The covariation of South African and foreign equity returns during bull and bear runs: Implications for portfolio diversification

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DECLARATION

I, the undersigned, Godfrey Mhlanga hereby declare that this dissertation is my own original work and this work has not been presented at any other University for similar academic assessment or for any other degree.

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ABSTRACT

This study examines the pattern of covariation of the industrial index returns of South Africa and foreign industrial sectors. This follows recent increase in national equity correlations and increases in the influence of industry effects in portfolio diversification. The covariation pattern in returns across industries and countries during both bull and bear runs is examined using correlation analysis to determine if there is a difference between the two epochs. The study presents preliminary evidence of the covariation between sectors during a bear and a bull run. Return covariation among sectors is impelled to a greater extent by country-specific factors than by industry-specific factors, implying the segmentation of industrial sectors. Thus, South African investors can in general gain more if a portfolio comprising shares across industries and countries is held, even if these investors buy shares from similar industries.

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CHAPTER ONE

INTRODUCTION

The covariation of equity prices or returns among the world's equity markets is vital to investors seeking international portfolio diversification. Such covariation has increased in recent years, generating significant interest among academic financial economists and portfolio managers. Despite the identification of international portfolio diversification benefits by Grubel (1968) and Levy & Sarnat (1970), such benefits have diminished due to the ability of investors domiciled in one country to purchase Exchange Traded Funds (ETFs) comprising foreign shares as well as increasing covariation between global equity markets. Covariation is increasing due to the gradual abolition of capital market restrictions and advances in technology since the 1980's. In the latter case, the consequence has been that information pertinent to investment decisions is available more easily and cheaply. Increases in equity market covariation amplify the exposure of individual domestic markets to the vagaries of global financial asset markets and affect the potential gains available from internationally diversified equity portfolios. Investors can gain by holding an investment portfolio comprising equities with diverse risk-return characteristics. In the simple bilateral case, if there is negative correlation between the return to a domestic asset and the return to a foreign asset, then an investor can gain by constructing a portfolio comprising the foregoing assets since declines in the domestic asset's price will be balanced by growth in the foreign asset's price and vice versa. Investments in such globally segmented markets yield greater returns to a globally diversified investment portfolio, for a given level of risk. When investors diversify to a significant extent in the bilateral case, it is expected that the correlation between the returns to the two assets will increase in magnitude and become positive, implying a drop in home bias and the integration of these asset markets. Such integration has renewed interest in covariation among asset markets as it manifests in greater volatility linkages between markets arising from global events. This has also been accompanied by financial market liberalisation. As a result, there has been a profound change in the length and magnitude of bull and bear runs on equity markets during the last two decades, which cause or exacerbate equity market covariation. Greater covariation between national equity market returns is identified by Meric & Meric, 1998; Brooks & Catào, 2000 and Baca *et al.,* 2000 and attributed to globalisation, financial and trade liberalisation, the synchronisation of capital market regulations as well as advances in information technology.

Although significant attention has been given to the study of covariation among national equity market returns, little attention has been given to the portfolio diversification implications of equity return covariation among industry sectors of companies listed on an equity exchange. However, interest in the portfolio implications of sector or industry index returns is growing (Roll, 1992; Hargis & Jianpin, 2006 and Meric *et al*.., 2008). Flavin, (2004) finds high return variation in returns of sector equity indices of sectors in the same country due to sector dispersion. Thus, economic agents should invest in diverse sectors, because a shock to the economy will have different effects on the returns of equities in various sectors, thus yielding a well diversified portfolio.

National and regional asset class delineation is used by practitioners in passive global investment strategies (Soriano & Climent, 2000). This is consistent with the assumption that most of the benefits of international diversification can be ascribed to national effects. Industry allocation in investment considerations is often considered a secondary issue, despite the segmentation of industrial sectors across countries. Such segmentation is due to the heterogeneous characteristics of individual sectors (Baca, *et al.*, 2000, Cavaglia *et al.*, 2000). Asymmetries in sector return movements are the result of some industries being more sensitive to some shocks than others, such as the effect of commodity prices being greater on mining stocks than on financial stocks, since the earnings of the latter companies are less reliant on commodity prices than the former.

When the heterogeneity of industrial sectors is considered in international portfolio diversification decisions, investors can gain despite the increasing integration of national equity markets. The major source of industrial equity heterogeneity is the sectors' characteristic differences across countries (Baele & Inghelbrecht, 2005). Sectors with higher international trade exposure tend to covary more with similar sectors internationally. For example, financial and energy stocks covary to a considerable extent due to these stocks being associated with channels that propagate shocks across countries. However, overall sector differences between countries means that their reaction to common shocks will be different, thereby yielding greater potential gains when investors choose international portfolio diversification across sectors.

Extant studies of covariation tend to focus on developed equity markets only, partly due to data availability constraints and investors' needs. Few studies have been done in emerging and underdeveloped equity markets of Latin America, Asia and Africa. Most of the studies done on the African equity markets (Lamba & Otchere, 2001, Ogum, 2001) focus on issues of market integration and volatility linkages.

This study investigates the covariance structure of sector equity returns during a bull and a bear market and evaluate the portfolio diversification implications of such a structure from the point of view of a South African investor. The covariance structure is examined for South African and selected foreign sector equity market returns. This is to assist investors in selecting equities from sectors with negative return covariation, as this will maximise portfolio returns or minimise average portfolio risk. The study seeks to establish if the covariance structure differs during bull and bear periods. This will assist regulators and monetary policy authorities in anticipating the sign and magnitude of net portfolio investment changes during bull and bear runs in the case of South African equity market and therefore design appropriate regulations and practices that minimise disruptions to the local financial market.

The remainder of this study is organised as follows. Chapter Two describes the theoretical and empirical literature. The data and method used in the empirical analysis are described in Chapter Three, while Chapter Four contains the results of this analysis. Chapter Five concludes the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter describes the theoretical and empirical literature relating to equity portfolio diversification between industries, countries and regions during bull and bear market periods.

2.2 Theoretical Literature

The theory guiding portfolio diversification is discussed and it begins with the simple mean variance model, followed by the Capital Asset Pricing model and its later variants and ends with the recent Resampled Efficiency technique

2.2.1 Mean Variance Framework

Harry Markowitz (1952, 1959) introduces the mean-variance concept that guides optimal portfolio selection by identifying securities that yield maximum returns for a given level of risk. The optimal portfolio should lie on Markowitz (1959)'s efficient frontier and as such is called an efficient frontier portfolio.

Tobin (1958), Sharpe (1964) and Lintner (1965) then extend the mean variance concept. Tobin (1958) adds a risk-free asset to the universe of investment assets, making it feasible to buy both risky and risk-free assets. Investors can borrow at a lower rate and then invest for higher returns in a process called leveraging of portfolios. However, optimal portfolio selection using the Markowitz-Tobin separation theory has practical difficulties because investors must calculate the covariance of returns for each asset comprising a given assets universe. This deficiency is addressed by Sharpe (1964) and Lintner (1965) who introduce the single period Capital Asset Pricing Model (CAPM), which decomposes asset risk into asset-specific and systematic risk with risk premium being only paid for systematic risk.

2.2.2 Capital Asset Pricing Model (CAPM)

The single period CAPM model is obviously deficient in inter-temporal portfolio considerations. Merton (1973) assumes that investors choose portfolios over multiple periods, thus the inter-temporal CAPM (ICAPM) is developed in which excess returns are considered proportional to expected variance of returns on the general market index. Thus, the risk premium for an asset or portfolio of assets depends on conditional expected covariance, which is time-varying, implying that the risk premium is dynamic and depends on the expected state of the market. Mankiw &

Shapiro (1986) propose that the risk premium on an asset depends on the covariance of an asset with consumption rather than the conditional expected variance with the market portfolio as in the ICAPM. This is referred to as the consumption-CAPM (C-CAPM) model. The main deficiency of the C-CAPM is that it considers only consumption to be the only relevant factor in explaining equity returns.

Instead of assuming a single factor model with time-varying coefficients, multifactor models with additional explanatory factors, but with constant coefficients are proposed for a portfolio model that can better explains risk premium. In these models, equity returns depend on the covariances of all factors with the asset's return. These factors are can be accurately measured than consumption. Fama & French (1992a) develop a three factor model CAPM after observing that small capitalisation and value stocks tends to earn higher returns than those estimated by the CAPM, with size and the value of equities used as factors explaining returns. The three-factor model significantly improves the performance of the standard CAPM in explaining equity returns, explaining most of the variation in returns.

With globalisation, investors face additional risks in the form of currency and country risks, all termed 'world risk'. Campbell (1993) develops the international CAPM, which consists of regions and countries as separate asset classes. This model can forecast risk premia, sensitivity (betas) of the portfolio and optimal currency hedge and asset allocation for an optimally diversified portfolio. The international CAPM is similar to the standard CAPM except that it includes additional covariances for the real exchange rate and inflation. Ng (2004) finds that these additional variables are sufficient hedging terms to explain returns from foreign assets.

Kraus & Litzenberger (1976) suggest that higher moments be included in asset pricing because equity returns are not normally distributed, thus, investment portfolios must contain skewness and kurtosis measures in addition to mean and variance as measures of risk and return. Ferson & Harvey (1998) show that multifactor models underperform in explaining risk premia because such models ignore conditioning information on returns. Harvey & Siddique (2000) use the three-moment CAPM that incorporate coskewness[1] in asset returns to price risk and show that a link between risk premia and systematic coskewness exists. In addition to mean and variance, Ferson & Harvey (1998) and Harvey & Siddique (2000) include coskewness in a three moment CAPM to explain excess returns of equities. Investors prefer portfolio returns that are skewed

[1] Coskewness is a statistical measure of symmetry in a variable in relation to another variable, while cokurtosis is measure of the peakiness of the probability distribution of variable relative to another

rightwards. Skewness is important in strategic investment decision making where equities exhibit asymmetric ex post returns due to agency and limited liability problems. Dittmar (2002) adds a fourth-moment in the CAPM to take into account cokurtosis in pricing risk. Equity return distributions are leptokurtic and this is an indication of high future downside risk and such risk should be optimally priced in the portfolio. This implies that risk premia on equity is explained by covariance, coskewness and cokurtosis.

2.2.3 Resampled Efficiency Technique

Michaud (1998) introduces the Resampled Efficiency technique given the deficiencies of the mean variance approach of Markowitz (1959). Mean variance deficiencies are that its estimates are very sensitive to uncertainty in the risk and returns. This leads to an unstable portfolio management framework, ambiguous portfolio optimality and inefficient out of sample forecasts. These problems lead to equal weighting of assets in the portfolio, an outcome that has no practical value because assets have unique risk-return characteristics. Michaud (1998) argues that the value limit of the mean-variance does not lie with the theory, but with the inputs used, of which the most conspicuous is the tracking error. This is crucial in portfolio management because if risk-return estimates are uncertain and sensitive to changes in optimisation inputs, portfolio optimality becomes quite ambiguous. Michaud (1998) uses the Monte Carlo Resampling and bootstrapping methods with mean-variance optimisation to produce a more realistic level of uncertainty in investment information. In addition, the technology includes trading and rebalancing rules for optimal trade and portfolio rebalancing. The resulting portfolio is an average of many properly associated portfolios that are mean-variance optimal and therefore safe, stable and are less extreme investments. Michaud & Michaud (2002) introduce meta-resampling to eliminate the problem of asset weight skewness in portfolio rebalancing and monitoring. Markowitz & Usmen (2003) test and confirm the superiority of the Resampled Efficiency Technique over simple mean-variance approach. Michaud & Michaud (2008) further refines the Resampled Efficiency techniques by factoring in an estimation error (uncertainty) in a Bayesian-like framework and also include other improvements to the optimisation inputs that address other pitfalls of mean-variance analysis.

This body of theory forms the basis of portfolio diversification based on asset class, country and industry allocation in security selection. It also guides investment strategies pursued, for example tactical, passive and dynamic asset allocation to maximise portfolio gains for a given level of risk.

2.3 Empirical Literature

The empirical literature comprises studies of the inter-temporal stability of equity covariance between international equity markets, state dependence of equity covariation during high and low volatility regimes and also during bull and bear market periods.

2.3.1 Inter-temporal Covariation Of Equity Prices

Levy & Sarnat (1970) follows Grubel (1968) and Lee (1969) in using the Markowitz-Tobin model as a rule for international portfolio diversification. These authors find that the degree to which risk is reduced or portfolio rewards are enhanced depends on the correlation between equity returns contained in a portfolio. Levy & Sarnat (1970) note that the prevalence of positive correlation between equity returns within domestic economies is greater than correlation between twenty-eight national equity markets for the 1951-1967 period, thus international portfolio diversification can be more beneficial than domestic portfolio diversification.. Levy & Sarnat (1970) use a set of efficient portfolios by selecting those countries associated with greater returns for a given level of risk and the CAPM to determine the proportion or weighting of each country in the portfolio. South Africa features in the five preliminary portfolios as a borderline investment country with countries such as Venezuela, New Zealand and Mexico. To select the final optimal portfolio for a US investor, correlation analysis is used to determine the covariation of equity in the selected countries. The inclusion of equities from both the developed and emerging equity markets in an American investor's portfolio significantly improves the performance of the portfolio. This result demonstrates that international portfolio diversification is beneficial, so practitioners have since been considering international equities in optimal portfolio construction.

