Trading relationships in European Equity Markets Implications for Investors

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Abstract

The paper examines the question whether the economic convergence taken place over the 1990s between European countries produced a co-movement in their capital markets that increased correlations amongst equity markets, which subsequently reduce the benefits for investors in Europe equity markets. The study uses data from 1988 to 2003 in which both correlation and cointegration analysis is used to describe the behaviour of the above markets. This paper sets out to answer the following questions. Firstly, has the long run relationship between European equity markets changed? Second, what does the dynamic relationship between markets over the period suggest? Third, has the return and volatility transmission process between markets changed over the period of the study. Results suggest there appears to be potential gains for investors in diversifying across the European stock markets. With a few exceptions, there is little evidence to indicate the existence of any cointegrating vectors in either the multivariate or pairwise cointegration tests.

Trading relationships in European Equity Markets Implications for Investors.

This paper examines the relationships between European equity markets and the major United States market the S&P 500 index. International portfolio diversification produces economic gains because stock markets in different countries display relatively low correlations, based on the notion that most economic disturbances are country-specific. International portfolio diversification aims to substantially reduce portfolio risk and increase expected returns. Previous studies have demonstrated the advantages of international diversification, the most recent of which are those by Errunza and Padmanabhan (1988) Meric and Meric (1989), Divecha et al. (1992) Michaud et al (1996), and De Fusco et al (1996). The common theme underlying these studies is that low correlations provide advantages to the holders of international diversified portfolios. The reasons for low international correlations, are barriers to international trade and investment, inadequate information on foreign securities or simply home investor bias. In contrast another group of studies including Roll (1988), Lau and McInish (1993), Koutmos and Booth (1995) Meric and Meric (1997) an Campbell et al (2002), Daly (2003) document a significant increase in correlations and volatility transmission between equity markets during and after the 1987 and 1997 stock market crashes. In the latter studies analysts have pointed to increased financial integration brought about by liberalisation and deregulation of capital markets as the main reason for increased correlations amongst global equity markets.

An interesting question arises from the prospective of investors in European equity markets is that whether the significant changes that has occurred across European capital markets, (eg. European Monetary Union and more recently the introduction of the Euro), affected the so-called benefits of international portfolio diversification of European equity markets? In other words has the economic convergence between European countries produced a co-movement in their capital markets that has increased correlations amongst equity markets that subsequently reduce the benefits for investors in Europe.

This paper examines market integrations during the 1990s and early in the new millennium by focusing on the following issues. Firstly, has the long run relationship between the equity markets changed? Second, what does the dynamic relationship between markets over the period suggest? Third, has the return and volatility transmission process between markets changed over the period of the study.

Methodology.

The main aim of the paper is to examine the linkages in returns and volatility of European equity markets and the US. Equity market relationships can be examined using the following framework in prices:

$$\text{P euro, t} = \beta_0 + \beta_{Pus,t} + e_t$$

Where euro is the index of (FTSE, DAX30, CAC, ISEQ, etc) respectively and US is the S&P500 index. Within this type of equation a number of relationships between equity markets can be analysed utilising a number of modelling techniques. These techniques provide a solution for describing the extent of the relationship between equity markets. The research design and issues addressed in the paper are as follows;

1. What is the long run relationship between the European markets and the US market?

2. What is the dynamic relationship between European equity markets and the US market?

3. What are the return and volatility linkages between the European markets and the US market?

Data

The study comprises daily stock market indices at closing times as collected from Datastream, unadjusted for a fifteen-year period from 16 – 02 –1988 to 15 – 12 – 2003. The indices used are the French, German, Greece, Ireland, Netherlands, Spain, UK and the USA. When national stock markets were closed due to national holidays, bank holidays or for some other reason the index price is removed from analysis. Most of the analysis uses returns that are denoted as the first differences of the natural logarithm of prices.

The study is divided into three periods to capture the effect of increasing or decreasing financial and economic integration between the European markets and the US market over time. The timing of the sub-periods is based on key economic and political events as follows;

1. 6 February 1988 to 30 July 1993 involving the period leading up to and including the ERM crises.

2. 2 August 1993 to 31 December 1998 involving the period after the ERM crises and prior to the introduction of the Euro.

3. 1 October 1998 to 15 December 2003 involving the introduction of the Euro.

Results

Descriptive Statistics

We begin by examining the summary statistics of country stock market indices over the sub periods. An initial comparison of these price indices (in their levels) indicates a general increase in the maximum and minimum values of all stock market price indices over each sub period. Likewise the average price indices for all markets over the three sub periods increased significantly. Across all sub periods the market indices generally exhibit positive ‘skewness’ with some exceptions where the indices indicate some negative but insignificant ‘skewness’ in the first and third sub periods. Although the summary statistics shown in Tables 1 – 4 provide some degree of relevant information, it is more appropriate to examine the summary statistics for the daily percentage returns of the indices. Figure 1 presents time series plots of the returns for all eight-country stock markets used in the study.

