Financial and Economic Integration - a European or Global Phenomenon

A Thesis submitted to the University of Manchester for the Degree of Doctor of Philosophy in the Faculty of Business Administration

2002

Eduardo Barbosa do Couto

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ABSTRACT

This research examines European financial and economic integration to see whether this is part of or additional to a global phenomenon. It expands previous research by examining how financial, economic and monetary indicators of European Union countries separately and as a block correlate with those of the U.S. and Japan, and whether effects differ between large and small markets within the E.U..

The results generally give evidence that stock market integration reflects other measures of economic and monetary integration, namely interest rates, exchange rates and trade. The findings confirm a strong increase over time in the intra European correlations for financial and economic variables against generally smaller changes in E.U. connections with Japan and the U.S. and between Japan and the U.S.. The results show that financial, economic and monetary European integration is a regional phenomenon more than a reflection of a global trend toward integration. Globally countries within European Union are shown to be closer financially, economically and monetarily with themselves than with U.S. or Japan.

The study also measures the impact of economic and monetary European integration in terms of the effects on the theoretical optimal European portfolios for representative European Union resident investors. The research focuses on European and national risk and on the consistency, level and changes in optimal European weights under European integration using Markowitz mean/variance efficiency and the Sharpe ratio. The research shows that there is a trend towards a higher European influence on risk and a concentration on a smaller number of markets at any one time with increasing focus on E.U. markets offering the highest returns.

The study also indicates an increase in the level of concentration of optimal weights in the theoretical optimal portfolio as European markets raising concerns about overshooting as investment funds move dramatically between markets. There are also some practical concerns about the liquidity of small national markets under integration raising problems of their viability in an integrated Europe.

DECLARATION

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or institute of learning.

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To Professor Douglas Wood

My very special thanks for the constant and exceptional guidance, and for encouraging me throughout the research project. I believe that I have learned a lot with his experience and knowledge, and I am sure that his insights will more than help me in the future.

To my colleagues, friends, and family

For the suggestions, encouragement, and emotional support.

To MBS staff

For their kindness and efficiency

To Fundação para a Ciência e a Tecnologia

For supporting the research financially

DEDICATION

To my family

THE AUTHOR

Eduardo Couto has a degree in Business Administration from the Higher Institute of Economics and Management (ISEG) of the Technical University of Lisbon (UTL) and a Master in Management from the same institution. His professional background includes several years' experience in industrial and commercial companies, including the Banking sector. In 1985 he joined the Higher Institute of Economics and Management (ISEG) of the Technical University of Lisbon (UTL), where he taught several subjects, including Mathematics of Finance, International Finance, Banking, Financial Markets and Portfolio Theory. He also taught in the University of Azores, the University of Evora, the Portuguese Open University, and the Higher Institute of Banking Management. He has taught on Undergraduate, Masters, and Post-Graduate Courses. He has also been involved in consulting with small companies, training courses, and seminaries in a number of institutions, namely the Portuguese Banking Institute. In September 1995, he joined the Doctoral Programme at Manchester Business School. Before he joined the Doctoral Programme he was co-author of two books "Mathematics of Finance" and "Exchange Market and Exchange Risk Management", and published some articles in Portuguese reviews.

CHAPTER 1 INTRODUCTION

1.1 THE PURPOSE OF THE THESIS AND THE MAIN RESEARCH QUESTIONS

The purpose of this thesis is to measure the impact of economic and monetary European integration in terms of the effects it may have on the optimal portfolios for representative European Union (E.U.) resident investors in the E.U. and global markets. Because the optimal European portfolio is strongly influenced by the correlation between European stock markets, the volatility of stock markets and the level of systematic risk within them we started by analysing the way the process of economic and monetary European integration had resulted in the alignment within and between economic and financial trends in Europe

The first research question ask whether the integration efforts, notably the single market programme and the financial liberalisation, have achieved integration of economic and monetary conditions in Europe and created a group of countries exhibiting more common factors, each with each other than any of the members had with the major external economies.

The assumption based on the previous works of Johnson and Soenen (1993), Freimann (1988) and Beckers (1999) is that progressive economic, monetary and financial integration in Europe should be marked by an associated progressive increase in correlation coefficients within the European Union in terms of both financial and economic indicators.

If this happened, the next objective is to investigate whether there is a link between the country correlation of economic and monetary indicators and the equivalent correlations between their stock market returns, so we can address the issue of changing risk in member countries in the E.U. and the risks E.U. investors experience in cross-border intra Europe and extra Europe investment.

However, we are also concerned that integration may reflect a common effect of globalisation rather than European integration. Based on the literature (Johnson and Soenen 1993, and Freimann 1998), there seems to be a potential trend towards world integration driven by factors such as the abolition of exchange controls, increasing trade relaxation through GATT and WTO, and the rapid development of global communications, trade and cross-border ownership.

This would be evident in an increase of correlation coefficients between the U.S. and/or Japan, both with each other and with members of the European Union. Any such trend can be compared with that expressed in intra-E.U. links in order to see whether there is a "Europeanisation" alongside globalisation or whether much of the European experience would have happened anyway as a result of globalisation, and its companion forces of growing cross-border investments and transactions.

The second research question is whether economic and monetary integration in Europe is creating a homogeneous group of countries exhibiting more similar and higher systematic risk against the European benchmark than against U.S. and Japanese markets.

If European integration has occurred in terms of economic and financial variable convergence, the question then arises as to whether the returns of individual European stock markets are increasingly explained by European systematic risk. The implication

would be a decrease in "home bias" in national investments and an increase in the risk/return relative to home market for cross-border investment within Europe. Effectively national stock markets' returns within Europe should be marked by a progressive increase in their betas when regressed against the European Union returns index.

The third research question is whether economic and monetary integration has reduced the total volatility of returns within each European market; whether this has been offset by increases in the systematic risks of the European market; and whether there has been an increase in overall risk in Europe and across Europe and major external markets represented by the United States and Japan.

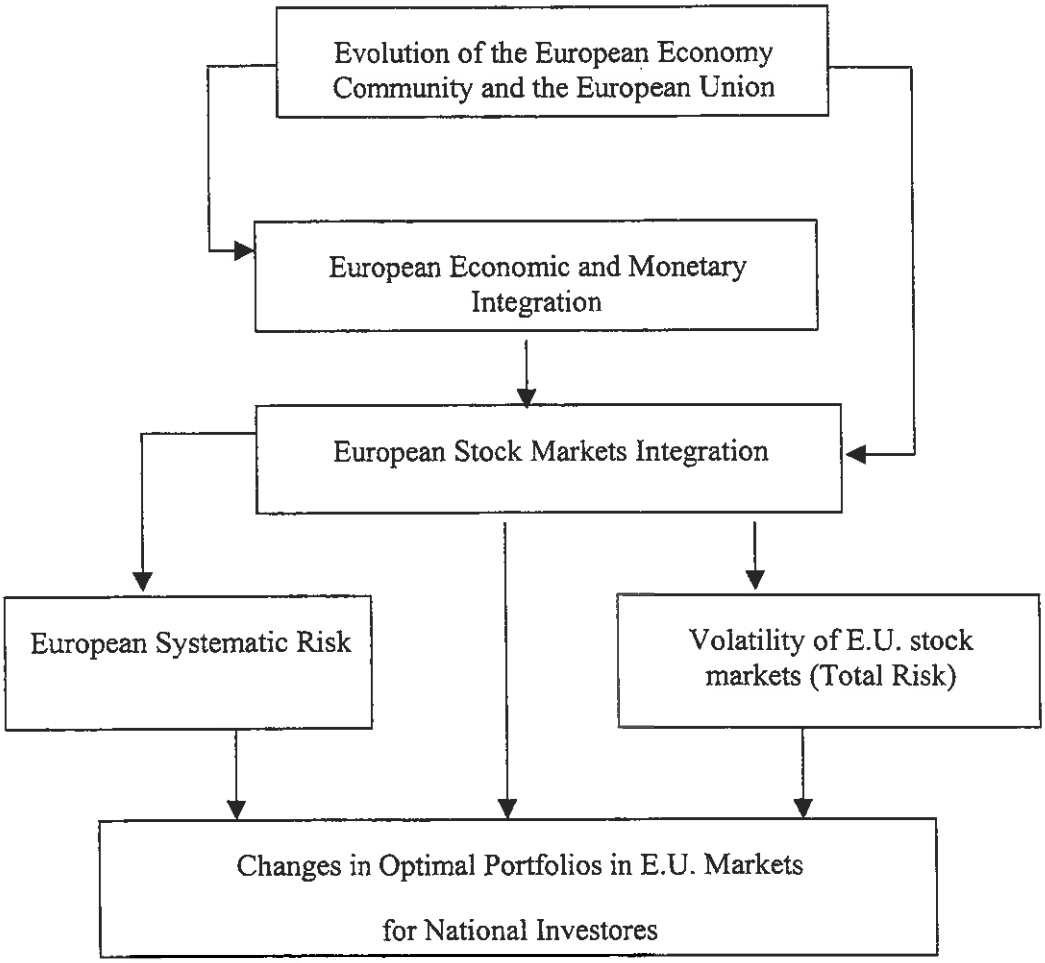
If European integration in the form of progressive economic, monetary, institutional and financial arrangements results in the independent riskiness of each market within the E.U. stock market reducing, then the issue of whether diversification opportunities have increased or decreased and whether increasing correlations between markets could increase portfolio risk within Europe even though optimal portfolios from each European investor's perspective have become more diversified across E.U. countries.

Finally, the last research question is whether the process of economic and monetary European integration over the last two decades has increased or decreased the stability and concentration of country weights in optimal portfolios of representative E.U. national investors in the 1990s compared with the 1980s.

If the European capital market is integrated, the intuition is that the optimal portfolio from the perspective of national investors in each E.U. state should have become more similar with returns differing only in respect of efficient currency adjustments, with convergence to the Euro eliminating this difference.

Three specific objectives appear from this research question: firstly to see if the country investment proportions in optimal portfolio for each E.U. investor is becoming more stable as European integration changes the correlations of economic and monetary factors; secondly to examine whether the weights of the optimal European portfolio for national investors in different E.U. countries are becoming more similar; and thirdly to observe if optimal portfolios are increasingly focused on fewer stock markets as portfolio theory would anticipate if correlation rises, and whether home bias exists and is changing.

1.2 THESIS PLAN



1.3 INTEREST OF THE RESEARCH

These issues are relevant for European Union investors for several reasons.

1. In several respects, the E.U. bears comparison with the United States and Japan. It is a federated entity now with a common currency and monetary policy that is overseen by an autonomous regulatory body, the supranational European Central Bank (ECB). Nevertheless, the European Union differs since the U.S. and Japan are fully integrated economic entities, whilst the European Union continues to have significant differences in legal, financial and administrative regimes despite progress toward harmonisation.

With a population around 300 million, a 19.4 percent share of the world's GDP (the United States accounts for 19.6 percent) and a huge pool of savings, the European Union is a large element in the world capital market. The new union, which effectively creates the world's second-largest equity market with a value of approximately $4.3 trillion, generates 18.8 percent of the world's exports (compared with 14.1 percent for the United States) and represents 28 percent of world stock market capitalisation.

A study of how economic and monetary European integration has been reflected in European stock markets will therefore be of interest both for European investors and to companies seeking capital within the E.U. and expecting to pay the risk premium that investors buying assets in that economic area require.

2. These issues are also relevant for European Union investors because the elimination of some important barriers, such as exchange rate risk and reporting standard differences, and the creation of a common European monetary policy and a more homogeneous tax system would lead us to expected an increase in the proportion of

non-domestic European assets in the portfolios of E.U. investors and also an increasing proportion of non-domestic assets in E.U. company balance sheets.

The improvements in access to information about companies in other countries and the existence of more European companies in more than one stock exchange (cross listing), together with lower trading costs are also factors that contribute to the replacement of a traditional domestic or home country biased portfolio by European portfolios.

3. Portfolio theory supports the idea that investors should optimise their portfolios, reducing the risk without correspondingly reducing the rate of returns. An investigation examining changes in the optimised European portfolio as European economic and monetary integration increases can help investors clarify future expectations. If it is expected that a future increase in European integration in both economic and financial markets will occur, knowledge about the consequences of this integration will be very useful for investors, especially institutions such as international funds and life insurance companies that hold long-term investment portfolios and who increasingly have opportunities through deregulation to pursue European or global diversification. Thus, it is highly relevant to examine the interdependencies between European stock markets and the degree to which the optimal European portfolio changes to reflect this.

4. An understanding if there is a trend toward "Europeanisation", rather than globalisation and if this trend is more evident in small rather than in large national markets within the E.U. may also have relevance for future investment decisions. It may have interesting consequences for the segmentation of the European capital market into national and regional markets.

1.4 STRUCTURE OF THE THESIS

In the following chapter we review the literature on economic and financial integration and on portfolio theory. The objective is to review the methodologies of previous empirical work and discuss the main findings. We discuss how the methodologies discussed can be adapted to contribute to the research issues arising from the unprecedented integration programme represented by the E.U. experiment and also discuss some of the limitations of previous work.

Chapter 3 describes the main events in the evolution of the European Economic Community and European Union, and considers their impact on economic and monetary developments in European financial markets, in particular the segmentation of European stock markets. In this chapter we trace the origins of the E.E.C. and its development into the current E.U.. We look more closely at the Maastricht treaty, including the so-called convergence criteria affecting mainly macroeconomic variables and we pay particular attention to the main economic and monetary differences between the 1980s and 1990s.

In chapter 4 we analyse the correlation of returns of European stock markets allowing us to contrast the evolution economic linkages within Europe with that found between European markets and the external markets of the United States and Japan. Because of the potential strong influence of the 1987 crash on the co-movements of international stock markets, the analysis was performed both including and excluding the year 1987.

In chapter 5 we examine economic indicators of European economic and monetary integration. The analysis is divided into two main parts: the first considers the analysis of the level of correlations between economic and monetary variables within European

countries, and between European countries and the U.S. and Japan. In the second part the association between the correlation of economic and monetary variables and the correlation of security market is analysed.

In chapter 6 we analyse the evolution of European systematic risk for each E.U. stock market. This is performed based on the analysis of the beta coefficients from regressions between returns in each E.U. stock market and returns on the European Index. The chapter considers the systematic risk of each European market in three parts, based on a multi-index model including the European Union weighted index, and indices for the American and Japanese stock markets.

The potential multicollinearity between these three variables lead us to decompose the multi-index return model in three single-index return models based on the European benchmark, U.S. market and Japanese market. The aim is to clarify the European betas separating the effects of the American market from those represented by the Japanese market.

Chapter 7 provides an alternative perspective on the integration of European stock markets, based on examining the changes on absolute volatility of each European stock market. It examines how the European integration process is reflected in the absolute riskiness of the E.U. stock market. We analyse the changes on the volatility of E.U. markets with results including and excluding the 1987 crash.

In chapter 8 the optimal European portfolios for representative national investors in E.U. markets are computed. The optimal portfolio was examined in three different ways:

- By comparison of the optimal weights solution of each investor over time to see if the optimal portfolio for each E.U. investor is becoming more stable as European integration increases the correlations of economic and monetary factors.

- Through analysis of differences in the weights of the optimal E.U. portfolio computed for investors from different countries. This allows us to compare the optimal weights solution of different national investors in the same period.

- By analysis of the level of concentration of each optimal solution per representative national investor in particular markets over time. This allows us to observe if the optimal investments are increasingly focused on the same and the same number of stock markets as correlation of returns between markets rises, and differences in macro factors relevant to returns narrow.

In the last chapter we discuss the findings of our empirical analysis in comparison with findings from previous work. We also discuss the further research and the academic and practical contributions of this research.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter we review the literature on economic and financial integration, and portfolio theory. The objective is to review the methodologies employed in previous empirical work, the main findings and some of the limitations.

The chapter reviews literature covering six related issues:

- Economic and monetary integration
- Stock market integration
- Portfolio theory
- Market model and multi-index models
- Volatility of international markets, and
- International diversification.

The chapter is structured in the following way: Section two considers work on economic and monetary integration particularly in Europe. Here we also discuss the literature linking economic and monetary integration between countries and stock market integration. Section three covers the integration of international stock markets, especially European exchanges. Section four provides a review of portfolio theory and diversification effects. In section five studies of risk based on both the market model and multi-index models are considered and section six considers total risk (absolute volatility of returns). Section seven considers portfolio issues such as home bias and

international diversification. Finally the last section outlines issues to be considered. A more focused discussion of some of the key literature also appears in the later empirical chapters.

2.2 ECONOMIC AND MONETARY INTEGRATION

According to Tucker et al. (1991), integration should result in higher correlations of monetary indicators, as their economies become more interdependent. Also the size of the trade sector relative to the economy may proxy for the degree of integration and enhances cross-country correlation between consumption and business cycles (Krugman and Obstfeld, 1997).

Generally studies show an increase in correlations of economic and monetary variables alongside an increase in correlation between stock markets. This seems to indicate that there is a common trend to economic and financial integration. As an example, Freimann (1998) used an approach based on the differences of economic and monetary variables between Germany and other E.U. countries. He used four macroeconomic variables (GDP growth, inflation, government bond yields, and exchange rates) in relation to five European countries (with Germany providing the benchmark) using monthly data from 1975 through 1996. The results show that there is a slight trend towards "integration", reflected in a narrowing of mean differences from Germany. From the 1970s to the 1980s the differentials for the economic variables have narrowed, and at the same time the correlation of stock market returns have increased.

This confirmed Tucker et al. (1991) results that used inflation rates, exchange rates and stock market returns for the period 1977-1988. He studied twelve European Union

countries using quarterly data obtained from the International Monetary Fund Statistical Yearbooks, and found an increase in the correlation coefficients between European inflation rates and also between exchange rates.

However, Chen et al. (1986) argue that the literature is not completely clear about the linkage between economic and monetary variables and stock market behaviour: "No satisfactory theory would argue that the relation between financial markets and macro economy is entirely in one direction. However, stock prices are usually considered as responding to external forces" (p. 384). He also states, "A rather embarrassing gap exists between the theoretically exclusive importance of systematic state variables and our complete ignorance of their identity. The co-movements of asset prices suggest the presence of underlying exogenous influences, but we have not yet determined which economic variables, if any, are responsible" (Chen et al. 1986, p. 384).

Solnik (1984) investigated the relationship between stock market returns and three monetary variables (inflation rates, interest rates and exchange rates) using monthly total returns on nine major markets over the period January 1971 to December 1982. The results found a consistent negative relation between equity returns and inflation rates and interest rates, although the relation between currency movements and stock market behaviour is weak.

A slightly different approach was followed by Asprem (1989) who used quarterly International Financial Statistics data from 1968 to 1984. Based on regression analysis with stock prices (not returns) as the dependent variable and 19 macroeconomic indicators as independent variables he found that employment, imports, inflation and interest rates are the most relevant variables in determining the stock prices. These four

variables seem to be negatively correlated to stock prices. It was also shown that both the European stock index and the U.S. SeP 400 explain the variation in the stock prices more strongly than any of the economic and monetary variables.

Chen and Zhang (1997) and Ratner and Leal (2000) investigate the relationship between trade and equity market correlation for countries that have some common membership in trade groups and this has particular implications for the European Union countries. Ratner and Leal (2000) examined external trade (IMF Direction of Trade Statistics) and monthly equity market returns (IFC) country indices for seven Latin American equity markets and the U.S. between 1983-1996. They found a positive and statistically significant relationship between bilateral trade and the correlations of equity index returns. This finding is supported by Chen and Zhang (1997) for Pacific Basin countries.

Trade liberalisation is among the usual market opening economic and financial reforms that have had a positive impact on market valuations (Henry, 2000). Small markets in particular may become more efficient with trade liberalisation, with returns showing random walk properties (Kawakatsu and Morey, 1999).

In chapter 5 we extend these works by considering additionally how economic and monetary indicators of European Union countries as a block correlate with those of the U.S. and Japan, and whether effects differ between large and small markets within the E.U.. We update the four economic variables used by Tucker et al. (1991), Solnik (1984) and Freimann (1988) but additionally add imbalance in trade. Furthermore, the more recent data covers a major programme of global capital market deregulation and the specific 1991 Single Market reforms inside the E.U..

2.3 STOCK MARKET INTEGRATION

A number of studies, some dating back to the 1970s and earlier, have examined the correlation of returns between national stock markets. Most research on returns correlation in the 1960s focused on a few major markets, reflecting the availability of data at that time (e.g. Agmon 1972, Solnik 1974, Lessard 1976, Joy et al. 1976, Watson 1978 and Hilliard 1979)[1]. Generally these studies found weak correlations across-countries attributable to exchange controls, poor communications infrastructure, and limited international standardisation of financial, accounting and economic information.

One clear issue for investors seeking optimal portfolio diversification is the stability of the variance/covariance matrix between national returns. Maldonado and Saunders (1981) using monthly rates of return for The US, Japan, Germany, Canada and the U.K. from 1957 to 1978, argue that intertemporal relationships between correlation coefficients are unstable, while Philippatos et al. (1983) claim stability. Using principal components analysis on monthly rates of return for fourteen countries from 1959 to 1978, their results suggest that national market indices are interrelated over time through a common factor.

Meric and Meric (1989), analysing seventeen national stock markets using Box's M statistical tests from 1973 to 1987, find that correlation stability is higher for long horizons than for short ones. Also Meric and Meric (1998), using monthly returns from 1975 until 1994, found that the co-movements of the world's ten largest stock markets

[1] Levy and Sarnat (1970) considered 28 countries.

showed stability before the 1987 crash. Partly the different results reflect unresolved methodological issues (Solnik 1977).

A positive trend in correlation of returns among G-7 countries over the period 1970-1993 was reported by Erb et al. (1994) with this effect particularly noticeable amongst European economies. Studies of this period generally indicate that correlation coefficients between stock markets around the world are substantial and significant, although correlations vary over time and across countries, and the patterns of variation differ between different pairs of countries (Johnson and Soenen 1993, Solnik et al. 1996). Correlations are typically higher in down markets than in up markets (Erb et al., 1994).

Erb et al. (1994) confirm a business cycle effect with higher correlations when pairs of economies were contracting. Correlations were also lower when the respective business cycles were out of phase.

Correlations also increase in periods of high return volatility (Solnik et al. 1996, Freimann 1998). The 1987 "crash" led to a sharp increase in correlations in 1987, providing the highest correlations across the 1958 to 1995 time period.

A variety of other studies show that the stock market crash of October 1987 produces rather untypical estimates of correlation (King and Wadhwani 1990, Hamao et al. 1990, Le 1991, Malliaris and Urrutia 1992, Arshanapalli and Doukas 1993, Lee and Kim 1993).

Meric and Meric (1998) analysed the co-movements of the world's 10 largest stock markets before and after the 1987 stock market crash, from 1975 until 1994 using

monthly returns. The results show that the correlation coefficients are generally substantially higher in the post-crash period than in the pre-crash period. This finding is confirmed by Markellos and Costas (1997) who examined the correlation between European stock markets and the equity markets of New York and Tokyo using monthly observations on seven small national basket indices, using price return indices (excluding dividends) collected from the Main Economic Indicators (OECD), over the period 1974-94.

Several studies are specifically concerned with the impacts of changes in the international environment, namely the integration policies amongst European Union countries.

Johnson and Soenen (1993) examined the correlations between eight European equity markets, the U.S. and Japan using monthly total returns in local currency obtained from the BARRA International Ltd for the period 1973-1990 and concluded that it appears the eight main European stock markets have become more correlated among themselves since 1985. The overall correlations for European countries in the 1985-90 period (0.5) are much higher than that in the previous six-year period (0.34). The results also indicate that the returns on E.U. stock markets are more highly correlated with the U.S. than with Japan. These conclusions are to some extent limited because a number of major European programmes took place after that date.

