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Dynamics of Equity Market Integration in Europe: Impact of Political Economy Events

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Abstract

Unlike most prior literature in finance and economics, this article focuses on events in the political economy and examines the integration of European equity markets over the 1988 through 2002 period using two innovative techniques that assess how the level of integration in equity price indices changes over time. The results show that notwithstanding the rising interdependencies between the European and US equity markets during the mid- to late 1990s, the long-run integrative relationships governing the European markets strengthen only in the late 1980s. This evidence suggests that despite several years of political willingness by European leaders to integrate economies, the equity markets only responded to the Delors Report (1989) and the Strasbourg Declaration (1989) that the European Economic Community would move towards European Monetary Union, but they provided little positive long-run response to subsequent developments pertaining to European Monetary Union.

Introduction

The economic, monetary and political unification of Europe is clearly a major historic process of much interest. Prior to the 20th century attempts at European unification, which began with the Treaty of Rome (1957) and proceeded with increasing efforts throughout the 1960s and 1970s, there had been centuries of intrigue, discord and warfare amongst the European powers including two world wars and decades of cold war between socialist and capitalist states. Thus, the union of European states has a great deal of history to overcome and this unification has understandably been a slow and a deliberate process. Efforts at European integration sometimes foundered on the economic uncertainty of the early 1980s. Nevertheless, in 1979 came the exchange rate mechanism (ERM) of the European monetary system (EMS) and in 1987 the Single European Act was adopted. This provided a legal basis for the four freedoms of movement in the European Economic Community (EEC) – capital, goods, people and services.

Today, unification is occurring against a backdrop of increasingly integrated global markets. Technology is making globalization more feasible and globalization is enhancing the returns to new technology. These mutually reinforcing trends of technology and globalization render national economies ever more open while raising global growth rates (see Aggarwal, 1999). In this environment, European countries face significant pressures to integrate their economies even if only to compete with the large North American and Japanese economies. It is widely recognized that financial markets are also undergoing a prolonged, if discontinuous, process of integration. While it is clear that there is now substantial monetary integration in Europe (see Baele *et al*., 2004a, b), the extent of equity market integration is less clear. This article investigates the process of European equity market integration. It is concerned with two main issues: *firstly* the evolution and extent of European equity market integration and *secondly* the extent to which European equity market integration has reflected the legislative and political initiatives towards European monetary union (EMU).

The extant literature provides three overall conclusions concerning international equity market integration. *Firstly*, it finds, given prudent macroeconomic management and the availability of high quality factors of production, a potential for real net economic benefits via the process of equity market integration (see Bekaert and Harvey, 1995, 1997, 2003; Levine and Zervos, 1998; Henry, 2000a, b). This strand of the literature serves to motivate the measurement of international equity market integration. *Secondly*, in integrated equity markets, ‘domestic investors are able to invest in foreign assets and foreign investors in domestic assets; hence, assets of identical risk command the same expected return, regardless of trading location’ (see Bekaert and Harvey, 2003). Equity market integration, however, is a dynamic process and it is difficult to measure. Compounding this issue of measurement there are issues around the nature of equity market integration.

Kearney and Lucey (2004) outline three basic approaches which they then categorize under two broad categories to evaluate financial (here equity) market integration. Direct measures use the law of one price to investigate the extent to which the rates of return on financial assets with similar risk characteristics and maturity are equalized across political jurisdictions. Two main types of indirect measure can be considered; one invokes the concept of international capital market completeness while the latter is based on the extent to which domestic investment is financed from world savings. The analysis here, in common with the great preponderance of research in the area, is based on the first approach which is based on the logic that unrestricted international capital flows would, through seeking the best available return, lead to equalization of rates of return across countries. In effect, this measure applies the law of one price to financial assets, whereby assets with identical cash flows should command the same return. The difficulty in operationalizing this approach is that of finding financial assets that are sufficiently homogeneous in terms of their risk profiles to allow meaningful comparisons to take place. Kearney and Lucey further break down the papers in this area into three types: testing the segmentation of equity markets via the international CAPM, testing the extent and determinants of changes in the correlation or cointegration structure of markets, and papers that propose time-varying measures of integration. The latter set of papers can and does draw methodological approaches from either of the first two. Increasing integration of equity markets and capital markets in general can be expected to have three broad sets of implications if as generally expected the integration spurs greater development of the financial sector (see Pagano, 1993). *First*, the attractiveness of international portfolio diversification will weaken as returns are equalized across countries. *Second*, the more complete the world's capital markets are, the more robust will the economies of individual states be. *Third*, household savings rates will consequently change over time. The former two elements are in general seen to have positive effects on economic growth while the last is more uncertain.

