose among portfolios based on individual risk-return preferences was formulated (Wang & Forsyth, 2010). Some authors like Wu and Chen (2015) and Calafiore (2008) have asserted that the Markowitz optimization technique is formulated for a single time period. Hence, this has led to controversies about how it can be applied to a multiple time period, resulting in the formulation of dynamic models by some researchers (Gulpinar & Rustem, 2007).

2.6.2 Static and dynamic models

Static and dynamic models are the popularly known models in portfolio optimization (Wu & Chen, 2015). Static is sometimes referred to as the tactical asset allocation (Calafiore, 2008). With the static or tactical asset allocation investors define the mean-variance approach across a single period (Brennan et al., 1997). For a static model, investors make the asset allocation choice at the start of their investment horizon and wait until the period ends to obtain the expected returns on their portfolios with the aim of maximizing their utility at the end of this period (Mossin, 1968). That is, with the assumption of a static time period, investors can neither include more asset classes, adjust their wealth nor change the composition of the portfolio during the period (Zhang, Liu, & Xu, 2012). However, in the real world, portfolio

optimization and asset allocation decisions by some investors deviate from the Markowitz static model (Liu & Zhang, 2015). This has led to the formulation of multi-period or dynamic models (Wu & Chen, 2015).

A dynamic model assumes that investment decisions are made over multiple time periods. With the dynamic model, investors are capable of making changes prior to the end of the investment period (Liu et al., 2012). Some investors would want to adjust their wealth from time to time (Liu & Zhang, 2015). Whereas, others would also want to make adjustments to the asset mix that forms the portfolio or in some cases include other asset classes that would offer higher expected returns on their portfolios (Zhang et al., 2012). Mossin (1968) formulates the structure of a multi-period model as follows. Investors pre-determine a future time, at which they can consume their wealth. However, these investors still have the intention of maximizing their expected return at this future date. This model therefore assumes that, the time between the present and the investment period can be separated into several time periods, either of equal lengths or not. Hence, at the end of these periods, the expected returns on the portfolios are obtained and based on these, a decision on the asset mix of the portfolios are made for the subsequent periods.

2.6.3 Separation Theorem

The idea behind the separation theorem is that the optimal choice (optimal portfolio) of investors is independent of their expected returns and risk preferences in the presence of a risk-free asset (Elton & Gruber, 1997). The separation theorem has simplified computations in portfolio selection, in that, now the portfolio issue may be seen as determining the portfolio tangent to a ray which passes through a risk free asset in an expected return-standard deviation cosmos (Elton & Gruber, 1997). This theorem also brought about the mutual fund theorem,

which stipulates that all types of investors can obtain their preferred portfolio by combining two mutual funds, the first, consisting of the optimal portfolio and the second, the risk-free asset (Lin & Lu, 2012).

A popularly known separation theorem is the two-fund separation theorem (Tobin, 1958). This theorem stipulates that any portfolio on the efficient frontier can be represented linearly by two respective portfolios on the same efficient frontier and on the other hand, any two convex combination of efficient portfolios (portfolios on the efficient frontier) result in an efficient portfolio (Yao et al., 2014). The separation theorem also enhanced the development of the Capital Asset Pricing model (CAPM). That is, the modern portfolio theory in combination with the separation theorem contributed tremendously in the establishment of the CAPM in finance (Sharpe, 1964).

2.6.4 Role of Stock Market

The stock market is basically a platform serving as primary markets where corporations, other incorporated bodies and governments can raise capital by channelling savings of the investors into productive ventures thereby helping firms to identify funds and grow (Arnold, 2008). In recent times, the contributions of the Stock Exchange to development leads of economic growth (Watson, 2009) have been recognized in most parts of the world. Because investors in financial securities with a stock market quotation are assured that they are generally able to sell their shares quickly, easily, cheaply and with a reasonable degree of certainty about the price, hence investors are willing to supply funds to firms at a lower cost than they would if selling was slow or expensive.

The stock markets therefore encourage investment through the mobilization of savings; which is vital in economic development. On top of stimulating the investment of domestic savings, the stock market is also useful for attracting foreign investments. Also, Ntiwaah (2004) identified that the stock market offers users of funds an avenue for raising funds to finance their activities a major role played by the Stock Exchange as a way of providing access to huge sums of money from individuals. However, the stock market also provides additional information on financial liberalisation and deepening, primarily a platform for risk diversification for investors and capital raisers. Following the main objective of this study trying to provide to issuers and, or, investors the return and risk of trading in securities of any selected companies on the GSE, below the theoretical thematic review provides a full idea of the operations of the GSE according to the risk and return accompanied.

2.7 Reviews of Empirical Works

A number of studies have been conducted on the issues of portfolio risk Management (e.g. Gurrib & Alshahrani, 2012; Ocran, 2010; Owusu & Ayimah, 2012; Darko, 2012; Garcia-Herrero and Vázquez, 2013; Yu & Huang, 2013; Yang & Hung, 2010; Zhang, Wang, Chen & Nie, 2007). Gurrib and Alshahrani (2012) in their study titled Diversification in portfolio Risk Management: A case study of United Arab Emirates financial market concluded that it is a known fact that diversification of portfolio assists in the reduction of the associated risk involved in it. However, they maintain that one cannot completely eradicate risk entirely by means of diversification. Their methodology was a reliance on data drawn from twenty different companies under the broad categories of banking, transportation, real estate and construction, insurance and telecommunication. The mean stock prices, their variances and the rate of return produced by these twenty companies were held for one year. Their research finding revealed that different sectors of the economy produced different risk levels and

returns. They identified one company in the Real Estate and Construction sector, having the greatest return rate among the twenty sampled companies drawn from the different sectors. This same company produced the greatest variance share price, which is usually used as a proxy of risk. It follows that an investment may yield the highest return rate, but with the greatest variance, its achievement may be very volatile and hence very unreliable and uncertain.

Ocran (2010) in his study titled Measuring the systematic risk of companies listed on the GSE concluded that returns of most stocks vary less than proportionately than the returns of the entire market using monthly stock prices ranging from the period 1999-2009. This study was more comprehensive in that it covered virtually all companies listed on the Ghana Stock exchange and therefore gives us the sector-specific dynamics. However, it fails to tell us the optimal portfolio mix for the current and the potential investors. Owusu and Ayimah (2012) carried out a performance of the Ghana Commercial Bank in the pre and post enlistment eras on the GSE. They concluded that the GCB was more liquid in the five years prior to its listing on the stock market. Their main focus was to ascertain how the macroeconomic environment influences the performance of the stock market in Ghana. Following from this research it will be misleading to maintain that financial companies do not perform on the GSE owing to the GCB case. The same analysis when applied to other financial companies listed on the GSE may yield inconsistent results and more so the differences in time periods need to be considered.

Darko (2012) in his study titled “Constructing optimal stock portfolio with Markowitz model” maintained that investors in Ghana in investing vest 83.4 percent of their capital in the non-financial index whilst investing 16.56 percent in the financial index. His conclusion is based

on the analysis of a four-year monthly data on stock prices, market capitalization and dividend per share from 2007 to 2010. However, his study fails to tell us which specific sector is more profitable to invest in because of the broad categorization of financial and non-financial. Whilst admitting the relative good performance of the nonfinancial, it might not necessarily be the case that all listed companies is of good performance. Such study would have benefited from a disaggregation of all listed nonfinancial companies to know their respective return and risk rates. Accordingly, the present study sought to address this gap in the literature.