In another study Stan Beckers (1999) examined whether there has been a significant increase in the average correlations between European capital markets over ten years for 14 countries. All equity data was from Financial Times International and represented daily price indexes in local currencies from January 1988 until December 1997

excluding dividends. A statistically significant upward trend in the correlations, with the average correlation increasing by 0.024 per year, was found.

Also Freimann (1998) found that the average of correlations increased from an average 20 per cent in the 1970s to more than 50 per cent in the 1990s. The work considered seven European stock markets using monthly data from January 1975 through December 1996 based on market returns excluding dividends.

The consistent outcome for all these studies seems to be that taking a returns correlation approach, European stock markets have over time begun to behave more similarly while no similar conclusion can be drawn for correlations between E.U. stock markets, the U.S. and Japan. Also the October 1987 crash is so major that it overwhelms patterns in surrounding years.

2.4 PORTFOLIO THEORY

In this section a review of modern portfolio theory is followed by a discussion of empirical work exploring its implications.

2.4.1 The Markowitz mean-variance formulation

Portfolio theory is concerned with the choice of efficient combinations of assets in terms of mean/variance of returns. Harry Markowitz (1952, 1959) is acknowledged as providing the cornerstones of modern portfolio theory by measuring risk (Michaud and Bergstrom, 1996).

Although investors have long been aware, in a qualitative sense, of the benefits resulting from diversification of security holdings, the Markowitz model represented the first substantial quantitative analysis of these benefits (Lofthouse, 1997).

The assumptions underlying the model are as follows (Dobbins et al., 1994):

- The return on an investment adequately summarises the outcome of the investment.
- Investors' risk estimates are proportional to the variance of return they perceive for a security or portfolio.
- Investors are willing to base their decisions on just two parameters: the expected return and variance of return.
- The investor exhibits risk aversion, so for a given expected return he prefers minimum risk, or for a given level of risk the investor prefers maximum expected return.

The Markowitz approach deals with a defined universe of risky investments, seeking to define combinations (portfolios) that are efficient in offering the highest return for a given level of risk. Investors by definition prefer portfolios on this frontier rather than interior portfolios, given the assumption of risk aversion (Francis, 1991).

2.4.2 Selection of the optimal portfolio or market portfolio

The Markowitz efficient frontier was extended by William Sharpe (1963, 1964) by introducing the risk-free rate of interest (R_F), proxied by three-month Treasury Bills (or similar), to define a capital market line (CML), which either intersects or is tangential to

the Markowitz frontier at just one point. This then defines a reference portfolio, the market portfolio (usually called M).

The trade-off between risk and return implies that rational investors expect a higher return for investing in a risky market portfolio than in risk-free assets. Ex post they may not get the higher return but they must always expect it, otherwise rational (risk averse) investors would switch from equities into Treasury Bills (Copeland and Weston, 1988).

Using Tobin's (1958) separation theorem, an investor's choice of risk level is independent of the problem of deriving the optimal portfolio of risky securities since the risk level of an optimum or market portfolio can, by definition, be adjusted more cheaply using the risk free asset than by altering the risky asset portfolio. Therefore, all investors are directed towards the market portfolio, and hold a portfolio on the CML, that is, a portfolio comprising some ratio of the risky portfolio M and the risk-free security (Strong, 2000).

2.4.3 National diversification

Since the pioneering work of Markowitz (1952), portfolio theorists have examined ways of expanding the range of investment types to include domestic non-equity financial and real assets, and international financial assets.

Several studies have noted diversification gains from the inclusion of real estate in portfolios containing domestic financial assets. Brueggeman, Chen and Thibodeau (1984, 1992) find superior portfolio performance (as measured by the Sharpe measure) from portfolios including commercial real estate. Webb and Rubens (1986, 1988) create portfolios containing three financial assets and three types of real estate and show that

real estate dominates the mean-variance efficient portfolios. Ross and Zisler (1991) note real estate's low correlation with financial assets but suggest that the use of appraisal-based real estate estimates will overstate the percentage of real estate to be included in portfolios. A summary of the work in this area can be found in Worzola (1992).

Burik and Ennis (1990) show imperceptible gains from the inclusion of international bonds in national portfolios, while Rosenberg (1990) and Filatov et al. (1991) argue that statistically significant gains are possible with international bonds when employing a hedging strategy.

Rubens et al. (1998) investigated whether investing in alternative investments (real estate and bonds) provides statistically significant increases in portfolio performance. They constructed base portfolios as benchmarks to measure potential portfolio performance gains. The portfolios are constructed using the Markowitz mean/variance model with optimal allocations selected by choosing the portfolio with the highest Sharpe measure (excess return per unit of risk). The risk-free rate is an average of the six-month Treasury bill rate over the time period examined. The results show that, in the 1978-93 sample period, the gains realised resulted in higher Sharpe measure, but were not statistically significant.

2.5 MARKET MODEL AND MULTI-INDEX MODELS

2.5.1 The market model

Changes in some economic and monetary variables tend to have similar effects on all companies and their national stock markets. The common risk associated with a

specified portfolio: national, European, Global is termed market risk, or non-diversifiable risk while the risk that can be removed by diversification is called specific risk, diversifiable risk or non-market risk (Evans and Archer 1968, Jensen 1972).

Accordingly portfolio theory suggests that investors should not expect to be rewarded for taking on specific risk, because this can be avoided by diversification (Gordon and Francis, 1991).

The market model (or single-index model) (Sharpe, 1963) captures this by explaining the risk of an asset solely in terms of its link to market (index) returns:

$$R_i = \alpha_i + \beta_i R_M + e_i \qquad \text{equation 2.1}$$

Where:

- R_i - is the return of an individual security
- R_M - is the return of the market index
- α_i - is the value of the intercept,
- β_i - is the slope of the characteristic line
- e_i - is a random error term.

The coefficient β_i indicates the expected responsiveness of the return of security *i* to changes in the level of the market index and is a measure of the market or systematic risk of a security (or portfolio). The intercept term α and error term e_i capture returns not explained by the market returns, weighted by the beta or systematic risks of a security (Sharpe, 2000).

2.5.2 Practical problems with portfolio indexes

A methodological question here could be the difference of using total return or price indexes and the value-weighted or equal weighted indexes.

Most of the market indexes available (MSCI, FT-Actuaries, IFC, and the majority of local stock indexes[2]) are broadly based market value-weighted indexes. This type of index is true a market portfolio in the sense that when the index portfolio held by an investor, it truly represents movements in the market. This is not true of equal weighted indexes, such as U.S. Dow Jones or the Japanese Nikkei (Solnik, 1998).

Some indexes used in previous studies are price indexes (Asprem 1989, Markello and Costas 1997, Freimann 1998, Beckers 1999) and others are return indexes (Solnik 1984, Johnson and Soenen 1993). Most local market indexes published do not include dividends, although some countries do report dividend-adjusted indexes. Local indexes are more used by domestic investors while international indexes (such as MSCI, FT-Actuaries, IFC) are more used by institutional investors. The reasons for this preference are that, first, international indexes are calculated in a single consistent manner, allowing for direct comparisons between markets; and secondly these companies provide regional and global indexes (World, European, EAFE, etc.), which are what international money managers need in order to measure overall performance. Moreover

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[2] Local indexes are those published by the local stock exchange (Elton and Gruber 1995, and Solnik 1998)

international market indexes generally are return indexes (i.e. they include dividends). These are the main reasons why we decided to work with international indexes.

Although some differences appear between results, especially in terms of the rate of return or risk, these methodological issues don't seem to change the major conclusions of previous works about stock market integration and the benefits of international diversification.

2.5.3 Multi-index models

2.5.3.1 Models and objectives

Some of the methodological issues associated with the use of single factor models in explaining international portfolio returns are met by working with multi-index models, which should take into account segmentation of national stock markets so perhaps making a security's returns sensitive to national, European and Global portfolios (Roll and Ross, 1980).

Multi-index models introduce extra-indices in the hope of capturing additional pricing factors:

$$R_i = \alpha_i + \beta_{i1} I_1 + \beta_{i2} I_2 + \ldots + \beta_{ik} I_k + e_i \qquad \text{Equation 2.2}$$

Where:

- R_i - is the return of an individual security
- α_i - is the value of the intercept
- β_{ik} - is the sensitivity of an individual security to the Index k

- I_k – are returns on Index k
- e_i - is a random error term.

In order to use the multi-index models one must have estimates of the β_{ik}'s for the equation 2.2 with β_{ik}'s having the same role as a risk measure as β_i in the single index model. A β_{ik} of 2 would mean that if the index (representing one variable) increases (or decreases) by 1%, the stock's return is expected to increase (or decrease) by 2%.

Multi-index models can be used to form expectations about returns, to study the impact of events, and as a method for attributing the cause of good or bad performance on a portfolio. They can be also a way to analyse the systematic risk adding more factor to the single index model. "However, the cost of introducing additional indices is the chance that they are picking up random noise rather than real influences" (Elton and Gruber 1995, p. 160).

There has been a renewed interest in multi-index models with the Arbitrage Pricing Theory (APT) approach pioneered by Ross (1976). The contribution of the APT compared with the multi-index models is in demonstrating how and under what conditions one can go from a multi-index model to a description of market equilibrium in asset prices (Ross, et al. 1996).

2.5.3.2 Number of factors in multi-index models

Gibbons (1982) results find six or seven significant indices whereas other studies show little gain beyond three (Roll and Ross 1980, Booth et al. 1993). However, the number of significant indices seems to be a function of the number of countries/firms that are being analysed (Dhrymes et al. 1984, Diacogionnis 1986).

Roll and Ross (1984) argue that the number of factors is not relevant since factors are extracted by incremental importance in explaining the variance of returns, with Krans (1985) also arguing the best test of APT is to analyse how good the model is in explaining the stock returns compared to other models.

2.5.3.3 Variables selection in multi-index models

There is a continuing debate (Roll and Ross 1984, Brumeister and Wall, 1986) over whether explanatory variables should have theoretical grounding or whether a purely empirical approach is acceptable. With instability in relationships, ad-hoc variables may have poor forecasting ability.

Two methods for testing the APT model appear in the literature. One method is to estimate I_k's using factor analysis (i.e. we first estimate which are the pricing factors that are statistically significant) and then estimate the betas for these factors (Roll and Ross 1980, Cho et al. 1984, Dhrymes et al. 1984). An alternative method is to specify *a priori* a set of factors (I_k's) based on economic theory and then to estimate the β_{ik}'s.

Chen and Jordan (1993) compared the two approaches: selecting the variables based on factor analysis and defining the variables *a priori*. For them the major advantage of using factor analysis is that we do not need to know the factors in advance. The advantage of selecting the factors is to avoid the econometric problems of using factor analysis and to base the selection on economic theory.

Two different types of variables have been explored as factors. Macroeconomic variables were used by Keran (1971), Homa and Jaffee (1971), Malkiel and Quandt (1972), Robichek and Cohn (1974), Chen, Roll and Ross (1986), Brumeister and

McElroy (1988), Berry, Brumeister and McElroy (1988), and Sorensen et al. (1989)[3]. Alternatively market indices have been used as determinants of security returns (King 1966, Cohen and Progue 1967, Agmon and Lessard 1977, Fama and French 1993)).

2.5.3.4 Macroeconomic factors in multi-index models

Multi-index models incorporating macroeconomic factors include Keran (1971) who explained returns on the Standard and Poor's 500 stock prices levels in terms of expected corporate profits and current interest rates, which were in turn viewed as being determined by expectations of the rate of inflation, the real growth rate and the change in the stock of real money. Homa and Jaffee (1971) and Modigliani (1972) related the level of the Standard and Poor's index to the money supply and its growth rate, while Malkiel and Quandt (1972) looked for links to forecasts of the gross national product.

In a slightly different approach Hamburger and Kochin (1972) sought to explain the risk premium on the stock market as a function of macroeconomic instability. They found that equity prices were negatively related to the variability in the rate of inflation and in rates of changes in money supply and real corporate profits.

Using a multi-index model based on two variables - changes in real economic growth and inflation rates - Robichek and Cohn (1974) tested the hypothesis that the beta is related directly to the macroeconomic environment. They used monthly data from 1963 to 1970 for about 814 U.S. firms, finding that a statistically significant number of firms

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[3] A more detailed discussion of the findings of these studies is performed in chapter 6 in the section "Previous Works".

displayed levels of systematic risk that varied as a function of economic growth and inflation.

2.5.3.5 Domestic, sector and international factors

Other research investigated sector effects alongside national and international market effects (Agmon 1972, 1973, Lessard 1974, Roll 1992, Heston and Rouwenhorst 1995). If the single market programme and the single currency has reduced market segmentation and increased cross-border investing and industrial consolidation, the particular market where a company is quoted is no longer going to reflect pure national risk as is the case, for example, of Nokia in Finland.

In the 1970s Lessard (1976) and Solnik (1974) researched the relative importance of industry, domestic, and international factors in stock returns and concluded that international factors were weaker than domestic. Currency movements generally have weak effects. More recent works confirm those conclusions (Drummen and Zimmermann 1992, Heston and Rouwenhorst 1994, Griffin and Stulz 1997).

King (1966) measured effects of common movements between securities beyond market effects and found that, over 1972-60, about half of the total variation in a stock's price was accounted for by a market index while an average of another 10% was accounted for by industry factors.

Another test of the multi-index model by Cohen and Pogue (1967) used a multi-index model with the market index and industry index, and concluded that this two-factor model explains more of variability in returns than the single index model.

However, Beckers, Connor and Curds (1996) concluded that the countries-model has a three times higher average R^2 than the global industries-model. In addition, Solnik, et al. (1996) and Griffin and Karolyi (1998) found that adding global industry factors to national factors provides only a slight marginal improvement in variance explained.

Local factors seem to be even more important in emerging markets than in developed markets. Harvey (1995) found that very few emerging markets have any significant exposure to international risk factors. Bekaert and Harvey (1997) and Aggarwal, Inclan and Leal (1999) also present evidence that local shocks are more predominant drivers in emerging markets than in developed markets. Since in our sample of European markets, Greece, Portugal, Ireland and Finland are small or emerging markets (see Divecha et al. 1992, Harvey 1995, Khanna 1996, Masters 1998), we might expect that these markets are segmented and are more influenced by domestic factors than large European markets.

Across the European Union, industry effects have grown in importance over the past decade while country effects (differences) seem gradually to trend lower, meaning that industry affiliation is likely to replace country affiliation in the future as the dominant explanation of equity returns. However, country affiliation remains the dominant influence (Urias 1997, Diamond et al. 1997, Rouwenhorst 1999). Differences among E.U. member states still remain, and E.U. members still control their own fiscal, regulatory and tax policies, and each is still a distinct labour market. Even technical standards can vary from country to country. And, of course, cultural and linguistic diversity is largely unaffected. Thus, basing European equity asset allocation primarily on country-specific signals has been the correct approach historically.

In chapter 6 we specify a set of three portfolios based on the weighted European index and the two major stock market indexes outside the European Union: the U.S. and Japan. The objective is to observe the behaviour of the systematic components of risk, captured by the β_{ik}'s.

2.6 VOLATILITY OF INTERNATIONAL STOCK MARKETS

Studies on international stock markets show that E.U. markets were generally more volatile (riskier) than the U.S. or Japan in the 1970s and 1980s (Hunter and Coggin 1990, Odier and Solnik 1993). However three E.U. markets (Belgium, Germany and Holland) had volatility below the U.S. and Japanese levels until the mid-1980s (Hunter and Coggin, 1990).

The results depend on the time period considered, with Tang (1995) using data from 1970 to1990 and finding that the Japanese market had the lowest volatility, while Hanna et al. (1999) using data from 1988-1997 found that the United States market was the most stable stock market.

Allan (1982) used data from 1970-81, and found large markets became less volatile over time with support from Stan Beckers (1999) for 1988-1997. Odier and Solnik (1993) studied the period 1970-1990 and concluded that the volatility of the major stock markets has not been stable over time and exhibited no trend.

The influence of the 1987 crash in the level of stock markets' volatility is reported by Roll (1988), Bennett and Kelleher (1988), Le (1991) and Drummen and Zimmermann (1992), who found an increase in the volatility of all markets during the crash.

Remaining questions are whether European economic and monetary integration has reduced the volatility of E.U. stock markets compared with the U.S. and Japan. Also whether European economic and monetary integration has led to a more uniform risk among E.U. stock markets.

2.7 INTERNATIONAL DIVERSIFICATION AND HOME BIAS

2.7.1 International diversification

In this section a review of literature in international diversification is followed by a discussion of empirical work exploring its implications, including a discussion of the home bias phenomenon.

The theoretical logic of portfolio theory becomes more complicated once we start to consider investor behaviour in an international context where security markets are to some degree segmented by currency, accessibility and information differences (Grable, 1996).

The potential for investors to reduce national systematic risk by diversifying their portfolios internationally was noted by Grubel (1968), Levy and Sarnat (1970), Solnik (1974), and Rugman (1976). More recent works also indicate the continuing benefits from international diversification (Bailey and Stulz 1990, Eun and Resnick 1994, Jankus 1998, Ho et al. 1999, Cavaglia et al. 2000).

Further opportunities to assemble a portfolio where components are priced incorrectly relative to one another were noted by McDonald (1973) who described them as segmentation gains.

Essentially, international investment has three sources of risk:

- the unsystematic risk of a security which is completely diversifiable,
- a country-related risk which is reducible only via international investment, and
- systematic risk related to the world economy.

To the extent that pricing of assets in national markets is not consistent with systematic risks in a global portfolio, national markets are segmented, where segmentation can be defined as the condition where "two assets which belong to different countries but have the same risk with respect to some model of international asset pricing without barriers to international investment have different expected returns" (Stuiz 1981b, p. 358).

The level of integration or segmentation between markets has generally been measured using correlation analysis between assets or between portfolios (country indices, industry indices or other kind groups of assets) (Levy and Sarnat 1970, Agmon 1972, Solnik 1974, Lessard 1976, Johnson and Soenen 1993, Markellos and Costas 1997, Freimann 1998, Beckers 1999). To the extent that correlations of returns between potential assets in a portfolio (securities or markets) are less than one, the assumption is that diversification gains in the form of risk reduction are possible (Black, 2000).

In practice, market returns are positively correlated as they are all influenced by the same economic and political international factors. Therefore, only a certain part of total risk - the specific risk relating to individual markets – is eliminated by international diversification (Levy, 1996).

2.7.2 Currency risk

An argument against international diversification is that currency risk (i.e. exchange risk) can offset the reduction in security risks achieved by international diversification, i.e. its impact on the investment return may exceed that of capital gain differences, especially over short periods of time.

First, market risk and currency risk are not additive. This would be true only if the two were perfectly correlated. In fact, there is a weak, and sometimes negative, correlation between currency and market movements (Adler and Dumas, 1983). Exceptions are found in some emerging markets where there are strong correlation between the national currency and the national market movements (Divecha et al. 1992, Park and Agtmael 1993).

Furthermore, empirical studies (Jorion 1989, Odier and Solnik 1993) indicate that currency risk, as measured by the standard deviation of the exchange rate movements, is much smaller than the risk of the corresponding stock market.

According to Solnik (1998), currency fluctuations have never been the major component of total return on a diversified portfolio over a long period of time. This stems from the fact that the depreciation of one currency is often offset by the appreciation of another.

In addition, currency risk between the eleven E.U. countries within the Euro area has been eliminated in the European Union, although it remains for four E.U. countries outside the Euro.

2.7.3 The benefits of international diversification

The size of the diversification effect has historically been around a 50% reduction in risk compared with a national portfolio. Madura and Reiff (1985) show unchanged returns and a 50% reduction in the risk in currency hedged international equity, while Hunter and Coggin (1990) report a 44% drop, both though well above the theoretical 90% risk reduction. As with Fouse (1992) though, ex post benefits would be undermined by instability in the variance covariance matrix of country returns.

Errunza (1983) and Divecha et al. (1992) show that investment in risky emerging markets reduces overall portfolio risk with Masters (1998) calculating a 6% weight to such assets. Khanna (1996) notes the low correlation of emerging markets with major markets and also the high but volatile returns they provide. Speidell and Sappenfield (1992) also note the high diversification potential of emerging markets due to low correlations of returns with the world market. None of these authors, however, address one of the concerns we raise in a later chapter, i.e. the capacity of emerging markets to provide optimal weightings of assets and if they have not what will happen to asset prices as a result.

Cumby and Glen (1990), Eun, Kolodny and Resnick (1991), Apap and Collins (1994), Droms and Walker (1994), Solnik (1995), and Aiello and Chieffe (1999) find advantages in international mutual funds.

Russell et al. (1998) tests whether U.S. exchange-listed foreign securities such as ADRs, MNCs, and closed-end country funds behave more like the New York composite index than the market they represent. His study suggests that these securities do not provide significant diversification benefits for the U.S. investor. Senschack and

Beedles (1980) provide a good summary of the evidence up to the 1980s and conclude the evidence seems that positioning in U.S. multinational firms does not provide all the benefits available from direct investment in foreign securities. Jacquillat and Solnik (1978), Dada and Williams (1993), Siegel et al. (1995), and McCarthy (2002) confirmed that holding the shares of domestic MNCs is not a good alternative to international portfolio diversification.

Markellos and Costas (1997) examine the diversification benefits available to U.S. and Japanese investors in seven of the smaller European stock markets, using data collected from the Main Economic Indicators (OECD), over the period 1974-1994. The results show continuing opportunity for diversification within European stock markets, especially from smaller markets such as Greece.

In another recent study, Adjaoute and Danthine (2001) examined the impact of EMU on portfolio diversification opportunities. They focused on 11 equity markets and examined the implications for optimal portfolio allocations in terms of risk and return of the economic and monetary integration process during 1990-98. The indices used are Datastream Global Equity indices in local currency, which are constructed excluding dividends. To optimise the European portfolio, the Markowitz model and Sharp index were used. They found that diversification opportunities within the Euro-area have been reduced because there was a significant increase in the correlation between stock returns.

2.7.4 Home bias in international portfolios

Despite the theoretical advantages of international portfolio diversification, actual equity portfolio holdings reveal a strong bias towards domestic stocks with, for

example, U.S. investors holding 93.8% of their equity portfolio in domestic stocks, Japanese investors 98.1%, and U.K. investors 82% (French and Poterba, 1991). These portfolios are therefore under diversified and hence inefficient.

Various imperfections in international stock markets have been proposed to explain this observed pattern in equity holdings. Monetary investment barriers such as differences in transaction costs or unfavourable taxation may lead to imperfectly diversified portfolio holdings being captured, for example, in equilibrium models by Black (1974) or Stulz (1981a). Cooper and Kaplanis (1994) find that for reasonable levels of risk aversion costs such as withholding taxes or additional foreign transaction costs are too low to explain home bias. Tesar and Werner (1995) show that turnover rates are significantly higher for foreign stocks than for domestic stocks, which does not support an explanation based on transaction cost difference either. Another obstacle for foreign equity investment would be regulatory investment barriers. Particular groups of investors, such as insurance companies or pension funds, are still subject to rather restrictive regulations requiring them to match assets to liabilities (Davis, 1991). Uppal (1992) concluded that it is unlikely that these factors are significant enough to explain the degree of the bias in portfolios that is observed empirically. Furthermore, the deregulation of European financial markets during the last decade is gradually lowering these constraints.

Another potential explanation is based on deviations from purchasing power parity. Adler and Dumas (1983) and Stulz (1981b) present models incorporating deviations from purchasing power parity and inflation risk against which investors try to hedge. However, Cooper and Kaplanis (1994) show that deviations from purchasing power parity in combination with inflation risk may rationalize the observed equity holdings

only for very low levels of risk aversion. On the other hand, Glassman and Riddick (1996) point out that if purchasing power parity holds this would exaggerate the degree of the home bias. Thus although all of the effects mentioned so far could induce a home bias in equity portfolios, none seems to be sufficiently large to explain the magnitude of the home bias.