Equity market integration is driven by market forces but constrained by regulatory barriers and the level of integration is neither uniform across market segments nor across time. In order to make progress, despite these difficulties, much of the extant literature concedes the use of proxies such as interpreting increasing equity market interdependencies as tending to be consistent with and indicative of increasing equity market integration (see Erb *et al*., 1996; Longin and Solnik, 1995; Rangvid, 2001; Forbes and Rigobon, 2002; Hardouvelis *et al*., 2006; Sentana, 2002; Cappiello *et al*. 2003; Baele, 2005; Kearney and Poti, 2006; Kim *et al*., 2005). The rationale supporting this *modus operandi* stems from the notion that moving from a segmented regime to an integrated regime induces a convergence in the determinants of cross-corporation cash flows and discount rates, i.e., a heightened sensitivity to common factors and, as a result, rising equity market return correlations.[1] Consequently, increasing equity market interdependencies are found to be consistent with (although neither necessary nor sufficient to conclude on) increasing equity market integration. *Thirdly*, the extant literature (see Bracker and Koch, 1999; Bracker *et al*., 1999; Pretorius, 2002; Hardouvelis *et al*., 2006) identifies a set of common factors which determines this convergence of cross-corporation cash flows and discount rates. This set includes, of foremost importance, increasing international trade and increasing proportions of foreign asset holdings of the corporations concerned. Of secondary importance, increasing business cycle synchronization, low and convergent inflation and interest rates and declining fiscal imbalances and production growth differentials probably also facilitate stock market integration. The process of moving to the EMU strengthens these factors, hence motivating the underlying calendar of events relating to the development of the EMU used in this article.

Taken together, these contributions indicate the real economic benefits of international equity market integration, they provide a justification for the measurement of co-movements as an insightful approximation for the changing level of equity market integration over time and they point to the EMU as an important determinant of that process.

The preponderance of the previously cited articles with respect to the measurement of equity market integration focuses on the European equity markets. A specific weakness of several of these studies is that a focus on comparative statics or, at best, dissipative short-run interdependencies, neglects an important aspect of time variation in equity risk premiums (see Campbell, 1987; Harvey, 1989, 1991; Bekaert and Harvey, 1995). In the same vein, a further weakness of the literature on international equity market integration is that it focuses virtually exclusively on short-term conditional and unconditional correlations. Investors tend to have relatively longer investment time horizons, and hence the importance of short-term correlations, from the perspective of an investor seeking diversification benefits, is not well established. As the prior literature fails to account for dynamic long-run interdependencies amongst European equity markets and the US equity market it may yield only confusing and partial results. This article aims to address this weakness in the extant literature.

Furthermore, unlike much prior literature, this article focuses on events in the political economy. Specifically, it adopts two complementary techniques including a dynamic robust eigenvalue analysis, i.e., multilateral robust

[1] Forbes and Chinn (2004) indicate that economic and industrial structures in countries differ and therefore cash flow and discount rate determinants will not necessarily fully converge even in the context of an absence of regulatory impediments.

correlations and the Hansen and Johansen (1999) recursive cointegration procedure, to measure varying equity market integration over time. These techniques generate time varying measures of co-movement which are plotted against the dates of selected key events in the formation of the EMU. Interestingly, the evidence seems to indicate that despite several years of political demonstrations by European leaders to integrate economies, the equity markets only responded to the Delors Report and the Strasbourg Declaration (in the late 1980s) that the European Economic Community would move towards European monetary union, but they provided little positive long-run response to subsequent developments pertaining to European monetary union.

Finally, our examination of European and US equity market integration also helps to resolve a significant discrepancy between findings reported in two recent contributions to the literature: namely those of Baele (2005) and Kim *et al*. (2005). Specifically, Baele (2005) shows that the shock spill-over intensities increased significantly in the late 1980s and the early 1990s, while Kim's investigation points to a clear increase in equity market co-movements in the two-year period prior to the introduction of the euro in January 1999 (Hardouvelis *et al*., 2006 provide results corroborating these latter findings). Using a Granger causality test Kim *et al*. (2005) find that the causal process ran from EMU to European stock market integration. Baele (2005) employs a regime-switching model and accounts for asymmetries while Kim *et al*. (2005) use a thick tailed likelihood function to investigate Europe's equity markets' conditional correlations. These papers share a focus on short-run interdependencies while they point to different periods of intense activity with respect to integration. It is precisely this inconsistency that constitutes the final motivation for this article. This timing inconsistency is of much importance. If the intensity of European equity market integration heightened in the late 1980s and the early 1990s then this coincided with the influence of underlying legal innovations, i.e., in the aftermath of the Single European Act. However, if the late 1990s experienced this relative heightening of equity market integration then it meant that the culmination of the process to EMU exerted the greater influence on the process of European equity market integration.

The article is structured as follows. We begin, in section I, by introducing the sample data studied. In section II we describe the methodologies adopted to study the dynamic process that is European equity market integration. In section III we present the results generated by the aforementioned innovative statistical methodologies. In section IV we provide a concise summary of the empirical findings, highlighting implications for the literature, and drawing together the main conclusions. The final section summarizes the article and concludes.

