MASTERS IN BANKING AND FINANCE

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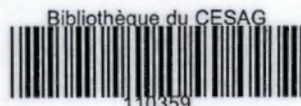
MASTER'S THESIS
TOPIC:

THE OPTIMIZATION OF PORTFOLIO MANAGEMENT IN EMERGING CAPITAL MARKETS: THE CASE OF EDC INVESTMENTS LTD

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Summary

Abbreviations

AEP	: Analytical Equity Portfolio
ALCO	: ALM Committee
ALM	: Asset/Liability Management
APT	: Arbitrage Pricing Theory
BoG	: Bank of Ghana
CAL	: Capital Allocation Line
CAPM	: Capital Asset Pricing Theory
CESAG	: Centre Africain d'Etudes Supérieures en Gestion
EDC	: Ecobank Development Corporation
EIL	: EDC Investments Ltd
EMH	: Efficient Market Hypothesis
ETI	: Ecobank Development Corporation
FINSSP	: Financial Sector Strategic Plan
GoG	: Government of Ghana
GSE	: Ghana Stock Exchange
HPR	: Holding Period return
HPY	: Holding Period Yield
LIBOR	: London Interbank Offered rate
LTS	: Long term Savings
MPC	: Monetary Policy Committee
MPT	: Modern Portfolio Theory
MVO	: Mean-Variance Optimization
NBER	: American National Bureau of Economic Research
NHTC	: National Trust Holding Company
PNDCL	: Provisional National Defence Council Law
SEC	: Securities Exchange Commission
SEM-LCIC	: SEM Listed Company Industrial Classification
SIL	: Securities Industry Law
TAA	: Tactical Asset Allocation

The optimization of portfolio management in emerging capital markets: the case of EDC investments ltd

Abstract

The study investigates how portfolio management could be optimized in emerging market by focusing on equity portfolio management at EDC Investments Ltd. Therefore the merit of a rotation strategy that shifts the equity portfolio allocation among cyclical and defensive stocks listed on the Ghana Stock Exchange is investigated over 5-year period from January 2006 to December 2010. The rotation strategy uses the Bank of Ghana's monetary policy stance to time the economic trend in the portfolio allocation process. The strategy produced more than 300% in excess of the market returns and more than 150% in excess of the sample portfolios' returns over the sample period. Besides, diversification across major African equity markets shows that, exposing the portfolio to various markets precludes the portfolio from being subject to the fluctuations of only one market while enhancing performance.

Key words: asset allocation, portfolio diversification

L'optimisation de la gestion de portefeuille dans les marchés émergents : cas d'EDC Investments Ltd

Résumé

Le présent mémoire étudie l'optimisation de la gestion de portefeuille dans les marchés émergents en se focalisant sur la gestion du portefeuille d'action à EDC Investments Ltd. Le bénéfice d'une stratégie de rotation qui alterne l'allocation du portefeuille d'action entre actions « cycliques » et « non-cycliques » cotées sur le Ghana Stock Exchange est donc exploré sur une période de cinq ans, de Janvier 2006 à Décembre 2010. La stratégie de rotation utilise les signaux de politique monétaire de la Bank of Ghana pour déterminer les différentes phases économiques dans le processus d'allocation de portefeuille. La stratégie a généré au moins 300% de rentabilité plus que le marché (le GSE All-share Index) et au moins 150% plus que la rentabilité produite par l'échantillon de portefeuilles sur la période investiguée. Par ailleurs la diversification à travers les grands marchés d'action africains montre que l'exposition à plusieurs marchés évite au portefeuille d'être soumis aux fluctuations d'un seul marché tout en accroissant sa performance.

Mot-clé: allocation d'actif, diversification de portefeuille

List of tables and figures

List of tables

List of figures

Introduction

The Ghana capital market like other emerging capital markets is growing fast. Investments advisory industry is growing too in order to meet investor's needs. The prevailing investment climate is typical of emerging markets and is marked by an unstable macroeconomic environment, limited financial instruments, illiquid secondary markets, distortions in valuation and pricing of financial instruments, high transaction costs and the lack of rating agencies among others. The establishment of the Ghana Stock Exchange (GSE) in July 1990 was to provide means of financing for companies by going public and to make available a range of investment instruments. The Securities Exchange Commission was likewise set up in September 1998 to assure sound investment practices in the industry by serving as the regulatory organisation for the Ghanaian capital market.

Ghana has in recent years enjoyed relative political stability. Political risk seems to have diminished, which attracts investors and increases business in the investment management industry. The promulgation of the Securities Industry Law (PNDCL 333) in 1993 and its amendment (Act 590) in 2000, has opened new doors for investment advisory firms. Besides, a number of initiatives by the government make it even more important for companies to position themselves to take advantage of these initiatives, which are likely to result in increased funds for management. These new initiatives are the Long Term Savings (LTS) scheme, the Financial Sector Strategic Plan (FINSSP), the establishment of the Venture Capital Fund and the new National Pension Act, 2008 (Act 766) in force since 1st January 2010. There are also socio-cultural changes that are perceived to impact the industry. These include the growing investment culture among Ghanaians, the widening of the middle brocket and the growing interest of non-resident Ghanaians to invest in local securities. All these have brought competition in the industry.

Competition in the industry basically involves soliciting for funds for management. The major source of income for investment advisors is the management fees charged on the funds they manage. A significant feature of the industry is that investors are

willing to patronize best performing fund managers, and portfolio performance steams from the optimization of its management.

There is evidence that fund managers can increase an investor's wealth through their asset allocation decisions.

The Modern Portfolio Theory, "MPT" (Markowitz 1952) which has brought about revolution in the portfolio management industry says that in order to make a single period allocation decision an investor should select an efficient portfolio.

The above and many more, make it imperative that to achieve better performance one should optimize portfolio management.

The financial industry, and in particular the investment management sector in Ghana, has been experiencing fierce competition in recent times following the recent political stability in the country, and a number of initiatives taken by government to strengthen the financial industry. The growing investment culture among Ghanaians has not only brought more businesses in the industry, but also more competition. Institutional and individual investors are now looking for the kind of investment that could earn maximum return, considering their tolerances for risk. Then they consider their fund managers' ability and skills in helping them achieve this goal.

Some of the Investment advisory firms such as EDC Investment Ltd, has set up Research Department, which analyzes the economy and industries, evaluates firms' strategies and competitive advantages, and recommends individual stocks for purchase or for sale.

A consistent portfolio management seems to be the major way that could help EDC Investment Ltd achieve performance and through this, maintain its position as a leading company in the industry. In this regard, we may ask the following question: **what tools and strategies can EDC Investments Ltd use to well manage its and client funds?**

Throughout this research we shall attempt to answer this question in order to bring forth sound and winning portfolio management practices that can be implemented by investment professionals in emerging market and EDC Investments Ltd in particular.

The broad objective of this project is to provide further insights to the way portfolio of financial assets could optimally be managed in emerging capital markets through the case of EDC Investment Ltd, a licensed member of the Ghanaian Securities and Exchange Commission (SEC). Specifically, the project seeks to examine equity management practice at EDC Investment Ltd and how the actual device could be improved.

This project is expected to bring out sound and winning portfolio management practices that could be implemented by investors in emerging capital market especially at EDC Investment Ltd. The topic is essential for professionals involved in investment management. It is also useful for Universities and CESAG for academic purposes. Finally, conducting this project would sharpen our knowledge in the field of portfolio management

The thesis starts with an introduction which covers background information, Statement of the problem, Objectives of the study and Significance of the study and the outline. It ends with the conclusion. The body of the thesis is organised into three chapters as follows:

Chapter one presents a literature review to bring deep insight on the most important and relevant issues concerning portfolio theory, asset allocation, risk and performance measurement and market efficiency and outlines the methodology of the study. The study is performed based on the different studies and theories, the outcomes are evaluated and meaningful suggestions and conclusions are drawn.

Chapter two covers the presentation of EDC Investments Ltd and its portfolio management practices.

Chapter Three covers the empirical study. It presents the recommended portfolio for EDC Investments Ltd and provides comparative analyses of the performances of the recommended portfolio, the sample portfolios under study and the benchmarks. It ends with the limitations of the study, the recommendations and the refinements of the study.

Chapitre 1: Optimal portfolio management, concept and methodology

Optimal portfolio management is the focus of the actual study. In this respect, we shall review in the first chapter the literature that underpins the practice of optimal portfolio management. In so doing, we shall discuss the portfolio management process. Afterward, we shall review the tools used to optimally manage a portfolio, and end with the presentation of the methodology implemented to conduct the study.

I.   The Portfolio management process

Portfolio management is the administration of financial assets put together in a portfolio. These financial assets are subject to commercial transactions on financial markets all over the world. In this section, we shall review the characteristics of financial markets. We shall then describe the portfolio management process and end with the recent developments of portfolio management theory.

1. Capital market efficiency hypothesis or Random Walk Theory

The Efficient Markets Hypothesis (EMH) concept accounts for the characteristics of financial markets. In this sub-section, we define the EMH concept and the various types of efficient markets that can be encountered and the implications for the portfolio manager or the investor.

1.1. The definition of Efficient Market Hypothesis

Consistent portfolio management practices help investors achieve their investment goals. Portfolio management Theory lets us know that, investment strategies depend somewhat as to whether assets are fairly priced in the market. The Efficient Market Hypothesis (hereafter EMH) which became more popular by the works of Eugene FAMA (1970), sheds light on security pricing and the way it affects market efficiency. Financial markets primary goal is to allow the allocation of resources in the economy and the ideal market according to FAMA (1970) is that in which investors can choose among securities which represent ownership of a firm's activities under the

assumption that prices at any point in time reflect all information available in the market. Therefore he discloses that: *A market in which prices always fully reflect all available information is called efficient.* Consequently Efficient Markets Hypothesis asserts that equity prices reflect all information available about the companies performances on the market and therefore it is senseless to seek for excess return more than the market overall (Jonathan CLARKE, 1993). The essence of the EMH is that, stock prices quickly adjust to new information that come to the market and since such information is random, changes in stock prices are also unpredictable. In line with this reasoning, one should expect all market participants to achieve the same returns on average. However, knowing that the level of return is dependent on the investor risk/reward preferences, all investors cannot earn the same returns.

FAMA (1970) identifies three forms of efficient markets depending on the nature of the information subset of interest: the Weak Form Efficiency, the Semi-Strong Efficiency and the Strong Efficiency.

1.1.1. The Weak Form Efficiency and Return Predictability

The Weak Form Efficiency derives from tests in which the information subset of interest is just past prices or return histories (FAMA, 1970). In other words, Weak Form Efficiency accounts for market in which "all available information" reflected in security prices is defined as past prices and past return sequences. Consequently, stock returns cannot be predicted based upon past information that everybody else knows.

1.1.2. The Semi-Strong Form Efficiency and the Events Study

The semi-strong form efficiency, deals with tests in which the concern is whether prices efficiently adjust to other information that is obviously publicly available, such as announcement of annual earnings, stock splits, etc (FAMA, 1970). Therefore, market that quickly adjusts to new information is said to be semi-strong form efficient. This introduced the Event Study which examines the process by which common stock prices adjust to information. The Event Study has become an important industry over the past half-century. It has been used to analyze the effect

of investment decisions, financing decision and changes in corporate control on security prices, and has become more popular in corporate finance field.

1.1.3. The Strong Form Efficiency and Private Information

The strong form test of the efficient market model are concerned with whether all available information is fully reflected in prices in the sense that no individual has higher expected trading profits than others because he has monopolistic access to some information (FAMA, 1970). Therefore, the shading between the semi-strong form and the strong form efficiency is that, in the later case, no one is able to consistently profit from the market even if trading on insider information or private information. Moreover, markets anticipate future development of companies to the sense that, security prices may have taken into account foreseeable information, and prices would have adjusted in more objective way than the insiders.

Michael JENSEN (1969) argues in support of the Strong Form of market efficiency that although corporate insiders have access to "Private information" they are apparently unable to forecast returns accurately enough to cover their research and transaction costs and that is a striking piece of evidence in favour of the strong form of market efficiency.

1.2. Addressed criticisms against the Efficient Markets Hypothesis

The EMH and its empirical findings stimulated controversial debates and attracted criticisms from academics and investment professionals. The EMH challengers found through various analyses, anomalies and evidences that markets are not efficient as claimed by its proponents. The most important critics were addressed by DEBONDT and THALER (1985, 1987) and Jegadeesh NARASIMHAN and Sheridan TITMAN (1990).

Indeed DEBONDT and THALER contend that, stock market overreacts to information causing returns to deviate from their average risk-adjusted long term return so that their reversal should be predictable from the past return data alone, with no use of any accounting data such as earnings. Therefore, buying past losers and selling past winners should result in profitable strategy which violates the EMH.

Likewise, Jegadeesh NARASIMHAN and Sheridan TITMAN in 1990 also contradict the EMH and contend that, stock market underreacts to information so that there is short term momentum in stock prices. Therefore the momentum strategy of buying past winners and selling past losers may be profitable. However short-term momentum patterns appear not to be consistent overtime. MALKIEL (2003) stressed that this momentum strategy appeared to produce positive relative returns during some periods of the late 1990s but highly negative relative returns during 2000 and therefore is not useful for investors in fashioning an investment strategy that will dependably earn excess returns. Moreover, Jonathan CLARKE (1993) observed that, these strategies involve high number of transactions which ultimately mop up the generated excess returns.

1.3. Applications of Markets Efficiency for investors

The EMH literature and empirical studies **suggest** that markets are **reasonably** efficient. That means there no need trying to beat the market from active management strategies since the resulting transaction costs and research costs will reduce the subsequent returns. Rather, investors should follow a passive investment strategy, which makes no attempt to beat the market (*Jonathan CLARKE, 1993*).

However, this does not mean portfolio management or investment advisory is useless or one should adopt a systematic Buy-and-hold strategy. Earnings can still be optimized through relevant asset allocation, consistent diversification, regular portfolio rebalancing (shift between asset classes) to adjust to the prevailing economic trend and by minimizing investment cost and taxes. Asset allocation indicates the assets classes to include and the relative proportions of the funds to invest in each class to meet the investor risk/reward preferences. Moreover diversification reduces the risk undertaken in investing in one or few assets. In conclusion, as observed by Bodie ZVI et al (2001):

There is a role for portfolio management even in an efficient market. Investors' optimal positions will vary according to factors such as age, tax bracket, risk aversion, and employment. The role of the portfolio manager in an efficient market is to tailor the portfolio to these needs, rather than to beat the market.

Thus, the portfolio manager uses proper process to manage the investor's portfolio. In the next section, we shall discuss in breadth what this process is.

2. The portfolio management process in focus

Portfolio Management is defined as the administration of a pool of investments vehicles such as shares, bonds and other securities, selected on the basis of clearly articulated investment objectives (such as asset protection, capital enhancement, income), by an advisor or broker on behalf of a client. It is a continual process which never stops once the funds are initially invested according to a plan specified in the investment policy statement. After the funds are invested, the manager keeps monitoring and updating the portfolio's status and the client's needs.

First, the investor alone or with the assistance of an investment advisor should construct a policy statement which specifies his investment objectives, constraints and risk tolerance. The policy statement which serves as the investment plan's road map should ensure whether investment decisions are appropriate for the investor. Because investor needs change over time, the policy statement must be periodically reviewed and updated.

The second step is to study the economic conditions and forecast future trends. The investor's needs, as reflected in the policy statement and financial market expectations will jointly determine investment strategy. However, as economic conditions are dynamic and are affected by government policies, politics, industry struggles, politics, and changing demographics and social attitudes the portfolio will require constant monitoring and updating to reflect changes in financial market expectations.

In the third step the advisor uses the policy statement and financial market forecasts to tailor a portfolio that fit to the investor's needs and preferences. This involves constructing a portfolio that will maximize the investor's expected returns given his risk tolerance as suggested by MARKOWITZ portfolio selection theory.

The fourth step in the portfolio management process is the continual monitoring of the investor's needs and capital market conditions and, when necessary, updating the policy statement and the investment strategy is modified accordingly if

13

necessary. The monitoring process also calls for the portfolio's performance evaluation where the results achieved are compared to the expectations and the requirements listed in the policy statement. This evaluation induces a feedback loop to the previous steps in order to review the investor's needs or to adjust the investment strategies implemented before if necessary. The rational is to review the whole process to identify flaws with the view to correct them in order to achieve the investor's investment goals. Therefore, portfolio management is a dynamic, interactive and continual process which never stops once the funds are initially invested according to the investor's written policy statement. These steps are necessary for both individual and institutional investors. The portfolio management process as described here is shown in the **Figure 1**.

Figure 1: Portfolio management process
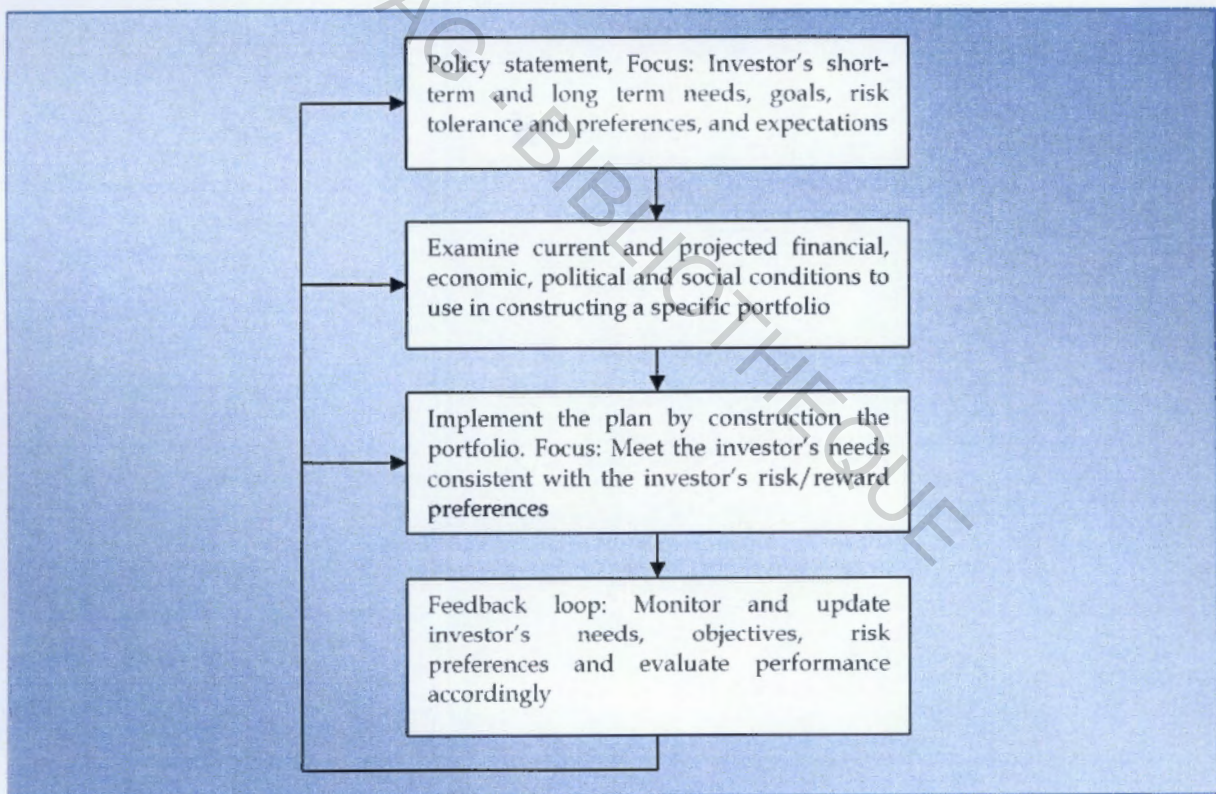
Source: Reilly and Brown, 2003

2.1. The policy statement construction

The policy statement construction is the first stage in the portfolio management process and can be viewed as the road map that guides the investment process.

While it does not guarantee the investment success, it provides a sound framework and discipline for the investment process by limiting the possibility of making inappropriate and hasty decision. It helps lay the foundation for successful investment strategies by delineating the investor's investment objectives and constraints. However, Van SCHALKWYK and J. HATTINGH (2008) suggested that the policy statement should be reviewed at least annually to confirm goals or adjust them to the changes in investors needs and to evaluate allocation and methodology in light of the goals and changes in the economy as well as the financial market.

Investors can be classified as either retail investor or institutional investors. Retail investors are individuals while institutional investors include pension funds, mutual funds, unit trusts, insurance companies and banks. Each investor of these groups should specify their investment objectives and constraints when constructing the policy statement.

2.1.1. Investments objectives

Investments objectives are defined as investments goals expressed in terms of risks and returns and are dependent on the investor's needs and attitude towards risk — the risk tolerance.

Individuals attitude towards risk is driven by their personal net worth which depends on their position along the life cycle — start of career, start of retirement and death (MODIGLIANI and BRUMBERG, 1954, 1979). Besides, individual's family position also influence their risk tolerance in the sense that they are reluctant to engage in activities that are likely to preclude them from catering for their family. An investor experience of financial market also affects their risk tolerance. The reasoning is that investors rationally assess their risk tolerance only after suffering a loss. Individual needs may include on the other hand future investment such as housing, children college fees or income for retirement. Given the investor's needs and attitude against risk, the investment objective can be stated in terms of: 1) Capital preservation, 2) Capital appreciation, 3) Current income and, 4) Total return.

The Chartered Financial Analyst (CFA) Level I reading Materials 2010 provide for the aforementioned investment objectives as followed:

Capital preservation: involves earning a return on an investment that is at least equal to the inflation rate with little or no chance of loss in order to maintain the investor's purchasing power. This is a suitable goal if the funds will be needed in the close future.

Capital appreciation involves earning a rate of return which exceeds the rate of inflation over some period of time, usually through capital gains. This is appropriate when the need for the funds is in the future such as for retirement.

Current income is the objective when the primary purpose of an account is to produce income as opposed to capital appreciation. This is suitable for investors that need to supplement other sources of income to meet living expenses or some other planned spending, as in retirement.

Total return involves growing the portfolio's value to meet future needs through both capital gains and the reinvestment of current income. This would be an appropriate objective for an investor with a longer-term investment horizon but only moderate risk tolerance.

Investment objectives of **Institutional investors** which are major participants in the financial market are mainly driven by the need to generate excess returns to meet their specific obligations which pertain to the nature of their business. Their risk tolerance generally falls under Asset/Liability Management considerations. For instance a pension fund would need to position the value of its assets higher than the present value of its obligations to beneficiaries (the fund's funded status). Therefore, pension funds Asset/Liability management Committee (ALCO) may set risk measure in terms of Shortfall risk which is the risk that the portfolio value will fall below a stated threshold level over some time horizon. On the other hand, Banks typically borrow short and lend long and therefore, the mismatch between cash inflows and cash outflows expose them to interest risk. ALCO in this circumstance monitor the bank's securities portfolio in managing interest rate risk and liquidity positions (BAI Foundation, 1995). ALM helps banks target asset growth by adjusting liabilities to their needs. Therefore, banks and other institutional investors need to invest in the optimal securities portfolio as defined by Markowitz given their

expected returns likely to strengthen their profitability and long term operating viability, and their risk tolerance.

After setting his/her objectives, the investor should consider the constraints that affect the investment plans.

2.1.2. Investment constraints

Investments constraints trickle down to the investment plans and make it more difficult to achieve the plans' objectives. Both retail and institutional investors face the same type of constraints, albeit the nature of the constraints may significantly differ. These constraints are:

- Liquidity needs;
- Investment time horizon;
- Tax concerns;
- Legal and regulatory factors and;
- Unique needs and preferences of the investor.

Individual liquidity needs and tax concerns are the most obvious constraints because they may need cash from time to time to meet their short term needs even though they may be investing for medium to long term time period, and on the other hand, their incomes are chargeable. The investment horizon is referred to as the initial time period between investing and requiring the funds and depends on the investor's project and future needs. For instance an investor who needs to grow funds to support his children college fees in one year time cannot invest much of his portfolio in equity but rather in government one year-note. This is because equities appear to be suitable for long term investing. Unique needs and preferences constitute some of the constraints investors may have, that address special needs or place special restrictions on investment strategies for personal or socially conscious reasons. For instance, the fact that an investor may not want to include a tobacco company's shares in his/her portfolio or may be sensitive to particular shares is a kind of unique needs and preferences.

Institutional investment constraints depend on the nature of their activities. For example pension fund liquidity needs chiefly arise from the confrontation of

contributions made to the plan and the benefits disbursed to retirees. A greater number of retirees exacerbate pension funds' liquidity requirements. Besides, pension fund's investment horizon generally pertains to the proportion of active workers relative to retired workers. The fund's portfolio duration is longer with a larger number of active workers compared to retired workers number. Pension funds also meet legal constraints. Because of the sensitive and vital nature of pension income, plan sponsors and trustees are held to standards of care.

Banks liquidity needs arise from the net outflows of deposits and demand for loans. Liquidity requirement is crucial for banks and is a source of liquidity risk which often causes insolvency and bankruptcy. A bank's securities portfolio time horizon constraints reside in its need to manage interest rate risk while earning positive returns over the cost of funds. Besides, banks and other financial institutions are extremely regulated. The rationale of this battery of regulations is to protect investors and let them have confidence in the financial system. The financial system and the economy as a whole may suffer failure when investors lose confidence in the market. Therefore, In the light of these constraints, institutional investors cannot decide to invest in any kind of asset or indulge in any kind of investment activity likely to undermine their profitability and viability. They should also comply with regulations that preclude them sometimes from investing in specific securities likely to increase the risk exposure.

Once the policy statement constructed, the portfolio manager should consider the current and projected economic conditions in order to form a suitable portfolio to meet the investor's stated goals.

2.2. Analyzing the economy

The second step in portfolio management process is to analyze the economy in order to construct a portfolio that satisfies the investor's risk/reward preferences given the current and projected economic conditions. Thus, the economy analysis should suggest to the manager how much of the portfolio should be committed to bonds, stocks, and cash during the forthcoming investment period.

The rationale of economy analysis is that Security markets reflect what is expected to go on in an economy because the value of an investment is determined by its expected cash flows and its future required rate of return, both of which are influenced by the expected aggregate economic environment (REILLY, BROWN, 2003). Generally, economic conditions are induced by the business cycle and the government fiscal and monetary policies.

The American National Bureau of Economic Research (NBER) in its monitoring of business cycles studied the relationship between various economic variables and the behavior of the entire economy and has classified numerous economic variables into three groups: leading, coincident, and lagging indicator series. The leading indicators such as monetary policy, the level of unemployment, consumers demand, stock indices, and inventory among others move in advance of changes in the aggregate economy. Coincident indicators move at the same pace as the economy and tend to confirm a trend in the business cycle. These are increase in employment levels, personal income, industrial production, and sales. As to lagging indicators which are ratio of inventory to sales and company profits, change after the economy has entered a new phase of the business cycle. Therefore, tracing the economic indicators would arguably suggest where the economy is in the business cycle and where it is heading. Moreover, several studies demonstrated that, monetary policy have a bearing on the economic behavior. For instance, Milton FRIEDMAN and Anna J. SCHWARTZ (1963) in Money and Business Cycles documented that declines in the rate of growth of the money supply have preceded business contractions by an average of 20 months, while increases in the growth rate of the money supply have preceded economic expansions by about 8 months. Therefore, monetary policy can be viewed as a business cycle leading indicator. In the same line, several other studies contend that money supply has strong relationship with stock prices to the extent that changes in the growth rate of the money supply could serve as a leading indicator of stock price changes. These Studies among others include Beryl W. SPRINKEl, Money and Markets: A Monetarist View (1971), Michael W. KERAN; Expectations, Money, and the Stock Market, Federal Reserve Bank of St. Louis (1971)

and Kenneth HOMA and Dwight JAFFEE, The Study of Money and Stock Prices, (1971).

Inflation and interest rates also influence the security market. Interest rate levels are not only determined by central banks expansionist and restrictive policies, but are also driven by investor's anticipation of future inflation. Inflation reduces nominal returns to low or negative real returns in the hands of investors. Therefore, when investors anticipate an increase in inflation, they require high returns on their investments and interest rates are driven upward, which results in decrease in stock prices.

C. Mitchell CONOVER, Gerald R. JENSEN, Robert R. JOHNSON and Jeffrey M. MERCER (2007) investigated the efficacy of a sector rotation strategy that utilizes an easily observable signal based on monetary conditions using data of ten US sectors over the period beginning in January 1973 and ending in December 2005. They concluded that, performance is enhanced by shifting into cyclical stocks following Fed changes that signal a more expansive monetary policy, while the appropriate response to a signal of a more restrictive Fed policy is a shift into defensive stocks. Another study by James R. BOOTH and Lena Chua BOOTH of the Department of Finance-Arizona State University in 1997 reported that restrictive (expansive) monetary policy stance decreases (increases) returns of large and small stock portfolios and, in some cases, corporate bond portfolios. Therefore, they contended that monetary policy stance measures have explanatory power in forecasting stock and bond returns, beyond the business conditions proxies.

In summary, these empirical studies suggest that analyzing the economy when investing in securities portfolio is capital and may result in profitable strategies. At this point of the process, given the investor's policy statement and the economic conditions the portfolio manager can decide which asset to include in the portfolio. This is referred to as asset allocation decision and is to be discussed in the next section.

2.3. Asset Allocation decision

The asset allocation decision is the third step in the portfolio management process and accounts for a crucial part of the process. While the investment policy provides guidelines as to the asset classes to include and the relative proportions of the investor's funds to invest in each class, asset allocation consider how the investor divides funds into different asset classes.

In practice, the proportions of the asset classes to include in the portfolio are usually expressed in ranges rather than strict percentages. This allows the investment manager some freedom, based on his or her reading of capital market trends, to invest toward the upper or lower end of the ranges. The ranges represent the weights of asset classes included in the entire portfolio and are chosen to minimize the investor's risks while meeting the needs specified in the policy statement. To reach this end, managers usually use the Mean-Variance Optimization (MVO). The MVO refers to a mathematical process that calculates the security or asset class weights that provide a portfolio with the maximum expected return for a given level of risk; or, conversely, the minimum risk for a given expected return. The inputs needed to conduct MVO are security expected returns, expected standard deviations, and expected cross-security correlations. The MVO is usually run as a computer program and originated in MARKOWITZ portfolio theory which we shall develop later on in the study.

Asset allocation also calls for diversification among various asset classes. Asset allocation involves various strategies such as strategic asset allocation, integrated asset allocation, tactical asset allocation and insured asset allocation. All these concepts will be discussed in the next sections. But first of all, let us review the debates raised by the importance of asset allocation among investment professionals over the last decade.

2.3.1. The importance of asset allocation

Asset allocation is the most fundamental of investment decisions. However, like the literature demonstrates, its importance has been the subject of considerable debates among investment professionals for decades.

The debates were stimulated by the 1986-paper, "Determinants of Portfolio Performance" published in the Financial Analyst Journal by Gary BRISON, Randolf HOOD and Gilbert BEEBOWER (BHB). BHB regressed the quarterly time series returns of US pension funds over 1974 through 1983 on the weighted combination of indexes reflecting each fund's asset allocation policy. The ensuing average R-squared was 93.6%, and they concluded that on average about 93.6% of the funds' returns variation is explained by asset allocation policy. Similarly in 1991, BHB applied the same technique to time quarterly returns from 1978 to 1981 of 82 large US pension funds and concluded again that, more that 90% of the variability of the average fund's return is explained by the fund's asset allocation policy.

Addressing the same issue, Lehmann BLAKE and A. TIMMERMANN (1999) investigated asset allocation in the United Kingdom. Examining more than 300 medium-size to large actively managed U.K. defined-benefit pension schemes for the period 1986–94, Blake et al. concluded that asset allocation accounted for approximately 99.5 percent of the variation in plan total returns.

Roger G. IBBOTSON and Paul D. KAPLAN (2000) also addressed the issue of the importance of asset allocation. In their study, Roger et al. addressed the following question: 1) How much of the variability of the returns across time is explained by asset allocation policy 2) How much of the variation in returns among funds is explained by differences in policy 3) What proportion of the return level is explained by policy return. In an attempt to answer these interrogations Roger et al. found that, about 90 percent of variability in returns of a typical fund across time is explained by policy, about 40 percent of the variability of returns among funds is explained by policy and on average about 100 percent of the return level is explained by the policy return level. However, they observed that, the high R-squared is the result of the funds' participation in the capital market.

Very recently, in 2010 James X. XONG, Roger G. IBBOTSON, Thomas M. and Peng IDZOREK Chen published "The Equal Importance of Asset Allocation and Active Management" in the Financial Analyst Journal. James XONG et al. primary concern was to address the relative importance of asset allocation policy versus active portfolio management. They used 10 years of data spanning from 1999 to April 2009

collected from Morningstar US mutual funds database. To conduct their analyses, they decomposed the portfolio total returns into three components: 1) the market returns, 2) the asset allocation returns in excess of market return and 3) the returns from active portfolio management that refers to security selection, tactical asset allocation and fees. After running cross-sectional time regression they came to the subtle findings that overall, asset allocation policy and active management have about an equal amount of explanatory power after removing the applicable market effect.

Clearly, asset allocation decisions explain in great proportion the portfolio returns. However, the benefits of active portfolio management should not be ignored. It does not mean churning the portfolio allocation continually and regularly but tailoring the portfolio allocation to fit 1) medium to long-term economic trends on the one hand and 2) the changes in the investor's needs and risk/reward preferences on the other hand. Portfolio allocation also involves including assets or asset classes of different characteristics in the portfolio in order to reduce the exposure to one or few assets. This is referred to as portfolio diversification and will be the discussed in the next section.

2.3.2. Portfolio Diversification

In this section, we shall review what portfolio diversification consists of, its gains and the diversification at an international level.

2.3.2.1. Definition

Diversification is the technique of including securities that present different characteristics in a portfolio in order to reduce its overall risk. Each individual stock has specific characteristics which are offset when putting them altogether in the same portfolio. Therefore, adding many more securities in a portfolio spreads out the portfolio exposure to firm-specific factors and the portfolio volatility would continue to fall. The reason is that with all risk sources independent, the exposure to any particular source of risk is reduced to a negligible level. The risk that can be

eliminated by diversification is known as unique risk, firm-specific risk, non-systematic risk, or diversifiable risk.

After having defined the portfolio diversification, we shall consider in the next section the empirical evidence of its gains and limits.

2.3.2.2. Empirical evidences of diversification gains and limits

The empirical evidences of diversification gains and limits are brought over by various studies. J. L. EVANS, and S. H ARCHER (in "Diversification and the Reduction of Dispersion: An Empirical Analysis", 1968) observed that, the risk reduction effect diminishes rapidly as the number of stock increases. They concluded that the economic benefits of diversification are exhausted when a portfolio contains ten or so stocks. Along the same line, Meir Statman in "How many Stocks Make a Diversified Portfolio" (1987), an empirical study on the S&P 500 Index, concluded that instead of 10 stocks suggested by EVANS AND ARCHER (1968) a well-diversified portfolio of randomly chosen stocks must include at least 30 stocks for a borrowing investor and 40 stocks for a lending investor. MARKOWITZ in Portfolio Selection (1952, 1959) showed that, the efficient frontier is composed of optimal portfolios that provide the investor for minimum risk for a given expected returns. He observed that, these optimal portfolios present minimum risks because they are well diversified compared to individual stocks.

However, is the portfolio risk reduced to zero through diversification? The answer is no. Though portfolio risk fall as the number of securities increases, it cannot be reduced to zero because all the securities are affected by common macroeconomics risk factors which cannot be diversified away. These macroeconomics risk factors are referred to as market risk or systematic risk or non-diversifiable. The systematic risk is measured by Beta and originated in William F. SHARP's work on the Capital Asset Pricing Model (1964). William F. SHARP stress that, investors are concerned with the systematic risk since the specific risk can be eliminated through diversification. He concluded that only the systematic risk should be remunerated.