To select an ex-ante optimal investment strategy which is neither costly to estimate nor naïve, Philipatos *et al.* (1983) study international portfolio diversification focusing on sufficient conditions for an inter-temporal stability of a correlation matrix of national equity indices. Philipatos *et al.* (1983) advocate for the use of a full covariance model, one that incorporate an entire correlation matrix, of the kind used by Maldonado & Saunders (1981) on multi-directional correlation between the US equity returns to other countries' returns. Monthly equity returns from industrialised countries comprising, US, UK, Netherlands, Belgium, Switzerland, Canada, Denmark, Austria, France, Germany, Italy, Sweden, Japan and Norway for the period January 1959 to December 1978. Methods used in this study to examine the pattern and stability of correlations between national markets in the sample period are cross country correlations,

covariance matrix analysis as well as Principal Components Analysis. Philipatos *et al.* (1983) conclude that equity market relationships are stable between countries during medium term investment horizons. Results support the stability of inter-market relationships or predictable covariance structures in markets of developed countries' equity markets. Thus, there are few gains associated with international portfolio diversification as national equity index movements are predictable.

Meric & Meric (1989) study the influence of seasons on the covariance structure of industrial stocks and the stability of inter-temporal aggregate market relationships. The correlation matrix identifies industrial equities from which a diversified portfolio can be constructed. Meric & Meric (1989) argue that portfolio diversification across countries, even in the same industry is more beneficial to the investor than domestic diversification across industries as factors that drive industrial sectors are diverse and affect industrial equities differently. Seasonality in equity covariation is tested and it is found that correlations between equities change with seasons, implying that, portfolio managers can maximise portfolio diversification benefits by rebalancing the industrial/sector weights in a portfolio for each season. Meric & Meric (1989) use equity indices spanning from January 1973 to December 1987 from seventeen industries and seventeen leading industrial countries. The correlation matrix is obtained from principal component analysis. The findings are that correlations are seasonally unstable for industrial equity, because in the short term, industry-specific factors influence equity movement more than country factors. National equity indices are unstable in the short term but become more stable with time as covariations are eventually driven by fundamentals instead of news events. Therefore, there is more potential for portfolio diversification at industry level across countries than domestically in the short term, while country diversification is more beneficial during longer horizons.

De Goeij & Marquaring (2004) model the conditional time-varying covariance of equity and bond returns in order to analyse the inter-temporal relationship of bond and stock returns. De Goeij & Marquaring (2004) assume that the covariance matrix follows a multivariate GARCH process which allows for asymmetric responses in the conditional covariance to equity return shocks. In addition, leverage effects evident in the asymmetric responses of variances and covariances to shocks can be attributed to a "herd effect" which occurs during bear market phases. During such phases, investors pay less attention to economic and investment fundamentals and sell their stock holdings out of panic, thinking that others are selling, thus prices decrease. This leads to higher volatility and covariation during bear than in bull periods.

Daily data from two stock market indices, the NASDAQ composite and the Standard & Poor's 500 are used, while the bond indices used are the one-year and the ten year US Treasury bond index for January 1982 - August 2001 period. Following Bollerslev *et al.* (1988) and Kroner & Ng (1998), the conditional covariance matrix is estimated by assuming that it follows a GARCH process. De Goeij & Marquaring (2004) find that variances and covariance respond asymmetrically to return shocks. Covariance between stock returns and the bond yields seem to be greater after bad news than after good news of the same magnitude. However, these cross asymmetries in the covariance structure of equity returns are important for portfolio diversification. Investors can benefit from tactical asset allocation if they consider the leverage effects of asymmetric conditional covariance and time-varying risk premia.

Covariation of equity returns among European industrial sectors are investigated by Taing & Worthington (2005). The covariance structure of the post-Euro adoption period from 1999 to 2002 is examined using index data from six selected members of the European Union comprising Belgium, Finland, Germany, Ireland, France and Italy. The indices are classified according to the Global Industry Classification Standard (GICS) as consumer discretionary, consumer staples, financials, industrials and materials. Covariation among these equity returns is examined using Multivariate co-integration procedures, Granger Causality tests and Vector-Autoregressive techniques to establish short and long term covariance structures among the sectors within the selected countries. Taing & Worthington (2005) find that equity market linkages and covariation exist between European Union industrial sectors. Few long term relationships and many short run causal relationships are found among industrial sectors. The sectors that covary the most are the consumer discretionary, financials and the materials sectors; hence, gains from diversifying only in these sectors across the countries are minimal. More gains can however be obtained by investing in the remaining industries.

2.3.2 Covariation Of Equity Returns During High And Low Volatility Regimes

Roll (1992) examines the relationship between industrial structure and the comparative behaviour of international equity markets. This relates particularly the existence of puzzling features such as high levels of volatility in some markets, low correlations among global equity markets despite rapid integration and the failure of macroeconomic variable to explain a significant portion of equity returns behaviour. Using industrial and national equity indices data from twenty-four countries across the world including South Africa, Roll (1992) uses the Herfindahl measure of industry and country concentration in a bivariate regression to determine

the contribution of country and industry effects on stock market movements. The results are that the correlation structure and covariance patterns are affected by differences in volatilities of equity indices. South Africa's and Hong Kong's equity markets are the most volatile due to idiosyncrasies in their constituent industries. For example, South Africa is dominated by resources listings, which are volatile due to changing world commodity prices. Countries with similar industry constituents covary more than those with different industries. Currency risk also influences equity volatility and covariation. Roll (1992) concludes that the higher a Herfindahl index is for a given portfolio, the less diversified the portfolio is, as measured against the Herfindahl three-digit industry index benchmark. National equity indices returns behaviour is also found to be influenced by the technical process of index construction, where concentrated portfolios may show variability mimicking a particular industry while diversified indices show less variability. Despite increasing integration, macroeconomic variables are found only to explain a small portion of observed volatility in equity prices.

Arshanapalli *et al.* (1997) study the common volatility process in the financial assets of nine industrial stocks in three economic regions to identify their covariance structure and to unravel the portfolio diversification implications of identified covariation. The paper uses a common feature ARCH procedure following Engle & Kozicki (1993) on industrial indices that are not affected by the problem of composition apparent in composite national indices. National or domestic intra-industry has minimal potential diversification benefits due to greater covariation among their indices, whilst more portfolio diversification benefits can be obtained by investing across regions, even in the same industry. Diversification is found to be more beneficial to investors who invest in different industries across regions due to regional and industry specific factors that reduce the covariation in the returns of stocks in the portfolio. These results are consistent with Roll (1992) who finds higher correlations in similar industries than in different industries, which implies the potential for gains in an internationally diversified portfolio containing stocks from different sectors and from different countries or regions.

Ramchand & Susmel (1998) also investigate whether correlation between equity returns between major equity markets change between a high volatility and a low volatility market regime by comparing the correlation and variance between American equity returns and leading foreign equity returns over time. Although there is empirical evidence of cross country correlations increasing over time due to financial and economic integration (King & Wadhani, 1990, Meric *et al.*, 1998, 2001, 2007), there is considerable evidence that correlations also increase during

unstable times such as low and high volatility market periods. A switching ARCH (SWARCH) technique, comprising time-varying variance and conditional variance and covariance captures the changing volatility regimes. Ramchand & Susmel (1998) apply the bivariate SWARCH model on sample data and results affirm the existence of a time and state (regime) varying covariation between international stock markets. Ramchand & Susmel (1998) find that correlations during high volatility state are between two and three- and-half times higher than during a low volatility regime

To test the proposition that covariance asymmetry rather than beta asymmetry is a better a better framework for analysing changing risk premia, Dean & Faff (2000) examine individual Australian equities after arrival of good and bad news arrives and when market conditions change. Dean & Faff (2000) argue that examining the co-variances of equity returns for asymmetry is a natural way to investigate whether the systematic risk of an asset varies asymmetrically to changing market conditions inter-temporally. Daily total equity returns from the Australian Stock Exchange (ASX) top fifty and selected stocks outside the top fifty are used in this study for the period January 1988 - November 1999. The findings of this study are that good news at the market level reduces the stock return covariance, implied volatility and therefore the risk premium on stocks while bad news increases stock return covariances substantially so that there is a need for risk premium to increase.

Given that findings of earlier empirical studies on the inter-temporal stability of markets covariation are contradictory, Chesnay & Jondeau (2001) investigate the correlation patterns during periods of high and low volatility. Stable market relationships are found by Kaplanis, (1988) and Ratner (1992) while inter-temporally changing relationships are found by Lee & Kim (1993) and Bertero & Mayer (1990). This issue is crucial to portfolio management as potential benefits of diversification diminish when they are needed most, that is, when markets are turbulent due to rising risk or falling returns. The study uses a multivariate Markov switching model, in which the correlation matrix can change across regimes and the second step tests whether the correlations are regime dependent. Equity returns from the DAX (Germany), Standard & Poor's (US) and the FTSE indices (UK) for the period 1988 to 1999, the most dominant and traded stocks in each market are considered. Chesnay & Jondeau (2001) conclude that stock market correlations effectively increase during turbulent times, that is, during a period of high stock market volatility. Thus, the benefits from diversification between stock markets studied drop when risk is high.

The hypothesis of high stock returns correlations across the American, British, Germany, French and Japanese equity markets during high volatility periods in equity markets is also tested by Longin & Solnik (2001). These authors posit that testing the hypothesis of higher correlations during volatile stock market periods is difficult and often mislead researchers to produce spurious results of the relationship between volatility and correlations. The usual approach among practitioners is to condition correlations on realised equity returns, which can lead to the wrong conclusions due to the complex dynamics of these returns. Boyer *et al.* (1999) show that conditional correlation is non-linear if conditioned on returns. Thus, Longin & Solnik (2001) investigate the correlation structure of equity returns using the extreme value method. This follows Ledford & Tawn (1997), who derive an asymptotic distribution of the conditional tail correlation, a technique which is impossible using other methods. The extreme value method is superior to other methods because its results hold for many parametric distributions of returns. Monthly index returns for the US, UK, Germany, Japan and France for the period 1959 to 1996 are used in the study. Solnik & Longin (2001) find that large negative returns do not converge to zero but tend to increase as the threshold level increases; hence multivariate normality in negative returns is rejected. However, the hypothesis of multivariate normality in returns cannot be rejected as positive returns converge to zero. Thus, correlations between equity returns increase during negative volatility shocks but not during positive shocks. Another important finding is that, it is not volatility per se that affects equity return correlations as postulated in many studies, but that factors driving volatility and correlations are similar. The difference in conclusions about the relation between volatility and correlations may be attributed to the postulated data generating process and therefore the model specified, rather than volatility actually impelling equity market correlations.

Bartram & Wang (2005) study the relationship between market cross-correlation and volatility. In view of Forbes & Rigobon's 2002 finding that the covariation of global stock market returns is a result more of interdependence than contagion, which is in contrast to suggestions by many empirical studies that link correlation to volatility (Ramchand & Susmel, 1998, Solnik & Longin, 2001, Butler & Joaquin, 2002). Forbes & Rigobon (2002) argue that correlation coefficients are biased measures of dependence when the market is highly volatile, and that there is no evidence of contagion when the correlations are corrected for such biases. Solnik & Longin (2001) finds volatility and correlations as caused by common factors. Bartram & Wang (2005) explore the impact of volatility on cross market dependence using simulated series of financial returns, which follows an alternative stochastic process similar to that of financial data used in other empirical

research. This study's results which are based on the simulated time series of returns show a correlation bias for a regression with homoscedastic error terms and a constant variance framework similar to Forbes & Rigobon (2002). However, Bartram & Wang (2005) conclude that correlations are not biased measures of dependence in volatile markets if heteroscedastic errors and a time-varying variance structure are assumed, hence a correction for the unconditional correlations during market crises may be superfluous. Bartram & Wang (2005) find that contagion exists as a real phenomenon during a stock market crisis, but also notes that if the data generating process has conditional heteroscedasticity, a conditioning bias may exist. and it will be difficult to distinguish it from the fundamental market dependency. Bias may also exist if the correlations are conditioned on generally large movements which are outliers. The results of this study show that market dependence is not generally influenced by volatility and is consistent with earlier studies (Ang & Chen, 2002, and Longin & Solnik, 2001).

Recognising that obtaining uncorrelated securities in an international portfolio is a key issue in maximising portfolio profits in investment and risk management, D'Ecclesia & Constantini (2006) investigate the covariation among international stock market returns. This study argues that events of global magnitude such as the 1987 American stock market crash, the Iraq invasion of Kuwait in 1990 and the 2001 terrorist attacks in America causes a global reaction (volatility) in the equity markets. Such a reaction increases covariation between markets due to global wide panic among investors, thereby reducing the effectiveness of global portfolio diversification strategies. The common trend and cycles method developed by Valid & Engle (1993) is employed in the study. The method tests if set economic variables are moving together and if covariance structures can be identified among the set of time series. The method is widely used to understand the transmission of business cycle from one country to another, and it has been rarely used in financial data. D'Ecclesia & Constantini (2006) therefore used this method following its successful application by Hecq *et al.* (2000), and Sharma & Wongbangpo (2002). The theoretical motivation for using this method is the assumption that the equity market's behaviour mimics that of the macro-economy (cyclical) in the short run, but follows a random walk in the long run. Four monthly stock market indices for UK, USA, Japan and Canada from 1978 to 2002 are used. Using a Beveridge-Nelson (1981) multivariate framework that decomposes the time series into common cycles and trends, the method was applied to the sample data. D'Ecclesia & Constantini (2006) find that there is only one common cycle and three long run trends in these equity markets. Thus, the four markets' returns covary in the short run due to global events and in the long run they are driven mainly by a trend dynamic which

responds to domestic economic fundamentals. Thus, the common cycle shows that even though portfolio diversification benefits diminish after global events in the short run, diversification is beneficial in the long run due to the long term trend components as stock markets behaviour is driven more by domestic economic fundamentals than by individual events.