A further explanation of observed equity holdings would be asymmetric expectations. French and Poterba (1991) argue that domestic investors have more optimistic expectations about domestic stocks than about foreign ones. Kilka and Weber (2000) conducted a cross-country study in Germany and the U.S to test this hypothesis by comparing participants' judgments about a common set of German and U.S. stocks. Results show that both test groups feel more competent in assessing domestic stocks. Informational asymmetries are normally considered to be the underlying reason for such differences.

Levy and Livingston (1995) show in a mean-variance portfolio optimisation framework that superior information about a specific asset, expressed either by lower expected standard deviation or by higher expected return, may be a strong reason not to diversify. Thus, systematically different expectations could readily explain portfolio holdings biased by country of investor.

2.8 CONCLUSIONS

Several studies on economic convergence across countries show that there is a slight trend toward "integration" at least from the 1970s to 1980s (Tucker et al. 1991, Solnik 1994, Freimann 1998).

We extend these works (in chapter 5) by considering additionally how economic and monetary indicators of European Union countries as a block correlate with those of the U.S. and Japan, and whether effects differ between large and small markets within the E.U.. We update the economic variables generally used by Tucker et al. (1991), Solnik (1984), and Freimann (1988) and added imbalance in trade. Also our study covers a more recent period with a major programme of global capital market deregulation and reforms inside the EU.

In terms of stock markets' integration, generally previous studies in the 1970s found weak correlations across-countries attributable to exchange controls, poor communications infrastructure, and limited international standardisation of financial, accounting and economic information (Levy and Sarnat 1970, Agmon 1972, Solnik 1974, Lessard 1976, Joy et al. 1976, Watson 1978 and Hilliard 1979).

Studies subsequent to this period generally indicate that correlation coefficients between stock markets around the world are substantial and significant, although correlations vary over time and across countries, and the patterns of variation differ between different pairs of countries (Johnson and Soenen 1993, Solnik et al. 1996).

Several studies are specifically concerned with the European Union countries (Freimann 1998, Beckers 1999). The results show that, on average, correlations increased since the beginnings of the 1980s. The results also indicate that in the 1970s and 1980s, the returns on E.U. stock markets are more highly correlated with the U.S. than with Japan (Johnson and Soenen, 1993).

However, the literature is not completely clear about the linkage between economic and monetary variables and stock market behaviour (Chen et al. 1986). It is relevant to

examine the convergence of European economies and the degree to which the European stock markets' changes reflect this. In chapter 5 we analyse whether the economic and monetary integration has implied that returns correlation of European stock markets have begun to behave more similarly inside the European Union and between E.U. stock markets, than in relation to the U.S. and Japan from the 1980s to 1990s.

Also the previous findings about the evolution of the international stock markets indicate that E.U. markets were generally more volatile (riskier) than in the U.S. or Japan in the 1970s and 1980s (Hunter and Coggin 1990, Odier and Solnik 1993). However the level of volatility of each market over time depends on the time period considered (Tang 1995, Hanna et al. 1999).

The question is whether European economic and monetary integration have reduced the volatility of E.U. stock markets compared with the U.S. and Japan, and whether European economic and monetary integration is leading to more uniform risk among E.U. stock markets. This will be investigated in chapter 7. Also changes in economic and monetary variables tend to have similar effect on all companies and their national stock markets, at least for the large E.U. economies. This leads us also to investigate in chapter 6 the behaviour of the systematic components of risk, based on a set of three portfolios: the weighted European, U.S. and Japan.

As convergence increases, this should prompt investors to reassess their strategic asset allocations, rebalancing away from their national markets toward other European or world markets. Administratively, European diversification has been facilitated by the relaxation of exchange controls and general stability arising from the economic and

monetary European Union. However, increasing convergence reduces the benefits of cross E.U. diversification.

Markellos and Costas (1997) show continuing benefits from diversification within European stock markets for U.S. and Japanese investors. These benefits were especially apparent in the smaller of the markets examined. However, Adjaoute and Danthine (2001) found that diversification opportunities within the Euro-area have been reduced because there was a significant increase in the correlation between stock returns.

Also several studies indicate the potential of emerging stock markets (including some E.U. markets) for international portfolios based on low correlation of emerging markets with major markets (Divecha et al. 1992, Speidell and Sappenfield 1992, Khanna 1996, Masters 1998). Other studies found advantages in international mutual funds (Cumby and Glen 1990, Eun, Kolodny, and Resnick 1991, Apap and Collins 1994, Droms and Walker 1994, Solnik 1995). Russell et al. (1998) considers the options that investing in ADRs and MNCs, while Jacquillat and Solnik (1978), Senschack and Beedles (1980) and Dada and Williams (1993) state that holding the shares of domestic MNCs is not a good alternative to international portfolio diversification.

All of these studies about international portfolio diversification and some of them based on the Markowitz model and Sharpe Index technique examine the benefits of international investments in terms of reducing the level of portfolio risk or increasing the level of portfolio returns. Our research uses the same methodology (Markowitz mean/variance efficiency and the Sharpe ratio) for optimising European portfolio to focus on optimal weights. No significant research has been published on the changes on

optimal weights of the European portfolio as a result of the new environment created by the economic and financial European integration.

The trend of these changes is one objective of our research. The question is whether the process of economic and monetary European integration has increased or decreased the stability and concentration of country weights in optimal portfolios of representative E.U. national investors.

CHAPTER 3 THE HISTORY OF THE EUROPEAN MONETARY UNION

3.1 INTRODUCTION

This chapter is not intended to provide a comprehensive review of the vast literature concerned with the European Economic Community (E.C.C.) and European Union (E.U.). Instead the intention is to examine the main economic and monetary events, which shaped the structure of European financial markets, especially stock markets.

Monetary co-operation in Western Europe began long before the creation of the EC, with the European Payments Union (EPU) in 1950. The EPU provided limited convertibility within Western Europe and provided a framework for full currency convertibility, achieved in 1958. Gros and Thygesen (1992) provide a detailed history; also Ungerer *et al.* (1990), Papadia and Saccomani (1994) supply a useful chronology.

From time to time, however, proposals were made to move beyond mere co-operation between national currencies to full-fledged monetary unification, sometimes by officials and sometimes by academics. Eventually this led to the Exchange Rate Mechanism and in due course to national currencies across Europe being replaced by the Euro.

This chapter is organised in the following way: sections one and two look at the origins of the E.E.C. and section three looks at the next stage of E.U. development. Section four discusses European currency agreements and crisis handling mechanisms. Sections five and six examine the Single European Act and the removal of capital controls while Section seven looks more closely at the Maastricht treaty, including the so-called

convergence criteria. Section eight and nine assesses the main differences between the 1980s and 1990s and analyse the evolution of different types of economic integration over time. The last section presents a summary of the main conclusions of economic and monetary integration process.

3.2 THE TREATY OF ROME

Beginning in 1951, the Treaty of Paris established the European Coal and Steel Community; subsequently the states of Western Europe signed a series of agreements in an effort to increase trade cooperation and, eventually, to harmonise monetary policy.

The treaty of 1957, which created the E.E.C., made no provision for monetary union. It focused on the creation of a customs union eliminating trade barriers between the six founding countries (Belgium, France, Germany, Italy, Luxembourg and Netherlands) and harmonising tariffs in relation to non-members.

Since 1958 there have been five enlargements involving ten countries: Denmark, Ireland and the UK joined the E.U. in January 1973, Greece in January 1981, Portugal and Spain in January 1986, East Germany in October 1990 as a consequence of German reunification, and Austria, Finland and Sweden in January 1995.

In December 1969, the six original members signed up for a more ambitious goal: complete economic and monetary union by the end of 1980 (McDonald and Dearden, 1999). A common vision was developed in the Werner report.

3.3 THE WERNER REPORT

In October 1970 the Werner Report, a plan for full economic and monetary union was unveiled. It resulted in a new system of semi-fixed exchange rates amongst E.E.C. members and called for the completion of monetary union by 1980. The report made detailed recommendations for the first two stages of the process and described in more general terms the reforms that would have to occur in the third stage.

The first stage focused on the coordination and convergence of monetary and fiscal policies. Governments' national policies should reflect Community guidelines, and policy convergence should take place fast enough to obviate the need for exchange rate changes in the second stage. Exchange rate fluctuations would narrow, and a fund for monetary cooperation established to provide short-term balance of payments credit to individual EC countries. By that time, the size and financing of national budgets would be decided at the EC level by a body responsible to the European Parliament (Kenen, 1995).

3.4 EXCHANGE RATE AGREEMENTS AND CRISIS

3.4.1 "The snake": 1972-79

In March 1971, the EC Council of Ministers endorsed the strategy proposed by the Werner Report and took steps to implement some of its recommendations. In March 1972, exchange rate fluctuations were reduced by limiting the swings in bilateral exchange rates to a 2 and 1/4 percent band. This arrangement was known as the "snake in the tunnel" because it made the participating currencies move up and down together

within the wider 4 and 1/2 percent band established for the dollar by the Smithsonian Agreement of 1971. The snake, established in April 1972, had a tortuous history. There were three Deutchmark revaluations, 15 other parity changes, plus a merry-go-round of joinings, leavings and re-joinings.

However, the worldwide shift to floating exchange rates in March 1973 abolished the tunnel, allowing the snake to float and some members were forced to allow their currencies to float independently. Divergence, not convergence, was occurring everywhere as economies and governments were adapting differently to the oil shock of 1973-74. Inflation rates were rising but at different speeds, as were unemployment rates (Baer and Padoa-Schioppa 1989, Giovannini 1990a, Gros and Thygesen 1992).

In 1977 the idea of monetary union was resurrected. European politicians wanted to create a stable framework for the conduct of European trade, especially in Germany, which was keen to establish a means of shielding the Deutchmark from the increasingly unstable US dollar.

3.4.2 The European Monetary System, 1979

A new "zone of monetary stability" in Europe, the European Monetary System (EMS was established in June 1978, by six of the nine community countries. On the design and evolution of the EMS, see Giovannini (1989), Ungerer et al. (1990), Gros and Thygesen (1992), and Fratianni and Von Hagen (1992).

The main features of the EMS were defined in December 1978, and an agreement among the EC central banks brought the EMS into being in March 1979. The EMS was designed to be a more flexible, symmetrical version of the Bretton Woods System,

which had governed global exchange rate arrangements from the end of the Second World War until the move to floating exchange rates in 1973.

The European Monetary System, which gave effect to some of these ideas, had four main features: the Exchange-Rate Mechanism (ERM), the European Currency Unit (ECU), Financing facilities, and the European Monetary Fund. All currencies that were members of the ERM were linked by a central rate against the ECU, which was a weighted basket of EC currencies. Market rates were permitted to fluctuate 2.25 per cent on either side of their central ECU rate.

Eight EC countries joined the ERM initially. Italy, still subject to inflation, was allowed to adopt a wide 6 percent band instead of the narrow 2 and 1/4 percent. Spain joined the ERM in June 1989, the United Kingdom in October 1990, and Portugal in April 1992, each of them with a 6 percent band. Italy moved to the narrow band in January 1990, but it left the ERM entirely, along with the United Kingdom, during the exchange rate crisis of September 1992. Greece had not joined at that time.

A set of mechanisms was devised to maintain currencies within the permitted bands, but if a problem proved persistent, realignment of the central rate was a last resort.

There were 37 realignments in the years 1979-92, notably in 1983 and 1985. However, the system settled down, and from January 1987 to August 1992 there were no realignments at all. An analysis of the realignments is provided by Britton (1991) and Begg and Wyplosz (1993). These divergences of ERM exchange rates during the 1980s can be seen as ample testimony to a continued lack of substantive coordination among the ERM countries during the 1980s, especially in the monetary sphere (Giavazzi and Pagano, 1988).

3.4.3 The ERM crisis of 1992-93

By the summer of 1992, the ERM included all 12 European community members, and four other countries had linked their currencies to the ECU. But in September 1992, the foreign exchange markets launched a speculative attack against the pound and the lira, forcing both to leave the exchange rate mechanism. By the end of the year Spain and Portugal had also been forced to devalue. Currency turbulence continued through the winter of 1992 and the spring of 1993. Finally, in August 1993, even stronger speculation against the fixed floor and ceiling limits forced a widening of the fluctuation bands from +/-2.25 per cent to +/-15 per cent, a drastic relaxation. For a summary see Collignon *et al.* 1994, and Roberts 1998).

From the summer of 1993, the ERM continued as a less rigid association of currencies. In July 1995, the central rates of the peseta and escudo were devalued.

3.5 THE SINGLE EUROPEAN ACT IN 1986 AND THE INTERNAL MARKET BY THE END OF 1992

Two key measures were the Single European Act in 1986 and the completion of the internal market by the end of 1992. Agreement to the Single European Act had far more wide-ranging implications for European integration than its rather simple title suggests. It was the rocket that, to borrow Delors's own phrase, would launch "a Europe without frontiers". For an analysis of the importance of the Single European Act see Gros and Thygesen (1992).

The decision to complete the internal market lent strength to the belief that closely integrated national economies (like those at the core of the EC) have more to gain from exchange rate stability than from occasional realignments. The EC countries could not reap the full gains from the internal market unless they banished the exchange rate risks and conversion costs arising from the use of separate national currencies (Fratianni and Von Hagen, 1992).

Among the first steps taken to complete the internal market was the lifting of all capital controls by July 1990. Capital controls did not prevent speculative crises in the early 1980s, although they probably limited the volume of capital flows associated with them. It has been argued, moreover, that the open-ended credit facilities of the EMCF were more important than capital controls in curbing speculative pressures (see Collignon et al. 1994, and Costin 1996).

3.6 REMOVAL OF CAPITAL CONTROLS

Against the development of internationalisation and integration of financial markets in the 1970s and 1980s, Europe's national segmentation increasingly became an obstacle to the efficient allocation of capital. In particular, the smaller countries whose markets were less liquid or the countries where economic and monetary policies did not aim at price stability, were unattractive to international investors. The deregulation of financial services and the liberalisation of capital flows was therefore a necessary response to an anachronistic situation (Padoa-Schioppa and Saccomanni, 1992).

Progress in lifting capital controls was gradual, although the aim was achieved before the deadline of July 1990, in spite of some temporary derogations for Spain and

Portugal (1992). The removal of capital controls by July 1990 was argued to be a necessary condition of financial market integration in Europe (Kenen, 1995).

The Single Market programme was based on the affirmation of the principles of basic freedoms: freedom of establishment and free movement of goods, capital and services (see Collignon *et al.*, 1994).The freedom of establishment, under the Second Banking Directive of 1989, gave banks or insurance companies of any EC member country the right to establish themselves freely in any other country subject to the receiving country's legislation. This right results from the freedom of movement of legal entities.

Free movement of capital was already envisaged by the Treaty of Rome, and reinforced by EC Directives in 1987 and June 1988, which established that all capital controls were to be abolished by 1 July 1990. These directives first removed restrictions on commercial credit, which were linked to the exchange of products, of direct investments and of personal capital. With the second phase was the creation of a Single European Market for financial assets and related portfolio investment (bonds, shares, etc). In a final step, other capital movements, in particular money market instruments, short-term capital, etc, were liberalised.

Free supply of financial services. The Second Banking Directive of 1989 opened the Single Market for banking and credit institutions, with a "single passport" authorising banks to open branches in partner countries from 1 January 1993. These banking activities were then subject to home country control and a minimal harmonisation of prudential surveillance rules (see Faugere, 1992).

3.7 THE MAASTRICHT TREATY, 1992

3.7.1 The origins of the Maastricht Treaty

The Delors Report was discussed at the Madrid summit of June 1989, and its proposals for a European single currency became the basis of the Maastricht Treaty. The Maastricht Treaty was signed in February 1992. The main body of the treaty laid down the steps by which economic and monetary union would be achieved. It was assumed that the stability of the ERM and the convergence of inflation rates and interest rates amongst EMS members would continue.

It fixed currency composition until the final stage of EMU, when the ECU as a basket gave way to the Euro. Gros and Thygesen (1992), Italianer (1993), Bini-Smaghi et al. (1994) provide detailed histories. The ratification of the new treaty took much longer than expected, because of vigorous opposition in some member countries, including Denmark, France, Germany, and the United Kingdom, but the treaty still took effect in November 1993.

3.7.2 The economic policy areas of the E.U.

Article 3 in the Treaty on European Union gives an overview of the various policy areas, some of which have been relatively insignificant, but the following are of major importance (see Hansen and Nielsen, 1997):

- The Common Agricultural Policy (CAP)
- Policies concerning the establishment of the Common Market
- The Competition Rules, which also regulate subsidies

- The Common Commercial Policy, and
- The Regional Policy.

The Common Agricultural Policy has traditionally been regarded as the most important E.U. policy area, at least from an economic point of view (Buckwell et al., 1982, Tyers and Anderson, 1986), and it absorbs over half the E.U. budget. Until 1992, the central element of CAP was the price guarantee policy, designed to benefit both producers and consumers. The prices are maintained by import levies, export subsidies and official E.U. support purchases. In 1992 there was a comprehensive reform of the CAP moving the burden of agricultural subsidy from E.U. consumers to E.U. taxpayers. It made the costs transparent, but it didn't reduce the pressure on the E.U.'s budget (see Hansen and Nielsen, 1997).

From the mid-1980s, the establishment of a common market became a central matter, reducing tariffs and quotas on trade, and also other obstacles to the movement of commodities as well as legal barriers to the free movement of labour and capital. The Single Market programme by 1992 required the removal of such obstacles to trade as discrimination in public purchasing and differences in product standards, and is clear evidence of changed policy from the 1980s to 1990s.

The Competition Rules limit the misuse of monopoly power and national subsidies in inter-country commerce. Competition policy (known as anti-trust policy) is in the E.U. in Articles 85 and 86 of the Treaty on Europe Union. Article 85, known as the Cartel Rule, forbids firms to fix prices, divide markets or limit production; but the prohibition applies only in so far as it affects trade between nations. Article 86 is known as the Monopoly Rule and forbids misuse of a firm's market dominance. The misuse referred

to the traditional monopoly behaviour, whereby production is restricted in order to keep prices high. The Monopoly Rule also applies only where it affects trade between countries.

There have, however, been few substantive Commission decisions on restrictive agreements and dominant firms (see Hoeller and Louppe, 1994). Mergers are the most extreme form of restrictive agreement, and horizontal mergers (those between firms producing the same product) can lead to one firm with market dominance and therefore within the purview of Articles 85 and 86.

Concern about the surge in EU-wide mergers led to adoption of the European Merger Control regulation in 1989 (Council Regulation 4046/89). This gives the Commission the power to prevent mergers where the firms involved have in total a global turnover of over 5 billion ECU or where at least two of the involved firms each have an E.U. turnover of over 250 million ECU (see Hansen and Nielsen, 1997).

The Common Commercial Policy means that there is a common external tariff and a common trade policy towards third-party countries. This ensures that a member country can neither obtain an unfair competitive advantage by importing raw materials or intermediate products more cheaply than other members, nor profit from cheaper imports, which are re-exported to other members.

The Article 110 of the Treaty on European Union has as its goal the elimination of restrictions and the reductions of customs duties on external trade, although in practice the E.U. tries to achieve this through multilateral agreements under the leadership of the World Trade Organisation (WTO) rather than unilaterally.

The Customs Union and Single Market discriminate against third-party countries, and therefore the EU's external trade policy is of great importance for the degree of competition in many E.U. markets (see Hansen and Nielsen, 1997).

The Regional Policy exists primarily to redistribute income from richer to poorer members and thereby to promote economic and social cohesion. This requires huge income transfers from the richest countries to the poorest countries via the EU's called Structural Funds. In the early 1990s progress was made to increase the help that was given to poorer regions of the Community. The structural adjustment funds were considerably expanded and proposals on how to make best use of the "Cohesion Fund" were put forward in a package of proposals commonly called Delors II. The 'Cohesion Fund' (founded on the basis of Article 130d of the Maastricht Treaty) is intended to help in the areas of the environment and trans-European transport infrastructures. Delors II (Commission, 1989) recommended that the funds should be concentrated in those regions with a per capita GDP that is less than 75 per cent of the average of the E.U., namely Ireland, Northern Ireland, Portugal, Greece, Southern Italy, most of Spain, Corsica and the French Overseas Departments. However, Germany and the U.K., the two largest net contributors to the budget of the Community, expressed concern over the cost of the structural funds and the "Cohesion Fund" (see McDonald and Dearden 1999).

3.7.3 The stages of Maastricht treaty

The Maastricht Treaty instigated a three-stage process for the achievement of European economic and monetary union:

Stage I: 1979-93 (the stabilisation stage). Stabilisation of exchange rates in the ERM. (subsequently disrupted by the crisis of 1992-93).

Stage II: 1 January 1994 to 31 December 1998 (the convergence stage). Economic convergence through the achievement of a common set of "convergence criteria". The establishment of an institutional framework to meet the economic, political and administrative requirements of EMU.

Stage III: 1 January 1999 onwards (the single-currency stage). Introduction of a single currency, initially as a set of fixed exchange rates but from 2002 in the form of a new single currency, subsequently named the Euro.

All E.U. members were potentially eligible to join EMU, but to qualify they had to satisfy a set of convergence criteria, defined in the Maastricht Treaty of February 1992 (see next section).

In May 1998, the intergovernmental conference was able to declare that 11 of the 12 applicant countries were eligible to move on to Stage Three of EMU on 1 January 1999. Only Greece was judged not to have met the necessary criteria. The U.K., Denmark and Sweden opted not to join the first wave. EMU's charter membership consists of Spain, Italy, Portugal, Austria, Belgium, Luxembourg, Germany, France, Finland, Ireland and the Netherlands.

3.7.4 The convergence criteria

In order for EMU to stand a chance of working, it is essential for the economies and economic policies of participants to achieve a degree of convergence prior to entry. The convergence criteria specified in the Maastricht Treaty were:

- countries should have a budget deficit of 3 per cent or less of GDP
- the ratio of gross national debt to GDP should not exceed 60 per cent of GDP
- inflation should not exceed by more than 1.5 per cent of the average of the three best performers
- member countries must maintain their exchange rates within the permitted bands of the exchange rate mechanism for at least two years
- long-term interest rates must not deviate more than 2 per cent from the interest rates of the three lowest inflation countries.

3.7.5 Introduction of the Euro

After much conjecture and controversy, the name of the new European currency was announced in 1995 as the Euro. A detailed three-phase agenda for the introduction of the Euro was set out:

Phase A: May 1998 - Naming of the countries to participate in EMU at the start.

Phase B: 1 January 1999 - Launch of EMU through the irrevocable locking of the conversion rates of the participating currencies with the Euro and the assumption of responsibility for the single monetary and exchange rate policy by the European System of Central Banks.

Phase C: January 2002 - National currencies will be abolished and the Euro will be the sole legal tender in the E.U. area.

3.8 THE EUROPEAN UNION INTEGRATION PROCESS – 1980S VERSUS 1990S

After reviewing the main events of the European integration process, it is worth stressing the major differences between the Europe of the 1980s, in which the Werner Committee worked, and the Europe of the 1990s, in which the Delors Committee worked. These help to explain the differences cross-countries among economic and monetary European indicators between these two decades and, perhaps, the difference in their subsequent impact on the interdependence of European stock markets.

In the 1980s although the Werner Report had recommended a narrowing of exchange rate fluctuations, governments were not able to keep exchange rates fixed over long periods of time. There was large number of exchange rate realignments, reflecting large differences in the levels and volatility of inflation. Most EC countries were still using capital controls and there were large country differences in economic and monetary indicators such as interest rates.

Europe had less settled views about the appropriate division of powers between the Community and its members. France, for example, still strongly opposed any transfer of national sovereignty to EC institutions. Hence, the Werner Report provoked opposition when it called for strict limits on national autonomy in monetary and fiscal matters. Giovannini (1990b), Gros and Thygesen (1992), and Jacquet (1993) make some of these same points.