I. Data

Daily data for the largest stock markets of the EU (European Union), namely those of France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom are analysed. All data are integrated of order 1, $I(1)$, in levels.[2] We estimate systems that include the EU FTSE country level indices only and those that also include a United States FTSE country level index.[3] The first system shows the extent of intra-EU integration, while the second shows the extent of EU market integration with the world market effects. Specifically, the various sub-systems consist of: *first* the European equity markets expressed in euro, *second* the same system expressed in US dollars; and *third* and *fourth* both systems extended to include the US equity market denominated in the aforementioned currencies. We use two numeraire currencies, the euro and the US dollar, in order to capture the perspectives of both the 'domestic' and the 'international' investors. The dataset covers the period of the process to EMU and commences on 1 January 1988 and ends on 30 September 2002, providing 3,847 data points in total.

II. Econometric Estimates of Integration over Time

The following sub-sections provide an overview of the econometric methodologies adopted to examine time varying equity market integration.

Dynamic Eigenvalue Analysis

This approach extracts the most important uncorrelated sources of information from a multivariate system. In this vein, components extracted are constructed such that the explanatory power of the incremental component is maximized given the restriction of orthogonality. This is equivalent to an inquiry into the eigenvalues and vectors of the original data matrix. In this context, the eigenvalues may be understood as the unconditional variances of the projections of points on each of the components. The eigenvectors are the direction cosines showing how far the original variable space is to be rotated. In order to find the eigenstructure of the standardized data matrix X ($X \sim (0, 1)$), of equity market returns, we perform a singular value decomposition

$$X = P\Delta U' \tag{1}$$

[2] For reasons of brevity the results have not been included in the body of the text.
[3] FTSE All-World indices are used here. One of the criticisms that can be levied at many of the prior studies cited above is that they rely on indices that have potentially different construction and inclusion patterns. The indices adopted here are designed to be consistent across countries and thus they allow for comparative studies.

The P variable contains the matrix of eigenvectors of XX' and U contains the matrix of eigenvectors of $X'X$. The Δ matrix contains the square roots of the eigenvalues of XX' or equivalently of $X'X$. The eigenvalues are ranked according to size. The larger the first eigenvalue estimate, the higher the estimate of multilateral correlation in the system. An inspection of the evolution of this estimate therefore provides an outline of the evolution of the level of multilateral linear interdependencies in the system. Complementary to cointegration analysis which considers co-movements in the levels of the equity market indices, an eigenvalue analysis inquires after co-movements in their returns. Hence, a dynamic eigenvalue analysis serves to complement the cointegration analyses by capturing interdependencies of a relatively short-term nature.

Time Varying Cointegration Analysis

This methodology is used to explore the evolution of the quantity of common stochastic trends in the various systems of equity markets considered. Initially, all series are shown to have a unit root (i.e., a stochastic trend). Subsequently, it is investigated whether any of the stochastic trends are common across the indices. To commence, we take a vector Y_t that contains a set of variables, i.e., a set of equity market index price levels. We invoke the Granger representation theorem. The theorem states *first* that if all the variables are integrated of order one, $I(1)$, (i.e., they each contain a unit root) and *second* if there exists a cointegrating relationship (i.e., the long-run information matrix, π, has a reduced rank) between the variables, then the VAR(p) process may be written in the error correction format as

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{k-1} \pi_i \Delta Y_{t-i} + u_t + \varepsilon_t \qquad (2)$$

The symbol u_t is a vector of constants. The errors, ε_t, are assumed to be independent and Gaussian with mean zero. The order of the model is determined parsimoniously, by multivariate Akaike and Bayesian Information Criteria, following Richards (1995).[4] Furthermore, in the light of Granger's representation theorem, the information matrix can be decomposed into the loading coefficients, α, and the linearly independent cointegration relations,

[4] Richards (1995) points to the inappropriate use of a long lag structure to capture mean reversion and induce error terms consistent with the Gaussian assumption under which the Johansen methodology is derived. Particularly, the removal of non-normalities is inappropriate if stock price changes are fundamentally fat-tailed or otherwise non-normal. Moreover, if the long lag structure implies a small sample problem it is likely that the null hypothesis of no cointegration is rejected too frequently, i.e. a size problem. Small samples may arise due to long lag structures, in conjunction with low periodicity data, over a time period of insufficient length. It is in the light of this discussion that this article parsimoniously estimates the vector error correction model and studies large samples of data.

β'. The symbols α and β represent ($p \times r$) matrices and the matrix, π, has rank equal to r; and it can be written as $\pi = -\left(1 - \sum_{i=1}^{k} A_i\right)$; and the matrix $\pi_i = -\sum_{j=i+1}^{k} A_j$.

In order to observe the evolution of the number of stochastic trends, this article adopts the recursive cointegration approach of Hansen and Johansen (1999), Rangvid (2001) and Rangvid and Sorensen (2002), which has been successfully used in the analysis of integration and interdependencies by Yang *et al*. (2004), Yang (2005), Phylaktis and Ravazzolo (2005a, b) and Kim *et al*. (2005).