In Tables 9 to 12 we compare the volatility of daily stock market returns over the three sub periods. For the seven European markets the average daily stock return was approximately 0.03 per cent over sub period 1, compared to the US daily stock market return of 0.04 per cent. Over sub period 2 the average daily stock market return for the seven European markets was 0.07 percent identical to the return on the US market. For sub period 3 the average daily stock market return for the seven European markets was (minus) –0.02 per cent fall compared to the US market of (minus) –0.01. All stock markets have sustained a higher relative increase in volatility as measured by their standard deviation over the three sub periods culminating in the most recent period October 1998 to December 2003.

The characteristics of the stock market returns as described above, provide a general comparison for both the European markets and the US market respectively. However inference on the integration of stock markets is restricted here to examining whether distributional features are similar. These measures do not however measure stock market integration. A simple test for integration between stock markets is to consider the correlation coefficients across daily returns of stock market indices. By comparing sub periods one can determine whether the stock markets have become increasingly integrated. The correlation matrices for each sub period are reported in Tables 14 to 16. A comparison of the average correlation coefficients across the three sub periods between the US and the combined seven European markets indicate an increase in correlations from 0.23 to 0.33. All European markets recorded an increase in return correlations with the US market over sub periods 1 and 2, while the return correlations between the US market and the European markets with the exception of Germany also recorded an increase in return correlations over sub periods 2 and 3. Interestingly Greece records the lowest return correlation with the US market over all periods but this is increasing across all periods. Also of interest is the return correlations between the major economies of the European community, although the correlation between UK and Germany increases from 0.10 to 0.20 over sub periods 1 and 2, the return correlation's between these markets becomes negative (-0.01) over sub periods 2 and 3. Overall these results indicate that the majority of stock markets in the study have become more integrated between each other (Germany been the exception) and between the European markets and the US market. However, a drawback of this test is that it is a static test, measuring only short-run market integration.

Cointegration.

A long-run relationship between two stock market indices, j and k, can be represented by

$$Ln(P_t^j) = a_0 + a_1 Ln(P_t^k) + e_t$$

where the stock market integration in the long-run implies a linear relationship between the natural logarithms of the portfolio price indices, $Ln(P^j)$ and $Ln(P^k)$. This is a test of the cointegration of two variable series. If $Ln(P^j)$ and $Ln(P^k)$ are cointegrated, the error term e_t in the above equation is stationary and there exists a long-run equilibrium relationship between the two series.

If, as is typical for financial time series, $Ln(P^j)$ and $Ln(P^k)$ are both non-stationary and their first differences R^j and R^k are stationary, they are integrated of the order one, I(1). When each price index is I(1) and there is a linear combination of market indices that are stationary, the indices are said to be cointegrated and hence there exists a form of long-run stock market integration.

In order to gain more insight into the integration of the above markets, in the next section we apply cointegration techniques to determine the nature of any long-run relationships, which may exist over the sub-periods in the study. The presence of highly correlated long-run relationships between the markets indicates that there exist little gains from diversifying amongst these markets.

Below we describe both bivariate and multivariate tests for cointegration between the stock market indices of a number of Asian economies at the centre of the 1997 financial crisis. Johansen cointegration tests are performed over the entire sample period 1988 to 2003 and the three-sub periods. Changes to the underlying relationships between these stock markets arising from changes in economic structures would provide useful information to both stock market investors and international agencies concerned with the long term effects on equity markets in the region.

The first step in cointegration is to test whether the variables in question are stationary or moving with time. If a variable is non-stationary in time then it is said to have a unit root. The standard tests for stationarity or the existence of a unit root are the Dicky-Fuller (1979) and augmented Dicky-Fuller (ADF) tests. In Table 17 to 20 below, results indicate the existence of unit roots in the levels of all the indices (ie. the null hypothesis cannot be rejected). Furthermore, there is no evidence to support the presence of a unit root in first differences of the stock price indices. These results are broadly consistent with the hypothesis that national stock index series are individually integrated of order one, I (1).

Cointegration test results.

The Johansen and Juselius cointegration test is applied to several pairs of stock markets and groups of stock markets, as follows. The first cointegration series is checked pairwise between each country and the US. The second cointegration tests are performed for multivariate cointegration for the entire period and each sub period. The first step in the JJ cointegration test is to determine the lag length for the vector-autoregression (VAR). A log-likelihood statistic compares the adequacy of m versus m + 1 lags. Results of this test indicate that the null hypothesis of more than one lag in the VAR cannot be rejected. Cointegration tests can be interpreted as follows. If two or more shared common stochastic trends exist in a given pair or group of countries, then some countries equity markets behave independently of others in the long run. By contrast, if we find only one shared common stochastic trend in a given group or pair of markets, then these equity markets have a single common long run path and any one equity market may be representative of the behaviour of the group. The implications for the investor are that you only need to invest in one market. Results of the JJ tests are displayed in Tables 21 to 25. In Table 21 the results from the bivariate cointegration tests are displayed, that is those tests for each country with the US, whereas Table 22 provides the results from the multivariate cointegration tests. The cointegration tests are provided under five differenc assumptions regarding the trends underlying the series as suggested by Johansen (1995a), the following five deterministic trends assumptions are tested namely, $H_2(r)$, $H^*_1(r)$, $H_1(r)$, $H^*(r)$ and $H(r)$.