At the beginning of the 1990s most of the capital controls were gone, and there was the deadline of 1992 for removing the rest. Furthermore, the Commission published new legislation, including the Second Banking Directive (1989), to unify European financial markets.

By the end of the 1980s, the establishment of a common market reduced tariffs and quotas on trade, and also other obstacles to the movement of commodities as well as legal barriers to the free movement of labour and capital. The Common Commercial Policy in the 1990s provided for a common external tariff and a common trade policy towards third-party countries, ensuring that a member country cannot obtain unfair competitive advantages by importing raw materials or intermediate products more cheaply than other members.

In the 1990s the Competition Rules policy limited the monopoly power and national subsidies in inter-country commerce, and the Regional Policy redistributed income from rich members to the poor members and thereby promoted economic and social cohesion through the EU's called Structural Funds (see Hansen and Nielsen, 1997).

The policy regime therefore changed substantially between the 1980s and 1990s. By the early 1990s the differences between nominal interest rates were already small between European Union countries; and in the middle of the decade a common monetary policy and fixed exchange rates created a different financial environment within the European Union. The Delors Report listed four necessary conditions for a monetary union: the total convertibility of currencies, the complete liberalisation of capital flows, full integration of financial markets, and an irrevocable locking of exchange rates. By the middle of the 1990s, the first and second requirements had already been met in Europe.

3.9 THE EVOLUTION THROUGH DIFFERENT TYPES OF ECONOMIC INTEGRATION

Hansen and Nielsen (1997)[4] proposed a classification for the different types of integration depending on the 'width' and 'depth' of the resulting unification (Table 3.1).

Table 3-1
Main types of economic integration

Types of Economic integration	No internal visible trade restrictions	Common external trade restrictions	No internal invisible trade restrictions	Free mobility of factors of production and financial assets	Common currency	Common economic policy
Free trade area	x					
Customs Union	x	x				
Single market for commodities	x	x	x			
Common market	x	x	x	x		
Monetary union	x	x	x	x	x	
Economic union	x	x	x	x	x	x

Source: Hansen, J. and Nielsen, J., 1997

A free trade area consists of a group of countries among which there are no 'visible trade restrictions', such as the barriers of tariffs (customs duties) or quotas (quantitative restrictions) on trade. This means that trade takes place freely within the group of countries.

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[4] For a similar classification see also McDonald and Deaden (1999).

In a customs union there is free trade between member countries and also a common external tariff, that is, all member countries impose the same tariffs on countries outside the customs union.

In a single market for commodities (single market) all visible and invisible barriers on trade within the market have been abolished. This includes product standards, which differ from country to country, and the tendency of public authorities to prefer to buy from domestic suppliers.

A common market presupposes a single market for commodities, and in addition has free mobility of factors of production and of financial assets, without approval from any authority.

A monetary union reflects a higher degree of integration, composed by a common market and irrevocably fixed exchange rates or a common currency for all member countries.

An economic union is a monetary union with a strong co-ordination of the economic policy. Whereas monetary union implies a unified monetary policy, economic union mainly concerns fiscal policy. An economic union has uniform or very similar tax rates and procedures and high degree uniformity in transfer payments.

According to the definitions of Table 3-1, the E.U. in its present form is a fully developed customs union and a single market for commodities and a common market. Moreover, monetary co-operation is steadily increasing, and plans exist for a monetary union. Since some sector policies are very much the outcome of joint decisions, and

since macroeconomic policy will be increasingly co-ordinated with the creation of monetary union, the E.U. also contains elements of an economic union.

3.10 CONCLUSIONS

The European Economic and Monetary Union (EMU) promises to create a single economic entity that rivals the size and economic might of the United States. The creation of the European Single Market was based on the affirmation of the principles of basic freedoms: freedom of establishment and free movement of goods, capital and services.

The Maastricht Treaty laid out the timetable for the creation of a single currency in conjunction with a tightly coordinated program of fiscal discipline among participating countries called the Stability and Growth Pact.

According to Hansen and Nielsen (1997) classification of the E.U. has more or less continually moved towards closer economic integration from a customs union completed in 1968 to the common market completed in 1992. The process of integration has, however, at times almost been interrupted. Between 1973, when the first oil crisis occurred, and the mid-1980s there was almost no progress. The first plan for an economic and monetary union, the Werner Plan of 1970, was not largely implemented; and only with the Delors Plan of 1989, incorporated in the Treaty on European Union, was progress towards an economic and monetary union made.

The aim of the EMU is to create an area of price stability and establish a common economic policy for the region as a whole. This will provide an environment conducive

to greater market efficiency and productivity, making Europe more globally competitive.

This long programme of standardisation and alignment of economic and financial environments across the E.U. should in principle lower the segmentation of European capital markets. This in turn should lead to lower divergence in the level and volatility of financial returns between member countries. Common European risk should become a larger part of national risk but from an investment viewpoint the implications for absolute risk levels are less clear as diversification opportunities within Europe and between Europe and the rest of the world are also affected.

A largely uncharted issue is that the convergence process, if it increases the correlation of returns, may also increase investor sensitivity to smaller expected differences between countries, leading to larger cross border portfolio flows that create, albeit short term, self-sustaining risk and return differences. In the empirical chapters that follow the implications of E.U. convergence measures will be tracked in terms of contemporaneous developments in financial markets and investment returns.

CHAPTER 4 CORRELATION OF EUROPEAN STOCK MARKETS

4.1 PURPOSE OF THE CHAPTER

The purpose of this chapter is to track changes in the correlation of returns of European stock markets. Following the methodology used by Johnson and Soenen (1993), Erb et al. (1994), Solnik et al. (1996), Markellos and Costas (1997), and Freimann (1998), this chapter compares the market weighted average correlation for individual E.U. countries with the E.U. market overall for two periods, 1982-1989 and 1990-1996.

Differences in observed correlations between these two periods give some idea of the development of correlation as European integration proceeds. An associated study gives benchmark figures involving correlations of returns with E.U. countries, Japan and the U.S., and also between Japan and the U.S..

To clarify that correlations have increased two sensitive issues were addressed: the concern that correlation was due to trend rather than to volatility, and that the 1987 crash created an artificial jump in correlation in the first sub period.

Previous research studies (Le 1991, Lee and Kim 1993, Solnik et al. 1996, Meric and Meric, 1998) show that correlation trends are heavily influenced by the common experience of the 1987 crash. To isolate this period, the analysis was performed both including and excluding the year 1987.

The study accordingly considered correlations in three groups:

- Correlations between stock markets within the European Union;
- Correlations between E.U. stock markets and two major markets outside EU: United States and Japan; and
- Correlations between the American and Japanese stock markets.

The stock markets studied represent around 90 percent of the world equity markets and include 10 of the 15 leading markets by valuation (Table 4.1).

Table 4-1

Ranking of developed stock markets based on capitalisation

(Source: Morgan Stanley Capital International, 1997)

Ranking	Market	Capitalisation in Billions of USD	% of the world Capitalisation
1	* USA	7836	45.1%
2	* Japan	3071	17.7%
3	* UK	1740	10.0%
4	* Germany	648	3.7%
5	* France	601	3.5%
6	Canada	464	2.7%
7	Switzerland	407	2.3%
8	* Holland	393	2.3%
9	Hong Kong	393	2.3%
10	Australia	306	1.8%
11	* Italy	253	1.5%
12	* Sweden	240	1.4%
13	* Spain	193	1.1%
14	Singapore	146	0.8%
15	* Belgium	115	0.7%
	World	17391	100.0%
* Stock markets included in this research			

The markets considered comprise the major capital markets. Countries outside these three main groupings are likely to access capital markets within the ten we have considered for their large or illiquid transactions.

The European Union members, while collectively accounting for a share of world activity comparable with Japan or the U.S. differ in that the U.S. and Japan are fully integrated economic entities, whilst the European Union continues to have significant

differences in legal, financial and administrative regimes between countries despite progress toward harmonisation.

With European integration the progressive economic, monetary and financial integration in Europe should be marked by a progressive increase in correlation coefficients within the European Union in terms of both financial and economic indicators (Johnson and Soenen (1993), Markellos and Costas (1997), and Freimann (1998). With alignment of economic and currency effects, the returns of individual European stock markets should be increasingly explained by European systematic risk resulting in increasing cross-border investment movements within Europe. Correlations between markets would tend toward 1 and in any event be higher and have increased more than correlations between European member returns and Japan or U.S. returns.

However integration may reflect a common effect of globalisation, rather than European integration. This would be evident in an increase of correlation coefficients between the U.S. and/or Japan, both with each other and with members of the European Union. Any such trend can be compared with that expressed in intra-EU links in order to see whether there is "Europeanisation" alongside globalisation or whether much of the European experience would have happened anyway as a result of globalisation, and its companion forces of growing cross-border investments and transactions.

In this chapter we therefore try to answer the following three questions:

1. Are correlation coefficients between European stock markets increasing over time?
2. Is a similar pattern evident between E.U., U.S. and Japanese stock markets and between the Japanese and U.S. stock markets?
3. Are the events in 1987 so important in the volatility history that they are effectively collinear and need to be separately handled?

4.2 PREVIOUS STUDIES

4.2.1 Cross-country correlation of stock market returns

In this section we explore previous work dealing with the behaviour of cross-country correlations of stock market returns. A number of studies have considered the correlations between international stock markets. Some of the studies consider events before the 1970s, a very different environment from the current situation. Moreover, research on returns correlation in the 1960s focused on a few major markets, reflecting the availability of data at that time (see, e.g., Levy and Sarnat 1970, Agmon 1972, Solnik 1974, Lessard 1976, Joy et al.1976, Watson 1978, and Hilliard 1979). All of these studies found that correlations across countries were statistically insignificant or when significant they were weak. This happened between European markets and also between them and the U.S. and Japan. For example for seven European countries Freimann found that the average of correlations between European markets during the 1970s were around 0.20. His findings display that until the 1980s there was not a European trend when correlations between European countries are compared with U.S. or Japan.

At that time there were major barriers, such as exchange controls, weaker technology, limited international information and communication, and trade and investment limitations, with investment and ownership restrictions blocking the increase of international investments, particularly in some small countries.

Subsequently the European Union provided a new and important element in the international economic and financial environment, since it provides for total

liberalisation of capital movements, freedom of establishment for financial institutions, a common central banking system, and the creation of a single currency.

Studies subsequent to this period though generally indicate that correlation coefficients between stock markets around the world are substantial and significant. Only a few of these studies though were specifically concerned with the European Union, and in particular the impacts of a specific change in the international environment, namely the integration policies amongst European Union countries.

A study by Johnson and Soenen (1993) examined the correlations between eight European equity markets (Belgium, Denmark, France, Germany, Italy, the Netherlands, Britain, and Spain) and two external markets, the U.S. and Japan. The choice of European stock markets was determined by the data available. They used monthly total returns in local currency obtained from the performance-rating agency BARRA International Ltd. They split the sample period 1973-1990 into three six-year periods and concluded that European security markets were more correlated with each other in the later period than in the earlier periods. However they concluded, "EC equity markets are partly integrated and partly segmented" (p. 91) because the co-variation between equity markets is still considerably below one.

The results also indicate that the correlations coefficients seem to vary quite substantially over time. Overall it appears the eight European stock markets have become more correlated among themselves since 1985. The overall correlations for European countries in the 1985-90 period (0.5) are much higher than that in the previous six-year period (0.34). The results also indicate that the returns on E.U. stock markets are more highly correlated with the U.S. than with Japan (for example, they

found that the average correlation between E.U. countries and the U.S. was 0.46 and only 0.32 with Japan in the 1973-1990 period). The correlations between E.U. market returns and the U.S. increased from 0.43 in the first six-year period to 0.49 in the last six-year period, whereas the correlations between E.U. markets and Japan increased from 0.30 to 0.33 in the same periods. We should note that the last period (1985-90) included the year 1987.

These conclusions are to some extent limited by being based only on eight European stock markets and so do not allow a complete picture of all correlations between European Union stock markets, in particular the small capital markets within Europe. Secondly the data used on the study ends in 1990 whereas a number of major programmes such as the complete internal market or the total freedom for financial services in the European Union and the single currency programme took place after that date. Moreover the results of the last period are perhaps strongly influenced by the year 1987 when the international crash happened.

Another interesting study of cross-border correlation conducted by Erb et al. (1994) examined the correlations between G-7 economies, which include Canada and six of the economies in the current study (France, Germany, Italy, Japan, United Kingdom and U.S.). They used monthly total returns (i.e. including dividends) data in U.S. dollars based on the Morgan Stanley Capital International (MSCI) indices from January 1970 through to December 1993.

The results show that over the long term, the correlations appear to have been gradually increasing since 1982. For instance, for France the average of correlations with the other countries range from 30-50 percent in 1982 but increased to 30-80 percent by 1993.

They consider that many of the increased correlations are probably the result of closer intra-European ties. For example, they found that correlation between French and German markets increased from 50 percent in 1982 to almost 80 percent in 1993.

For correlations between Japanese returns and those in other G-7 markets they found that markets had no obvious trends. "In 1982, the correlations ranged from 5 percent with the U.S. to 40 percent with Germany. In 1993 these correlations were 25 percent and 55 percent, respectively" (p. 37). Compared with the other G-7 countries, their results indicate that Japan has the lowest correlations with the other markets and an insignificant trend.

Interestingly they found that equity cross-correlations have a cyclical component related to the business cycles in the respective countries. Cross correlations are highest when pairs of economies were contracting but converged less strongly when both economies were expanding. Correlations were noticeably lower when the respective business cycles are out of phase. For example, they found that the United States-United Kingdom correlation is 46% in shared expansions and 55% in shared recessions. In periods when growth in the two countries is out of phase, the correlation is 38%. Similar results occurred for other G-7 countries.

A study by Solnik et al. (1996) found interesting links between return correlations and market volatility. The study focused on the correlation between returns in six markets comprising the U.S., Germany, France, the United Kingdom, Switzerland, and Japan. They considered both local-currency returns and dollar returns (the results were very similar, then they reported only in local currency), comparing all these markets with the U.S. market. They also studied the relation between German and French market returns

using local currencies. Monthly returns (excluding dividends) data were used from 1958 to 1995, with data smoothed using a 36-month moving average.

Their results indicate that international correlations vary over time and across countries, and the patterns of variation differ between different pairs of countries. Using a simple least-squares line over all the periods they showed that the trends in correlations were strongly positive for U.S./U.K. and U.S./Japan, slightly positive for U.S./Germany and U.S./Switzerland, and flat for U.S./France.

However we should look at these results with caution. As in any time-series study, the starting date can be of importance. These least square lines were constructed using data from 1958 and all the other previous studies show that in the 1950s and 1960s the correlation coefficients between stock markets were very low and the majority statistically insignificant. Even a small increase can thus easily give strong positive trends. The authors indeed recognise that much of the correlation increase occurred at the start of the series. "Although the correlations of individual foreign stock markets with the U.S. stock market seem to have increased slightly over the past 37 years, this is not the case for the past 10 years" (p. 33).

They also found that international correlations increase in periods of high volatility of returns (measured by the variance of rate of returns). The 1987 "crash" led to a sharp increase in correlations in 1987, providing the highest correlations of the total time period.

A study by Markellos and Costas (1997) also examined the correlation between European stock markets and the equity markets of New York and Tokyo. Monthly observations on seven small national basket indices were used: Austria, Belgium,

Greece, Holland, Ireland, Italy and Spain. Data on price return indices (excluding dividends) were collected from the Main Economic Indicators, the Organisation for Economic Cooperation and Development, over the period January 1974-March 1994. The returns were calculated in local currency units.

The data were divided into separate nonoverlapping subsamples with the first subsample covering the period January 1974-September 1987 while the second subsample was November 1987-March 1994. The sample is split by the October 1987 international stock market crash. The second period coincided with one part of the increase in European economic and financial integration with many of the remaining trading restrictions for international investors in the markets (for example, Spain in 1992) were abandoned.

The study showed that at least since the October 1987 crash, the European markets studied had become increasingly correlated. The average of the nine correlation coefficients increased from 0.40 in the first period to 0.55 in the second. The average correlation of the European countries with Japan remained constant at 0.29, while the average of European correlations with the U.S. market rose from 0.30 to 0.39.

In another study Beckers (1999) examined whether there has been a significant increase in the average correlations between European capital market over ten years and tries to answer the question: are European equity markets becoming more homogeneous?

All equity data was from Financial Times International and represents daily price indexes from January 1988 until December 1997, for Austria, Ireland, Belgium, Italy, Finland, Netherlands, France, Spain, Germany, Denmark, Sweden, Norway, U.K. and

Switzerland. They calculated returns in local currency based on daily stock prices, therefore excluding dividends.

To analyse the data they fitted a trend line through the average of the correlations between these countries at three-month (based on daily price data) intervals over the ten years. In other words, for a three-month period they calculated the correlations between the different markets and then the average correlation across these markets.

They found a statistically significant upward trend in the correlations, with the average correlation increasing by 0.024 per year. The results seem to indicate that the European economic integration seems to affect stock markets within the European Economic Community.

They also split the analysis by estimating correlations for quarters when, on average, the market was up separately from those when the market was down. The results confirm the Erb et al. (1994) findings that correlations are typically higher in down markets than in up markets.

Freimann (1998), using monthly data from January 1975 through December 1996, also investigated the behaviour of cross-country correlations. The work was performed only for seven European stock markets (France, Italy, Spain, United Kingdom, Germany, Holland and Sweden), based on market returns excluding dividends. In this case correlations returns were analysed in two ways: first dividing the entire period into three periods (1975-79, 1980-89, 1990-96), and after using averages of five-year rolling correlations. Outside Europe Freimann only found return correlations for Germany with the U.S. and Japan.

For those seven European countries the Freimann results show that the average of correlations increased a lot since the beginnings of the 1980s: "The correlations between European markets during the 1970s was, on average, slightly more than 20 percent, but this number tripled in the 1990s" (p. 36).

The highest and lowest correlations reveal that the Dutch stock market is the most correlated with those seven markets, whereas Italy, Spain and Sweden are the least correlated and so the most segmented.

Freimann also found that throughout the 1970s and into the 1980s, market returns in Italy, Spain and Sweden had low correlations with other European countries in their sample, and were thus offered diversification, which made them ideal supplements to a core European portfolio. Such diversification opportunities seem to be disappearing. In the 1990s, even the lowest correlation figures in his sample in Europe are close to 50 percent.

The Freimann results also show that the biggest increases in correlations between those seven European stock markets occurred in periods of large negative returns, such as the crash of 1987 and the Kuwait crisis of 1991. Freimann didn't analyse the behaviour of all European Union stock markets against the U.S. and Japan (only Germany). They find that after the effects of the 1987 crash died down, measured correlation of market returns between Germany, U.S. and Japan receded to levels experienced before the crash. However, the changes in the European stock market structure were permanent "since the beginning of the 1990s, the average correlation between European markets has remained well above 50 percent" (p. 39).

This seems to indicate that the increase in correlations between the European stock markets is not simply caused by the co-movement in stock market returns observed globally after the crash of 1987.

The consistent outcome for all these studies is that European stock markets have over time begun to behave more and more similarly, although precise levels are dependent on the sample period used in each study.

4.2.2 The impact of the 1987 stock market crash on the correlation coefficients

The October 1987 crash caused a shock to stock investors around the world. One of the features of the October 1987 crash was its simultaneous occurrence in all major markets with very similar severity. During the crash, most national stock markets moved in the same direction and declined more than 20 percent without any obvious innovation of fundamental information such as interest rates or growth rates.

Le (1991) investigated the effects of the 1987 crash on correlation coefficients. He examined the correlations of returns between the U.S. and 16 other countries (including 8 E.U. countries) from the period of October 1984 to December 1989, using monthly returns excluding dividends. The data was obtained from The Economist and The Wall Street Journal and they were converted into U.S. dollars. The sample period was divided into two periods: October 1984 to September 1987 and November 1987 to December 1989. October 1987 was excluded. The results show that the significant downturn on all markets in October 1987 caused a dramatic increase in correlation coefficients. They found that Japan offered the poorest returns after the crash and it was also the country with the lowest correlations with the others.

In another study, Lee and Kim (1993) analysed the effects of the October 1987 crash using weekly data on returns (excluding dividends) for 12 national stock markets indices (only five of them E.U. markets) over the period from August 1984 to December to 1990, both in local currency and U.S. dollars. The data was from The Financial Times for North American and European countries and The Asian Wall Street Journal for the Pacific Basin Asian countries. The overall sample period was divided into two equal 38-month sub-periods, namely, the pre-crash period (August 1984-September 1987) and the post-crash period (November 1987-December 1990). October 1987 was excluded. The results show that for the pre-crash period, the equally weighted average correlation coefficients for returns across the countries was 0.14 and in the post-crash period was 0.26. Therefore, one may conclude that the interrelationship among price movements across different national stock markets had become stronger after the crash.

Meric and Meric (1998) analysed the co-movements of ten stock markets before and after the 1987 stock market crash. They used monthly stock market index total returns and data were obtained from Morgan Stanley Capital International (MSCI) publications. The study covers the national stock markets of two North American (Canada and U.S.), four European (France, Germany, Switzerland, and U.K.), and four Far East (Australia, Hong Kong, Japan, and Singapore) countries. MSCI index total returns are adjusted for exchange rate changes.

Data was from February 1975 until February 1994 and was divided into three subperiods: November 1975-May 1981 (Period I), June 1981-September 1987 (Period II), November 1987-February 1994 (Period III). The month of October 1987 was

excluded from the sample, since the authors considered that all national stock markets experienced unusually large swings during the crash month.

Box's M statistic is used to test the hypothesis that the stock market index return correlation matrices of different periods (Periods I and II, and Periods II and III) were significantly different.

The results show that the correlation coefficients are generally substantially higher in the post-crash period than in the pre-crash period. The average correlation coefficient for all ten stock markets increased from 0.316 in the pre-crash period to 0.440 in the post-crash period, an increase of 39.2%. The test statistics show that the correlation matrix for the period after the crash is significantly different from the correlation matrix for the period immediately before the crash at the conventional 5% level.

Although they changed significantly after the crash, the co-movements of the world's ten largest stock markets showed stability before the crash. The test statistics show that the correlation matrices of Periods I and II are not significantly different.

These findings showing that correlation between these stock markets increased indicate that the benefits of international portfolio diversification with these stock markets decreased after the 1987 crash compared with the period before the crash.

4.3 DATA

The majority of previous work on cross-country correlations and the insight they provide for European Union integration (Johnson and Soenen 1993, Erb et al. 1994, Solnik et al. 1996, Freimann 1998, Beckers 1999) were generally based on major

economies for which data was readily available. A study that includes all European stock markets and examines the segmentation between small and large markets within the E.U. provides an additional dimension to understand the behaviour of E.U. equity markets under "Europeanisation". Apart from updating previous work, the extended study attempted here can determine if changes occurring in E.U. cross-country correlations are similar for small and large markets both within the Union and related to external economies.

This chapter also considers E.U. integration alongside the general trend of globalisation by comparing the equity market correlations of various E.U. markets with each other and with the two major economies: U.S. and Japan. The results from this analysis can then be used to explore the relationship between economic and monetary European indicators and the level of cross-country correlations between stock markets.

In order to replicate and update previous studies, the main data, in the form of Morgan Stanley's Capital International Indices (11 European Stock Markets), IFC Emerging Market Indices for Portugal and Greece and FT / S&P WORLD indices in the case of Ireland were included to the latest date available at the start of research in 1996. These stock market indices are total return indices, which mean that they include both changes in stock prices, and dividends.

Bearing in mind the possible influence of 1987 mentioned in literature (Le 1991, Lee and Kim 1993, Solnik et al. 1996, Meric and Meric 1998) and the possible need to exclude some years of data, the sample period was divided into two sub-samples: 1982-89 and 1990-96. The objective was to analyse the differences between the two periods

and also to investigate to what extent shared experience in 1987 accounted for inter-period difference.