Knif & Pynnonen (2007) analyse contemporaneous stock return correlations by specifically examining the volatility driven correlations in the national and international stock markets. This follows financial theory assertions and earlier empirical findings that return correlations and volatility are major factors influencing portfolio management strategies and asset pricing methods (Engle, 2002, and Tse & Tsui, 2002). The study utilises daily close to close equity index returns from New York (S&P 500), London (FTSE 100), Frankfurt (DAX), Toronto (S&P TSX composite), Hong Kong (Hang Seng), Tokyo (Nikkei), Amsterdam (AEX general), Paris (CAC40), Copenhagen (KFX), Oslo (OSE all share), Zurich (SSMI) and the Helsinki (HEX all share) equity markets. The data is from December 1989 to February 2004 and the returns are calculated as log first differences. Knif & Pynnonen (2007) use the LOGIT regression to investigate the incremental effect of volatility on equity correlations. The basic LOGIT model is enhanced by including the log volatilities of other markets as covariates in the basic model, thus making it possible to extract the volatility effect in the equity correlations. The correlation analysis is split into three categories, that is, world markets, European markets and the Nordic markets. Generally in the larger world equity markets there is weak evidence of volatility-induced correlations except for the UK and German case, where volatility-induced correlations are significant. In the smaller Nordic equity markets, volatility-induced correlations are significant, not only among the Nordic financial community, but also from the bigger global stock markets, especially in the European stock markets. Thus, correlations among these equity markets depend on volatility in at least one of the markets. These findings by Knif & Pynnonen (2007) support the view that correlations among stock markets are to some extent induced by volatility in at least one of the markets in the set.

Cuńado *et al.* (2008), following Knif & Pynnonen (2007), test whether stock market volatility influence market behaviour during US bear and bull market phases. Daily index data from the S&P 500 spanning August 1, 1928 - December 29, 2006 is used. The study uses the Lagrange Multiplier technique and a Whittle function to approximate a likelihood function. Cuńado *et al.* (2008) find that there is significant volatility persistence during bear and bull phases of the stock market. However, this study does not find conclusive evidence on whether systematic risk is

higher during bear or bull phases in the US equity market. This result can be attributed to the existence of a credible policy making environment, where economic cycles are usually met with an appropriate corrective fiscal or monetary and regulatory policy move, thus assuring investors of minimal losses and thereby averting protracted bear runs. This induces investors to react in a feasible manner during bear runs which is no different to behaviour in bull markets, thereby averting disruptive and unnecessary investor panic. This result diverges from the findings of De Goeij & Marquaring (2004) and Casarin & Trecroci, (2007) where volatility and covariation increase during bear rather than bull markets.

2.3.3 Covariation Of Equity Returns After Market Crashes And During Bull And Bear Markets

Meric *et al.* (2001) study the covariation of the equity returns in the United States, Argentina, Brazil, Chile and Mexico before and after the 1987 international equity market crash to assess the impact of the crash on equity returns and the implications on portfolio diversification in Latin American emerging markets for an American investor. The examination of the pattern of equity returns correlation is to enable American investors to weigh optimally, Latin American equities in their portfolios. Meric *et al.* (2001) study the stability of the correlations inter-temporally, focusing on the level and pattern of stock return correlation before and after the 1987 international equity markets crash. If correlations increased after the crash, then Latin American equities will be under-represented in the US investor's portfolio unless Latin American equities have exceptionally high returns given their risk profile. Covariance analysis using Principal Component Analysis following Meric *et al.*, (1989, 1996), Makridakis & Wheelwright (1974) and Philipatos *et al.* (1983) is used to study the covariation of the equity markets in the pre and post crash periods. A covariance analysis is applied separately to each sub-period to establish the covariance structure of each. The Latin American countries in the sample are selected based on market capitalisation and liquidity, with the sample period being February 1984 - June 1991. The pre-crash period is February 1984-September 1987, while the remainder was the post-crash period with both periods excluding the crash month of October 1987. Meric *et al.* (2001) finds a significant increase in the covariance structure of United States of America and the Latin American countries' equities, implying a need to underweight the Latin American equities in the portfolio of an American investor.

Ang & Chen (2002) study US equity portfolios and aggregate equity indices and find that correlations are greater by an average of 11.6% during downside market (bear) than during

upward market (bull) especially if the downside is more protracted. This is attributed to investors being more averse to downside risk than they are to gains of equal magnitudes (Longin & Solnik, 2001). Asymmetry was also found to be higher in smaller, value stocks and recent looser stocks, but lower for the large-cap stocks and recent winner stocks. To determine asymmetry in stock return correlations, Ang & Chen (2002) develop their own summary statistic called the H-statistic, which takes into account the asymmetry in the correlations when stock market returns are high and low. The H-statistic measures asymmetry by tracing the behaviour of the tails of the distribution, and is conditioned on the downside movement, in contrast to the frequently used GARCH covariance, which is conditioned on the negative shocks on the returns. Therefore, the statistic does not relate to a specific model, hence it can be used to test different models, as well as correcting for biases (Forbes & Rigobon, 2002), and therefore avoid the spurious findings of correlation asymmetry in empirical research. The paper confirms the existence of asymmetrical response in correlations in domestic equity markets, as well as with international markets during upside and downside equity market movements.

Flavin (2004) investigates the portfolio diversification benefits based on country and industry effects on equities before and after introduction of the Euro as a common currency in several Euro-zone countries. Countries' aggregate equity market indices are argued to covary less because of convergence in composition of national equity indices. A panel data approach proposed by Heston & Rouwenhorst (1995) is employed in this study because it separates the industry from country effects in national equity correlations and precludes any interaction between the industry and country effects. By estimating a constrained dummy variable model, this method constrains the weighted industry and country effects to sum up to zero. Imposition of constraints in estimations equate to measuring the industry effects relative to the weighted portfolio of Euro-zone equities. Industry and country stocks are weighted in relation to the proportion of their contribution to the Euro-zone total stocks. In this way, the relative strength of industry against country effects is determined by deviations of a country's equity from the benchmark Euro-zone portfolio. Flavin (2004) shows that equity market correlations increase after the Euro's introduction, meaning that geographical diversification left investors with only industry dispersion as an effective tool for international portfolio diversification. These findings show that industry factors are more important relative to geographical factors in Euro-zone portfolio management (both country and regional). This finding is consistent with the findings of Harvey & Ferson (1991), Cavaglia *et al.* (2000) and Yang *et al.* (2003). In the pre-Euro period, country effects dominated the industry effects, implying that during that period portfolio

diversification strategies based on aggregate country equity indices had more potential benefits than those in industrial sectors after the Euro's introduction. However, the dominance of industry effects may be attributed to more than the common currency factor, since the same findings in the same period also hold even for countries outside the European zone for example in Asian markets, Yang *et al.*, (2003) and the G7 countries, Baca *et al.*, (2000), suggesting that there may be other factors at play as well.

Soriano & Climent (2006) examine the influence of region and industry factors on the covariation of equities across countries and industries. This follows a recent rise in industry effects on portfolio diversification (Arshanapalli, *et al.*, 1997, Taing & Worthington, 2002 and Flavin, 2004). Soriano & Climent (2006) attempt to determine the role of regional and industrial factors in influencing the covariation patterns of industrial equities and aggregate national indices, hence the portfolio management strategies that can be employed to maximise portfolio gains. Covariance of industrial equities is analysed using a multivariate GARCH model that uses a BEKK asymmetric specification to allow for a time-varying variance-covariance structure, first proposed by Engle & Kroner (1995). A variance comparison of the country or industry effects with the industry or regional estimated average was done to analyse the relative importance of each in the countries studied. Soriano & Climent (2006) find that regional effects generally dominate industry effects in influencing covariation on the majority of equities, except during the sustained IT industry-specific bubble at the turn of the new millennium. Country effects are found to be more dominant in the emerging markets of Asia, while country effects for mature markets of North America and Europe are found to be small. So country based portfolio diversification strategies are more beneficial in emerging markets, while industry diversification is more beneficial in mature markets. These findings are consistent with Brooks & Del Negro (2004) and Chen *et al.*, (2006), who also find that some of the covariation is due to equity market volatility transmission especially between individual industries and the North American and European regions.

Meric *et al.*, (2007) study the impact of global events on the correlation patterns between national equity markets, and the implications this has on international portfolio diversification. The study uses the September 11 terrorist attacks in the United States to examine correlation between the national equities of the US, Japanese and some selected twenty-one European countries to see if the long term covariance structure changes after the event as compared to the period preceding it. Previous studies show that covariance structures of benchmark national equity indices change

significantly after global events, such as the 1987 stock market crash (Arshanapalli *et al.*, 1993, Lee & Kim, 1993, Meric *et al.*, 2001.). Correlation analysis in the Principal Components framework is used to unravel the covariance structures in the pre-attack and the post attack periods. Meric *et al.*, (2007) divided the sample period into two five year periods; September 9, 1996 to September 3, 2001 is the pre-attack period and from September 17 to September 11 2006 as the post-attack period. The periods are of equal duration for comparability. It is found that covariation between the global national stock markets increases after the attacks, as fewer factors are found to be driving covariation in the post-attack period. Potential international portfolio diversification benefits available to investors after the attacks thus decrease. The findings are consistent with Yang *et al.* (2003), who also conclude that the international emerging markets crisis of 1997-1998 increased the covariation among national stock markets returns such that benefits of diversification have been greatly reduced. Global markets are found to covary more with emerging markets after the crisis than before augmenting evidence of global events influencing greater covariation between global stock returns.

Meric *et al.* (2008) used principal component analysis and the Granger Causality tests to find the portfolio diversification implications of the covariation between sector equity indices during bull and bear markets for the United States of America, United Kingdom, Germany, France and Japan during September 1997 to October 2002 period. September 1997 to March 2000 is identified as the bear market, while the period April 2000 to October 2002 is identified as the bull market. The sector classification used is the Financial Times Actuaries Index, and these are resources, basic, general, cyclical consumer goods, non-cyclical consumer goods, cyclical services, non-cyclical services, information technology, utilities and financials. Results show that during the bear market, industrial sectors of different countries commove more, implying limited potential benefits for global sector portfolio diversification during this period as investment decisions are based less on economic fundamentals, but more on emotional and cognitive biases due to fear of capital losses. However, Meric *et al.*, (2008) note that, this is reversed during the bull market when sectors in different countries are clustered in terms of regional affiliation, implying that investors can obtain more benefits from sector global diversification, even by investing in the same sector in different countries. Each country's bull market is peculiar, as its specific characteristics are defined by domestic economic fundamentals, hence the lack of covariation between industries and national stock markets during a bull run.

It is apparent from the third and fourth statistical moments of returns that the latter do not follow the normal distribution. The relation between index returns may be non-linear given the asymmetric response of each of these industries to exogenous shocks. In view of these facts and in view of Principal Component Analysis (PCA) being applied, without considering Jolliffe's (2002) recommendation that PCA be transformed when returns are non-normal, the results of many of these studies may be impugned.

2.3.4 Covariation Of Equity Returns That Include South African Equities

International portfolio diversification is premised on the notion that an investor is able to predict the future relationships in returns of different assets classes or asset markets. This crucial condition must be satisfied ex ante, before the actual realisation of the ex post diversification benefits. This implies that future asset returns movements and relationship must be anticipated with a higher degree of certainty for diversification benefits to be realised ex post. Since this study focuses on covariation of South African against foreign equity sectors (from the point of view of a South African investor), literature that discusses or include South African stock market returns is imperatively.

Watson (1980) studies the stationarity of stock market correlation coefficients between countries. The countries included in the study are South Africa, Denmark, New Zealand, Australia, Japan and the United States. The sample period (1970-1977) is divided into two-year and four-year sub-periods. Stationarity of correlation coefficients is tested by examining inter-country correlations to determine if their coefficients are significantly different between sub-periods and secondly, by regressing the inter-country correlations over the sample period to determine if the correlation coefficients change over time. Results from Watson (1980)'s analysis are that in general inter-country correlation coefficients are very low, thus supporting the existence of potential benefits from international portfolio diversification. Correlation coefficients for South Africa, Denmark, Japan and New Zealand in the last two year sub-period were significantly higher than those of other sub periods. This illustrates that the correlation coefficient became time dependent in the last two year sub period, possibly due to trade and stock market liberalisations that took place in the late 1970s and throughout the 1980s.

To assess the benefits of investing in Africa, Fowdar (2008) investigates the benefits to a Mauritian investor who invests exclusively on African stocks. The following African countries are included: South Africa, Mauritius, Zimbabwe, Botswana, Zambia, Kenya, Ghana, Namibia and Nigeria. The method employed in this study involves constructing a minimum variance

portfolio which is analysed and compared as more countries are added to it and the portfolio is also compared with the MSCI and the G7 indices as benchmarks for a globally diversified portfolio. Thus a portfolio of African equity is constructed from select stocks using the Country Risk Ranking criterion. Since Mauritius is the primary focus country for the intended portfolio, countries with low and negative correlation are added to the portfolio until a country with the largest correlation is reached. A minimum variance portfolio is thus created by calculating the variance covariance matrix for all countries and then adding countries with the minimum variance to the African portfolio, starting with Mauritius. The study finds that all other countries except South Africa have low and negative covariance with the MCSI and the G7 global indices. The high positive covariation between South Africa and the global indices may be attributed to the fact that South Africa's stock market is relatively large and liquid compared to its African counterparts, hence it can respond to global shocks rapidly. Other factors such as thin trading (Roll, 1992 and Bradfield, 1989: 4-16) and financial market regulations and controls may also constrain trading in stocks and therefore contribute to the low correlations. This finding indicates the segmentation of African financial markets and therefore huge potential benefits from continental portfolio diversification. Fowdar (2008) also notes that using only correlations in portfolio selection will be misleading since investment into Africa is constrained by huge political risks, lack of information, poor accounting practices, lack of a good regulatory environment and sound corporate governance. South Africa though seems to have done a lot to address many of these concerns, and has received positive responses from global investors leading to huge foreign direct investments.