The starting point adopted is the relationship between the number of cointegration vectors and the number of common trends in a multivariate system. Specifically, the number of common trends is calculated via an estimation of the rank of the information matrix and by subtracting this estimate from the number of non-stationary integrated series in the system. Therefore, the number of common stochastic trends is easily deducible from the number of cointegration relations asserted and the dimension of the multivariate process investigated. A set of time-series that are in the process of converging will show increasing numbers of cointegrating vectors or equivalently a declining number of common stochastic trends.

To implement this methodology, analysis is performed on the parameters of the long-run information matrix, using a sequential extension of the sample. The aim is to assert the number of cointegrating vectors and therefore the number of stochastic trends. In particular, graphical procedures are adopted based on recursively calculated eigenvalues, to evaluate the constancy of the parameters over time.

In order to accomplish this analysis, we adopt the traditional likelihood based cointegration approach which generates two statistics of primary interest concerning the rank of the long-run information matrix, π. The first is the λ_{trace} statistic and the second is the $\lambda_{\max}$ statistic.[5] The λ_{trace} statistic is (in the context of this article) a test of the general question of whether there exist one or more cointegrating vectors. The associated null hypothesis is that there are no cointegrating vectors. The $\lambda_{\max}$ statistic allows testing of the precise number of cointegrating vectors. In a recursive study these test statistics can

[5] $\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1-\lambda_i)$ and $\lambda_{\max}(r) = -T \ln(1-\lambda_{r+1})$ where λ_i is the estimated value of the i[th] characteristic root and is obtained from the estimated pi matrix provided by the familiar vector error correction model, specified in equation 1.6.

be plotted over time to examine the time varying nature of stock market integration.[6]

The use of test statistics, with respect to the eigenvalues, to detect possible instabilities requires no prior knowledge of structural breaks or time dependencies. Indeed, an important property of this methodology is that we do not have to impose *a priori* restrictions on the timing of structural breaks. In this article, we adopt this approach to help identify the evolution of the linkages between these capital markets.

If there is a static number of cointegrating vectors then recursive estimation will simply lead to an upward trend in the λ_{trace} statistic (i.e., less imprecision). Therefore, as the sample period is extended, if the number of cointegration vectors increases, this provides evidence consistent with the hypothesis that the series are increasingly inter-linked, that they are increasingly driven by the same common stochastic trends, i.e., the markets are increasingly driven by the same common shocks with a permanent effect. This is tantamount to the strengthening of the long-term relationship governing the evolution of the process.

Intuitively, this makes sense. Consider a set of p series which have n cointegrating vectors, $n < p$. This implies that there are n linear combinations of the p vectors that are stationary. If we later find that we have k vectors, $n < k < p$, there are additional combinations that can be used in the representation of the p data. The phenomenon of declining numbers of common trends may be interpreted as tantamount to increasing levels of arbitrage activity that interlinks the stock markets in the long term.

III. Results

In the light of the importance of stock market integration, it is worthwhile examining how alleged salient events and policies appear to influence, or at least coincide with changes in the level of equity market integration amongst the continental European and the important world equity markets. To commence, therefore, the selected underlying key events in the process to EMU are presented in Table 1. For additional details regarding these events see one of the many books on European integration (Gillingham, 2003). This section proceeds to provide, compare and contrast the empirical results generated by the three aforementioned methodologies.

[6] Further details regarding the dynamic cointegration approach can be found in Barari and Sengupta (2002). Therein the process is described whereby the investigator can plot over time the values of selected test statistics from the traditional cointegration approach.

Table 1: Key Political and Economic Events of the EMU Process

Date	*Event*
20-9-88	Margaret Thatcher, Prime Minister of the UK, delivers a heavily sceptical speech on the future development of the union (*Bruges Speech*)
12-4-89	*Delors Report* lays out the future roadmap for EMU
27-4-89	*Madrid Declaration* adopts the Delors Report and commits the EEC (*sic*) to EMU
9-11-89	*Fall of Berlin Wall*
9-12-89	*Strasbourg Declaration* declares that the EEC will move towards EMU. Start of Phase I of EMU
29-5-90	European Bank for Reconstruction and Development (*EBRD*) established
19-6-90	*Schengen* agreement signed, providing for a common travel area in Europe
3-10-90	*German re-unification*
15-12-90	*Rome Declaration* launches intergovernmental conference on EMU
10-12-91	*Treaty of Maastricht* agreed, transforming the EEC into the European Union
21-12-91	*Soviet Union collapses*
2-6-92	*Danish referendum rejects* Maastricht treaty
18-6-92	*Irish referendum accepts* Maastricht treaty
20-6-92	*French referendum accepts* Maastricht treaty
12-12-92	*Edinburgh Declaration* amends Maastricht treaty to assuage Danish and endorses moves to EMU
1-1-93	*Single european market* (part of Maastricht treaty) in force. This represents the culmination of the original aims of the European Economic Community – the Common Market.
18-5-93	*Second Danish referendum* accepts Maastricht treaty
2-8-93	ERM bands widened from 2.25% to 15% each direction
29-10-93	*Brussels Declaration* on the start of Phase II of EMU
1-11-93	*European Union created* with ratification of all elements of Maastricht treaty
1-1-94	European Monetary Institute (*EMI*) – forerunner of European Central Bank is established, launching Phase II of EMU
12-6-94	*Austria votes to join EU*, including EMU
16-10-94	*Finland votes to join EU*, including EMU
13-11-94	*Sweden votes to join EU*, including EMU
28-11-94	*Norway votes to not join EU*
26-3-95	*Schengen II* extends common travel area
31-5-95	*Green Paper* on practicalities of monetary union (note transfer etc.)
16-12-95	*Madrid Declaration II* adopts 1 January 1999 for launch of euro and start of Phase III of EMU
14-12-96	*Dublin Declaration* outlines the legal mechanisms for Phase III of EMU
2-10-97	*Treaty of Amsterdam* ratifies into law the Dublin Declaration
25-3-98	*Phase III membership notified*: 11 members that may adopt the euro and move to Phase III named
3-5-98	*Determination Mechanism* for irrevocable conversion rates outlined
26-5-98	European Central Bank *(ECB)* Board agreed
1-6-98	*ECB established*
1-1-99	*Euro launched*
22-9-00	*ECB intervention to support euro*
28-9-00	*Danish Referendum rejects joining euro*
2-1-01	*Greece becomes 12th euro area member*
1-1-02	*Euro replaces national currencies. Phase III ends. EMU complete*

