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THE EFFECTS OF THE MAASTRICHT ON PORTFOLIO DIVERSIFICATION

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ABSTRACT: *Whether economic interdependence among countries is a contributing factor to co-integration and common stochastic trends in international stock markets is indiscernible due to conflicting results from prior empirical works. The purpose of this study is in two folds: Firstly to investigate whether the implementation of the Maastricht treaty has played any role in determining the long-run relationship between U.K stock market and other E.U and non-E.U stock markets and also to investigate the extent to which world stock markets have been correlated in the short-run over the study period and how such relationships would benefit investors in their portfolio diversification decisions. Data for this study was obtained from M.S.C.I indices and covered the period from 1985-2003. The methodologies used for this study are the correlation coefficient, the Vector Error Correction model and Vector Autoregressive model for the short-run relationship as well as the Johansen Co-integration approach for testing the long-run stochastic trend among the variables under consideration. The results for the short-run relationship among the variables indicates that in general, stock markets from the developed economies have become integrated in the short-run after the implementation of the Maastricht treaty compared to the pre-Maastricht treaty era. The results also show that the U.K stock market shows high correlation with the U.S stock market both before and after the implementation of the treaty and that correlation with other European Union economies, increased after the treaty. The co-integration results for the pre-Maastricht treaty period showed 2 co-integrations among the variables but there was no evidence of co-integration after the implementation of the treaty. However, when test was carried out for the whole study period, the results showed 1 co-integration among the sample country indices. The implication from the above results shows that diversification benefits for international investors wishing to invest into these developed markets especially in the short-run should expect reduced gains. However, long-term diversification benefits are possible as long as the correlations between these markets are low.*

KEYWORDS: European Union, Co-integration, Maastricht Treaty, Portfolio Diversification, Stock Market.

INTRODUCTION

The purpose of this chapter is to provide a brief explanation as to why this study on portfolio diversification is of an interest, my motivations for choosing this topic, a brief summary of what is in each chapter, a trace of how researchers have applied varying techniques to explain portfolio diversification as well as a brief summary of the historical events towards the formation of the EU through the implementation of the Maastricht treaty. The chapter is divided into 4 major sections. Section 1.1 talks about why the study is of interest to the academic circles, section 1.2, talks about my motivation for choosing this topic, section 1.3 looks at the E.U and the Maastricht Treaty and it entails a brief history of the European Unity Movement, the Development of EU and a look at the Maastricht Treaty. Finally, section 1.4 provides a summary for the chapter.

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One of the most intriguing studies that have attracted the attention of researchers over the past decades has been the theoretical concept of Portfolio diversification and the extent to which International Stock Markets are linked or integrated. Two equity markets are said to be integrated if the reward for various investment risks is the same in each market. If these rewards were different, a portfolio manager could increase expected return without altering risk by shifting investment to those countries with the higher return (Letall, 1995). The theory of portfolio diversification date back to Markowitz (1952) who showed how an investor can reduce the standard deviation of portfolio returns by choosing stocks that do not move exactly together. Grubel (1968) employed Markowitz model to present a paper on international portfolio theory which was later expanded by Levy and Sarnat (1974). Both of these studies employed the price indices of the common stocks of different countries to test the benefits of Markowitz diversification at the international level and concluded that when an American investor diversified his portfolio to include securities from other nations he was able to obtain a higher rate of return or lower variance, Novack (2001).

Various studies continue to apply varying techniques to explain how international investors can benefit from portfolio diversification. One of the techniques used to explain this benefit is to study the short run correlation matrix between national stock markets. Low correlation between the world equity markets indicates that investors may gain from international diversification e.g., Solnik, (1974); Watson, (1978); Meric& Meric, (1989) etc. According to this technique, an investor can benefit from portfolio diversification by selecting portfolios comprising of stock markets with negative or low correlations.

Further studies by Goodhart, (1988); Divercha et al., (1992); Defusco et al., (1996); Kohers, (1998); Errunza et al. (2001) etc, have recommended the inclusion of Emerging market stocks into ones portfolio structure because of their higher returns and low correlation with developed markets. Recent studies however, have criticized the mean-variance and correlation matrix approach and relied instead on an alternative methodology pioneered by (Dickey and Fuller, 1979); Engle and Granger, (1987); Johansen and Juselius, (1990) to determine the degree to which two markets are integrated both in the short and in the long run. According to Clare, et al. (1992), the correlation coefficient methodology used to measure the degree of integration between any two markets may be misleading since markets often diverge considerably in the short-run (i.e. periods of up to a year), but may be well integrated over longer periods. The correlation coefficient approach cannot distinguish between short and long-run covariation and as a result analyst are forced to consider different sample periods making inferences based on differing correlation coefficients for those periods. Thus a fund manager who diversifies between two markets believing that they will be spreading their risk by simply looking at the correlation coefficients may not achieve the degree of diversification initially anticipated.