Studies of Zhang, Wang, Chen and Nie (2007) also employed possibility means, variances and efficient frontiers (possibility distributions) to a mean-variance technique, instead of the usual probability distributions used by most academic researchers. They found that by employing this possibility technique they are able to solve and construct large, efficient portfolio sets and choices for investors. Both studies employed securities from the Shanghai stock exchange. Zhang (2007) applied a sample of 5 securities whereas Zhang et al. (2007) applied a sample of 10 securities in developed economies. However, While, Yang and Hung (2010) examined 5 stocks, Kraus and Litzenberger (1976) considered stocks listed on the New York Stock Exchange constantly for 10 years. They found that the inclusion of these higher moments result in changes in the constructing of optimal portfolios, shapes of efficient frontiers, and the magnitude of risk as compared to using Markowitz's mean-variance analysis. Other studies have also employed a dynamic asset allocation in their portfolio selection, since the Markowitz mean-variance analysis is over a single time period, which is not the case of most investments in the real world. Studies such as Yu and Huang (2013) employed multi-period or continuous-time asset allocations to dynamic situations. However, though several techniques (dynamic programming, stochastic programming, sample paths, decision trees with quadratic programming, an analytical optimal solution) have been

proposed for handling the dynamic asset allocation, most of these techniques are usually problematic when employed in a real world numerical data (Gulpinar & Rustem, 2007).

Garcia-Herrero and Vázquez (2013) found that the benefits of diversification are also realized in the banking industry when banks have subsidiaries by employing a sample of 38 banks from 8 developed economies. They also found that, subsidiaries of banks situated outside their respective home countries, specifically developing economies tend to offer better risk-expected return trade-offs than their parent banks. This, therefore further indicates the substantial benefits of cross border diversification.

Despite, the substantial studies on the benefits of portfolio diversification, much work has been conducted in developed countries as compared to developing countries. For example, authors like Garcia-Herrero and Vasquez (2013), Aslanidis and Casas (2013), Guidolin and Hyde (2012), Chu (2011), While, Yang and Hung (2010) have all focused on developed economies. A study by Driessen and Laevan (2007) who conducted a cross country study with a sample of 52 countries only considered only 18 developing countries, of which 6 were African countries. This indicates that developing countries lack adequate studies on portfolio diversification. Despite the fact that there are some studies on portfolio risk and return through diversification in both developed and developing countries, it seems most of these studies turn not to look at inter-sectoral diversification.

For instance, Mensah, Aboagye and Akosa (2013) conducted a study looking at monetary policy regimes and asset allocation on the Ghana Stock Exchange (GSE). The authors followed the GSE industrial classification to select the following sectors; Financials, Distribution, Food and Beverages, ICT, Mining, Agriculture and Manufacturing. However,

the studies did not specify the number of stocks (companies) within each sector and how each of these stocks contributes to the sector. To the best of my knowledge, a few studies such as Ayentimi, Mensah and Naa-Idar (2013) have tried to bridge this gap by performing some studies on inter-sectoral diversification. There is therefore the need for more inter-sectoral studies to provide a better picture of the merits of local diversification in portfolio selection and to understand how each selected stock in a sector have an impact on portfolio selection. It seems only a few researchers like Harvey (1995) and Mensah et al. (2013) have considered country specific optimized portfolio choice in Africa, and specifically Ghana. Africa is gradually becoming a place of interest in terms of investment. Driessen and Laevan (2007) found that investing in Africa tends to offer higher expected returns and better investment opportunities. This is because Africa is gradually becoming a lucrative investment destination as a result of its risky nature and the disintegration of the returns of most African markets. They also realised that the diversified portfolios constructed offered the highest expected returns and best risk-expected return tradeoffs, specifically portfolios which included African stocks. This, therefore, lays a strong foundation for studies targeting developing economies, especially in Africa.

In spite of all these, the Markowitz's mean-variance theory continues to be the foundation of modern portfolio theory because, first, it places huge data requirements on investors. Also, there is no empirical evidence to suggest that including higher moments in the framework changes the appeal of the portfolio selected (Elton & Gruber, 1997). Second, this theory continues to stand firm, because, its significance is highly recognized, well established and greatly acknowledged globally (Elton & Gruber, 1997). This study, therefore, applies a Markowitz optimization technique in the selection of a portfolio across eleven African stock markets.

2.8 Institutional Profile of the Ghana Stock Exchange

The Ghana Stock Exchange (GSE) currently has 38 listed companies and two corporate bonds. In October 2006, two and three years fixed rate Government of Ghana bonds was also listed. The two year bonds have coupons ranging between 15.8 and 17 percent per annum whilst the three year bonds carry coupon rates between 16 and 17.5 percent. Listed companies fall within the manufacturing, financial, mining, oil sectors amongst others. There are listing requirements which include capital adequacy, profitability, spread of shares, year of existence and management efficiency. The GSE performance is mainly monitored by the GSE all-shares-index (GSI), which is a weighted index. Although, non-resident investors can deal in securities listed on the exchange without obtaining prior exchange control permission, there are some restrictions on portfolio investors not resident in Ghana. The Securities and Exchange Commission is the regulator of the exchange. Indeed, the exchange was adjudged as the world's best-performing market at the end of the first quarter of 2004 with a year return of 144 percent, in United States dollar terms, compared to 30 percent by Morgan Stanley Capital International Global Index, 26 percent Standard and Poor in the USA, and 32 percent in Europe (Databank Group, 2004).

According to Kyereboah-Coleman and Agyire-Tettey (2008) as cited in Owusu and Ayimah (2012), this remarkable performance is attributed to a relatively stable and good macroeconomic performance during the period and a subsequent pickup in investment and economic activity. Within the period, a number of new public offers were also introduced with the divestiture of shares existing (SOE) on the exchange. However, since 2005, the GSE has witnessed an abysmal performance and assumed a bearish outlook in spite of the sustained macroeconomic stability and gains in the country. In the view of Owusu and Ayimah (2012),

this poor performance can be attributed to several factors, including the fact that the market may be correcting itself due to overvaluation of equities during the 2004 bull runs. Owusu and Ayimah further maintain that the petroleum price increases fuelled inflation expectations which resulted in large diversions of funds away from shares in the stock market in short-term instruments in money markets. Kyereboah-Coleman and Agyire-Tettey (2008) further contend these reasons notwithstanding, the poor performance of the GSE continue to be puzzling.

Current trends in market indicator though show that the market appears to be picking up slightly in performance with a year-to –date change in the GSE GSI at 0.76 percent and a market capitalization at GH¢11. 27 billion as at January 2007. They indicated, in general, that the factors that have been identified as being responsible for the performance of the GSE include macroeconomic factors such as inflation rate, interest rate and Gross Domestic product (GDP) growth. The GSE – Composite Index (GSE-CI) recorded a year to date gain of 78.81%, ending the year 2013 with 2,145.20 points while the GSE Financial Stock Index (GSE-FSI) also recorded a return of 71.81% ending the year 2013 with 1,784.05points. The return on index recorded on the Ghana Stock Exchange for the year 2013 makes the Exchange one of the best performing stock market in Sub-Saharan Africa. The GSE-CI and the GSE-FSI recorded a return of 23.81% and 20.94% in December 2012. Market capitalization of listed securities at the end of December 2013 was GH¢61, 158.29million compared to the December 2012 end figure of GH¢57, 264.22million, an increase of 6.80%. Domestic Market capitalization recorded a 76.68% increase ending December 2014 with GH¢11, 694.93 compared to GH¢6, 753.14 recorded for the same period in 2012 (Ghana Re, 2013). This clearly shows that there were more price increases in the primary listings on the market.

2.9 Chapter Summary

This chapter gave a brief overview of relevant theories and concepts in portfolio diversification, asset allocation and portfolio optimization. Theories and concepts such as, portfolio theory, portfolio diversification, separation theorem, static and dynamic models are discussed. This chapter also gives a general overview of some research works that has been done.



CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter explains the research design that was employed to investigate inter-sectoral diversification. The chapter also focuses on the data sources and process of data collection. Finally, a description of the statistical technique used for data capture, analysis and presentation are also discussed in this chapter.

3.1 Research Design

Considering the main research designs that are available for any empirical study, thus the quantitative, qualitative and mixed-method approach, this study employs a quantitative approach. Quantitative research involves counting and measuring of events and performing the statistical analysis of a body of numerical data (Smith, 1988). From the literature, quantitative approach to research allows a researcher to test the objective theories by examining the relationship that may exist among variables. With the help of statistical packages and tools these variables are measurable (Creswell, 2009). Also, since the data being used is purely quantitative, the quantitative approach is more appropriate.