Source: Authors' calculations.
Notes: The table contains a set of the key political and economic events of the European monetary union's development during the period September 1988 to January 2002.

Dynamic Eigenvalue Results

The evolution of the explanatory power of the first eigenvalue over a 12-month (250 observations) moving window initiated on 1 January 1988 and ending on 30 September 2002 for the various systems of equity market indices is estimated and plotted. The analysis is time varying in that the window moves – by dropping a single initial observation and including a single incremental observation – for each estimate of the first eigenvalue. In each estimation window, to correct for the potentially invidious presence of time varying volatility (see Forbes and Rigobon, 2002), we initially filter the data using a GARCH (1, 1) model. The series are then standardized ~ (0, 1) prior to the eigenvalue analysis. In this sense the eigenvalue estimates are robust to heteroscedasticity. The results of this process are presented as a time series plot of the percentage variation explained by the first eigenvalue for each 12-month window. Shown in Table 2 and Figure 1 are the results of the robust eigenvalue analyses.

Overall, we observe a gradual but uneven increase in the degree of common variance explained by the first eigenvalue. The explanatory power rises from about 40 per cent at the start of the sample period to a climax of about 70 per cent in the final years of the sample period. The explanatory power exhibits two clear peaks. The first occurs in the 1990–92 period (for the dollar denominated series only) coinciding with the referendums on the Treaty of Maastricht, the Edinburgh declaration and, apparently in anticipation of the inception of the single European market. The second peak, during the 1997–99 period, spans the establishment of the European Central Bank and the launch of the euro. We note from Table 2 that, on average, statistically distinct results are found when one measures in euro or US dollar terms, or when one uses the United Kingdom equity index alone or both the United Kingdom and the United States equity indices as world proxies in the system. Finally, it is noteworthy that the equity markets sub-system containing the US market, the UK market and the continental European markets, when expressed in dollar terms, exhibits the lowest level of multilateral correlations from as early as August 1994. This suggests a relative potential for diversification amidst the entire set of European markets and the US market when expressed in dollars, at least for short term investors.

Evolutionary Cointegration Results

The recursive cointegration approach involves a traditional cointegration analysis for an initial period from 1 January 1988 through to 21 March 1988. The procedure derives the statistics of interest, namely the λ_{max} and λ_{trace} statistics over the chosen period t_0 to t_n. This period is then extended by j and