In the next section, we shall consider portfolio diversification at an international level. It has the merit to expose a portfolio to various markets around the world.

2.3.2.3. International diversification

Diversification can be implemented in either the domestic or the international market. Starting from the fact that each domestic market has its specific risk factors, forming an international portfolio would reduce exposure to any domestic market specific factors. Therefore, with the domestic markets high volatility, one way to reduce portfolio risk is to realize an international exposure in equity market. Earlier studies in the 70s, such as H. LEVY and M. SURNAT (1970) D. R. LESSARD (1973, 1976), B. SOLNIK (1974), investigated the performance of ex post efficient portfolios and demonstrated that the benefits of internationally diversified portfolios stem from the fact that the co-movements between different national equity markets are relatively low. Gyongyi BUGAR and Raimond MAURER in Efficient Risk Reducing Strategies by International Diversification: Evidence from a Central European Emerging Market (1999) investigated an international diversification strategy from the standpoint of a Hungarian investor and concluded that international diversification has drastically reduced the risk of the domestic stock investment. Robin BROOKS and Marco DEL NEGRO in International Diversification Strategies published in Federal Reserve Bank of Atlanta Working Paper November 2002 also investigated the benefit of international diversification strategies and concluded that, investment strategies based upon cross-country diversification still have merit. However, foreign exchange risk is a major source of risk for the internationally diversified investor. Therefore, if the investor can properly hedge this risk, then international diversification has potential benefits compared to domestic portfolio holdings.

Portfolio diversification either domestic or international reduces securities' specific risks and leave over the systematic risk that cannot be diversified away. A portfolio manager should make use of diversification to reduce specific risks and demand compensation for systematic risks incurred. Portfolio diversification intermingles

with asset allocation strategies. In the next section, we shall focus on the various asset allocation strategies in use and when to implement each of them.

2.3.3. Asset allocation strategies

The **Policy Statement** is an important component of the portfolio management process. It provides strategic guidelines to achieving the investment objectives relative to the investor's return objectives, risk tolerance and investment constraints. The way an investor or fund manager splits out the total funds into asset classes is the process of **Asset Allocation Decision** and is driven by the investor's **Policy Statement** (REILLY, BROUN, 2003).

Asset allocation as earlier discussed is a key component of the portfolio management process. Asset allocation strategies can take various forms. One general approach has been introduced by William SHARP in 1987, the Integrated Asset Allocation. However, SHARP observed that Strategic, Tactical and Insured asset allocation are simply special cases of the more general integrated asset allocation.

2.3.3.1. Integrated Asset Allocation

Generally speaking, *integrated asset allocation* separately analyzes (1) financial market conditions and (2) the investor's objectives and constraints. It then puts them together to define the portfolio mix that best fits to the investor's objectives and constraints given the financial market forecast. The ensuing returns over the relevant time horizon are used as input to an iterative process which incorporates changes over time in the investor's objectives and constraints and financial market expectations. The portfolio mix is therefore updated accordingly to capture these changes. This approach to portfolio formation is depicted in **Figure 2**.

Sharp identified three major steps in this integrated approach.

The first step comprises the analysis of the financial market conditions (C1) and the investor's current net worth (I1, defined as assets less liabilities). The results obtained from the analysis of the investor's current net worth are processed through risk tolerance function (I2) to determine the investor's risk tolerance (I3). On the other hand, based on prediction procedures (C2), expected returns, risks and correlations

for the considered asset classes are derived (C3). The results for (C3) can be obtained by using methods such as constructing an efficient frontier of the portfolio with optimal risk/return combinations; While (I3) might derive from the investor's asset investment policy.

The second step is to combine the result obtained from the first step to select through an optimizer the single best portfolio for the investor. By optimizer (M1) Sharpe denotes any decision rule, mathematical function or computer program, used to select the optimal portfolio for the particular investor under the given market circumstances.

The third step starts from the realized return of the selected best portfolio of the second step. The actual performance is then compared with the manager stated expectations (M3). From there, the manager may adjust the portfolio by including new information into the optimization process. This update is concerned with changes in financial market conditions or changes in the investor's needs. That should be done knowing that the prediction procedures (C2), Risk tolerance function (I2) and optimizing method (M1) should not be changed over time. The "feedback loops" from (M3) to (C1) and (I1), show that portfolio management is a dynamic process.

Figure 2: Integrated Asset Allocation
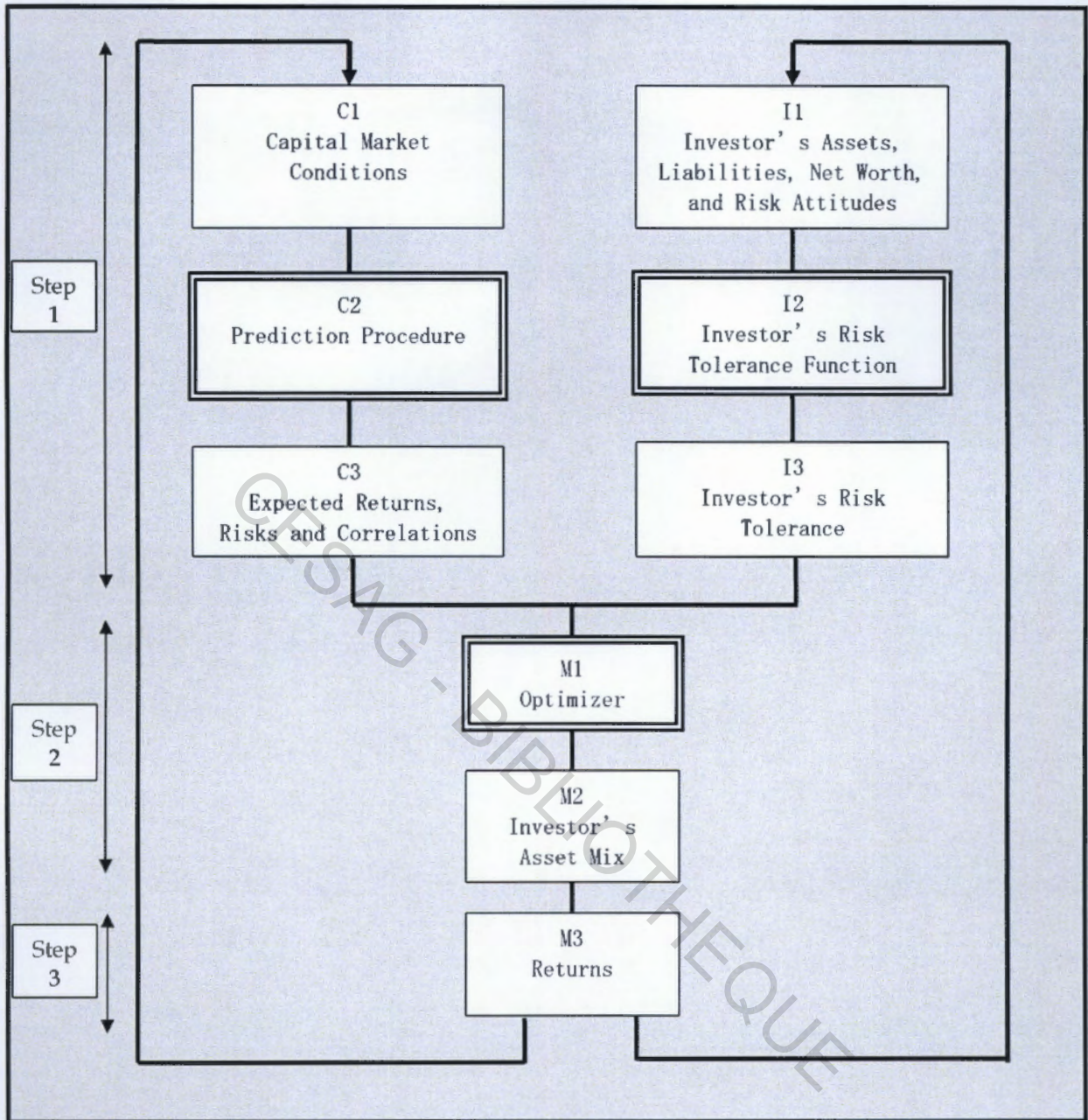
Source: Sharpe, William F. (1987)

2.3.3.2. Strategic Asset Allocation

The *strategic asset allocation* determines the long-term asset weight in a portfolio (REILLY, BROWN 2003). In strategic asset allocation, an investor's return objectives, risk tolerance, and investment constraints are integrated with long-run capital market expectations to establish exposures to permissible asset classes (MAGINN et al, 2007). Typically long-term average asset returns, risk, and covariance are used as

28

estimates of capital market results. Most often, MARKOWITZ Mean-variance Optimization or Monte Carlo optimization is used to set asset class weights that can be used a long term guide for investing. However the portfolio is periodically rebalanced to adjust it to the specified asset weights.

Sharp observed that, the strategic asset allocation is equivalent to the integrated asset allocation approach when the feedback loops are not incorporated. This entails that the manager will select the optimal portfolio that best meets the investor's investment needs given the market conditions. However, once the portfolio mix is set up, the manager should not regularly adjust the asset weights neither according to changes in the investor need, nor to changes in market expectations.

2.3.3.3. Tactical Asset Allocation (TAA)

Contrary to *strategic allocation strategy*, tactical approach to portfolio formation frequently updates the asset class weight to capture and take advantage of changes in market conditions. This assumes that the investor's risk tolerance and investment constraints are remained unchanged over time. SHARP observed that TAA is equivalent to an integrated approach to asset allocation that removes the feedback loop involving investor-specific information.

Tactical asset allocation is frequently based on the premise of *mean reversion*, which holds that whatever a security's return has been in the recent past, it will eventually revert to its long-term average (mean) value (REILLY, BROWN, 2003). To capture this mean reversion concept, let the ratio of stock and bond returns be normally 123%, suggesting that equity is riskier than bond. Then, if in the most recent investment period, stock returns were double those of bond returns, the tactical investor might determine that bonds were now undervalued relative to stock and most likely to be the best-performing asset class in the coming period. Accordingly, he should then overweight the fixed-income component of his portfolio. Consequently, SHARP concluded that TAA is a contrarian strategy in nature in the sense that the investor will always be buying undervalued assets and selling the asset class that are overvalued.

How frequently the investor chooses to adjust the asset class mix in the portfolio is imbedded in factors, such as the general level of volatility in the capital markets, the relative size of the equity and fixed-income risk premiums, and changing fundamental macroeconomic environment.

2.3.3.4. Insured Asset Allocation

The *insured asset allocation* is the final asset allocation strategy that Sharpe describes. He stresses that the assumptions under this approach holds is that the investor's objectives and constraints change as his/her wealth changes, whereas the market conditions are expected to remain relatively constant over time. Therefore the insured asset allocation is comparable with the integrated asset allocation if the feedback loop on capital market is removed.

For example, rising portfolio values increase the investor's wealth and consequently his or her ability to handle risk, which means the investor can increase his or her exposure to risky assets; whereas declines in the portfolio's value lower the investor's wealth, consequently decreasing his or her ability to handle risk, which means the portfolio's exposure to risky assets must decline (REILLY, BROWN, 2003).

Very often, insured asset allocation involves investing in only two asset classes, risky and risk-free asset. The portfolio is tilted towards the best performing class over a specific time period, within the proportion of changes in the investor's net worth. Therefore this strategy is the opposite of what would happen under tactical asset allocation.

2.3.3.5. Which asset allocation strategy to use?

Overall, which portfolio formation method is applied is ascribable to the perceptions of changes in the client's objectives and constraints and the perceived changes in capital market conditions.

If the investor believes that capital market conditions are relatively constant over time, he might use insured asset allocation. If rather, he believes that his goals, risk preferences, and constraints are constant, he likewise might use tactical asset allocation. In the case, both capital market conditions and the investor's goals, risk

preferences and constraints are constant, he might use the strategic asset allocation. Sharp suggested that, under the assumption that both the investor's needs and capital market conditions are variable, integrated asset allocation must be used to constantly adjust the portfolio mix to reflect current changes in these parameters.

After having reviewed the whole process of portfolio management, we shall now see how portfolio management theories have evolved over the past half-century.

3. Portfolio management in progress: the Modern Portfolio Theory (MPT)

In the early 1930s, the investment community talked about Investment-risk-return, but there was no specific measure for these terms and concepts. The Modern portfolio theory brought in the 1950s economics, quantitative methods, and the scientific perspective to the study of investments.

John B. WILLIAMS (1938) in "The Theory of Investment Value" early set the rule of discounted future returns when selection investment portfolio. He stated that the investor should select the portfolio that maximizes discounted future returns. By future returns, Williams assumes the expected or anticipated returns, since the future in full of uncertainty. John R. HICKS (1939) applying William's rule to firms in "Value and Capital" suggested that the anticipated returns should incorporate an allowance for risk. That means the rate at which the anticipated returns are discounted should vary with risk for particular securities. Harry MARKOWITZ (1952) extended these landmark theories to craft a quantitative model to constructing securities portfolio backing on the trade-off between risk and return.

MARKOWITZ found that, the variance which measures the returns' variability can account for portfolio risk under reasonable assumptions. He then used a quadratic utility function to strike the balance between risk and return and was able to select an optimal portfolio in terms of risk/reward preferences. MARKOWITZ observed that, in the universe of portfolios, there were well diversified portfolios which maximize the expected return for a given level of risk, or minimize the risk for a given level of expected return. These portfolios when plotted in a Risk/reward space form a curve which he named the "Efficient Frontier". The MARKOWITZ model is based on

31

several assumptions regarding investor behaviour: 1) Investors consider each investment alternative as being represented by a probability distribution of expected returns over some holding period, 2) Investors maximize one-period expected utility, and their utility curves demonstrate diminishing marginal utility of wealth, 3) Investors estimate the risk of the portfolio on the basis of the variability of expected returns, 4) Investors base decisions solely on expected return and risk, so their utility curves are a function of expected return and the expected variance (or standard deviation) of returns only, 5) For a given risk level, investors prefer higher returns to lower returns. Similarly, for a given level of expected return, investors prefer less risk to more risk.

James TOBIN (1958) in "Liquidity Preference as Behaviour towards Risk" contributed to the MARKOWITZ model and observed that under certain conditions, the model implies that investment choice process can be compartmentalized into two stages: first the choice of a unique optimum combination of risky assets and second, a segregate choice of the allocation of funds between such a combination and riskless assets. TOBIN concluded that, though the only thing that varies among investors is the portion of funds invested in risky and/or riskless assets, this does not show which risky assets to include and in which proportion.

A little later, John R. HICKS (1962) building upon TOBIN (1958) model framework, derive corresponding conclusions about individual investor, suggesting more explicitly the nature of the conditions under which the process of investment choice can be dichotomized.

In 1964, William F. SHARP added a riskless asset to the opportunity set and transformed MARKOWITZ portfolio theory into Capital Market Theory. The Capital market theory extends portfolio theory and develops a model for pricing all risky assets, the Capital Asset Pricing Model (CAPM). The rationale of the model is that, in a world dominated by risk-averse investors, a risky portfolio must be expected to yield higher returns than a less risky portfolio, or it would not be held (Michael C. JENSEN, 1969). Sharp argues that, the model sheds considerable light on the relationship between the price of an asset and the various components of its overall risk and deserves consideration as a model of the determination of capital asset

prices. He introduced the concepts of systematic and unsystematic risk as components of an asset total risk. The CAPM lies in assumptions similar to those of MARKOWITZ model.

Michael C. JENSEN (1969) built upon the CAPM to craft a measure of portfolio "performance", the Jensen Ratio which is defined as the difference between the actual returns on a portfolio in any particular holding period and the expected returns on that portfolio conditional on the riskless rate, its level of "systematic risk," and the actual returns on the market portfolio. Jensen observed that the Jensen Ratio measures only a manager's ability to forecast security prices.

E. S. PHELPS (1962), J. TOBIN (1965), Robert C. SAMUELSON P. A. (1969) and MERTON (1969) observed that most models of portfolio selection have all been one-period models. They proposed multi-period or continuous-time portfolio selection models. They examine the combined problem of portfolio selection and consumption rules for an individual in a continuous-time model, where his income is generated by returns on assets.

In the early 1970s, the investment professional's community began to indentify some flaws in the CAPM as an explanation of the link between risk and return. There was mixed support for a positive linear relationship between rates of return and systematic risk for portfolios of stock, with some recent evidence indicating the need to consider additional risk variables or a need for different risk proxies (REILLY and BROWN, 2003). The measure of non-diversifiable risk might come from sensitivity towards multiple factors instead of the CAPM's use of a one-factor market portfolio. In response to the CAPM tests' critics, Stephen ROSS developed in 1976 "The Arbitrage Theory of Capital Asset Pricing" (APT) including multiple factors, source of Systematic. The APT operates under several assumptions: 1) Capital markets are perfectly competitive; 2) Investors always prefer more wealth to less wealth with certainty; 3) The stochastic process generating asset returns can be expressed as a linear function of a set of K common risk factors (or indexes). However, the APT does not tell what the K risk factors are and how the sensitivity of returns to these factors can be measured.

These theories and models have had and still having great influences on the way portfolio managers analyze and manage the couple Risk/rewards of their investments.

The next section considers various tools portfolio managers use to manage their client portfolios such as Return, Risk, Portfolio performance indicators, the Efficient frontier and the Capital Allocation Line (CAL) among others. We shall also review how these tools are used in practice.

II. Portfolio management tools

In this section, we define investment's risk and return and consider how they are used to construct an optimal portfolio. In addition, portfolio managers or investors are concerned with the performance of their portfolios. In this respect, we shall review how portfolio's risk and return can be used to construct indicators that help assess the realized performance over a period of time.

1. Investment's risk and return

The securities to include in a portfolio depend on the investor's risk tolerance. Therefore, to form a portfolio, the manager should determine the return expected by the investor and the risk he is ready to incur. In the following sections we shall discuss investment's returns and risks in portfolio formation.

1.1. Investment's return

Investment is the current commitment of funds for a period of time in order to derive future payments. People invest to earn a return from savings due to their deferred consumption. The return is usually a monetary compensation an investor demand in order to defer current consumption. When investing, the investor expects a certain level of return: this is called the expected return. The expected return basically depends on (1) the time the funds are committed, (2) the expected rate of inflation and (3) the uncertainty of the future payments.

In the end of an investment program or after a period of investment, the holding period return (HPR) is used to appraise the realized returns. The holding period

return is the ratio of all future cash flows (ending value of the investment + Dividends or Interests) to the beginning value of the investment. The formula is as follow:

$$HPR = \frac{\text{Ending Value of Investment} + \text{Dividends or Interests}}{\text{Begenning Value of Investment}}$$

Thus HPR measures the return earned on an investment over a period of time. It expresses the change in value of the investment over the investment period. The HPR may be equal to, greater or less than one (1). If the HPR is 1, then the investment has not gained or lost value over the period. If it is greater than 1, the investment has gained value and if it is less than 1, the investment has lost value. In order to express the return as a rate, the HPR is converted to another measure called the holding period yield (HPY).

The HPY is obtained by subtracting 1 from the HPR as shown in the formula bellow:

$$HPY = HPR - 1$$

Here, the HPY may be zero (0), positive or negative. Again, if the HPY is 0, then the investment has not gained or lost value over the period. If it is positive, the investment has gained value and if it is negative, the investment has lost value.

The return an investor expects when investing may not be realized. This is the risk associated with investment and will be the focus of the next section.

1.2. Investment's risk

When investing in a security such as a stock, an investor has a certain return in mind. The level of return as we said earlier is dependent on (1) the time the funds are committed, (2) the expected rate of inflation and (3) the uncertainty of the future payments and is referred to as the expected return. The expected return may be achieved or not. This uncertainty is the source of risk associated with investments. Uncertainty in security returns arises from many sources such as the economy, politics and natural disasters. In addition, specific company events such as strikes and management weaknesses can cause uncertainty.

The risk of the returns on a security is given by the extent to which individual returns departure from the expected return. The application of statistics makes possible the

quantification of the risk inherent in security return. The statistical measures used in this respect are the variance and the standard deviation[1].

Generally, risk and return are related. That means the level of return pertains to the risk incurred. The higher the risk, the higher is the return. Thus to select an investment, the investor is always confronted with the expected risk-return trade-offs for the alternative investments available. **Figure 3** shows the risk/return pattern of various investment vehicles. It can be observed that:

- Treasury bills are risk-free assets and provide the lowest return, while derivatives are the riskiest and best profitable instruments;
- Government securities are generally less risky than corporate securities while corporate securities offer better return;
- Bonds are generally less risky than stocks and stocks are more profitable than bonds.

Figure 3: The risk/return pattern of investment vehicles
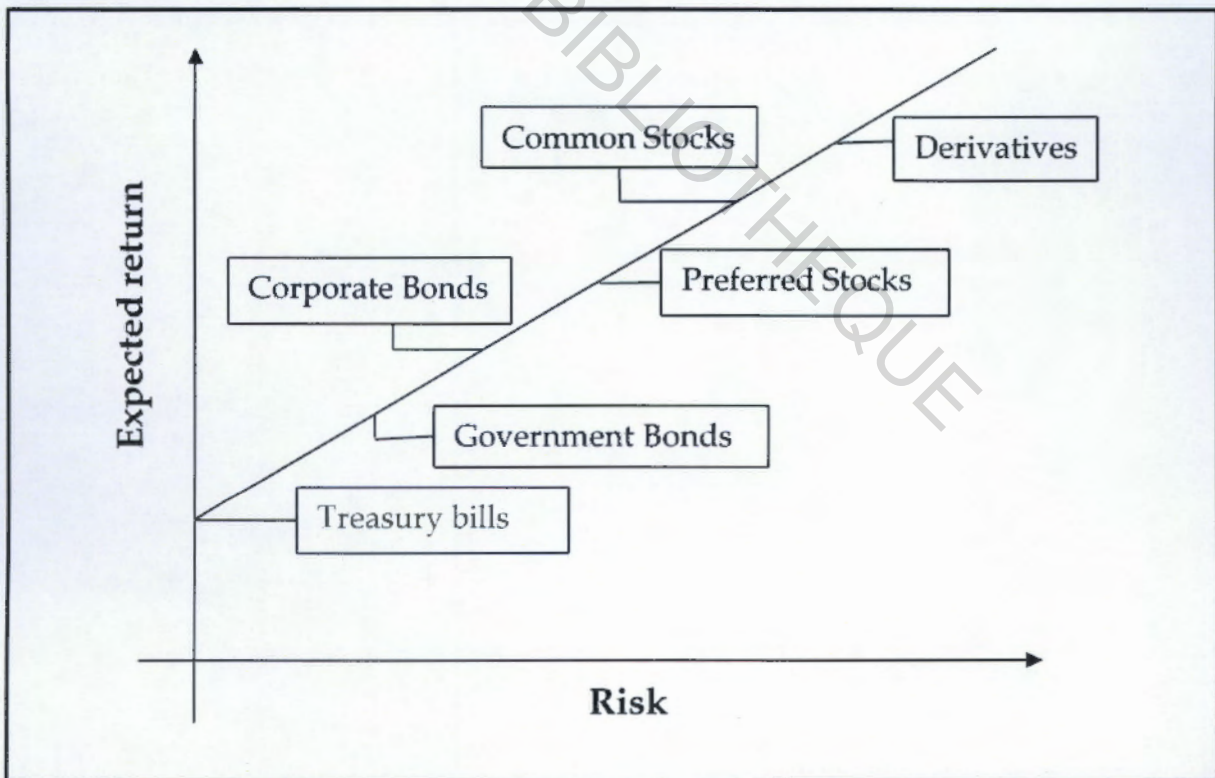
Source: OUATTARA Aboudou (2010), *Placement et Gestion de Portefeuille, lecture note, CESAG*

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[1] The variance and standard deviation are discussed is more detail in the optimal portfolio selection section.

Consequently, an investor will invest in a security depending on his/her attitude toward risk—that is the risk aversion. Risk aversion is where, given the choice between two assets with equal rates of return, investors will choose the asset with the lowest risk or variance of expected returns.

Investors expect high return but do not want to take on risk. One way to resolve this trade-off is to combine various investment vehicles in a portfolio in order to reduce the risk incurred while increase the portfolio return. This is the process of optimal portfolio selection and will be our focus in the next section.

2. Optimal portfolio selection: the efficient frontier and the capital allocation line (CAL)

The optimal portfolio is the one composed of risky and riskless assets that optimizes the couple risk-return attributes. ZVI Bodie et al. (2001) explained that the optimal portfolio selection can be broken down into three major steps: 1) Specify the expected returns, variance and covariance of all securities; 2) Establish the risky portfolio that results in the minimum variance efficient frontier and 3) Allocate funds between the risky portfolio and the risk-free asset to arrive at the complete optimal portfolio which corresponds to the investor's risk-reward preferences.

The first step in the optimal portfolio selection is to determine the risk–return opportunities available to the investor given the expected returns, variances and covariance among the set of available securities. MARKOWITZ documented that the portfolios that offer the optimal risk-return trade-off lie on the minimum-variance frontier of risky assets given the expected returns. This frontier is a graph of the lowest possible variance that can be attained for a given portfolio expected return (**Figure 4**). Therefore, all the portfolios that lie along the upward side of the minimum-variance frontier provide the best risk–return combinations and thus, are candidates for the optimal portfolio. Any portfolio lying on the lower portion of the minimum-variance frontier is inefficient because a portfolio lying on the upward side provides a higher return for the same risk. Moreover, all individual securities lie to the right inside the frontier implying that investing in a single security is risky and

not efficient. Diversifying investments leads to portfolios with higher expected returns and lower standard deviations (risk).

Figure 4: Minimum-variance frontier
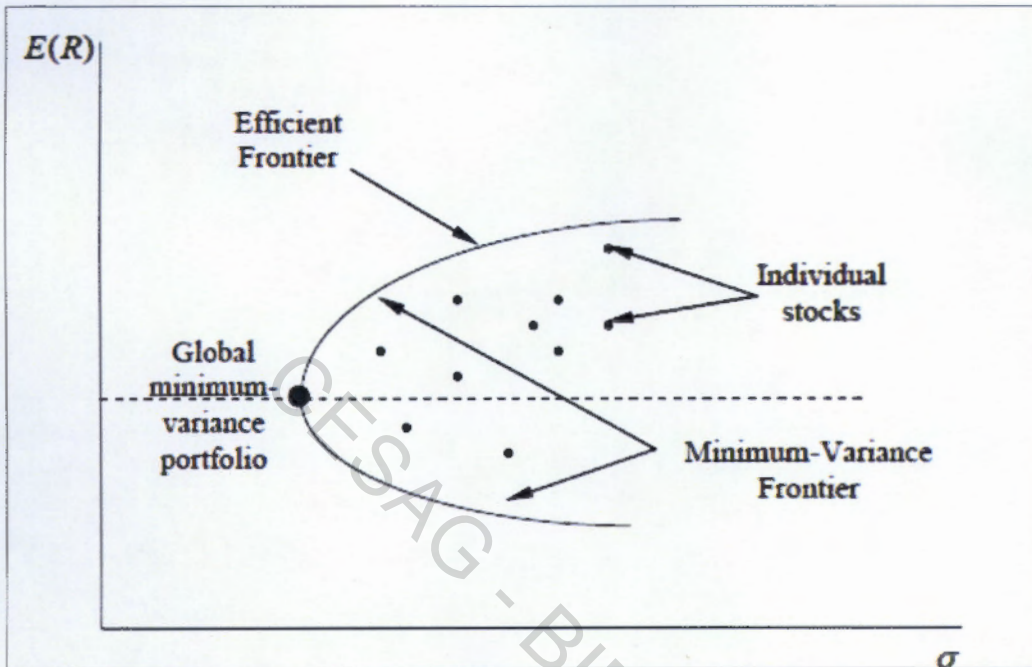
Source: ZVI Bodie et al.

The expected returns and standard deviations of the portfolios lying along the efficient frontier are determined by the following formulas, where $E(r_p)$ is the portfolio's expected return, $E(r_i)$ is an individual security's expected return, w_i is the weight of an individual security in the risky portfolio, the variance of the risky portfolio and $Cov(r_i, r_j)$ the co-variance between two individual securities.

The optimal risky portfolio P is obtained by computing the Sharp ratio of the various portfolios along the efficient frontier (**Figure 5**). The optimal portfolio is the one for

which the Sharp ratio[2] is maximized. The Sharp ratio (S_P) is given by the following formula:

$$S_P = \frac{E(r_P) - r_f}{\sigma_P}$$ where r_f is the risk-free rate of return.

The Sharp ratio equals the increase in the expected return of the complete portfolio (riskless and risky) per unit of additional standard deviation caused by the increase of the risky portfolio.

After determining the optimal risky portfolio, the next step is to allocate the investor's funds between a risk-free asset and the risky portfolio. That optimal risky portfolio is the best risky portfolio for all clients from a fund manager's standpoint, regardless of risk aversion; and the allocation however, of the complete portfolio to T-bills versus the risky portfolio, depends on personal preference, where the client is the decision maker (Bodie ZVI et al, 2001). To allocate the complete portfolio (risky and riskless assets) the fund manager uses the Capital Allocation Line (CAL) and the Utility Function.

Figure 5: Capital Allocation Line
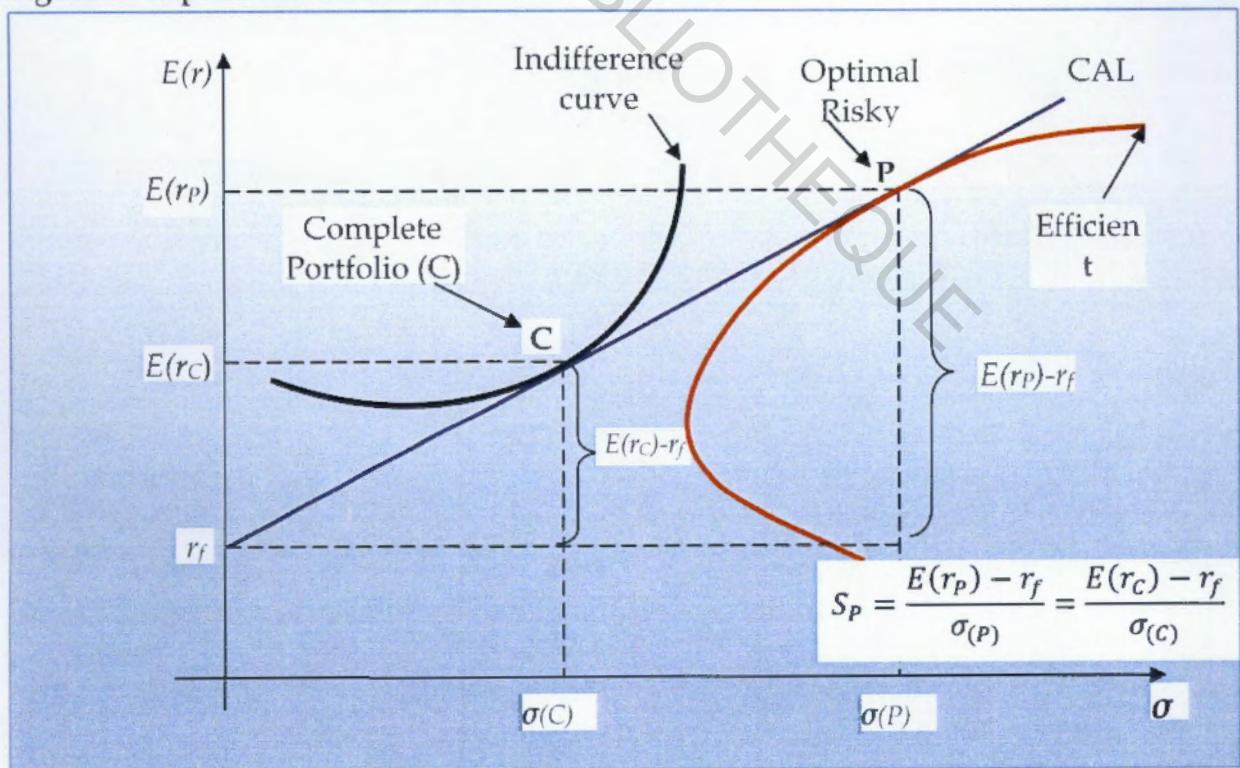
Source: ZVI Bodie et al.

The CAL represents different combinations of the risk-free asset and the risky portfolio and is a straight line originating at the risk-free rate of return and going through the points representing portfolios with greater proportion of risky assets. The slope of the CAL is precisely the sharp ratio computed earlier to determine the optimal portfolio P which occurs at the CAL's tangency point with the efficient frontier. This CAL with the highest Sharp ratio is the steepest one which maximizes the investor's risk/reward preferences. The particular point on the CAL which represents the complete combination for a client is reached by considering the client's risk aversion. Individual investor differences in risk aversion imply that, given an identical opportunity set (that is, a risk-free rate and a reward-to-variability ratio), different investors will choose different positions in the risky asset. In particular, the more risk-averse investors will choose to hold less of the risky asset and more of the risk-free asset. The Utility Function gives the utility an investor derives from a portfolio with a given expected return and standard deviation and is in large part matter of risk aversion. The Utility Function produces Indifference curves in standard deviation and expected returns plane. Changes in risk aversion lead to various indifference curves. The complete portfolio C — that is the combination of the optimal risky portfolio and the risk-free asset, occurs at the tangency points of the client's indifference curve (given his risk aversion) with the CAL. The overall standard deviation of the complete portfolio may be lower or higher than that of the optimal risky portfolio depending on the proportion of the risky portfolio within the entire complete portfolio. The following formula gives the value of the complete portfolio's standard deviation $\sigma_{(C)}$:

$$\sigma_{(C)} = y * \sigma_{(P)}$$

Where y is the weight of the optimal risky portfolio within the complete portfolio and $\sigma_{(P)}$ the standard deviation of the optimal risky portfolio.

Thus, the riskiness of the complete portfolio is only dependent on the risky portfolio and its weight within the complete portfolio. An increase in the weight induces an increase in the complete portfolio's overall risk and an increase in the expected return as well.

This way of selecting an optimal complete portfolio is known as the "separation property" introduced as early as in 1958 by TOBIN and was later improved within the CAPM framework. TOBIN (1958) observed that, MARKOWITZ portfolio selection can be separated into two independent tasks: first, determination of the optimal risky portfolio; and second, a personal choice of the best mix of the risky portfolio and the risk-free asset which hinges on the investor's risk aversion.

After the selection, the portfolio is managed throughout the investment period. As we said earlier, the portfolio management is a continual process which never stops once the funds are first invested. The manager may adjust the portfolio allocation from time to time in order to take into account changes in investor's objectives or changes in market conditions. In the end, performance indicators help the investor evaluate how the fund manager managed the funds. In order to get insight into portfolio performance appraisal, the next section focuses on portfolio performance indicators and their applications.

3. Portfolio performance indicators

Performance indicators are used to appraise the performance achieved by a fund manager, to determine which funds to entrust with a particular fund manager or to determine where an investor should place his funds. They can also be used to compare the performance of various portfolios based on the risk undertaken by the fund managers.

In general three performance indicators are used to achieve the aforementioned objectives. These are:

- The Sharp Ratio,
- The Treynor Ratio and,
- The Jensen' Alpha.

3.1. The Sharp Ratio

In the optimal portfolio selection section, we discussed the Sharp Ratio and we said that the optimal portfolio is the one that achieves the highest sharp ratio. Besides, the sharp ratio is a risk-adjusted return that relates the portfolio excess return to its total

risk –the standard deviation. The excess return is the difference between the portfolio return ($R_{P,t}$) and the return on the risk-free asset (which can be the 91-day Treasury bill of the Government of Ghana). The sharp ratio can therefore be used to appraise the risk-adjusted performance of an investment portfolio. It accounts for the level of return achieved by the manager, given the risk incurred. It can also be used to compare the portfolio return with a passive benchmark or the return achieved by various funds. As seen earlier, the Sharp ratio formula is given by:

$$S_P = \frac{R_{P,t} - R_f}{\sigma_P}$$

Where $S_{P,t}$ = the Sharp Ratio of portfolio P in period t

$R_{P,t}$ = the return produced by portfolio P in period t

R_f = the return on the risk free asset

σ_P = the total risk of portfolio P

For two funds, the one that shows the higher Sharp Ratio is the best performer.