2.4 Summary of Literature and Conclusion

Literature on equity correlation with South Africa as the anchor country is scanty except that which includes South Africa only as an alternative asset in a universe of assets available to the investor (Fowdar, 2008, Roll, 1992, Levy & Sarnat, 1970 and Watson, 1980). This study is the first of its kind (at least to my knowledge) which attempts to fill this literature gap by anchoring South Africa as the primary country. Literature on the covariation of equity returns discussed in this chapter shows that phenomena such as market regime liberalisation, financial market crisises and global events, high volatility regimes as well as market states such as bears increase the magnitude, direction and patterns of equity covariation and vice-versa. The increase of equity covariation reduces portfolio diversification benefits available to the investor because all constituent assets in the portfolio behave similarly. The next chapter describes the data and method used in empirical analysis.

CHAPTER THREE

EMPIRICS

3.1 Introduction

This chapter describes the data characteristics and the method applied in the study of the equity markets of the five countries mentioned in Table 3.1 to assist in determining the optimum combination of equities for sector portfolio diversification.

Table 3.1: Overview of Equity Markets: 2007

Market	Benchmark Equity index	Benchmark equity index performance (%)	Market Capitalisation (USD millions)	Domestic market capitalisation (% of global market capitalisation)	Average Daily Turnover (USD millions)	Value of Shares traded (USD millions)	Rating of Benchmark Government bonds (S&P rating)
South Africa (JSE)	ALSI	16.6	828,185.3	1.36	1,694.9	423,731.8	BBB+
UK (LSE)	FTSE 100	2.0	3,851,705.9	6.35	40,683.8	10,333,685.9	AAA
USA (NYSE)	S&P 500	6.6	15,650,832.5	25.79	119,163.3	29,909,993.0	AAA
Germany Deutsche Börse	DAX 30	17.6	2,105,197.8	3.47	17,162.4	4,324,928.4	AAA
Japan (TSE)	NIKKEI 225	-12.2	4,330,921.9	7.14	26,433.3	6,476,147.9	AA

Source: International Federation of Stock Exchanges database (2008) and Standard & Poor's (2008)

Of the equity markets considered in this study, the New York Stock Exchange (NYSE) is the most liquid equity market and comprises approximately a quarter of total global equity market capitalisation. The Johannesburg Securities Exchange is miniscule in comparison to other equity markets and relatively illiquid. The illiquidity of the Johannesburg Stock Exchange is the result of thin trading in the listed stocks, with only a blue chip stocks (top 40) trading frequently than the bulk of other listed stocks. Thin trading on the JSE and its related problems are studied by Bradfield (1989). However, the Johannesburg Securities Exchange performs nearly as well as Germany's Deutsche Borse, with only a 100 basis point difference separating the two indices in 2007. This is consistent with superior returns being earned on riskier assets, evident in South Africa's credit rating being inferior to the other countries in the sample. The ratings of the sovereign benchmark bonds reflect perceived credit risk, political or any other country-specific

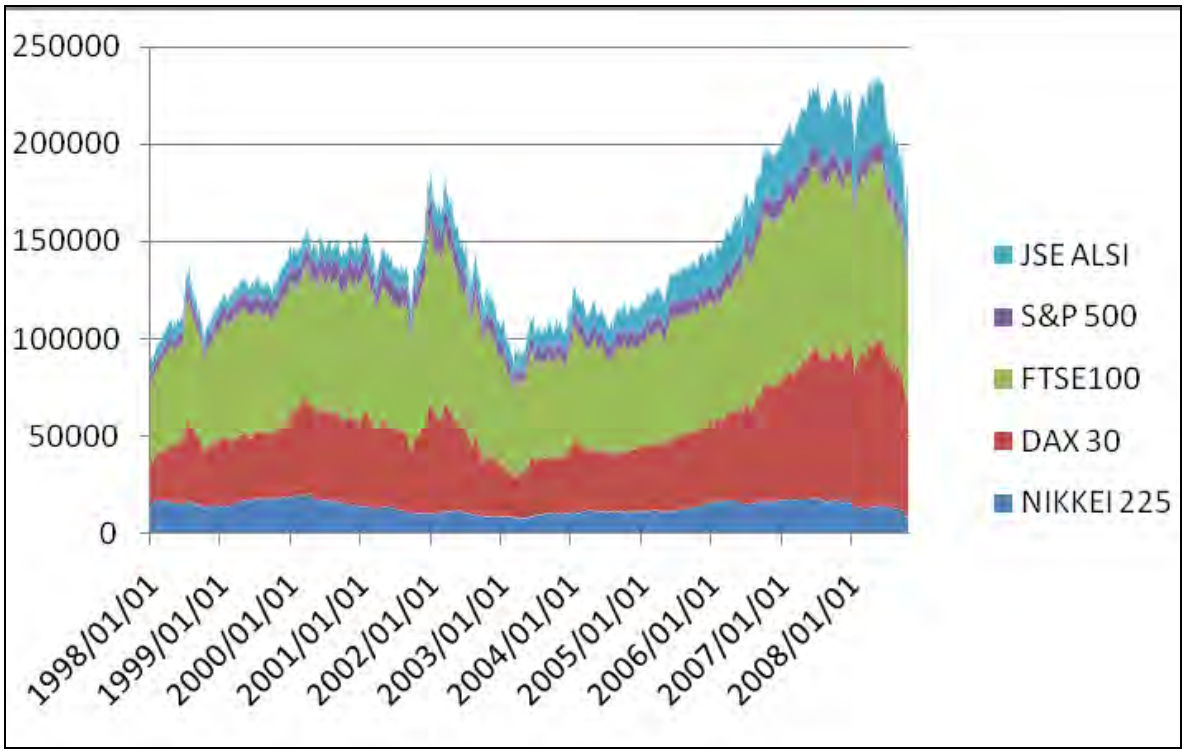
risk. The UK, USA and Germany are ranked highly with the AAA rating while Japan is rated AA and South Africa's rating is BBB. Developed foreign equity markets' returns are expected *a priori* to lead those of South Africa due to efficiency in the former equity markets. This is because developed equity markets have sufficient infrastructure to swiftly gather and process news affecting the global economy compared to emerging markets like South Africa. Market size is also expected to influence both contemporaneous and cross correlations, with the bigger equity markets of the developed foreign countries expected to give the signals on market direction to the smaller markets in response to market data such as news and events. Trading time differences also influence correlation patterns, with equity exchange markets opening earlier in a given day offering market direction to those that open later in the day. In this sample, Japan's market opens first while USA's equity market opens last so it is assumed that relevant news from Japan's market will serve as a signal to other markets.

3.2 Data

Daily closing value weighted equity price indices for the five countries' industrial sectors, as classified by Morgan Stanley Capital International (MSCI), are obtained from Thomson DataStream. The cross-section of industry indices for each country differs given that developed equity markets have more listed companies in a given industry than South Africa does.

Daily equity returns (R) are calculated by taking natural logarithmic first differences of the price indices such that $R_t = \ln(P_t/P_{t-1}) \times 100$ for each sector. The data spans the January 1998 – December 2006 period. The period 1998-2002 is identified as the bear run based on the performance of the equity price indices of the countries in the sample, while the remaining period, 2003-2006 is considered the bull run period. Bull and bear runs are obtained analogously to business cycles where expansions and contractions in equity markets or movements in equity prices between peaks and troughs define bull and bear runs. A bull run occurs when equity prices grow by ten to twenty percent from the local trough (Harding & Pagan, 2001). The bear run is defined analogously. The difference in the length of time comprising the bull run and the bear run may lead to bias, thus the results will be interpreted with caution.

Figure 3.1: Benchmark National Stock Price Indices



Source: Intenational Federation of Exchanges, 2008

Figure 3.1 reveals equity price growth greater than the ten to twenty percent threshold which delimitates a bull run between 2003 and 2006. This is evident across all benchmark equity indices in the sample. During the period identified as a bear run (1998-2002), equity prices drop by more than fifty percent from the local peak of late 2006.

During the 1998-2006 period (Table 3.2.1), information technology stock returns are the most volatile of all industry stocks across all countries except Japan. The returns to energy stocks in the US and Japan surpasses those of other industries but these returns fluctuates the most in the case of these countries. This may be due to the effect of announcements of innovations by companies affecting investor sentiments and causing speculation to a significant extent. If returns follow the normal distribution, skewness would be zero and kurtosis would be three. Skewness measures the asymmetry of the probability density function of returns around its mean. Positive (negative) skewness indicates more frequent growth (declines) in equity price indices than implied by the normal (Gaussian) distribution. Kurtosis measures the peakedness of returns. Distributions with kurtosis exceeding three have fat tails and are leptokurtic, while those with a kurtosis value less than three are platykurtic. Leptokurtosis indicates extreme values in returns and is one of the stylized facts of empirical finance. Investors would prefer positive

skewness in returns, however, leptokurtic preferences would depend on whether investors are risk averse, risk neutral or risk seeking. During the 1998-2006 period, a negative skewness is apparent in most industries' returns across countries and the magnitude of leptokurtosis differs considerably across industries.

Table 3.2.1: Descriptive Statistics: Full Period (1998-2007)

Country	Industrial index	Mean (%)	Std. Dev. (%)	Skewness	Kurtosis
GERMANY	CONSUMER DISCRETIONARY	0.001	1.717	-0.120	5.677
	CONSUMER SERVICES	-0.036	1.921	-0.100	14.510
	CONSUMER STAPLES	0.047	1.810	-0.106	6.822
	FINANCIALS	0.001	1.982	-0.125	7.728
	HEALTHCARE	0.024	1.407	-0.127	6.803
	INDUSTRIALS	0.024	1.955	-0.020	5.013
	INFORMATION TECHNOLOGY	0.009	2.969	0.212	7.295
	MATERIALS	0.021	1.668	0.362	9.784
	UTILITIES	0.024	1.678	0.129	5.733
JAPAN	CONSUMER DISCRETIONARY	0.017	1.342	-0.047	5.125
	CONSUMER SERVICES	-0.009	1.468	-0.107	8.220
	CONSUMER STAPLES	0.010	1.085	0.031	4.851
	ENERGY	0.037	1.974	0.212	5.102
	FINANCIALS	0.005	1.825	0.319	5.503
	HEALTHCARE	0.030	1.265	0.210	5.666
	INDUSTRIALS	0.020	1.259	-0.017	4.588
	INFORMATION TECHNOLOGY	0.013	1.836	-0.039	4.784
	MATERIALS	0.038	1.485	0.100	4.975
SOUTH AFRICA	CONSUMER DURABLES	0.083	1.928	0.344	6.210
	ENERGY	0.083	1.734	-0.003	5.509
	FINANCIALS	0.039	1.341	-0.343	8.808
	HEALTHCARE	0.054	1.457	-0.054	7.749
	INDUSTRIALS	0.068	1.305	-0.394	7.981
	INFORMATION TECHNOLOGY	-0.028	2.293	-0.713	10.152
	TELECOMMUNICATION	0.077	2.189	0.135	7.906
UNITED KINGDOM	CONSUMER DISCRETIONARY	0.004	1.329	0.120	6.287
	CONSUMER DURABLES	0.040	1.493	0.070	5.732
	CONSUMER SERVICES	0.017	1.472	-0.268	6.569
	ENERGY	0.017	1.671	-0.017	5.557
	FINANCIALS	0.014	1.471	-0.028	6.360
	HEALTHCARE	0.005	1.611	0.110	7.869
	INDUSTRIALS	-0.007	1.103	-0.311	5.443
	INFORMATION TECHNOLOGY	-0.068	2.666	-0.452	9.308
UNITED STATES	CONSUMER DISCRETIONARY	0.020	1.358	-0.129	7.803
	CONSUMER STAPLES	0.007	1.018	-0.395	11.733
	CONSUMER SERVICES	0.028	1.376	-0.669	12.720
	ENERGY	0.040	1.492	0.040	4.635
	FINANCIALS	0.023	1.442	0.201	6.012
	HEALTHCARE	0.016	1.263	-0.102	7.011
	INDUSTRIALS	0.020	1.288	-0.159	7.569
	INFORMATION TECHNOLOGY	0.018	2.205	0.229	6.657
	MATERIALS	0.015	1.452	0.178	5.709
	UTILITIES	0.010	1.209	-0.323	9.228

Table 3.2.2: Descriptive Statistics: Bear Run (1998-2002)

Country	Industrial index	Mean (%)	Std. Dev. (%)	Skewness	Kurtosis
GERMANY	CONSUMER DISCRETIONARY	-0.051	1.943	-0.133	5.141
	CONSUMER SERVICES	0.042	2.280	-0.095	4.822
	CONSUMER STAPLES	-0.065	1.730	-1.165	22.279
	FINANCIALS	-0.057	2.267	-0.073	7.072
	HEALTHCARE	-0.014	1.631	-0.152	5.067
	INDUSTRIALS	-0.013	2.284	-0.018	4.043
	INFORMATION TECHNOLOGY	-0.036	3.675	0.183	5.438
	MATERIALS	-0.025	1.823	0.026	5.534
	UTILITIES	-0.039	1.860	0.161	5.128
JAPAN	CONSUMER DISCRETIONARY	-0.018	1.489	0.041	4.877
	CONSUMER SERVICES	-0.021	1.169	0.167	4.669
	CONSTAPLES	-0.023	1.738	-0.107	7.097
	ENERGY	0.014	2.270	0.248	4.645
	FINANCIALS	-0.067	1.982	0.523	5.492
	HEALTHCARE	0.010	1.433	0.329	5.469
	INDUSTRIALS	-0.026	1.338	0.172	4.510
	INFORMATION TECHNOLOGY	-0.022	2.139	0.021	4.113
	MATERIALS	-0.009	1.633	0.314	4.937
SOUTH AFRICA	CONSUMER DURABLES	0.077	2.115	0.445	6.037
	ENERGY	0.101	1.751	0.055	5.404
	FINANCIALS	-0.008	1.560	-0.295	7.686
	HEALTHCARE	0.012	1.652	-0.028	7.224
	INDUSTRIALS	0.031	1.507	-0.346	7.306
	INFORMATION TECHNOLOGY	-0.126	2.792	-0.683	8.012
	TELECOMMUNICATION	0.006	2.560	0.226	7.226
UNITED KINGDOM	CONSUMER DISCRETIONARY	0.004	1.992	-0.001	4.573
	CONSUMER DURABLES	-0.014	1.574	0.068	5.876
	CONSUMER SERVICES	-0.033	1.564	0.183	5.167
	ENERGY	-0.021	1.760	-0.232	5.217
	FINANCIALS	-0.010	1.771	-0.024	4.984
	HEALTHCARE	-0.005	1.896	0.140	6.814
	INDUSTRIALS	-0.072	1.247	-0.275	4.769
	INFORMATION TECHNOLOGY	-0.142	3.269	-0.410	7.393
UNITED STATES	CONSUMER DISCRETIONARY	-0.002	1.624	-0.132	6.457
	CONSUMER STAPLES	-0.010	1.240	-0.371	9.419
	CONSUMER SERVICES	-0.018	1.615	-0.733	11.594
	ENERGY	0.004	1.655	0.191	4.602
	FINANCIALS	0.001	1.778	0.216	4.494
	HEALTHCARE	0.009	1.534	-0.097	5.566
	INDUSTRIALS	-0.005	1.551	-0.145	6.195
	INFORMATION TECHNOLOGY	-0.017	2.741	0.250	4.931
	MATERIALS	-0.013	1.701	0.256	5.033
	UTILITIES	-0.031	1.443	-0.254	7.797

During the bear run (Table 3.2.2), across most countries' industries average returns decline, with the information technology sector's returns being the most volatile, as is to be expected with the end to the information technology bubble. In addition, extreme values are apparent in a range of industries, with a negative skew in returns for most industries across most countries.