Table 2: Statistical Analysis of Eigenvalue and Recursive Lambda Parameters

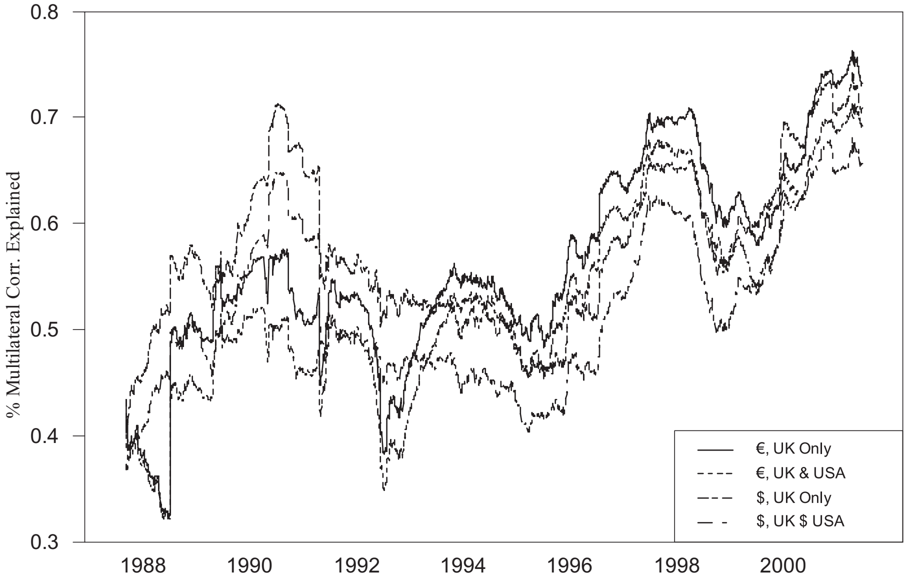
Series	*Pair being tested*	*Mean Difference*	*t-value*	*p-value*
Lambda Trace Statistics, λ	λ in € terms with UK as world proxy = λ in € terms with UK and USA as world proxy	0.16	81.98	0.00
	λ in $ terms with UK as world proxy = λ in $ terms with UK and USA as world proxy	0.14	73.58	0.00
	λ in € terms with UK as world proxy = λ in $ terms with UK as world proxy	0.06	28.72	0.00
	λ in € terms with UK and USA as world proxy = λ in $ terms with UK and USA as world proxy	0.09	49.59	0.00
Eigenvalues/Multilateral Correlations (MCs)	MCs in € terms with UK as world proxy = MCs in € terms with UK and USA as world proxy	0.03	17.22	0.00
	MCs in $ terms with UK as world proxy = MCs in $ terms with UK and USA as world proxy	0.06	31.55	0.00
	MCs in € terms with UK as world proxy = MCs in $ terms with UK as world proxy	0.02	2.36	0.00
	MCs in € terms with UK and USA as world proxy = MCs in $ terms with UK and USA as world proxy	0.02	20.80	0.00

Source: Authors' calculations.
Notes: The table contains a statistical analysis of eigenvalue and recursive lambda trace statistics. Specifically, hypotheses tests are performed using the student's t-test. The null hypothesis is that the difference between parameter values (i.e., eigenvalues or lambda trace statistics) is equal to zero. The test statistics correspond to the full sample periods used for estimation.

the statistic is re-estimated from t_0 to t_{n+j}. We let j = a single day, for each incremental new estimation. Eventually, the estimation procedure reaches the end of the data (equivalent to the static traditional cointegration estimation over all time periods). The relevant statistic is plotted and the interpretation proceeds by examination of the plotted statistic. An upward trend indicates either increased integration and/or a move towards integration; a downward trend indicates decreased integration and/or a move away from integration.

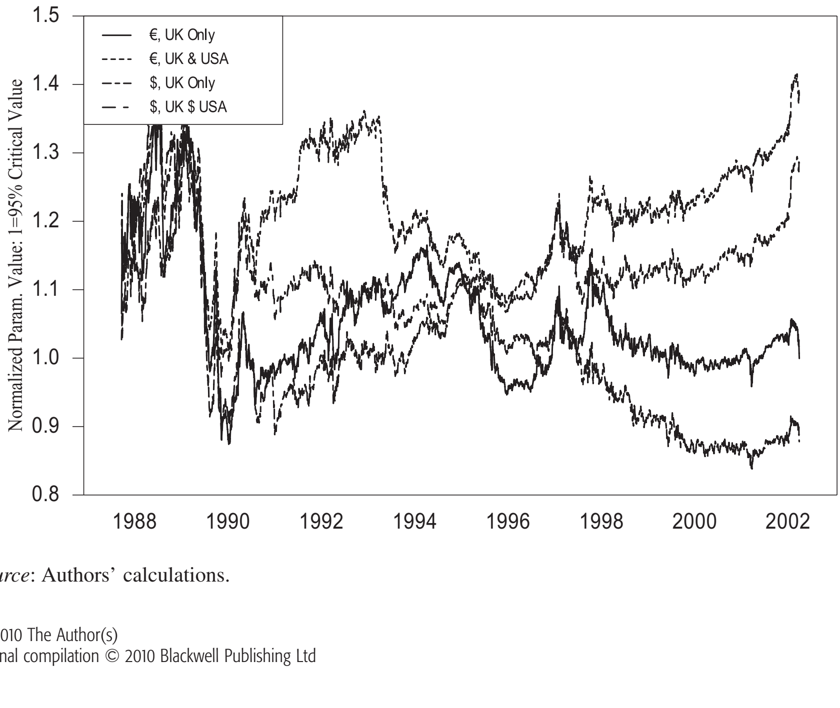
Shown in Figure 2 is a plot of the recursively estimated global λ_{trace} statistics and Figure 3 shows the recursively estimated λ_{max} statistics. For ease of interpretation, the λ_{trace} statistic has been normalized to be equal to 1 at the