3.2. The Treynor Ratio

The Treynor Ratio lay down on the Capital Asset Pricing Model. It assumes that, only the market risk should be rewarded since diversification cancels out the portfolio's specific risk. It is given by the ratio of the portfolio excess return to its market risk – the beta. The formula is as follow:

$$T_{P,t} = \frac{R_{P,t} - R_f}{\beta}$$

Where $T_{P,t}$ = the Treynor Ratio of portfolio P in period t

$R_{P,t}$ = the return produced by portfolio P in period t

R_f = the return on the risk free asset

β = the market risk of portfolio P

It compares the performance of a fund to that of a benchmark, or the performance of two or several funds. For two funds, the one that shows the higher Treynor Ratio is the best performer.

3.3. Jensen's Alpha

The Jensen's Alpha is given by the following formula :

$$\alpha_P = R_P - \underbrace{[R_f + \beta_P(R_M - R_f)]}_{}$$

Return predicted by the CAPM

Where α_P = the portfolio's Jensen's Alpha

R_P = the portfolio's actual return

R_f = the return on the risk free asset

R_M = the equity market return

β_P = the portfolio's market risk

Thus, the Jensen's Alpha is given by the difference between the actual portfolio's rate of return and the return predicted by the CAPM. Therefore the portfolio's alpha value indicates how much of the portfolio's rate of return is due to the manager's skills to achieve above average risk-adjusted returns, by good market timing and/or suitable security selection. A positive and greater Alpha indicates high portfolio performance.

At this point of the study, we have discussed portfolio allocation and how to measure its performance over a period of time. In the next section, we shall see how the portfolio management tools are used in practice.

4. Portfolio management in practice

In this section we focus on practical aspects of portfolio management, such us the identification of the investor's risk profile and corresponding portfolio allocation, the use of the MVO, and how a fund manager can passively or actively manage a portfolio.

4.1. Investor's risk profile and portfolio allocation: the use of questionnaires

In the portfolio management process, we said that the investor first constructs his investment policy in which he must specify his investment objectives, constraints, and time horizon. For this end, investment advisors help investors by providing them with a questionnaire or a form to fill in. The questions are designed through

sophisticated techniques derived from utility theory and behavioral economics in order to gauge investors' risk tolerance and investment objective category such as 1) Capital preservation, 2) Capital appreciation, 3) Current income and, 4) Total return. After the completion of the form, the advisor may place the investor in one of the four investment objective categories according to personal information provided. Each investment objective category corresponds to specific asset class allocation within the entire portfolio. For instance, **Figure 6** shows Merrill Lynch[3] investment objective categories and the corresponding asset allocation.

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[3] Merrill Lynch a US company, is one of the world's premier providers of wealth management, securities trading and sales, corporate finance and investment banking services.

Figure 6: Merrill Lynch investment objective categories and asset allocation

How Much Risk?
Merrill Lynch asset allocation
recommendations in its new categories

| ☐ Stocks | ☐ Bonds | ☐ Cash |

CONSERVATIVE FOR INCOME
30%
60%
10%

CONSERVATIVE FOR GROWTH
60%
30%
10%

MODERATE RISK
50%
40%
10%

AGGRESSIVE RISK
60%
40%
0%

BENCHMARK
(Merrill's allocation for a large, balanced corporate
pension fund or endowment)
50%
45%
5%
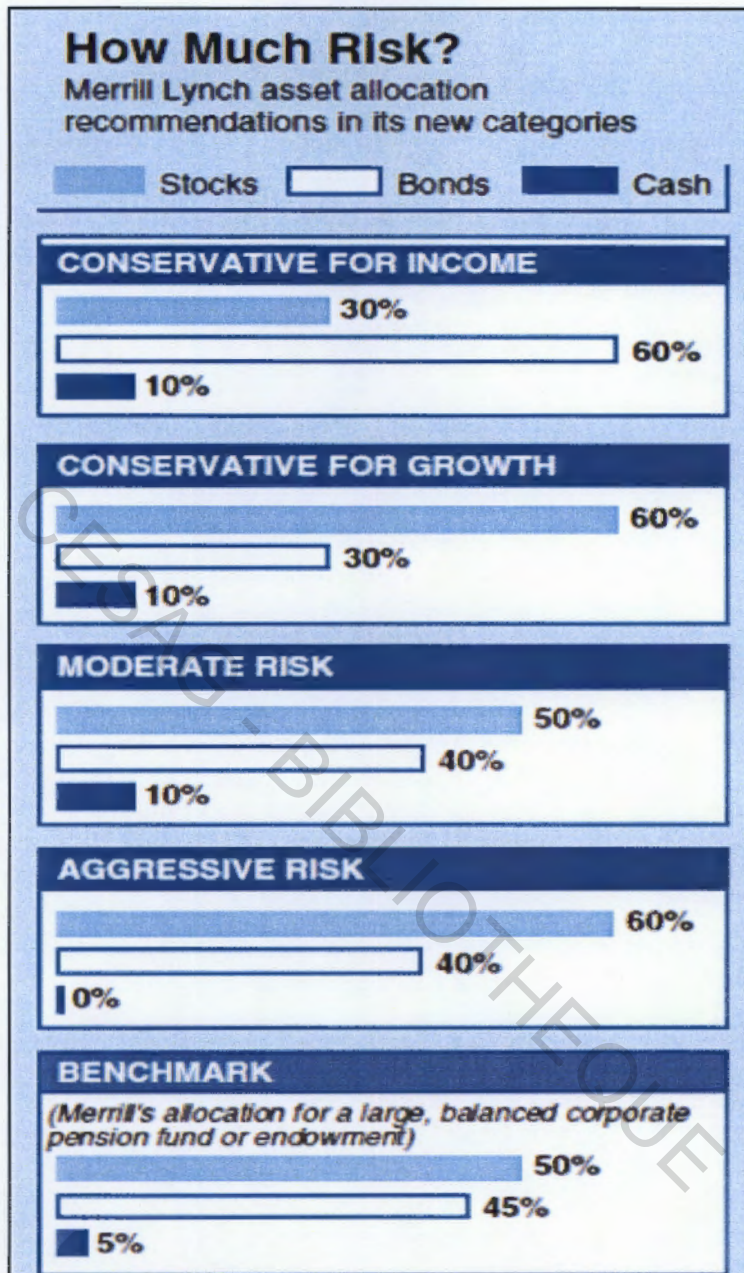
Source: Merrill Lynch in *The Wall Street Journal* (1990)

It can be identified from the figure, four categories express in terms of 1) conservative for income, 2) conservative for growth, 3) moderate risk and 4) aggressive. Each category corresponds to a specific asset allocation. For instance, if an investor falls under the conservative for income category, Merrill Lynch would suggest the investor to invest the funds in stocks for 30%, in bonds for 60% and in cash for 10%.

In addition an investor how falls under aggressive risk would be advised to invest his funds in stocks for 60% and in bonds for 40%.

The use of questionnaire is one way to allocate investment portfolios. Another method is the Mean-variance optimization (MVO) which practical aspect will be discussed in the next section.

4.2. The Mean-variance optimization in practice

In the optimal portfolio selection section, we discussed the implementation of Mean-variance optimization (MVO) in selecting an optimal portfolio. MVO as we said, refers to a mathematical process that calculates the security or asset class weights that provide a portfolio with the maximum expected return for a given level of risk; or, conversely, the minimum risk for a given expected return. The inputs needed to conduct MVO are security expected returns, expected standard deviations, and expected cross-security correlations. When first developed, mean-variance optimization was applied (if at all) only to portfolios of individual stocks. The method resulted in huge volume of calculations. For instance, for n individual stocks, the manager should determine $\frac{n(n-1)}{2}$ co-variances and $2n$ variances and returns.

Thus for 10 stocks, 45 co-variances and 20 variances and returns should be determined; for 20 stocks, 190 co-variances and 40 variances and returns should be determined; and for 30 stocks, 435 co-variances and 60 variance and returns should be determined. For this inconvenience, the technique is applied with increasing frequency on an asset class level because asset classes are not as many as individual stocks and the manager does not need several estimates.

Precisely, given the investor's risk tolerance and objectives, the manager sets the weights of the various asset classes in ranges, determines the risk and expected return of each asset class, the co-variance between the asset classes and uses the Mean-variance optimizer to obtain the portfolio's optimal allocation.

Optimization has also found a home with pension funds who consider not just the assets themselves when choosing investment mixes, but the fund liabilities and the

interaction between the two. The resulting allocations maximize the expected fund surplus (assets minus liabilities) for a given level of risk.

The consequence of mean-variance optimization is a set of asset class weights that can be used as a long-term guide for investing. This is often described as the portfolio's strategic asset allocation plan. The portfolio weights should be updated occasionally to reflect changes in estimates of the long-term parameters or different needs of the portfolio. However, these changes will likely result in small revisions in the portfolio composition.

Most often, portfolio managers may manage their portfolios in order to track the performance of a benchmark or to beat the benchmark. These ways of managing portfolios call for passive and active portfolio management and are subjects of the next section.

4.3. Passive portfolio management versus Active portfolio management

A portfolio can be managed using passive methods or active methods.

4.3.1. Passive portfolio management

In passive management, the investor does not attempt to reflect his investment expectations through changes in security holdings (MAGINN et al, 2007). The prominent equity passive management approach is indexing which principle is to track the performance of a benchmark index by replicating its couple risk-return. Here, rather than attempting to beat the market by exploiting superior information or insight, passive managers act to maintain an appropriate risk–return balance given market opportunities.

Full replication is the most obvious indexing investment where all the securities in the index are purchased respectively in proportion to their weights in the benchmark index. This technique helps ensure close tracking. Indexing investment can also be implemented through **sampling technique which** entails investing in a representative sample of stocks that compose the benchmark index. Indexing strategies allow holding well diversified portfolio without the need to conduct any

security analyses. Fixed income securities such as bonds can also be managed passively. One special case of bond passive management is the immunization strategy that attempts to insulate or immunize the portfolio from interest rate risk.

An investor can opt to manage his portfolio actively in order do better than a specific benchmark. In the next section we shall review active portfolio management strategies used by investment professionals.

4.3.2. Active portfolio management

In contrast to Passive management, Active management involves a set of strategies implemented in an attempt to beat on risked-adjusted basis a passive benchmark portfolio. MAGINN et al (2007) stressed that, to add value, the active manager must sharpen information, investment insights, and investment tools such as equity valuation models to the point at which he has a distinct competitive advantage over his peers. As observed by William F. SHARP in *The Arithmetic of Active Management* (1991), *an active investor is one who is not passive. His or her portfolio will differ from that of the passive managers at some or all times. Because active managers usually act on perceptions of mispricing and because such perceptions change relatively frequently such managers tend to trade fairly frequently – hence the term "active".* Generally, active management can be dichotomized into fundamental strategies and technical strategies.

4.3.2.1. Fundamental analysis

Fundamental analysis is the process of discovering the price for which a security should sell using the company's fundamentals. Fundamental analyses chiefly consist of the top-down three-step approach and the bottom-up stock picking approach. The most obvious difference between the two approaches is the perceived importance of the economy and a firm's industry on the valuation of a firm and its stocks. However both approaches attempt to identify and invest in undervalued stocks in order to beat the market.

4.3.2.1.1. Top-down approach

The top-down approach involves three levels of analysis. Proponents of the top-down approach believe that both the economy and the industry effect by far have a significant bearing on individual stocks performances. Thus the starting point for the top down approach is an analysis of the economy. This is followed by analysis of the industry is which the company operates, and ends with analysing the specific company in the context of the overall economy as well as its industry.

4.3.2.1.2. Bottom-up approach

Contrary to the top-down, advocates of the bottom-up, argue that it is possible to detect mispriced securities that are likely to provide superior returns *regardless* of the market and industry outlook. Therefore the company itself is the main concern of the bottom-up approach. The industry and the economy are rejected to the second importance.

The top-down and bottom-up approaches described are applied when dealing with shares. In the context of bond active management can take two forms. Active managers either use interest rate forecasts to predict movements in the entire fixed-income market, or they employ some form of intra-market analysis to identify particular sectors of the fixed-income market or particular bonds that are relatively mispriced.

While some investors make use of fundamental analysis in their investment decision, others favour technical analysis which is reviewed in the next section.

4.3.2.2. Technical analysis

In contrast to fundamental, Technical analysis involves the examination of past market data such as prices and the volume of trading, in an effort to estimate future price trends in order to take any investment decision. The rationale of technical analysis is quite contrary to the efficient market hypothesis which contends that past performance has no bearing on future price performance. Technical analyst usually

form portfolios on the basis of past price trends by assuming that either: (1) they will reverse their trends — the contrarian strategy or (2) past price trends will continue in the same direction — the momentum strategy. The contrarian strategy is based on DEBONT and THALER (1985, 1987) study. They found that market overreacts to new information and that their reversal should be predictable from the past return data alone, with no use of any accounting data such as earnings. Therefore, specifically, two hypotheses are suggested: (1) Extreme movements in stock prices will be followed by subsequent price movements in the opposite direction. (2) The more extreme the initial price movement, the greater will be the subsequent adjustment. Accordingly, the contrarian strategy involves buying past loser and selling past winners. Conversely, the momentum strategy following, JEGADEESH and TITMAN (1993) acts on the belief that there is a momentum in stock prices because market under-reacts to new information. The reasoning of this is that new information of the firm earnings slowly incorporates the stock prices. Old information persists with no or under reaction to new ones. Consequently, the prevailing trend continues until the new information incorporates the price several months latter — hence the price momentum. Therefore the momentum strategy consists of buying past winners and selling past losers.

In summary, it is clear that fundamental analysis and technical analysis are opposed on the determinant of future price trends. However both aim at identifying mispriced securities in order to beat the market or a stated benchmark. These ways of managing investment portfolios are opposed to passive portfolio management. Some professionals believe that one can do better by actively manage a portfolio. Conversely, EMH contends the contrary and suggests passive portfolio management. This controversial debate on the issue is still topical and the academic "battle" between the proponents and challengers of active portfolio management on the one hand and passive portfolio management will continue.

After having presented the literature that underpins portfolio management, we shall now look at the methodology of the study in the next section.

III.   The methodology of the study

The objective of this study is to bring out sound and winning portfolio management practices that could be implemented by investors in emerging capital market especially in Ghana. Therefore, the study covers two major analyses: (1) the implementation of defined portfolio management strategies based on the Bank of Ghana monetary policy stance over the period of study and (2) the study of the benefit of equity portfolio diversification across African stock markets. The former aims to examine EIL portfolio management strategies and appraise the performance of a sample of EIL's client portfolios, concurrently with a recommended constructed portfolio—the Analytical Equity Portfolio (AEP). The AEP is constructed using MARKOWITZ mean-variance optimizer (MVO) and is managed throughout the period of study based upon the Bank of Ghana monetary policy stance. The second attempts to appraise the benefit of equity portfolio international diversification across major African stock markets mainly, from the standpoint of a Ghanaian investor. The motive is that instead of being subject to the Ghanaian equity market fluctuations alone, a portfolio would be better off when exposed to various stock markets.

To properly conduct the analyses, the next sections provide details of the data (1) and the methodology of the study (2).

1. Data: collection, treatment and computerizing

In order to attain the objectives aforementioned, the study employs secondary and primary data.

1.1. Secondary data

The secondary data includes books, academic and professional articles and journals that deal with the topic of the actual study. These data focus on the Efficient Market Hypothesis, the Modern Portfolio Theory, the Portfolio management process, the merit of portfolio diversification and the analysis of current and projected economic conditions in investment management, the importance of asset allocation and asset

allocation strategies, and are produced by well-known authors such MARKOWITZ, SHARP, FAMA among others. The empirical findings and the theoretical developments presented in these articles and books are used to perform our study, evaluate the outcomes and draw conclusions. However, there are limitations in the use of the secondary data, since few studies has been conducted before in this specific area of investment management in African emerging markets.

1.2. Primary data

The primary data consist of share price time series (collected from the GSE), the Bank of Ghana policy rates, the 91-day Treasury bill rates, EIL's client portfolios data and the indices of some African capital markets.

1.2.1. The GSE stocks

The stocks used in the study are listed on the GSE and may be classified as cyclical or non-cyclical.

1.2.1.1. Non-cyclical and cyclical stocks

Non-Cyclical stocks are opposed to cyclical stocks and their differences rest on their relationship with the performance of the economy. Because investors cannot change economic trends, they have to tailor their investment practices to its ebbs and flows in order to identify where to invest when the economy starts to decline or to rise.

Non-cyclical stocks or defensive stocks do well in economic slumps and tend to lag behind in economic upswings. All is about what people can do without if their budgets are tight.

The classic example of non-cyclical stocks is utilities. Everyone from consumers to businesses needs water, gas, and electricity no matter what the state of the economy. People also cannot put off household non-durable goods, such as toothpaste, toilet paper, cleaning materials even if things are tight. Non-cyclical stocks account for necessities and are not subject to economic gyrations. Consequently, they are good stocks to invest in when the investor anticipates an economic downturn.

Cyclical stocks move in tandem with the business cycle. They stocks are those goods and services for consumers and businesses that they buy when the economy is doing well. Because businesses and consumers spend more when their budgets are not depressed, cyclical stocks perform well in economic upturns. Said differently, in economic slumps, with less disposal income businesses and consumers cannot afford luxuries and material goods and services. However, when things are tight, businesses and consumers reduce their spending to the necessities and only non-cyclical stocks perform well in downturns as mentioned above. Cyclical stocks are therefore high correlated with the business cycle.

Classic examples of cyclical stocks are automobile companies. Indeed, when the economy is doing well and people are working, car sales do well. However, if there are layoffs and uncertainty or high interest rates, people may decide to hold on to their car another year. Businesses expand during good times. They buy new equipment and build new facilities, so equipment sales and construction are cyclical stocks. Cyclical stocks represent good investment vehicles when the outlook for economy brightens up.

As we said earlier, non-cyclical stocks and cyclical stocks differ according to their correlation with the economy. One way to identify these stocks is to compute their Betas. Beta (β) is a market risk measure brought over by the CAPM which originated in the works of William F. SHARP (1964). Beta measures the correlation between stocks and a market index that represents the whole economy. Said differently, it measures the degree to which a stock is more volatile than the market average. It is given by the following formula:

$$\beta = \frac{Cov(r_i, r_m)}{\sigma_m^2}$$

Where: r_m = the return on the market index

r_s = the return on the stock

σ_m^2 = the variance of the market index

$Cov(r_i, r_m)$ = the co-variance between the return on the market index and the return on the stock

The value of Beta may be equal to, greater or less than 1. Stocks that are sensitive to the market have betas greater than or equal to 1. These stocks represent the cyclical stocks. Conversely, stocks with betas less than 1 are less sensitive to the market and represent the non-cyclical stocks.

The beta obtained using the above formula is called "regression beta", because the formula rests on regression techniques. Therefore the regression beta is influenced by the choice of the market index, the choice of the time period (2 years, 3 years, 5 years etc...) and the choice of return interval (daily, weekly, monthly, quarterly etc...). In addition, most services adjust their regression betas towards one, using fairly simple techniques. To illustrate, Bloomberg estimates an adjusted beta by doing the following:

Adjusted Beta = Regression Beta*(0.67) + 1.00*(0.33)

Why adjust betas towards one? The rationale is that in the long run, companies that survive in the market tend to increase in size over time, become more diversified and have more assets in place, producing cash flows. All of these factors should push betas towards one.

In the study, we use the regression beta and the Bloomberg's adjusted beta to classify the GHS stocks into non-cyclical and cyclical stocks (**see Appendix II**).

1.2.1.2. The stock price time series

The monthly data of individual share prices collected from the Ghana Stock Exchange span from January 2000 to December 2010-- a total of 132 monthly prices. The monthly time series data are used in order to reduce bias resulting from non-trading in individual securities. The price series are used to estimate individual share risks and expected returns which are input into the MVO and to track the value of the AEP along the study period. For this reason the series are split up into two arrays. The first array of 72 monthly prices, spans from January 2000 to December 2005 and is used to compute the individual share prices' risk/return pattern presented in **Appendix II**. The second array of 60 monthly data from January 2006 to December 2010 is used to manage the AEP over the study period.

1.2.2. The Bank of Ghana series

The monetary policy rates and 91-day Tbill rates are collected from the Bank of Ghana Monetary Policy Committee (MPC) reports and the Bank of Ghana weekly auction reports respectively. Since its establishment in 2002, the MPC has undertaken three major monetary policy measures so far: expansive measures from July 18th, 2003 to August 27th, 2007; restrictive measures from October 22nd, 2007 to September 23rd, 2009 and then expansion measures from November 20 2009 to date (see **Table 1**). These monetary policy stances (three) are used to time the stock market over the study period. Each stance is identified by the direction of the policy rate changes (upwards or downwards). Upwards changes represent restrictive policy measures, while downwards changes represent expansive policy measures.

Table 1: Bank of Ghana's Monetary Policy Periods

Policy Period	Policy	start Date	Start Rate	No of Rate changes	Total Change in rates
1	Expansive	18-juil-03	26%	9	-14.5%
2	Restrictive	22-oct-07	13.5%	5	+6%
3	Expansive	20-nov-09	18%	5 through dec 2010	-5% @ dec 2010

Source: The Bank of Ghana

1.2.3. EIL's client portfolios data

To review EIL portfolio management performance, semi-annually reports from January 2006 through December 2010 of its client portfolios are collected. The sample is composed of 22 funds and is selected from institutional and individual portfolios. A five-year period analysis is deemed relevant to yield significant conclusions likely to draw attention.

1.2.4. Major African stock market indices

Finally, the African diversification analysis uses seven (7) major stock market indices published by the African Business Research institute of the African Business Research Ltd (See **Table 2**). Monthly time series data are collected for each index

series over the period spanning from January 2000 to December 2010. All the indices are reported in US Dollar term to measure the returns in the same currency unit. This results in 132 monthly index levels for each market index which are used to estimate the input list (standard deviations and geometric average rate of returns) to feed the MVO in order to derive the efficient internationally diversified portfolios.

Table 2: Risk/return of major African stock markets

Countries	Standard Deviation (%)	Average Annual Return (%)
Morocco	17,62	9,15
Egypt	34,07	17,07
Ghana	22,87	21,41
Mauritus	17,31	14,70
Nigeria	25,78	14,19
JSE	18,82	13,15
Botswana	14,24	14,92
UEMOA	5,31	5,72

Source: African Business Research institute

At this point, we have reviewed the data used in the study. In the next section, we will focus on the analysis model implemented to conduct the study.

2. Analysis model

In this section, we will review the computation of the risk/return measures, the AEP management strategies, the benchmarks used to appraise the performance of the sample portfolios and the AEPs and the African diversification analysis procedures.

2.1. The computation of the risk/return measures

After pooling all data—individual securities and the various indices, monthly returns are calculated using the following formula:

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

The expected returns of each individual security of various market indices are estimated using the Geometric Average Monthly Returns (GAMR). Investors are typically concerned with long-term performance when comparing alternative

investments. The geometric average (relative to Arithmetic) is considered a superior measure of the long-term mean rate of return because it indicates the compound annual rate of return based on the ending value of the investment versus its beginning value. The GAMR is computed as follow:

$$GAMR = \left[\frac{P_{t+n}}{P_t}\right]^{1/n}$$

Where n is the number of months, P_t the beginning price level and P_{t+n} the ending price level.

The risk is estimated by the return's standard deviations for individual securities and the various market indices. The formula is as follow:

$$\sigma = \left[\frac{\sum_{t=1}^{n}(R_t - \bar{R})^2}{n-1}\right]^{1/2}$$

Where $\bar{R}$ is the mean return, R_t the monthly return and n the number of months.

The MVO gives us the optimal portfolio which maximizes the Reward-to-variability Ratio (the Sharp Ratio, S_P) and is computed using the Government of Ghana (GoG) 91-Treasury Bill rate as the risk-free rate. The computation of the Sharp Ratio holds only for the first analysis. For this purpose, the 91-Tbill rate is converted to a monthly rate through the following formula:

$$R_{fm} = (R_f + 1)^{1/12} - 1$$

Where R_{fm} is the risk-free rate, stated on a monthly basis and R_f, the annual risk-free rate of return.

Thus, the Sharp ratio is given as follow:

$$S_P = \frac{E(R_P) - R_{fm}}{\sigma_P}$$

Where $E(R_P)$ is the portfolio expected return and σ_P the portfolio risk or standard deviation.

2.2. The recommended portfolio: the AEP construction and management strategies

In examining EIL portfolio management strategies, only one portfolio is constructed (AEP) and managed throughout the sample period. The rationale is that the portfolio manager should construct only one optimal risky portfolio which shows the optimal

weight of each individual stock to invest in. The portfolio manager then offers this optimal portfolio to all clients regardless of their degree of risk aversion. The degree of risk aversion of the client comes into play only in the capital allocation decisions where the portions of the funds to invest in risky and riskless assets are determined. Thus the only difference between client's choices is that the more risk-averse client will invest more in the risk-free asset and less in the optimal risky portfolio than will a less risk-averse client. However, both will use the same risky Portfolio as their optimal risky investment vehicle. Thus, the AEP performance is compared to that of equity portfolios in the sample under study. The value of the AEP in Ghana Cedi term is the average of the values of client's equity portfolios in the sample under study. The value is set at GH¢ 50,000 at the beginning of the investment program (**Appendix V**).

The Analytical Equity Portfolio (AEP) is managed over the sample period by implementing two different strategies, both of which exploit easily observable signals of monetary policy stances: 1) An industry/company rotation strategy (the Strategy A) and 2) A rebalancing strategy which consists of shifting the portfolio allocation between 91-Day Tbills and stocks listed on the Ghana stock Exchange (the Strategy B). The monetary authority —The Bank of Ghana pursues its policy which aims at ensuring price stability (low inflation rate), sustainable and strong economic conditions. Typically, the Bank of Ghana tightens monetary policy in the face of rising economic activity and inflation, and easies monetary policy in the face of falling economic activity and inflation. Thus the economy goes through upswings and downswings and the monetary authority reacts to maintain stability. The economic upswings and downswings correspond respectively to the monetary authorities' expansive (easy policy) and restrictive (tight policy) policies. The first strategy exploits the merit of investing in cyclical industries during economic upswings, and defensive industries during economic downswings using monetary policy stance observable signals. The second strategy relies on Adam, ANOKYE M. and George TWENEBOAH work (*Macroeconomic Factors and Stock Market Movement: Evidence from Ghana*, 2008) which documents that high-treasury bill rates encourage investors to purchase more government instruments and that treasury bills tend to

compete with stocks and bonds for the resources of investors. High interest rates attract more savings and discourage the flow of capital to the stock markets leading investors to demand for a higher risk premium which impedes investment and slows down economic development, while low interest rates encourage higher capital flows to the stock market: then companies experience the "Wealth Effect", increase their investments at low capital cost which spur the economic activities and increase expectations for higher rates of returns. This evidence has also been brought over by Godwin CHIGOZIE OKPARA for the Nigerian market in *Monetary Policy and Stock Market Returns: Evidence from Nigeria*, 2010.

In the first strategy, the Bank of Ghana's monetary policy rate changes are used to shift the AEP allocations toward cyclical stocks during expansive monetary stances and toward defensive stocks during restrictive monetary stances. In the second strategy, still the Bank of Ghana's monetary policy rate changes are used to tilt the AEP toward cyclical stocks during expansive monetary stances and toward the 91-Day T bills during restrictive monetary stances. Precisely when the Bank of Ghana enters an expansive policy (respectively a restrictive policy), the portfolio allocation is shifted to cyclical stocks (respectively defensive stocks) after 250 bp to 350 bp changes in the first strategy. In the second strategy, the same principles are applied expect that the portfolio allocation is shifted to 91-Day T bills during restrictive policy stances. We found that, at least 250 bp to 350 bp changes in the policy rate are significant to make impact on economic variables and revert the prevailing economic trend. This also would ensure that the strategies avoid any lock-ahead bias and can be implemented on an ex-ante basis.

2.3. The benchmarks

In order to appraise the performance of the AEP relative to the sample, three passive benchmarks are used: 1) The GSE All-share Index, 2) An Equally-weighted portfolio across the various cyclical and defensive stocks listed on the GSE (the Benchmark A) and 3) A Portfolio half invested in the Equally-weighted portfolio across the various cyclical and defensive stocks listed on the GSE and half invested in 91-Day T Bills (the Benchmark B).

59

2.4. The African diversification analysis

In the international diversification analysis, efficient portfolios are constructed and their risk-return patterns are compared with that of individual market indices to derive the benefit of the strategy. **Table 2** depicts the risk-returns characteristics of each country index used in the analysis.

In this chapter, we have reviewed portfolio management literature as a whole. Precisely, we have discussed (1) the EMH and considered its implications for investors; (2) the portfolio management process; (3) the recent evolution of portfolio management theory; (4) some aspects of the practice of portfolio management and finally (5) the methodology of the study. This presentation allowed us to get insight into the ins and outs of portfolio management practice and the methodology implemented to conduct the study. In the next chapter, we shall consider portfolio management at EDC Investment Ltd and present the performance of the sample portfolios under study.

Chapitre 2: Portfolio management at EIL

In this chapter, we shall present EIL (I) and discussed its investment vehicles (II). That will allow us to present EIL's investment strategies and to review the performance of a sample of EIL's client portfolios over the period of study (III).

I. Presentation of EDC Investments Ltd (EIL)

EDC Investments Limited (EIL) is one of the leading investment advisors in the Ghanaian market. The Company was incorporated in Ghana 2007 as a wholly – owned subsidiary of the Ecobank Development Corporation (EDC) to provide funds and investment management service to clients. It is licensed by the Securities and Exchange Commission (SEC) and also an active player on the Ghana Stock Exchange (GSE).

The Company operates under the various laws applicable in Ghana including the Securities Industry Law (SIL) PNDCL 333 as amended. Prior to the incorporation of EIL, the fund and investment management business was a department under EDC Stockbrokers Ltd which was established in 1990 to provide brokerage and advisory services.

EIL's client base is made up both individual and corporate funds across various sectors such as energy, mining, Manufacturing, Banking, Governmental agencies, educational institutions, health service providers, and religious associations.

Bases on the SEC 2009 report on fund management, EIL is the largest institutional fund manager in terms of funds under management and second largest fund manager.

EIL currently manages amongst other things, provident and pension funds, end of service benefit schemes, and mutual funds. EIL also has the capability to advise on the establishment of endowment funds, end of service benefit scheme, provident and pension Schemes including helping to constitute the board of trustees and preparation of investment policy statements, trust deeds, fund rules, etc.

EIL is the fund manager of iFund Mutual Fund Ltd, a public-owned collective investment scheme with approximately 7,800 shareholders.

1. Vision, Mission and Value of EIL

EIL as a wholly-owned subsidiary shares EDC's mission and vision.

The vision of EDC is to be an outstanding world-class African Investment Banking Group, operating in all principal markets of the world."

EDC's Mission is "To provide a full range of world-class investment banking services to individuals, companies, and governments in Africa and across the globe. In carrying out our mission, we seek to develop our people, our most treasured assets, and improve their wellbeing. Our overriding commitment is to contribute immensely to the societies in which we live and operate while enhancing shareholder value."

The values that underpin EDC's activities and operations are expressed follow:

  ▶ Focus on the client,

  ▶ Exceed client's expectations,

  ▶ Keep commitment,

  ▶ Do the right thing always.

EIL's stated capital amounts to one hundred thousand Ghana Cedis only (GHS 100,000) and is fully owned by EDC.

2. EIL's Organizational Structure

At the apex of EIL organizational structure is the Board of directors who oversees the general administration of the Company and draws its broad policies. Below is the Head with the key responsibility of drafting and implementation of strategies in conformity with the broad policies set up by the Board. The Head is followed by a number of portfolio managers.

On investment purposes there is an investment committee that is responsible for the review of investment papers. Below is **Figure 7** which depicts the organizational chart of EIL.

Figure 7: EIL's Organisational structure
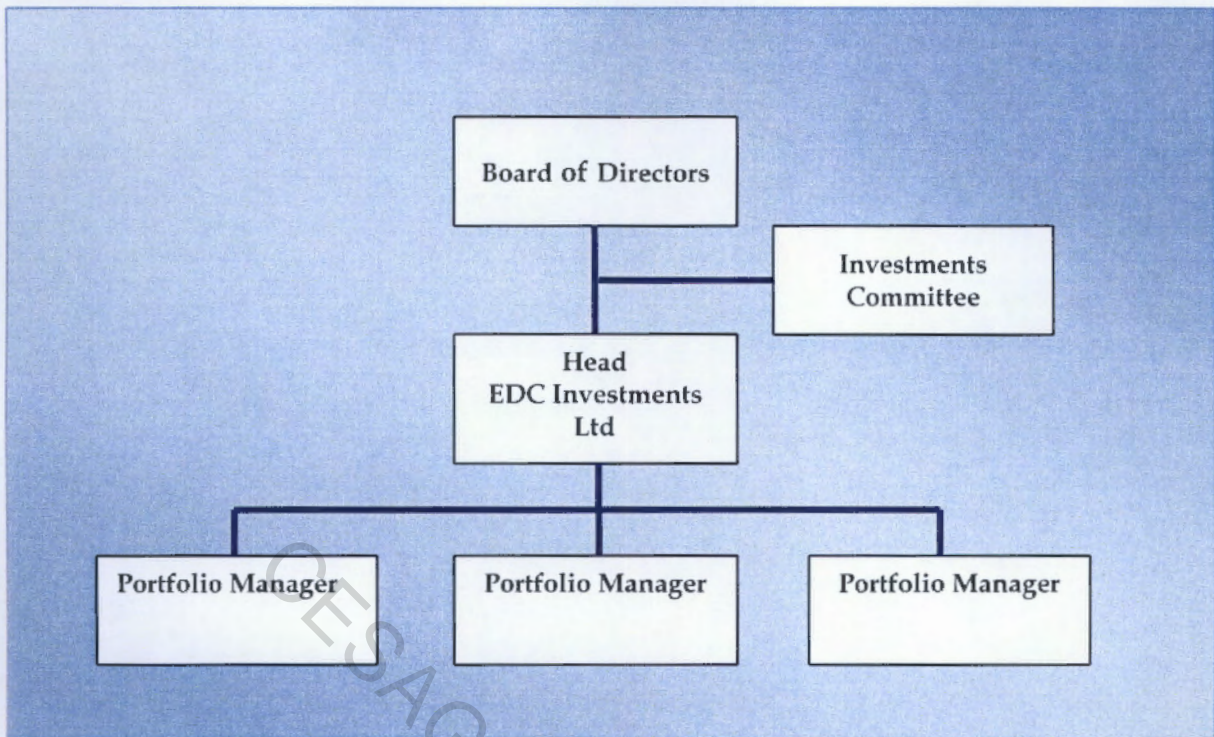
Source: EDC Investments Ltd

3. Operations

EIL's core business spans managing Provident and Pension funds assets, Individual wealth and other institutional assets. Presently, it manages over GH¢130 million in assets on behalf of its clients. As at December 2010, EIL's clients amounted to 70 institutional investors and 60 Individual investors.

As we now know more about EIL and its activities, we shall now look at its investment vehicles in the next section.

II.   Investment vehicles of EIL

The investment landscape in Ghana has been changing rapidly. Well before the establishment of the Ghana Stock Exchange, securities were being traded in Ghana. On short term market, Treasury bills and Bank of Ghana bills were being issued by the Bank of Ghana. Equity securities were being traded over the counter. The establishment of the GSE in 1990 represented a revolutionary change in securities

market in Ghana. From initial 9 listings in 1990, the GSE currently has 35 fully listed companies and one provisional listing.