The alternative approach known as cointegration allows researchers to combine all the historical information at once and can decompose the movement of time series variables into their short (or dynamic) and long-run components thus enabling investors to make long-term sensible investment decisions. Researchers have therefore adopted this approach recently to explain long-run benefits to portfolio diversification. According to this technique, an investor stands to gain from portfolio diversification in the long-run if he/she selects a portfolio of stock markets that are not co-integrated. Alternatively, if two or more markets exhibit cointegration then the benefit of portfolio diversification is reduced. However, various studies carried out using this technique have produced conflicting results as to the extent ad which markets are co-integrated. For example, Kanas (1998); Gerrits (1999); Seabra (2001); Chang (2001) etc, have all argued that the existence of cointegration between stock markets does not provide benefits

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to international diversification whilst Byers (1993) argues that cointegration provides some restricted benefits as long as the cointegration coefficients are low.

The above review traces the evolution of the relationship among international stock markets and how researchers have applied varying techniques to explain gains from portfolio diversification. This review lays the foundation for the literature review in chapter 2 which provides more detail summary as to what researchers have done in the areas of correlation coefficient and cointegration in explaining portfolio diversification gains to international investors. The relationship among international equity markets in explaining how investor can benefit from portfolio diversification, clearly provides varying views and opinion as to factors responsible for determining how different stock markets are related both in the short and long-term. Whilst some researchers argue that stock market linkages are influenced by closer economic integration (see Bachman et al. (1996); Phengpis et al. (2004), others such as Blackman, Holden, Thomas (1994); Masih and Masih (1997, 2001); and Parhizgari et al. (1994) etc., have suggested that financial market globalization and improvements in technological changes among countries have played significant role in determining how stock markets are related. Cheung and Lai (1990), on the other hand, see macroeconomic factors as responsible, whilst Arshanapalli, B., Doukas, J. and Lang, L. (1995) see the 1987 stock market crash as responsible for common stochastic trend among international equity markets. It is very difficult to attribute a single factor as being the sole cause for how stock markets are inter-related in the long-run. The evidence from the short-run relationship among international stock markets through the technique of correlation matrix, suggest that generally world stock markets especially from the developed markets have become closer as evidenced by the increase in correlation between markets thus implying reduced diversification gains for investors. Lessons from this would guide me through my study and offer me the opportunity to investigate some of these diverse claims and thus contribute to the ongoing debate on international stock market linkages.

Motivation

Giving the extent of conflicting findings from the above empirical research works, and increasing regional, economic cooperation and groupings among countries, this study intends to provide further insight into whether economic interdependence among national stock markets is an important contributing factor to cointegration and common stochastic trends. This study would also test the hypothesis that correlation between stock markets has been increasing. The analysis in this study has implications for international portfolio diversification. If stock markets share a common trend that implies that the markets move together and anyone market will be representative of the behavior of that group of markets. That implies that investing in these markets will provide no long term gains to portfolio diversification. With the globalization of the world economy and increasing regional trade relations among countries to take advantage of modern complex competitive market, the EU was formed with the long-term objective to foster trade and facilitate a process of economic integration, involving commodity, capital, and factor market integration among member countries. At the center of this closer economic integration is the Maastricht Treaty adopted and ratified in 1992 by member countries.

As a key strategic member of the EU and one of the biggest economy in the world with the state of the art capital market my study intends to focus on the UK capital market by investigating its short and long-term relation with other global stock markets through the methodology of cointegration and to investigate the role and to what extent the implementation

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of the Maastricht Treaty has played in shaping the relationship between the UK stock market and other world markets. My studies would also investigate the correlation coefficients between the UK and other world stock markets to ascertain whether the correlation between these world stock markets have been changing or have remained constant over the period under study. The findings from this study would help to provide useful investment decision and insight to an international investor hoping to take advantage and benefit from portfolio diversification.

LITERATURE REVIEW

Portfolio Theory

To understand portfolio diversification, we first need to understand the concept of risk and return. Risk can be defined as the chance that some unfavorable event will occur and it is normally measured by the volatility of returns, which is the variance or standard deviation. The riskiness of an assets cash flows can be considered on a stand-alone basis (each asset by itself) or in a portfolio context, where the investment is combined with other assets. [Brigham et al., 2001]. The expected return on an investment is the mean value of its probability distribution of returns. The greater the probability that the actual return will be far below the expected return, the greater the stand-alone risk associated with an asset. An assets risk consists of unique risk, which are risk factors affecting only a particular firm and which can be eliminated through diversification as well as market risk which are macro-economic sources of risk that affect the overall stock market and which can be eliminated through diversification. [Brigham et al. (2001) pp. 230, 267]. An investor who holds a portfolio of securities is interested only in how each security affects the risk of the entire portfolio. The contribution of a security to the risk of a portfolio depends on how the security's return varies or is correlated with the investors other holdings. Thus a security that is risky if held in isolation may nevertheless serve to reduce the variability of the portfolio as long as its return varies inversely with those of the rest of the portfolio. Because the returns on assets in different countries are not perfectly correlated, global diversification may result in lower risk for an international investor holding a globally diversified portfolio of stocks. [Brealey et al., 2001].