1. $H_2(r)$: The level data y_t have no deterministic trends and the cointegration equations do not have intercepts:

2. $H^*_1(r)$: The level data y_t have no deterministic trends and the cointegration equations have intercepts:

3. $H_1(r)$: The level data y_t have linear trends and the cointegration equations have only intercepts:

4. $H^*(r)$: The level data y_t and the cointegration equations have linear trends:

5. $H(r)$: The level data y_t have quadratic trends and the cointegration equations have only linear trends:

From the findings in Table 21 under the five cointegrating assumptions outlined above we can see that there are mixed results as far as the first sub period is concerned. In particular there appears to exist different cointegrating relationships between each country and the US with the exception of Spain where no cointegration is found. The second sub period, results displays some degree of cointegration for all countries. The third sub period, surprisingly, suggests no cointegration with the US market for five of the seven European countries, the exceptions are Spain and the UK. Results for multivariate cointegration tests are provided in Table 22, where clear signs of cointegration exists in sub periods 2 and 3 but again these results do no provide any level of confidence that a significant change has occurred within the EU equity markets particularly since the adoption of the Euro currency (UK excepted) by these European Union countries. Overall the cointegration tests suggests that country differences have not yet disappeared within the EU equity markets. It would therefore be premature to say that country diversification within the EU is not a primary motive for investors interested in pursuing international portfolio diversification.

Granger causality tests.

Results from the cointegration tests suggest that there is no consistent evidence of a long-run relationship between the US and the European equity markets, in each sub period as shown in the Table 23, the possibility of a short-run relationship may still exist. Next we employ Granger casuality tests to determine how much of a current variable, Y, can be explained by past values of y and whether adding lagged values of another variable, X, can improve the explanation. In this case, Y is said to be 'Granger-caused' by X if X helps explain to predict Y what one is looking for is the coefficents on the lagged X's to see if they are statistically significant based on an F-test.

The Granger-casuality tests were applied to the first differences of to each European equity market with the US market across all three-sub periods. We also performed the same test for each market with Germany. The results in Panel A suggest Granger-casuality running from the US to France, Greece, Ireland, Netherlands, Spain and the UK without any feedback in the first sub-period. Interestingly the US does not Granger cause Germany over this period. Over the sub-period 2 the US does Granger cause all the EU markets with feedback from the UK, and Germany to the US. Over sub-period 3 the US Granger case France, Greece, Ireland, Netherlands, Spain and the UK with no feedback, while Germany Granger cause the US with no feedback from the US to Germany. In Panel B, Germany Granger case France, Spain, UK, Greece, Ireland and the Netherlands with no feedback covering all three sub-period with no feed back.

What can we conclude overall, from the cointegration and Granger causality tests results above regarding the potential diversification benefits fro a US investor wishing to invest in the European equity markets? Firstly, the cointegrability property of equity markets in European markets covered in this study has decreased due to several changes within the European Rate Mechanism. Therefore the absence of cointegration amongst the EU equity markets may reflect a gradual process of convergence of the interest rates of induvidual EMS countries (with that of Germany's). a process that makes cointegration relationships variant over time. Other factors such as for instance the weaker European countries such as Greece, Protugal and Spain have undertaken various market liberalisation stages compared to their more advanced partners. The relaxation of restrictions on foreign exchange and capital flows may not be sufficient to attract foreign investors and further strengthen international capital market linkages. Other factors such as poor accounting standards, information dissemination and political risks may influence the movement toward a universal EU capital market. These reasons do provide significant justifications why European equity markets have not shown long term comovement with each other suggesting that potential diversification benefits within Europe still exists for a US investor.

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Table 1 Level Summary Statistics for the Whole Period

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
FR	2957.39	6922.33	1441.17	1400.99	1.09	3.05
GE	2626.67	6266.15	1225.75	1294.98	0.90	2.58
GR	1727.30	6355.04	260.04	1277.53	1.39	4.34
IR	3132.25	6457.69	1094.88	1628.53	0.35	1.52
NE	310.79	701.56	98.75	183.39	0.60	1.93
SP	5565.80	12816.80	1873.58	2999.96	0.57	1.87
UK	3985.68	6930.20	1763.20	1443.08	0.37	1.80
US	760.12	1527.45	274.28	374.31	0.41	1.74

Table 2 Level Summary Statistics for the Sub1

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
FR	1817.85	2129.32	1441.17	142.90	-0.15	2.42
GE	1474.13	1859.92	1225.75	142.54	0.74	3.00
GR	777.82	1684.31	260.04	312.31	0.24	2.89
IR	1470.52	1893.10	1094.88	193.31	0.13	2.09
NE	129.18	153.80	98.75	11.14	-0.52	3.09
SP	2690.41	3374.31	1873.58	283.48	-0.25	2.85
UK	2412.66	2957.30	1763.20	262.64	0.05	2.32
US	371.93	456.33	274.28	47.68	-0.03	1.91