Figure 1: Evolution of First Eigenvalue



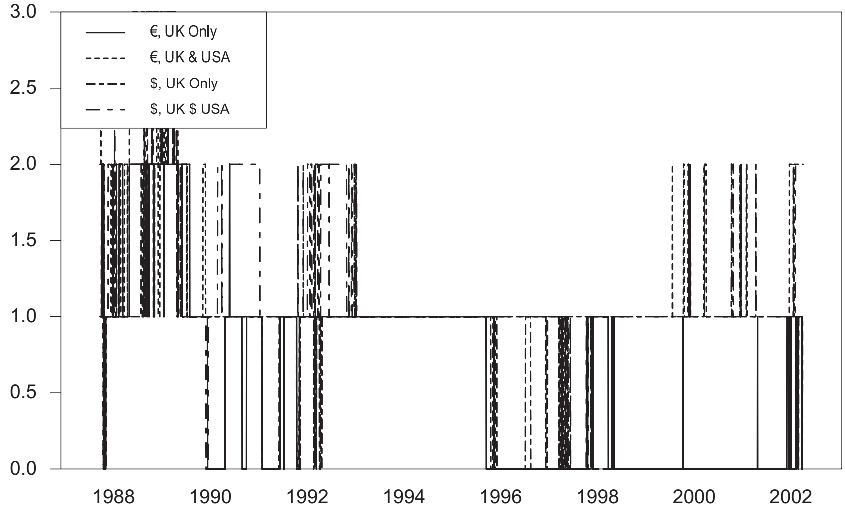
Source: Authors' calculations.

Figure 2: Recursive Lambda-Trace Statistic



Source: Authors' calculations.

Figure 3: Min. Number of Cointegrating Vectors



Source: Authors' calculations.

95 per cent critical value. A lag length of 1 is selected via the multivariate akaike information and bayesian information criteria over the full sample period, for all sub-period estimations. A number of points are evident from these figures. First, in the full European and United States equity market system, irrespective of the numeraire currency, there is an increase in the λ_{trace} statistic during two periods: 1988 through to 1990 and 1998 through to 2002. Between 1988 and 1990 the European equity market system, excluding the United States market, also experiences an increasing λ_{trace} statistic. This indicates that a process of increased convergence was under way, both globally and within Europe, from 1988 to 1990 and solely on a global level in the 1998 to 2002 period. In support of these findings, the Figure 5 λ_{max} statistics indicate that there were up to 3 cointegrating vectors between 1988 and 1993, and up to 2 cointegrating vectors between 2000 and 2002, in the European and the United States equity market system. The European equity market system in isolation exhibits a stable λ_{trace} statistic indicating a single cointegration vector between 1998 and 2002. The first period spans the Delors report in 1988, which sketched a future road map for EMU, to the re-unification of Germany in October 1990, to the creation of the European Union in November 1993 and the second period of heightened equity market integration spans the entire phase III of EMU. During the interval between these periods there was typically a single cointegration vector. Generally, the world equity market systems exhibit the greatest number of cointegration vectors.

Second, for the preponderance of the time period under investigation, the λ_{trace} statistic exceeds the 95 per cent critical value, hence we can be confident that the European markets were generally integrated internally and with the United States market irrespective of the numeraire currency selected. It is noteworthy that at no stage was there an absence of cointegration between the European markets and the United States market, using either numeraire currency. This reflects a marked interdependence between world equity markets. That said, an examination of those periods where the λ_{trace} statistic does fall below the 95 per cent level reveals further insights. These periods include January 1990 to December 1991 (the period of non-cointegration being slightly longer when measured in dollar terms), February 1996 to June 1997 (for the euro denominated series) and January 1998 through to the end of sample period, September 2002 (for the dollar denominated series). Significant events during the first period of non-cointegration include the re-unification of Germany, the Treaty of Maastricht and the collapse of the Soviet Union. The second period commences with the Madrid Declaration II and the launch of phase III of EMU. It also spans the Treaty of Amsterdam. The final period commences with a determination mechanism for the irrevocable conversion of exchange rates, the creation of the European Central Bank (ECB), the inclusion of Greece as the 12th euro area member and the launch of the euro.

IV. Empirical Findings and Literature Contributions

The dynamic multilateral robust correlation analyses indicate that when the indices are expressed in United States dollar terms, interdependencies rise in both the 1990–92 and in the 1997–99 periods. However, when using the euro as a numeraire currency, correlations tend to rise markedly only in the latter period. In contrast to the phases of peaked short-run correlations the periods of heightened long-run correlations extend from 1988 through to 1993 and throughout the 1998 to 2002 period. Hence, the robust correlation peaks are only approximately congruent with the recursive cointegration analyses illustrating an important distinction between transient and long-run interdependencies. Furthermore, the recursive cointegration analyses provide evidence that reflects different hierarchies of groupings with respect to the criterion of interdependence than those suggested by the dynamic multilateral robust correlations. For example, in stark contrast to the results provided in the dynamic multilateral robust correlations analyses, the recursive cointegration analyses suggest that the greatest growth of long-run correlations occur amongst the European and the United States equity markets, irrespective of the numeraire currency adopted, since 1998. The dynamic multilateral robust correlation analyses suggest that this grouping exhibits the smallest short-run correlations during the period since 1998. Moreover, during the period 1990 to 1993, there is a substantial growth in the magnitude of the λ_{trace} statistic for the European and United States equity markets when denominated in euro while there is no corresponding peak in the euro denominated robust multilateral correlations. These points further underscore the importance of considering long-run correlations when accounting for the perspective of an investor with a long-run time horizon, rather than relying on short-run correlations alone.