4.4 DEFINITIONS AND CONCEPTS USED IN THE CHAPTER

4.4.1 Rate of return

To calculate the correlation coefficients the monthly rate of total returns of the Morgan Stanley Capital Indices in local currency was used as the primary source[5]. The monthly rate of return was defined as:

$$R_t^i = \ln \frac{I_{t+1}^i}{I_t^i} \qquad \text{equation 4.1}$$

Where:

I_t^i = is the index of stock market i at month t

R_t^i = is the monthly rate of return of market i at month t

Logarithm first differences define the monthly rate of return because Morgan Stanley Capital International Indices are continuously compounding indices.

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[5] Johnson and Soenen (1993), Erb et al. (1994), Solnik et al. (1996), Freimann (1998), Beckers (1999) used local currencies.

4.4.2 Weighted-average correlations

To implement European correlation analysis, a weighted-average return index was constructed for the E.U. using the market capitalisation of each stock market during each period as the weighting factor for combining correlation between a given country and the 13 remaining members of the EU. The relevant market capitalisations used to compute the European index and large/small sub indices are given in table 4.2.

Table 4-2

Proportional market capitalisation per period for E.U. stock markets

Average of each period

Markets	1982-89	1990-96	1982-96
LARGE			
UK	42.3%	40.4%	41.4%
Germany	18.4%	15.7%	17.0%
France	10.3%	14.1%	12.2%
Sub-total	*71.0%*	*70.2%*	*70.6%*
SMALL			
Holland	7.6%	8.1%	7.8%
Italy	7.1%	5.4%	6.3%
Sweden	4.3%	4.0%	4.2%
Spain	3.4%	4.4%	3.9%
Belgium	2.8%	2.6%	2.7%
Denmark	1.4%	1.8%	1.6%
Finland	1.0%	1.0%	1.0%
Ireland	0.5%	0.6%	0.6%
Austria	0.5%	1.0%	0.7%
Portugal	0.3%	0.4%	0.4%
Greece	0.2%	0.5%	0.3%
Sub-total	*29.0%*	*29.8%*	*29.4%*
Total	*100.0%*	*100.0%*	*100.0%*

The table 4.2 shows that countries such as France, Spain, Portugal and Greece increased their relative share of total European capitalisation. This has several explanations.

Generally during the 1980s, prior to the European Union reforms, many large firms in these countries were nationalised and therefore not listed on capital markets. The privatisation of some of these companies and the consequent inclusion on the stock exchange increased the sizes of these markets.

Also there was reliance on bank financing, with banks themselves typically state controlled. Long-term Bank finance reduces the need for outside equity capital. The introduction of European regulation limiting banking risks and the liberalisation of movements of capital contributed to a more market-oriented financial strategy in European companies, and a greater unwillingness of banks to take equity risk.

It was also common in the 1980s for European banks to own shares in their clients, however in the 1990s they moved further towards the market system. By contrast, for example, U.S. commercial banks were prohibited by law (Glass-Stegall Act) from participating in their clients' equity (Solnik, 1998)[6]. This regime forces companies, especially small and medium sized ones, to raise capital in the marketplace, thereby increasing the stock exchange capitalisation, whereas in a bank demanded system, the banks and insurance companies simply take additional shares.

Demirguc-Kunt and Levine (1996) found that the size of the stock market is highly correlated with the development of non-bank financial corporations, insurance companies and private pension funds.

The market capitalisation data were sourced from Morgan Stanley Capital International (MSCI) except for Portugal and Greece where they were not available from MSCI over the whole period. In these cases IFC-Emerging Markets data were used. For the purpose of segmenting by size, large European markets might have been defined as markets including 50% of European capitalisation. However this would have excluded France and left the large group consisting of a Euro member and the U.K., which has stayed

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[6] Grass-Stegall Act was not repealed until February 1999.

outside the Euro. The decision therefore was to consider all markets accounting for more than 10% of the total European market capitalisation as large.

The weighted-average correlation for each country was constructed by weighting respective pairwise correlation coefficients by the proportional weights show in table 4.2.

$$corra_w^i = \sum_{i=1}^{14}\sum_{k=1}^{13} corr(R_t^i; R_t^k) * \frac{y^k}{(1-y^i)} \qquad \text{Equation 4.2}$$

Where:

Corr = correlation

a_w = weighted-average

i and j = stock market *i*

R_t = returns in local currency at month *t*

$Corr(a_w)^i$ - weighted-average correlation of returns for market *i*

$corr\left(R_t^i; R_t^k\right)$ = correlation coefficient between returns of markets *i* and *k*

y^k = the percentage market size for country *k*

y^i = the percentage market size for the excluded country *i*

In other words correlation coefficients between each country *i*, and other countries *k*, were computed then weighted to provide the weighted correlation of country *i* based on the correlation with other members of the E.U..

The weighted-average approach was used to reduce the data and help with interpretation of results. Each European correlation-matrix has 91 correlation values (14 * 13 / 2) and the weighting procedure helps establish an overall position for the matrix. It would otherwise be difficult to understand the connections between all of them in two different periods.

4.5 CORRELATIONS BETWEEN EUROPEAN UNION STOCK MARKETS

The aim of this section is to report the correlations between pairs of E.U. stock markets from the 1980s to 1990s. Table 4.3 shows the changes in correlation values from one period to another. Based on weighted-average, in almost all countries the average changes in respect of the E.U. were large and positive.

As the results indicate (Table 4.3) the correlations generally increased strongly from the first to the second period, i.e. correlations have increased from the 1980s to 1990s, on average from 0.43 in the period 1982-89 to 0.58 in the 1990s. This corroborates the Freimann (1998) results that "From mid-1980s until the early 1990s, correlations increased to more than 60 percent" (p. 37).

Table 4-3

Weighted-average correlation of returns in E.U. markets

Country	1982-89	1990-96	% Changes	1982-96
LARGE				
UK	0.49	0.60	22%	0.53
Germany	0.48	0.61	27%	0.53
France	0.51	0.67	31%	0.57
Sub-mean	*0.49*	*0.63*	*27%*	*0.55*
SMALL				
Holland	0.60	0.71	17%	0.63
Italy	0.39	0.46	17%	0.43
Sweden	0.43	0.53	22%	0.47
Spain	0.38	0.62	61%	0.48
Belgium	0.54	0.65	22%	0.58
Denmark	0.28	0.55	92%	0.39
Finland	0.13	0.51	287%	0.44
Ireland	0.65	0.61	-6%	0.63
Austria	0.29	0.49	68%	0.38
Portugal	0.25	0.46	83%	0.29
Greece	0.07	0.21	184%	0.13
Sub-mean	*0.37*	*0.53*	44%	*0.44*
Mean	*0.43*	*0.58*	34%	*0.49*
Stdev	17%	12%		

A t-test comparing the means of correlations by market between the 1980s and 1990s confirm that the changes of mean correlations were statistically significant (Table 4.4).

Table 4-4

T-test results of comparisons of means by market between both periods

Markets	t value	df	Sig. (2-tailed)
Austria	-7.11	12	0.000
Belgium	-5.36	12	0.000
Denmark	-10.47	12	0.000
France	-5.53	12	0.000
Germany	-6.36	12	0.000
Greece	-4.57	12	0.001
Italy	-4.13	12	0.001
Holland	-6.25	12	0.000
Spain	-7.29	12	0.000
Sweden	-3.82	12	0.002
UK	-2.60	12	0.023
Ireland	-2.02	12	0.067
Portugal	-5.59	12	0.000
Finland	-11.54	12	0.000
95% Confidence Interval of the Difference			

The only apparent exception seems to be Ireland. The explanation in this case is that while the correlation between Ireland and the majority of other European markets increased from the first to the second period (Table 4.5), the correlation of Ireland with the U.K. fell.

Table 4-5

Correlations between Ireland market and E.U. markets

Countries	1982-89	1990-96	%Changes
UK	0.82	0.64	-22%
Germany	0.49	0.60	22%
France	0.55	0.59	8%
Holland	0.66	0.70	6%
Italy	0.38	0.47	21%
Sweden	0.65	0.52	-20%
Spain	0.63	0.62	-3%
Belgium	0.63	0.68	8%
Denmark	0.40	0.63	58%
Finland	0.28	0.48	74%
Austria	0.28	0.46	65%
Portugal	0.40	0.53	32%
Greece	0.14	0.29	101%

This reflects the fact that the U.K. stock market represents more than 40 percent of European markets so a decrease in Ireland's correlation with the U.K. offsets increasing correlation with other E.U. countries so decreasing Ireland's weighted-average correlation with European stock markets. In part this result is consistent with broader integration because Ireland moved from a Sterling linked currency to an independent floating currency before entering the European Exchange Rate Mechanism (ERM) and Ireland remained within the ERM after the U.K. was forced to leave.

The lowest market correlations are evident in countries recently integrated in the European Union and those that have few international companies. Stock markets from small peripheral countries as Greece, Portugal and Finland were notably less correlated than other European countries during the first period. However, the results also indicate

that they rapidly become more correlated with other European stock markets. They registered the highest increases from the first to the second period, and overall their correlations with other European countries have rapidly reached approximate parity with average European correlations. On the second period even the lowest correlation figures in Europe are close to 50 percent, with only one exception: the Greek stock market.

The highest correlations reveal that on the first period Ireland and Holland were the most correlated with other European stock markets, a situation reflecting their cross connection with the U.K. market (including important cross listed companies such as Guinness, Unilever and Shell). On the second period the European correlation values were more homogeneous, but Holland remained the most correlated stock market within the European Union, reflecting the high trade and financial connection it has with the rest of the E.U. and the importance of external trade in the Dutch economy.

These results confirm previous work. Freimann (1998) found that among the E.U. markets the return in the Dutch stock market had the highest correlation with the European Union stock markets, whereas some peripheral markets were the least correlated.

The distribution of correlation for the two periods is shown in Figure 4.2. The modal class was 0.3-0.4 on the first period and 0.5-0.6 on the second period. Moreover, not only are correlations rising but it is also evident that there is much less dispersion than previously. The level of dispersion of all correlations (measured by the standard deviation) was 17.1% on the first period whereas in the second period it was 12.6%.

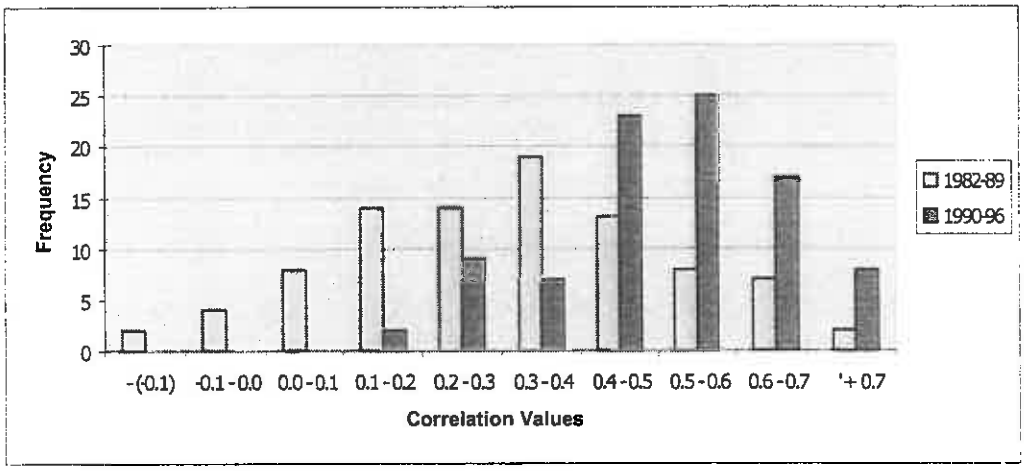

Figure 4-1

Histogram based on the values of correlation-matrix per period

This increase in intra European stock market correlation seems to be structural, in that for the almost all years in the interval 1990-1996 correlations increased and the standard deviation between correlations fell (Table 4.6).

Table 4-6

European correlations by year

Period	Mean	> 0.5	Stdev
1982-89	0.31	18.7%	21.2%
1983-90	0.39	31.9%	19.9%
1984-91	0.41	39.6%	18.0%
1985-92	0.42	39.6%	17.6%
1986-93	0.44	40.7%	17.1%
1987-94	0.46	42.9%	16.6%
1988-95	0.44	40.7%	16.3%
1989-96	0.48	49.5%	15.4%

This means that correlations are becoming more similar as well as higher. The implication is that potential diversification benefits across Europe based on peripheral European countries are disappearing. Countries within the E.U. which only some years ago offered low correlations with the European core markets, have moved much more in line with the rest of Europe, and at present, they display almost the same correlations of

about 50 percent as core E.U. economies. This means that opportunities for diversification within Europe for investors resident in E.U. countries have fallen.

4.6 CORRELATIONS BETWEEN EUROPEAN, AMERICAN AND JAPANESE STOCK MARKETS

One possibility is that correlations between European stock markets reflect a pattern of stronger co-movements in the stock market as a result of globalisation between all world markets. To investigate this further the previous analysis was repeated, but with Japan and the U.S. added to the study.

The results in table 4.7 gives the correlation coefficients between E.U. and U.S. stock markets, and show a decline between the 1980s and 1990s. This was particularly noticeable for all the large markets (and also for Ireland, which had the strongest link to the U.S. in the 1982-89 period).

Table 4.7

Correlation of returns between E.U. and U.S. and Japanese equity markets

Stock	USA				JAPAN			
Market	1982-89	1990-96	Changes	1982-96	1982-89	1990-96	Changes	1982-96
Large								
UK	0.75	0.63	-15%	0.71	0.38	0.37	-3%	0.36
Germany	0.46	0.44	-4%	0.45	0.27	0.32	19%	0.29
France	0.56	0.53	-4%	0.55	0.39	0.40	1%	0.40
Sub-mean	*0.59*	*0.54*	*-8%*	*0.57*	*0.35*	*0.36*	*6%*	*0.35*
Small								
Holland	0.67	0.62	-7%	0.65	0.40	0.40	0%	0.38
Italy	0.34	0.24	-31%	0.30	0.33	0.42	27%	0.39
Sweden	0.46	0.47	3%	0.45	0.22	0.47	115%	0.37
Spain	0.44	0.47	6%	0.45	0.33	0.57	76%	0.46
Belgium	0.53	0.52	-2%	0.52	0.43	0.36	-15%	0.39
Denmark	0.43	0.33	-23%	0.39	0.22	0.36	65%	0.29
Finland	0.07	0.31	367%	0.27	0.02	0.29	1346%	0.26
Ireland	0.77	0.50	-35%	0.65	0.44	0.49	11%	0.46
Austria	0.20	0.20	0%	0.20	-0.03	0.20	735%	0.13
Portugal	0.25	0.38	55%	0.27	0.43	0.37	-14%	0.35
Greece	0.20	0.08	-63%	0.15	-0.03	0.07	355%	0.03
Sub-mean	*0.40*	*0.37*	*25%*	*0.39*	*0.25*	*0.36*	*246%*	*0.32*
Mean	*0.49*	*0.45*	*8%*	*0.48*	*0.30*	*0.36*	*126%*	*0.33*
Stdev	21%	16%			17%	12%		

Across a similar period 1975-96, Freimann (1998) concluded that after the effects of the 1987 crash died down, globally measured correlations between the U.S., Japan and Germany receded to levels experienced before the crash.

The highest European correlations with the United States stock market also curiously seem to be the European markets that have the highest correlations within the European Union: Holland, Ireland, and also U.K.. These countries though had an above average fall in their correlations with the U.S. between the two periods, while the countries with the lowest correlations were more likely to show increases.

Exactly the same results follow if we examine the overall U.S. correlation with the value weighted European Index. Here the correlations between E.U. markets and the

United States market decreased on average 10 percent from the first to the second period (Figure 4.2).

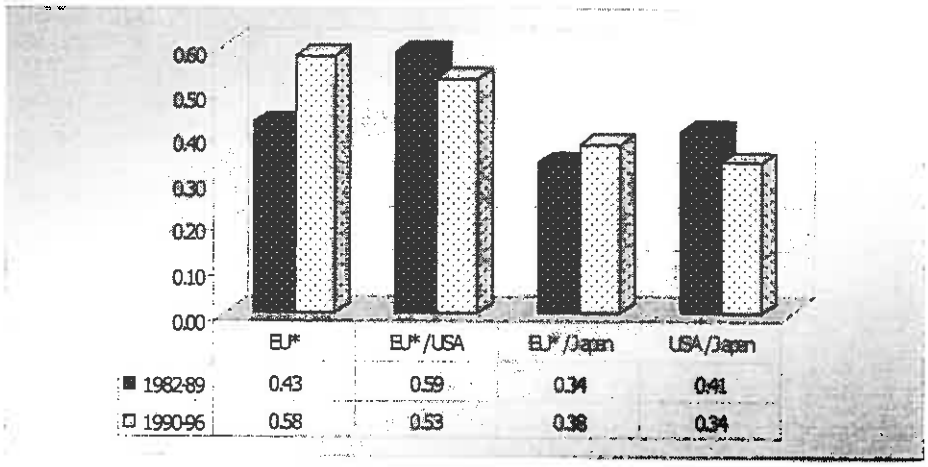

Figure 4-2
Summary of correlations where EU* means European weighted-average returns

However, contrary to a general expectation that globalisation would bring markets together the correlations between U.S. and Japan decreased noticeably between the first and second periods.

In contrast correlations between E.U. stock markets and the Japanese market show an increase from the 1980s to 1990s (table 4.6), although the overall correlation level with Japan was lower in both periods than the correlation between European markets and the U.S., or within the European Union. European weighted-average (based on market capitalisation) correlations with the Japanese stock increased 12 percent from the 1980s to the 1990s.

Again the lowest and highest correlations involve the same European countries, irrespective of whether the comparison is with the United States, Japan or within European Union. Therefore what appears to be happening is that the specific element of

low correlation country return variation seems to be disappearing rapidly under globalisation.

4.7 THE 1987 CRASH AND STOCK MARKET CORRELATIONS

Several studies indicate that the year 1987 and 1988, which covered a major stock markets crash and recovery (with Japan a continuing exception) had a strong influence on stock market correlations around the world (Le 1991, Lee and Kim 1993, Solnik et al. 1996, Meric and Meric 1998).

The influence of this period 1987-88 was isolated for examination separately from the first sub period 1982-89 and the same years were also taken out of the full sample period for comparison purposes. In both cases the 24 months of 1987 and 1988 were excluded from the calculated correlations between European Union markets, United States and Japan.

The results indicate a clear reduction on the correlation values in every market, for this 1982-89 period irrespective of whether the correlations are within the E.U., between the E.U. and outside economies, or between the United States and Japan (Tables 4.8).

Table 4-8

Correlations between E.U. stock returns without the years 1987 and 1988 in the period 1982-89

Stock Market	European weighted average			Japan			USA		
	1982-89	1982-89*	Changes	1982-89	1982-89*	Changes	1982-89	1982-89*	Changes
Large									
UK	0.49	0.42	-14%	0.38	0.33	-13%	0.75	0.61	-18%
Germany	0.48	0.37	-22%	0.27	0.29	9%	0.46	0.32	-30%
France	0.51	0.47	-8%	0.39	0.38	-5%	0.56	0.46	-18%
Sub-mean	*0.49*	*0.42*	*-15%*	*0.35*	*0.33*	*-3%*	*0.59*	*0.46*	*-22%*
Small									
Holland	0.60	0.48	-19%	0.40	0.39	-4%	0.67	0.54	-19%
Italy	0.39	0.35	-12%	0.33	0.27	-18%	0.34	0.32	-6%
Sweden	0.43	0.30	-31%	0.22	0.13	-39%	0.46	0.37	-19%
Spain	0.38	0.23	-40%	0.33	0.27	-18%	0.44	0.19	-57%
Belgium	0.54	0.42	-21%	0.43	0.31	-28%	0.53	0.34	-36%
Denmark	0.28	0.22	-21%	0.22	0.07	-66%	0.43	0.32	-24%
Finland	0.13	0.13	0%	0.02	0.02	0%	0.07	0.07	0%
Ireland	0.65	0.49	-24%	0.44	0.28	-37%	0.77	0.59	-23%
Austria	0.29	0.18	-38%	-0.03	-0.01	-66%	0.20	0.11	-43%
Portugal	0.25	0.11	-58%	0.43	0.31	-27%	0.25	-0.05	-120%
Greece	0.07	-0.19	-356%	-0.03	-0.10	-296%	0.20	-0.02	-111%
Sub-mean	*0.37*	*0.25*	*-56%*	*0.25*	*0.18*	*-54%*	*0.40*	*0.25*	*-42%*
EU mean	*0.43*	*0.34*	*-35%*	*0.30*	*0.25*	*-29%*	*0.49*	*0.36*	*-32%*
Japan							0.41	0.35	-14%
USA				0.41	0.35	-14%			

1982-1989* excludes 1987-1988

The weighted-average correlations between E.U. stock markets for 1982-86 were also far lower than those calculated for 1982-89 and the small peripheral markets, such as Greece and Portugal appeared the most affected markets when the years 1987 and 1988 were excluded from the calculations[7].

A t-test comparing the difference in means of returns of E.U. markets by market during the 1980s, including and excluding the years 1987-88 show that the differences were statistically significant for almost all markets, with the exceptions of France, Italy and Finland (Table 4.8a).

[7] For Finland the data starts after 1988, so there was no 1987 data for comparison.

Table 4-8a

T-test results of comparisons of means by market during the 1980s including and excluding the years 1987-88

Markets	t	df	Sig. (2-tailed)
Austria	2.357	12	0.04
Belgium	5.088	12	0.00
Denmark	3.190	12	0.01
France	1.426	12	0.18
Germany	4.082	12	0.00
Greece	5.325	12	0.00
Italy	1.090	12	0.30
Holland	3.144	12	0.01
Spain	4.161	12	0.00
Sweden	3.012	12	0.01
UK	2.617	12	0.02
Ireland	3.603	12	0.00
Portugal	2.626	12	0.02
Finland	-1.642	12	0.13

Figure 4.3 shows European correlation with and without the years 1987 and 1988. It indicates that the modal class was 0.3-0.4 on the first period with the inclusion of years 1987-88 and 0.2-0.3 without these two years, which confirms the influence of the years 1987-88 in the correlations of the period 1982-89.

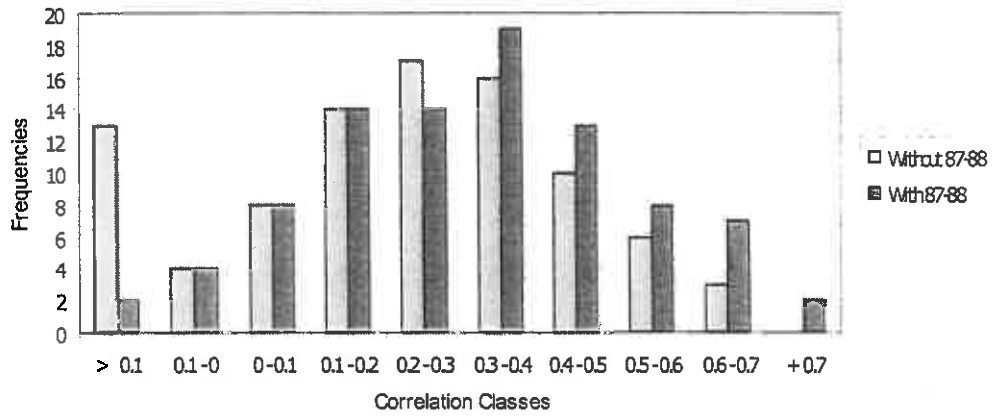

Figure 4-3

Histogram using E.U. correlations in 1982-89 with and without the years 1987 and 1988

The recalculation also affects the correlations between E.U. stock markets and United States or Japan markets. In all cases, omitting the years 1987 and 1988 lowers correlation values.