Today, portfolio managers and specially EIL, usually select from a large universe of investment vehicles composed of:

- Money market instruments
- Listed shares
- Unlisted shares
- Bonds
- Unit Trusts and Mutual Funds

1. Money market instruments

Money market instruments are instruments that have a maturity of one-year or less at issue. The most actively traded money market instruments are Treasury bills. The instruments that are currently being issued by the government of Ghana are:

- 91-Day-Treasury bills
- 182-Day Treasury bills
- 1-Year Note

EIL also invests in other money market instruments such as Commercial papers and banks' Certificate of deposits and **Time deposits.**

Commercial papers are short-term unsecured notes issued by large reputable corporations to raise money on a short-term basis.

Banks' **Certificates of deposits** (CDs) are short-term instruments issued by Banks to finance their activities. CDs are usually held by financial and non-financial institution such as Banks, Companies, Money market mutual funds, Pension funds and government agencies.

A **time deposit** or **term deposit** is a money deposit at a bank that cannot be withdrawn for a certain "term" or period of time (unless a penalty is paid). When the term is over it can be withdrawn or it can be held for another term. Generally speaking, the longer the term is, the better the yield on the money. The interest rate is guaranteed not to change for the nominated term, so you'll know exactly what your

investment's worth. In addition, the interest rate is slightly higher than the treasury instruments for the same term because of the risk premium required by investors.

2. Listed shares

Listed shares are company shares listed on the Ghana Stock Exchange. Currently, EIL invests in 35 shares listed on the GSE. SEM Financial Group Ltd a financial company incorporated in Ghana developed industries classification for GSE listed companies—the SEM Listed Company Industrial Classification (SEM-LCIC). Under the SEM-LCIC, publicly quoted companies are grouped into six broad industries such as:

- Mining
- Manufacturing and construction
- Food, beverage and tobacco
- Distribution and trading
- Diversified
- Financial and real estate

For the need of the actual study, we classified the GSE listed shares as non-cyclical and cyclical stocks. This classification has been done in the methodology of the study discussed in **Chapter 1**. Note that, Treasury bills and listed stocks represent the essentials of investment instruments of EIL.

3. Unlisted shares

Unlisted stocks are those that are note listed on an organised market such as the GSE. These stocks are traded over-the-counter. Company in Ghana such as Sell, National Investment Bank and Pasico have their shares traded informally at brokerage houses. The National Trust Holding Company (NHTC) a brokerage house incorporated in Ghana is active in the trading of unlisted shares.

EIL does not invest much of its client's funds in unlisted shares.

4. Bonds

Bonds are interest-bearing instruments with maturities that at issue exceed one year. Unlike stocks which pay dividends as and when declared by the Board of Directors, issuers of bonds are required to make regular payments of interest and have repay the principal of the bond at maturity.

Generally, there are two kinds of bonds: fixed rate bonds and floating rate bonds. A fixed rate bond is a bond whose coupon rate is fixed and does not change till maturity. Conversely, a floating rate bond is a bond whose coupon rate is pegged to a benchmark such as Treasury bill rate and adjusted periodically.

Bonds may be issued by the Government (Government bonds) of Ghana and companies (Corporate bonds). The bonds that are currently available on the Ghanaian market are:

- Government bonds
    - 2-Year Fixed rate Bond
    - 3-Year Fixed rate Bond
    - 5-Year Fixed rate Bond
    - 5-Year Golden Jubillee Bond
- Corporate bonds
    - HFC Series J Dollar, a floating rate corporate bond denominated in dollars and pegged to the 6-month LIBOR

5. Unit trusts and Mutual Funds

Unit Trusts and Mutual Funds are collective investment schemes. Although the legal constitution of Unit Trusts and Mutual Funds differ, their characteristics as investment vehicles are identical.

A Unit Trust consists of a collection of securities, with the beneficial interest in the assets of the Trust divided into units. The assets of the Trust are held by a trustee on behalf of beneficial owners who hold units of the trust[4]. The trustee is a company appointed by the Manager (who establishes the Trust) to take into its custody or

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[4] Ghana Stock Exchange Securities courses 2010

under its control the property of the unit trust and hold it in trust for the investors. There are about five Unit Trusts in Ghana.

Mutual Funds are corporate entities with shareholders except that the corporate entity invests only in securities of other companies[5]. Shareholders of Mutual Funds hold shares which are equivalent to units in a Unit Trust. The assets of a Mutual Fund are held by a Custodian, a financial company appointed by the Mutual Fund Company (which establishes the Mutual Fund) to keep custody of all the securities owned by the fund. There are about 12 Mutual Funds in Ghana.

EIL also invests in Unit Trusts and Mutual Funds if its clients' objectives and risk preference match the risk and performance of the Unit Trusts or Mutual Funds.

In summary, EIL invests in various instruments in the domestic market only. As we shall see later on, domestic market investment exposes the portfolio to the unique risk of that market and an international diversification should be preferred. After having reviewed the investment instruments favoured by EIL, we shall then look at its portfolio management practices.

III. Portfolio management at EIL

In this section, we shall focus on EIL's portfolio management strategies. A sample of EIL's client portfolios will be then reviewed in order to apprehend the pertinence of these strategies.

1. EIL's portfolio management characteristics

The observed performance of EIL's client portfolios under study is ascribed to its portfolio management characteristics: the investment management philosophy and portfolio management approach and process. Therefore, after having presented EIL, we shall now focus on its investment management philosophy, its portfolio management approach and process.

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[5] Ghana Stock Exchange Securities courses 2010

1.1. EIL Investment Management Philosophy

EIL's investment management philosophy is based upon the premise that preservation of capital is the key priority. EIL therefore seeks to add value to its clients' portfolios through:

> ▸ Achievement of attractive returns using modern investment disciplines;

> ▸ A clear understanding of the client's risk profile;

> ▸ Development of appropriate benchmarks and reporting mechanisms.

In summary, EIL's investment philosophy is to seek the preservation of capital, while producing returns commensurate with the established benchmarks, based on careful attention to detail, extensive planning and rigorous portfolio selection.

1.2. EIL's Investment Management Processes and strategies

EIL's investment process begins with fundamental research and market analysis to identify the impact of expected macro-economic trends on the value of each portfolio. This "top-down" approach is combined with rigorous analysis of the asset classes available, as well as the individual securities to be selected. Due consideration is given to issues such as the liquidity of the instruments, credit risk, historical and projected financial performance, price and trading history and relative value analysis. Often, this involves discussions with the management of issuers to gain insights into their businesses.

For fixed income investments, EIL evaluates the trade-offs between the various maturities available and determine the extent to which the pricing and liquidity of these securities adequately compensate investors for longer-term exposure. As a result of this evaluation process, EIL has at all times, a "universe" of potential investment avenues which is updated on a regular basis and to which most of its client portfolios are allocated, depending on the agreed investment guidelines.

EIL develops a set of investment guidelines based on discussions with the management. These guidelines will address issues such as the maximum exposure limit for each investment or asset class, credit and financial strength criteria, the allocation of investments between fixed income instruments, equities and other asset

classes, the procedures for approval of investment decisions and reporting requirements.

Client's funds are managed based on portfolio management agreements signed with them. The portfolio agreement summarizes the investment policy and serves as the guideline for the investment program, with the view to properly achieve the client's needs and objectives. It also outlines the responsibilities of the parties as well as the management fees. The funds are managed to ensure the portfolios are well diversified in order to minimize risk and maximize returns. In addition, it is meant to ensure that clients' short-term liquidity requirements such as withdrawals and auditors fees can be met. Thus the choice of an appropriate asset mix for a particular client is amongst other things, dependent on the funds objectives, the risk tolerance level of the client and frequency of withdrawals.

Upon a critical observation of the sample portfolios over the period of study, it follows that EIL makes use of integrated asset allocation in the sense that both capital market conditions and investor's objectives act as leading factors that guide changes in the "asset-class level allocation", in an effort to take advantage of the market. A closer look at the equity sub-portfolio in the sample suggests that EIL adopts a strategic view in managing equity—that is equity investment is long-term investment. Consequently, there is no need to churn up the equity portfolio composition to capture short-term trends. This can be viewed as passive investment strategy. However, it is not as it looks. Indeed, EIL constructs its client's portfolios through stock selection and favours equities it believes (through valuations) are strategically positioned for long-term growth and value. The stock selection also aims to outperform the market and to deliver excess returns to its clients. EIL's client equity portfolios performance is also influenced to some extent by client regular account withdrawals and contributions. Indeed, disbursements in the form of bulk withdrawals may require the disposal of some stocks which is likely to put drag on the portfolio performance. On the other hand, contributions allow EIL to invest in new opportunities and therefore to enhance the portfolio's performance. Contributions are also used as portfolio balancing tool.

Now that we have reviewed EIL's portfolio management strategies, we shall focus in the next section, on the analysis of the performance of the client's portfolios under study.

2. The performance of the client's portfolios under study

In this section we shall scrutinize the performance the sample portfolio under study. The sample is composed of 22 funds and is selected from institutional and individual portfolios. Semi-annually reports from January 2006 through December 2010 of each fund are collected for this purpose.

Figure 8 depicts the average performance of the sample portfolios[6] compared to the GSE All-Share Index over the period of study. The graph shows that the returns on both the sample portfolio and the GSE All-Share Index assumed a similar trend: increase in returns from 2006 to end of 2008, followed by a dramatic downturn during the first half of 2009 before bouncing back in the second half of the period up to 2010. This implies that the sample portfolios allocation is basically composed of stocks that drive the market or follow the market. It can also be deduced from these observations that regardless of its clients' risk tolerance, EIL's equity allocation does not differ significantly from one client to another. Thus in fund management business, the fund manager can use the same equity allocation for several clients.

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[6] Appendix VII depicts the performance of each client equity portfolio of the sample

Figure 8: Semi-annual returns of the sample portfolios and the GSE All-share Index
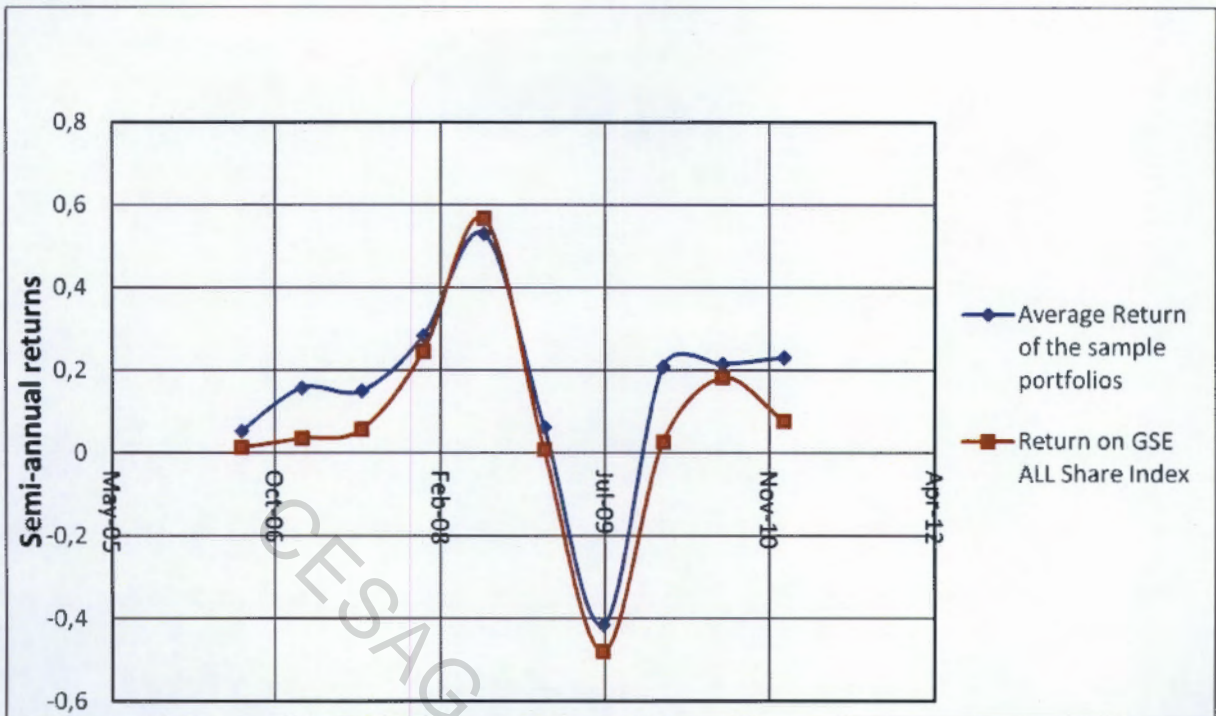
Source: EDC Investments Ltd, The Ghana Stock Exchange

That equity allocation is supposed to be the optimal one, likely to produce better returns. The weight in which to invest the equity portfolio within the entire portfolio only comes into play when considering the client's attitude toward risk. Thus for a less risk-tolerant investor, the equity portfolio's weight is reduced in favour of bonds and treasury securities, whereas a more risk-tolerant client would overweight the equity portfolio to the detriment of bonds and treasury securities. **Figure 8** does not show clearly how well or badly the samples portfolios did compared to the benchmark index. To figure out these aspects of the analysis, **Figure 9** delineates the annual average returns produced by the sample portfolios, the total annual return yielded by the GSE All-share Index, the 91-Day Treasury bills and the annual inflation rate.

Figure 9 shows that, on average the sample portfolios outperformed the GSE All-share Index over the period of study. This accounts for the EIL's ability to select stocks that are likely to do better than the market.

Figure 9: Average annual return of the sample portfolios versus Benchmarks and inflation

	2006	2007	2008	2009	2010
■ Average Annual Total return of the sample portfolios	21,84%	47,63%	62,57%	-29,37%	49,61%
■ Annual Total Return on GSE	4,97%	31,84%	58,06%	-46,58%	27,44%
■ 91-Day T Bill's Annual Return	10,65%	9,95%	15,50%	26,05%	15,55%
■ Annual Inflation	10,51%	12,65%	18,96%	15,94%	8,59%
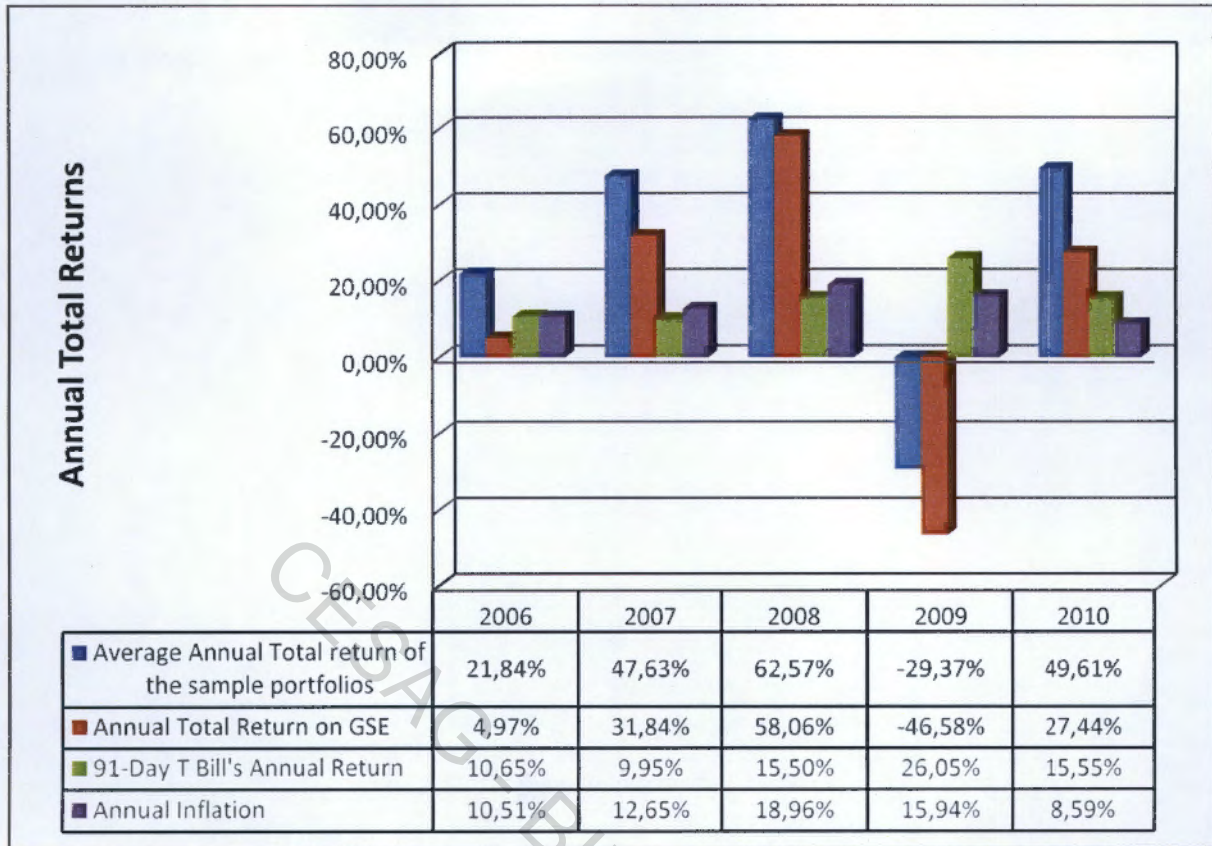
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

The allocation within the sample portfolios also explains why during the market downturn of 2009, the market fell by - 46.58% while the sample portfolios on average fell by only - 29.37%. Both the sample portfolios and the market index outperformed the 91-Day Treasury bills except in 2009 during the market downturn, where they yielded their highest return (26.05%) since their high of 29.12% yielded in 2003. In addition, Treasury bill rates went up in 2009 due to the increase in the Bank of Ghana policy rate in an effort to curtail the inflation which ultimately went down in 2010 followed by the Treasury bill rates. Indeed, in pursuance of a restrictive monetary policy which started in October 2007, the Bank of Ghana ratcheted up the monetary policy rate from 12.5% in October 2007 to 18.5% in February 2009 after 600 basis points increase which induced the reduction in inflation rate from 18.96% in 2008 to 8.59% in 2010 and obviously the observed capital market downturn of 2009 which affected EIL's client's equity portfolios consequently.

In order to better appraise the sample portfolios' value creation, **Figure 10** depicts the value attained by a Ghana Cedi EIL invested in equity on behalf of its clients from

January 2006 to December 2010, compared to a Ghana Cedi invested in the GSE All share Index and 91-Day Treasury bills and the effect of inflation over the same period. It can be read from the graphs that, EIL generated about One Ghana Cedi Fifty Pesewas (GH¢ 1.50) more than the Index and One Ghana Cedi (GH¢ 1) more than the 91-Day Treasury bills at the inception of 2011. In addition, considering the effect of inflation the sample portfolios earned on average GH¢1.23, 91-Day T bills earned Eighteen Ghana Pesewas (GHp 18) and the GSE All-share Index lost GHp 38, all in real terms. Thus the sample portfolios outperformed by far the GSE All-share Index based on absolute returns — that is regardless to the risk undertaken by EIL in managing its clients' equity portfolios.

Figure 10: The value of a Ghana cedi invested in the sample portfolios versus the benchmarks and inflation
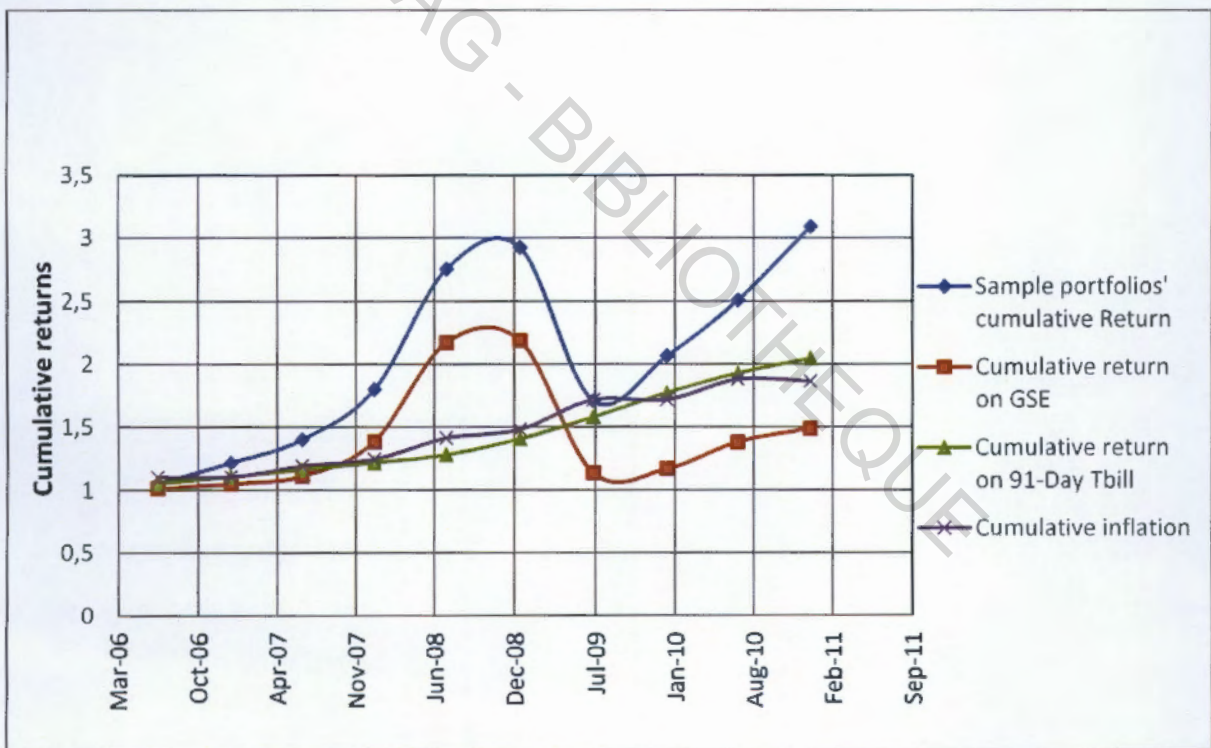
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

In order to bring out the risk-adjusted performance of the sample portfolios relative to the benchmark index (the GSE All-share Index), **Table 3** presents various risk-adjusted measurements namely the Sharp Ratio, the Treynor Ratio and Jensen's Alpha. Thus, according to **Table 3**, the sample portfolios on average have the best

risk-return trade-off (highest Sharpe's ratio and Treynor Ratio) and earned significant positive excess return relative to GSE All-Share

Table 3: Risk-adjusted performance of the sample portfolios and the GSE All-share Index (2006-2010)

Items	Average Annual return	Annual Standard Deviation	Adjusted Beta	Sharp Ratio	Treynor Ratio	Jensen's Alpha	Paired t-test p-value
Sample Portfolios	25,31%	23,91%	0,9293	0,4145	0,1067	0,1652	0,0057
GSE All Share Index	8,29%	25,91%	1,0000	-0,2745	-0,0711	0,0000	0,0057
Average Annual return of 91Day T bills = 15.40%							

Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

Index (positive Jensen's Alpha). A Paired t-test[7] performed on the sample portfolios average excess returns relative to the Index suggests that the average excess returns yielded by the sample portfolios are significantly different from zero and are brought about upon skills rather than chance (p-value of 0.0057 less than the confidence level of 0.05).

In short, the sample portfolios clearly reported better results than the benchmark index and the 91-Day Treasury bills during the same sample period for capital returns. Besides, the sample portfolios have been proven to achieve higher risk-adjusted returns.

In this chapter, we have presented EDC Investments Ltd, its main activities and investment vehicles. We have lingered on its investment management characteristics and understood their strength and weakness. We have also presented the performance of the sample portfolios under study and observed that the sample performed better than the market index over the study period. However, the sample and the market index performed badly during the downturn of 2009. In the next chapter, we shall move to the recommended portfolio management strategies by presenting constructed portfolios and their comparative performance versus the sample portfolios and some benchmarks such us the market index.

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[7] Appendix I explains in more details the Paired t-test

Chapitre 3: Optimal portfolio management for EIL

In this chapter we shall examine the principles of optimal portfolio construction (I). Then, to understand the construction of the AEP, an example of optimal portfolio is constructed using a MVO based on Microsoft Excel (II). We end the chapter by presenting the comparative performance of the AEP versus the sample portfolios and the stated benchmarks (III).

I. The recommended optimal portfolio for EIL: the AEP construction procedures

This section describes in more details the procedures actually followed in this study to:

a) construct the recommended portfolio labelled the Analytical Equity portfolio (AEP), using monetary policy stance signals. The Microsoft Excel model used to construct the AEP is presented using a basic example based on six cyclical stocks and one defensive stock. This aims to illustrate the procedures employed and to provide deeper insight into the construction of the AEP which is actually the recommended equity portfolio for EIL.

b) conduct the African international diversification analysis.

The optimal portfolio selection can be summarized into two broad stages: 1) the selection of stocks with the determination of their risk/return pattern and the correlation among them and 2) the use of these items to feed the Mean-variance optimizer and the construction of the CAL in order to arrive at the optimal portfolio.

1. The GSE's stocks' return, risk and correlation matrix

This stage can be organized into two steps:

1.1. Stock selection

Based on the strategies to be implemented, the stocks listed on the Ghana Stock Exchange on 31st December 2005 are classified as cyclical and non-cyclical (or defensive) stocks. The principle of the strategies is to invest in cyclical stock when the

Bank of Ghana enters expansive policies and to invest in defensive stocks or 91-Day Treasury bills when the Bank of Ghana follows restrictive policies. Referring to **Table1**, it follows that the bank of Ghana was going through an expansive monetary policy on 1st January 2006. Therefore the stocks of the **Panel A** of **Appendix II** are candidate for portfolio allocation on 1st January 2006, the starting date of the strategy implementation. The AEP is thus constructed on that day using the candidates on **Panel A** of **Appendix II** and a model built in Microsoft Excel. Here, we select six stocks of **Panel A** and one stock of **Panel B** to construct an optimal portfolio as an example of the AEP construction procedures.

1.2. The input list: the selected stocks' risk, return and correlation matrix

After the stocks are selected, the average returns and standard deviations of returns are calculated using monthly historical data from January 2000 to December 2005. The formulas used are those presented in the Methodology. Then the correlations among them are also determined using the following function: correlation.coefficient ( ).The results are presented in **Table 4**.

Table 4: Standard deviation, average return and correlation matrix

	A	B	C	D	E	F	G	H
1		Standard Deviation	Average Return					
2	FML	36,44	61,26					
3	GCB	43,27	44,29					
4	GGBL	42,85	42,53					
5	HFC	39,23	42,11					
6	SSB	48,10	24,30					
7	UNIL	28,38	43,07					
8	TOTAL	17,00	17,68					
9								
10	Correlation Matrix							
11		FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
12	FML	1	0,16	0,23	0,21	0,20	0,09	0,16
13	GCB	0,16	1	0,13	0,34	0,33	0,10	0,30
14	GGBL	0,23	0,13	1	0,46	0,32	0,26	0,17
15	HFC	0,21	0,34	0,46	1	0,27	0,29	0,28
16	SSB	0,20	0,33	0,32	0,27	1	0,41	0,17
17	UNIL	0,09	0,10	0,26	0,29	0,41	1	0,18
18	TOTAL	0,16	0,30	0,17	0,28	0,17	0,18	1

Source: The Ghana Stock Exchange

The co-variances of the stocks are derived from the following formula:

$$Cov(r_i, r_j) = \rho_{ij}\sigma_i\sigma_j$$

Where ρ_{ij} is the correlation coefficient between stock i and j, σ_i standard deviation of stock i and σ_j standard deviation of stock j. **Table 5** presents the implementation of this formula in computing of the co-variances of the seven selected stocks and the ensuing results.

Table 5: Co-variance matrix

	A	B	C	D	E	F	G	H
20	Covariance Matrix							
21		FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
22	FML	=B12*B2*B2	=C12*B3*B2	=D12*B4*B2	=E12*B5*B2	=F12*B6*B2	=G12*B7*B2	=H12*B8*B2
23	GCB	=B13*B2*B3	=C13*B3*B3	=D13*B4*B3	=E13*B5*B3	=F13*B6*B3	=G13*B7*B3	=H13*B8*B3
24	GGBL	=B14*B2*B4	=C14*B3*B4	=D14*B4*B4	=E14*B5*B4	=F14*B6*B4	=G14*B7*B4	=H14*B8*B4
25	HFC	=B15*B2*B5	=C15*B3*B5	=D15*B4*B5	=E15*B5*B5	=F15*B6*B5	=G15*B7*B5	=H15*B8*B5
26	SSB	=B16*B2*B6	=C16*B3*B6	=D16*B4*B6	=E16*B5*B6	=F16*B6*B6	=G16*B7*B6	=H16*B8*B6
27	UNIL	=B17*B2*B7	=C17*B3*B7	=D17*B4*B7	=E17*B5*B7	=F17*B6*B7	=G17*B7*B7	=H17*B8*B7
28	TOTAL	=B18*B2*B8	=C18*B3*B8	=D18*B4*B8	=E18*B5*B8	=F18*B6*B8	=G18*B7*B8	=H18*B8*B8

	A	B	C	D	E	F	G	H
20	Covariance Matrix							
21		FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
22	FML	1327,664	245,543	360,688	295,094	354,469	92,513	96,547
23	GCB	245,543	1871,895	242,379	579,411	696,897	123,770	222,856
24	GGBL	360,688	242,379	1835,918	772,954	666,374	316,393	125,036
25	HFC	295,094	579,411	772,954	1539,166	506,529	327,005	189,127
26	SSB	354,469	696,897	666,374	506,529	2313,318	556,101	141,769
27	UNIL	92,513	123,770	316,393	327,005	556,101	805,330	145,210
28	TOTAL	96,547	222,856	125,036	189,127	141,769	86,999	289,072

Source: The Ghana Stock Exchange

Now that we have determined the input lists which are the stocks' risk and return and their co-variance matrix, we shall look at how to use them to feed the optimizer and derive the optimal portfolio.

2. The MVO and CAL of the GSE's selected stocks

This stage can be organized into two steps:

2.1. Determination of portfolio variance and mean return

In order to arrive at an optimal portfolio, the portfolio variance and mean return are calculated. Here, the formula used to compute the portfolio variance is:

$$\sigma_P^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)$$

Or

$$\sigma_P^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \rho_{ij} \sigma_i \sigma_j$$

These calculations are presented in **Table 6**, where each cell contains the product of the weights of two stocks and their covariance. Note that when $i=j$, the correlation coefficient equals one (1) and the product of σ_i into σ_j gives the variance of stock i . Thus when standing on the diagonal of the co-variance matrix (**Table 5**), the formula gives the sum of the variance of individual stocks. **Table 6** also presents the calculations' results. The sum of all those products results in the portfolio variance which is given in cell B41.

The portfolio mean which is the weighted average return of the seven stocks is given in cell B43. The formula used in this case is:

$$r_P = \sum_{i=1}^{n} w_i r_i$$

Note that the actual value of the portfolio variance in cell B41 and the portfolio mean in cell B43 are obtained by setting equal weights for all stocks and in this case each stock's weight would be 1/ 7= 0.143.

Table 6: Portfolio variance and mean return formula matrix

30	Efficient Frontier Construction Matrix							
31	Portfolio	FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
32	weights	=A33	=A34	=A35	=A36	=A37	=A38	=A39
33	0,143	=A33*B32*B22	=A33*C32*C22	=A33*D32*D22	=A33*E32*E22	=A33*F32*F22	=A33*G32*G22	=A33*H32*H22
34	0,143	=A34*B32*B23	=A34*C32*C23	=A34*D32*D23	=A34*E32*E23	=A34*F32*F23	=A34*G32*G23	=A34*H32*H23
35	0,143	=A35*B32*B24	=A35*C32*C24	=A35*D32*D24	=A35*E32*E24	=A35*F32*F24	=A35*G32*G24	=A35*H32*H24
36	0,143	=A36*B32*B25	=A36*C32*C25	=A36*D32*D25	=A36*E32*E25	=A36*F32*F25	=A36*G32*G25	=A36*H32*H25
37	0,143	=A37*B32*B26	=A37*C32*C26	=A37*D32*D26	=A37*E32*E26	=A37*F32*F26	=A37*G32*G26	=A37*H32*H26
38	0,143	=A38*B32*B27	=A38*C32*C27	=A38*D32*D27	=A38*E32*E27	=A38*F32*F27	=A38*G32*G27	=A38*H32*H27
39	0,143	=A39*B32*B28	=A39*C32*C28	=A39*D32*D28	=A39*E32*E28	=A39*F32*F28	=A39*G32*G28	=A39*H32*H28
40	1	=SOMME(B33:B39)	=SOMME(C33:C39)	=SOMME(D33:D39)	=SOMME(E33:E39)	=SOMME(F33:F39)	=SOMME(G33:G39)	=SOMME(H33:H39)
41	Porfolio Var	=SOMME(B40:H40)						
42	Portfolio SD	=RACINE(B41)						
43	Portfolio mean	=SOMMEPROD(A33:A39;C2:C8)						

30	Efficient Frontier Construction Matrix							
31	Portfolio	FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
32	weights	0,143	0,143	0,143	0,143	0,143	0,143	0,143
33	0,143	27,095	5,011	7,361	6,022	7,234	1,888	1,970
34	0,143	5,011	38,202	4,947	11,825	14,222	2,526	4,548
35	0,143	7,361	4,947	37,468	15,775	13,599	6,457	2,552
36	0,143	6,022	11,825	15,775	31,412	10,337	6,674	3,860
37	0,143	7,234	14,222	13,599	10,337	47,211	11,349	2,893
38	0,143	1,888	2,526	6,457	6,674	11,349	16,435	2,963
39	0,143	1,970	4,548	2,552	3,860	2,893	1,775	5,899
40	1	56,582	81,281	88,158	85,904	106,846	47,104	24,686
41	Porfolio Var	490,561						
42	Portfolio SD	22,149						
43	Portfolio mean	39,321						

Source: The Ghana Stock Exchange

After having determined the portfolio's mean return and variance using equal weights or the seven stocks, in the next step we shall implement the MVO to derive the optimal weights using the Excel solver. The CAL is then constructed to identify the optimal portfolio.

2.2. The MVO and the CAL

Our objective is to determine the optimal weights of each stock to invest in. Therefore the Excel Solver is used to compute the optimal weights for a given value of the portfolio mean return (portfolio expected return). The objective is to arrive at optimal weights which minimize the portfolio variance for the stated expected return. In the Solver we set the objective function to minimize the variance of the portfolio (B41). Then the input range of the variables that need to be calculated is set. In our case, we want to calculate the optimal portfolio weights which minimize the portfolio variance. Thus, the cells that we need the Solver to calculate are A33-A39. Finally, the

necessary constraints should be entered. Those are that the sum of the weights should equal to 1, and each stock's weight should be zero or positive since short sales are not allowed on the Ghana Stock Exchange. Another constraint is to limit the portfolio exposure to each stock at 10%, 20% etc. However, the actual analysis does not use such constraint. To sum up the constraints used are as follow:

$$\sum_{i=1}^{n} w_i = 1$$

$$0 \le w_i$$

The final constraint that has to be set is that the portfolio mean return (B43) equals a target mean return. The entire efficient frontier is generated by computing several couples of portfolio variance and portfolio mean return. This is done by changing the target mean return, usually setting it to values around the mean return attained by the equally weighted portfolio. Every time that a different mean return value is set, the Solver recalculates the weights and the portfolio variance. When enough risk-return points have been generated, the efficient frontier can be built. However, the optimal portfolio remains to be determined. This is obtained by calculating the Reward-to-variability ratio, according to the formula mentioned before. Using the 91-Day T bill rate as of end of December 2005 (11.40%) the Sharp Ratios are computed for each couple of portfolio variance (Standard Deviation) and portfolio mean return as depicted in **Table 7**. The optimal portfolio is the one for which the Sharp ratio is maximized.