Previous Studies

The potential gains from international diversification strategies have been highlighted in a number of studies. Below are reviews of some of these studies: Writing under the heading International Diversification of Investment Portfolios, Levy et al., tested the hypothesis that international diversification offers potential gains in terms of risk reduction to an international investor. Levy et al (1970).Their studies were developed based on the pioneering work of Markowitz (1959) and Tobin (1958) who provided a positive explanation and normative rules for the diversification of risky assets. They argued that as long as the correlation of returns among investment options is not perfect, a necessary, but not sufficient condition for gains in portfolio diversification exist. In order to examine the potential gains accruing from international diversification, Levy et al., selected twenty-eight country indexes comprising both developed and developing countries for the period 1951-1967 and calculated the mean rates of return and standard deviations for each of these countries. A correlation matrix structure for these country indexes were also calculated for the same sample period. Also a set of efficient portfolios resulting in efficiency frontier were also calculated based upon a

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combination of investments in various countries which either maximizes the rate of return given the variance or minimizes the variance given the rate of return.

Finally, utilizing the market equilibrium model developed by Lintner (1965) an optimum portfolio combination was obtained. Choosing only nine countries out of twenty-eight for the optimal portfolio construction based upon the correlation matrix, the result showed that even though Japan was characterized by a high level of risk, it had a relatively large share in the portfolio owing to its degree of negative covariance with the other members of the set. Also, the optimal portfolio was made up of 40-60% of proportion of investments in developing countries such as Venezuela, South-Africa, Mexico etc and this is so because they had negative or low correlation coefficients with the other countries in the set. The proportion of investments by developed countries were however low because their correlation with one another were high. The findings also showed that when all funds were diversified among the 28 countries, the mean rate of return and standard deviation were 12% and 8% respectively which provided gains to an international investor compared to when funds were invested in a particular country or in a group of similar countries. For example, the expected return and standard deviation for US were 12.1% and 12.1%, that of developing countries were 5% and 26.5%, Western Europe 15.5% and 23.5%, and the common market 15.5 and 25% respectively.

Their study concluded that gains from portfolio diversification can be obtained by selecting portfolio that includes both domestic and international stocks with low correlation. Also even though a stock market might have high standard deviation, gains to portfolio diversification can still be obtained as long as it has a low correlation with other countries comprising the portfolio set.

In 1974 writing under the topic "why not Diversify Internationally rather than domestically", [Solnik, 1974], tested the hypothesis that risk reduction can be attained through portfolio diversification in foreign as well as in domestic equities. His study were based on previous studies by Evans et al. (1968) and Wagner et al.(1971) who studied the relation between the riskiness of a portfolio assembled on the US market and the number of securities included. Solnik argued that the total risk of a portfolio will depend not only the number of securities included in the portfolio, but also on the riskiness of each individual security and the degree to which these risks are independent of each other.

Solnik collected weekly price indices from seven European Countries for the period 1966-1971 using over 300 European stocks as well as the weekly prices of stocks on the NYSE for the same sample period. His methodology was to calculate the portfolio mean return and standard deviation for each of the seven European stock markets as well as the NYSE based upon varying number of domestic stocks held in a portfolio. The mean and standard deviation for an international portfolio comprising of stocks made up of all eight sample country indices was also calculated. Finally, an international portfolio was constructed whose composition was made up of industrial stocks from the eight countries and another portfolio made up of a combination of country and industrial stocks from the eight sample country indices.

The results from the portfolio comprising purely domestic stocks, shown that of the eight countries Netherlands, Belgium, and US, had the lowest risk reduction of 24.1%, 20% and 27% respectively whilst the most risky country was Switzerland, Germany and Italy with 44%, 43.8% and 40% respectively. UK and France were 34.5 and 32.6% respectively. By comparing the results of an internationally diversified portfolio with each of the domestic portfolios, the outcome showed a substantial risk reduction for the international portfolio of 11.7% far lesser

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than each of the eight country indices. The results also showed that inter-industry diversification was inferior to inter-country diversification. However, a combined procedure with both industrial and geographical diversifications produced slight better results.

Meric& Meric (1998), however looked at diversification from the view point of how stock markets have been moving over the years especially before and after the 1987 stock market crash by studying the correlation-matrix structure of the world's largest stock markets and how changes in these pattern has affected gains from diversification. Their study concluded that world stock markets have become more integrated and harmonized after the crash resulting in less gain to international investors from diversification compared to the pre-crash period. In terms of the long-run relationships among world stock markets, Taylor et al. (1989); Byers et al. (1993); Kanas (1998); Gerrits et al. (1999) and Apilado et al. (2004) used cointegration techniques to investigate the extent to which international stock markets are integrated and how international investors would benefit from these relationships. The results and findings from these studies however produced conflicting results.