Table 3 Level Summary Statistics for the Sub 2

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
FR	2467.42	4388.48	1721.14	684.90	1.18	3.22
GE	2464.96	4859.76	1588.35	871.53	1.02	2.75
GR	1251.43	2825.52	762.01	540.95	1.40	3.77
IR	2823.54	5471.61	1646.20	1115.20	0.95	2.62
NE	291.99	597.01	152.84	122.74	0.81	2.26
SP	5120.62	10952.50	2865.10	2314.71	1.05	2.76
UK	4052.52	6179.00	2876.60	957.17	0.70	2.16
US	705.84	1241.81	438.91	235.13	0.58	1.97

Table 4 Level Descriptive Statistics for Sub3

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
FR	4558.20	6922.33	2403.04	1171.98	0.18	1.90
GE	3880.36	6266.15	1625.27	1178.02	-0.06	1.94
GR	3135.11	6355.04	1467.30	1208.22	0.70	2.43
IR	5022.51	6457.69	3620.04	615.18	0.01	2.45
NE	501.04	701.56	218.44	133.61	-0.37	1.81
SP	8739.24	12816.80	5364.50	1818.35	0.01	1.88
UK	5382.06	6930.20	3287.04	986.64	-0.37	1.66
US	1182.17	1527.45	776.76	198.87	-0.17	1.81

Table 5 Level Correlation for the Whole Period

	FR	GE	GR	IR	NE	SP	UK	US
FR	1.00	0.97	0.91	0.91	0.96	0.94	0.91	0.94
GE		1.00	0.90	0.91	0.98	0.97	0.95	0.95
GR			1.00	0.82	0.89	0.90	0.87	0.90
IR				1.00	0.95	0.95	0.93	0.96
NE					1.00	0.98	0.98	0.98
SP						1.00	0.97	0.98
UK							1.00	0.98
US								1.00

Table 6 Level Correlation for the Sub Period 1

	FR	GE	GR	IR	NE	SP	UK	US
FR	1.00	0.78	0.19	0.47	0.71	0.39	0.55	0.50
GE	0.78	1.00	0.34	0.57	0.35	0.35	0.15	0.09
GR	0.19	0.34	1.00	-0.29	-0.29	-0.32	0.22	0.25
IR	0.47	0.57	-0.29	1.00	0.48	0.82	-0.16	-0.31
NE	0.71	0.35	-0.29	0.48	1.00	0.56	0.56	0.52
SP	0.39	0.35	-0.32	0.82	0.56	1.00	-0.06	-0.20
UK	0.55	0.15	0.22	-0.16	0.56	-0.06	1.00	0.94
US	0.50	0.09	0.25	-0.31	0.52	-0.20	0.94	1.00

Table 7 Level Correlation for the Sub Period 2

	FR	GE	GR	IR	NE	SP	UK	US
FR	1.00	0.98	0.97	0.95	0.96	0.98	0.94	0.92
GE	0.98	1.00	0.95	0.98	0.99	0.99	0.98	0.96
GR	0.97	0.95	1.00	0.92	0.94	0.95	0.91	0.90
IR	0.95	0.98	0.92	1.00	0.99	0.99	0.99	0.98
NE	0.96	0.99	0.94	0.99	1.00	0.99	0.99	0.98
SP	0.98	0.99	0.95	0.99	0.99	1.00	0.98	0.96
UK	0.94	0.98	0.91	0.99	0.99	0.98	1.00	0.99
US	0.92	0.96	0.90	0.98	0.98	0.96	0.99	1.00

Table 8 Level Correlation for the Sub Period 3

	FR	GE	GR	IR	NE	SP	UK	US
FR	1.00	0.98	0.71	0.72	0.96	0.89	0.87	0.90
GE	0.98	1.00	0.78	0.72	0.98	0.94	0.92	0.94
GR	0.71	0.78	1.00	0.34	0.79	0.87	0.85	0.86
IR	0.72	0.72	0.34	1.00	0.74	0.61	0.68	0.64
NE	0.96	0.98	0.79	0.74	1.00	0.93	0.96	0.95
SP	0.89	0.94	0.87	0.61	0.93	1.00	0.95	0.97
UK	0.87	0.92	0.85	0.68	0.96	0.95	1.00	0.97
US	0.90	0.94	0.86	0.64	0.95	0.97	0.97	1.00

Table 9 Return Descriptive Statistics for the whole period

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RFR	0.02	7.00	-7.68	1.35	-0.12	5.92
RGE	0.02	7.55	-13.71	1.47	-0.41	8.69
RGR	0.05	13.75	-10.65	1.77	0.12	8.29
RIR	0.03	6.04	-7.57	0.97	-0.39	8.66
RNE	0.03	9.52	-7.53	1.31	-0.17	8.12
RSP	0.03	6.84	-8.88	1.31	-0.22	6.61
RUK	0.02	5.90	-5.89	1.04	-0.11	5.99
RUS	0.03	5.57	-7.11	1.02	-0.16	7.13