Table 7: Efficient frontier and sharp ratio

62	Sharp Ratio			
63	Risk-free rate in % (91-Day Tbill rate as at 31/12/2005)=			11,4
64	Portfolio Mean Return (%)	Standard Deviation (%)	Sharp Ratio	Sharp Ratio (computation)
65	46	20,011	1,729	=(A65-D63)/B65
66	47	20,468	1,739	=(A66-D63)/B66
67	48	20,939	1,748	=(A67-D63)/B67
68	49	21,422	1,755	=(A68-D63)/B68
69	49,5	21,668	1,758	=(A69-D63)/B69
70	50	21,916	1,761	=(A70-D63)/B70
71	50,5	22,175	1,763	=(A71-D63)/B71
72	51	22,474	1,762	=(A72-D63)/B72
73	51,5	22,818	1,757	=(A73-D63)/B73
74	52	23,205	1,751	=(A74-D63)/B74
75	53	24,101	1,726	=(A75-D63)/B75
76	54	25,158	1,693	=(A76-D63)/B76
77	Highest Sharp Ratio		1,763	=MAX(D65:D76)

Source: The Ghana Stock Exchange, the Bank of Ghana

The graph of the points represented by the couple (Standard deviation and portfolio mean return) in **Table 7**, gives the Efficient Frontier depicted in **Figure 11** in Standard deviation and Mean return plane. The highest Sharp ratio gives the slop of the steepest Capital Allocation Line (CAL) which point of tangency with the efficient frontier gives the optimal portfolio.

Figure 11: Efficient frontier of seven stocks of the GSE as of 31/12/2005
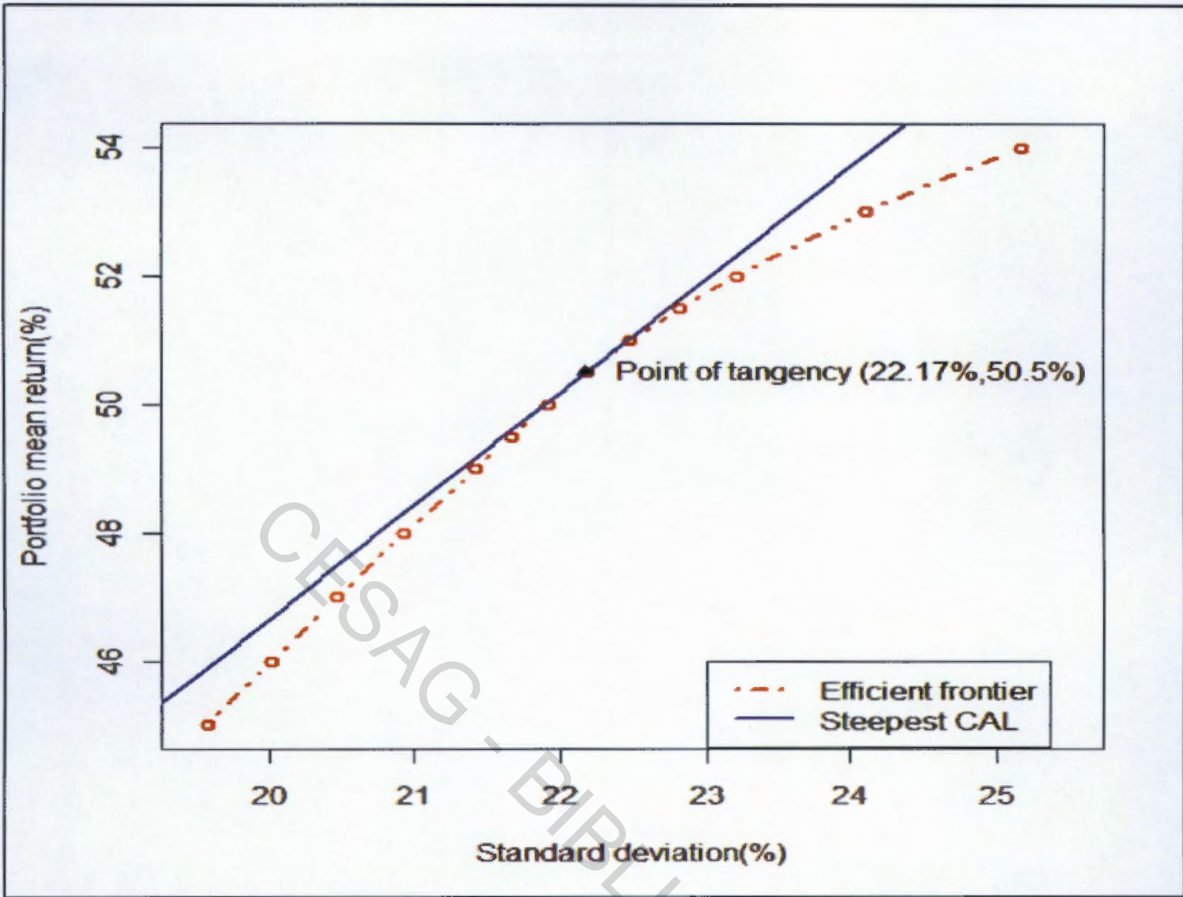
Source: The Ghana Stock Exchange

The optimal weights are shown is **Table 8**. These weights lie on the highlighted row together with the standard deviation and average return of the optimal portfolio[8]. This portfolio which is composed of Fan Milk Ltd, Ghana Commercial Bank Ltd, Guinness Ghana Breweries Ltd, Home Finance Company Ltd and Unilever Ghana Ltd outperformed on a risk-adjusted basis, its component stocks, the GSE All-Share Index and the benchmark 91-Day Treasury Bill over the study period from January 2006 to December 2010 (See **Figure 12**). However the performance of this portfolio could have been improved if the weights have been re-estimated once or twice over the sample period to capture the trends in the component stocks' changes in profitability. Note that, here, the stocks in the portfolio are selected for their cyclical

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[8] Appendix III details the risk and return of the optimal portfolio given as an example and its component stocks

nature since the Bank of Ghana was following an expansive monetary policy when the portfolio was constructed and the weights were kept unchanged.

Table 8: Optimal weights

45	Restricted efficient frontier								
46	Portfolio	Standard	Optimal weights in efficient portfolios						
47	Mean Return(%)	Deviation(%)	FML	GCB	GGBL	HFC	SSB	UNIL	TOTAL
48	46	20,011	0,335	0,112	0,042	0,017	0	0,367	0,128
49	47	20,468	0,347	0,117	0,042	0,018	0	0,378	0,098
50	48	20,939	0,360	0,122	0,042	0,020	0	0,389	0,068
51	49	21,422	0,372	0,127	0,043	0,021	0	0,400	0,037
52	49,5	21,668	0,378	0,130	0,043	0,022	0	0,405	0,022
53	50	21,917	0,385	0,132	0,043	0,023	0	0,410	0,007
54	50,5	22,175	0,402	0,131	0,040	0,020	0	0,408	0
55	51	22,474	0,429	0,127	0,033	0,013	0	0,397	0
56	51,5	22,818	0,456	0,123	0,026	0,0		0,387	0
57	52	23,205	0,484	0,118	0,020	0,0		0,377	0
58	53	24,101	0,539	0,107	0,002			0,353	0
59	54	25,158	0,595	0,091	0	0	0	0,315	0

Emmanuel: Optimal weights, SD and Mean return of the optimal portfolio

Source: The Ghana Stock Exchange

Figure 12: The performance of the optimal portfolio
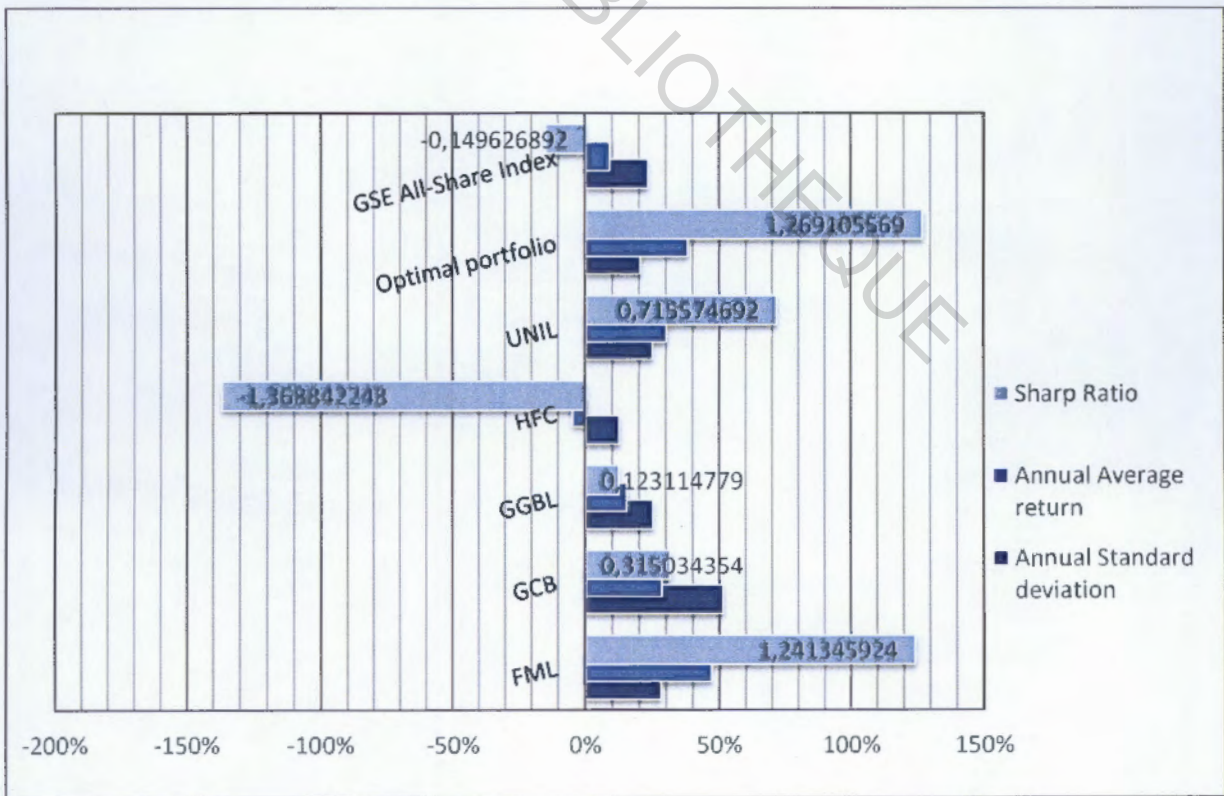
Source: The Ghana Stock Exchange

This results account for the merit of market timing and portfolio selection over strategic asset allocation where optimal weights determined at the start of the investment program are kept unchanged. However, if an investor invested in this portfolio on 1st January 2006, he would have significantly outperformed the GSE All-share Index by end December 2010.

The African international diversification analysis uses similar procedures as described above, in terms of the optimization method. Expected returns, standard deviations and co-variances of seven equity markets are computed to feed the optimizer. Efficient combinations of these indices are then derived and analyzed in order to bring evidence of the merit of investing across Africa.

At this stage, we have discussed an example of how the AEP is actually formed. The AEP which performance is compared to the sample portfolios under study is actually constructed with more stocks as shown in **Appendix V**. The **Appendix V** also presents the implementation of the two strategies described in the methodology, the monthly value of the AEP and the semi-annual returns over the study period. Actually, to allocate the AEP on 1st January 2006 stocks are selected among cyclical stock as the BoG was going through an expansive policy (refer to **Table 1**). The shift of the portfolio allocation to either non-cyclical stocks or 91-Day T bills occurs after 250 to 350 basis points changes in the Bank of Ghana policy rate at the start of an inverse monetary policy stance. Thus the two strategies are implemented separately. When the portfolio allocation is shifted towards non-cyclical stocks, the same procedures of optimization are used to reallocate the portfolio. Obviously the optimizer is not requested in the case where the portfolio is shifted to 91-Day T bills. However, when the portfolio is shifted back toward cyclical stocks (as a respond to the start of expansive policy stance) the reallocation appeals to the optimizer. The next section presents the performance of the AEP thus formed versus the benchmarks and the portfolios under study.

II. The recommended portfolio for EIL: the performance of the AEP versus the benchmarks and the sample portfolios

The study attempts to implement the use of the Bank of Ghana's monetary policy stance to time the economic trend in portfolio management. The economic outlook serves as a guide as to how to allocate equity portfolios in an effort to take advantage of the expected trend. Thus based on Markowitz portfolio optimization framework, an equity portfolio (AEP)[9] is constructed. This portfolio is managed throughout the sample period according to two strategies: 1) the portfolio is basically invested in cyclical stocks during Bank of Ghana expansive policies and is shifted to non-cyclical stocks when the Bank of Ghana enters restrictive monetary policies (Strategy A), or 2) the portfolio is basically invested in cyclical stocks during Bank of Ghana expansive policies and is shifted to 91-Day Treasury bills when the Bank of Ghana enters restrictive monetary policies (Strategy B).

Here, we present the results of the strategies implemented by analysing the comparative performance of the AEP versus the stated benchmarks and the portfolios under study.

1. The AEP versus the stated benchmarks

In order to evaluate the performance of the constructed portfolios over the sample period according to the chosen benchmarks, descriptive statistics are presented for all 60 monthly returns for the portfolios and the benchmarks. Three passive benchmarks are used to appraise the constructed portfolios performance: 1) The GSE All-share Index which is the market Index, 2) An Equally-weighted portfolio invested across 21 cyclical and defensive stocks listed on the GSE and is labeled Benchmark A and 3) A Portfolio half invested in the Benchmark A and half invested in 91-Day T Bills — that is 50%*Benchmark A + 50% *91-Day T bills and labelled Benchmark B. The market index and the Benchmark A are used for the portfolio managed under strategy A and the market index and the Benchmark B are used for the portfolio managed under

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[9] Appendix V gives more details on the AEPs

strategy B. **Figure 13 and Figure 14** depict the constructed portfolios' return fluctuations compared with their benchmarks[10].

Figure 13: The Analytical Equity Portfolio managed under strategy A and selected benchmarks
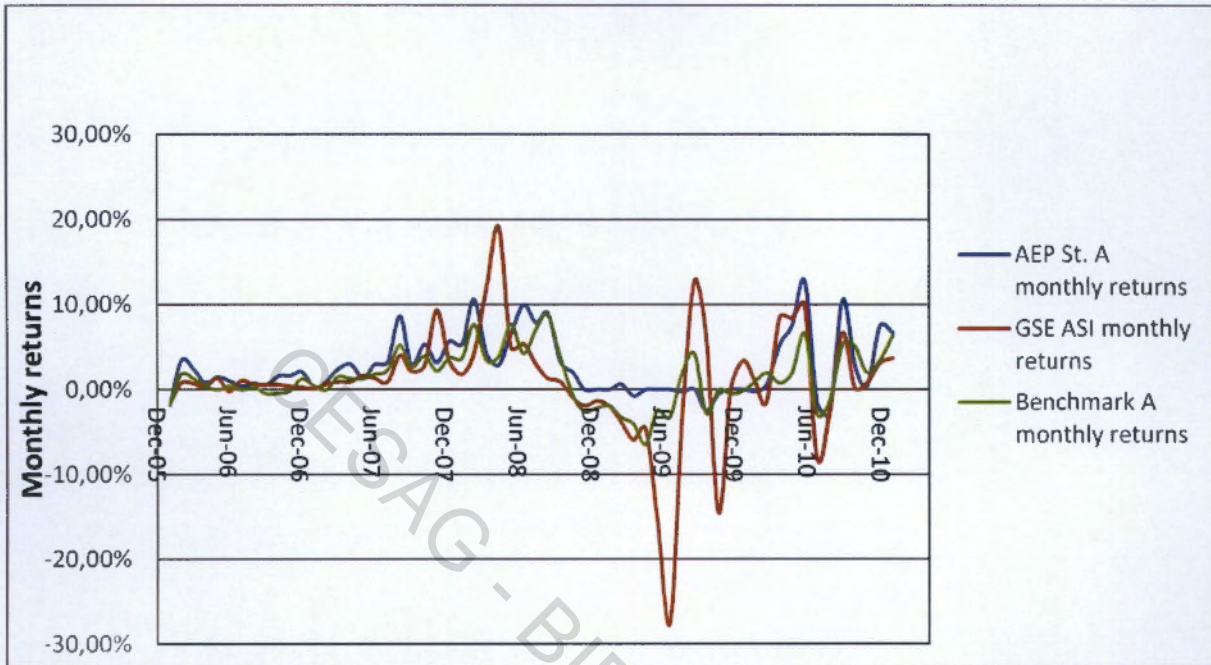
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

Figure 14: The Analytical Equity Portfolio managed under strategy B and selected benchmarks
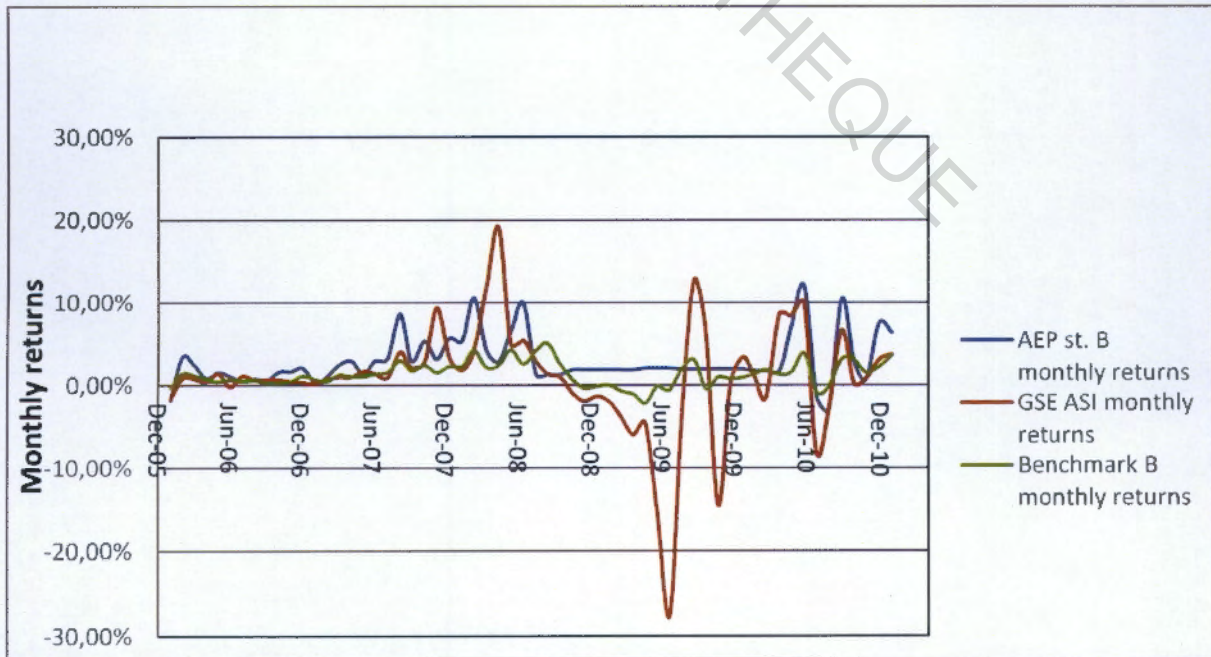
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

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[10] Appendix IX provides further details on the constructed portfolios and their benchmarks

It can be derived from the graphs that, the return on the market index is more volatile than the constructed portfolios and that the portfolio managed under strategy A is more volatile than the benchmark A while the portfolio managed under strategy B is likewise more volatile than benchmark B. In addition the graphs show the striking performance of the constructed portfolios relative to the market index during 2009. Thus while the market index went down by about 27% in Jun 2009 and by 14% in December 2009 the portfolio managed under strategy A's monthly return remained relatively close to 0%. On the other hand, the portfolio managed under strategy B maintained on average a monthly return of 2% over 2009.

The striking performance showed by the constructed portfolios during the 2009 downturn was the result of the "Shield" formed by moving the portfolios allocation into defensive posture.

To confirm the movements of the portfolios returns obtained from **Figure 13 and Figure 14**, descriptive statistics and Sharp Ratios are calculated and presented in **Table 9** for the various variables. The Shapiro-Wilk normality tests[11] are performed to find out whether the returns come from normal distribution or not. This would suggest the appropriate hypothesis test to use in order to find out whether the observed excess returns are significantly different from zero. Thus if the distribution comes from normal distribution, the Student's t-test is used. However, if the data is not believed to be taken from normally distribution population, then the Paired t-test and the Wilcoxon signed rank test are more suitable.

Table 9: Descriptive statistics of the constructed portfolios and their benchmarks

	n	Shapiro-Wilk normality test p-value	Mean	SD	Minimun	Maximum	Sharp Ratio
AEP St. A	60	2,69E-04	2,70%	3,56%	-2,95%	12,76%	1,81
AEP st. B	60	2,11E-06	2,91%	2,98%	-2,99%	12,16%	2,49
GSE ASI	60	3,68E-06	0,96%	6,63%	-27,64%	19,13%	-0,14
Benchmark A	60	8,23E-01	1,42%	3,19%	-6,51%	8,77%	0,27
Benchmark B	60	5,55E-01	1,31%	1,50%	-2,22%	5,02%	0,29

Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

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[11] Appendix I provides insight into the Shapiro-Wilk normality test

The results in **Table 9** show that only Benchmark A and Benchmark B's returns come from normal distribution (p-value greater than the significance threshold of 5%). Therefore, to assess whether the observed excess returns are statistically significant, we shall ran later on the Paired t-test and the Wilcoxon signed rank test instead of the Student's t-test. **Table 9** also clearly shows that the market index was the most volatile (highest standard deviation) and the worst performer (lowest Sharp ratio and average monthly return) over the sample period. Besides, the constructed portfolios were the best performers headed by the portfolio managed under strategy B (highest Sharp Ratio and average monthly return).

Figure 15 and Figure 16 show the value gained by a Ghana Cedis invested in the constructed portfolios and relative to their benchmarks. Clearly, the "Shield" underpinned the constructed portfolios' value which either remained stable (Strategy A) or increased (Strategy B) where the market portfolio was losing value.

Figure 15: The value of a Ghana cedi invested in the AEP of strategy A and selected benchmarks
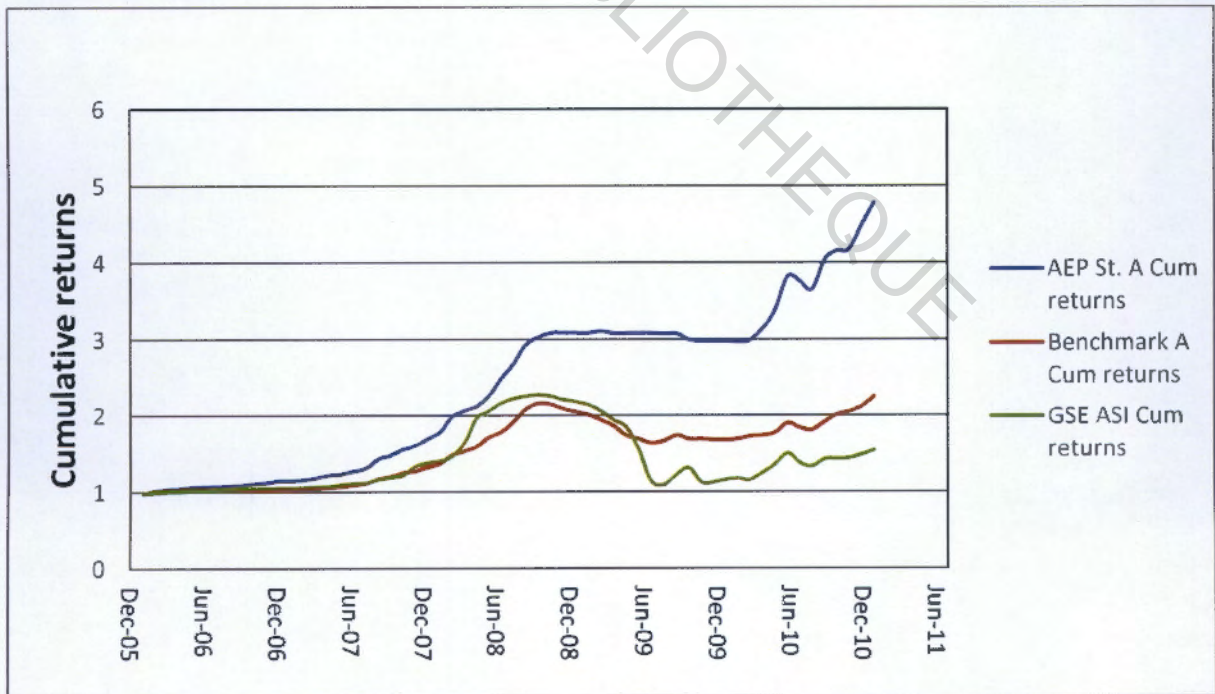
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

Figure 16: The value of a Ghana cedi invested in the AEP of strategy B and selected benchmarks
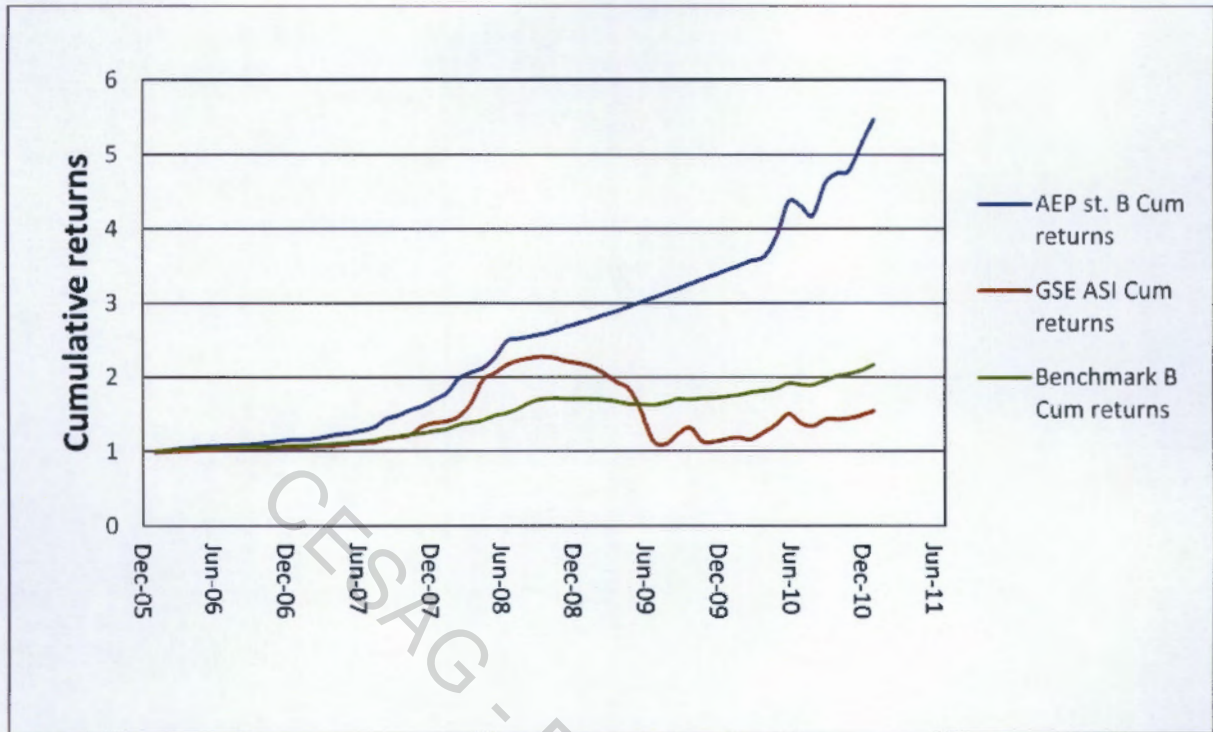
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

Consequently, at the inception of 2011 the portfolio of Strategy A produced a cumulative return of 378% and the portfolio of strategy B produced 447% while the market portfolio generated only 54%. Note also that an investor who invested in the passive Benchmark A and Benchmark B would have outperformed better than the GSE All Share Index by yielding at least 100% over the sample period.

In order to ascertain that the above interpretations of the results are unbiased and accurate we performed statistical tests (**Table 10**) such as Paired t-test and Wilcoxon Signed rank test[12] as announced earlier. In fact, the statistical tests are performed on monthly excess returns which are the paired differences of the constructed portfolios and their relative benchmarks. Both the Paired t-test and the Wilcoxon Signed rank test clearly show that the excess returns are statistically significant and economically meaningful (p-values lower than the confidence level of 0.05 or 5%). In other words, the observed excess returns are significantly different from zero and are achieved upon skill instead of chance.

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[12] Appendix III explains in more details the Wilcoxon Signed Rank test

Table 10: Paired sample statistical tests

| | | Paired defferences | | | Paired t-test | | Wilcoxon Signed rank test |
	Excess returns formulas	Excess returns' mean	Standard Deviation	t	p-value	(p-value)
Pair 1	AEP st.A — GSE ASI	1,74%	6,61%	2,28	2,63E-02	3,23E-04
Pair 2	AEP st.A — Benchmark A	1,28%	2,16%	4,63	2,07E-05	3,46E-05
Pair 3	AEP st.B — GSE ASI	1,96%	6,82%	2,46	1,69E-02	2,72E-04
Pair 4	AEP st.B — Benchmark B	1,60%	2,48%	5,19	2,76E-06	2,17E-06

Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

Thus, it appears that moving the portfolio's allocation into defensive posture protects against the poor performance experienced by cyclical stocks during economic downswings and spur returns by the end of investment programs.

2. The AEP's performance versus the portfolios under study

Figure 17 presents the annual returns of the constructed portfolios and the sample portfolios as well as the level of the monetary policy rate.

Figure 17: The annual total return of the constructed portfolios versus the sample portfolios and the monetary policy rate
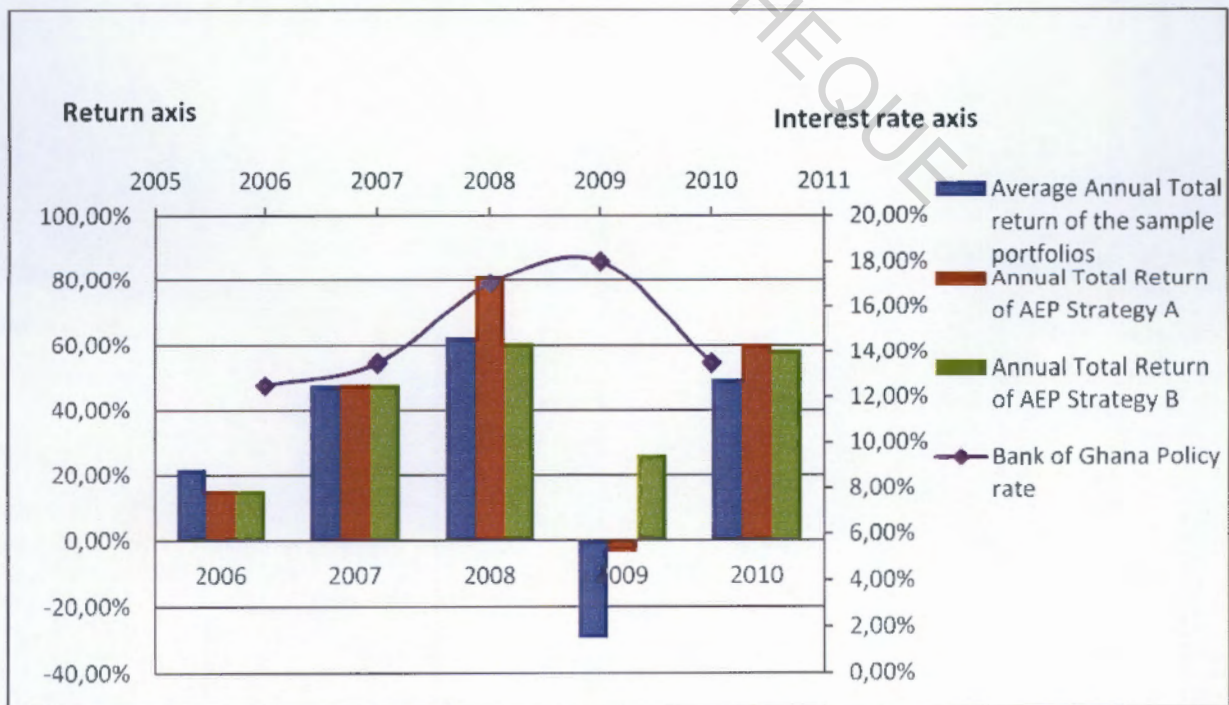
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

The graph clearly shows that, the sample portfolios and the constructed portfolios yielded comparable returns from 2006 to end of 2008 and in 2010 while in 2009 the primacy of the constructed portfolios' return is neat. This implies that, the various portfolios' equity allocations are basically identical during the years where their performances are comparable. As discussed earlier when analyzing the performance of the sample portfolios, EIL constructs its client's portfolios through stock selection and favours equities, it believes (through valuations) are strategically positioned for long-term growth and value. Likewise, it was observed that in general the sample portfolios performed well when the market was doing well and badly in 2009 when the market suffered from a dramatic downturn. This implies that, the sample portfolios' allocation was basically composed of cyclical stocks which followed the market trend and drove the portfolios' value. It can also be read from the graph that, in 2009 where the sample portfolios lost 29.37% on average, the AEP managed under strategy A only lost 3.47% and the AEP managed under strategy B gained 26.05%. We saw that, the Bank of Ghana monitors the Ghanaian economy in an effort to maintain the inflation rate close to its target and to assure price stability and strong economic growth. Thus in 2009 the policy rate reached 18% from 12.5% in August 2007 and investors changed their anticipation toward companies' future earnings and dropped out from the stock market which went down by 46.58%. However, the AEPs performance did not follow the market trend as the portfolios allocation was shifted at end of Jun 2008 from cyclical stocks to defensive stocks under strategy A and to 91-Day treasury bills under strategy B after 350 basis points increase in the policy rate. In November 2009, as the inflationary outlook for 2010 was good and to allow economic recovery, the Bank of Ghana began an easy policy by reducing its policy rate. The rate quickly went down from 18.50% in September 2009 to 13.50% in December 2010. Investors again modified their anticipations concerning companies future earning and the stock market enjoyed an upturn by the end of 2010. Therefore, following our two strategies, the AEP was shifted back from defensive stocks to cyclical stocks under strategy A (at the end of February 2010 after 250 basis points decrease in the policy rate) and from 91-Day treasury bills to cyclical stocks under strategy B (at the end of March 2010 after 250 basis points decrease in the policy rate)

in order to allow the portfolio to take advantage of the listed company's future earnings prospects. The results are visible on **Figure 17** as the AEPs yielded 60% on average by the end of 2010. **Figure 18** clearly depicts how the constructed portfolios performed during the downturn and how their cumulative value by the end of 2010 was spurred compared to the sample portfolios.