The correlations between small and large markets were also more affected than the correlations between large stock markets by the 1987 crash. In other words the small markets had little European systematic risk in the period prior to the major shocks.

The modification makes the earlier conclusions more vivid. If the years 1987-88 are excluded, the increases in correlations within E.U. and between E.U. and Japan are bigger from the first sub period to the second, and also the increased correlations between E.U. and U.S. are more substantial than when 1987-88 are incorporated (Table 4.9). Among the correlations between E.U. and U.S., only Ireland and Italy now appear to decrease from the 1980s to 1990s.

Table 4-9

Correlations excluding 1987 and 1988

Stock	E.U. Weighted Average			USA			JAPAN		
Market	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.42	0.60	0.52	0.61	0.63	0.62	0.33	0.37	0.36
Germany	0.37	0.61	0.51	0.32	0.44	0.38	0.29	0.32	0.32
France	0.47	0.67	0.59	0.46	0.53	0.50	0.38	0.40	0.41
Sub-mean	*0.42*	*0.63*	*0.54*	*0.46*	*0.54*	*0.50*	*0.33*	*0.36*	*0.36*
Small									
Holland	0.48	0.71	0.59	0.54	0.62	0.58	0.39	0.40	0.39
Italy	0.35	0.46	0.42	0.32	0.24	0.29	0.27	0.42	0.38
Sweden	0.30	0.53	0.44	0.37	0.47	0.42	0.13	0.47	0.37
Spain	0.23	0.62	0.45	0.19	0.47	0.33	0.27	0.57	0.47
Belgium	0.42	0.65	0.55	0.34	0.52	0.42	0.31	0.36	0.35
Denmark	0.22	0.55	0.39	0.32	0.33	0.33	0.07	0.36	0.25
Finland	0.13	0.51	0.47	0.07	0.31	0.29	0.02	0.29	0.26
Ireland	0.49	0.61	0.59	0.59	0.50	0.53	0.28	0.49	0.47
Austria	0.18	0.49	0.37	0.11	0.20	0.17	-0.01	0.20	0.16
Portugal	0.11	0.46	0.34	-0.05	0.38	0.23	0.31	0.37	0.36
Greece	-0.19	0.21	0.05	-0.02	0.08	0.03	-0.10	0.07	0.02
Sub-mean	*0.25*	*0.53*	*0.42*	*0.25*	*0.37*	*0.33*	*0.18*	*0.36*	*0.32*
Mean	*0.34*	*0.58*	*0.48*	*0.36*	*0.45*	*0.41*	*0.25*	*0.36*	*0.34*
Stdev	19%	12%	14%	21%	16%		15%	12%	

A t-test comparing the difference in means of returns of E.U. markets by market between 1980s (excluding the years 1987-88) and 1990s, reinforce the conclusions of section 4.5 that the change of mean correlations were statistically significant for all E.U. markets (Table 4.9a).

Table 4-9a

T-test results of comparisons of means by market between 1980s (excluding 1987-88 years) and 1990s.

Markets	t	df	Sig. (2-tailed)
Austria	-8.403	12	0.000
Belgium	-7.733	12	0.000
Denmark	-8.865	12	0.000
France	-5.715	12	0.000
Germany	-12.736	12	0.000
Greece	-8.235	12	0.000
Italy	-5.013	12	0.000
Holland	-9.312	12	0.000
Spain	-9.252	12	0.000
Sweden	-5.975	12	0.000
UK	-6.089	12	0.000
Ireland	-4.156	12	0.001
Portugal	-6.572	12	0.000
Finland	-4.945	12	0.000
95% confidence interval of the difference			

However the correlations between the American and Japanese stock markets is unaffected, showing a decrease with or without 1987-88 inclusion (Figure 4.4).

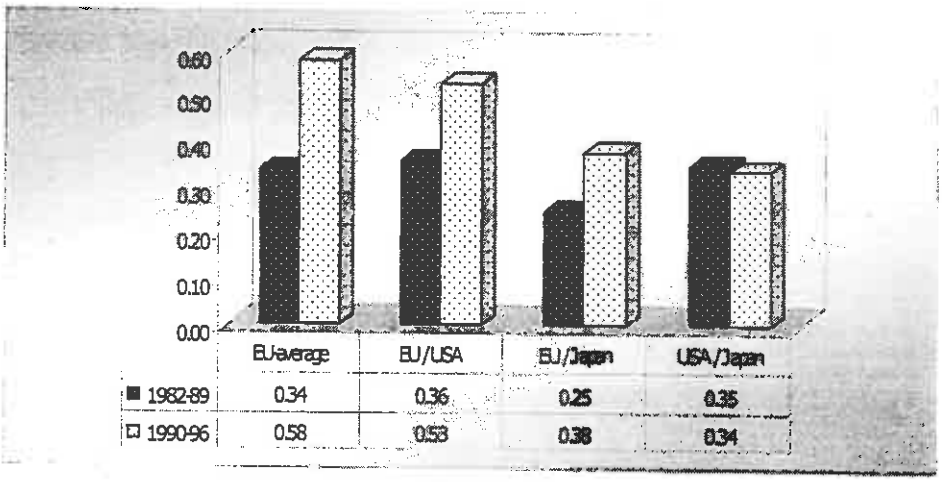

Figure 4-4

Summary of correlations without the years 1987-88

The results confirm the previous findings that the crash of 1987 significantly influenced the correlation values obtained as average for stock markets in the 1980s (Le 1991, Lee and Kim 1993, Solnik et al. 1996).

The generally established conclusion (Erb et al. 1994, Solnik et al. 1996) that correlations increase during crisis periods is therefore supported, partly to a large liquidity effect as strong shocks affect all stock markets around the world simultaneously.

4.8 TREND EFFECTS IN CORRELATION RETURNS

In this section the impact of return trends on the correlation between stock markets is considered. This is because correlation coefficients will be influenced by trend as well as volatility of returns. If the U.S. is subject to a new paradigm, the U.S. market may for example trend upwards relative to E.U. or Japanese markets but this tells us little about the information connectivities between markets. The E.U. may still follow U.S. deviations round its trend in terms of deviations round its own lower trend.

We therefore seek reassurance that the integration conclusions we draw are not simply reflecting shared trend effects rather than connectedness between markets. The approach therefore was to repeat the earlier analysis, but this time by adjusting returns to trend relative returns. The trend of each market was based on a 24 month moving average of returns. To calculate the adjusted monthly rate of returns, the moving average ratio return was deducted from the periodic return.

$$R(dif)_t^i = (R)_t^i - MA\ (R)_t^i \qquad \text{equation 4.3}$$

Where:

- $(R)_t^i$ - monthly rate of returns for market i at month t
- MA $(R)_t^i$ - 24 months moving average rate of returns for market *i* at month *t*
- $R(dif)_t^i$ - difference between monthly rate of return and moving average rate for market i at month t

The new correlation matrixes were then calculated following previous procedures based on two return differences.

The results (Tables 4.10, 4.11 and 4.12) show that in general the correlations are very similar to those shown in tables 4.2 and 4.5. This means that trend effects in each stock market do not seem to account for the correlations effects observed.

Only in few a cases did it appear that trend differences were distorting the correlation values. On the first period this was the case for Ireland against E.U. and U.S. markets, and Portugal against E.U. markets and the Japanese market. On the second period all differences were very small. During the entire period only correlations between the U.K. market and other E.U. markets were affected by adjusting for trend differences.

Therefore the previous conclusions of a strong increase in the correlations with the implication of connectedness within the European Union remain unchanged and are judged to be robust in respect both of major volatility episodes (1987-88) and trend differences.

Table 4-10

Correlations between E.U. markets and the trend effects. E.U. weighted average by market capitalisation

Stock Market	With trend			Without trend			Differences		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.49	0.60	0.53	0.30	0.36	0.33	0.19	0.24	0.21
Germany	0.48	0.61	0.53	0.42	0.52	0.46	0.06	0.09	0.07
France	0.51	0.67	0.57	0.50	0.59	0.53	0.01	0.09	0.04
Sub-mean	*0.49*	*0.63*	*0.55*	*0.41*	*0.49*	*0.44*	*0.09*	*0.14*	*0.11*
Small									
Holland	0.60	0.71	0.63	0.59	0.65	0.61	0.01	0.05	0.02
Italy	0.39	0.46	0.43	0.41	0.44	0.42	-0.01	0.02	0.00
Sweden	0.43	0.53	0.47	0.48	0.52	0.49	-0.05	0.01	-0.02
Spain	0.38	0.62	0.48	0.43	0.59	0.50	-0.04	0.03	-0.02
Belgium	0.54	0.65	0.58	0.55	0.64	0.58	-0.01	0.01	0.00
Denmark	0.28	0.55	0.39	0.31	0.55	0.42	-0.02	-0.01	-0.02
Finland	0.13	0.51	0.44	0.00	0.50	0.50	0.13	0.01	-0.07
Ireland	0.65	0.61	0.63	0.34	0.60	0.55	0.31	0.01	0.08
Austria	0.29	0.49	0.38	0.31	0.49	0.39	-0.02	0.00	-0.01
Portugal	0.25	0.46	0.29	-0.10	0.47	0.22	0.35	-0.01	0.07
Greece	0.07	0.21	0.13	0.11	0.20	0.15	-0.04	0.01	-0.02
Sub-mean	*0.37*	*0.53*	*0.44*	*0.31*	*0.51*	*0.44*	*0.06*	*0.01*	*0.00*
Mean	*0.43*	*0.58*	*0.49*	*0.36*	*0.50*	*0.44*	*0.07*	*0.08*	*0.05*
Stdev	17%	12%		20%	12%		13%	7%	

Table 4-11

Correlations between E.U. markets and U.S. and the trend effects

Stock Market	With trend			Without trend			Differences		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.75	0.63	0.71	0.80	0.63	0.74	-0.05	0.00	-0.03
Germany	0.46	0.44	0.45	0.54	0.44	0.50	-0.08	0.00	-0.05
France	0.56	0.53	0.55	0.62	0.54	0.59	-0.06	-0.01	-0.05
Sub-mean	*0.59*	*0.54*	*0.57*	*0.65*	*0.54*	*0.61*	*-0.06*	*0.00*	*-0.04*
Small									
Holland	0.67	0.62	0.65	0.72	0.61	0.68	-0.05	0.01	-0.03
Italy	0.34	0.24	0.30	0.40	0.23	0.33	-0.06	0.00	-0.03
Sweden	0.46	0.47	0.45	0.52	0.47	0.49	-0.06	0.00	-0.03
Spain	0.44	0.47	0.45	0.52	0.45	0.49	-0.08	0.02	-0.04
Belgium	0.53	0.52	0.52	0.60	0.52	0.57	-0.07	0.00	-0.05
Denmark	0.43	0.33	0.39	0.47	0.33	0.41	-0.05	0.00	-0.02
Finland	0.07	0.31	0.27		0.29	0.29	0.07	0.02	-0.02
Ireland	0.77	0.50	0.65	0.54	0.50	0.52	0.23	0.00	0.14
Austria	0.20	0.20	0.20	0.23	0.20	0.21	-0.03	0.00	-0.01
Portugal	0.25	0.38	0.27	0.07	0.37	0.23	0.17	0.01	0.04
Greece	0.20	0.08	0.15	0.27	0.07	0.18	-0.06	0.01	-0.03
Sub-mean	*0.40*	*0.37*	*0.39*	*0.43*	*0.37*	*0.40*	*0.00*	*0.01*	*-0.01*
Mean	*0.49*	*0.45*	*0.48*	*0.54*	*0.45*	*0.51*	*-0.03*	*0.00*	*-0.02*
Stdev	21%	16%		20%	16%		10%	1%	

Table 4-12

Correlations between E.U. markets and Japan and the trend effects

Stock	With trend			Without trend			Differences		
Market	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.38	0.37	0.36	0.42	0.38	0.38	-0.04	-0.02	-0.02
Germany	0.27	0.32	0.29	0.27	0.34	0.30	-0.01	-0.03	-0.01
France	0.39	0.40	0.40	0.42	0.43	0.41	-0.02	-0.03	-0.01
Sub-mean	*0.35*	*0.36*	*0.35*	*0.37*	*0.39*	*0.36*	*-0.02*	*-0.03*	*-0.01*
Small									
Holland	0.40	0.40	0.38	0.44	0.43	0.41	-0.04	-0.02	-0.03
Italy	0.33	0.42	0.39	0.38	0.44	0.41	-0.05	-0.01	-0.02
Sweden	0.22	0.47	0.37	0.26	0.49	0.40	-0.05	-0.02	-0.03
Spain	0.33	0.57	0.46	0.33	0.58	0.46	0.00	-0.01	-0.01
Belgium	0.43	0.36	0.39	0.47	0.39	0.41	-0.05	-0.02	-0.01
Denmark	0.22	0.36	0.29	0.23	0.39	0.32	-0.01	-0.04	-0.02
Finland		0.29	0.26		0.30	0.30		-0.01	-0.04
Ireland	0.44	0.49	0.46	0.41	0.50	0.48	0.03	-0.01	-0.02
Austria	-0.03	0.20	0.13	-0.07	0.23	0.11	0.04	-0.03	0.01
Portugal	0.43	0.37	0.35	0.10	0.39	0.27	0.33	-0.02	0.08
Greece	-0.03	0.07	0.03	0.02	0.09	0.06	-0.04	-0.02	-0.03
Sub-mean	*0.27*	*0.36*	*0.32*	*0.26*	*0.38*	*0.33*	*0.02*	*-0.02*	*-0.01*
Mean	*0.31*	*0.36*	*0.33*	*0.31*	*0.38*	*0.35*	*0.00*	*-0.02*	*-0.01*
Stdev	16%	12%		17%	12%		10%	1%	

4.9 CONCLUSIONS

The results of this chapter indicate that correlations between European stock markets have increased more rapidly in the period 1982-96 than could be explained by any general process of globalisation. In fact the E.U./U.S., and U.S./Japan correlations appear to show no positive trend and therefore globalisation showed a weak integration effect compared with the major changes observed within the "single market" project. So far as Europe is concerned, the increase was stronger between small peripheral markets and large markets (the exception was the Irish market), which means that small peripheral countries offer less diversifiable specific risk and more European systematic risk than previously.

The 1987 crash gave an exaggerated view of the correlations coefficients between stock markets in the 1980s, particularly for correlations that involve small markets. If the years 1987 and 1988 were excluded from the analysis, the correlations on the first period 1982-89 were much smaller than if they are included and consequently conclusions about the underlying increase across the two periods would be even more noticeable. The years 1987 and 1988 corroborate those (Erb et al. 1994, Solnik et al. 1996) findings that in periods of high volatility of returns, the correlations between stock markets are higher.

Differences in correlation between stock markets were analysed to check whether these might be influenced by trend differences in returns of each stock market. Recalculating the correlations based on deviations of returns around the trend had little impact on correlations, which means that the trend differences between stock markets were not sufficiently marked to influence the value of correlations. In only a few cases did analysis based on deviations round the trend alter correlation values. Accordingly the conclusion that there was a sharp increase in the correlations within European Union between 1989 and 1996 is robust.

This increase in correlations seems to be structural and the dispersion of correlations was falling. Nevertheless the results still indicate that country factors have a continued influence in Europe, because correlations are far below one, despite the strong increases in the 1990s.

The results also show that despite globalisation, inter-blocks on average correlations are falling in the case of the E.U./U.S.. The fall was especially noticeable for all European large markets and also for the Irish market.

Correlations between European markets and the Japanese market show an increase from the first to the second period. However the level of E.U./Japan correlation is lower than the correlations between European markets and between European markets and the U.S.. The correlation between the U.S. and Japan had a strong decrease (-17%) from the first to the second period and was the lowest in 1990-96.

We would therefore argue that increased correlations between European stock markets maybe reflects continuing alignment of European real and financial variables, such as the interest rate differentials, exchange rates volatility, inflation rates differential, or the differentials of GDP growth rates.

The reduced divergence across Europe and increasing co-movements between the individual European stock markets is potentially a result of the fixing of exchange rates through EMU, which resulted in one interest rate level for participant countries. Before this change, exchange rates variability and interest rate differentials could have provided a significant part shortfall of correlation within the European Union. Whether this explanation is a significant one will be considered in the next chapter.

CHAPTER 5 CORRELATIONS BETWEEN EUROPEAN ECONOMIC AND MONETARY INDICATORS

5.1 PURPOSE OF THE CHAPTER

The purpose of this chapter is to examine links between the correlation of economic and monetary indicators in the E.U. and the correlations of stock markets as discussed in Chapter 4.

The chapter has three aims. The first is to observe the level of correlation of economic and monetary variables between E.U. countries and compare this with correlations between Europe and the U.S. and Japan. This allows us to contrast economic and monetary convergence within the European Union with global economic patterns.

The second is to establish whether countries that exhibit high correlations of economic and monetary variables also exhibit high correlations between their stock markets. This suggestion is common in the literature although evidence is rather incomplete (Solnik 1984, Asprem 1989, Tucker et al. 1991, Ratner and Leal 2000).

The third objective is to observe which variables, if any (from the selected variables), are significant in this potential relationship between economic and monetary indicators and stock market correlations.

These issues may be relevant for European Union investors for two main reasons. First, the elimination of some important barriers, such as exchange rate risk and the creation of a common European monetary policy and a more homogeneous tax system would be

expected to lead to an increase in the proportion of cross-border European direct and portfolio investments. Moreover, easier access to information about companies from other countries and the existence of more European companies in more than one stock exchange, together with lower trading costs, can also contribute to an increase in cross border investment within European portfolios.

If a connection between economic and monetary convergence and the continuing integration of stock markets is evident, we should expect a continuing increase in correlation in economic and monetary indicators between European markets, as found by Tucker et al. (1991): "To the extent that stock markets are affected by similar economic conditions and members economies become more integrated, these stock markets should become more highly correlated. Also, an increase in capital mobility resulting from lessened capital restrictions should increase the influence of one member's stock market conditions on the others" (Tucker et al. 1991, p. 339).

This is likely to reduce the diversification potential of moving from single country portfolios to European portfolios within Europe to access different growth and inflation exposures, though it may also have lowered the volatility of individual country markets and the E.U. market as a whole. Although correlations are high and increasing, they are still below one so continue to allow some scope for the European investors to benefit from diversification.

The analysis is divided into two main parts: the first covers correlations between economic and monetary variables within European countries, and between European countries and the U.S. and Japan; the second the association between correlations of economic and monetary variables and the correlations of national security markets.

In this chapter we try to answer the following three questions:

1. For each European country, how does inter-European "integration" compare with "integration" of European economies with American and Japanese economies?

2. For each European country, does economic and monetary "integration" in the form of correlation changes parallel security market correlation changes?

3. Do changes in correlations between national economic variables parallel changes in security correlations more closely than correlation of monetary variables?

5.2 PREVIOUS WORK

5.2.1 Economic and monetary integration

In general, stock prices have been considered a good indicator of real economic activity but they also seem to be strongly influenced by the volatility of monetary variables (Solnik 1984, Asprem 1989).

There are several empirical studies of economic convergence across countries. Freimann (1998) performed a study based on the differences of economic and monetary variables between Germany and the other E.U. countries. He used four macroeconomic variables (GDP growth, inflation, government bond yields, and exchange rates) in relation to five European countries (France, Italy, Spain, and United Kingdom with Germany providing the benchmark) from January 1975 through December 1996. In terms of economic variables Freimann's results seem to show that there is a trend toward "integration" reflected in a narrowing of mean differences from Germany. His

conclusion is that the differentials in economic variables have narrowed, particularly from the 1970s to the 1980s. By the end of 1993, the effects of German reunification had petered out, and after the spreads for GDP growth rates, inflation, and bonds yields were low. One exception to "convergence" is the foreign exchange market, where volatility remained persistently high.

We extend Freimann's work by considering how European Union countries as a block correlate with the U.S. and Japan, the largest economies outside the European Union and whether differences exist in the external links between large and small security markets. In addition, we use five economic variables, including Freimann's four variables and adding the imbalance in trade, to reflect the exchange pressure on countries.

The study by Tucker et al. (1991) analysed the integration of inflation rates, exchange rates, and stock markets based on correlation analysis across countries for the period 1977-1988 divided into two subperiods: 1977-1982 and 1983-1988. They studied twelve European Union countries: Belgium, Denmark, France, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain, United Kingdom, and West Germany. Quarterly data obtained from the International Monetary Fund Statistical Yearbooks are used. For Tucker a comparison of inflation correlations over these two periods can indicate whether inflationary trends are becoming more similar among the twelve members. The coefficients reported suggest that this is the case. The overall average correlation coefficient for each subperiod is 0.23 and 0.29. Accordingly Tucker et al. (1991) integration should also result in higher correlations among exchange rate changes as economies become more interdependent. For the same two periods, the

overall average correlations are 0.50 and 0.54, suggesting more common rate movements among EEC nations.

We also extend the Tucker work by considering additionally how European Union countries as a block correlate with the U.S. and Japan, and whether there are differences between large and small markets. Moreover, we use five economic variables, including Tucker's two variables and adding interest rates, growth of GDP and the bilateral imbalance in trade. Tucker's sample period is extended to cover the period after capital controls were eliminated (in the majority of member's nations by 1990) to see whether transferability of capital produced higher correlation between economic and monetary variables.

5.2.2 Economic and monetary integration and stock market correlations

Solnik (1984) investigated the relationship between stock market returns and three monetary variables (inflation rates, interest rates and exchange rates) using monthly total returns on nine major markets (Belgium, Canada, France, Germany, Holland, Switzerland, U.K., U.S. and Japan), i.e. including only four E.U. markets. The analysis consisted of regressing the level and changes in each variable against national stock market indices country by country over the period January 1971 to December 1982.

The results show a consistent negative relation between equity returns and inflation rates and interest rates for every single country. The regression coefficients over all countries using generalised least squares showed that both coefficients are highly significant.

The results indicate that the relation between currency movements and stock market returns is weak, despite a positive coefficient between stock market returns (in local currency) and exchange rate movements.

Asprem (1989) also conducted a study in investigating the relations between stock indices, asset portfolios and macroeconomic variables in ten European countries (Denmark, Finland, France, Germany, Italy, Norway, Holland, Sweden, Switzerland and United Kingdom). The study used quarterly data from International Financial Statistics Data from 1968 to 1984, and OLS multiple regression.

The results show that employment, imports, inflation and interest rates are the most relevant variables from the 19 used in the study in determining the stock prices. These variables seem to be negatively correlated to stock prices. So far as timing is concerned, movements in stock prices were found to lead measures for real activity, indicating a rational expectations basis for stock markets pricing.

The association between stock prices and macroeconomic variables are strongest in the cases of Germany, Holland, Switzerland and the United Kingdom but weaker for other countries and the findings show some contradictory results.

They also evaluate economic and monetary variables relative to two stock market portfolios. A European stock index based on a group of companies in each country was constructed and it was shown that this portfolio explains the variation in the stock prices (not returns) more strongly than economic and monetary variables. They also used the U.S. SeP 400 index as an independent variable for explaining the stock price movements and found a relationship weaker than the European index portfolio, but

stronger than all economic and monetary variables. This finding will be investigated further in chapter 6.

Tucker et al. (1991) also analysed the integration of inflation rates, exchange rates, and stock markets using correlation analysis across countries. Their results indicate that "It appears that stock markets are more integrated. The average stock market correlations in the period 1983-88 (0.425) is much higher than that in the period 1977-82 (0.074)." (p. 339). Their results suggest more highly correlated inflation rates, exchange rates, and stock market returns among European countries as a result of increased integration efforts and expectations.

Johnson and Soenen (1993) use the correlations of exchange rate movements to measure integration between eight European countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Britain, and Spain) and two external markets, the U.S. and Japan. They used mean and standard deviation of monthly exchange rate changes measured against the U.S. dollar.