Table 3.2.3: Descriptive Statistics: Bull Run (2003-2006)

Country	Industrial index	Mean (%)	Std. Dev. (%)	Skewness	Kurtosis
GERMANY	CONSUMER DISCRETIONARY	0.079	1.373	0.040	5.085
	CONSUMER SERVICES	0.049	0.963	-0.019	4.310
	CONSUMER STAPLES	0.018	2.112	0.507	9.092
	FINANCIALS	0.058	1.496	-0.128	6.300
	HEALTHCARE	0.064	1.058	0.124	10.597
	INDUSTRIALS	0.078	1.439	0.091	6.040
	INFORMATION TECHNOLOGY	0.042	1.650	0.570	7.785
	MATERIALS	0.086	1.408	1.080	19.965
	UTILITIES	0.103	1.376	0.136	6.291
JAPAN	CONSUMER DISCRETIONARY	0.039	1.156	-0.277	4.962
	CONSUMER SERVICES	0.032	0.947	-0.203	4.789
	CONSUMER STAPLES	0.007	1.072	-0.079	5.215
	ENERGY	0.056	1.562	-0.137	4.802
	FINANCIALS	0.054	1.623	-0.054	4.895
	HEALTHCARE	0.033	1.033	-0.355	4.713
	INDUSTRIALS	0.061	1.213	-0.471	5.234
	INFORMATION TECHNOLOGY	0.043	1.352	-0.231	4.767
	MATERIALS	0.071	1.336	-0.488	4.948
SOUTH AFRICA	CONSUMER DURABLES	0.084	1.566	0.079	5.991
	ENERGY	0.072	1.745	0.009	5.410
	FINANCIALS	0.079	1.041	-0.211	6.323
	HEALTHCARE	0.083	1.183	-0.015	5.705
	INDUSTRIALS	0.104	0.998	-0.356	5.112
	INFORMATION TECHNOLOGY	0.089	1.391	0.211	6.969
	TELECOMMUNICATION	0.162	1.669	0.074	4.415
UNITED KINGDOM	CONSUMER DISCRETIONARY	0.039	1.160	-0.016	4.310
	CONSUMER DURABLES	0.044	1.511	0.003	4.908
	CONSUMER SERVICES	0.025	1.003	-0.181	6.097
	ENERGY	0.034	1.071	-0.217	6.412
	FINANCIALS	0.019	1.073	-0.022	6.038
	HEALTHCARE	0.006	1.139	0.055	5.737
	INDUSTRIALS	0.060	0.968	-0.301	5.701
	IINFORMATION TECHNOLOGY	0.003	1.585	-0.053	6.037
UNITED STATES	CONSUMER DISCRETIONARY	0.028	0.942	0.002	5.147
	CONSUMER STAPLES	0.032	0.658	-0.096	4.830
	CONSUMER SERVICES	0.073	0.991	0.032	5.105
	ENERGY	0.092	1.292	-0.367	3.560
	FINANCIALS	0.021	0.999	-0.118	6.858
	HEALTHCARE	0.024	0.795	-0.046	4.384
	INDUSTRIALS	0.049	0.886	-0.070	4.337
	INFORMATION TECHNOLOGY	0.061	1.240	-0.109	4.756
	MATERIALS	0.058	1.127	-0.249	4.018
	UTILITIES	0.060	0.893	-0.390	4.998

During the bull run (Table 3.2.3) extreme values are also apparent in a range of industries, however stock prices across most industries and countries grow rather than decline as was the case during the bear run, which is consistent with actual events.

The general pattern of a negative skew and leptokurtosis indicate that the returns contained in the sample follow a non-normal distribution. Thus, a non-parametric or distribution-free approach will be used in the analysis of covariation during bull and bear runs. Specifically,

correlation analysis will be conducted with techniques amenable to the fact that returns follow a non-normal distribution and one index return has a non-linear relation with another.

3.3 Method

Correlation analysis is used following Ang & Chen (2002) to analyse the sign and magnitude of the relationship between industrial sector returns in South Africa and those of developed nations during bull and bear runs contemporaneously and across time. It is assumed that an investor picks a pair of indices from different countries and industrial sectors that have negatively correlated returns, both contemporaneously and across time. Contemporaneous correlations (ρ) are expressed as:

$$\rho_{X,Y} = \frac{E((X - \bar{X})(Y - \bar{Y}))}{\sigma_x \sigma_y} \quad \text{..... (1)}$$

Where:

X = South African industry index returns

$\bar{X}$ = arithmetic mean values of X

Y = developed country industry index returns

$\bar{Y}$ = arithmetic mean values of Y

σ = standard deviations of each variable

The foregoing correlation coefficient takes a value between -1 and +1, where a coefficient of -1 indicates perfect negative correlation, which is desired by an investor and +1 indicates perfect positive correlation between two index returns. For example, if the covariance between the South African Consumer Durable sector and the Germany Consumer durable sector is 0.00007, the standard deviations of these sectors are 0.01683 and 0.01748 respectively, then, the correlation coefficient between these two sectors is:

$$\frac{0.00007}{0.01683 \times 0.01748} = 0.23890$$

For hypothesis testing, a t-test is conducted on the contemporaneous correlation to determine the coefficients' statistical significance using:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{(3)}$$

Where:

t =t-statistic

n =number of return observations attached to a given index

r =correlation coefficient

Continuing with the example if n=2609 and r = 0.23890:

$$t = \frac{0.23890\sqrt{2609-2}}{\sqrt{1-0.23890^2}} = 12.56178$$

A null hypothesis that there is no correlation between South Africa and foreign industrial sectors is set and a t- test is then conducted on the correlation coefficients to determine their statistical significance. Calculated t-values are compared with critical values from all correlation coefficients in the vector series. If calculated values are greater than the critical values, the null hypothesis is rejected. This t-test of the significance of the correlation coefficient is computed assuming that returns follow the normal distribution but earlier it was found that the empirical Probability Density Function (PDF) of index returns do not follow the normal distribution. Thus, the index returns are inverted using the Fisher inversion function, a hyperbolic tangent transformation of the correlation coefficient to both normalise and stabilise the variance between arrays of industry returns (Winterbottom, 1979). The Fisher Inversion function is expressed as:

$$x = \frac{e^{2y}-1}{e^{2y}+1} \quad \text{(2)}$$

where:

x = output data

y = input data

e = Euler's e

This process alters the probability density function (PDF) of the data generating process and makes it approximately Gaussian (Ehlers, 2002). The transformation of equity returns is done to enable hypothesis testing with the correlation coefficient.

Cross correlation analysis is then used to evaluate whether South African industrial index returns lag developed countries' returns, hence, it tests whether news or shocks in developed countries' equity markets influence returns in developing countries. This is due to stock traders in South Africa following developments in equity markets of developed countries, especially markets that open earlier in a given trading day, to anticipate capital flows between countries as part of trading strategies. South African traders would be expected to take cues on market direction from traders in developed country equity markets such that the South African industrial returns should lag those of the United States, Europe and especially the Japanese equity market given that the latter market lies seven time zones ahead of South Africa. Trading times are expected to influence the cross correlations, with equity markets that trade first being expected to provide market direction in the processing of news and events information. However, the market size effect is expected to dominate the trading time differences for the United States' equity market. This is due to American equity markets being larger than other equity markets. The latter trades last in the global time line, so traders in other equity markets will refer to developments in the US equity market for market direction a day later.

The cross correlation coefficient measures the covariation of industrial returns across periods such that a developed country's industry return during a latter period is assumed to lead its South African counterpart in an earlier period. The cross correlations are expressed as:

$$c_{xy}(l) = \frac{\sum_{t=1}^{n+k}((y_t - \bar{y})(x_{t-k} - \bar{x}))/n}{\sigma_x \sigma_y} \quad , \quad l=0, -1, -2 \ldots \quad (4)$$

where: x= developed countries' industry returns

$\bar{x}$ = arithmetic mean returns to developed country index

y= South African industry index returns

$\bar{y}$ = arithmetic mean returns to South African industry

l= lag length, measured in units of time

t= initial date

k= constant 0, 1, 2...

In this case the lag length is one day so l=1. The cross-correlation coefficient also takes a value between -1 and +1, with the magnitude of either sign approaching the value of 1 indicating a stronger relation between two industry indices across countries and points in time. Contemporaneous and cross correlations estimates between South African and foreign equity markets during both the bull and bear runs appear in the next section.

3.4 Conclusion

This chapter discusses all the empirics which consist of the data distribution and method. The descriptive statistics show that the data is typical of financial time series, that is, leptokurtic and non-normal in distribution. Thus a distribution-independent method of correlation analysis is chosen and is applied to the data in the next chapter.

CHAPTER FOUR

EMPIRICAL RESULTS

4.1 Introduction

The empirical analysis of the covariation of industry equity returns between South Africa and developed foreign financial markets is conducted and reported beginning with contemporaneous correlation analysis and followed by cross correlation analysis. Results are interpreted and conclusion arrived at given.

4.2.1 Equity Returns Covariations And Its Implications On Diversification

Correlation analysis of sector equity returns between South Africa and foreign countries show that several South African industry returns, especially financial industry returns are highly correlated with British financial industry returns during the bull and bear periods. This may be attributed to some South African firms such as Old Mutual, Liberty International, Barloworld Limited among others maintaining primary listings in London, New York and secondary listings in Johannesburg (Seedat and Liao, 2007). A null hypothesis that there is no correlation between South African industries and their foreign counterparts is put forward. A t-test is used to determine the significance of correlation coefficients. Results from the significance test confirms the presence of inter-sector correlation in the global village, with most the correlation coefficients of the industry index returns being significant at 1%, 5% and 10% significance level. Almost all calculated t-statistics are greater than critical values at 1%, 5% and 10%, hence we reject the null of no correlation between South Africa and foreign industrial sectors. This illustrates that there is positive covariation among global sector equity returns. Combinations of such shares in a portfolio would yield few benefits to investors seeking diversification. During both the bear run and the bull run, the strongest statistically significant correlation is between South African and British financial stock returns mainly due to cross-listing and the fact that the financial sector transfers funds between industries thus when one industry is affected by a shock, the financial sector is almost always affected. In general, during the bull and the bear run, regions which South African companies trade to a significant extent and which have equity exchanges operating in the same time zones like Britain and Germany have strongly correlated returns. Thus, it is futile for South African investors to hold a portfolio of German and especially British stocks. It would have been worthwhile for a South African investor to have held a portfolio comprising South African industrial stocks and American and Japanese industrial stocks during

the bear and the bull period. This is because correlation are low, thus showing segmentation. The correlation between energy and consumer staples industries between South Africa and America is stronger. This is because these industries are involved in international trade and are influenced more by global factors such as oil price adjustments by the Organisation of Petroleum Exporting Countries (OPEC) than by domestic factors like monetary and fiscal policies.