Figure 18: The value of a Ghana cedi invested in the constructed portfolios versus the sample portfolios and inflation
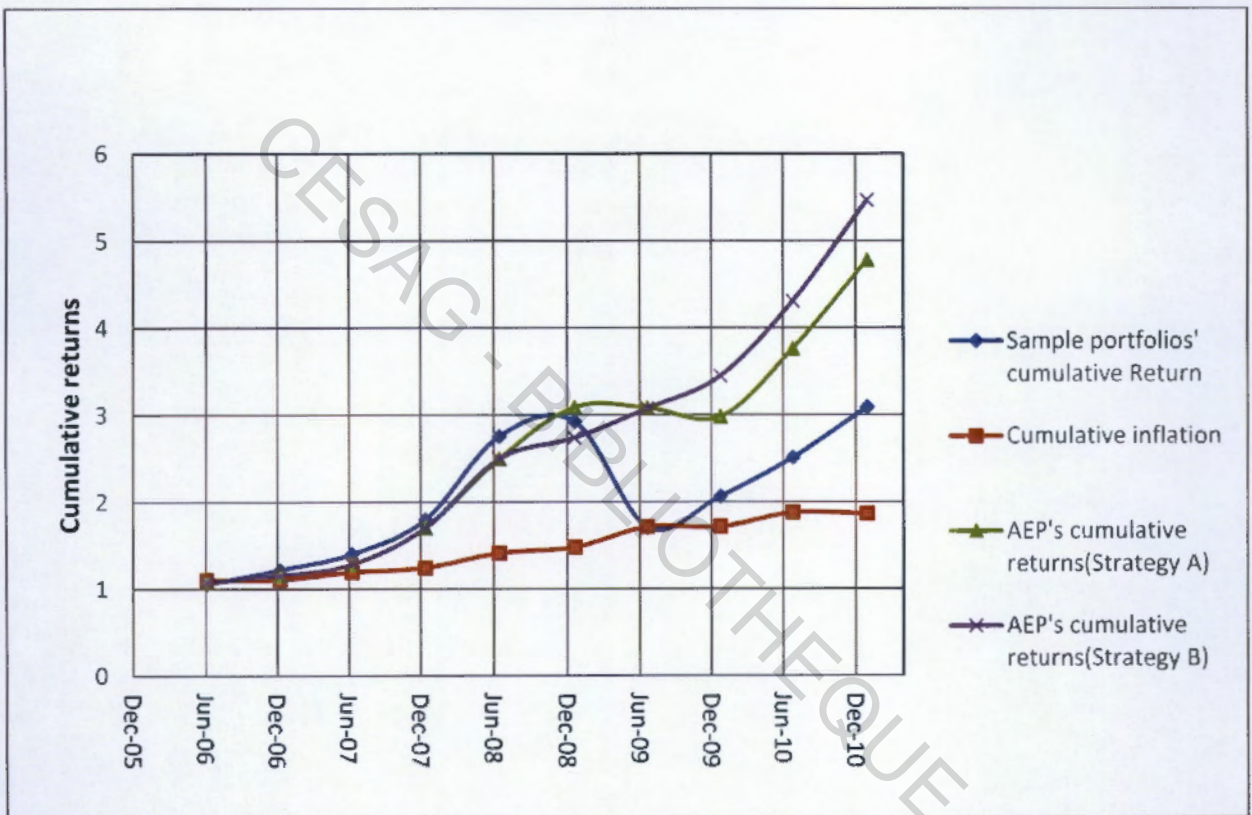
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

It also shows how the downturn hurt the sample portfolios relative to the constructed portfolios. Thus a Ghana Cedi invested in the constructed portfolios in January 2006 reached GH¢ 4.78 under strategy A, GH¢ 5.47 under strategy B while the sample portfolios only attained GH¢ 3.09 by the end of 2010. In other words, the constructed portfolios generated total returns of 378% under strategy A, 447% under strategy B and the sample portfolios generated on average 209% by the end of 2010. In addition, considering the effect of inflation, the constructed portfolios gained a

real value of GH¢ 2.92 under strategy A, GH¢ 3.61 under strategy B and the sample portfolios yielded on average a real value of GH¢ 1.23 over the sample period.

Visibly, shifting the constructed portfolios allocation from cyclical posture to defensive posture (strategy A) and to riskless assets (strategy B) protected them from the 2009 downturn's harm relative to the sample portfolios. Therefore, the strategies implemented in managing the constructed portfolios account for the supremacy of their total returns over those produced by the sample portfolios.

3. The comparative performance of the AEPs, the sample portfolios and the benchmarks

Here, **Figure 19** is presented to give a better view of the wealth created by the various strategies and the sample portfolios relative to the stated benchmarks. Casting one's eyes on the graph, it can be observed that the constructed portfolios outperformed the benchmarks and the sample portfolios.

Figure 19 : Cumulative returns of the constructed portfolios versus the benchmarks and the sample portfolios
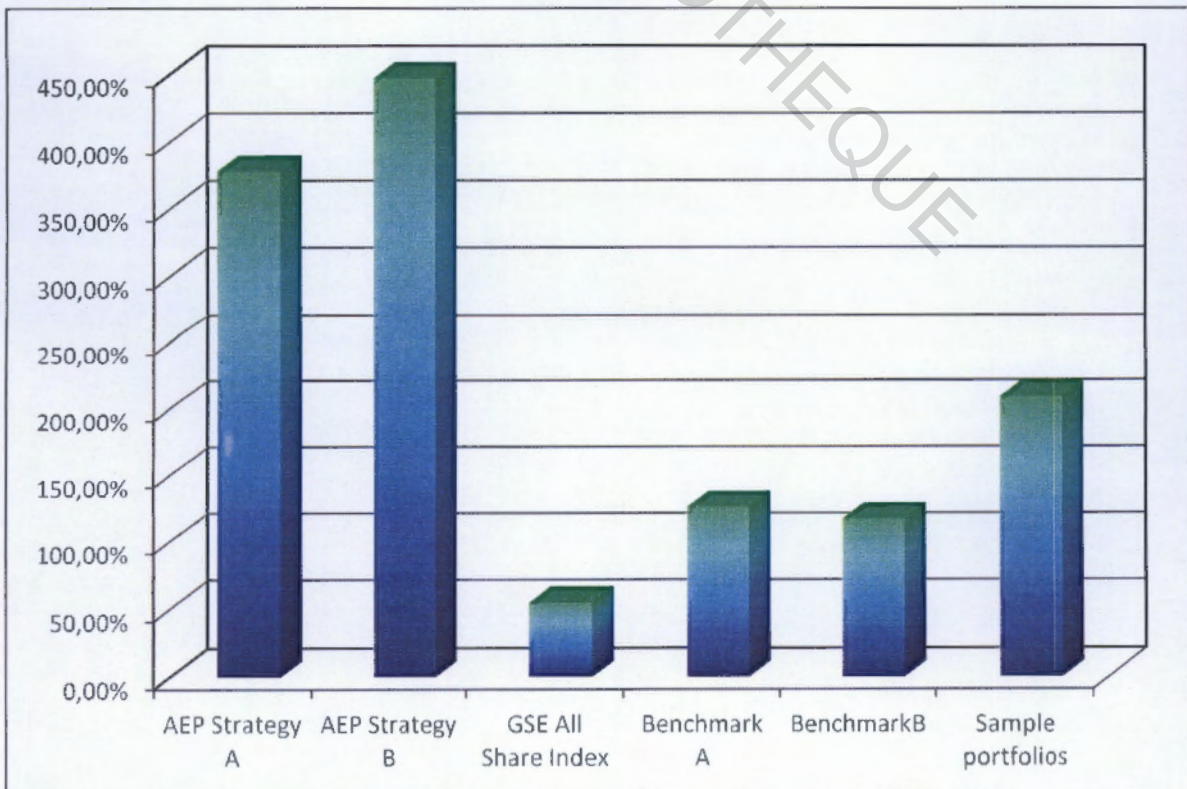
Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

This observation can be confirmed based on portfolio performance indicators earlier mentioned. These indicators are presented in **Table 11** which shows that, the constructed portfolios produced the best risk-adjusted returns, headed by the portfolio of strategy B (highest Sharp ratio). The Treynor Ratio which accounts for the portfolios' returns relative to their market risks (Betas) also suggests that the constructed portfolios outperformed the sample portfolios. All the portfolios performed well relative to the market index (positive Jensen's Alpha). However, the constructed portfolios did better in outperforming the market index (highest Jensen's Alpha).

Table 11: Performance measures

	Sharp ratio	Treynor ratio	Jensen's Alpha
Analytical Equity Portfolio Strategy A	1,81	0,45	0,24
Analytical Equity Portfolio Strategy B	2,49	0,58	0,27
Sample Portfolios	0,41	0,11	0,17

Source: EDC Investments Ltd, The Ghana Stock Exchange, The Bank of Ghana

In summary, the results show that using the Bank of Ghana's monetary policy stance as indicator of when to shift an equity portfolio to a more aggressive or defensive posture over the sample period, would have spurred portfolio performance significantly. The strategy does not require frequent portfolio rebalancing. Over the five-year period, the Bank of Ghana undertook only two changes in the monetary policy stance and the constructed portfolios were rebalanced twice following these changes. Therefore the strategy is cost effective.

In the next section, we shall consider the African diversification analysis. This will allow us to draw conclusion on the benefit of such a strategy.

III. Gain from African diversification

The analysis attempts to appraise the benefit of equity portfolio international diversification across major African stock markets mainly, from the standpoint of a Ghanaian investor. Seven (7) major stock market indices[13] published by the African

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[13] The monthly returns of the country indices are provided in Appendix X

Business Research institute of the African Business Research are used for the analysis. **Table 12** presents the descriptive statistics of the 131 monthly returns of the seven markets over 2000 to 2010.

Table 12: Descriptive statistics of seven stock indices across Africa

	n	mean	SD	Minimum	Maximum	Shapiro-Wilk normality test p-value
Botswana	131	1,26%	4,11%	-10,15%	14,43%	1,43E-02
Egypt	131	1,81%	9,84%	-33,19%	36,60%	4,38E-02
Ghana	131	1,86%	6,60%	-27,64%	31,35%	3,90E-08
Mauritus	131	1,28%	5,00%	-18,59%	16,63%	2,29E-05
Morocco	131	0,86%	5,09%	-15,61%	20,13%	3,15E-02
Nigeria	131	1,40%	7,44%	-30,64%	38,20%	5,19E-07
South.Africa	131	1,19%	5,43%	-20,56%	14,03%	1,20E-02

Source: African Business Research institute

The returns and standard deviations were used to generate the efficient frontier of portfolios invested in the various indices. **Figure 19** shows the ensuing efficient frontier and relative to the indices' risk/reward pattern in the sample period.

Figure 20: Efficient frontier for diversification across Africa equity markets
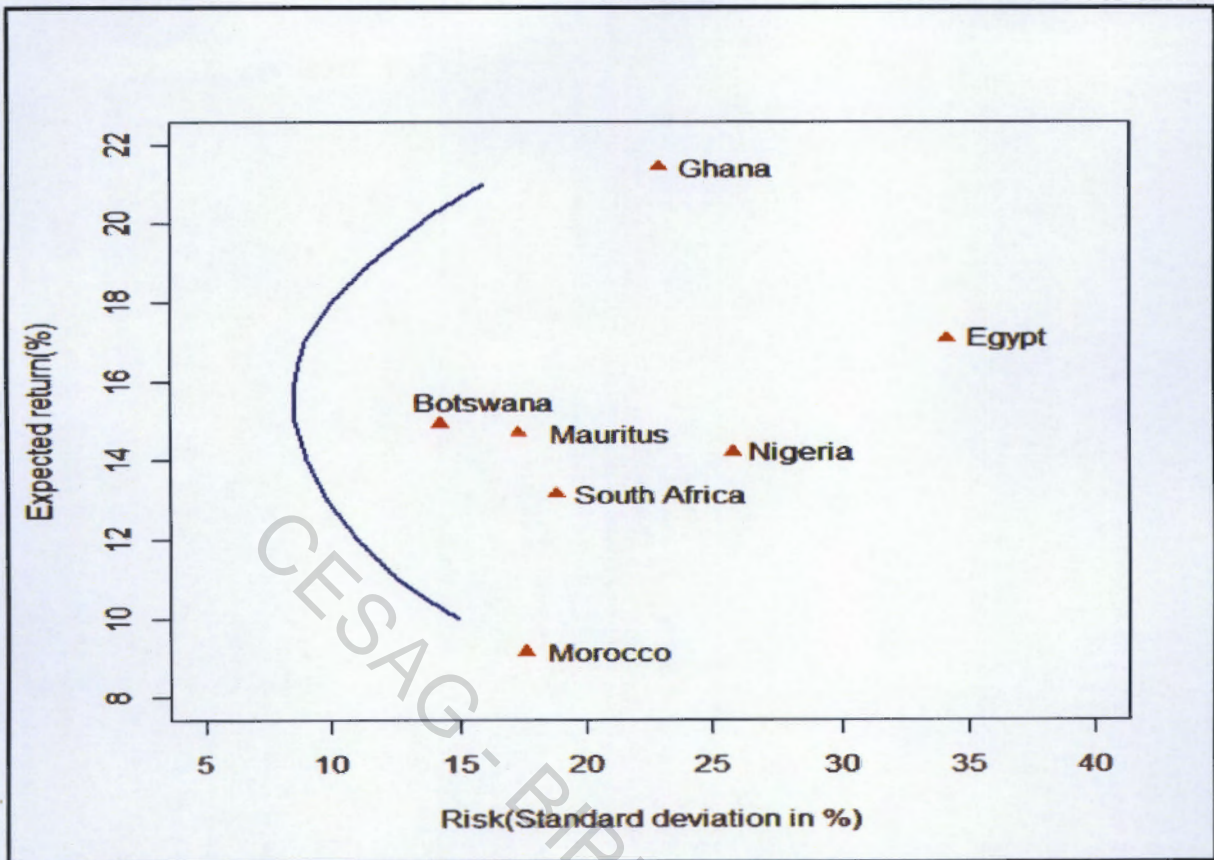
Source: African Business Research institute

Thus, it can be derived from the graph that for any particular index, there is a portfolio on the efficient frontier that provides higher expected returns for the same risk or a portfolio that provides the same expected returns for lower standard deviation. The figure depicts clearly, the benefits from diversification across Africa. Therefore instead of being subject to the Ghanaian equity market fluctuations alone, a portfolio would be better off when exposed to various stock markets.

The next section presents the synthesis of the work conducted and will allow as delineating the limitations of the study.

IV.   Synthesis of the findings

The study analyzes the portfolio management practices at EIL. In this respect, a sample of its client portfolios is examined along with the recommended constructed portfolios, from January 2006 through December 2010.

The constructed portfolios were managed following strategies using the Bank of Ghana easily observable monetary policy signals. The strategies consist of 1) shifting the portfolio allocation in between cyclical stocks and non-cyclical stocks during economic upswings and economic downswings respectively (strategy A); and 2) shifting the portfolio allocation in between cyclical stocks and 91-Day Treasury bill during economic upswings and economic downswings respectively (strategy B). To appraise the performances of the various portfolios, four benchmarks were used: 1) The GSE All-share Index which is the market Index; 2) An Equally-weighted portfolio invested across 21 cyclical and defensive stocks listed on the GSE and is labeled Benchmark A; 3) A Portfolio half invested in the Benchmark A and half invested in 91-Day T Bills — that is 50%*Benchmark A + 50% *91-Day T bills and labelled Benchmark B and 4) the 91-Day Treasury bill. The market index and the 91-Day Treasury bill were used to appraise the performance of the sample portfolios. Then, the market index and the Benchmark A were used for the portfolio managed under strategy A and the market index and the Benchmark B were used for the portfolio managed under strategy B. All the portfolios' performances were also assessed in real term using the prevailing inflation rates.

The study also investigates the benefit of international diversification across Africa. An efficient frontier of portfolios composed of various market indices were constructed and interpreted.

In the end of the aforementioned analyses, we obtained the following results:

a. Overall, the sample portfolios outperformed the market index and the 91-Day Treasury bill. Precisely, a Ghana Cedi invested in the sample portfolios earned in real term about One Ghana Cedi Twenty Three Ghana Pesewas (GH¢ 1.23), while the same investment in the benchmarks lost Thirty Eight Ghana Pesewas (GHp 38) in the case of the market index, and gained Eighteen Ghana Pesewas (GHp 18) in the case of the 91-Day Treasury Bill. Besides, the sample portfolios have been proven to achieve the higher risk-adjusted returns (higher Sharp Ratio, Treynor Ratio and Jensen's Alpha).

b. The portfolio managed under strategy A generated excess returns that are statistically significant. Thus the actual portfolio produced cumulative returns

of about 378% while the benchmark A produced about 126% and the market index produced about 54% of cumulative returns. The portfolio also achieved higher risk-adjusted return compared to its benchmarks.

c. The portfolio managed under strategy B also generated significant excess return. The portfolio gained cumulative returns of about 447% while the benchmark B earned about 117% and the market index 54% of cumulative returns. The portfolio also achieved higher risk-adjusted return compared to its benchmarks.

d. When comparing the constructed portfolios to the sample portfolios, it follows that the constructed portfolios outperformed the sample portfolios. In fact, the portfolio of strategy A gained 378% of cumulative returns while the portfolio of strategy B gained 447% and the sample portfolios gained 209%. Besides, the constructed portfolios achieved the highest risk-adjusted returns.

e. The efficient frontier obtained from the international diversification analysis suggested that investing in a well diversified portfolio across Africa is more efficient than investing only in one market such as The Ghana Stock Exchange.

These results clearly show the benefits of the strategies used to manage the constructed portfolios. In fact, the strategies tailored the constructed portfolios' allocation to the prevailing economic trends during the sample period, what the sample portfolios and the passive benchmarks failed to do. These results are obtained upon assumptions in order to simplify the implementation of the study. Therefore, the study suffers from limitations which we shall consider in the next section.

V. Limitations of the study

The portfolio improvement reported in this study from incorporating monetary policy conditions and the international diversification should be viewed as an indication of the potential benefits of the strategies. Nevertheless, the observed results of the study should not be taken as granted because of limitations it suffers from. These limitations are as follow:

1. The expected returns used to feed the MVO in the study are evaluated based on companies' historical prices. Since companies seize, financial leverage, beta and future earnings prospect among others change over time, the expected returns estimated based on the company's fundamentals should produce better results. The bias of the use of historical data is that what happened in the past is not likely to happen again and may lead to a wrong estimate of the optimal portfolio.

2. The study makes use of regression beta to classify the GSE stocks as cyclical and non-cyclical. This criterion may be insufficient and may classify a stock as cyclical or non-cyclical while the company's fundamentals suggest the opposite.

3. The study did not take into account transaction costs during the rebalancing, which is not practical. Therefore, the reported capital returns should be slightly higher than the reality.

4. During the rebalancing, the study made the assumption of the disposal of the portfolios' allocation and the acquisition of new stocks being done the same date. This is not practical and since security trading is dependent on market liquidity. Since emerging markets show low liquidity because of thin-trading, the reported capital returns should be slightly higher than the reality.

5. The return estimation from the sample portfolios is semi-annually based, while the constructed portfolios and the GSE All Share Index returns are reported monthly. Therefore, the results will be biased in some level.

6. The analysis of international diversification across Africa did not take into account the foreign exchange risk involved in investing across several countries. An investor who decides to internationally diversify his portfolio should find proper means to hedge the portfolio's foreign exchange risk exposure. However, the foreign exchange risk does not preclude the strategy from its winning benefits.

7. The study arbitrary considers that, 250 to 350 basis points of changes in the monetary policy rate may revert the economic trend — that is from downturn

to upturn and inversely. This assumption may contain flaws that are likely to reduce the accuracy of the results.

8. In order to simplify the analyses, the study employs only one economic indicator: the monetary policy. This may not produce results as accurate as when several indicators are used.

Having presented the limitations of the study, we shall now present our suggestions to EIL through recommendations as well as the refinements of the study in the next section. These are ways and means EIL could use with a view to improve its portfolio management practices and stand out in the crowd by well managing its client's funds.

VI. Recommendations and refinements of the study

In the end of this study and in line with the results presented above, the following actions can be suggested to EIL:

1) EIL should conduct fundamental analysis on listed stocks in order to identify cyclical stocks from non cyclical stocks. In so doing, EIL will come to know which stocks to invest in according to the economic outlook;

2) There are several economic indicators. However, EIL may use the Bank of Ghana's easily observable monetary policy signals to time the economic conditions in order to consistently allocate its client equity portfolios with the view to always add value to the portfolios and help them achieve their investment objectives.

3) EIL may shift its client's portfolio allocations between stocks and fixed income securities in order to keep the portfolios' value increasing no matter what happens in the economy.

4) Upon discussion with its clients, EIL should diversify the portfolio allocations across other equity markets in Africa and beyond. This would reduce their exposure to the Ghanaian market and help them benefit from other market trends.

However, given the limitations mentioned in the previous section, the accuracy of the findings may be reduced. Besides, to make the above recommendations produce more realistic results, refinements of the strategies may be envisaged. These refinements may include the following research areas:

1. The study uses regression betas to classify the stocks listed on the GSE into cyclical and non-cyclical stocks. As observed by DAMODARAN Aswath, regression betas contain flaws due to estimation choices - the time period used, the return interval and the index. He suggests the use of a firm's fundamentals in conjunction with historical beta estimates to provide superior predictors of future betas. The ensuing betas reflect the businesses a firm is operating in and its current financial leverage. This alternative to regression betas is likely to results in finer classification of stocks into cyclical and non-cyclical.

2. Further research could investigate the relationship between the Bank of Ghana's monetary policy and the return on the GSE in order to define stringently the level of changes in the policy that have a bearing on equity returns. The outcome of such a study would suggest when to shift the portfolio allocation subsequently to some changes in the policy rate.

3. The study does not take into account the transaction costs during the rebalancing. Further research could investigate the effect on the portfolio return by incorporating the transaction costs.

4. Further research could also investigate the liquidity costs in emerging markets and their impact on the portfolio performance.

5. The study also employs only one leading economic indicator—the monetary policy. Further research could explore adding other leading indicators such as consumer demand and the level of inventory among others. This is likely to result in a more stringent timing of the economic trend.

6. Finally advocates of international diversification could refine the framework explored in this study by investigating 1) the impact of foreign exchange risk on the performance of internationally diversified portfolio and 2) foreign exchange risk hedging tools available to Ghanaian investors.

Conclusion

The study investigates how optimally EDC Investments Ltd manages its client portfolios by focusing on the management of the equity sub-portfolios of a sample composed of 22 client portfolios over a period spanning from January 2006 through December 2010. In this respect, we constructed an equity portfolio which is managed according to two strategies based on the Bank of Ghana monetary policy signals.

The portfolio management literature suggests the allocation of portfolio based on the investor's risk/reward preferences as well as current and projected economic conditions. The literature also tells us to invest in cyclical stocks during economic upswings and in defensive stocks during economic downswings. Given that the Bank of Ghana pursues its monetary policy which aims at ensuring price stability (low inflation rate), sustainable and strong economic conditions; it typically tightens monetary policy in the face of rising economic activity and inflation, and easies monetary policy in the face of falling economic activity and inflation. Therefore, the constructed portfolios were managed using announced Bank of Ghana policy changes as indicators of when to shift the allocation to a more aggressive or defensive posture. The reported results show that the constructed portfolios significantly outperformed the sample portfolios, the market index and the stated passive Benchmarks. The results also show that the sample portfolios and the constructed portfolios performed almost the same during the market upswings and as the rotation strategy assumes defensive posture during restrictive monetary stance, it was during this period that the most prominent improvement in portfolio performance is observed. The impact was visible as the constructed portfolios outperformed the sample portfolios by at least 300% over the sample period. It follows that, EIL selects good cyclical stocks which have the potential to spur its client portfolios during economic upswings. However, this allocation is maintained even during economic downswings by virtue of strategic equity allocation. Strategic allocation has the drawback not tailoring the portfolio allocation to changes in the economic conditions. Equity markets go through upswings and downswings and being able to protect the investor' portfolio from losing value during downturns has

the effect of enhancing the portfolio's total returns by the end of the investment program as observed for the constructed portfolios.

In addition, international diversification comes to improve the overall performance of the equity portfolio by allowing the portfolio to take advantage of various markets' risk/reward patterns. For instance in 2009, when the Ghanaian market went down by 46%, South Africa market went up by 30%. A Ghanaian investor exposed to both markets would have been better off than it would if he invested only on the GSE.

Investors are particularly concerned with the value of their portfolios. For Investment managers like EIL, succeeding in protecting client's portfolios would help them keep these clients and bring more businesses, given the increasing competition in the industry.

In the end of this study, we cannot contend that it is perfect and does not contain any bias. This project needs refinements to include other practical aspects of portfolio management, as mentioned earlier. However, implementing this project allowed us to get deeper insight into portfolio manager theories and practices in Ghana especially.

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Appendices

Appendix I: Statistical tests

I-The Shapiro-Wilk test[14]

Given a sample $X1, \ldots ,Xn$ of n real-valued observations, the Shapiro–Wilk test (Shapiro and Wilk, 1965) is a test of the composite hypothesis that the data are i.i.d. (independent and identically distributed) and normal, i.e. $N(\mu, \sigma^2)$ for some unknown real μ and some $\sigma > 0$.

In practice, the test is simple to apply on a computer using R (free statistical software).

Namely, let $X = (X1, \ldots ,Xn)$ be the data vector, represented in R if entered individually as $c(X1, \ldots ,Xn)$. Type shapiro.test(X) and you will see as output a test statistic called W (for Wilk) and a p-value. If the p-value is less than, say, the conventional level 0.05, then one rejects the normality hypothesis, otherwise one doesn't reject it.

The Shapiro-Wilk test procedures are intricate without the use any of the statistical packages. The test statistic W is given by the following formula:

$$W = \left(\sum_{j=1}^{n} a_j X_{(j)} \right)^2 / \left(\sum_{j=1}^{n} (X_j - \bar{X})^2 \right)$$

where

$X_{(j)}$ (with parentheses enclosing the subscript index j) is the jth order statistic, i.e., the jth-smallest number in the sample;

$\bar{X} = (X1 + \ldots + Xn)/n$ is the sample mean;

the constants a_j are given by the following formula:

$$(a_1, \ldots, a_n) = \frac{m'V^{-1}}{(m'V^{-1}V^{-1}m)^{1/2}}$$

where

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[14] The notions developed in this section are based on R. Dudley (2010), *The Shapiro–Wilk Test For Normality*

$m = (m_1, \ldots, m_n)'.(m_1, \ldots, m_n) = (EZ_{(1)}, \ldots, EZ_n)$ are expected standard normal order statistics of the standard normal order statistics $Z_{(1)} \leq Z_{(2)} \leq \cdots \leq Z_{(n)}$ of $Z_1, \ldots, Z_n$ which are i.i.d N(0,1).

V is the *nxn* covariance matrix of the standard normal order statistics $Z_{(j)}$.

The Shapiro-wilk test statistic W always satisfies $0 < W \leq 1$. For values of W close enough to 1 (depending on *n*) the normality hypothesis will not be rejected. For smaller W it will be rejected. For n = 2, normality can never be rejected, so the test is useful only for n ≥ 3.

The Shapiro-Wilk normality test is used in the study to assess whether the returns time series come from normal distribution or not. This would suggest the appropriate hypothesis test to use in order to find out whether the observed excess returns are significantly different from zero. Thus if the distribution comes from normal distribution, the Student's t-test is used. However, if the data is not believed to be taken from normally distribution population, then the Paired t-test and the Wilcoxon signed rank test are more suitable.

II-Paired t-test

The Student's *t*-Test is a hypothesis testing normally used to determine whether two population means are equal. The test requires that the samples are independent and are taken from normally distributed populations. The Shapiro-wilk normality test shows that the returns series used in the study do not come from normal distribution. In this case the Paired t-test which does not require that the samples are taken from normal distribution is used. The paired differences are calculated as the difference between the portfolios' return and their benchmarks' return over the same time periods. Then it is tested whether the average difference between the monthly returns is significantly different from zero, based on the standard error of the average difference estimated from the sample data.

The first step in hypothesis testing is to state the claim that is to be tested. This is called the null hypothesis (or simply the null), denoted by H0. Against the null, an alternative claim (hypothesis) is stated, which is denoted by H1. The objective of

hypothesis testing is to decide whether to reject the null in favor of the alternative while identifying the probabilities of the possible errors in the determination. In this case the form of a two-tailed test for the hypothesized mean difference is:

$$H_0: \mu_d = 0 \quad \text{Versus} \quad H_1: \mu_d \neq 0$$

Where μ_d is the mean of the population of paired differences.

In order to determine whether the mean difference is significantly different from zero, we compute the test statistic and p-value with n-1 degrees of freedom under the null hypothesis as follow:

$$t = \frac{\bar{d} - 0}{S_{\bar{d}}}$$

Where $\bar{d}$ = sample mean difference calculated as $\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i$

n = number of paired observations

d_i = difference between the ith pair of observation

$S_{\bar{d}}$ = standard error of the mean difference determined as $S_{\bar{d}} = S_d/\sqrt{n}$

S_d = paired differences' standard deviation determined as $S_d = \sqrt{\frac{\sum_{i=1}^{n}(d_i-\bar{d})^2}{n-1}}$

Then the computed test statistic is compared to the t-value derived from the student statistical table for a significant level α=5% and n-1= 60-1=59 (Table 11) degrees of freedom. If the computed test statistic is greater than the t-value, the null hypothesis is rejected and you will conclude that the populations have different means or the observed mean is significantly different from zero.

Likewise, the probability of observing the null hypothesis (H0) is computed. This probability called p-value has a value ranging from zero to one. If the p-value is less than the significance level (5%), you'll conclude that the observed difference between sample means is unlikely to be due to chance. Instead, you'll conclude that the populations have different means. This implies that the probability for the sample means to be identical (H0) is too small or less than 5% and there is $(1 - p$ value$)$ probability to have different means.

III-The Wilcoxon signed rank test

The **Wilcoxon signed-rank test** is a non-parametric statistical hypothesis test that compares two paired groups. It can be used as an alternative to the paired Student's t-test when the population cannot be assumed to be normally distributed. The Wilcoxon Signed Rank procedure assumes that the sample we have is randomly taken from a population, with a symmetric frequency distribution. The symmetric assumption does not assume normality, simply that there seems to be roughly the same number of values above and below the median. The Wilcoxon procedure computes a test statistic T that is compared to an expected value taken from the Wilcoxon critical values table. Likewise, the statistical probability p of attaining T from a population that is symmetrically distributed around the median is also computed.

The Wilcoxon signed rank test procedures

The Wilcoxon Signed Rank test calculates the difference between each set of pairs and analyzes that list of differences. Therefore it requires that the data are measured at an interval level of measurement. Suppose we have a paired population of 2n total observations, the Wilcoxon test first computes the differences (Zi) between each set of pairs and ranks the absolute values of the differences from low to high. Then it sums the ranks of positive differences and the ranks of negative differences and reports the two sums. For a two tailed test, the test statistic T is the smaller of the two sums. Besides, If the two sums of ranks are very different, the P value will be small.

For x_i and y_i ($i = 1, 2, …..n$) the paired observations of the two populations, the procedure is as follow:

1. Form $a_i = x_i - y_i$,for $i = 1,2,……$n. The differences a_i are assumed to be independent. Each a_i comes from a continuous population and is symmetric about a common median θ. The null hypothesis tested is $H_0: \theta = 0$.

2. Form $s_i = |a_i|$, for $i =1,2,……$n

3. Drop every $a_i = 0$, leaving a sample size of m

4. Assign ranks $r_1, \ldots \ldots, r_m$ to $s_1, \ldots \ldots, s_m$ after sorting into ascending order.

5. Form

$$T_+ = \sum_{i=1}^{m} r_i z_i \quad and \quad T_- = \sum_{i=1}^{m} r_i (1 - z_i)$$

$where\ z_i = \begin{cases} 1\ if\ a_i > 0 \\ 0\ if\ a_i < 0 \end{cases}$

6. Compute the test statistic T. For a two tailed distribution; it is equal to the smaller of the two sums T_+.and T_-. Thus $T = Min(T_+, T_-)$. If T is less than the critical value derived from the Wilcoxon table, then the null hypothesis is rejected.

7. To compute the p-value, T is compared to a table of all possible distributions of ranks. If p-value is less than the significance level, then the null is rejected and you will conclude that the populations have different mean.