For example, Taylor et al. (1989) and Byers et al. (1993) looked at cointegration from the point of UK stock market and other world stock markets after the abolition of the UK exchange control. Whilst Taylor found cointegration between UK and other European stock markets but not with the US, Byers on the other hand did not find cointegration between UK and other European markets as well as the US. Kanas (1999), however found cointegration between UK and US after the 1987 stock market crash but not before implying reduction to diversification benefits after the crash. Again the study by Gerrits et al. (1999) between European stock markets and the US, showed that the European stock markets were cointegrated among themselves and between the US stock market thus a reduction from diversification benefits. Finally Apilado et al. (2004), found that EMU stock markets were cointegrated whilst non-EMU stock markets were not cointegrated thus showing that stronger economic integration plays a significant role in determining how markets move together in the long-run implying that international investors can benefit from portfolio diversification by selecting stocks from countries with less stronger economic ties and trade links.

In short, the lesson we have learnt from the above literature review is that in order to take advantage from portfolio diversification, an investor should have a portfolio of stocks spread across different countries with low or negative correlation, and that even though a stock market may exhibit high risk or standard deviation, an investor can still benefit from selecting that stock as long as there is a low correlation between the stock and other stocks comprising the portfolio. We have also learnt from the literature on cointegration that generally, developed stock markets have become more integrated and share common stochastic trends especially after the October 1987 stock market crash leading to reduced diversification benefits and that various factors do contribute to long-term relationship among international stock markets.

METHODS

For Portfolio Diversification:

This paper utilizes the Markowitz Portfolio theory model [Markowitz (1952)] to determine the correlation matrix between the variables. The Markowitz variance- covariance analysis is given by the equation

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$$V_p = \sum_{i=1}^{k}\sum_{j=1}^{k}\left(X_i X_j Cov_{ij}\right) \quad (1)$$

V_p is the portfolio variance, k is the number of assets in the portfolio,

X is the share of assets i or j within the portfolio and Cov_{ij} is the covariance between assets i and j, and is calculated by:

$$Cov_{ij} = s_i s_j r_{ij} \quad (2)$$

Where s_i and s_j are the standard deviations for assets i and j respectively; and r_{ij} is the correlation coefficient between assets i and j. The expected return is determined by

$$E_p = \sum_{i=1}^{k}[X_i E(R_i)] \quad (3)$$

E_p is defined as the return on the portfolio, and $E(R_i)$ is the expected return for security i.

[Shachmurove, 1998)].

After expressing the country indices in the form $R_t = 100 \log\left(\frac{P_t}{P_{t-1}}\right)$, the study used Eviews to calculate the correlation coefficient matrix for the variables for the three sample periods.

Cointegration Test:

According to Ken Holden (2004), if X is $I(1)$ and Y is $I(1)$ but $(Y - \alpha - BX)$ is $I(b)$ then X and Y are cointegrated and $(\alpha\ \beta)$ is called the cointegration vector. More generally, if X and Y are $I(a)$ and $(Y - \alpha - BX)$ is $I(b)$ then X and Y are cointegrated of order $(a - b)$. The most common cases are $a = 1$ and $b = 0$ but other cases do arise.

Implications of Cointegration.

If Y and X are $I(1)$ and are cointegrated so that $u = Y - \alpha - BX$ is $I(0)$ then, in the long run, Y and X do not drift apart, since u has a constant mean, which is zero. Hence $Y = \alpha + X\beta$ can be interpreted as an equilibrium or long-run relat5ionship and is frequently given an economic interpretation. Here u is referred to as the error-correction term (ECT) since it gives the value of the "error" in $Y = \alpha + X\beta$ and so is the deviation from equilibrium which, in the long run, is zero. Notice that if Y_t and X_t are cointegrated, so must be Y_{t-i} and X_{t+j} and so are, for example $(Y_{t-2}, X_{t+1})\ and\ (Y_t, X_{t-1})$. This means that care is needed in interpreting a cointegrating regression. It is essential to ignore the time subscripts since it is a long-run relationship.

The Granger Representation Theorem.

If Y and X are both $I(1)$ and are cointegrated then there exists an error correction model (ECM) of the form:

$$DY_t = -\rho_1 u_{t-1} + \text{lagged}\ (DX, DY) + d1(L)e_{1t}$$

$$DX_t = -\rho_2 u_{t-1} + \text{lagged}\ (DX, DY) + d_2(L)e_{2t}$$

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Where $u = Y - \alpha - \beta X$ is error-correction term (ECT) and ρ_1 and $\rho_2$are not both zero. Here e_i is a white noise residual and $d_i(L)$ is a lag operator so that past values of e_i also appear in the equation. Notice that each of the terms in these equation is $I(0)$. This theorem tells us that if Y and X are cointegrated then an ECM linking them exists. It also states that if the ECM exists, then the error-correction term, $u_{t-1}$is (0) and so Y and X are cointegrated. Here these equations give the short-run dynamics and the cointegrating regression gives the long-run equation.