They split the sample period 1973-1990 into three six-year periods and concluded that the correlation of exchange rates among EC countries has been much higher than between members and non-members. For the three consecutive periods (1973-78, 1979-84, and 1985-90), the overall average correlation of exchange rates among EC countries has consistently increased from 0.7 to 0.79 and finally 0.89.

These conclusions are to some extent limited by being based only on eight European stock markets and so does not allow a complete picture of all correlations of exchange rates between European Union stock markets. Secondly, the data used on the study ends

in 1990 whereas there was an important exchange rate crisis in the 1990s and the single currency programme took place after that date.

5.2.3 The influence of trade between countries on stock market correlations

In this section, we consider the connection between commercial trade between countries on the correlations between their stock markets.

A study conducted by Ratner and Leal (2000) examined external trade (IMF Direction of Trade Statistics) and monthly equity market returns's IFC country indices for the seven largest Latin American equity markets and the U.S.. They found a positive and statistically significant relationship between bilateral trade and the correlations of equity index returns. The study covered Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, and the U.S. from 1983 through 1996.

They regressed market correlations and external trade flows for each country pair. A positive beta indicates that equity correlation is directly related to bilateral external trade. Significantly positive beta coefficients were observed for all countries. These results suggest that the intensification of bilateral trade is associated with increased bilateral equity market correlation, with the relationship more intense for the most recent subperiod (1990-1996) when they segmented the sample into two subperiods. As trade agreements expand, it is likely that the emerging economies of Latin America will become increasingly interrelated. The lack of significant bilateral trade in the 1980s coincides with insignificant security market correlation in the same period. These findings suggest that an increase in bilateral external trade, or trade liberalisation, is associated with an increase in cross-country stock market correlations. This result is

hardly surprising because it reflects the fact that companies are less national. We are no longer measuring pure national risk.

Chen and Zhang (1997) report a similar finding in Pacific Basin countries, with a common factor being that both samples are defined by membership of trade groups and this has particular implications for the European Union countries. Based on these studies external trade linkages were therefore regarded as important economic variables in explaining correlation between stock markets.

These studies gave us some guide to selecting which economic and monetary variables we should use in this research. Moreover inflation rates, interest rates, rate of GDP growth and exchange rates were four out the five "convergence criteria" used by European Union. The result should be that these variables would be expected to be converging in E.U. countries between the 1980s and the 1990s.

5.2.4 Theoretical reasons for convergence of the selected variables

5.2.4.1 Convergence of inflation rates

Theoretically the convergence of inflation rates is important for an economic and monetary union to reduce or avoid an inflationary bias. If countries with higher inflation join the E.U., the European Bank would set interest rates relative to the new average inflation rate and the inflation would increase for all countries. To prevent these countries with low inflation (for example Germany) E.U. will restrict entry to countries with low inflation rates (see De Grauwe, 1997).

The Maastricht entry conditions can now be interpreted in this perspective. Before the union starts, the candidate member countries are asked to provide evidence that they care about a low inflation rate in the same way as countries with low inflation do. This should be done by first bringing down their inflation rate to a low level and after by having more synchronised co-movements of inflation rates through time.

5.2.4.2 Convergence of exchange rates

Theoretically, in open economies exchange rate adjustment is not a very useful mechanism. Currency depreciation is offset by increased inflation. However, in closed economies the exchange rate is necessary to prevent competitiveness with the rest of the world being eroded by domestically generated inflation (Cole and Owen, 1999).

The main motivation for requiring exchange rate convergence between E.U. countries and banning devaluation is that it prevents countries from manipulating their exchange rates to secure temporary increases in competitiveness (De Grauwe, 1997).

However external influences did force realignments after the Treaty of Maastricht was signed. Initially, the "normal" band for fluctuation was 2 x 2.25%. However, after August 1993, the "normal" band within the EMS was 2 x 15%, a considerably larger band of fluctuation. This means that the E.U. countries needed to go forward in the monetary integration process to avoid this type of situations in the future.

5.2.4.3 Convergence of interest rates

The justification for the interest rates convergence is that excessively large differences in the interest rates can lead to large capital gains and losses at the moment the EMU

takes effect (De Grauwe, 1997). Large interest rate differentials can create disturbances in national capital markets. A falling interest differential between national bonds should be expected as monetary integration goes forward with rates becoming more correlated.

5.2.4.4 Convergence of the growth of GDP

If the economies of the E.U. are converging in terms of GDP growth rate, then there is less need for any exchange rate adjustment between them, since all economies will be in expansion or contraction together. There would also be less need for labour to flow from one country to another, since job markets would all be at a similar stage in the economic cycle. This is very important for EMU since it would mean that the inflexibility of the European labour market would be less of a disadvantage. One measure of convergence is in increased correlation of the economic cycle, with European influence outstripping U.S. influence (Cole and Owen, 1999).

5.2.4.5 Trade

Accordingly to Mundell (1961) and Krugman and Obstfeld (1997) trade openness, as measured by bilateral trade transactions, is an important factor in economic convergence. The 1992 reforms removed many trade barriers associated with standards, market access and public procurement.

5.3 METHODOLOGY

5.3.1 Global Methodology

To analyse economic and monetary "integration" we followed the Tucker et al. (1991) and Johnson and Soenen (1993) approach using correlation analysis based on five variables: exchange rates, inflation rates, Government bond rates, growth rate of GDP and trade[8]. The first three variables comprise monetary variables while the other two represent economic variables. The description of the variables is in section 5.5.

Correlation analysis between countries was performed for each variable, a methodology quoted in the previous chapter. The analysis was performed for sub-periods and also for the entire period.

As in the previous chapter the study considered three issues:

- Changes in correlations between economic and monetary variables within member countries of the European Union;
- Correlations between E.U. economic and monetary variables and two major developed economies outside EU: United States and Japan; and
- Correlations between American and Japanese economic and monetary variables.

[8] Solnik (1984) used exchange rates, interest rates and inflation rates. Tucker et al. (1991) used exchange rates and inflation rates. Freimann (1998) used GDP growth rate, inflation rates, government bond yields and exchange rates. Chen and Zhang (1997) and Ratner and Leal (2000) used trade.

Trade imbalance, which represents some degree of disequilibrium within the convergence system, was analysed separately. For each of the remaining four variables there is a correlation matrix with 91 coefficients, which means 364 values across four variables. A statistic to summarise the results was required. With no a priori reasons for differential weighting, the indicator was constructed (section 5.5.5) on the simple average of the results of the four variables[9]. Obviously averages suppress information but the number of factors explaining each pairwise effect may be very extensive.

5.3.2 Weighted-average index of each economic or monetary variable for E.U. countries

To simplify the European correlation analysis, an index weighted by Gross Domestic Product (GDP) of each country was used. Separate large/small country sub-indices were also calculated. These are given in table 5.1.

Table 5-1
GDP share of E.U. members by period

Country	1982-89	1990-96	1982-96
UK	16.2%	15.5%	15.9%
Germany	22.6%	23.6%	23.1%
France	17.7%	17.0%	17.4%
Holland	4.2%	4.3%	4.3%
Italy	16.5%	16.2%	16.4%
Austria	2.3%	2.4%	2.3%
Belgium	3.0%	3.1%	3.0%
Denmark	1.7%	1.6%	1.6%
Greece	1.7%	1.8%	1.8%
Spain	7.8%	8.2%	8.0%
Sweden	2.7%	2.4%	2.5%
Ireland	0.7%	0.8%	0.7%
Portugal	1.6%	1.8%	1.7%
Finland	1.4%	1.3%	1.4%
Total	*100.0%*	*100.0%*	*100.0%*

[9] Solnik (1984), Tucker et al. (1991) and Freimann (1998) used simple average to summarise and compare the findings.

The index for each variable was constructed by weighting the value of the variable from each country by the country's proportional GDP weight shown in table 5.1.

$$EUindex_t^V = \sum_{i=1}^{14} V_t^i \frac{GDP^i}{\sum_{i=1}^{13} GDP^i} \qquad \text{equation 5.1}$$

Where:

EUindex – European Index of variable V at month t

V^i_t – value of the variable i at month t

$\sum_{i=1}^{14} GDP^i$ = total European GDP

$\frac{GDP^i}{\sum_{i=1}^{13} GDP^i}$ = relative GDP (measure in percentage)

Note: The denominator uses 13 European countries excluding the country under analysis.

The correlations between each variable in each country and the E.U. weighted index were used to summarise the data and hence simplify interpretation of results.

5.4 DATA

This chapter uses economic and monetary variables. For each variable we try to have a homogeneous definition across countries or the closest available substitute. This objective was achieved for four of the five variables. Government bonds present the

difficulty that it was not always possible to have the same bond maturities in deriving interest rates so the nearest equivalent rate was taken.

Inflation rates, GDP data and governments bond rate data were obtained from OECD (Main Economic Indicators – Statistics Directorate), while exchange rates were obtained from DataStream. Trade data come from Statistics of Foreign Trade, also published by OECD. Monthly data for inflation rates, exchange rates and governments bond rates and annual data for growth of GDP and trade were used. Table 5.2 displays the simple average of each variable per country for the entire period 1982-96.

Table 5-2

Value of the variables - average of the period 1982-1996

Country	Exchange Rates (a)	GDP growth rate (b)	Inflation Rates	Government bond yields	Total Trade Billions of U$
Austria	4.3%	2.5%	3.0%	7.5	6157
Belgium	0.7%	2.1%	3.3%	9.2	16273
Denmark	0.5%	1.8%	3.6%	9.7	4815
Finland	2.3%	2.3%	4.1%	11.0	3593
France	1.3%	2.3%	3.8%	9.6	30048
Germany	-0.6%	2.7%	2.5%	7.0	51431
Greece	11.7%	1.6%	14.7%	19.8	2029
Holland	-0.3%	2.5%	2.1%	7.2	17423
Ireland	1.5%	4.7%	4.2%	10.6	3142
Italy	3.5%	2.0%	6.6%	12.9	23779
Portugal	7.7%	3.4%	11.3%	15.4	2546
Spain	4.0%	2.7%	6.6%	12.6	9848
Sweden	3.4%	2.8%	5.3%	11.3	7395
UK	2.7%	2.7%	4.5%	9.8	28367
US	2.0%	3.1%	3.5%	8.3	70005
Japan	-2.3%	3.2%	1.4%	5.5	40405

(a) Rate of change against Swiss Franc
(b) 1990 constant prices

5.5 CORRELATIONS OF ECONOMIC AND MONETARY VARIABLES

5.5.1 Correlations of rate of change of exchange rates

In this section correlation between exchange rates within the European Union and with the U.S and Japan were analysed.

For this purpose exchange rates against the Swiss franc were used for all currencies including US$ and Yen, essentially for two reasons. First we needed a currency external to the study (hence not one of the 16 currencies considered in the study). Second the Swiss franc is historically stable against a basket other currencies.

To convert exchange rates to returns, cross rates were used to provide a return for an investor in country A and holding Swiss Francs.

$$\mathrm{Re}_{t+1}^{i/SF} = \ln \frac{e_{t+1}^{i/SF}}{e_t^{i/SF}} \qquad \text{Equation 5.2}$$

Where:

$e_t^{i/SF}$ = Exchange rate of currency i against Swiss Franc

$\mathrm{Re}_{t+1}^{i/SF}$ = Rate of change of currency i from t to $t+1$

Table 5.3 shows the correlations of exchange rates between E.U. countries and the U.S., and between E.U. countries and Japan, and all currencies against Swiss Franc. Within the E.U. the table displays the correlations between each currency changes and a weighted (by GDP) changes of E.U. countries against the Swiss Franc.

Table 5-3

Correlations of national exchange rate changes and weighted changes of E.U. countries (all currencies against the Swiss Franc)

Country	Correlations with the EU index			Correlations with U$			Correlations with Yen		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.37	0.58	0.46	0.47	0.46	0.46	0.18	0.20	0.18
Germany	0.65	0.67	0.63	0.31	0.50	0.39	0.13	0.32	0.23
France	0.64	0.68	0.63	0.33	0.49	0.39	0.19	0.22	0.19
Small									
Holland	0.71	0.75	0.71	0.29	0.51	0.38	0.07	0.32	0.20
Italy	0.67	0.61	0.59	0.52	0.51	0.48	0.29	0.14	0.18
Sweden	0.52	0.49	0.50	0.59	0.39	0.49	0.34	0.09	0.19
Spain	0.64	0.68	0.65	0.51	0.43	0.47	0.24	0.17	0.20
Belgium	0.66	0.70	0.65	0.26	0.45	0.33	0.13	0.23	0.18
Denmark	0.72	0.71	0.70	0.36	0.50	0.42	0.18	0.30	0.24
Finland	0.58	0.47	0.52	0.53	0.30	0.41	0.33	0.11	0.20
Ireland	0.69	0.65	0.66	0.40	0.56	0.48	0.18	0.26	0.23
Austria	0.36	0.36	0.35	0.68	0.85	0.75	0.34	0.45	0.39
Portugal	0.56	0.67	0.58	0.41	0.43	0.41	0.23	0.23	0.21
Greece	0.42	0.75	0.51	0.39	0.62	0.45	0.18	0.33	0.22

The results show a high degree of correlation of returns in European Union countries. The majority of correlations are over 0.5. This is higher than the Tucker et al (1991) who found an average correlation between 12 E.U. countries of 0.54 in the period 1983-88 compared with our average correlation of 0.57 for 15 E.U. countries for the period 1982-89.

Also currencies that have low correlations with other European currencies in the first period, such as Greece, U.K. and Portugal, become more correlated in the second period. The currency showing the highest average correlation with other European currencies during the entire period was the Dutch Guilder; the lowest was the Austrian Schilling.

The level of dispersion in correlations across E.U. currencies is also decreasing (Figure 5.1), confirming that the correlations are becoming more similar, in contrast to the correlations between E.U. currencies and US dollars or Japanese yen.

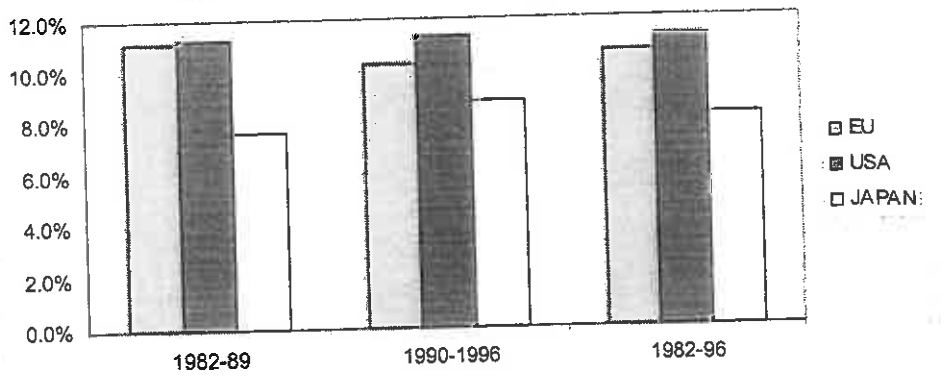

Figure 5-1

Level of dispersion of correlations measured by the standard deviation

The Swiss Franc returns of European currencies as a group were less correlated with US$ than they were between themselves (Figure 5.2). This was particularly evident during the first period especially for the group of the "core" countries in E.E.C. (France, Germany, Holland and Belgium). However in the second period these "core" currencies become more correlated with US$ (Table 5.3).

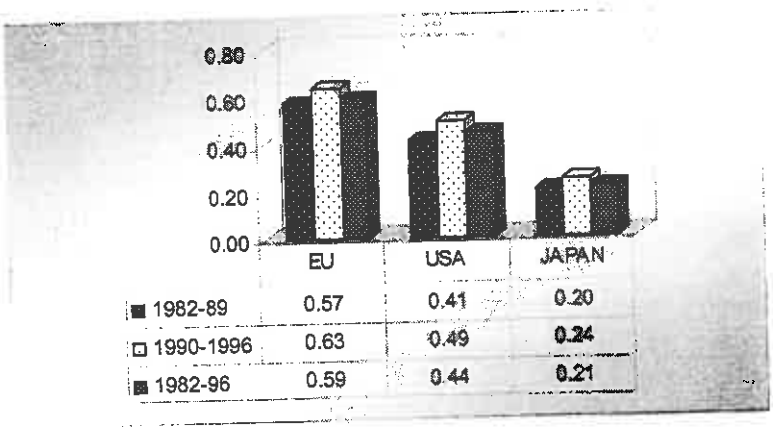

Figure 5-2

Average of correlations between currency rate changes against the SFr

The E.U. currencies changes (against the Sfr) had correlations with Japanese yen changes (against the SFr) on average under 0.25. Even though correlations increased from the first to the second period, they remain very low compared with the correlations among E.U. currencies or between E.U. currencies and U.S. dollars.

Correlation between the Japanese yen and US dollars (both of them against Swiss Franc) was low in the first sub-period, although it had an increase of 70% from the first to the second sub-period (Figure 5.3). This indicates that exchange rates are becoming correlated around the world although they are much higher between European countries.

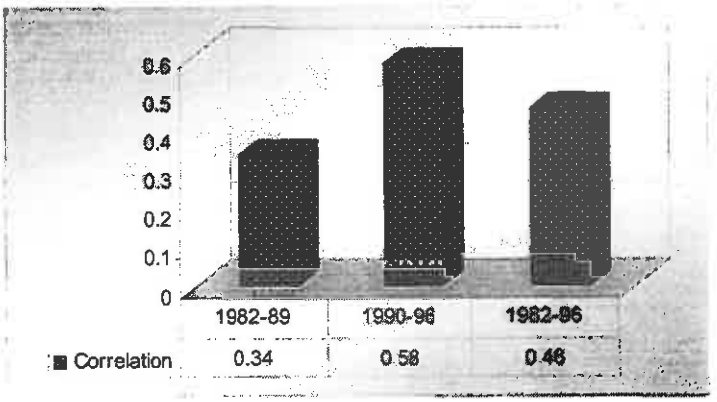

Figure 5-3
Correlation between US$ and Yen

5.5.2 Correlations of inflation rates

The Consumer Price Index (CPI) proxied inflation rates and where unavailable the nearest available alternative was chosen. In table 5.4 the index used in each case is listed.

Table 5-4

Data selected about Consumer Prices Index

Country	Name
Austria	OE CONSUMER PRICES - ALL ITEMS
Belgium	BG CONSUMER PRICES - ALL ITEMS
Denmark	DK CONSUMER PRICES - NET PRICE INDEX:TOTAL
France	FR CONSUMER PRICES - ALL ITEMS
Germany	BD CPI - EXCLUDING ENERGY (WEST)
Greece	GR CONSUMER PRICES - ALL ITEMS
Italy	IT CONSUMER PRICES-ALL ITEMS
Holland	NL CONSUMER PRICES - ALL ITEMS
Spain	ES CONSUMER PRICES - ALL ITEMS
Sweden	SD CONSUMER PRICES - ALL ITEMS
UK	UK CONSUMER PRICES - ALL ITEMS
Ireland	IR CONSUMER PRICES - ALL ITEMS
Portugal	PT CONSUMER PRICES - ALL ITEMS LESS RENT
Finland	FN CONSUMER PRICES - ALL ITEMS
USA	US CONSUMER PRICES - ALL ITEMS
Japan	JP CPI - ALL ITEMS INCLUDING IMPUTED RENT

The inflation rate or change in consumer prices was calculated as a return in the following way:

$$R_{INF}^{i} = \frac{CPI_{t+1}^{i}}{CPI_{t}^{i}} - 1 \qquad \text{Equation 5.3}$$

Where CPI_t^i is the Consumer Price Index of country i at time t. The correlation analysis was based on the monthly inflation rates.

Table 5.5 shows the correlations of inflation rates between E.U. countries, between E.U. countries and U.S. and between E.U. countries and Japan. Within the E.U. the table displays the correlations between each country and a weighted (by GDP) index of E.U. inflation rates.

Table 5-5

Correlations of national inflation rates

Country	Correlations with the EU index			Correlations with USA			Correlations with Japan		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.15	0.10	0.13	0.25	0.19	0.23	0.27	0.58	0.38
Germany	0.28	0.05	0.14	0.20	-0.03	0.10	0.02	-0.22	-0.07
France	0.39	0.26	0.36	0.20	0.58	0.33	0.21	0.55	0.29
Small									
Holland	0.14	0.16	0.11	0.09	0.46	0.22	0.35	0.42	0.37
Italy	0.32	0.22	0.31	0.13	0.30	0.20	0.22	0.08	0.18
Sweden	0.25	0.20	0.24	0.28	0.43	0.34	0.18	0.28	0.22
Spain	0.18	0.12	0.20	0.05	0.36	0.15	0.00	0.17	0.05
Belgium	0.35	0.18	0.30	0.35	0.39	0.37	0.23	0.00	0.15
Denmark	0.17	0.18	0.21	0.12	0.43	0.23	0.26	0.44	0.30
Finland	0.29	0.28	0.33	0.30	0.52	0.38	0.24	0.33	0.26
Ireland	0.44	0.14	0.39	0.21	0.09	0.21	0.08	0.11	0.09
Austria	0.17	0.13	0.14	0.15	0.10	0.13	-0.22	-0.31	-0.25
Portugal	0.28	0.34	0.32	-0.17	0.36	-0.01	-0.13	0.27	-0.03
Greece	0.15	0.06	0.13	-0.02	0.23	0.08	0.36	0.46	0.39

The results shows that the average correlations of inflation rates between European Union countries decreased from under 0.4 in the first period to under 0.3 in the second period. In the first period the inflation rates correlations were lower between European countries and the U.S. and Japan than they were among European countries (Table 5.5). In the second period there was a sharp increase for most countries in extra E.U. correlations (Figure 5.4), indicating a more global (world) integration in inflation rates in the 1990s than in the 1980s.

There were marked exceptions. In the case of Germany, external correlations fell and even became negative over the period, echoing the low German correlation with the U.S..

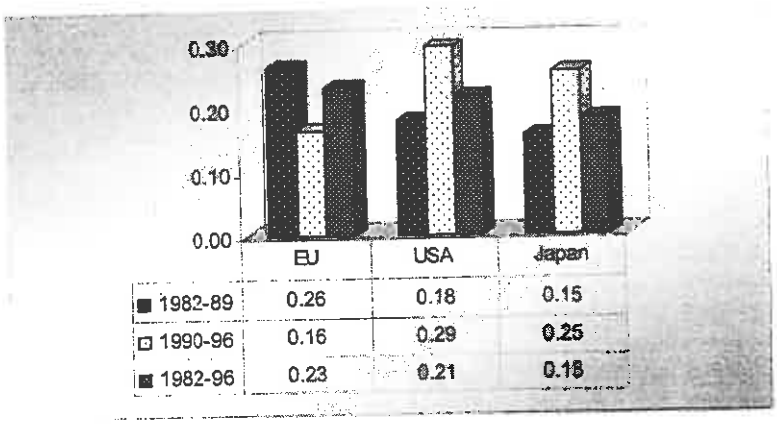

Figure 5-4

Average of inflation rates correlations between E.U. countries and between E.U. countries and U.S. and Japan. In the case of E.U. it is the average of correlations between each country and the E.U. weighted index of inflation rates

The correlation of U.S. and Japanese inflation rates was almost the same in both sub-periods (in 1982-89: 0.3, and in 1990-96: 0.29) and the average of correlations between E.U. countries and the U.S. is higher than the average of correlations between E.U. countries and Japan (Table 5.5).

Although one of the E.U. convergence criteria was based on the approximation of national economies to the average European inflation rate, the correlation results seem to reflect more a globalisation process (the correlations of inflation rates between E.U. countries decreased on average from the 1980s to 1990s).

However the level of dispersion of correlations between E.U. countries decreased, which means that the correlations although low, were more similar. However, dispersion in correlations of inflation between the E.U. and the U.S. and Japan, respectively, were higher than among E.U. countries and in addition they increased strongly from the first to the second period (Figure 5.5).