Table 10 Return Descriptive Statistics for the Sub 1

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RFR	0.03	6.81	-7.57	1.13	-0.34	7.92
RGE	0.02	7.29	-13.71	1.21	-1.28	23.54
RGR	0.09	13.75	-10.65	1.96	0.34	9.72
RIR	0.02	5.85	-7.48	0.91	-0.19	11.18
RNE	0.03	5.10	-6.79	0.89	-0.68	9.21
RSP	0.01	6.84	-8.88	1.06	-0.47	12.85
RUK	0.04	5.44	-4.14	0.85	0.27	5.82
RUS	0.04	3.67	-6.32	0.81	-0.43	7.62

Table 11 Return Descriptive Statistics for the Sub 2

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RFR	0.04	6.10	-5.63	1.20	-0.13	5.16
RGE	0.06	6.11	-8.38	1.24	-0.72	7.46
RGR	0.08	7.66	-8.02	1.60	-0.14	7.03
RIR	0.08	6.04	-7.57	0.87	-0.60	13.14
RNE	0.09	5.73	-6.12	1.14	-0.31	7.10
RSP	0.08	6.32	-7.34	1.26	-0.48	7.08
RUK	0.05	4.35	-3.66	0.88	-0.11	5.29
RUS	0.07	4.99	-7.11	0.87	-0.67	12.36

Table 12 Return Descriptive Statistics for the Sub 3

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RFR	-0.01	7.00	-7.68	1.65	-0.01	4.75
RGE	-0.03	7.55	-9.16	1.87	-0.02	4.66
RGR	-0.02	7.62	-9.69	1.75	0.04	6.37
RIR	0.00	4.78	-5.91	1.13	-0.34	5.13
RNE	-0.04	9.52	-7.53	1.75	0.03	5.87
RSP	-0.02	6.03	-7.13	1.55	0.04	4.23
RUK	-0.02	5.90	-5.89	1.33	-0.12	4.80
RUS	-0.01	5.57	-6.01	1.32	0.13	4.35

Table 13 Return Correlation for the Whole Period

	RFR	RGE	RGR	RIR	RNE	RSP	RUK	RUS
RFR	1.00	0.07	0.21	0.49	0.80	0.74	0.74	0.41
RGE	0.07	1.00	-0.01	-0.05	0.04	0.06	0.07	0.26
RGR	0.21	-0.01	1.00	0.24	0.23	0.22	0.19	0.10
RIR	0.49	-0.05	0.24	1.00	0.52	0.44	0.52	0.22
RNE	0.80	0.04	0.23	0.52	1.00	0.71	0.75	0.40
RSP	0.74	0.06	0.22	0.44	0.71	1.00	0.64	0.36
RUK	0.74	0.07	0.19	0.52	0.75	0.64	1.00	0.40
RUS	0.41	0.26	0.10	0.22	0.40	0.36	0.40	1.00

Table 14 Return Correlation for the Sub 1

	RFR	RGE	RGR	RIR	RNE	RSP	RUK	RUS
RFR	1.00	0.07	0.17	0.38	0.70	0.57	0.57	0.28
RGE	0.07	1.00	-0.02	-0.03	0.04	0.00	0.10	0.31
RGR	0.17	-0.02	1.00	0.23	0.15	0.19	0.09	0.04
RIR	0.38	-0.03	0.23	1.00	0.39	0.35	0.39	0.15
RNE	0.70	0.04	0.15	0.39	1.00	0.54	0.59	0.29
RSP	0.57	0.00	0.19	0.35	0.54	1.00	0.44	0.21
RUK	0.57	0.10	0.09	0.39	0.59	0.44	1.00	0.33
RUS	0.28	0.31	0.04	0.15	0.29	0.21	0.33	1.00

Table 15 Return Correlation for the Sub 2

	RFR	RGE	RGR	RIR	RNE	RSP	RUK	RUS
RFR	1.00	0.22	0.18	0.50	0.71	0.69	0.71	0.36
RGE	0.22	1.00	0.03	-0.06	0.15	0.22	0.20	0.45
RGR	0.18	0.03	1.00	0.25	0.23	0.20	0.20	0.10
RIR	0.50	-0.06	0.25	1.00	0.57	0.45	0.57	0.20
RNE	0.71	0.15	0.23	0.57	1.00	0.66	0.72	0.34
RSP	0.69	0.22	0.20	0.45	0.66	1.00	0.63	0.35
RUK	0.71	0.20	0.20	0.57	0.72	0.63	1.00	0.38
RUS	0.36	0.45	0.10	0.20	0.34	0.35	0.38	1.00