Univariate Analysis:

Cointegration presupposes that variables in the system are non-stationary and integrated of the same order. The Augmented Dickey-Fuller (ADF) unit root tests introduced by Dickey and Fuller (1979, 1981) are employed to test the univariate behaviour of the stock index series under the null hypothesis that the series is non-stationary and integrated of order 1. [Apilado et al. (2004)]. This is shown as an equation below.

Hypothesis

$$H_0: \Phi = 0 \text{ in } \Delta Y_t = \alpha + \Phi Y_t + \Phi_1 \Delta Y_{t-1} + \Phi_2 \Delta Y_{t-2} + \Phi_3 \Delta Y_{t-3} + \Phi_4 \Delta Y_{t-4} + \varepsilon_t \text{ so}$$

that ΔY_t is stationary and Y is I(1).

$$H_1: \Phi < 0 \text{ so that } Y \text{ is stationary.}$$

Existence of a common trend between any two series does not always imply that there is a meaningful economic relationship between them. If the series are not stationary (i.e. their mean variance and auto-covariance's are not independent of time), the regressions involving these series can falsely imply the existence of a relationship. This is called as spurious regression by Granger and Newbold (1974). Ignoring this fact and estimating a regression model containing non-stationary variables might lead to insensible results. Dickey and Fuller (1979) consider three different autoregressive (AR) equations which can be used to test the presence of a unit root:

(1) $\Delta y_t = \gamma y_{t-1} + \varepsilon_t$
(2) $\Delta y_t = \alpha_0 + \gamma y_{t-1} + \varepsilon_t$
(3) $\Delta y_t = \alpha_0 + \alpha_{1t} + \gamma y_{t-1} + \varepsilon_t$

The first equation is a pure random walk model, a drift term is added in the second one, and the last equation includes a linear time trend as well. In all equations, the test parameter is $\gamma = 0$, which means y_t contains a unit root. (Erdal et al. 2001)

Testing for Cointegration

Following from the tests for stationarity, the common test of whether two variables are cointegrated is to estimate the OLS regression of $Y = \alpha + X\beta + u$ and test if the residuals are stationary using the Dickey-Fuller or ADF test. In this case the ADF regression is, with

$u = Y - \alpha + \beta X$. If we let, $Du_t = u_t - u_{t-1}$, then $Du_t = y_1 u_{t-1} + y_2 Du_{t-1} + \cdots + e_t$ Where the observed residuals replace the theoretical ones and enough lagged values of Du are included to make the residuals random. There is no intercept term included since the mean of u is zero, and the mean of Du is also zero. The hypotheses are:

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H_0: $y_1 = 0$ so that u is $I(1)$ and there is no cointegration

H_1: $y_1 < 0$ and u is $I(0)$ so there is cointegration .

Engle and Granger (EG) methodology:

Engle and Granger (Econometrica, 1987) propose a two-step estimation method:

(i) step 1: Estimate $Y = \alpha + \beta X + u$ by OLS to give the observed residuals u^*t

(ii) step 2: Estimate the ECMs using u^*_{t-1} for u_{t-1} in

$$DY_t = -\rho_1 u_{t-1} + \text{lagged } (DX, DY) + d1(L)e_{1t}$$

$$DX_t = -\rho_2 u_{t-1} + \text{lagged } (DX, DY) + d_2(L)e_{2t}$$

This method has been commonly used in empirical work. However, recent developments suggest that it is not satisfactory, particularly when there are more than two variables included in the model, and Johansen method is preferred.

Multivariate analysis based on Johansen approach:

The main advantages of using Johansen multivariate procedure instead of the Engle and Granger approach is that Johansen approach can consist of $I(0)$ or $I(1)$ whereas the Engle and Granger (1987) requires that the two series are of the same degree of integration. Another advantage of using Johansen approach is that the Engle and Granger approach restricts one of the coefficients in the cointegration vector to be equal to 1 and the results of the procedure are not invariant to this normalization see Engle and Granger (1987). The Johansen procedure imposes no such restriction. Also, the null hypothesis for the Engle and Granger (1987) approach is that the variables are not co-integrated; in the Johansen procedures no such assumption is required about the number of Cointegration vectors.