Appendix II: The cyclical and non-cyclical stocks' risk/reward patterns

Panel A: Cyclical stockc

Company	Share Code	Nature of Business	Annual Standard deviation	Annual Average Return	Row Beta	Adjusted Beta*	Market Capt. (¢ b.) As at 31/12/05
Aluworks Limited	ALW	Production and sale of aluminium based products, which consist of aluminium sheet-in-coil, circles, flat sheets, corrugated roofing sheets	75,18%	12,52%	1,43	1,29	208,51
Cal Bank Ltd	CAL	Banking and other banking-related activities	39,43%	-27,27%	1,60	1,40	310,19
Clydestone (Ghana) Ltd.	CLYD	System Integration; Outsourcing; Network design	58,68%	38,66%	1,17	1,11	34,00
Cocoa Processing Co. Ltd.	CPC	Processing of raw cocoa beans into semi-finished and confectionery products.	46,22%	-1,66%	1,44	1,30	516,89
Enterprise Insurance Co. Ltd.	EIC	Provision of insurance services and insurer in fire, marine, motor and general accident.	53,32%	24,44%	0,72	0,81	175,29
Fan Milk Ltd.	FML	Production of dairy products such as Fanyogo. Fanmilk and Fanice in various flavours;	36,44%	61,26%	0,60	0,73	312,52
Ghana Commercial Bank Ltd.	GCB	Banking and related services	43,27%	44,29%	1,35	1,24	1112,10
Guinness Ghana Breweries Ltd.	GGBL	Production of Guinness Extra Stout. Star Beer. Gulder. etc and non-alcoholic liquor "Malta Guinness and Amstel Malta"	42,85%	42,53%	1,11	1,07	1274,56
HFC Bank (Ghana) Ltd.	HFC	Investment management and savings	39,23%	42,11%	1,25	1,17	600,95
Mechanical Llyod Co. Ltd.	MLC	General merchandizing of consumer goods and equipments. marketing of Motor Vehicles	61,17%	60,88%	1,81	1,54	125,24
Produce Buying Company Ltd.	PBC	To purchase cocoa beans from farmers. and to store them in purpose-built sheds at village/society level. cart these to collection points for inspection. grading and sealing by the Cocoa Boards Quality Control Dept.	48,42%	36,24%	1,41	1,28	1440,00
Standard Chartered Bank Gh. Ltd.	SCB	Banking and related services	32,03%	38,16%	0,53	0,69	2287,49
Starwin Products Ltd.	SPL	Manufacturing of pharmaceutical drugs.	47,52%	8,68%	1,26	1,18	42,96
SG-SSB Limited	SSB	Banking and related services.	48,10%	24,30%	1,39	1,26	1026,00
Trust Bank Ltd. (The Gambia)	TBL	Banking	41,04%	75,48%	1,35	1,23	810,00
Unilever Ghana Ltd.	UNIL	Manufacturing of soaps. detergents. foods and personal products. Distribution and service enterprises.	28,38%	43,07%	0,65	0,76	962,50
Total Capitalization							11239,19
Capitalization-weighted Row Beta							1,09
Capitalization-weighted Adjusted Beta							1,06

*Adjusted Beta= Row Betax0,67+1x0,33

Source: The Ghana Stock Exchange

Appendix II the cyclical and non-cyclical stocks' risk/reward patterns (end)

Panel B: Non-cyclical stocks

Company Name	Share Code	Nature of Business	Annual Standard deviation	Annual Average Return	Row Beta	Adjusted Beta*	Market Capt. (¢ b.)
Accra Brewery Company Ltd.	ABL	Brewing of beer/malt drink (Club Beer, Castle Milk Stout, Castle Beer, Club Shandy, Club Dark, Club Mini, Escape and Vitalmalt) and the manufacture of aerated club soft drinks: Cola, Citro, Ginger Ale, Muscatella, Orange, Soda and Quinine Tonic.	34,18%	18,76%	0,32	0,54	324,28
Africa Champion Industries Ltd	ACI/SPPC	Manufacture of toilet rolls.printing. typing and writing papers.	27,79%	17,53%	-0,03	0,31	7,58
AngloGold Ashanti Ltd.	AGA	Exploration, development and mining of gold	21,61%	59,85%	-0,06	0,29	79092,03
Camelot Ghana Ltd.	CMLT	Advance printing of Pre-printed and customized forms. Security Printing.	29,27%	72,76%	0,07	0,37	11,12
Pioneer Kitchenware Ltd.	PKF	Production of aluminium household wares such as Heavy Casseroles etc	29,94%	18,37%	-0,04	0,30	13,19
PZ Cussons Ghana Ltd.	PZ	Manufactureers of over-the-counter pharmaceutical preparations, cosmetics and beauty products.	30,19%	42,49%	0,13	0,42	182,00
Sam Woode Ltd.	SWL	Publishing. printing and related businesses	2,93%	1,92%	0,02	0,35	6,33
Total Petroleum Ghana Ltd.	MOGL/TOTA	Marketing of petroleum products and services.	17,00%	17,68%	0,32	0,55	179,55
	Total Capitalization						79816,09
	Capitalization-weighted Row Beta						-0,06
	Capitalization-weighted Adjusted Beta						0,29

*Adjusted Beta= 0,67xRow Beta+1x0,33

Source: The Ghana Stock Exchange

Appendix III: The performance of the Optimal Portfolio

Optimal weights

Stock	FML	GCB	GGBL	HFC	UNIL
Weight	0,40	0,13	0,04	0,02	0,41

Risk free rate: 91-Day T bill rate as at 31/12/2010 = 12,25%

Date	FML	GCB	GGBL	HFC	UNIL	FML Monthly returns	GCB Monthly Returns	GGBL Monthly Returns	HFC Monthly Returns	UNIL Monthly returns	Optimal portfolio Monthly returns(Rop)
31/12/2005	1,580	0,674	0,774	0,600	1,540						
31/01/2006	1,580	0,620	0,820	0,600	1,540	0,00%	-8,01%	5,94%	0,00%	0,00%	-0,81%
28/02/2006	1,580	0,615	0,855	0,600	1,540	0,00%	-0,81%	4,30%	0,00%	0,00%	0,07%
31/03/2006	1,580	0,615	0,857	0,600	1,540	0,00%	0,00%	0,14%	0,00%	0,00%	0,01%
28/04/2006	1,590	0,630	0,857	0,600	1,540	0,65%	2,46%	0,06%	0,00%	0,00%	0,58%
31/05/2006	1,591	0,631	0,990	0,540	1,540	0,02%	0,17%	15,52%	-10,00%	0,00%	0,45%
30/06/2006	1,594	0,631	0,984	0,540	1,540	0,22%	0,00%	-0,63%	0,00%	0,00%	0,06%
31/07/2006	1,601	0,631	0,950	0,540	1,500	0,41%	-0,03%	-3,44%	0,00%	-2,60%	-1,04%
31/08/2006	1,615	0,631	0,925	0,540	1,510	0,91%	-0,03%	-2,63%	0,00%	0,67%	0,53%
29/09/2006	1,616	0,615	0,925	0,540	1,500	0,06%	-2,50%	0,03%	0,00%	-0,66%	-0,57%
31/10/2006	1,656	0,615	0,925	0,540	1,500	2,44%	0,00%	0,00%	0,00%	0,00%	0,98%
30/11/2006	1,701	0,615	0,925	0,540	1,500	2,74%	0,00%	-0,05%	0,00%	0,00%	1,10%
29/12/2006	1,800	0,615	0,925	0,540	1,500	5,84%	0,00%	0,00%	0,00%	0,00%	2,35%
31/01/2007	1,801	0,620	0,900	0,540	1,500	0,07%	0,81%	-2,68%	0,00%	0,00%	0,03%
28/02/2007	1,900	0,612	0,930	0,540	1,500	5,47%	-1,29%	3,34%	0,00%	0,00%	2,16%
30/03/2007	1,910	0,670	0,935	0,540	1,500	0,53%	9,48%	0,57%	0,00%	0,00%	1,48%
30/04/2007	1,925	0,678	0,937	0,540	1,501	0,79%	1,25%	0,16%	0,00%	0,07%	0,52%
31/05/2007	1,951	0,681	0,946	0,540	1,515	1,33%	0,32%	0,92%	0,00%	0,93%	0,99%
29/06/2007	1,960	0,681	0,955	0,540	1,901	0,48%	0,03%	1,02%	0,00%	25,48%	10,62%
31/07/2007	1,971	0,687	0,961	0,500	1,903	0,57%	0,91%	0,58%	-7,41%	0,08%	0,26%

118

Appenditix III: The performance of the optimal portfolio (Continued)

Date	FML	GCB	GGBL	HFC	UNIL	FML Monthly returns	GCB Monthly Returns	GGBL Monthly Returns	HFC Monthly Returns	UNIL Monthly returns	Optimal portfolio Monthly returns(Rop)
31/08/2007	2,110	0,950	0,967	0,540	2,001	7,05%	38,31%	0,67%	8,00%	5,17%	10,15%
28/09/2007	2,111	0,950	1,070	0,540	2,050	0,02%	0,00%	10,65%	0,00%	2,45%	1,43%
31/10/2007	2,150	0,960	1,211	0,540	2,100	1,87%	1,04%	13,13%	-0,04%	2,44%	2,40%
30/11/2007	2,375	0,971	1,215	0,540	2,100	10,46%	1,14%	0,40%	0,00%	0,01%	4,38%
31/12/2007	2,390	0,995	1,230	0,540	2,110	0,63%	2,47%	1,21%	0,00%	0,46%	0,81%
31/01/2008	2,663	1,006	1,234	0,540	2,120	11,41%	1,07%	0,33%	0,04%	0,49%	4,94%
29/02/2008	2,700	1,160	1,360	0,540	2,160	1,40%	15,35%	10,21%	0,00%	1,87%	3,74%
31/03/2008	2,850	1,310	1,460	0,540	2,230	5,56%	12,93%	7,35%	0,00%	3,24%	5,54%
30/04/2008	3,180	1,380	1,640	0,610	2,260	11,58%	5,34%	12,33%	12,96%	1,35%	6,65%
30/05/2008	3,320	1,380	1,780	0,620	2,460	4,40%	0,00%	8,54%	1,64%	8,85%	5,75%
30/06/2008	3,600	1,350	2,160	0,620	2,700	8,43%	-2,17%	21,35%	0,00%	9,76%	7,93%
31/07/2008	3,790	1,350	2,250	0,620	2,880	5,28%	0,00%	4,17%	0,00%	6,67%	5,00%
29/08/2008	4,680	1,300	2,550	0,620	3,510	23,48%	-3,70%	13,33%	0,00%	21,88%	18,40%
29/09/2008	5,000	1,300	2,550	0,620	4,500	6,84%	0,00%	0,00%	0,00%	28,21%	14,24%
31/10/2008	5,000	1,290	2,200	0,620	4,580	0,00%	-0,77%	-13,73%	0,00%	1,78%	0,08%
28/11/2008	4,500	1,140	2,000	0,620	4,400	-10,00%	-11,63%	-9,09%	0,00%	-3,93%	-7,51%
31/12/2008	4,500	1,100	2,000	0,620	4,000	0,00%	-3,51%	0,00%	0,00%	-9,09%	-4,16%
30/01/2009	4,500	0,980	2,000	0,620	4,000	0,00%	-10,91%	0,00%	0,00%	0,00%	-1,43%
27/02/2009	4,500	0,620	1,800	0,620	3,600	0,00%	-36,73%	-10,00%	0,00%	-10,00%	-9,29%
31/03/2009	4,000	0,450	1,800	0,620	3,500	-11,11%	-27,42%	0,00%	0,00%	-2,78%	-9,19%
30/04/2009	3,000	0,600	1,790	0,620	3,500	-25,00%	33,33%	-0,56%	0,00%	0,00%	-5,70%
29/05/2009	2,500	0,480	1,770	0,620	3,500	-16,67%	-20,00%	-1,12%	0,00%	0,00%	-9,36%
30/06/2009	2,800	0,540	1,260	0,620	3,490	12,00%	12,50%	-28,81%	0,00%	-0,29%	5,20%
31/07/2009	3,330	0,750	1,260	0,620	3,400	18,93%	38,89%	0,00%	0,00%	-2,58%	11,65%
31/08/2009	4,100	0,800	1,260	0,620	3,420	23,12%	6,67%	0,00%	0,00%	0,59%	10,41%
29/09/2009	4,300	0,800	1,300	0,620	3,420	4,88%	0,00%	3,17%	0,00%	0,00%	2,09%
30/10/2009	4,610	0,900	1,320	0,620	3,420	7,21%	12,50%	1,54%	0,00%	0,00%	4,60%

Appendix III: The performance of the optimal portfolio (Continued)

Date	FML	GCB	GGBL	HFC	UNIL	FML Monthly returns	GCB Monthly Returns	GGBL Monthly Returns	HFC Monthly Returns	UNIL Monthly returns	Optimal portfolio Monthly returns(Rop)
30/11/2009	4,720	0,820	1,350	0,620	3,410	2,39%	-8,89%	2,27%	0,00%	-0,29%	-0,24%
31/12/2009	5,550	0,740	1,350	0,620	3,400	17,58%	-9,76%	0,00%	0,00%	-0,29%	5,67%
29/01/2010	6,050	0,730	1,340	0,620	3,400	9,01%	-1,35%	-0,74%	0,00%	0,00%	3,41%
26/02/2010	6,800	0,800	1,350	0,620	3,390	12,40%	9,59%	0,75%	0,00%	-0,29%	6,15%
31/03/2010	6,900	0,950	1,390	0,550	3,390	1,47%	18,75%	2,96%	-11,29%	0,00%	2,94%
30/04/2010	7,100	1,130	1,450	0,600	3,620	2,90%	18,95%	4,32%	9,09%	6,78%	6,76%
31/05/2010	7,680	1,780	1,650	0,620	3,820	8,17%	57,52%	13,79%	3,33%	5,52%	13,69%
30/06/2010	7,800	1,620	1,550	0,590	3,600	1,56%	-8,99%	-6,06%	-4,84%	-5,76%	-3,23%
30/07/2010	7,600	1,560	1,560	0,560	3,600	-2,56%	-3,70%	0,65%	-5,08%	0,00%	-1,59%
31/08/2010	8,600	1,900	1,560	0,520	4,400	13,16%	21,79%	0,00%	-7,14%	22,22%	17,06%
30/09/2010	9,010	2,000	1,560	0,490	5,060	4,77%	5,26%	0,00%	-5,77%	15,00%	8,61%
29/10/2010	9,170	1,900	1,560	0,470	5,520	1,78%	-5,00%	0,00%	-4,08%	9,09%	3,68%
30/11/2010	10,500	2,300	1,560	0,470	5,600	14,50%	21,05%	0,00%	0,00%	1,45%	9,18%
Monthly Standard deviation						8,08%	14,76%	7,20%	3,61%	7,17%	5,88%
Annual Standard deviation						27,99%	51,13%	24,94%	12,49%	24,84%	20,38%
Annual Average return						46,99%	28,36%	15,32%	-4,85%	30,03%	38,11%
Sharp Ratio						1,241	0,315	0,123	-1,369	0,716	1,269

Source: The Ghana Stock Exchange

120

Appendix IV: The sample portfolios' semi-annual returns

Exhibit 1: Individual portfolio's semi-annual returns
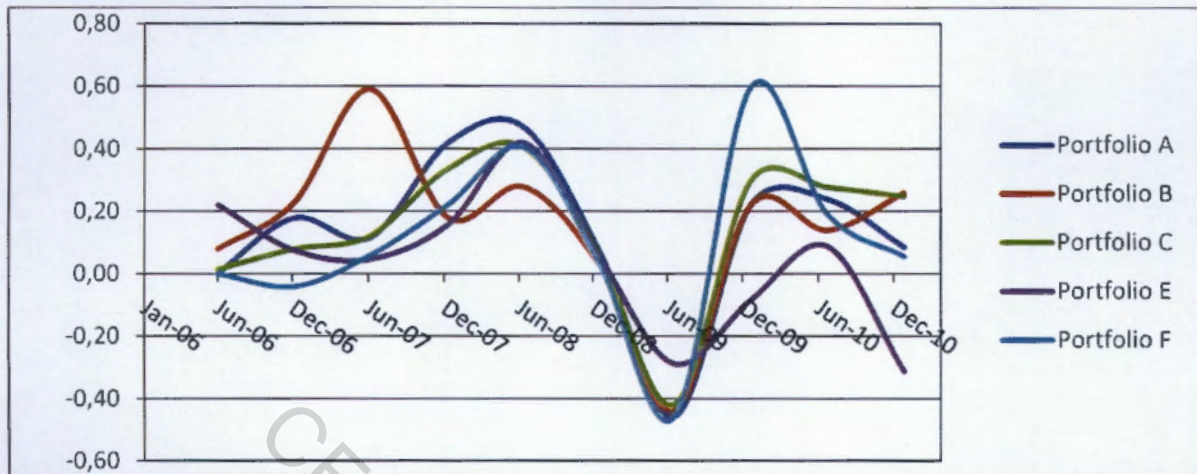
Source: EDC Investments Ltd
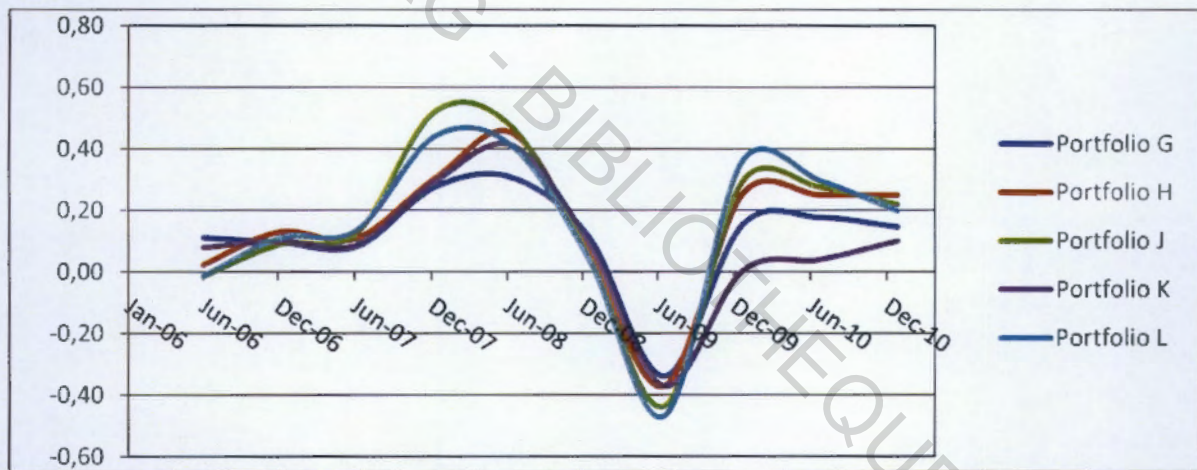
Source: EDC Investments Ltd

Source: EDC Investments Ltd

Source: EDC Investments Ltd

Source: EDC Investments Ltd

Exhibit 2: Average return of the sample portfolios versus the GSE All-share index

Source: The Ghana Stock Exchange, EDC Investments Ltd

Appendix V: The recommended portfolio (AEP) investment program
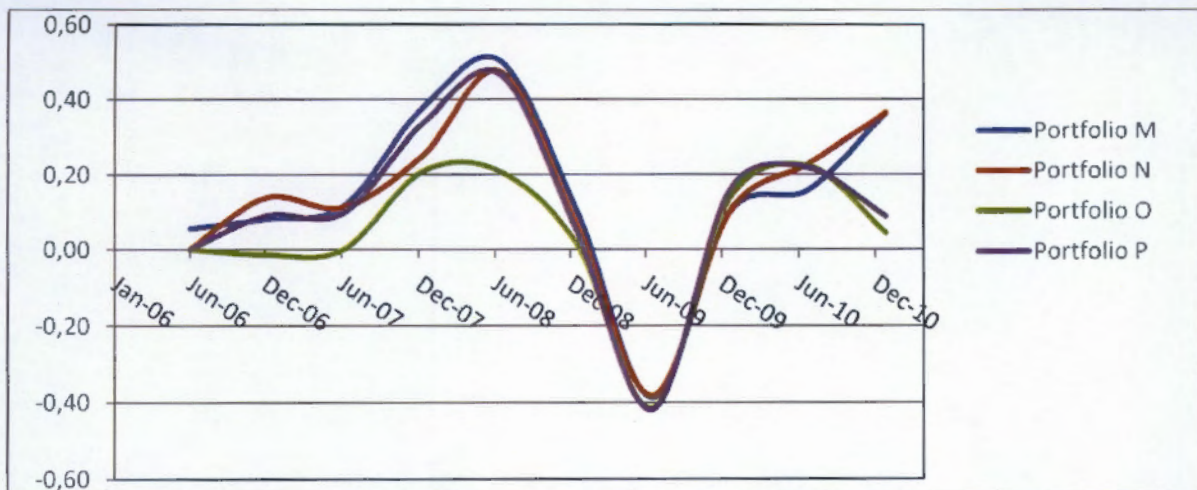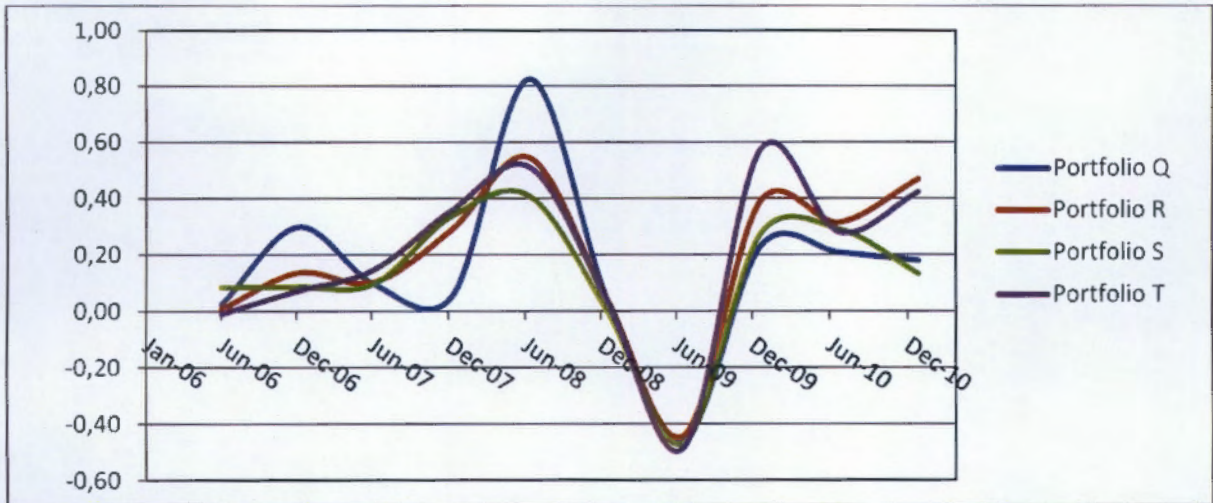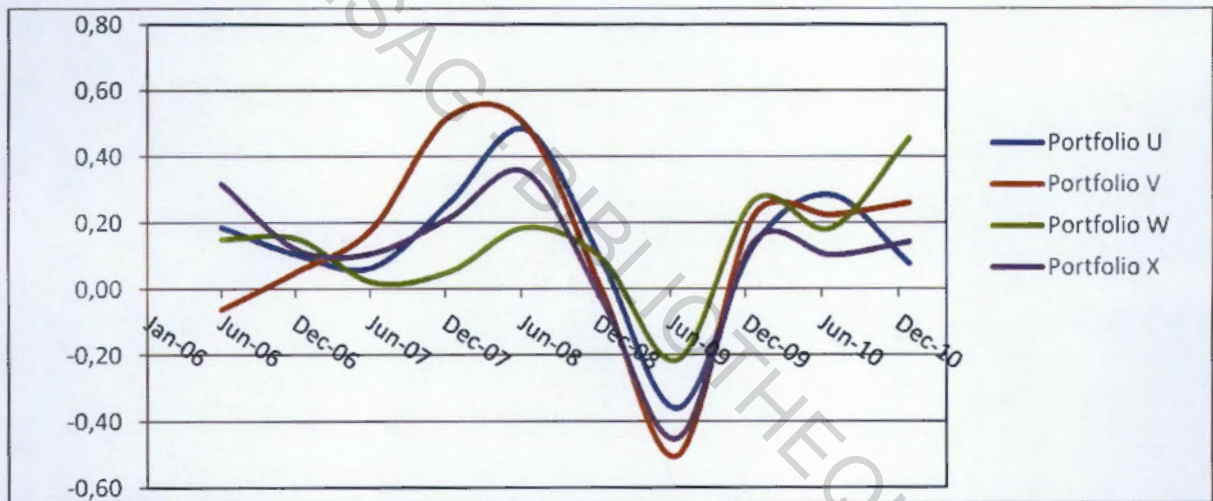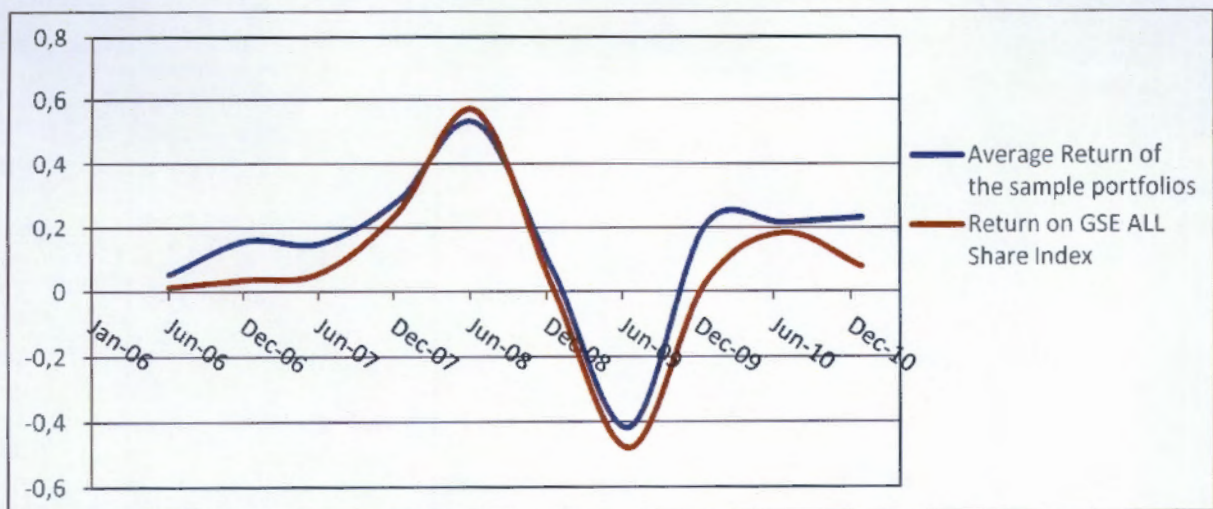
Strategy A: investing in cyclical stocks (during expansive monetary policy stance) and in defensive stocks (during restrictive policy stance)
Strategy B: investing in cyclical stocks (during expansive monetary policy stance) and in 91 day T bills (during restrictive policy stance)

<u>Exhibit 1: Investment is Cyclical stocks</u>

Program start: investment in cyclical stocks (strategy A and B) from 01/01/2006 to 30/06/2008

Starting Value of the portfolio=   50 000

	BOPP	CAL	CFAO	EBG	EIC	FML	GCB	GGL./GGBI	HFC	SCB	SSB	TOTAL	UNIL	Portfolio V	Semi-annual Return
weight	0,025	0,100	0,025		0,100	0,100	0,100	0,100	0,025	0,200	0,025	0,100	0,100		
Allocated value per type of share	1 250,000	5 000,000	1 250,000	-	5 000,000	5 000,000	5 000,000	5 000,000	1 250,000	10 000,000	1 250,000	5 000,000	5 000,000	50 000,000	
Quatity Date	2 272,727	25 000,000	31 250,000	-	7 292,882	3 164,557	7 418,398	6 459,948	2 083,333	769,231	1 736,111	1 315,789	3 246,753		
31/12/2005	1 250,000	5 000,000	1 250,000	-	5 000,000	5 000,000	5 000,000	5 000,000	1 250,000	10 000,000	1 250,000	5 000,000	5 000,000	50 000,000	
31/01/2006	1 250,000	4 225,000	1 250,000	-	5 001,459	5 000,000	4 599,407	5 297,158	1 250,000	10 000,000	1 215,278	5 000,000	5 000,000	49 088,301	
28/02/2006	1 250,000	3 625,000	1 246,875	-	5 002,188	5 000,000	4 562,315	5 525,194	1 250,000	10 000,000	1 215,278	7 105,263	5 000,000	50 782,112	
31/03/2006	1 250,000	4 825,000	1 246,875	-	5 010,939	5 000,000	4 562,315	5 532,946	1 250,000	10 000,000	1 215,278	7 105,263	5 000,000	51 998,616	
28/04/2006	1 250,000	4 855,000	1 246,875	-	5 250,875	5 032,278	4 674,332	5 536,176	1 250,000	10 000,000	1 215,278	7 105,263	5 000,000	52 416,078	
31/05/2006	1 250,000	4 855,000	1 246,875	-	5 294,632	5 033,228	4 682,493	6 395,349	1 125,000	10 000,000	1 215,278	7 105,263	5 000,000	53 203,118	
30/06/2006	1 250,000	4 855,000	1 246,875	-	5 907,235	5 044,304	4 682,493	6 355,297	1 125,000	10 000,000	1 171,875	7 105,263	5 000,000	53 743,341	7,49%
31/07/2006	1 250,000	4 855,000	1 246,875		5 932,760	5 064,873	4 681,009	6 136,951	1 125,000	10 538,462	1 171,875	7 105,263	4 870,130	53 978,197	
Amount to allocate on 31/07/06 to include EBG=				53 978,197											
weight	0,025	0,088	0,025	0,088	0,088	0,088	0,088	0,088	0,025	0,200	0,025	0,088	0,088		
Allocated value per type of share	1 349,455	4 723,092	1 349,455	4 723,092	4 723,092	4 723,092	4 723,092	4 723,092	1 349,455	10 795,639	1 349,455	4 723,092	4 723,092	53 978,197	
Quatity Date	2 453,554	24 320,764	33 820,926	4 036,486	5 805,891	2 951,010	7 485,091	4 971,676	2 498,991	788,003	1 999,192	874,647	3 148,728		
31/07/2006	1 349,455	4 723,092	1 349,455	4 723,092	4 723,092	4 723,092	4 723,092	4 723,092	1 349,455	10 795,639	1 349,455	4 723,092	4 723,092	53 978,197	
31/08/2006	1 349,455	4 620,945	1 349,455	4 768,705	4 833,985	4 765,882	4 721,595	4 598,800	1 349,455	11 189,641	1 349,055	4 723,092	4 754,580	54 374,645	
29/09/2006	1 349,455	4 377,737	1 349,455	4 892,625	4 894,366	4 768,833	4 603,331	4 600,292	1 349,455	11 820,122	1 199,515	4 723,617	4 723,092	54 651,895	
31/10/2006	1 349,455	4 377,737	1 349,455	5 065,790	5 080,155	4 885,398	4 603,331	4 600,292	1 349,455	12 214,439	1 199,515	4 724,054	4 723,092	55 522,168	
30/11/2006	1 349,455	4 499,341	1 349,455	5 450,063	5 115,571	5 019,079	4 603,331	4 597,806	1 349,455	12 450,446	1 199,515	4 724,579	4 723,092	56 431,188	
29/12/2006	1 349,455	5 362,728	1 349,455	5 456,925	5 119,635	5 312,409	4 603,331	4 597,806	1 349,455	12 450,446	1 199,515	4 725,716	4 723,092	57 599,969	6,71%
31/01/2007	1 349,455	5 362,728	1 349,455	5 473,879	5 123,118	5 315,950	4 640,756	4 474,508	1 349,455	12 608,046	1 199,515	4 731,839	4 723,092	57 701,798	
28/02/2007	1 349,455	5 153,570	1 183,732	5 503,345	5 146,922	5 606,920	4 580,876	4 624,156	1 349,455	13 081,636	1 222,506	4 742,509	4 723,092	58 268,175	
30/03/2007	1 349,455	5 669,170	1 183,732	5 691,445	5 168,985	5 636,430	5 015,011	4 650,506	1 349,455	13 239,709	1 263,690	4 745,221	4 723,092	59 685,901	
30/04/2007	1 337,187	6 080,191	1 183,732	5 719,701	5 461,602	5 680,990	5 077,886	4 657,963	1 349,455	14 184,603	1 270,687	4 745,921	4 726,241	61 476,159	
31/05/2007	1 337,187	6 372,040	1 183,732	5 780,248	5 517,338	5 756,536	5 094,353	4 700,720	1 349,455	14 231,726	1 429,623	4 749,856	4 770,323	62 273,138	

123

Appendix V: the recommended portfolio (AEP) investment program (Continued)

	BOPP	CAL	CFAO	EBG	EIC	FML	GCB	GGL/GGBI	HFC	SCB	SSB	TOTAL	UNIL	Portfolio Value	Semi-annual Return
29/06/2007	1 337,187	6 615,248	1 183,732	5 818,595	5 709,513	5 784,276	5 095,850	4 748,448	1 349,455	14 232,593	1 512,589	4 762,451	5 985,732	64 135,669	11,35%
31/07/2007	1 226,777	7 789,941	1 183,732	5 980,861	6 276,168	5 817,032	5 142,257	4 775,792	1 249,495	14 247,092	1 803,272	4 763,326	5 990,770	66 246,516	
31/08/2007	1 226,777	8 269,060	1 183,732	6 117,698	6 968,230	6 227,222	7 112,333	4 807,611	1 349,455	15 760,058	1 863,447	4 794,463	6 300,605	71 980,692	
28/09/2007	1 226,777	8 329,862	1 183,732	6 498,742	6 968,230	6 228,403	7 112,333	5 319,693	1 349,455	16 548,061	2 099,752	4 797,700	6 454,893	74 117,633	
31/10/2007	1 226,777	8 548,748	1 183,732	6 663,431	6 968,811	6 344,968	7 186,436	6 018,214	1 348,955	18 990,869	2 181,119	4 802,248	6 612,329	78 076,638	
30/11/2007	1 202,242	10 097,981	1 183,732	6 782,911	6 981,584	7 008,945	7 268,023	6 042,078	1 348,955	19 011,042	2 220,703	4 802,248	6 613,274	80 563,718	
31/12/2007	1 202,242	10 749,777	1 183,732	8 072,972	7 547,658	7 052,915	7 447,665	6 115,162	1 348,955	20 488,075	2 498,991	4 802,685	6 643,816	85 154,646	32,77%
31/01/2008	1 177,706	12 306,306	1 183,732	8 779,357	8 360,483	7 857,951	7 527,007	6 135,048	1 349,455	20 961,665	2 608,946	4 806,534	6 676,248	89 730,439	
29/02/2008	1 177,706	17 024,534	1 183,732	9 970,120	9 811,956	7 967,728	8 682,705	6 761,479	1 349,455	21 000,277	2 698,910	4 819,303	6 801,253	99 249,160	
31/03/2008	1 373,990	17 024,534	1 183,732	10 615,958	10 450,604	8 410,380	9 805,469	7 258,647	1 349,455	21 094,837	2 978,797	4 871,782	7 021,664	103 439,850	
30/04/2008	1 742,024	15 078,873	1 183,732	12 109,458	10 857,016	9 384,213	10 329,425	8 153,549	1 524,384	21 118,477	2 958,805	4 889,275	7 116,126	106 445,358	
30/05/2008	3 165,085	16 051,704	1 352,837	13 441,498	11 785,959	9 797,355	10 329,425	8 849,583	1 549,374	21 386,398	2 698,910	5 247,880	7 745,871	113 401,881	
30/06/2008	2 944,265	17 024,534	1 352,837	15 944,120	13 585,785	10 623,638	10 104,873	10 738,820	1 549,374	24 294,129	2 698,910	5 344,091	8 501,566	124 706,942	46,45%

End of cyclical stock investing (From 01/01/2006 to 30/06/2008)   Portfolio ending value = 142 706,942

Strategy A: back to cyclical stock investing on 30/04/2010. Portfolio value as of 30/04/2010= 149 537,827

	BOPP	CAL	CFAO	EBG	EIC	FML	GCB	GGL/GGBI	HFC	SCB	SSB	TOTAL	UNIL	Portfolio Value	Semi-annual Return
weight	0,025	0,088	0,025	0,088	0,088	0,088	0,088	0,088	0,025	0,200	0,025	0,088	0,088		
Allocated value per type of share	3 738,446	13 084,560	3 738,446	13 084,560	13 084,560	13 084,560	13 084,560	13 084,560	3 738,446	29 907,565	3 738,446	13 084,560	13 084,560	149 537,827	
Quatity	7 330,286	76 967,999	124 614,856	4 140,684	6 029,751	1 924,200	16 355,700	9 692,267	6 029,751	963,207	8 307,657	1 869,223	3 859,752		
29/02/2010	3 738,446	13 084,560	3 738,446	13 084,560	13 084,560	13 084,560	13 084,560	13 084,560	3 738,446	29 907,565	3 738,446	13 084,560	13 084,560	149 537,827	
31/03/2010	3 665,143	14 623,920	3 738,446	15 941,632	12 180,097	13 276,980	15 537,915	13 472,251	3 316,363	31 545,017	3 738,446	13 383,636	13 084,560	157 504,403	
30/04/2010	3 665,143	17 702,640	3 738,446	14 782,240	9 888,792	13 661,820	18 481,941	14 053,787	3 617,851	38 248,935	4 236,905	13 402,328	13 972,303	169 453,129	
31/05/2010	6 010,834	21 551,040	3 738,446	13 829,883	8 441,652	14 777,856	29 113,146	15 992,240	3 738,446	39 982,707	5 566,130	13 589,250	14 744,253	191 075,882	
30/06/2010	5 351,109	20 781,360	3 738,446	13 829,883	10 190,279	15 008,760	26 496,234	15 023,013	3 557,553	41 321,564	5 150,747	13 794,865	13 895,108	188 138,920	26,21%
30/07/2010	5 424,411	20 011,680	3 738,446	12 215,016	7 175,404	14 623,920	25 514,892	15 119,936	3 376,661	41 417,885	4 569,211	15 514,550	13 895,108	182 597,119	
31/08/2010	5 571,017	23 090,400	3 738,446	13 250,187	10 250,577	16 548,120	31 075,830	15 119,936	3 135,471	41 523,837	5 815,360	15 794,933	16 982,910	201 897,023	
30/09/2010	5 717,623	22 320,720	3 738,446	13 871,290	9 707,899	17 337,042	32 711,400	15 119,936	2 954,578	42 381,091	5 399,977	16 935,159	19 530,346	207 725,506	
29/10/2010	5 717,623	21 551,040	3 738,446	12 629,085	11 155,040	17 644,914	31 075,830	15 119,936	2 833,983	42 776,006	5 316,901	17 477,234	21 305,832	208 341,867	
Effet of the delisting of EIC and listing of EGL with exchange of 1 share EIC against 5 shares EGL															
Quatity	7 330,286	76 967,999	124 614,856	4 140,684	30 148,756	1 924,200	16 355,700	9 692,267	6 029,751	963,207	8 307,657	1 869,223	3 859,752		
30/11/2010	5 131,200	23 090,400	2 492,297	12 422,051	17 486,278	20 204,100	37 618,110	15 119,936	2 833,983	43 469,515	4 984,594	17 570,695	21 614,612	224 037,770	
Effet of FML Bonus shares (5 new shares for 1 held)															
Quatity Date	7 330,286	76 967,999	124 614,856	4 140,684	30 148,756	11 545,200	16 355,700	9 692,267	6 029,751	963,207	8 307,657	1 869,223	3 859,752		
31/12/2010	5 497,714	23 860,080	2 492,297	12 422,051	15 074,378	28 285,740	44 160,390	15 119,936	2 653,090	43 498,411	5 316,901	18 692,228	21 961,990	239 035,205	27,05%