3.2 Data Sources and collection

Data was obtained from secondary sources. Stock prices from 2009 to 2014 were collected from the Ghana Stock Exchange for the purpose of the analysis. Treasury bill rate is used as a proxy for the risk-free asset in the study. These treasury bill rates were derived from the Bank of Ghana database. It was computed by adding all the monthly treasury bill rates over the number of months. Literature from journals, books and any other source relevant to this study were also gathered. This provided a well-balanced and fair data for the analysis.

3.3 Population and Sampling Techniques

The population for this study is all companies listed under the Ghana Stock Exchange. The companies listed are put into eight sectors. However, in this study, data were received for five sectors. These sectors are namely banking and finance, manufacturing, mining, distribution, and food and beverages. These five sectors and their respective companies were fundamentally selected because of two reasons. Firstly, these stocks in these sectors met the required number of years that were needed under each sector, and, secondly all variables required for analysis were available for all these stocks under the Ghana Stock Exchange. The data selected from above were based on the two criteria indicated above, and this technique is chosen to give every company the chance of being selected for the study. With the intention of forming an optimal diversified portfolio, the stocks were selected from the five diverse industries, to be precise, Banking and finance, Manufacturing, Mining, Distribution, and Food and Beverages. The companies are chosen because of its availability among the listed firms on the GSE. The names of the twenty five (25) companies selected for the portfolio formation have been clustered below with regards to their respective sectors:

A. Banking and Finance

1. Eco bank Transnational Incorporation(ETI)
2. Ecobank Ghana Limited(EBG)
3. Ghana Commercial Bank(GCB)
4. CAL Bank Limited (CAL)
5. HFC Bank Ltd (HFC)
6. Standard Chartered Bank (SCB)
7. Trust Bank Limited (TBL)

B. Manufacturing

1. Aluworks Ltd(ALW)
2. Ayrton Drugs Manufacturing Company Limited(AYRTN)
3. Golden Web Limited(GWEB)
4. Camelot Ghana Limited(CMLT)
5. Sam Wood Ltd. (SWL)
6. Pioneer Kitchenware Ltd. (PKL)
7. Unilever Ghana Limited (UNIL)
8. PZ Cussons Ghana Ltd. (PZC)

C. Mining

1. Anglogold Ashanti Limited(AGA)
2. Golden Star Resources Limited(GSR)
3. AngloGold Ashanti Limited (AADs)

D. Distribution

1. Ghana Oil Company(GOIL)
2. Mechanical LLOYD Company Limited(MLC)
3. Produce Buying Company(PBC)
4. Total Petroleum Ghana Limited (TOTAL)

E. Food and Beverages

1. Fan Milk Limited (FML)
2. Guinness Ghana Breweries Ltd. (GGBL)
3. Cocoa Processing Company (CPC)

Considering that, some sectors have less than three companies listed during the period of study, this research dropped sectors that had fewer than three companies. Available data for the periods of 2009 to 2014 listed on GSE has been used to achieve study results. The sectors;

Manufacturing, Mining, Banking and Finance, Distribution, and Food and beverage have been used to develop optimal portfolio.

3.4 Data Analysis

In the analysis, the free, open R-software was used to prepare the data that were collected and analysed. The data were also presented and analysed using descriptive statistics such as tables and curves. These methods were more convenient for the kind of data collected and also provided a better explanation of the variables in the study. Specific objectives were analysed based on the following indicators:

Methods

The price return for each month computed as:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} (1)$$

Where R_{it} is the monthly return for stock i and month t . P_{it} is the price of stock i at the beginning of the month, P_{it-1} price of stock at the end of the month.

The expected $E(R_x)$ of the sector x can be computed by

$$E(R_x) = \sum_{i=1}^N w_i (R_{it}) \quad (2)$$

The variance of each stock was used as a measure of risk and can be computed as:

$$\sigma_i^2 = E[R_{it} - E(R_x)]^2 \quad (3)$$

The expected portfolio return can be computed as:

$$E(R_p) = \sum_{i=1}^N w_i E(R_x), \text{ where } i=1, 2, \dots, N \quad (4)$$

Where w_i is the weight of an investor's budget dedicated to investing in a particular market stock.

Portfolio Optimization Model

Minimum Variance Portfolio: $\sigma_p^2 = \sum_{i=1}^N w_i^2 \sigma_i^2 + 2 \sum_{i,j=1}^N w_i w_j \text{cov}(R_i R_j)$ where $i \neq j$ (5)

Constraint to: $\sum_{i,j}^N W_{i,j} = 1, \quad W_{i,j} \geq 0$

Tangency Portfolio which Maximizes Sharpe Ratio is given by:

$$S_p = \left(\frac{E(R_p) - r_f}{\sigma_p} \right), \text{ where } i \neq j \quad (6)$$

Constraint to: $\sum_{i,j}^N W_{i,j} = 1, \quad W_{i,j} \geq 0$

Computing efficient portfolios

In computing the efficient portfolios, the R Software was used. The asset developed in this study provides an asset mix with no short selling that maximises investor returns and minimises their risk. The mean-variance efficient portfolios were computed using the following steps;

1. Specifying a portfolio an expected return vector and covariance matrix for the assets under consideration as well as a vector of portfolio weights are determined.
2. The global minimum variance portfolio that solves the optimization problem is determined.
3. A mean-variance efficient portfolio that achieves the target expected return solves the optimization problem is achieved.
4. The portfolio of risky assets with the highest Sharpe's are identified as the Tangency portfolios
5. The set of efficient portfolios of risky assets are computed as a convex combination of any two efficient portfolios.
6. In this study the global minimum variance portfolio is one portfolio and an efficient portfolio for determining the set of efficient portfolios of risky assets.
7. Finally plot the efficient frontier showing the original assets and the tangency portfolio

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.0 Introduction

Providing knowledge through diversification measures of stocks is the quest of every investor. It is always important to know the risk and return in investing in stocks. A well-diversified portfolio is the market portfolio, therefore choosing to hold a portfolio of several stocks enhances higher returns while reducing risk. From the secondary data received from the Ghana stock exchange, the share prices of 25 listed companies and their market activities from 2009 to 2014 are used to help achieve study objectives. Towards the end of this chapter, the study has developed an asset mix with no short selling that maximises investor returns and minimises their risk, and also provided a sectoral asset mix that constitutes an optimal portfolio.

4.1 Descriptive Statistics and Visualization plots of stock returns

Expected returns of monthly prices data of the stocks under this study have been computed and various group stocks which are put into five sectors are identified as the Finance sector consisting of seven stocks, four stocks contributing to the Distribution sector, three stocks identified by the Food and Beverage sector, the Manufacturing sector consisting of eight stocks, and three stocks identified in the Mining sector. Based on the weighted returns from the stocks identified for each sector, portfolios have been developed to the taste of any investor. In order to get a clearer view of the data that is used in the building of the portfolio asset mix of the study, the Table 4.1 below depicts various descriptive of the stocks under study.