Table 4.1.1: Contemporaneous Correlation during Full Sample Period (1998-2007)

	SA_ CONSGDS	SA_ ENERGY	SA_ FINANCIALS	SA_ HEALTHCARE	SA_ INDUSTRIALS	SA_ IT	SA_ TELECOM
GER_CONSDISCR	0.282***	0.239***	0.391***	0.291***	0.320***	0.313***	0.069***
GER_CONSTAPLES	0.117***	0.096***	0.165***	0.139***	0.136***	0.102***	0.264***
GER_CONSVS	0.201***	0.152***	0.182***	0.114***	0.142***	0.154***	0.116***
GER_FINANCIALS	0.328***	0.216***	0.407***	0.302***	0.316***	0.318***	0.272***
GER_HEALTHCARE	0.215***	0.161***	0.275***	0.221***	0.222***	0.182***	0.175***
GER_INDUSTRIALS	0.311***	0.238***	0.377***	0.273***	0.307***	0.307***	0.295***
GER_IT	0.219***	0.159***	0.303***	0.223***	0.249***	0.284***	0.256***
GER_MATERIALS	0.277***	0.251***	0.339***	0.265***	0.282***	0.255***	0.249***
GER_UTILITIES	0.170***	0.126***	0.238***	0.214***	0.157***	0.118***	0.120***
JP_CONSDISC	0.156***	0.206***	0.277***	0.195***	0.271***	0.249***	0.213***
JP_CONSTAPLES	0.086***	0.165***	0.214***	0.177***	0.212***	0.140***	0.125***
JP_CONSVS	0.145***	0.085***	0.137***	0.098***	0.130***	0.151***	0.118***
JP_ENERGY	0.076***	0.154***	0.132***	0.136***	0.126***	0.093***	0.081***
JP_FINANCIALS	0.115***	0.153***	0.208***	0.150***	0.195***	0.173***	0.125***
JP_HEALTHCARE	0.112***	0.103***	0.174***	0.120***	0.177***	0.115***	0.113***
JP_INDUSTRIALS	0.172***	0.222***	0.265***	0.196***	0.246***	0.240***	0.195***
JP_IT	0.165***	0.180***	0.248***	0.159***	0.238***	0.296***	0.221***
JP_MATERIALS	0.156***	0.206***	0.238***	0.172***	0.214***	0.204***	0.167***
UK__ENERGY	0.160***	0.225***	0.197***	0.154***	0.349***	0.134***	0.101***
UK_CONSDUR	0.197***	0.265***	0.295***	0.190***	0.234***	0.235***	0.189***
UK_CONSDISC	0.337***	0.269***	0.418***	0.279***	0.308***	0.399***	0.338***
UK_CONSVS	0.270***	0.243***	0.380***	0.262***	0.200***	0.312***	0.279***
UK_FINANCIALS	0.313***	0.273***	0.447***	0.322***	0.370***	0.352***	0.296***
UK_HEALTHCARE	0.172***	0.107***	0.232***	0.167***	0.224***	0.156***	0.143***
UK_INDUSTRIALS	0.312***	0.335***	0.433***	0.317***	0.365***	0.350***	0.291***
UK_IT	0.273***	0.226***	0.307***	0.210***	0.275***	0.406***	0.285***
USA_CONSDISC	0.223***	0.142***	0.251***	0.196***	0.195***	0.240***	0.227***
USA_CONSTAPLES	0.064***	0.061**	0.081***	0.065**	0.057***	0.028*	0.043***
USA_CONSVS	0.185***	0.125***	0.211***	0.159***	0.162***	0.167***	0.151***
USA_ENERGY	0.114***	0.157***	0.123***	0.109***	0.128***	0.080***	0.090***
USA_FINANCIALS	0.193***	0.128***	0.216***	0.174***	0.161***	0.208***	0.192***
USA_HEALTHCARE	0.114***	0.045**	0.102***	0.078***	0.086***	0.066***	0.101***
USA_INDUSTRIALS	0.209***	0.145***	0.231***	0.186***	0.179***	0.218***	0.199***
USA_IT	0.176***	0.114***	0.184***	0.124***	0.130***	0.189***	0.175***
USA_MATERIALS	0.198***	0.204***	0.220***	0.167***	0.180***	0.198***	0.197***
USA_UTILITIES	0.076***	0.096***	0.049**	0.037*	0.049***	0.069***	0.039**

*, **, *** denote the significance of correlation coefficients at 10%, 5% and 1% respectively

Table 4.1.2: Contemporaneous Correlation during Bear Run (1998-2002)

	SA_ CONSGDS	SA_ ENERGY	SA_ FINANCIALS	SA_ HEALTHCARE	SA_ INDUSTRIALS	SA_ IT	SA_ TELECOM
GER_CONSDISCR	0.248***	0.206***	0.389***	0.3028***	0.317***	0.330***	0.271***
GER_CONSSTAPLES	0.081***	0.045*	0.120***	0.112***	0.099***	0.080***	0.081***
GER_CONSSVS	0.147***	0.100***	0.116***	0.056**	0.089***	0.119***	0.078**
GER_FINANCIALS	0.280***	0.168***	0.406***	0.314***	0.316***	0.322***	0.276***
GER_HEALTHCARE	0.192***	0.122***	0.259***	0.216***	0.210***	0.175***	0.159***
GER_INDUSTRIALS	0.290***	0.216***	0.373***	0.280***	0.320***	0.370***	0.312***
GER_IT	0.202***	0.147***	0.302***	0.237***	0.260***	0.291***	0.277***
GER_MATERIALS	0.221***	0.204***	0.312***	0.264***	0.266***	0.257***	0.257***
GER_UTILITIES	0.138***	0.072***	0.226***	0.225***	0.150***	0.110***	0.104***
JP_CONSDISCR	0.125***	0.217***	0.282***	0.199***	0.275***	0.278***	0.213***
JP_CONSSTAPLES	0.126***	0.075***	0.125***	0.090***	0.124***	0.152***	0.113***
JP_CONSSVS	0.066***	0.153***	0.191***	0.169***	0.199***	0.123***	0.092**
JP_ENERGY	0.055**	0.108***	0.112***	0.132***	0.100***	0.076***	0.051**
JP_FINANCIALS	0.077***	0.144***	0.189***	0.142***	0.182***	0.177***	0.147***
JP_HEALTHCARE	0.109***	0.107***	0.179***	0.115***	0.178***	0.111***	0.110***
JP_INDUSTRIALS	0.156***	0.219***	0.260***	0.202***	0.237***	0.273***	0.185***
JP_IT	0.135***	0.176***	0.236***	0.146***	0.233***	0.317***	0.223***
JP_MATERIALS	0.142***	0.200***	0.223***	0.174***	0.201***	0.214***	0.149***
UK_ENERGY	0.303***	0.232***	0.400***	0.270***	0.232***	0.416***	0.352***
UK_CONSDURAB	0.164***	0.256***	0.265***	0.183***	0.186***	0.233***	0.177***
UK_CONSDISCR	0.232***	0.215***	0.357***	0.258***	0.172***	0.313***	0.267***
UK_CONS_SVS	0.123***	0.173***	0.169***	0.138***	0.092***	0.124***	0.071***
UK_FINANCIALS	0.283***	0.264***	0.445***	0.352***	0.240***	0.366***	0.296***
UK_HEALTHCARE	0.130***	0.066***	0.228***	0.166***	0.085***	0.155***	0.153***
UK_INDUSTRIALS	0.254***	0.307***	0.395***	0.323***	0.249***	0.359***	0.265***
UK_IT	0.235***	0.201***	0.284***	0.202***	0.187***	0.418***	0.289***
USA_CONSDISCR	0.245***	0.142***	0.259***	0.218***	0.185***	0.264***	0.256***
USA_CONSSTAPLES	0.049**	0.043*	0.053**	0.057**	-0.017	0.014	0.025
USA_CONS_SVS	0.187***	0.124***	0.203***	0.160***	0.135***	0.173***	0.153***
USA_ENERGY	0.119***	0.129***	0.109***	0.100***	0.053**	0.077**	0.090***
USA_FINANCIALS	0.209***	0.127***	0.223***	0.204***	0.118***	0.231***	0.216***
USA_HEALTH_CARE	0.111***	0.031	0.082***	0.079**	0.052**	0.062**	0.104***
USA_INDUSTRIALS	0.228***	0.137***	0.238***	0.209***	0.149***	0.240***	0.225***
USA_IT	0.179***	0.120***	0.182***	0.128***	0.112***	0.195***	0.191***
USA_MATERIALS	0.201***	0.180***	0.203***	0.160***	0.154***	0.205***	0.205***
USA_UTILITIES	0.071***	0.082**	0.022	0.02	0.049*	0.072***	0.026

*, **, *** denote the significance of correlation coefficients at 10%, 5% and 1% respectively

Table 4.1.3: Contemporaneous Correlation during Bull Run (2003-2007)

	SA_ CONSUMERGDS	SA_ ENERGY	SA_ FINANCIALS	SA_ HEALTHCARE	SA_ INDUSTRIALS	SA_ IT	SA_ TELECOM
GER_CONSDISC	0.347***	0.297***	0.393***	0.265***	0.324***	0.274***	0.246***
GER_CONSTAPLES	0.247***	0.242***	0.338***	0.245***	0.278***	0.206***	0.216***
GER_CONSVS	0.274***	0.196***	0.279***	0.189***	0.222**	0.248***	0.175***
GER_FINANCIALS	0.428***	0.302***	0.417***	0.277***	0.315***	0.310***	0.261***
GER_HEALTHCARE	0.263***	0.231***	0.310***	0.231***	0.250***	0.205***	0.212***
GER_INDUSTRIALS	0.359***	0.291***	0.388***	0.259***	0.276***	0.292***	0.253***
GER_IT	0.294***	0.224***	0.322***	0.196***	0.226***	0.251***	0.199***
GER_MATERIALS	0.376***	0.318***	0.392***	0.268***	0.313***	0.264***	0.232***
GER_UTILITIES	0.230***	0.204***	0.260***	0.191***	0.168***	0.138***	0.149***
JP_CONSDISCR	0.207***	0.195***	0.268***	0.187***	0.264***	0.192***	0.214***
JP_CONSTAPLES	0.175***	0.182***	0.256***	0.191***	0.236***	0.191***	0.186***
JP_CONSVS	0.129***	0.107***	0.165***	0.115***	0.143***	0.151***	0.128***
JP_ENERGY	0.117***	0.227***	0.174***	0.144***	0.181***	0.145***	0.145***
JP_FINANCIALS	0.177***	0.166***	0.243***	0.162***	0.220***	0.176***	0.208***
JP_HEALTHCARE	0.117***	0.101***	0.163***	0.128***	0.174***	0.129***	0.117***
JP_INDUSTRIALS	0.197***	0.227***	0.277***	0.185***	0.266***	0.193***	0.216***
JP_IT	0.232***	0.199***	0.276***	0.189***	0.247***	0.235***	0.215***
JP_MATERIALS	0.179***	0.216***	0.265***	0.169***	0.238***	0.195***	0.200***
UK__ENERGY	0.248***	0.335***	0.268***	0.196***	0.267***	0.169***	0.182***
UK_CONSDUR	0.248***	0.275***	0.352***	0.204***	0.283***	0.271***	0.216***
UK_CONSDISC	0.411***	0.345***	0.459***	0.299***	0.371***	0.354***	0.302***
UK_CONSVS	0.359***	0.310***	0.436***	0.270***	0.363***	0.309***	0.310***
UK_FINANCIALS	0.386***	0.309***	0.454***	0.253***	0.369***	0.310***	0.299***
UK_HEALTHCARE	0.271***	0.185***	0.245***	0.170***	0.225***	0.163***	0.117***
UK_INDUSTRIALS	0.415***	0.379***	0.505***	0.305***	0.415***	0.347***	0.341***
UK_IT	0.398***	0.319***	0.391***	0.244***	0.317***	0.357***	0.279***
USA_CONSDISC	0.176***	0.157***	0.231***	0.146***	0.148***	0.159***	0.150***
USA_CONSTAPLES	0.103***	0.104***	0.161***	0.087***	0.088***	0.077***	0.093***
USA_CONSVS	0.184***	0.138***	0.228***	0.154***	0.143***	0.144***	0.144***
USA_ENERGY	0.106***	0.195***	0.149***	0.123***	0.118***	0.089**	0.087***
USA_FINANCIALS	0.158***	0.144***	0.199***	0.104***	0.100***	0.128***	0.130***
USA_HEALTHCARE	0.128***	0.081***	0.162***	0.078***	0.101***	0.082***	0.093***
USA_INDUSTRIALS	0.169***	0.174***	0.213***	0.132***	0.141***	0.142***	0.127***
USA_IT	0.181***	0.125***	0.199***	0.121***	0.133***	0.164***	0.128***
USA_MATERIALS	0.191***	0.253***	0.256***	0.186***	0.190***	0.181***	0.176***
USA_UTILITIES	0.087**	0.128***	0.110***	0.073***	0.059***	0.052***	0.066**

*, **, *** denote the significance of correlation coefficients at 10%, 5% and 1% respectively

The magnitude of contemporaneous correlation increases from the bear run for South African consumer goods, energy, financials and industrials while it decreases for South African information technology, healthcare and telecommunications. Generally, the magnitude of correlation increases from the bear run to the bull run which means that there would be few benefits for South African investors if pairs of South African and foreign stocks were held during the period. All South African stock returns except energy become less strongly correlated with US financial and industrial stocks during the aforementioned period, implying potential

gains from diversification with these stocks. The Japanese equity market has relatively low contemporaneous relationships with the South African equity market. This is attributed to non-synchronous trading, where the Japanese equity market waits a full day for signals from the US equity markets.

Between the bear and the bull run (Table 4.1.2 and Table 4.1.3), there is no significant change in the range of correlation coefficients, reflecting stability of the equity return covariation pattern between these market states. A portfolio manager must avoid highly correlated industrial equities when selecting equity for effective portfolio diversification.