The Johansen method is based on estimating a vector autoregression (VAR) model in differences, which can be written, using Johansen's notation:

$$DX_t = \mu + \Gamma'_1 DX_{t-1} + \Gamma'_2 DX_{t-2} + \cdots + \Gamma'_{p-1} DX + \Pi X_{t-p} + BZ_t + U_t \qquad (4)$$

Where X is an $(m * 1)$ matrix of $I(1)$ variables, Z is an $(s * 1)$ matrix of $I(0)$ variable, the Γ'_j and Π are $(m * m)$ matrices of unknown parameters and B is an $(m * s)$ matrix of unknown parameters. M is the number of variables in X, and p is the maximum lag in the equation, which is a vector-auto regression (VAR). Using Granger Representation Theorem of the form:

$$DY_t = -p_1 u_{t-1} + \text{lagged}(DX, DY) + d(L)e_{1t} \qquad (5)$$

In the long run when DX = DY = 0, this reduces to 0 = -p1u, giving the cointegration relationships, while in the long run, equation 1 reduces to $0 = u + \Pi X_{t-p} + BZ_t$ so that Π gives the long-run relationship between the X variables- that is it is the cointegrated vector. The Γ' matrices in equation1 give the short-run effects. Johansen's method estimates (1) and provides various tests of restrictions on the Π matrix which reveal whether the variables are cointegrated and how many cointegrating vectors there are.

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In the view of Change (2001), Johansen (1988) proposed two test statistics for testing the number of cointegrating vectors: the trace (Tr) and the maximum eingenvalue (L-max) statistics. The likelihood ratio statistic for the trace test is:

$$-2\ln Q = -T\sum_{i=r+1}^{p-2}\ln(1-\lambda i) \qquad (6)$$

Now, $\lambda(r+1),\ldots.,\lambda p$, are estimates of $p-r$ smallest eigenvalues. The null hypothesis to be tested is that there are at most r cointegration vectors. That is the number of cointegration vectors is less than or equal to r, where r is 0, 1, or 2. In each case, the null hypothesis is tested against the general alternative.

Alternatively, the L-max statistic is:

$$-2\ \ln Q\ =\ -T\ \ln(1-\lambda r+1i),$$

In this test, the null hypothesis of r cointegrating vectors is tested against the alternative of $r+1$ cointegration vectors. Thus the null hypothesis $r\ =\ 0$ is tested against the alternative that $r\ =\ 1, r\ =\ 1$ against the alternative $r\ =\ 2$, and so forth.

RESULTS AND DISCUSSION

Correlation Co-Efficient Analysis:

To determine if there were any changes in the co-movement patterns of the market from pre-Maastricht period to the post-Maastricht period, Periods I and II are compared. To determine if there are any changes in the co-movement patterns of the market during the post-Maastricht periods, Periods II and III are compared.

PRE-MAASTRICHT TREATY ERA:

TABLE I	CORRELATION MATRIX-PRE MAASTRICHT TREATY ERA						
		PERIOD ONE: 1988:10 TO 1993:10					
STOCK MARKET	RAUS	RUS	RUK	RGER	RHK	RFR	RSWI
RAUS	1	0.514357	0.424422	0.253537	0.254455	0.253537	0.291168
RUS	0.514357	1	0.604524	0.611914	0.414169	0.611914	0.697828
RUK	0.424422	0.604524	1	0.381612	0.37229	0.381612	0.48625
RGER	0.253537	0.611914	0.381612	1	0.334033	1	0.646999
RHK	0.254455	0.414169	0.37229	0.334033	1	0.334033	0.26729
RFR	0.253537	0.611914	0.381612	1	0.334033	1	0.646999
RSWI	0.291168	0.697828	0.48625	0.646999	0.26729	0.646999	1

Table I, shows the correlation matrix structure for the sample country indices namely; Australia, United States, United Kingdom, Germany, Hong Kong, France and Switzerland for the pre-Maastricht treaty periods October, 1988 to October, 1993. As the table shows, the coefficient ranges from 0.253537 to 1. To test for the population correlation coefficient (ρ), the following hypotheses are stated below:

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H_0: $\rho = 0$ so there is no linear correlation between X and Y

H_1: $\rho > 0$ *or* $\rho < 0$ or $\rho \neq 0$ giving one-tailed or two-tailed tests, depending on the conclusion to be reached if H_0 is rejected.

For $n - 2 = 59$ degrees of freedom, the 5% critical value of T is 2. Since all the observed correlation coefficients from table 1 show values greater than .25, we reject H_0 and accept H_1 and conclude that $\rho > 0$. That is with a sample of 61 observations it is unlikely that the observed correlations from table 1 has occurred by chance and so the variables appear to move together. Thus all the coefficients are significant. (Holden, 2003).

The coefficients between UK and the rest of the sample country indices show low correlation from 0.37 to .48 except with the US where the coefficient is high at .60 implying that short-run diversification benefits is possible between UK stock market and the other stock markets except for the US market where diversification benefit is low. The highest coefficient is between France and Germany at 1 implying no diversification gains for investors diversifying into these markets for the period under study whilst the lowest coefficient is between Australia& France as well as Australia& Germany stock markets both at .253537 implying high short-run diversification benefits.