Table 4.1: Descriptive Statistics On Stocks Returns 2009 to 2014

Stocks	Sectoral	Average Return	Standard Deviation	Kurtosis	Skewness
<i>CAL</i>	Finance	0.0390	0.1996	21.0001	3.5927
<i>EBG</i>		0.0218	0.1039	3.0467	1.4007
<i>ETI</i>		0.0211	0.1491	2.5731	-0.1969
<i>GCB</i>		0.0342	0.1480	2.5661	0.7307
<i>HFC</i>		0.0291	0.1043	15.1838	3.2788
<i>SCB</i>		0.0220	0.0963	5.2657	1.8255
<i>TBL</i>		-0.0061	0.0432	10.7564	-2.1521
<i>GOIL</i>	Distribution	0.0276	0.1233	3.5112	0.6893
<i>TOTAL</i>		0.0315	0.1053	6.3495	1.4419
<i>MLC</i>		0.0265	0.1396	10.1711	2.5887
<i>PBC</i>		0.0023	0.1441	4.2010	0.7618
<i>FML</i>	Food and Beverage	0.0331	0.1101	2.8128	0.7440
<i>GGBL</i>		0.0153	0.0992	3.8953	-0.6892
<i>CPC</i>		0.0385	0.3224	3.3163	1.5626
<i>AGA</i>	Mining	0.0050	0.0204	26.5102	4.9748
<i>GSR</i>		-0.0001	0.0757	9.3162	1.6841
<i>AADs</i>		0.0066	0.0475	11.8291	2.2495
<i>AYRTN</i>	Manufacturing	0.0025	0.0427	2.8976	0.4521
<i>SWL</i>		0.0070	0.0818	25.9632	3.0874
<i>GWEB</i>		-0.0021	0.0719	21.5747	-1.4090
<i>PKL</i>		-0.0020	0.0170	71.0000	-8.4261
<i>UNIL</i>		0.0160	0.0648	2.8626	0.2311
<i>PZ/PZC</i>		0.0126	0.1180	10.5490	2.5166
<i>CMLT</i>		-0.0025	0.0517	18.9039	-3.1668
<i>ALW</i>		0.0045	0.2650	11.1815	2.6067

As shown from the descriptive statistics in table 4.1 above, it is envisaged that the highest expected return of stocks within the period of study was indicated from CAL, a mean return of 0.0390 while return on CPC followed subsequently with mean value of 0.0385. The standard deviation statistics shown indicates the dispersion of the returns data from the expected returns. The standard deviation simply measures the volatility of prices for that asset relative to itself. A high standard deviation indicates high risk, comparatively, with the returns stock data it is indicated that CPC has the highest risk value of 0.3224. Better visualising the relationship between risks and returns of the stocks under the study below figure 4.1 shows the relationship.

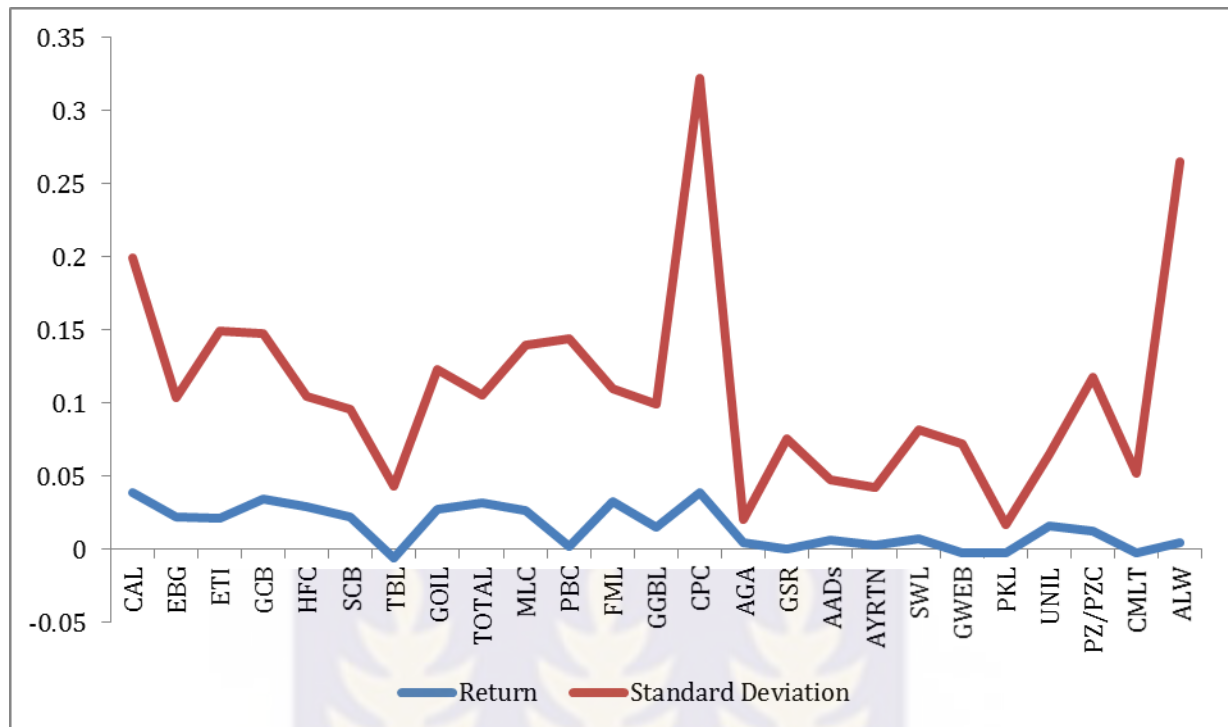


Figure 4.1: Risk Return relationship of GSE stocks prices 2009-2014

From the graph above, it was realized that the higher returns shown by some of the stocks have shown with higher risk, while others indicated otherwise. As shown from the risk-return relationship, it was inferred that higher risk always does not produce a higher level of returns. The kurtosis values for stocks are all shown to be positive, indicating heavy tailed and peakness relative to the normal distribution. The normality of the returns of the share prices are shown by the skewness values in the descriptive statistics table.

In order to create a portfolio of the various stocks under the five sectors, various market capitalizations of the stocks helped compute the weightings of the monthly returns of the stocks and subsequently created a portfolio for the sectors. This was done due to the illiquid nature of some stocks on the GSE. The market value-weighted sectoral portfolio also reflects the best return evolution of the investable assets on the GSE. Providing a view on the portfolio returns series data the table 4.2 below shows the descriptive in accordance with the sectors as shown.

Table 4.2: Descriptive statistics of sectoral returns 2009 to 2014

Sectors	Mean	Standard Deviation	T-stat	P-Value
Finance	0.0276	0.0864	2.6865	0.0090**
Distribution	0.0294	0.0829	2.9862	0.0039**
Food and Beverage	0.0248	0.0773	2.6980	0.0087**
Mining	0.0017	0.0736	0.1933	0.8473
Manufacturing	0.0160	0.0582	2.3129	0.0237*
Index	0.1485	0.0383		

** , * significant at $\alpha = 0.01, 0.05$ respectively

Evidence from this descriptive table indicates that over the period of study, the Finance, Distribution, Food and Beverage and Manufacturing sector produces significant returns on their investment. Thus, the P-value < 0.05. However, the returns for the Mining sector was also seen to be statistically insignificant over the period of study with a P-value >0.05. Also, shown by the various risk, it was envisaged that some sectors had a higher standard deviation as compared to others whose returns were statistically significant. Figure 4.2 shows how each portfolio returns performed over the period of study. It is seen that the returns of the distribution sector stands out, indicating a higher level of returns with its corresponding level of risk over the period of study. The finance sector is also seen to be the next sector that has recorded a higher level of returns with some level of risk.