Table 4.2.1 Cross Correlation during Full Sample Period (1998-2007)

	SA CONSGDS	SA ENERGY	SA FINANCIALS	SA HEALTHCARE	SA INDUSTRIALS	SA IT	SA TELECOM
GER_CONSDISCR	0.101	0.239	0.393	0.058	0.324	0.058	0.039
GER_CONSTAPLES	0.043	0.090	0.066	0.049	0.076	0.107	0.066
GER_CONSVS	0.097	0.152	0.069	0.055	0.063	0.052	0.001
GER_FINANCIALS	0.105	0.095	0.081	0.069	0.120	0.058	0.057
GER_HEALTHCARE	0.078	0.077	0.050	0.071	0.250	0.060	0.054
GER_INDUSTRIALS	0.096	0.115	0.085	0.079	0.115	0.074	0.064
GER_IT	0.095	0.098	0.065	0.039	0.075	0.087	0.043
GER_MATERIALS	0.099	0.113	0.061	0.070	0.088	0.045	0.049
GER_UTILITIES	0.088	0.080	0.060	0.070	0.096	0.063	0.058
JP_CONSDISCR	0.009	0.000	0.011	0.020	0.042	0.010	-0.019
JP_CONSTAPLES	-0.004	-0.007	-0.016	0.017	0.009	0.004	-0.035
JP_CONSVS	0.040	0.035	0.012	0.057	-0.002	0.030	0.003
JP_ENERGY	-0.031	0.011	-0.055	-0.014	-0.046	-0.014	-0.046
JP_FINANCIALS	0.019	0.020	0.018	0.027	0.023	0.022	-0.008
JP_HEALTHCARE	0.016	0.011	-0.024	-0.012	0.020	-0.015	-0.051
JP_INDUSTRIALS	0.172	0.003	-0.026	0.013	0.014	0.018	-0.037
JP_IT	0.143	-0.008	-0.004	0.014	0.012	0.022	-0.025
JP_MATERIALS	0.108	0.012	-0.025	0.012	0.010	0.003	-0.026
UK__ENERGY	0.020	0.118	-0.032	0.032	0.072	-0.050	0.026
UK_CONSDUR	0.067	0.057	0.046	0.049	0.046	0.085	0.055
UK_CONSDISCR	0.074	0.269	0.041	0.299	0.074	0.057	0.034
UK_CONSVS	0.055	0.243	0.046	0.062	0.075	0.042	0.038
UK_FINANCIALS	0.032	0.095	0.052	0.058	0.093	0.026	0.023
UK_HEALTHCARE	0.010	0.033	0.026	0.031	0.102	-0.025	0.015
UK_INDUSTRIALS	0.082	0.334	0.049	0.057	0.073	0.046	0.042
UK_IT	0.045	0.080	0.019	0.000	0.034	0.084	0.027
USA_CONSDISCR	0.220	0.180	0.247	0.192	0.242	0.212	0.201
USA_CONSTAPLES	0.193	0.139	0.231	0.173	0.231	0.181	0.174
USA_CONSVS	0.180	0.141	0.210	0.158	0.212	0.190	0.167
USA_ENERGY	0.148	0.243	0.197	0.123	0.211	0.115	0.171
USA_FINANCIALS	0.218	0.173	0.225	0.180	0.221	0.195	0.194
USA_HEALTHCARE	0.201	0.109	0.205	0.160	0.197	0.157	0.162
USA_INDUSTRIALS	0.210	0.211	0.234	0.180	0.252	0.199	0.194
USA_IT	0.176	0.141	0.226	0.167	0.214	0.224	0.192
USA_MATERIALS	0.201	0.245	0.223	0.184	0.224	0.173	0.202
USA_UTILITIES	0.177	0.164	0.206	0.160	0.193	0.139	0.180

The cross correlation coefficients range of South Africa's industrial sector and of European countries industries (UK and Germany) is nearly similar, but significantly different for the remainder of the countries in the sample. This can be due to non-synchronous trading which is cited as a major cause of lagged responses in return series across countries (Katsikas, 2007).

Table 4.2.2 Cross Correlation during Bear Run (1998-2002)

	SA CONSUGDS	SA ENERGY	SA FINANCIALS	SA HEALTHCARE	SA INDUSTRIALS	SA IT	SA TELECOM
GER_CONSDISCR	0.101	0.239	0.106	0.051	0.117	0.114	0.073
GER_CONSTAPLES	0.043	0.09	0.05	0.072	0.053	0.071	0.024
GER_CONSVS	0.097	0.098	0.061	0.043	0.071	0.09	0.027
GER_FINANCIALS	0.105	0.095	0.123	0.05	0.095	0.114	0.058
GER_HEALTHCARE	0.078	0.077	0.08	0.041	0.09	0.077	0.038
GER_INDUSTRIALS	0.096	0.115	0.105	0.037	0.106	0.143	0.109
GER_IT	0.095	0.098	0.097	0.025	0.07	0.167	0.103
GER_MATERIALS	0.099	0.113	0.12	0.074	0.113	0.093	0.053
GER_UTILITIES	0.088	0.08	0.101	0.068	0.1	0.06	0.053
JP_CONSDISCR	0.009	0	-0.017	-0.037	-0.015	-0.013	-0.046
JP_CONSTAPLES	0.04	0.035	-0.02	-0.01	-0.015	-0.001	-0.048
JP_CONSVS	-0.004	-0.007	0.021	0.004	0.005	0.001	-0.026
JP_ENERGY	-0.031	0.011	-0.014	-0.023	-0.007	0.041	-0.035
JP_FINANCIALS	0.019	0.02	-0.003	-0.025	-0.027	0.004	-0.03
JP_HEALTHCARE	0.016	-0.008	-0.007	-0.008	0.017	-0.026	-0.023
JP_INDUSTRIALS	0.004	0.012	-0.011	-0.017	-0.005	0.015	-0.043
JP_IT	0.012	0.088	-0.027	-0.041	-0.038	0.02	-0.032
JP_MATERIALS	-0.002	0.057	-0.005	-0.011	-0.01	0.02	-0.04
UK__ENERGY	0.06	0.118	0.059	0.062	0.074	0.047	0.029
UK_CONSDUR	0.03	0.057	0.057	0.022	0.044	0.048	0.009
UK_CONSDISCR	0.046	0.014	0.09	0.027	0.095	0.143	0.087
UK_CONSVS	0.044	0.072	0.083	0.057	0.097	0.09	0.047
UK_FINANCIALS	0.096	0.095	0.132	0.07	0.132	0.099	0.062
UK_HEALTHCARE	0.087	0.033	0.07	0.04	0.086	0.043	0.038
UK_INDUSTRIALS	0.063	0.09	0.097	0.066	0.087	0.085	0.045
UK_IT	0.273	0.076	0.076	0.006	0.077	0.158	0.072
USA_CONSDISCR	0.22	0.18	0.286	0.184	0.24	0.274	0.169
USA_CONSTAPLES	0.193	0.139	0.242	0.194	0.209	0.128	0.122
USA_CONSVS	0.18	0.141	0.232	0.155	0.203	0.196	0.119
USA_ENERGY	0.148	0.243	0.162	0.141	0.157	0.105	0.088
USA_FINANCIALS	0.218	0.173	0.295	0.212	0.253	0.247	0.169
USA_HEALTHCARE	0.201	0.109	0.236	0.159	0.198	0.165	0.117
USA_INDUSTRIALS	0.21	0.211	0.297	0.19	0.244	0.257	0.189
USA_IT	0.195	0.141	0.22	0.135	0.19	0.298	0.201
USA_MATERIALS	0.201	0.245	0.244	0.185	0.209	0.171	0.149
USA_UTILITIES	0.177	0.164	0.141	0.104	0.133	0.103	0.08

Table 4.2.3 Cross Correlation during Bull Run (2003-2007)

	SA CONSGDS	SA ENERGY	SA FINANCIALS	SA HEALTHCARE	SA INDUSTRIALS	SA IT	SA TELECOM
GER_CONSDISCR	0.074	0.052	0.393	0.058	0.324	0.058	0.039
GER_CONSTAPLES	0.062	0.051	0.066	0.049	0.076	0.107	0.066
GER_CONSVS	0.099	0.060	0.069	0.055	0.063	0.052	0.001
GER_FINANCIALS	0.105	0.074	0.081	0.069	0.120	0.058	0.057
GER_HEALTHCARE	0.040	0.071	0.050	0.071	0.250	0.060	0.054
GER_INDUSTRIALS	0.118	0.091	0.085	0.079	0.115	0.074	0.064
GER_IT	0.087	0.047	0.065	0.039	0.075	0.087	0.043
GER_MATERIALS	0.079	0.043	0.061	0.070	0.088	0.045	0.049
GER_UTILITIES	0.088	0.060	0.060	0.070	0.096	0.063	0.058
JP_CONSDISCR	0.036	0.020	0.011	0.020	0.042	0.010	-0.019
JP_CONSTAPLES	0.001	0.008	-0.016	0.017	0.009	0.004	-0.035
JP_CONSVS	0.033	0.020	0.012	0.057	-0.002	0.030	0.003
JP_ENERGY	-0.040	-0.023	-0.055	-0.014	-0.046	-0.014	-0.046
JP_FINANCIALS	0.035	0.036	0.018	0.027	0.023	0.022	-0.008
JP_HEALTHCARE	-0.020	-0.009	-0.024	-0.012	0.020	-0.015	-0.051
JP_INDUSTRIALS	0.012	0.000	-0.026	0.013	0.014	0.018	-0.037
JP_IT	0.046	0.000	-0.004	0.014	0.012	0.022	-0.025
JP_MATERIALS	0.002	0.012	-0.025	0.012	0.010	0.003	-0.026
UK__ENERGY	0.022	0.072	-0.032	0.032	0.072	-0.050	0.026
UK_CONSDUR	0.006	0.049	0.046	0.049	0.046	0.085	0.055
UK_CONSDISCR	0.016	0.056	0.041	0.299	0.074	0.057	0.034
UK_CONSVS	0.033	0.060	0.046	0.062	0.075	0.042	0.038
UK_FINANCIALS	0.034	0.030	0.052	0.058	0.093	0.026	0.023
UK_HEALTHCARE	0.017	0.010	0.026	0.031	0.102	-0.025	0.015
UK_INDUSTRIALS	0.044	0.033	0.049	0.057	0.073	0.046	0.042
UK_IT	0.004	0.030	0.019	0.000	0.034	0.084	0.027
USA_CONSDISCR	0.215	0.166	0.247	0.192	0.242	0.212	0.201
USA_CONSTAPLES	0.211	0.141	0.231	0.173	0.231	0.181	0.174
USA_CONSVS	0.180	0.144	0.210	0.158	0.212	0.190	0.167
USA_ENERGY	0.140	0.283	0.197	0.123	0.211	0.115	0.171
USA_FINANCIALS	0.199	0.156	0.225	0.180	0.221	0.195	0.194
USA_HEALTHCARE	0.175	0.108	0.205	0.160	0.197	0.157	0.162
USA_INDUSTRIALS	0.210	0.175	0.234	0.180	0.252	0.199	0.194
USA_IT	0.221	0.129	0.226	0.167	0.214	0.224	0.192
USA_MATERIALS	0.186	0.225	0.223	0.184	0.224	0.173	0.202
USA_UTILITIES	0.163	0.181	0.206	0.160	0.193	0.139	0.180

Synchronous trading between South Africa, Germany and UK equity markets enable the immediate transmission of correlation driving forces such as news across these countries' equity markets. During the bull or bear run and across sectors, correlation coefficients within a country do not change significantly. However, across countries, correlations are significantly different, suggesting that sector return covariation is not defined by bull, bear or industry specific factors, but by country and regional factors such as domestic and regional economic policies.

4.2.2 Sector Equity Returns Covariation During The Bull Run

Results presented in table 4.2.3 show that cross correlation between South Africa and foreign countries' sector equity returns are positive but low in the bull run. The same pattern is reported for the bear run. This indicates that there are similar equity covariation patterns in bull and in bear runs. Cross correlation coefficients are larger than contemporaneous correlation for returns of South African and USA sectors. American industrial stock returns are also found to lead South African industrial stock returns. Again, this pattern is consistently found in both bear and bull period across all industrial sectors and it is attributed to non-synchronous trading between the two exchanges. However, there is higher contemporaneous correlation between South Africa's industrial returns and European exchanges (UK and Germany) than when South Africa lags these markets. This may be due to South African, UK and German markets operating in the same or similar time zones such that any market information is transmitted across all the three markets in the same trading day with only a slight delay. Generally, Japanese sectors have higher contemporaneous correlations with the South African market because both countries take signals from the US equity market and the South African equity market also take signals from the Japanese equity market, since the Japanese equity market trades first in a given day. However, in relative terms, correlations between South Africa and Japanese industries are very modest. This may be due to minimal trade linkages between the two countries. For example, Japan's major export by value is motor vehicles and this is also the case for South Africa during the bull period, which attenuates trade linkages between these countries.

The sectors' indices appear to have correlation coefficients ranges that are clustered in terms of country or regional (Euro countries), than they are in terms of industry affiliations. Industrial sector stocks in the same country have coefficients within a proximity range, yet similar industries in different countries have correlation coefficients within a different range. This reveals the geo-political and economic linkages that exist between these two countries. These results indicate that during the bull period there is higher covariation between domestic sectors in all countries, but very low covariation between sectors of different countries, even for similar sectors. An investor's portfolio should consist of equities from diverse countries, rather than domestic sectors if he is to reap the benefits of diversification.

4.2.3 Sector equity returns Covariation during the Bear Run

During the bear run, increases in all Japanese sector returns cause decreases in South African financial, healthcare, industrial and telecommunication stock returns a day later (Table 4.2.2).

However, this phenomenon diminishes to some extent during the bull run (Table 4.2.3). The magnitude of cross correlation decreases during the bull run especially between the returns to South African energy stocks and all British and German stocks' returns is conspicuous. This implies the incorporation of relevant news by the foregoing stocks more quickly over time. Cross-correlation between most South African and British stock returns decrease in magnitude from the bear run to the bull run, which may imply that the structure of information transmission across the two markets has changed over time. However, Japanese industries have higher cross correlations coefficients between the two periods in general. This is attributed to the combined effect of size and non-synchronous trading between equity markets, with the larger US equity market opening later than other markets, yet all other equity markets waits for signals from the US market. This means that cross correlation coefficients will be larger than contemporaneous correlation coefficients.

4.3 Summary of Empirical Findings

In spite of distinctive patterns in contemporaneous and cross correlations, correlations are fairly random. The covariation structure of the industrial equity returns between South Africa and developed foreign industries are stable across bull and bear runs, implying that factors other than market conditions influence the covariation pattern. The stability in the covariation patterns suggests that sector covariation is influenced by an individual country's unique domestic factors that traverse market periods. Domestic country-specific factors in this regard may include prevailing domestic economic policies and socio-political environment. The results show that these factors affect domestic industrial sector variations in a way that surpasses the variations that arise from industry specific factors.