Table 16 Return Correlation for the Sub 3

	RFR	RGE	RGR	RIR	RNE	RSP	RUK	RUS
RFR	1.00	-0.01	0.27	0.53	0.89	0.84	0.83	0.48
RGE	-0.01	1.00	-0.03	-0.05	-0.02	-0.01	-0.01	0.15
RGR	0.27	-0.03	1.00	0.25	0.29	0.26	0.26	0.13
RIR	0.53	-0.05	0.25	1.00	0.56	0.48	0.57	0.26
RNE	0.89	-0.02	0.29	0.56	1.00	0.80	0.82	0.45
RSP	0.84	-0.01	0.26	0.48	0.80	1.00	0.74	0.42
RUK	0.83	-0.01	0.26	0.57	0.82	0.74	1.00	0.43
RUS	0.48	0.15	0.13	0.26	0.45	0.42	0.43	1.00

Table 17 Unit Root Test for the Whole Period

Country	Index	Level ADF Statistic	First Difference ADF Statistic
FR	ISEQ	-1.21641	-29.99702
GE	CAC40	-1.31356	-27.57715
GR	Althens SE	-1.41846	-27.17727
IR	IBEX	-0.87645	-27.47970
NE	AEX	-1.17799	-30.09235
SP	DAX30	-1.06613	-28.74986
Uk	FTSE100	-1.52593	-30.69443
US	S&P500	-1.06764	-29.97799

Table 18 Unit Root Test for the Sub Period 1

Country	Index	Level ADF Statistic	First Difference ADF Statistic
US	S&P500	-1.37369	-15.60715
Uk	FTSE100	-1.87827	-14.33887
IR	IBEX	-1.42302	-14.21001
FR	ISEQ	-2.76102	-15.28909
GR	Althens SE	-1.77156	-14.69434
SP	DAX30	-1.79696	-14.83606
GE	CAC40	-2.32313	-15.40179
NE	AEX	-1.28080	-15.12592

Table 19 Unit Root Test for the Sub Period 2

Country	Index	Level ADF Statistic	First Difference ADF Statistic
US	S&P500	1.04140	-16.89269
Uk	FTSE100	-0.07342	-17.81021
IR	IBEX	0.21743	-14.78858
FR	ISEQ	0.29484	-16.91941
GR	Althens SE	0.68842	-15.65836
SP	DAX30	0.39211	-16.22194
GE	CAC40	-0.20722	-15.95212
NE	AEX	0.32345	-17.02949

Table 20 Unit Root Test for the Sub Period 3

Country	Index	Level ADF Statistic	First Difference ADF Statistic
FR	ISEQ	-0.786134	-17.693
GE	CAC40	-0.762399	-15.98578
GR	Althens SE	-0.960072	-15.79106
IR	IBEX	-1.7176	-16.64889
NE	AEX	-0.566473	-17.74718
SP	DAX30	-1.273868	-17.11665
Uk	FTSE100	-0.883046	-18.32864
US	S&P500	-1.195701	-17.60496

Table 21 Cointegration Test Result

Each Country with US

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
FIRST SUB-PERIOD					
FR					
Trace	0	0	0	1	2
Max-Eig	0	0	0	0	0
GE					
Trace	0	0	0	0	2
Max-Eig	0	0	0	0	0
GR					
Trace	0	0	0	0	1
Max-Eig	0	0	0	0	1
IR					
Trace	0	0	0	0	2
Max-Eig	0	0	0	0	0
NE					
Trace	0	0	0	0	1
Max-Eig	0	0	0	1	1
SP					
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0
UK					
Trace	1	1	1	1	2

Max-Eig	0	1	1	0	0

SECOND SUB-PERIOD

FR

Trace	1	0	0	1	1
Max-Eig	1	0	0	1	1

GE

Trace	1	0	0	0	2
Max-Eig	1	0	0	0	0

GR

Trace	1	1	0	1	2
Max-Eig	1	1	0	1	2

IR

Trace	1	0	0	0	0
Max-Eig	0	0	0	0	0

NE

Trace	1	1	1	1	2
Max-Eig	1	1	1	1	2

SP

Trace	0	0	0	0	1
Max-Eig	0	0	0	0	1

UK

Trace	0	1	0	0	2
Max-Eig	0	0	0	0	2

3RD SUB-PERIOD

FR

Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

GE

Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

GR

Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

IR

Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

NE

Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

SP

Trace	1	1	1	0	2
Max-Eig	1	1	1	1	2

UK

Trace	0	0	0	0	2
Max-Eig	0	0	0	0	2

Table 22 MULTIVARIATE COINTEGRATION

WHOLE PERIOD

Trace	2	4	4	4	4
Max-Eig	1	1	1	1	1

1ST SUB-PERIOD

Trace	1	1	1	1	1
Max-Eig	0	0	0	0	0

2ND SUB-PERIOD

Trace	3	4	4	4	5
Max-Eig	3	2	4	3	4

3RD SUB-PERIOD

Trace	2	2	2	2	2
Max-Eig	2	2	2	2	2

Table 23 GRANGER-CAUSALITY TESTS

FIRST SUB-PERIOD

Pairwise Granger Causality Tests
Date: 12/22/03 Time: 17:29
Sample: 1 1207
Lags: 2