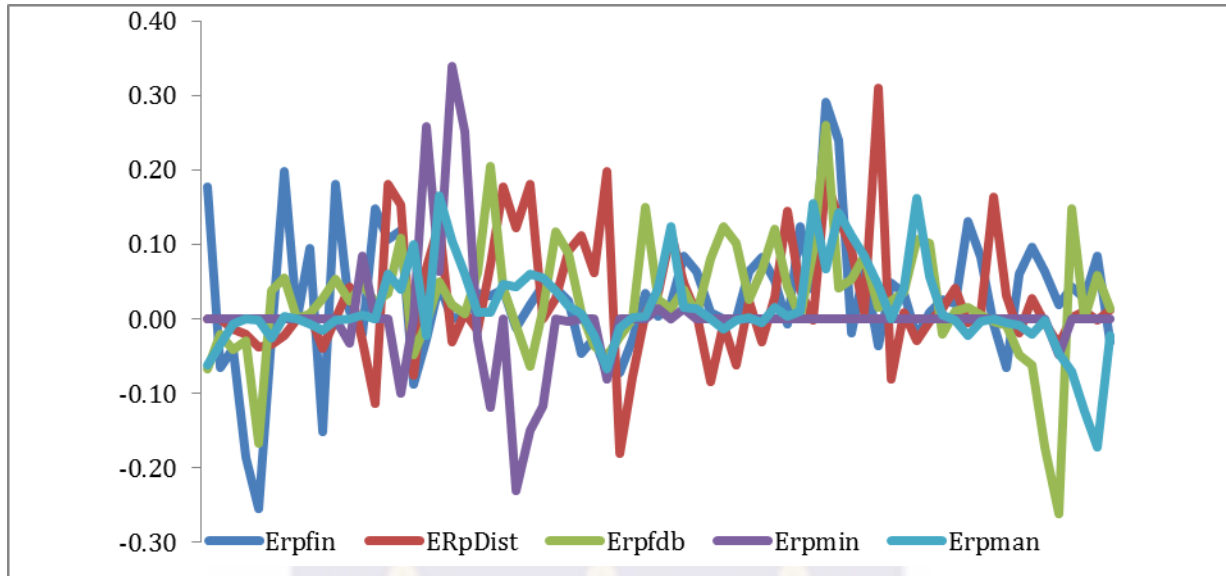


Figure 4. 2: Monthly expected returns of portfolios 2009 - 2014

Keys

Erpfin= Expected Portfolio return of Finance Sector

ERpDist = Expected Portfolio return of Distribution

Erpfdb = Expected Portfolio return of Food and Beverage

Erpmin = Expected Portfolio return of Mining Sector

Erpman = Expected Portfolio return of Manufacturing Sector

Also providing a visual plot of the risk and return among sectors, the Figure 4.3 below indicates how risk and return relates on the Ghana Stock Exchange. Shown by the scatter plot with a trend line, it is indicated that risk and return have an increasing trend. Thus a smaller return yields a lower risk while higher return also demands higher risk.

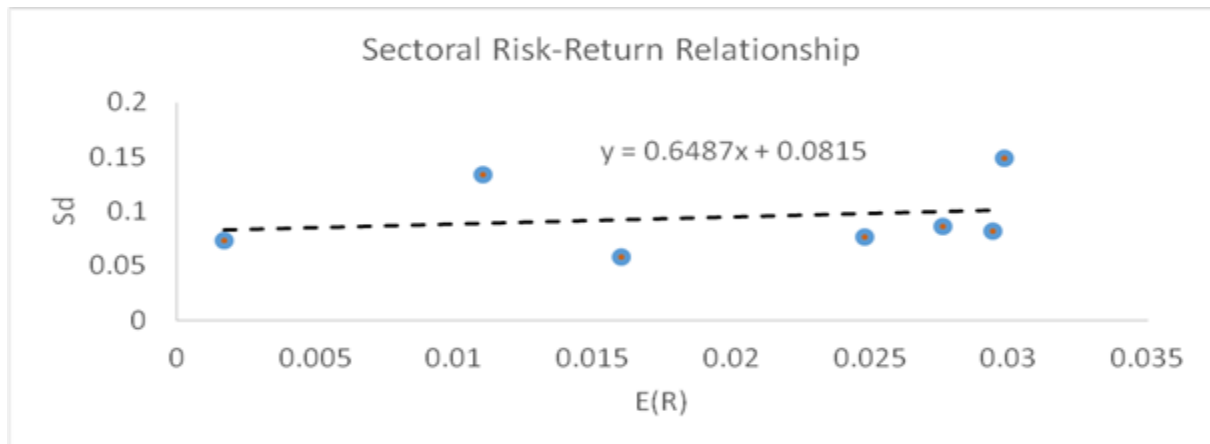


Figure 4. 3: Trend analysis of risk and return

The correlation matrix below indicates the nexus that exist between sector performances. The correlation values show the strength of the relationship that exists between the various sectors. It can be observed that the correlation coefficients reported in Table 4.3 between each of the sectors are less than 50%. This result is consistent with the study by Jacobs et al. (2014) who purported that stock returns of African economies are not related to each other. Therefore, it is inferred that investors may be exposed to higher investment opportunities if they invest and diversify in these sectors.

Table 4.3: Correlation matrix for sector returns 2009 to 2014

<i>Correlation</i>	Finance	Distribution	Food&Bev	Mining	Manufact
Finance	1				
Distribution	0.166	1			
Food&Bev	.341**	0.138	1		
Mining	-0.056	-0.186	0.004	1	
Manufact	0.074	.239*	.236*	0.113	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The covariance matrix of stock returns is one of the major inputs to the mean-variance optimization process. To better develop a portfolio that maximizes a higher expected return, the covariance estimates of these stocks is highly desirable. The covariance's provides an idea

on the degree to which the returns of two risky assets move together. The covariance matrix is estimated from the historical mean return data for every sector. The mean and standard deviation of the portfolio returns are estimated based on the covariance and mean returns. Shown in the Table 4.4 below, covariance's among the various sectors are low and some negative, indicating that stocks have smaller movements less frequently in the same direction, and therefore implies that putting stocks together will reduce the risk of the portfolio. The Variance-Covariance matrix is necessary to calculate the portfolio variance.

Table 4.4: Covariance matrix sector returns 2009 to 2014

<i>Covariance</i>	<i>Finance</i>	<i>Distribution</i>	<i>food&Bev</i>	<i>Mining</i>	<i>Manufact</i>
Finance	0.007				
Distribution	0.001	0.007			
food&Bev	0.002	0.001	0.006		
Mining	0.000	-0.001	0.000	0.005	
Manufact	0.000	0.001	0.001	0.000	0.003

4.2 Global Minimum Variance Portfolio

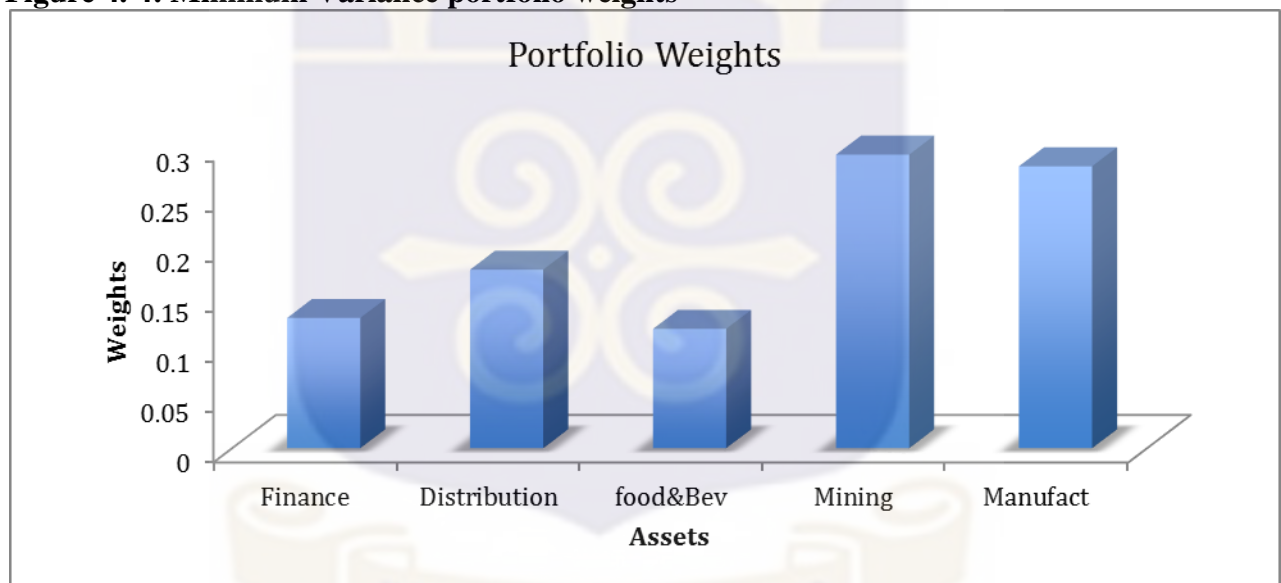
Taking into account five sectors that yielded the expected positive returns of any investor; this section brings to the study the various portfolios with returns and their subsequent risk where there is no short selling. The study first computed the global minimum variance portfolio that provides a portfolio that represents the lowest level of risk that can be achieved for each possible level of return. A set of minimum-variance weights for the return of this portfolio was also determined. In the Table 4.5 the study determines the weights, the return and the global minimum variance portfolio frontier.