The results obtained in this study are consistent with Lessard (1974), Baelle & Inghelbrecht (2005), Soriano & Climent (2006) and Meric *et al.* (1989, 2008), who find that country-specific factors dominate industry-specific factors in driving potential gains from international portfolio diversification. Despite convergence in composite national equity indices, international equity markets remain segmented at the industry level, which is evident in low cross country covariation. Thus, investors can benefit by holding a portfolio comprising stocks from industrial sectors across countries. However, these findings diverge from those of Harvey & Ferson (1991), Cavaglia *et al.* (2000), Yang *et al.* (2003) and Flavin (2004) who find that industry factors are more important than country and regional factors in portfolio diversification decisions. The differences in findings may be attributed to the time period examined, phenomena studied and methods applied.

CHAPTER FIVE

CONCLUSION

This study provides tentative evidence that a domestically diversified portfolio comprising stocks from different industry sectors yield few benefits to investors. During both bear and bull runs and also during the full period, industries in a country are highly correlated with each other so diversification offers limited scope for investors to earn abnormal returns. Thus, asset managers should consider international portfolio diversification in search of diversification benefits. A South African investor engaging in international cross-sector portfolio diversification can gain to a significant extent given that most South African sectors are less correlated with sectors of other countries. The generally low correlation coefficients between international sectors indicate the existence of low return covariation between international sectors. However, investing in same sectors internationally must be avoided in the energy and information technology sectors because these sectors' correlation coefficients are the largest, irrespective of country of origin. Thus, these sectors are affected more by global factors than by individual domestic factors.

This study finds that industrial sectors in the sample have correlation ranges in accordance with their country of origin. This implies the dominance of country factors over industry specific factors in influencing the behaviour of sector prices on domestic firms. This causes high sector covariation of sectors domestically but very low covariation internationally, even in similar sectors. Thus, a South African investor should construct a portfolio from stocks of industrial sectors in Germany, United States of America, United Kingdom and Japan. Investment is even beneficial in similar sector, the investor should however avoid concurrently holding energy and IT stocks because these two stocks covary highly irrespective of country.

The absence of a significant change in the covariance structure of sector equity returns in bull and in bear runs is evident in the lack of a significant change in the correlation coefficient range between the sectors examined. Thus, there may be high short term return covariance, which may induce capital flight, without a change in the covariation structure of industrial equity returns between South Africa and its developed nation counterparts. As a result, investors' portfolio rebalancing decisions should be based on market fundamentals in addition to market state changes (bull or bear). When the economic state changes and the magnitude and direction of capital flows are stable the regulatory and policy environment status quo should be preserved.

An area of further research that emerges from this study is to evaluate the covariation pattern of industrial equity returns during low and high volatility in equities, for example, examining covariation of equities during the current global financial crisis. Examining whether covariation increased or not during this period will assist asset managers and regulators to design appropriate strategies to deal with such scenarios in future and therefore reduce the uncertainty in investment strategy and policy direction that is characterising the current global financial crisis.

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Appendix

Table 3.1: Summary of Empirical Literature

AUTHOR	COUNTRIES	PERIOD	DATA FREQUENCY	DATA LEVEL	ISSUE STUDIED	METHOD	FINDINGS
Levy and Sarnat (1970)	Austria, Australia, Belgium, Chile, Ceylon, Canada, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, Mexico, Netherlands, New Zealand ,Norway, Peru, Philippines, Portugal, South Africa, Spain, Sweden, Switzerland, UK,USA and Venezuela	1951-1967	annual	National aggregate equity indices	International Diversification of Investment portfolios	Mean-Variance analysis	The addition of international equities in a US investor's portfolio is beneficial than domestic portfolio diversification, even with borderline (emerging markets) investment countries such as South Africa and Venezuela
Philipatos et al. (1983)	US, UK, Germany, France, Japan, Italy , Sweden, Netherlands, Belgium, Austria, Canada, Switzerland, Denmark and Norway	1959-1978	monthly	Industrial stock indices	Inter-temporal stability of stock market relationships	Principal Components Analysis	Stock market relationships and co-movements are found to be inter-temporally stable suggesting the existence of international economic fundamentals that contribute to the non-randomness and stability of inter-relationships
Meric & Meric (1989)	Netherlands, Switzerland, Belgium, France, U.K., Germany, U.S.A., Canada, Norway, Australia, Sweden, Singapore, Japan, Hong Kong, Austria, Italy, Spain	1973-1987	monthly	National stock indices and Industrial stock indices	Seasonality and inter-temporal stability in the international stock market relationships	Principal Components Analysis and Box's M statistic	Co-movements are found to be seasonally unstable, with period Sep-May stable but May-Sep very unstable. Correlations are found to be good proxies of co-movement and co-movement patterns, hence industrial diversification may result in more investment gains in the stable period. Diversification is found also to be beneficial in international than domestic diversification

Roll (1992)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Spain Malaysia, Mexico, Netherlands, New Zealand, Norway, Singapore, South Africa, Sweden, Switzerland, United States	1988-1991	daily	National aggregate stock indices and industrial indices	Industrial Structure and the Comparative Behaviour of International Stock Market	Bivariate regression	National stocks that comprise the same stock are found to commove more than those with dissimilar industries as constituents. Also South Africa's stock market is found to be highly volatile due to dominance of resources stocks in the ALSI, which follow the volatile resource prices. Currency volatility was also found to drive stock market volatility and correlations.
Arshanapalli et al. (1997)	USA , Australia, Hong, Kong, Japan, Malaysia, New Zealand, Singapore and all European countries	1993-1993	daily	Industrial stock indices	Common volatility in global capital markets	ARCH model	Returns volatility is found to be time varying and there is higher intra-industry common volatility, suggesting higher intra-industry integration than aggregate indices. Diversification is found to be more beneficial in industry portfolios across regions than in national indices and industry portfolios within regions.
Ramchand & Susmel (1998)	Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, UK, Hong Kong, Japan, Singapore, Australia, Canada, US	1980-1990	weekly	National stock indices	Correlation patterns during low and high volatility regimes and over time	Switching ARCH model that allows for time and state variability in the correlations	Correlations conclusively increase during high volatility regimes and also generally increase over time. So correlation patterns change with time and the state or regime of the stock market. Potential gains of diversification are high during low volatility and low correlation state of the market
Maheu & McCurdy (2000)	USA	1926-1995	monthly	Portfolio security prices	Identifying bull and bear markets by examining duration dependency in conditional mean and variance of stock returns	A Correlation integral-based method that detects interdependency in time series using the Behaviour Data System (BDS) test of Brock et al. (1987)	Results show that a high return phase is associated with a low variance state and a high variance state with low returns. Bull periods have low hazards but with high returns while bear periods are very volatile with low returns. This implies a high risk of loss during bear, without compensation for this high risk state.

Faff & Dean (2000)	Australia	1988-1999	daily	Individual company stocks and industry portfolios	Asymmetries in stock covariance and volatilities	EGARCH modelling technique	Study show consistent time-varying risk premium as shown by varying return covariance asymmetry. Good news reduces stock return covariance and volatility, while the bad news increase returns covariance and volatility. There is higher co-movement in stock returns in the high volatility regime.
Chesnay & Jondeau (2001)	UK and Germany	1988-1999	weekly	National stock indices	Stock return correlation patterns during high and low volatility	Multivariate Markov switching ARCH model to identify correlation patterns in aggregate stock indices	Correlations are found to increase during high volatility periods and to reduce during low volatility periods. This result mean that high risk periods are associated with higher co-movement and offer little in terms of diversifying options as equities commove.
Meric et al. (2001)	US, Argentina, Brazil, Chile and Mexico	1984-1991	daily	Aggregate National stock indices	Co-movement patterns of stock returns before and after the 1987 equity crash	Principal Component Analysis and Box's M test	Correlation between the US and the Latin American markets increased after the equity crash implying that co-movement in stock returns increased in the post crash period than in the pre-crash period. This has an effect of decreasing potential gains from diversification in the post crash period.
Solnik & Longin (2001)	US,UK, Germany, Japan and France	1959-1996	monthly	National stock indices	Stock return correlation patterns during high and low volatility	Bivariate correlation and return exceedance analysis using Extreme Value Method	Volatility per se does not affect stock market correlations; however, these correlations increase during bear and are low during bull periods, reducing diversification benefits when they are needed most.
Ang & Chen (2002)	USA	1963-1998	daily and monthly	Company stocks portfolios and the Aggregate stock indices	Asymmetric correlations of equity portfolios	Correlation analysis conditioned on the downside movement of the market using H-statistic	Study confirmed the existence of asymmetric response of correlations to shocks to the market. Equity portfolios are found to be more correlated with the aggregate indices in the downward markets than the upside market. Asymmetries are also found to he high for smaller, value stocks and recent looser stocks

Flavin (2004)	Selected countries in the Euro-zone	1995-2002	monthly	Aggregate National stock indices and Industry stocks	Country versus industry effects on portfolio diversification	Heston and Rouwenhorst (1995) panel data approach	Industry effects dominate the country effects on influencing the co-movement patterns of equities, because the factors that affect different industries are diverse. This implies that industry diversification will result in more portfolio gains than regional diversification.
De Goeij & Marquaring (2004)	USA	1982-2001	daily	National stock indices and bond indices	Inter-temporal covariance structure of bond and stock returns	Constant conditional correlation analysis using the GARCH modelling technique	Variances, covariances and returns are all asymmetrical in response. Covariances are higher during turbulent times than during good market time, implying low diversification benefits during turbulent times than tranquil times
Bartram & Wang (2005)	UK and USA	1978-1997	daily	National stock indices	Market cross correlation and volatility	Simulation using Monte Carlo simulation of Geometric Brownian Motion and GARCH model	Contagion was found to exist between the US and UK markets during financial crisis but they found it difficult to separate co-movement that is from market dependency from that which is volatility induced
Guidolin & Timmerman (2005)	UK	1976-2000	monthly	National stock indices and bond returns	Implication of bull and bear phases on stock and bond returns	Regime or state analysis using the Markov switching model	Paper found clear evidence that different market regimes have different risk and return characteristics. Bonds and equities returns volatilities and co-movement increase during bear than during bull periods. This difference mean that an optimal portfolio differs in its weight of asset classes and requires rebalancing as states changes, to maximise gains
Taing & Worthington (2005)	Belgium, Finland, Germany, Ireland , France and Italy	1999-2002	daily	Industrial/Sector stock indices	Co-movement of stocks after Euro currency introduction	Causality analysis of the market co-movement using the Multivariate cointegration, VAR and Granger Causality techniques	The industrial sectors show very fewer than expected inter-relationships. But causal relationships are found between large markets of Germany, France and Italy influencing those of smaller economies, that is Belgium, Finland and Ireland. The Euro-currency introduction however increased the co-movement in stock in the participating countries

Soriano & Climent (2006)	United States, Canada, Finland, Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Sweden , Luxembourg, Italy Netherlands, Portugal, Spain, United Kingdom Cyprus, Czech Republic, South Korea, Hungary, Poland, China, Hong Kong, India, Indonesia, Japan, , Malaysia, Pakistan, Taiwan, Philippines, Singapore, Sri Lanka, and Thailand.	1995-2004	daily	Industrial stock indices	Industry and Regional effects on co-movements of stocks across countries	Conditional variances and covariances are calculated using the GARCH and BEKK specification that uses a dummy variable approach	Regional effects are found to dominate industry effects on co-movements of stock returns. Basic and general industries have shown a high co-movement, while other industries show little interrelationships. The IT sector shows no relationships with international markets. This mixed result indicate that both regional and industry effects should be taken into account in selecting stocks for a portfolio.
D'Ecclesia & Constantini (2006)	US, UK, Japan and Canada	1978-2002	monthly	Aggregate National stock indices	Co-movement and correlations of international stock markets	Common trend and cycle method using cointegration and VAR techniques	Markets show high co-movement in the short run, arguably due to global events such as market and debt crisis, equity crashes and disasters, but however show low long term co-movements trend due to own domestic economic fundamentals driving both stock prices and returns. Result show that diversification is beneficial in the long run where market movements are guided by domestic economic fundamentals.
Meric et al (2007)	US, Japan, Sweden, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Spain, Switzerland, Turkey and UK	1996-2006	daily	Aggregate national indices	Co-movements of stocks after the September 11 attacks	Principal Component Analysis and Correlation Analysis	There was higher global co-movement of stocks after the terrorist attacks than for the period preceding the attacks. However, the co-movement patterns in small countries outside the mainstream economic blocks such as the European Union, such as Turkey, and Luxemburg show little increase in co-movement, hence offer better prospects for diversification benefits. Large stock markets of the EU such as German and Italy show higher co-movement after the attacks, hence diversification benefits potential is reduced

Knif & Pynnonen (2007)	UK, USA, Germany, Canada, Hong Kong, Japan, France, Denmark, Norway, Netherlands, Switzerland and Austria	1989-2004	daily	Aggregate national stock indices	Volatility driven changes in stock return correlation dynamics	LOGIT regression model	Results support the empirical findings of volatility influencing the pattern and intensity of market correlations. Correlations and therefore co-movements are therefore induced by volatilities in both the global market and the local market. Domestic volatility mainly influence correlations in smaller stock markets correlations such as that of Norway while the larger markets correlations are affected by global volatility.
Cunado et al. (2008)	USA	1928-2006	daily	Aggregate national stock index	Volatility influence on stock behaviour during bull and bear market	A causality test using the Lagrange Multiplier principle	Evidence from the paper show that there is volatility persistence during both bull and bear periods. This implies that there is higher volatility persistence in bull and bear phases, but no conclusive evidence whether volatility is higher in one of the periods
Meric et al. (2008)	US, UK, Germany, France & Japan	1997-2002	daily	Aggregate national stock indices	Co-movement of stocks during bull and bear periods	Principal Component Analysis and Granger Causality	Results show that in the bull market, sectors are clustered in terms of their country affiliation; hence diversification benefits can be obtained by investing even in same sectors across countries. In the bear market, sectors tend to highly commove across countries such that country diversification becomes less beneficial. However, the US market seems to have the largest influence over other markets especially during bear markets.