End of the investment program: ending value of GHS 210 840,09 from a starting value of GHS 50 000

Appendix V: the recommended portfolio (AEP) investment program (Continued)

Strategy B: back to cyclical stock investing on 31/03/2010. Portfolio value as of 30/04/2010= 181 509,411

	BOPP	CAL	CFAO	EBG	EIC	FML	GCB	GGL/GGBL	HFC	SCB	SSB	TOTAL	UNIL	Portfolio Value	Semi-annual Return
weight	0,025	0,0875	0,025	0,0875	0,0875	0,0875	0,0875	0,0875	0,025	0,2	0,025	0,0875	0,0875		
Allocated value per type of share	4537,735	15882,0735	4537,73528	15882,073	15882,073	15882,073	15882,073	15882,0735	4537,7353	36301,882	4537,7353	15882,073	15882,073	181509,411	
Quatity	9075,471	83589,8604	151257,843	4125,2139	7862,4126	2301,7498	16717,972	11425,9521	8250,4278	1108,4544	10083,856	2218,1667	4684,9774		
31/03/2010	4537,735	15882,0735	4537,73528	15882,073	15882,073	15882,073	15882,073	15882,0735	4537,7353	36301,882	4537,7353	15882,073	15882,073	181509,411	
30/04/2010	4537,735	19225,6679	4537,73528	14727,014	12894,357	16342,423	18891,308	16567,6306	4950,2567	44016,725	5142,7666	15904,255	16959,618	194697,493	
31/05/2010	7441,886	23405,1609	4537,73528	13778,214	11007,378	17677,438	29757,99	18852,821	5115,2652	46011,943	6756,1836	16126,072	17896,614	218364,701	
30/06/2010	6625,094	22569,2623	4537,73528	13778,214	13287,477	17953,648	27083,115	17710,2258	4867,7524	47552,695	6251,9908	16370,07	16865,919	215453,198	24,88%
30/07/2010	6715,848	21733,3637	4537,73528	12169,381	9356,271	17493,298	26080,036	17824,4853	4620,2396	47663,54	5546,1209	18410,783	16865,919	209017,022	
31/08/2010	6897,358	25076,9581	4537,73528	13200,684	13366,101	19795,048	31764,147	17824,4853	4290,2224	47785,47	7058,6993	18743,508	20613,901	230954,318	
30/09/2010	7078,867	24241,0595	4537,73528	13819,467	12658,484	20738,766	33435,944	17824,4853	4042,7096	48771,994	6554,5065	20096,59	23705,986	237506,594	
29/10/2010	7078,867	23405,1609	4537,73528	12581,902	14545,463	21107,045	31764,147	17824,4853	3877,7011	49226,461	6453,668	20739,859	25861,075	239003,57	
Effet of the delisting of EIC and listing of EGL with exchange of 1 share EIC against 5 shares EGL															
Quatity	9075,471	83589,8604	151257,843	4125,2139	39312,063	2301,7498	16717,972	11425,9521	8250,4278	1108,4544	10083,856	2218,1667	4684,9774		
30/11/2010	6352,829	25076,9581	3025,15685	12375,642	22800,997	24168,373	38451,336	17824,4853	3877,7011	50024,548	6050,3137	20850,767	26235,874	257114,98	
Effet of FML Bonus shares with 5 new shares for 1 held															
Quatity	9075,471	83589,8604	151257,843	4125,2139	39312,063	13810,499	16717,972	11425,9521	8250,4278	1108,4544	10083,856	2218,1667	4684,9774		
31/12/2010	6806,603	25912,8567	3025,15685	12375,642	19656,032	33835,722	45138,525	17824,4853	3630,1882	50057,802	6453,668	22181,667	26657,522	273555,868	26,97%

End of the investment program: ending value of GHS 273 555,87 from a starting value of GHS 50 000

Appendix V: the recommended portfolio (AEP) investment program (Continued)

Exhibit 2: Investment in defensive stocks and in 91 Day T bill

Strategy A: investment in defensive stocks in restrictive policy stance (from 30/06/08 to 30/04/2010)

Portfolio value as of 01/07/2008 = 124706,942

Date	ABL	AGA	ACI	CMLT	GSR	PAF/PKF	PZ	SWL	TOTAL	Portfolio Value	Semi-annual return
Weight	0,086	0,200	0,086	0,086	0,086	0,086	0,086	0,086	0,200		
Apportioned value	10 689,166	24 941,388	10 689,166	10 689,166	10 689,166	10 689,166	10 689,166	10 689,166	24 941,388	124 706,942	
Quatity Date	92 949,274	831,380	296 921,291	66 807,291	3 448,118	152 702,378	12 010,299	403 364,773	4 082,060		
30/06/2008	10 689,166	24 941,388	10 689,166	10 689,166	10 689,166	10 689,166	10 689,166	10 689,166	24 941,388	124 706,942	46,45%
31/07/2008	11 153,913	24 941,388	17 815,277	10 689,166	10 689,166	10 689,166	11 289,681	12 100,943	25 145,491	134 514,194	
29/08/2008	11 153,913	24 941,388	23 753,703	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	29 390,834	146 619,611	
29/09/2008	11 153,913	24 941,388	26 722,916	10 689,166	10 689,166	10 689,166	13 451,535	12 100,943	31 023,658	151 461,854	
31/10/2008	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 451,535	12 100,943	31 023,658	154 431,067	
28/11/2008	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 451,535	12 100,943	31 023,658	154 431,067	
31/12/2008	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 451,535	12 100,943	31 023,658	154 431,067	23,84%
30/01/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 451,535	12 100,943	31 023,658	154 431,067	
27/02/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	14 412,359	12 100,943	31 023,658	155 391,891	
31/03/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	31 023,658	154 190,861	
30/04/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	31 023,658	154 190,861	
29/05/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	31 023,658	154 190,861	
30/06/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	31 023,658	154 190,861	-0,16%
31/07/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	30 615,452	153 782,655	
31/08/2009	11 153,913	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	30 615,452	153 782,655	
29/09/2009	9 294,927	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	28 574,422	149 882,639	
30/10/2009	9 294,927	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	27 758,010	149 066,227	
30/11/2009	9 294,927	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	27 758,010	149 066,227	
31/12/2009	9 294,927	24 941,388	29 692,129	10 689,166	10 689,166	10 689,166	13 211,329	12 100,943	27 758,010	149 066,227	-3,32%
29/01/2010	9 294,927	24 941,388	29 692,129	10 689,166	10 344,355	10 689,166	13 211,329	12 100,943	27 758,010	148 721,415	
26/02/2010	9 294,927	24 941,388	29 692,129	10 689,166	10 344,355	10 689,166	13 211,329	12 100,943	28 574,422	149 537,827	

End of non-cyclical (defensive) stock investing   **Portfolio ending value= 149 537,83**

Appendix V: the recommended portfolio (AEP) investment program (end
Exhibit 2: Investment in defensive stocks and in 91 Day T bill (end)

Strategy B: Investment in 91 day T bill, from 30/06/2008 to 31/03/2010

Portfolio value as of 01/07/2008 =			124 706,942		
Date	Quater	92 day T bill rate (quaterly rates)	Cumulative re	Portfolio value	Semi-annual return
01/06/2008	Q2:	3,85%	-	-	46,45%
01/09/2008	Q3:	5,69%	1,038	129 504,709	
01/12/2008	Q4:	5,67%	1,098	136 879,751	9,76%
01/03/2009	Q1:	6,32%	1,160	144 645,797	
01/06/2009	Q2:	5,91%	1,233	153 793,696	18,76%
01/09/2009	Q3:	5,93%	1,306	162 876,599	
01/12/2009	Q4:	5,20%	1,383	172 530,200	12,18%
01/03/2010			1,455	181 509,411	

End of 91 day T bill investing   Portfolio ending value=   181 509,411

Source: The Bank of Ghana, The Ghana Stock Exchange

Appendix VI: Monthly returns of the constructed portfolios and their benchmarks

Period	AEP St. A	AEP St. A monthly returns	AEP St. A Cum returns	AEP st. B	AEP st B monthly returns	AEP st. B Cum returns	GSE ASI	GSE ASI monthly returns	GSE ASI Cum returns	Benchmark A	Benchmark A monthly returns	Benchmark A Cum returns	91Day Tbill monthly returns	Benchmark B monthly returns	Benchmark B Cum returns
30/12/2005	50 000,00			50 000,00			4 769,02			50 000,00					
31/01/2006	49 088,30	-1,823%	0,982	49 088,30	-1,823%	0,982	4 692,84	-1,598%	0,984	49 161,69	-1,677%	0,983	0,904%	-0,386%	0,996
28/02/2006	50 782,11	3,451%	1,016	50 782,11	3,451%	1,016	4 730,17	0,795%	0,992	50 048,64	1,804%	1,001	0,904%	1,354%	1,010
31/03/2006	51 998,62	2,396%	1,040	51 998,62	2,396%	1,040	4 764,07	0,717%	0,999	50 688,91	1,279%	1,014	0,904%	1,091%	1,021
28/04/2006	52 416,08	0,803%	1,048	52 416,08	0,803%	1,048	4 780,16	0,338%	1,002	50 912,27	0,441%	1,018	0,782%	0,611%	1,027
31/05/2006	53 203,12	1,502%	1,064	53 203,12	1,502%	1,064	4 843,80	1,331%	1,016	50 902,27	-0,020%	1,018	0,782%	0,381%	1,031
30/06/2006	53 743,34	1,015%	1,075	53 743,34	1,015%	1,075	4 833,33	-0,216%	1,013	51 118,07	0,424%	1,022	0,782%	0,603%	1,037
31/07/2006	53 978,20	0,437%	1,080	53 978,20	0,437%	1,080	4 885,34	1,076%	1,024	51 099,97	-0,035%	1,022	0,812%	0,388%	1,041
31/08/2006	54 374,64	0,734%	1,087	54 374,64	0,734%	1,087	4 913,25	0,571%	1,030	51 233,25	0,261%	1,025	0,812%	0,536%	1,047
29/09/2006	54 651,90	0,510%	1,093	54 651,90	0,510%	1,093	4 943,45	0,615%	1,037	50 989,54	-0,476%	1,020	0,812%	0,168%	1,048
31/10/2006	55 522,17	1,592%	1,110	55 522,17	1,592%	1,110	4 973,33	0,604%	1,043	50 766,03	-0,438%	1,015	0,889%	0,225%	1,051
30/11/2006	56 431,19	1,637%	1,129	56 431,19	1,637%	1,129	4 992,93	0,394%	1,047	50 694,61	-0,141%	1,014	0,889%	0,374%	1,055
29/12/2006	57 599,97	2,071%	1,152	57 599,97	2,071%	1,152	5 006,02	0,262%	1,050	51 330,80	1,255%	1,027	0,889%	1,072%	1,066
31/01/2007	57 701,80	0,177%	1,154	57 701,80	0,177%	1,154	5 012,16	0,123%	1,051	51 510,61	0,350%	1,030	0,851%	0,601%	1,072
28/02/2007	58 268,17	0,982%	1,165	58 268,17	0,982%	1,165	5 044,89	0,653%	1,058	51 480,25	-0,059%	1,030	0,851%	0,396%	1,077
30/03/2007	59 685,90	2,433%	1,194	59 685,90	2,433%	1,194	5 092,25	0,939%	1,068	52 256,74	1,508%	1,045	0,851%	1,180%	1,089
30/04/2007	61 476,16	2,999%	1,230	61 476,16	2,999%	1,230	5 139,65	0,931%	1,078	52 930,55	1,289%	1,059	0,767%	1,028%	1,101
31/05/2007	62 273,14	1,296%	1,245	62 273,14	1,296%	1,245	5 224,47	1,650%	1,096	53 599,18	1,263%	1,072	0,767%	1,015%	1,112
29/06/2007	64 135,67	2,991%	1,283	64 135,67	2,991%	1,283	5 294,58	1,342%	1,110	54 574,94	1,820%	1,091	0,767%	1,294%	1,126
31/07/2007	66 246,52	3,291%	1,325	66 246,52	3,291%	1,325	5 341,76	0,891%	1,120	55 822,59	2,286%	1,116	0,774%	1,530%	1,143
31/08/2007	71 980,69	8,656%	1,440	71 980,69	8,656%	1,440	5 557,38	4,036%	1,165	58 750,75	5,245%	1,175	0,774%	3,010%	1,178
28/09/2007	74 117,63	2,969%	1,482	74 117,63	2,969%	1,482	5 676,77	2,148%	1,190	60 300,52	2,638%	1,206	0,774%	1,706%	1,198
31/10/2007	78 076,64	5,342%	1,562	78 076,64	5,342%	1,562	5 839,62	2,869%	1,224	62 686,00	3,956%	1,254	0,782%	2,369%	1,226
30/11/2007	80 563,72	3,185%	1,611	80 563,72	3,185%	1,611	6 387,16	9,376%	1,339	64 049,55	2,175%	1,281	0,782%	1,479%	1,244
31/12/2007	85 154,65	5,699%	1,703	85 154,65	5,699%	1,703	6 599,77	3,329%	1,384	66 460,75	3,765%	1,329	0,782%	2,273%	1,273
31/01/2008	89 730,44	5,374%	1,795	89 730,44	5,374%	1,795	6 718,88	1,805%	1,409	68 935,62	3,724%	1,379	0,843%	2,283%	1,302
29/02/2008	99 249,16	10,608%	1,985	99 249,16	10,608%	1,985	7 005,29	4,263%	1,469	74 201,84	7,639%	1,484	0,843%	4,241%	1,357
31/03/2008	103 439,85	4,222%	2,069	103 439,85	4,222%	2,069	7 848,14	12,032%	1,646	76 740,03	3,421%	1,535	0,843%	2,132%	1,386
30/04/2008	106 445,36	2,906%	2,129	106 445,36	2,906%	2,129	9 349,59	19,131%	1,960	79 768,60	3,947%	1,595	0,864%	2,405%	1,419
30/05/2008	113 401,88	6,535%	2,268	113 401,88	6,535%	2,268	9 815,22	4,980%	2,058	85 893,34	7,678%	1,718	0,864%	4,271%	1,480
30/06/2008	124 706,94	9,969%	2,494	124 706,94	9,969%	2,494	10 346,30	5,411%	2,169	89 545,80	4,252%	1,791	0,864%	2,558%	1,518
31/07/2008	134 514,19	7,864%	2,690	126286,116	1,266%	2,526	10 650,72	2,942%	2,233	95 945,38	7,147%	1,919	1,266%	4,207%	1,581
29/08/2008	146 619,61	8,999%	2,932	127885,287	1,266%	2,558	10 790,95	1,317%	2,263	104 362,59	8,773%	2,087	1,266%	5,020%	1,661
29/09/2008	151 461,85	3,303%	3,029	129504,709	1,266%	2,590	10 890,80	0,925%	2,284	108 368,07	3,838%	2,167	1,266%	2,552%	1,703

Appendix VI: Monthly return of the constructed portfolios and their benchmarks (Continued)

Period	AEP St. A	AEP St. A monthly returns	AEP St. A Cum returns	AEP st. B	AEP st. B monthly returns	AEP st. B Cum returns	GSE ASI	GSE ASI monthly returns	GSE ASI Cum returns	Benchmark A	Benchmark A monthly returns	Benchmark A Cum returns	91Day Tbill monthly returns	Benchmark B monthly returns	Benchmark B Cum returns
31/10/2008	154 431,07	1,960%	3,089	131917,813	1,863%	2,638	10 781,02	-1,008%	2,261	107530,139	-0,773%	2,151	1,863%	0,545%	1,713
28/11/2008	154 431,07	0,000%	3,089	134375,881	1,863%	2,688	10 573,43	-1,926%	2,217	104742,103	-2,593%	2,095	1,863%	-0,365%	1,706
31/12/2008	154 431,07	0,000%	3,089	136879,751	1,863%	2,738	10 431,64	-1,341%	2,187	102502,010	-2,139%	2,050	1,863%	-0,138%	1,704
30/01/2009	154 431,07	0,000%	3,089	139420,963	1,857%	2,788	10 220,99	-2,019%	2,143	100508,774	-1,945%	2,010	1,857%	-0,044%	1,703
27/02/2009	155 391,89	0,622%	3,108	142009,353	1,857%	2,840	9 836,84	-3,758%	2,063	97233,510	-3,259%	1,945	1,857%	-0,701%	1,691
31/03/2009	154 190,86	-0,773%	3,084	144645,797	1,857%	2,893	9 247,17	-5,995%	1,939	93237,934	-4,109%	1,865	1,857%	-1,126%	1,672
30/04/2009	154 190,86	0,000%	3,084	147632,981	2,065%	2,953	8 822,91	-4,588%	1,850	87165,861	-6,512%	1,743	2,065%	-2,224%	1,635
29/05/2009	154 190,86	0,000%	3,084	150681,856	2,065%	3,014	7 496,02	-15,039%	1,572	84973,084	-2,516%	1,699	2,065%	-0,225%	1,631
30/06/2009	154 190,86	0,000%	3,084	153793,696	2,065%	3,076	5 423,98	-27,642%	1,137	82193,075	-3,272%	1,644	2,065%	-0,603%	1,621
31/07/2009	153 782,65	-0,265%	3,076	156763,609	1,931%	3,135	5 230,49	-3,567%	1,097	83824,689	1,985%	1,676	1,931%	1,958%	1,653
31/08/2009	153 782,65	0,000%	3,076	159790,874	1,931%	3,196	5 900,41	12,808%	1,237	87351,090	4,207%	1,747	1,931%	3,069%	1,704
29/09/2009	149 882,64	-2,536%	2,998	162876,599	1,931%	3,258	6 292,14	6,639%	1,319	84843,332	-2,871%	1,697	1,931%	-0,470%	1,696
30/10/2009	149 066,23	-0,545%	2,981	166032,907	1,938%	3,321	5 378,72	-14,517%	1,128	84785,991	-0,068%	1,696	1,938%	0,935%	1,712
30/11/2009	149 066,23	0,000%	2,981	169250,378	1,938%	3,385	5 386,48	0,144%	1,129	84333,149	-0,534%	1,687	1,938%	0,702%	1,724
31/12/2009	149 066,23	0,000%	2,981	172530,2	1,938%	3,451	5 572,34	3,450%	1,168	84227,543	-0,125%	1,685	1,938%	0,906%	1,739
29/01/2010	148 721,42	-0,231%	2,974	175472,797	1,706%	3,509	5 625,42	0,953%	1,180	85030,340	0,953%	1,701	1,706%	1,329%	1,763
26/02/2010	149 537,83	0,549%	2,991	178465,582	1,706%	3,569	5 541,15	-1,498%	1,162	86704,955	1,969%	1,734	1,706%	1,837%	1,795
31/03/2010	157 504,40	5,327%	3,150	181509,411	1,706%	3,630	6 014,34	8,539%	1,261	87367,802	0,764%	1,747	1,706%	1,235%	1,817
30/04/2010	169 453,13	7,586%	3,389	194697,493	7,266%	3,894	6 518,88	8,389%	1,367	89130,241	2,017%	1,783	1,142%	1,580%	1,846
31/05/2010	191 075,88	12,760%	3,822	218364,701	12,156%	4,367	7 172,08	10,020%	1,504	95003,669	6,590%	1,900	1,142%	3,866%	1,917
30/06/2010	188 138,92	-1,537%	3,763	215453,198	-1,333%	4,309	6 591,10	-8,101%	1,382	92234,024	-2,915%	1,845	1,142%	-0,887%	1,900
30/07/2010	182 597,12	-2,946%	3,652	209017,022	-2,987%	4,180	6 394,02	-2,990%	1,341	90949,673	-1,392%	1,819	1,016%	-0,188%	1,897
31/08/2010	201 897,02	10,570%	4,038	230954,318	10,495%	4,619	6 821,80	6,690%	1,430	95797,417	5,330%	1,916	1,016%	3,173%	1,957
30/09/2010	207 725,51	2,887%	4,155	237506,594	2,837%	4,750	6 835,71	0,204%	1,433	100696,454	5,114%	2,014	1,016%	3,065%	2,017
29/10/2010	208 341,87	0,297%	4,167	239003,57	0,630%	4,780	6 886,31	0,740%	1,444	102710,740	2,000%	2,054	0,984%	1,492%	2,047
30/11/2010	224 037,77	7,534%	4,481	257114,98	7,578%	5,142	7 101,23	3,121%	1,489	106297,990	3,493%	2,126	0,984%	2,238%	2,093
31/12/2010	239 035,20	6,694%	4,781	273555,868	6,394%	5,471	7 369,20	3,774%	1,545	113039,434	6,342%	2,261	0,984%	3,663%	2,169
Average monthly return		2,701%			2,915%			0,958%			1,418%			1,202%	1,310%
Monthly standard deviation		3,545%			2,983%			6,574%			3,165%			0,497%	1,492%
Annual standard deviation		12,280%			10,333%			22,774%			10,965%			1,720%	5,168%

Source: The Bank of Ghana, The Ghana Stock Exchange

Appendix VII: Country Index data

Date	Morocco	Egypt	Ghana	Mauritius	Nigeria	South Africa	Botswana
28/02/2000	-5,61%	-8,70%	-0,26%	-1,84%	4,08%	-5,78%	2,88%
31/03/2000	1,27%	-1,44%	3,15%	-3,41%	-0,36%	-0,09%	2,92%
30/04/2000	-5,86%	-12,07%	13,73%	-1,26%	-1,23%	-6,68%	1,40%
31/05/2000	4,10%	-0,74%	-6,78%	0,96%	3,44%	-1,09%	-0,01%
30/06/2000	-0,75%	-12,84%	0,64%	-0,28%	6,09%	5,47%	-3,79%
31/07/2000	-5,85%	-9,01%	0,50%	-1,34%	6,71%	0,68%	4,51%
31/08/2000	5,72%	-2,17%	0,01%	-0,63%	7,15%	9,71%	4,48%
30/09/2000	-1,57%	-9,72%	4,06%	0,58%	-1,29%	-2,57%	-5,84%
31/10/2000	-2,51%	-2,15%	0,97%	0,24%	1,60%	-1,50%	-0,49%
30/11/2000	-4,82%	6,74%	-0,33%	-1,17%	-3,69%	-4,08%	-2,82%
31/12/2000	-2,12%	-1,27%	-0,96%	-2,67%	13,58%	5,87%	1,90%
31/01/2001	-3,58%	4,40%	0,06%	0,22%	8,42%	9,53%	-0,10%
28/02/2001	11,67%	-12,27%	2,45%	1,49%	4,39%	-0,29%	11,07%
31/03/2001	-2,88%	-8,82%	2,23%	-1,28%	-0,23%	-9,22%	7,43%
30/04/2001	-3,41%	4,60%	-0,15%	2,11%	4,71%	9,99%	4,32%
31/05/2001	-1,88%	2,72%	-0,37%	-4,30%	5,86%	4,14%	7,72%
30/06/2001	-3,00%	7,62%	4,23%	1,08%	7,72%	-1,95%	4,56%
31/07/2001	-6,46%	-8,06%	9,83%	-3,93%	-3,30%	-6,97%	5,77%
31/08/2001	4,22%	13,77%	-7,29%	-1,61%	-2,34%	5,09%	2,74%
30/09/2001	-3,64%	-8,41%	0,68%	-2,62%	-0,53%	-10,00%	0,09%
31/10/2001	-5,01%	-2,81%	0,52%	-1,95%	7,95%	5,95%	4,14%
30/11/2001	3,95%	-9,67%	-0,26%	-0,23%	0,70%	10,98%	3,14%
31/12/2001	0,16%	-1,79%	-0,27%	-2,14%	-1,85%	11,19%	2,83%
31/01/2002	-3,47%	-8,58%	0,15%	9,67%	-2,86%	-1,02%	4,84%
28/02/2002	-1,08%	9,58%	1,31%	-0,25%	-0,64%	5,24%	0,51%
29/03/2002	-0,02%	3,23%	3,94%	0,13%	5,98%	1,29%	2,21%
30/04/2002	-3,33%	-6,45%	2,28%	-5,30%	1,65%	-0,07%	-1,74%
31/05/2002	-2,60%	0,70%	9,34%	0,11%	0,77%	1,75%	0,54%
28/06/2002	-2,26%	-1,54%	8,24%	1,31%	8,31%	-4,71%	-2,37%
31/07/2002	-4,65%	-0,68%	2,85%	1,97%	0,14%	-13,31%	-2,99%
30/08/2002	2,31%	1,85%	-10,30%	2,61%	-1,05%	4,74%	1,04%
30/09/2002	-3,83%	1,79%	-0,09%	1,20%	-4,19%	-2,19%	-0,47%
31/10/2002	-1,71%	0,37%	2,39%	-0,19%	-3,05%	-0,94%	-1,25%
29/11/2002	2,10%	1,58%	1,71%	1,77%	1,50%	2,00%	2,99%
31/12/2002	0,98%	-0,14%	2,40%	3,51%	4,43%	-3,00%	-1,09%
31/01/2003	3,01%	16,65%	2,82%	12,30%	9,57%	-5,16%	-2,25%
28/02/2003	4,87%	-3,98%	3,93%	-5,55%	2,78%	-4,50%	-5,24%
31/03/2003	-4,36%	2,08%	10,24%	0,44%	-1,01%	-8,60%	-1,15%
30/04/2003	6,30%	13,92%	7,47%	6,85%	-0,32%	-2,21%	-0,77%
30/05/2003	1,82%	15,56%	5,58%	4,57%	4,44%	14,03%	0,02%
30/06/2003	6,96%	4,58%	11,78%	2,39%	3,40%	-2,48%	-1,37%
31/07/2003	-1,18%	-4,82%	11,06%	-2,26%	-4,14%	5,48%	0,12%
28/08/2003	5,17%	11,22%	9,02%	-0,98%	12,45%	4,33%	0,94%
30/09/2003	1,11%	18,29%	4,72%	5,04%	5,10%	-2,88%	3,85%
31/10/2003	1,12%	10,30%	9,67%	7,17%	13,59%	9,41%	1,93%
28/11/2003	1,94%	1,22%	13,86%	3,18%	3,07%	-0,37%	3,27%
31/12/2003	2,13%	6,52%	7,65%	0,49%	4,19%	6,76%	1,22%
30/01/2004	4,37%	14,05%	6,88%	5,83%	12,84%	4,45%	1,00%
20/02/2004	3,04%	0,65%	13,55%	1,94%	5,00%	1,24%	3,82%
31/03/2004	5,48%	5,05%	31,35%	2,49%	-3,99%	-2,65%	2,27%

Appendix VII: Country Index data (Continued)

Date	Morocco	Egypt	Ghana	Mauritus	Nigeria	South Africa	Botswana
30/04/2004	3,30%	10,17%	14,87%	5,85%	12,65%	-1,55%	4,18%
28/05/2004	-1,66%	-7,45%	0,00%	1,07%	5,78%	-2,08%	2,61%
30/06/2004	-1,00%	1,41%	8,27%	0,78%	0,00%	-1,93%	-0,66%
29/07/2004	0,35%	9,47%	1,10%	-0,84%	-1,87%	1,35%	-0,27%
31/08/2004	1,46%	11,11%	2,71%	-1,15%	-7,38%	8,94%	-0,06%
30/09/2004	-1,53%	7,93%	-4,35%	2,91%	-8,29%	5,38%	2,02%
29/10/2004	-15,61%	0,00%	-0,93%	1,59%	2,71%	-1,12%	0,20%
30/11/2004	3,35%	27,39%	-2,68%	3,16%	-0,36%	7,40%	0,43%
31/12/2004	14,95%	6,58%	0,76%	2,63%	2,47%	1,33%	-0,79%
31/01/2005	0,89%	36,60%	1,34%	2,67%	-3,23%	1,12%	0,50%
28/02/2005	-2,54%	11,47%	-2,21%	0,89%	-4,86%	5,30%	1,32%
31/03/2005	-1,36%	0,19%	-4,21%	1,08%	-5,79%	-1,32%	2,71%
29/04/2005	2,03%	6,87%	-5,36%	-4,08%	6,19%	-5,58%	2,35%
31/05/2005	4,74%	2,45%	-0,95%	0,07%	-2,18%	9,80%	3,40%
30/06/2005	-0,37%	12,57%	-3,10%	1,28%	0,39%	2,67%	2,44%
29/07/2005	4,98%	0,75%	-14,16%	1,77%	1,61%	6,99%	1,11%
31/08/2005	4,01%	-1,02%	-3,78%	4,17%	4,68%	1,79%	-0,09%
30/09/2005	0,24%	13,73%	0,74%	8,58%	7,41%	9,48%	4,83%
31/10/2005	3,27%	2,65%	0,34%	-2,55%	5,02%	-2,62%	1,90%
30/11/2005	5,34%	0,28%	-2,07%	0,91%	-5,87%	2,08%	0,38%
30/12/2005	-0,38%	10,99%	-0,51%	-1,82%	-1,11%	7,88%	0,31%
31/01/2006	20,13%	26,73%	-1,60%	2,72%	-1,58%	9,11%	2,93%
28/02/2006	4,61%	-10,58%	0,80%	2,43%	0,58%	-3,34%	4,07%
31/03/2006	5,57%	-4,57%	0,72%	0,27%	-2,12%	6,64%	3,51%
28/04/2006	9,89%	-3,48%	0,34%	-2,42%	-0,15%	3,85%	4,98%
31/05/2006	-11,50%	-17,89%	1,33%	-1,92%	6,20%	-2,70%	2,30%
30/06/2006	0,39%	-11,01%	-0,22%	3,64%	5,72%	3,27%	4,07%
31/07/2006	-1,60%	18,89%	1,08%	3,56%	6,57%	-1,66%	4,79%
31/08/2006	11,52%	9,84%	0,57%	5,08%	18,71%	5,11%	8,73%
29/09/2006	2,51%	3,40%	0,61%	5,47%	-1,85%	1,92%	5,68%
31/10/2006	4,48%	2,55%	0,60%	11,07%	0,49%	4,31%	14,43%
30/11/2006	8,20%	-0,74%	0,39%	16,63%	-3,10%	2,62%	0,72%
29/12/2006	3,27%	6,29%	0,26%	-3,71%	5,46%	4,03%	1,22%
31/01/2007	10,98%	-4,27%	0,07%	4,08%	10,27%	2,14%	3,54%
28/02/2007	2,50%	7,33%	0,70%	3,78%	10,73%	1,37%	12,19%
30/03/2007	7,29%	0,37%	0,94%	3,49%	6,69%	5,70%	8,29%
30/04/2007	7,24%	3,29%	0,93%	2,59%	8,44%	3,31%	2,15%
31/05/2007	-3,82%	4,60%	1,65%	-2,89%	5,95%	1,62%	11,34%
29/06/2007	-3,29%	0,43%	1,34%	6,84%	2,44%	0,73%	8,40%
31/07/2007	1,24%	5,65%	0,89%	2,98%	3,66%	0,00%	2,81%
31/08/2007	8,73%	-6,01%	4,04%	-1,37%	-5,15%	0,00%	-0,13%
28/09/2007	1,54%	11,59%	2,15%	6,03%	-0,12%	0,00%	-0,99%
31/10/2007	0,26%	8,60%	2,87%	11,32%	-0,05%	0,00%	-5,64%
30/11/2007	-1,32%	3,52%	9,38%	6,52%	7,94%	0,00%	-2,93%
31/12/2007	0,09%	8,52%	3,33%	1,21%	4,93%	0,00%	-5,88%
31/01/2008	8,78%	-2,99%	1,80%	6,11%	3,00%	0,00%	-1,84%
29/02/2008	4,86%	10,75%	4,26%	2,45%	11,11%	0,00%	-0,96%
31/03/2008	1,42%	0,20%	12,03%	-6,59%	-3,16%	0,00%	-1,36%
30/04/2008	-2,04%	3,78%	19,13%	-1,45%	-5,67%	0,00%	-10,12%

Appendix VII: Country Index data (end)

Date	Morocco	Egypt	Ghana	Mauritus	Nigeria	South Africa	Botswana
30/05/2008	0,898%	-6,187%	4,980%	1,194%	-0,861%	0,000%	-4,465%
30/06/2008	-2,245%	-11,124%	5,411%	-1,795%	-5,057%	0,000%	3,596%
31/07/2008	-0,397%	-5,862%	2,942%	-6,030%	-5,073%	4,044%	3,165%
29/08/2008	-1,020%	-9,469%	1,317%	-4,345%	-10,020%	0,000%	4,390%
30/09/2008	-10,742%	-15,714%	0,925%	-5,451%	-3,292%	-20,557%	10,052%
31/10/2008	-4,086%	-33,190%	-1,008%	-15,171%	-21,400%	-11,933%	-1,825%
28/11/2008	-7,165%	-14,260%	-1,926%	-11,821%	-7,742%	1,038%	-6,443%
31/12/2008	-1,214%	13,670%	-1,341%	0,996%	-6,155%	1,413%	-10,037%
30/01/2009	-7,747%	-15,698%	-2,019%	-3,796%	-30,642%	-4,366%	-3,323%
27/02/2009	10,620%	-7,158%	-3,759%	-18,588%	7,167%	-10,232%	-4,469%
31/03/2009	-7,202%	16,577%	-5,995%	15,727%	-15,194%	12,656%	-0,715%
30/04/2009	5,151%	23,782%	-4,396%	5,057%	8,403%	-0,747%	-4,819%
29/05/2009	0,791%	9,130%	-15,210%	15,057%	38,198%	10,285%	-0,823%
30/06/2009	5,117%	0,663%	-27,642%	9,389%	-9,558%	-2,030%	2,352%
31/07/2009	-5,323%	8,254%	-3,567%	4,603%	-5,863%	8,742%	2,572%
31/08/2009	0,702%	8,940%	12,808%	0,766%	-9,007%	4,051%	5,353%
30/09/2009	-2,564%	0,538%	6,639%	10,779%	-4,103%	-1,174%	2,504%
30/10/2009	0,097%	3,025%	-14,517%	1,600%	-1,180%	5,676%	1,549%
30/11/2009	-5,264%	-15,759%	0,144%	-3,060%	-3,643%	1,700%	7,097%
31/12/2009	2,305%	5,799%	3,450%	1,884%	-0,872%	2,878%	-3,554%
28/01/2010	5,206%	7,848%	0,322%	3,609%	8,223%	1,265%	1,137%
26/02/2010	0,995%	0,348%	0,789%	-4,342%	1,975%	-4,170%	4,994%
31/03/2010	2,902%	1,291%	6,744%	-0,402%	12,970%	7,409%	-2,761%
30/04/2010	7,603%	9,486%	8,389%	2,915%	1,876%	-0,389%	0,925%
31/05/2010	-1,778%	-12,114%	10,020%	-4,582%	-1,021%	-5,005%	-3,536%
30/06/2010	-2,441%	-7,878%	-8,101%	2,745%	-3,052%	0,204%	0,989%
30/07/2010	0,073%	4,698%	-2,990%	3,742%	1,813%	4,025%	1,658%
31/08/2010	-0,393%	1,447%	6,690%	0,210%	-6,098%	-3,884%	-0,590%
30/09/2010	1,365%	3,532%	-0,592%	2,395%	-5,018%	5,360%	-0,544%
29/10/2010	2,525%	0,856%	1,546%	5,735%	8,640%	5,977%	-0,472%
30/11/2010	0,225%	0,206%	3,121%	2,414%	-1,108%	2,466%	-2,956%
31/12/2010	3,526%	6,522%	3,774%	3,181%	0,024%	3,007%	-10,145%
Annal SD	17,62%	34,07%	22,87%	17,31%	25,78%	18,82%	14,24%
Annal return	9,15%	17,07%	21,41%	14,70%	14,19%	13,15%	14,92%

Source: African Business Research Institute

Table of contents