MID-MAASTRICHT TREATY ERA

Table II, shows the correlation matrix structure for the sample country indices namely; Australia, United States, United Kingdom, Germany, Hong Kong, France and Switzerland for the mid Maastricht treaty periods November, 1993 to November, 1998. As the table shows, the coefficient ranges from .048115 to .717339

TABLE II	CORRELATION MATRIX-MID MAASTRICHT TREATY ERA						
		PERIOD TWO:1993:11 TO 1998:11					
STOCK MARKETS	RAUS	RFR	RGER	RHK	RSWI	RUS	RUK
RAUS	1	0.150696	0.048115	0.13255	0.104952	0.207532	0.167624
RFR	0.150696	1	0.583676	0.674531	0.569372	0.567245	0.497173
RGER	0.048115	0.583676	1	0.717339	0.52788	0.602386	0.680739
RHK	0.13255	0.674531	0.717339	1	0.591775	0.545075	0.519313
RSWI	0.104952	0.569372	0.52788	0.591775	1	0.512097	0.432133
RUS	0.207532	0.567245	0.602386	0.545075	0.512097	1	0.630048
RUK	0.167624	0.497173	0.680739	0.519313	0.432133	0.630048	1

Again testing for the population correlation coefficient (ρ), shows that out of 28 correlations, 6 correlations are not significant since they have values less than .25. We therefore reject H_0 and accept H_1 and conclude that $\rho \neq 0$. That is 22 of the correlations move together whilst 6 do not at 5% significant level.

The correlation between UK and the other stock markets increased between these periods compared to the first period. For example three stocks markets namely, Germany, Hong Kong and U.S. showed correlation with UK greater than .5 compared to the first period which is just one stock market i.e. the US stock market. This implies a reduction in short-run diversification benefits between UK stock market and the other stock markets in the second period compared to the first period. The highest correlation is between the Germany and the Hong Kong stock markets at .717339 and the lowest is between Germany and the Australian stock markets at

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.048115. Whilst there were 13 correlations showing coefficients greater than .5 in the second period, there were however only 7 correlations in the first period. This shows that on average correlation among the 7 countries increased in the second period compared to the first period thus implying gains from portfolio diversification reduced in the second period compared to the first period for the 7 country indices.

Another interesting observation is the correlation between Australia (a non-EU country) and the three E.U. countries. We can observe from table 2 that the correlation between Australia and U.K, Germany and France are not significant compared to period 1 where the values were significant. We can therefore conclude that short-run correlation between Australia and the three E.U countries have reduced in the mid period compared to the pre-Maastricht treaty period implying short-run diversification gains for this period.

POST-MAASTRICHT TREATY ERA:

TABLE III	CORRELATION MATRIX-POST MAASTRICHT TREATY ERA						
		PERIOD THREE:1998:12 TO 2003:12					
STOCK MARKETS	RAUS	RFR	RGER	RHK	RSWI	RUS	RUK
RAUS	1	0.805693	0.664943	0.041327	0.573515	0.776722	0.777414
RFR	0.805693	1	0.60528	0.144527	0.776356	0.823441	0.784327
RGER	0.664943	0.60528	1	0.079983	0.539758	0.639814	0.636449
RHK	0.041327	0.144527	0.079983	1	-0.02371	0.055188	0.051332
RSWI	0.573515	0.776356	0.539758	-0.02371	1	0.745664	0.654746
RUS	0.776722	0.823441	0.639814	0.055188	0.745664	1	0.930701
RUK	0.777414	0.784327	0.636449	0.051332	0.654746	0.930701	1

Table III, shows the correlation matrix structure for the sample country indices namely; Australia, United States, United Kingdom, Germany, Hong Kong, France and Switzerland for the post-Maastricht treaty periods December, 1998 to December, 2003. Again, the table shows that the coefficients ranges from -.02371 to 0.930701. Here also, a test for the population correlation coefficient (ρ), shows that out of 28 correlations, 6 correlations are not significant since they have values less than .25. We therefore reject H_0 and accept H_1 and conclude that $\rho \neq 0$. That is 22 of the correlations move together whilst 6 do not at 5% level of significant. The correlation between UK stock market and the other stock markets shows an increase for the third period compared to the first two periods. With the exception of the Hong Kong stock market, all the remaining stock markets had coefficients with the UK market greater than .6 with the highest again between UK and the US stock markets at .93071. The lower correlation between UK and the Hong Kong stock market at .051332 shows that diversification benefits between these two stock markets are possible in the third period. However, the general result for the third period shows that the UK market has become more correlated with the other stock markets except Hong Kong after the implementation of the Maastricht Treaty implying that short-run diversification benefits between UK and the other stock markets has reduced considerably after the implementation of the Maastricht Treaty.