Table 4.5: Global Minimum Variance Portfolio

Portfolio Expected Return: 0.01673324					
Portfolio Standard deviation: 0.03824046					
	<i>Finance</i>	<i>Distribution</i>	<i>food&Bev</i>	<i>Mining</i>	<i>Manufact</i>
Weights:	0.1298	0.1779	0.1189	0.2925	0.2809

It is shown that the minimum variance (risk) to expect from our portfolios is 0.038, the results indicate that risk averse investors should invest 12.98% in finance, 17.79% in distribution, 11.89% in food and beverage, 29.25% in the mining sector, and 28.09% in the manufacturing sector.

Figure 4. 4: Minimum Variance portfolio weights



4.3 Tangency Portfolio

Determining the tangency optimal portfolio for all investors, the study further developed the tangency portfolio that provides weights for all assets for investors who will like to invest for a long-term. A more risk-averse investor holds less of the tangency portfolio and more of the risk less asset. Less risk-averse investors hold more of the tangency portfolio and less of the

risk less asset. Therefore, for these two portfolios, which is the minimum variance portfolio and the tangency portfolio, the investor will choose which of the portfolios to invest.

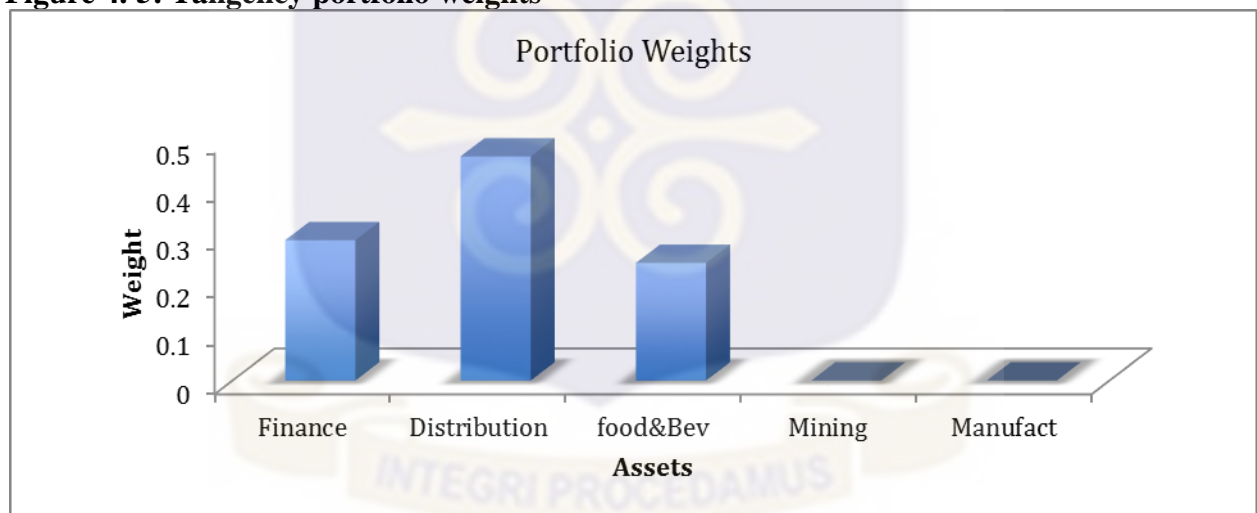
Table 4.6: Tangency Portfolio

Portfolio Expected Return: 0.02772456					
Portfolio Standard deviation: 0.05764426					
	<i>Finance</i>	<i>Distribution</i>	<i>food&Bev</i>	<i>Mining</i>	<i>Manufact</i>
Weights:	0.2911	0.4650	0.2440	0.0000	0.0000

NB: Risk free is 18% annually

From table 4.6 above, it can be envisaged the various weightings that investors can invest among sectors. It is inferred that to obtain an expected return higher than the Minimum Variance (MV) portfolio an investor needs to invest among sectors with respect to their weightings identified in this study.

Figure 4. 5: Tangency portfolio weights



As shown in the Table 4.6 tangency portfolio is expected to yield a return of 0.0277 of a high risk of 0.0576, comparatively with MVP, it is shown that the return of the tangency optimal portfolio is higher than that of the MVP. The result indicates less risk-averse investors should hold 29.11% in finance, 46.50% in distribution, and the remaining 24.40% in food and beverage.

4.4 Efficient Frontier Portfolios

The efficient frontier considers a universe of risky investments and explores what might be an optimal portfolio based upon those possible investments. Shown above by the MVP and the tangency portfolios it is quite clear where possible the investor can consider investing among this industry. The portfolios from the frontier provide the optimal possible level of risk and expected return for an investor. In the Table 4.7 we present the expected returns and possible risk of 10 portfolios of which an investor can invest.

Table 4.7: Frontier Portfolios

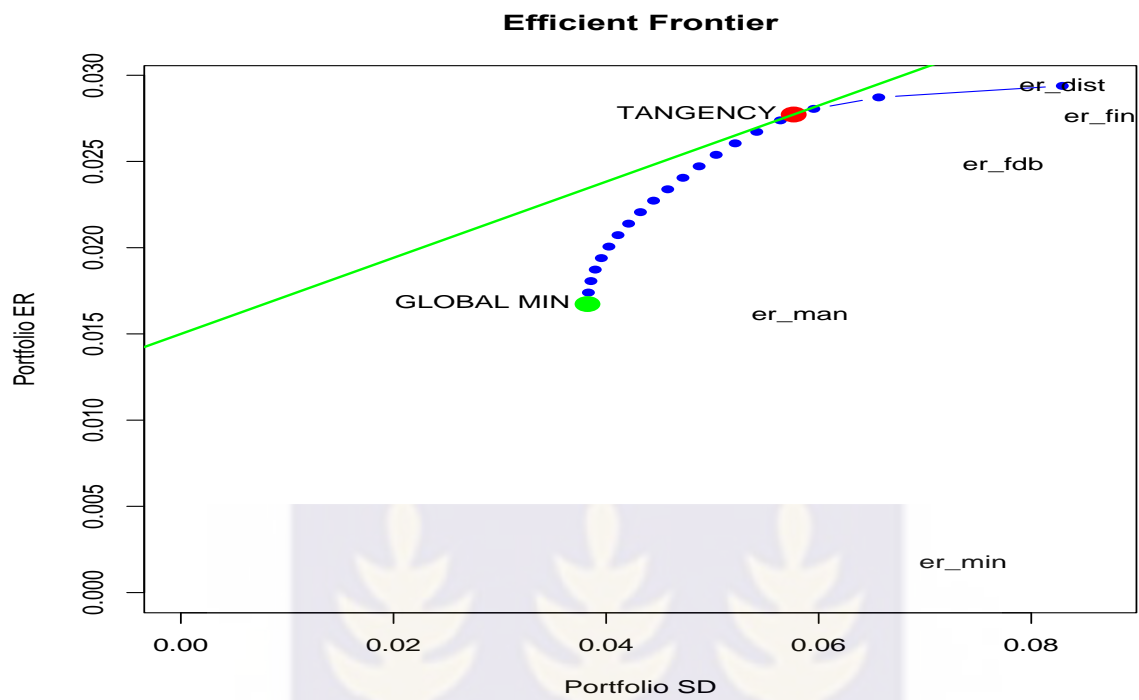
Expected Returns	Standard Deviations	<i>Finance</i>	<i>Distribution</i>	<i>Food&Bev</i>	<i>Mining</i>	<i>Manufact</i>
0.0167	0.0382	0.1298	0.1779	0.1189	0.2925	0.2809
0.0174	0.0383	0.1383	0.1901	0.1278	0.2697	0.2741
0.0181	0.0386	0.1468	0.2023	0.1367	0.2469	0.2672
0.0187	0.0390	0.1553	0.2146	0.1456	0.2241	0.2604
0.0194	0.0395	0.1638	0.2268	0.1545	0.2014	0.2535
0.0201	0.0403	0.1723	0.2390	0.1786	0.1634	0.2467
0.0207	0.0411	0.1808	0.2513	0.1558	0.1723	0.2398
0.0214	0.0421	0.1893	0.2635	0.1330	0.1812	0.2330
0.0221	0.0432	0.1977	0.2757	0.1103	0.1901	0.2262
0.0227	0.0445	0.2062	0.2880	0.1990	0.0875	0.2193

From the above table it was envisaged that at any level of volatility, the expected return of the portfolio is given. This gives the investor an idea about risk-return relationship of the portfolio. The investor therefore assesses its risk characteristics and selects the portfolio to

invest. The below graph also provide a visualization plot of the frontier portfolios shown in the table given the achievable region and the efficient frontier.