Null Hypothesis:	F-Statistic	Probability
FR does not Granger Cause SP	1.02148	0.36037
SP does not Granger Cause FR	3.39388	0.03390
FR does not Granger Cause US	2.75672	0.06390
US does not Granger Cause FR	37.3009	1.9E-16
FR does not Granger Cause UK	1.93446	0.14495
UK does not Granger Cause FR	0.43343	0.64838
GE does not Granger Cause FR	373.256	0.00000
FR does not Granger Cause GE	1.62554	0.19724
GE does not Granger Cause SP	250.804	0.00000
SP does not Granger Cause GE	2.27247	0.10350
GE does not Granger Cause UK	120.547	0.00000

UK does not Granger Cause GE	0.75456	0.47044
GE does not Granger Cause US	33.8211	5.1E-15
US does not Granger Cause GE	3.03474	0.04846
GR does not Granger Cause FR	1.55950	0.21067
FR does not Granger Cause GR	9.77682	6.1E-05
GR does not Granger Cause GE	1.38303	0.25122
GE does not Granger Cause GR	31.4554	4.8E-14
GR does not Granger Cause SP	1.93734	0.14454
SP does not Granger Cause GR	10.5518	2.9E-05
GR does not Granger Cause UK	0.71700	0.48842
UK does not Granger Cause GR	1.63844	0.19472
GR does not Granger Cause US	1.27136	0.28083
US does not Granger Cause GR	11.3968	1.2E-05
IR does not Granger Cause FR	0.59231	0.55321
FR does not Granger Cause IR	3.66378	0.02592
IR does not Granger Cause GE	4.89460	0.00764
GE does not Granger Cause IR	127.389	0.00000
IR does not Granger Cause GR	3.27621	0.03811
GR does not Granger Cause IR	5.92954	0.00274
IR does not Granger Cause SP	0.42094	0.65653
SP does not Granger Cause IR	3.16176	0.04270
IR does not Granger Cause UK	2.74626	0.06457
UK does not Granger Cause IR	15.8065	1.7E-07
IR does not Granger Cause US	2.94951	0.05275
US does not Granger Cause IR	87.9469	0.00000
NE does not Granger Cause FR	2.63251	0.07231
FR does not Granger Cause NE	1.37507	0.25322
NE does not Granger Cause GE	1.08361	0.33870
GE does not Granger Cause NE	501.116	0.00000
NE does not Granger Cause SP	0.17068	0.84311
SP does not Granger Cause NE	1.02594	0.35877
NE does not Granger Cause UK	3.97803	0.01897
UK does not Granger Cause NE	0.42878	0.65140
NE does not Granger Cause US	0.86797	0.42007
US does not Granger Cause NE	72.1870	0.00000
NE does not Granger Cause GR	2.51111	0.08160
GR does not Granger Cause NE	2.51866	0.08099
NE does not Granger Cause IR	1.58046	0.20631
IR does not Granger Cause NE	0.19333	0.82424
SP does not Granger Cause UK	1.06175	0.34618
UK does not Granger Cause SP	1.15101	0.31667
SP does not Granger Cause US	2.12491	0.11989
US does not Granger Cause SP	49.9957	0.00000
UK does not Granger Cause US	0.21287	0.80829
US does not Granger Cause UK	50.8264	0.00000

2ND SUB-PERIOD

Pairwise Granger Causality Tests
Date: 12/22/03 Time: 17:28
Sample: 1 1414
Lags: 2

Null Hypothesis:	F-Statistic	Probability
FR does not Granger Cause GE	2.59943	0.07467
GE does not Granger Cause FR	616.343	0.00000
FR does not Granger Cause GR	35.8277	6.7E-16
GR does not Granger Cause FR	0.69783	0.49784
FR does not Granger Cause IR	34.5402	2.3E-15
IR does not Granger Cause FR	31.2122	5.5E-14
FR does not Granger Cause NE	8.02664	0.00034
NE does not Granger Cause FR	2.58226	0.07596
FR does not Granger Cause SP	2.78156	0.06228
SP does not Granger Cause FR	10.8129	2.2E-05
FR does not Granger Cause UK	0.67938	0.50710
UK does not Granger Cause FR	5.33941	0.00490
FR does not Granger Cause US	5.41250	0.00455
US does not Granger Cause FR	73.4115	0.00000
GE does not Granger Cause GR	65.5018	0.00000
GR does not Granger Cause GE	2.28790	0.10186
GE does not Granger Cause IR	421.778	0.00000
IR does not Granger Cause GE	18.1353	1.7E-08
GE does not Granger Cause NE	881.941	0.00000
NE does not Granger Cause GE	16.4067	9.0E-08
GE does not Granger Cause SP	526.915	0.00000
SP does not Granger Cause GE	16.9746	5.2E-08
GE does not Granger Cause UK	484.875	0.00000
UK does not Granger Cause GE	13.7211	1.3E-06
GE does not Granger Cause US	116.679	0.00000
US does not Granger Cause GE	15.1368	3.1E-07
GR does not Granger Cause IR	11.4412	1.2E-05
IR does not Granger Cause GR	11.6923	9.2E-06
GR does not Granger Cause NE	1.65126	0.19218
NE does not Granger Cause GR	21.5047	6.3E-10
GR does not Granger Cause SP	8.19606	0.00029
SP does not Granger Cause GR	39.1821	0.00000
GR does not Granger Cause UK	1.48564	0.22671
UK does not Granger Cause GR	25.2095	1.8E-11
GR does not Granger Cause US	7.17973	0.00079
US does not Granger Cause GR	62.2894	0.00000
IR does not Granger Cause NE	20.6916	1.4E-09
NE does not Granger Cause IR	18.9346	7.7E-09
IR does not Granger Cause SP	19.0083	7.2E-09
SP does not Granger Cause IR	52.9938	0.00000
IR does not Granger Cause UK	20.3313	2.0E-09
UK does not Granger Cause IR	57.4131	0.00000
IR does not Granger Cause US	0.26761	0.76524
US does not Granger Cause IR	287.399	0.00000
NE does not Granger Cause SP	0.59738	0.55039
SP does not Granger Cause NE	25.2016	1.8E-11
NE does not Granger Cause UK	0.80995	0.44509