Furthermore, a look at table III shows that whilst there were 15 correlations with coefficients greater than .5, that of period I and II were 7 and 13 respectively. This again shows further increase in correlation among the 7 country indices after the implementation of the Maastricht Treaty. This imply that the 7 country indices have become more interdependent in the short-run since the implementation of the Maastricht Treaty as such diversification benefits among these 7 countries has reduced further in the period 1998:12-2003:12 compared to the periods 1993:11-1998:11 and 1988:10-1993:10.

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A final observation from Table III shows that compared to the first two periods, the correlation between Hong Kong and the rest of the country indices are not significant as all the coefficients are less than .25. This shows that the implementation of the Maastricht treaty has led to the Hong Kong stock market becoming less correlated with the other stock markets for the period 1998:12 to 2003:12 implying improve diversification gains between Hong Kong and the rest of the sample country indices.

The findings from this analysis are in agreement with some earlier studies. For example, Meric & Meric (1998), investigated the co-movements of the worlds ten largest stock markets namely Canada, US, France, Germany, UK, Japan, Hong Kong, Singapore, Australia, Switzerland before and after the 1987 stock market crash i.e.,1975:02-1981:05; 1981:06-1987:09; and 1987:11-1994:02 and concluded that the co-movements of the worlds ten largest stock markets became considerably more harmonized in the post-crash period than in the pre-crash period as the average correlation coefficients of all the ten stock markets increased from 0.316 in the pre-crash period to 0.440 in the post-crash period.

Similarly, Tang et al. (1995), investigated stock market integration before and after the 1987 stock market crash for the period 1983:02 to 1992:06 for Australia, Germany, Hong Kong, Japan, United Kingdom, and United States stock markets and concluded that potential gains from international diversification are reduced due to an increase in the correlation between stock market index returns after the stock crash.

CONCLUSION

The objective of this study is to investigate whether the implementation of the Maastricht treaty has played any role in determining the long-run relationship between U.K stock market and other E.U and non-E.U stock markets and also to investigate the extent to which world stock markets have been correlated in the short-run over the study period and how such relationships would benefit investors in their portfolio diversification decisions. Data for this study was obtained from M.S.C.I indices and covered the period from 1985:10-2003:12. The selected stock markets were the U.K, U.S., Germany, Hong Kong, France, Australia and Switzerland indices.

This study was chosen because of the conflicting results produced by previous researchers in explaining long-run relationships among international stock markets, particularly whether regional and economic integration plays any significant role in determining long-run relationship between markets that share common markets. Since Maastricht treaty was implemented to foster closer economic and regional integration among European countries and since no particular past paper had investigated stock market relationship from the point of implementation of the treaty, this study took this challenge.

Previous literature works that have investigated stock market relationships based on regional integration have not been conclusive. Studies by Corhay et al. (1993), examined the stock markets of European Union countries; Atteberry and Swanson (1997) studied the stock markets of three NAFTA countries; Masih and Masih (2001b), investigated the stock exchange of the Australia and some Asian countries; Bachman et al. (1996) and Phengpis et al. (2004), all found evidence of cointegration and related it to economic interdependence via economic policy cooperation and substantial trades among the countries under investigation. However, studies by Ewing, Payne, and Sowell (1999), find that NAFTA stock markets are not cointegrated over

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the period including the passage into NAFTA in 1994. Also, Pynnonen (1999), found weak cointegrating relation within Nordic stock markets despite strong sub-regional and regional economic ties. (Phengpis et al., 2004).

The methodologies used for this study are the correlation coefficient, the Vector Error Correction model and Vector Autoregressive model for the short-run relationship as well as the Johansen Cointegration approach for testing the long-run stochastic trend among the variables under consideration. To ascertain how stock markets were correlated, the study was divided into three periods i.e., pre, mid and post- Maastricht treaty era and the correlation matrix structure were compared between the three periods. The results showed that generally, stock markets from the developed economies have become integrated in the short-run after the implementation of the Maastricht treaty compared to the pre-Maastricht treaty era. The results also shows that the U.K stock market shows high correlation with the U.S stock market both before and after the implementation of the treaty and that correlation with other European Union economies, increased after the treaty.

To test the long-run relationship among the variables, this study used the Johansen multiple cointegration technique after the ADF unit root test had shown that the series were integrated of order one I(1). The cointegration results for the pre-Maastricht treaty period showed 2 cointegration among the variables but there was no evidence of cointegration after the implementation of the treaty. However, when test was carried out for the whole study period, the results showed 1 cointegration among the sample country indices. The short-run VEC and VAR results however did not produces satisfactory results but the VECM appear however to show a short-run dynamic relationship between DLUK and DLGER(-1) and DLFR(-1). The implication from the above results shows that diversification benefits for international investors wishing to invest into these developed markets especially in the short-run should expect reduced gains. However, long-term diversification benefits are possible as long as the correlations between these markets are low.

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