Shown in the figure 4.6, is the efficient frontier indicating the point of the achievable region. The portfolios on the efficient frontier are optimal in both the sense that they offer a maximum expected return for some given level of risk and minimum risk for some given level of expected return. It is shown by the blue point all coordinates of all possible portfolios that can be formed when all these risky assets are considered. It's shown that all portfolios from and above the global minimum portfolio provides a relevant portfolio that seek the investor interest, however, portfolios below this point returns lower expected return and higher risk. It is quite encouraging to select a portfolio that is above or on the global minimum point to receive higher returns with a given level of risk. It is shown that among all the sectors the distribution sector lies on the efficient frontier, indicating that, all other sectors are being dominated by the portfolios on this frontier. It is inferred that the risk lover will invest in the distribution sector so as to take the opportunity of the expected higher return. This result is in consonant with studies such as Bekaert and Harvey (2003), and De Roon et al. (2001) who also depicted the benefits of diversification on an efficient frontier. The tangency (optimal) portfolio is where the line touches the efficient frontier.

Figure 4. 6: Efficient Frontier



Keys

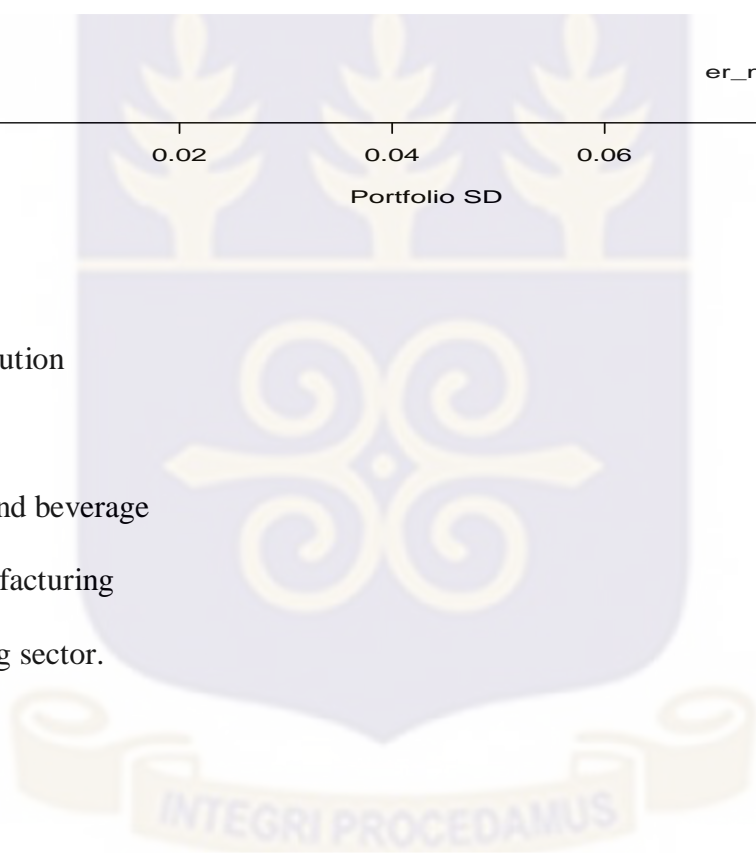
er_dist = distribution

er_fin = finance

er_fdb = food and beverage

er_man = manufacturing

er_min = mining sector.



CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Introduction

In this study, portfolio comprising of five sectors, these sectors have provided the asset that will provide to an investor the minimum risk, and the portfolio that provides the maximum returns. By adding to this, several portfolios have been created, an investor who considers risk to be an important element of an investment may try to choose any of the portfolio that is identified on the efficient frontier. This study has been able to develop several asset mix for different investors seeking to trade on the GSE. At the end of this chapter, the study has provided summary, conclusions and recommendation to decision makers and investors with several sectoral diversification opportunities to be considered.

5.1 Summary

This study demonstrates several diversification techniques to help develop an asset mix that maximizes overall investor returns, minimized overall investor risk and also constitutes an optimal portfolio. In view of these objectives, the global minimum variance portfolio, tangency portfolio and the efficient frontier portfolios are used to help achieve the study results.

From the global minimum variance portfolio, the study has identified a portfolio of five assets that yield returns of the lowest level of risk. It is envisaged that this portfolio provides the minimum risk among all other portfolios. From the GMVP it was shown that an investor should invest 12.98% in finance, 17.79% in distribution, 11.89% in food and beverage, 29.25% in the mining sector, and the remaining 28.09% in the manufacturing sector. This portfolio has lowest risk possible that risk averse may choose to generate a return the assets

can yield. Although, this does not yield the highest return among the portfolios, it is imperative that the return on this portfolio is good.

An investor who is a risk seeker looking for higher return may take more risk and will be however advised to invest in the tangency portfolio. The tangency portfolio provides the risk seeker holding onto more risk assets. Shown by the tangency portfolio an investor who is less risk-averse should hold 29.11% in finance, 46.50% in distribution, 24.40% in food and beverage, 0.00% in the mining sector, and 0.00% in the manufacturing sector. Comparatively with the MVP, the tangency portfolio provides higher returns of high risk to the low returns of a less risk shown by MVP.

The efficient frontier also gives a lot of portfolios that provides the optimal possibility of risk and expected return for all kinds of investors. The efficient frontier portfolios provide opportunities to investors on their investment decisions. It is shown on the efficient frontier several portfolios that give an investor an idea about risk-return relationship of the portfolio. The investor therefore chooses a portfolio to invest based on its risk characteristics (i.e. whether the investor is a risk-averse, risk lover and risk neutral). In these portfolios, it is shown that all portfolios from and above the global minimum portfolio provides a relevant portfolio that seek the investor interest, however, portfolios below this minimum point gives lower expected return and higher risk. The investor will therefore be able to assess the category of his risk appetite and choose a portfolio that is suitable. The study results are in consonant with studies such as Bekaert and Harvey (2003), and DeRoon et al., (2001) who also depicted the benefits of diversification on an efficient frontier.

5.2 Conclusion

The main aim of the study was to identify assets combination that minimizes investor's overall risk and increase their return. The study gives a clear indication that investors can invest and diversify within their local country if there is a constraint on diversifying overseas. However, investors should also look for portfolios with lower risk, which can give a considerable return, since a higher risk always does not produce a higher level of return as shown in the study. In addition, they should sometimes move out of their comfort zone and invest across sectors, since it offers higher and better investment opportunities as shown by this study. In all, Portfolio diversification is seen as very crucial in the process of portfolio risk management because it enables the investors to considerably reduce their portfolio risk without compromising their portfolio return.