UK does not Granger Cause NE	14.1350	8.4E-07
NE does not Granger Cause US	5.24653	0.00537
US does not Granger Cause NE	108.092	0.00000
SP does not Granger Cause US	5.55974	0.00393
US does not Granger Cause SP	52.2188	0.00000
SP does not Granger Cause UK	1.12490	0.32498
UK does not Granger Cause SP	2.41854	0.08942
UK does not Granger Cause US	9.86432	5.6E-05
US does not Granger Cause UK	74.5937	0.00000

3RD SUB-PERIOD

Pairwise Granger Causality Tests
Date: 12/22/03 Time: 17:24
Sample: 1 1292
Lags: 2

Null Hypothesis:	F-Statistic	Probability
FR does not Granger Cause GE	0.01592	0.98421
GE does not Granger Cause FR	1098.62	0.00000
FR does not Granger Cause GR	11.4053	1.2E-05
GR does not Granger Cause FR	3.60345	0.02751
FR does not Granger Cause IR	12.9451	2.7E-06
IR does not Granger Cause FR	10.2494	3.8E-05
FR does not Granger Cause NE	3.20143	0.04103
NE does not Granger Cause FR	0.45224	0.63630
FR does not Granger Cause SP	1.00885	0.36493
SP does not Granger Cause FR	1.64345	0.19372
FR does not Granger Cause UK	0.14115	0.86837
UK does not Granger Cause FR	1.54012	0.21475
FR does not Granger Cause US	0.07764	0.92530
US does not Granger Cause FR	80.0280	0.00000
GE does not Granger Cause IR	162.203	0.00000
IR does not Granger Cause GE	3.90632	0.02035
GE does not Granger Cause NE	890.267	0.00000
NE does not Granger Cause GE	0.21668	0.80522
GE does not Granger Cause SP	676.087	0.00000
SP does not Granger Cause GE	2.91788	0.05441
GE does not Granger Cause UK	568.318	0.00000
UK does not Granger Cause GE	2.27376	0.10334
GE does not Granger Cause US	259.553	0.00000
US does not Granger Cause GE	2.19986	0.11124
GR does not Granger Cause GE	4.22390	0.01485
GE does not Granger Cause GR	26.7090	4.3E-12
GR does not Granger Cause IR	0.45848	0.63235
IR does not Granger Cause GR	1.30095	0.27263
GR does not Granger Cause NE	2.72749	0.06576
NE does not Granger Cause GR	6.11969	0.00226
GR does not Granger Cause SP	4.24404	0.01455
SP does not Granger Cause GR	6.76725	0.00119
GR does not Granger Cause UK	2.22968	0.10798
UK does not Granger Cause GR	11.3617	1.3E-05
GR does not Granger Cause US	2.99391	0.05044
US does not Granger Cause GR	46.5570**	0.00000

IR does not Granger Cause NE	5.87412**	0.00289
NE does not Granger Cause IR	6.81934**	0.00113
IR does not Granger Cause SP	5.59960**	0.00379
SP does not Granger Cause IR	9.18278**	0.00011
IR does not Granger Cause UK	5.66639*	0.00355
UK does not Granger Cause IR	10.9120**	2.0E-05
IR does not Granger Cause US	3.18953*	0.04152
US does not Granger Cause IR	90.1460**	0.00000
NE does not Granger Cause SP	0.61641	0.54004
SP does not Granger Cause NE	2.83682	0.05898
NE does not Granger Cause UK	0.67333	0.51019
UK does not Granger Cause NE	4.39099*	0.01257
NE does not Granger Cause US	0.01204	0.98803
US does not Granger Cause NE	94.5294**	0.00000
SP does not Granger Cause UK	0.76809	0.46411
UK does not Granger Cause SP	0.46596	0.62764
SP does not Granger Cause US	3.72484*	0.02438
US does not Granger Cause SP	41.8934**	0.00000
UK does not Granger Cause US	2.51751	0.08106
US does not Granger Cause UK	83.9453**	0.00000

* Reject at 5% level of significance
** Reject both at 1% and 5% level of significance