Taken together, the results of the two methodologies, recursive cointegration and the dynamic multilateral robust correlation analysis, are largely congruent concerning the importance of the late 1990s as a period that experienced relatively heightened global equity market integration, irrespective of the numeraire currency adopted. In contrast, the analyses in respect to the European equity markets, in isolation, in the late 1990s, reveal a variety of results. The multilateral robust correlation analysis indicates heightened short-run interdependencies, irrespective of the numeraire currency, while the recursive cointegration analyses reveals stable λ_{trace} statistics. Specifically, there is cointegration in the European equity market set, when the indices are denominated in euro, and an absence of cointegration when the indices are denominated in dollars. Our analysis also reveals periods of heightened integration in the early 1990s: from 1988 to 1992 (recursive cointegration, irrespective of numeraire) and from 1990 to 1992 (dollar denominated robust correlations) across the full equity market systems including the United States and the equity market system containing the European markets in isolation.

These findings have important implications for the extant literature. A number of specific points should be noted. The *first* contribution of this article concerns the underscoring of a significant discrepancy between findings reported in two recent contributions to the literature: namely those of Baele (2005) and Kim *et al*. (2005). In particular, Baele (2005) shows that the shock spillover intensities increased significantly in the late 1980s and the early 1990s, while the Kim *et al*. (2005) investigation points to a marked increase in equity market co-movements in the two-year period prior to the introduction of the euro in January 1999. *Secondly*, this article reports that the timing of peaks, and the hierarchies of systems of equity markets, with respect to short-run interdependencies are not necessarily coherent with those of long-run interdependencies and this diminishes their significance from the diversification perspective of an investor with a long-run investment horizon. Moreover, it supports the measurement of short- and long-run interdependencies as complementary measures of equity market integration. *Thirdly*, short-run robust multilateral correlations heighten, both within Europe and across the global equity market system examined, between 1990 and 1992 (for the dollar denominated series) and between 1997 and 1999 (irrespective of numeraire currency). This provides evidence in support of both the Baele (2005) and Kim *et al*. (2005) findings. *Fourthly*, the recursive cointegration analyses suggest heightening long-run interdependencies in the late 1980s (irrespective of numeraire currency) both within Europe and in the global system of equity markets. In addition, the global system of equity markets exhibits rising long-run interdependencies in the early 1990s (for the euro denominated series) and since 1998 (irrespective of numeraire currency). Notably, the system of European equity markets, when examined in isolation, did not experience rising long-run interdependencies in this latter period. These findings therefore provide support for the Baele (2005) conclusion, that the period of the late 1980s and early 1990s experienced a relatively pronounced period of intensive equity market integration. *Finally*, the evidence suggests that the European and United States equity markets examined have become increasingly intertwined, from a short- and a long-run viewpoint, during the late 1990s, and a coherent body of evidence has emerged that short- and long-run relationships governing European equity market integration, in isolation, strengthened largely in the late 1980s and the early 1990s rather than in the late 1990s.

Summary and Conclusions

There is a discrepancy in the received literature concerning the timing of periods of heightened equity market integration in Europe. The significance of this discrepancy stems from a resulting confusion regarding the relative influence exerted by underlying events on the duration and intensity of periods of heightened European equity market integration. In this article, with a view to resolving this outstanding discrepancy, we have focused on the equity market integrative impact of political economy events and have built on prior research by measuring the extent of time-varying integration of European equity markets between 1988 and 2002. We have adopted a relatively new set of two complementary techniques that measured the time-varying integration in equity price levels and returns to evaluate the dynamic process of stock market integration in Europe. The two techniques were employed to study behaviour amidst various important sub-systems of equity market indices, including the United States equity market index. This article also provided a timeline of the key political and economic events of the EMU process, in the context of which the time-varying statistics generated by the adopted techniques were discussed.

Although our various measures differed somewhat as to the extent and speed of integration, the evidence presented is broadly in agreement on the importance of the late 1980s and early 1990s period demonstrating greatly increased long-run and short-run integration amongst the continental European and important world equity market indices. Specifically, the evidence gathered portrays a process of heightening long-run interdependencies amongst the European equity market indices in the late 1980s and then stabilizing interdependencies amongst the European equity market indices throughout the remainder of the period until 2002. In contrast, global equity market interdependencies also experience significant growth from the mid-1990s. Interestingly, this evidence suggests that despite several years of political willingness by European leaders to integrate economies, the equity markets only responded to the Delors Report (1989) and the Strasbourg Declaration (1989) that the European Economic Community will move towards European monetary union, they provided little positive long-run response to subsequent developments pertaining to European monetary union.

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