5.3 Recommendation

The study recommends the following to investors and other traders of the GSE, It tells which of the sectors should be much focused, thus, how much capital to invest across sectors on the Ghana Stock Exchange. In doing so, investors should based on the weightings that are identified by sectors and invest in order to form a portfolio by maximizing returns with the same level of risk or minimizing risk for a given expected return. The study also recommends that investors should analyse their risk and return characteristics and choose a portfolio that best suit them before investing among sectors so that they will not be at a loss. The findings from this study can inform companies and investors on the five stock exchanges on how to diversify across sectors, so as to optimize their utility of wealth based on their risk preferences, that is risk-averse and risk-lover. Since most countries have placed constraints of diversifying overseas, investors should not force or bother themselves to invest in such countries but rather concentrate on local investment.

5.4 Future Research Directions

Future research should focus on exploring more of the sectoral performance of the stocks for a more recent year, since most of the sectors of the study did not have a balance stocks. Perhaps, there may be adequate stocks some years to come. The study also assumed no short selling constraint. Hence, further research can assume short selling, if it applies in their context of study, to see how different the optimal choices would be.



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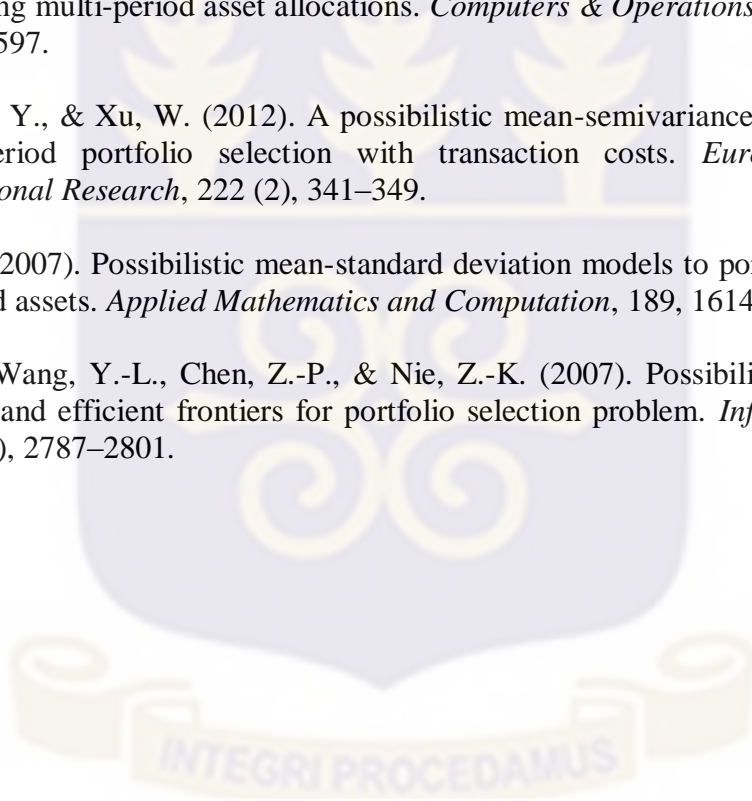
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APPENDIX I

Data on the expected portfolio return for sectors

Erpfin	ERpDist	Erpfdb	Erpmin	Erpman
0.18	0.00	-0.07	0.00	-0.06
-0.06	0.00	-0.02	0.00	-0.03
-0.04	-0.01	-0.04	0.00	-0.01
-0.19	-0.02	-0.03	0.00	0.00
-0.25	-0.04	-0.17	0.00	0.00
-0.02	-0.03	0.04	0.00	-0.02
0.20	-0.02	0.05	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.09	0.01	0.01	0.00	-0.01
-0.15	-0.04	0.03	0.00	-0.01
0.18	0.00	0.05	0.00	0.00
0.01	0.04	0.02	-0.03	0.00
-0.02	-0.03	0.05	0.08	0.01
0.15	-0.11	0.02	0.00	0.00
0.11	0.18	0.03	0.00	0.06
0.12	0.15	0.11	-0.10	0.04
-0.09	-0.08	-0.05	0.00	0.10
-0.03	0.07	-0.01	0.26	-0.02
0.05	0.13	0.05	0.06	0.16
0.00	-0.03	0.02	0.34	0.11
0.01	0.01	0.01	0.25	0.06
0.04	-0.02	0.06	-0.03	0.01
0.03	0.07	0.20	-0.12	0.01
0.04	0.18	0.04	0.00	0.05
-0.01	0.12	-0.01	-0.23	0.04
0.02	0.18	-0.06	-0.15	0.06
0.05	0.00	0.01	-0.12	0.06
0.04	0.03	0.12	0.00	0.04
0.02	0.09	0.09	0.00	0.02
-0.05	0.11	0.01	0.00	0.01
-0.03	0.06	-0.04	0.00	-0.02
-0.07	0.20	-0.05	-0.08	-0.07
-0.07	-0.18	-0.02	0.00	-0.01
-0.03	-0.08	0.00	0.00	0.00
0.03	0.01	0.15	0.00	0.00
0.00	0.03	0.03	0.01	0.04
0.02	0.12	0.01	0.00	0.12
0.09	0.05	0.04	0.01	0.02
0.06	0.01	0.01	0.00	0.01
0.01	-0.08	0.08	0.00	0.00

0.00	-0.01	0.12	0.00	-0.01
0.00	-0.06	0.10	0.00	0.00
0.06	0.02	0.03	0.00	0.00
0.08	-0.03	0.07	0.00	-0.01
0.05	0.03	0.12	0.00	0.02
-0.01	0.14	0.04	0.00	0.00
0.12	0.04	0.00	0.00	0.01
0.04	0.00	0.09	0.00	0.16
0.29	0.19	0.26	0.00	0.07
0.24	0.14	0.04	0.00	0.14
-0.02	0.09	0.05	0.00	0.11
0.07	0.01	0.08	0.00	0.08
-0.04	0.31	0.02	0.00	0.05
0.05	-0.08	0.02	0.00	0.00
0.03	0.01	0.04	0.00	0.04
-0.02	-0.03	0.11	0.00	0.16
0.01	0.00	0.10	0.00	0.06
0.03	0.01	-0.02	0.00	0.01
0.02	0.04	0.01	0.00	0.00
0.13	-0.01	0.02	0.00	-0.02
0.08	0.01	0.01	0.00	0.00
-0.01	0.16	0.00	0.00	0.00
-0.06	0.03	-0.01	0.00	-0.01
0.06	-0.02	-0.05	0.00	-0.01
0.10	0.03	-0.06	0.00	-0.02
0.06	0.00	-0.17	0.00	0.00
0.02	-0.03	-0.26	-0.05	-0.05
0.04	0.00	0.15	0.00	-0.07
0.03	0.01	0.00	0.00	-0.12
0.09	0.00	0.06	0.00	-0.17
-0.03	0.01	0.01	0.00	-0.02

APPENDIX II**Data on Treasury Bill (T-Bill) Rate Between 2009 to 2014**

Year	Month	T-Bill Rate-91 days
2009	1	24.7
	2	24.7
	3	24.8
	4	25.7
	5	24.7
	6	25.8
	7	24.9
	8	24.9
	9	24.8
	10	24.8
	11	24.9
	12	17.5
2010	1	18.9
	2	15.2
	3	14.6
	4	13.4
	5	12.9
	6	12.3
	7	12.7
	8	12.7
	9	12.5
	10	12.4
	11	12.33
	12	12.25
2011	1	12.15
	2	12.12
	3	10.11
	4	10.05
	5	10.49
	6	10.57
	7	10.2
	8	9.41
	9	9.41
	10	9.13
	11	9.63
	12	10.67
2012	1	10.85
	2	11.34
	3	12.3
	4	13.97

	5	16.92
	6	16.44
	7	21.15
	8	21.15
	9	21.03
	10	21.09
	11	22.34
	12	22.9
2013	1	22.9
	2	23
	3	22.16
	4	22.17
	5	23.03
	6	20.06
	7	22.07
	8	20.86
	9	21.59
	10	20.29
	11	19.23
	12	18.8
2014	1	19.46
	2	20.18
	3	22.19
	4	24.04
	5	24.07
	6	24.07
	7	20.07
	8	25.01
	9	25.04
	10	25.08
	11	25.73
	12	25.79