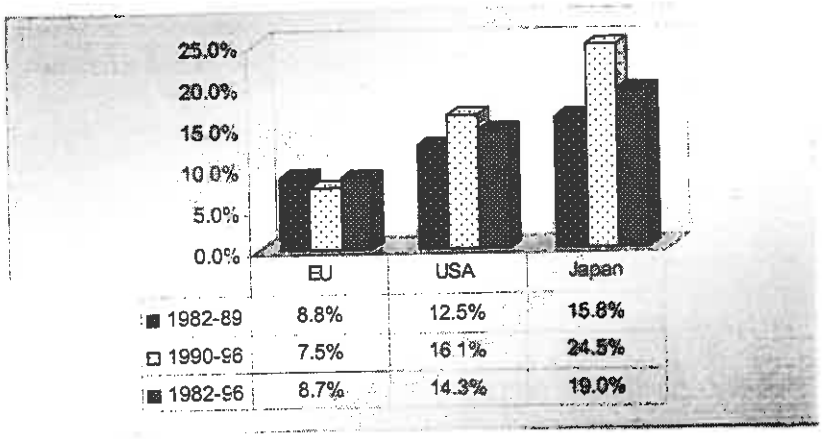

Figure 5-5

Standard deviation of inflation rates correlations

5.5.3 Correlations of government bond rates

The comparison used was 5-year bonds and where this is not available the nearest substitute was used. This resulted in the selected variables in table 5.6.

Table 5-6

Data selected about government bonds

Country	Name
Austria	OE GOVERNMENT BOND YIELD
Belgium	BG CENTRAL GOVERNMENT BOND - 5-YEAR
Denmark	DK GOVERNMENT BOND YIELD(5 YEAR GOVT.BONDS)
France	FR GOVERNMENT BOND YIELD
Germany	BD YLD.ON 2ND MARKET PUBLIC BONDS- 3 TO 7 YEARS (EP)
Greece	GR DISCOUNT RATE
Italy	IT GOVERNMENT BOND YIELD-MEDIUM-TERM(4-6 YEAR)
Holland	NL GOVERNMENT BOND RATE - SHORT TERM, 3-5 YEAR
Spain	ES SECONDARY MARKET(2+ YEARS)GOVT.BONDS-YLD
Sweden	SD GOVERNMENT BOND YIELD(10 YEARS & OVER)
UK	UK AVERAGE GROSS REDEMPTION YIELD ON 5 YR GOV.SECS
Ireland	IR CENTRAL GOVERNMENT BONDS - 5-YEAR (EP)
Portugal	PT GOVERNMENT BOND YIELD
Finland	FN TAXABLE PUBLIC BONDS - 3- TO 6-YEAR
USA	US TREASURY YIELD ADJUSTED TO CONSTANT MATURITY - 5 YEAR
Japan	JP GOVERNMENT BENCHMARK BOND YIELD - 8 TO 10 YEAR (EP)

Table 5.7 displays the correlations of Government bond rates between E.U. countries, between E.U. countries and the U.S., and between E.U. countries and Japan. Within the E.U. the table displays the correlations between each country and a weighted (by GDP) index of E.U. Government bond rates.

Table 5-7

Correlations between government bond rates

Country	Correlations with the EU index			Correlations with USA			Correlations with Japan		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.67	0.78	0.70	0.74	0.88	0.80	0.68	0.87	0.83
Germany	0.81	0.86	0.64	0.85	0.70	0.48	0.87	0.95	0.77
France	0.81	0.88	0.76	0.87	0.76	0.91	0.92	0.91	0.89
Small									
Holland	0.85	0.88	0.77	0.85	0.68	0.59	0.84	0.95	0.83
Italy	0.82	0.67	0.73	0.82	0.27	0.74	0.94	0.59	0.82
Sweden	0.58	0.75	0.60	0.63	0.84	0.73	0.63	0.76	0.70
Spain	0.76	0.85	0.75	0.82	0.62	0.82	0.78	0.83	0.83
Belgium	0.85	0.89	0.82	0.89	0.74	0.89	0.94	0.95	0.93
Denmark	0.70	0.89	0.73	0.80	0.69	0.85	0.79	0.88	0.83
Finland	0.59	0.89	0.72	0.62	0.60	0.66	0.69	0.91	0.84
Ireland	0.76	0.86	0.72	0.80	0.70	0.88	0.82	0.82	0.81
Austria	0.82	0.88	0.79	0.79	0.61	0.62	0.84	0.93	0.87
Portugal	0.51	0.84	0.69	0.59	0.57	0.67	0.61	0.95	0.84
Greece	0.36	-0.04	0.18	0.36	-0.10	0.28	0.49	0.02	0.29

The results (Table 5.7 and Figure 5.6) display that the correlations between Government bonds rates are the highest among economic and monetary variables, whether it is between E.U. countries or with the U.S. or Japan, underlining the emergence of a global market in risk free products no longer influenced by exchange restrictions.

The increase in the correlation of bond rates is in contrast with the small decrease in the correlations between inflation rates from the 1980s to the 1990s. This can be explained by expectations about the future inflation rates. We should expect a link between the behaviour of theses two variables: bond rates and inflation rates. Because we used medium and long-term bond rates, they should partially reflect the investors' expectations about future inflation rates. As European integration increases, investors

should expect more similar behaviour between European future inflation rates, even though the current correlations between inflation rates are temporarily decreasing. The correlations between bond rates should reflect these expectations.

As correlations don't reflect absolute differences so the bonds lead inflation expectations, proportionate bond variance on a smaller base become larger and correlations less.

The correlations between E.U. and U.S. bonds rates generally decreased from the first to the second period, whereas the correlations among E.U. bonds rates and between them and Japan bonds rates increased from the 1980s to 1990s. Nevertheless the correlations between bonds rates seem to be high and very similar between all these markets.

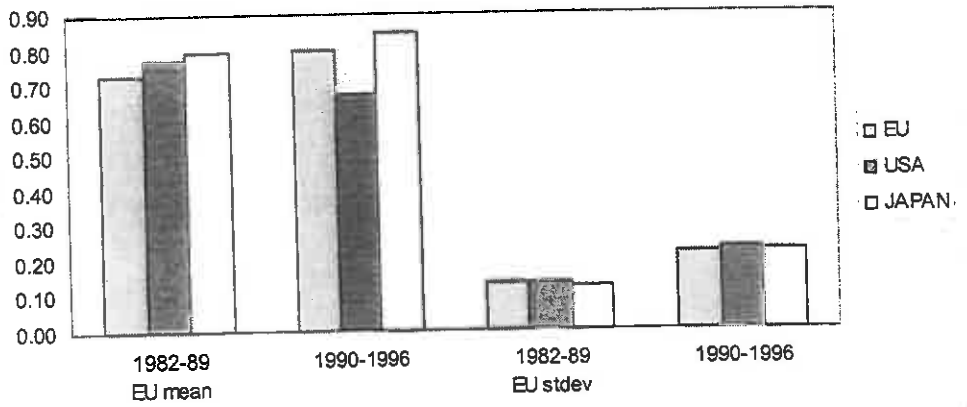

Figure 5-6

Average correlations and standard deviation of correlations between government bonds rates

The interesting feature of this summary (Figure 5.7) is the outlier nature of two economies whose entry into Euro-mechanism was not anticipated at the beginning of

the second sub-period. Greece and Italy have low and falling correlations, reflecting the major revisions in monetary policy as they aligned to European patterns. In both cases the decline in interest differentials relative to "core" E.U. countries was large.

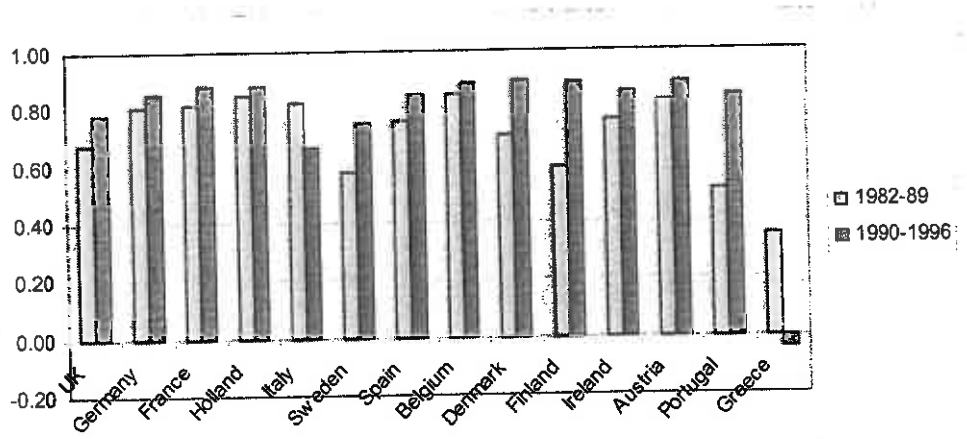

Figure 5-7
European average of bond correlations per European country

5.5.4 Correlations of rate of growth of GDP

The rate of growth of GDP was also considered again correlating changes of E.U. members against the E.U. weighted index and with growth in the U.S. and Japan. The GDP data is defined to be as close to a real international standard and reflects changes in national GDP. This data is provided by OECD (Main Economic Indicators – Statistics Directorate) at current prices expressed in U.S. dollars. The rate of growth was calculated using the following expression:

$$R^{i}_{GDP} = \frac{GDP^{i}_{t+1}}{GDP^{i}_{t}} - 1 \qquad \text{Equation 5.4}$$

Where:

R^i_{GDP} = rate of growth of GDP of country i at month t

GDP^i_t = Gross Domestic Product of country i at month t

Correlations were on growth of GDP using annual data. The correlations between growth rate of GDP for E.U. members (Table 5.8) were higher with the weighted E.U. index rate than they were with the U.S. or Japanese rates. The correlation of growth between the E.U. and U.S. is very small in a large number of cases and negative in other cases. However the correlation between E.U. countries and Japan were in some cases very high in the first sub-period, although there were large decreases from the first to the second period in some E.U. countries.

Table 5-8

Correlations between rates of growth of GDP

Country	Correlations with the EU index			Correlations with USA			Correlations with Japan		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	0.10	0.04	0.28	-0.05	0.73	0.55	0.29	-0.19	0.29
Germany	0.43	0.54	0.53	0.78	-0.09	0.31	0.63	0.48	0.53
France	0.50	0.62	0.66	-0.13	-0.21	0.20	0.86	0.69	0.81
Small									
Holland	0.35	0.59	0.53	0.73	0.26	0.49	0.43	0.56	0.52
Italy	0.59	0.63	0.67	0.45	-0.15	0.31	0.92	0.62	0.74
Sweden	0.34	0.34	0.47	0.57	0.29	0.51	0.51	0.32	0.54
Spain	0.45	0.39	0.50	-0.10	-0.56	0.08	0.58	0.82	0.82
Belgium	0.65	0.52	0.55	0.20	0.11	0.25	0.92	0.41	0.59
Denmark	-0.12	0.00	0.01	0.08	-0.16	0.09	0.06	0.07	0.11
Finland	0.60	-0.15	0.14	0.10	0.35	0.38	0.88	-0.13	0.27
Ireland	0.59	0.55	0.27	0.30	0.37	0.00	0.91	0.20	0.10
Austria	0.40	0.51	0.49	-0.17	-0.04	0.02	0.56	0.77	0.67
Portugal	0.31	0.57	0.41	-0.46	-0.20	-0.22	0.46	0.56	0.48
Greece	0.54	0.40	0.37	0.44	-0.34	0.12	0.79	0.22	0.33

The level of dispersion of these correlations was very high compared with the other economic and monetary variables examined. This is evident especially for correlations between E.U. countries and U.S. and Japan (Figure 5.8).

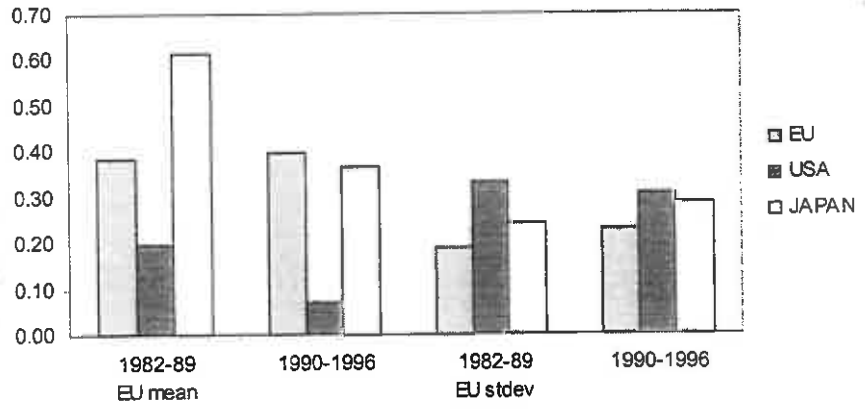

Figure 5-8

Mean and standard deviation of correlations between growth GDP rate. The E.U. mean is the average of correlations between each country and the E.U. index of GDP growth rates

Although the correlations across European countries indicate that growth for most countries was more similar to E.U. norms than with the U.S. or Japan, two countries were desynchronised with the growth of other E.U. countries. In the first period, the U.K. and Denmark were weakly correlated or negatively correlated with other E.U. countries and also with the U.S. and Japan. In the second period Finland was negatively correlated with other E.U. countries due to structural changes in the economy.

5.5.5 Trade

Trade openness provides another measure of convergence amongst countries aspiring to monetary union (Mundell 1961, Krugman and Obstfeld 1997). The data summarised in Table 5.9 shows for each EMU member the proportion of trade with all members in the E.U. block.

Table 5-9
Trade with E.U. countries as % of the world trade for each country
(Trade = imports + exports)

Country	1982-89	1990-96	Change
Austria	61.1%	67.5%	10.5%
Belgium	70.8%	74.7%	5.5%
Denmark	49.3%	60.6%	22.9%
France	55.9%	62.6%	11.9%
Germany	51.1%	55.2%	8.2%
Greece	55.8%	63.5%	13.9%
Italy	50.6%	58.5%	15.5%
Holland	67.0%	69.2%	3.4%
Spain	49.5%	65.1%	31.5%
Sweden	52.4%	58.4%	11.4%
UK	48.5%	54.6%	12.5%
Ireland	69.3%	68.3%	-1.4%
Portugal	58.0%	74.8%	28.9%
Finland	41.5%	52.7%	27.1%

The first point to note about this table is that total trade of the E.U. bloc is on average more than 60% between E.U. countries. The table also shows that the trade increased from the 1980s to 1990s for all countries with only one exception, Ireland with a very small decrease. However, Irish trade with E.U. countries remains very high. The European bloc is a segmented trading economy relative to the outside world, unsurprising given geographical closeness. If we look at the countries individually, we see that all of them had more than 50% of their trade with other members of European Union in the 1990s.

Comparing the part of trade between U.S., Japan and E.U. as a group, the results (Table 5.10) display two situations. First the percentage of total trade of the U.S. or Japan with the E.U. is not more than 20%. Second this percentage remained stable for the U.S. and Japan in our two periods.

Table 5-10
Trade with E.U. countries as % of the world trade for U.S. and Japan
(Trade = imports + exports)

Country	1982-89	1990-96	Change
USA - EU	20.3%	20.0%	-1.5%
Japan - EU	12.3%	15.8%	28.5%
USA - Japan	15.8%	14.6%	-7.6%
Japan - USA	28.5%	26.4%	-7.4%

5.5.6 Commercial integration

The aim of this section is to analyse the level of commercial integration between E.U. countries, the U.S. and Japan. Commercial integration is assumed to be proxied by the size of the surplus or deficit on trade relative to total trade (import and export) between each country pairs.

Some countries grow faster than others. Such differences in growth rates could lead to a problem when countries form a monetary union. De Grauwe (1997) illustrates that if the Ireland GDP growing at 6% per year compared with France at 2% and with equal income elasticities for imports from each other, Ireland will incur an unsustainable trade deficit. To capture this type of possibility, we investigate the trade imbalance or deficit as an indication of integration as an addition to our earlier interest in total trade.

To define the level of commercial integration, the size of the trade deficit in terms of total trade between two countries was used.

Ratio of Commercial integration = Commercial Deficit (exports-imports) / Total Trade

The idea behind this definition is that when two economies are commercially highly integrated, the volume of trade transactions between them rises and their economies therefore will encounter rapid feedback from shifts in relative competitiveness. This leads to the expectation that trade imbalance between economically integrated economies should be small.

The results (Figure 5.9) show that generally E.U. countries have a much lower trade imbalance between themselves than they have with the U.S. or Japan. This is particularly true of the large E.U. countries. Small countries, such as Portugal, Finland, Ireland, Spain and Greece notably have higher imbalances in their trade within the European Union (Table 5.11).

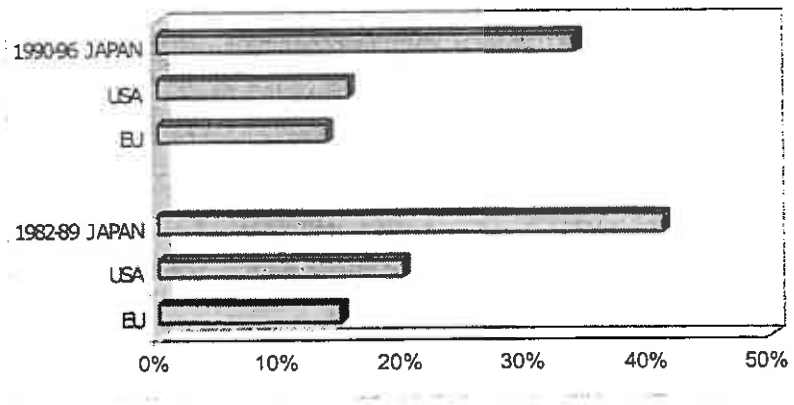

Figure 5-9
Trade imbalance: simple average of European countries

From the first sub period to the second large European countries became commercially somewhat more "integrated", i.e. the proportionate imbalance in trade decreased. In

contrast small countries increased the proportionate imbalance of trade possibly because they were able to sustain this through better access to financing.

European countries in general have smaller intra E.U. trade imbalances than their external imbalances with the U.S. and Japan. This is consistent with more integration, especially for large E.U. countries. The country most integrated with the U.S., as measured by proportionate imbalances, was the U.K. and the least integrated was Holland. Japan has higher imbalances with the majority of E.U. countries and with the U.S. than intra-European imbalances (Table 5.11).

Table 5-11

Trade imbalances as % of trade. For E.U. the simple mean was used

Country	Imbalance trade: EU mean			Imbalance trade with USA			Imbalance trade with Japan		
	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96	1982-89	1990-96	1982-96
Large									
UK	12%	11%	12%	6%	6%	6%	46%	29%	35%
Germany	18%	9%	12%	30%	20%	24%	47%	40%	43%
France	8%	9%	9%	10%	4%	7%	49%	43%	45%
Small									
Holland	13%	11%	11%	38%	43%	41%	44%	19%	30%
Italy	12%	8%	9%	27%	27%	27%	39%	5%	13%
Sweeden	15%	13%	14%	31%	28%	29%	5%	4%	4%
Spain	14%	19%	17%	14%	20%	17%	76%	77%	77%
Belgium	13%	11%	11%	25%	33%	30%	57%	58%	57%
Denmark	16%	10%	12%	30%	13%	20%	66%	68%	67%
Finland	19%	17%	16%	24%	15%	19%	4%	17%	13%
Ireland	22%	33%	29%	23%	4%	10%	0%	27%	15%
Austria	16%	13%	14%	22%	6%	11%	14%	2%	3%
Portugal	19%	21%	20%	21%	4%	12%	35%	24%	28%
Greece	26%	42%	36%	17%	38%	29%	41%	36%	38%

5.6 CORRELATION OF STOCK RETURNS WITH CORRELATION OF ECONOMIC AND MONETARY VARIABLES

The first aim of this section is to investigate whether countries with high levels of correlation of economic and monetary characteristics also have greater correlation in their equity markets.

The second aim is to see which economic and monetary variables are significant in accounting for connections between correlations of economic and monetary indicators and stock market correlations.

Chapter 4 provides some evidence that correlations between European stock markets have increased between 1982-89 and 1990-96, and the level of correlations between E.U. markets is higher than for E.U. markets with U.S. or Japanese markets.

In the earlier part of this chapter, we investigated a number of economic indicators showing that E.U. correlations for five indicators of economic activity were lower against the U.S. and Japan or between the U.S. and Japan.

Based on the literature (Solnik 1984, Asprem 1989, Tucker et al. 1991, Ratner and Leal 2000), we should expect a positive relationship between the correlation of economic and monetary indicators and the level of correlation of stock market returns.

To investigate this issue the following multiple regression model was used:

$$C(R^i : R^j) = \alpha + \beta_1 C(exr^{i/SFr} : exr^{j/SFr}) + \beta_2 C(GDP^i : GDP^j) +$$

$$\beta_3 C(Inf^i : Inf^j) + \beta_4 C(Bonds^i : Bonds^j) + \beta_5 ComDef^{i,j}$$

The dependent variable $C(R^i : R^j)$ is the correlation coefficient of returns of each pair of E.U. markets, and the independent variables are:

- $C(exr^{i/SFr} : exr^{j/SFr})$ - Correlation of the rate of change in exchange rates between countries *i* and *j*
- $C(GDP^i : GDP^j)$ - Correlation of growth rates of GDP between countries *i* and *j*
- $C(Inf^i : Inf^j)$ - Correlation of inflation rates between countries *i* and *j*
- $C(Bonds^i : Bonds^j)$ - Correlation of bond rates between countries *i* and *j*
- $ComDef^{i,j}$ – Imbalance trade (Commercial Deficit / total trade) between countries *i* and *j*

The correlations were calculated pairwise for the 14 countries for each variable (5 economic and market returns), giving a total of 91 * 6 correlations for each time window.

Among European countries, the results (Tables 5.12) corroborate the existence of a positive correlation between stock markets and economic variables. This was confirmed for both sub-periods and in the entire period.

Table 5-12

Results of the multiple regression model

Model Results	1982-89	1990-96	1982-96
Adjusted R^2	0.35	0.63	0.43
df	90	90	90
F	10.6	31.1	14.4
Sig.	.000(a)	.000(a)	.000(a)
(a) significant at 95%			

Analysing the beta coefficients, three variables were significant in the first period (Table 5.13).

Table 5-13

Beta coefficients of multiple regression model between returns correlations and correlations of four economic-monetary variables and imbalance trade

Period	Independente variables	Standardized Beta	t value	Sig.
1982-89	(Constant)	0.08	0.85	0.398
	EXR	0.10	1.02	0.309
	GDP	-0.04	-0.46	0.645
	INF	0.24	2.47	0.016
	BOND	0.27	2.87	0.005
	DEF	-0.35	-3.84	0.000
1990-96	(Constant)	0.15	2.88	0.005
	EXR	0.27	4.03	0.000
	GDP	0.13	1.86	0.066
	INF	-0.03	-0.46	0.647
	BOND	0.75	8.93	0.000
	DEF	-0.08	-0.93	0.356
1982-96	(Constant)	0.11	1.52	0.132
	EXR	0.24	2.92	0.004
	GDP	0.16	1.99	0.05
	INF	0.04	0.44	0.66
	BOND	0.37	3.75	0.000
	DEF	-0.25	-2.70	0.008

Table 5.13 shows some differences between the significance of the correlations between economic and monetary variables across countries and the stock market correlations among the two subperiods. First, the correlations of exchange rates become a significant variable for the stock market correlations in the 1990s, although following the SME crisis in 1992-93, E.U. exchange rates become more stable, because of expectations that countries join the Euro programme.

Secondly, imbalanced trade doesn't seem to be a significant factor in the stock market integration in the second subperiod. However, when we analyse the variance-covariance matrix between the correlations of the five factors (Table 5.14), the results show that

imbalance trade is highly correlated (-0.59) with the bond rates, in the second subperiod (-0.59 = -0.363 / (sqrt 0.1177 * sqrt 0.0317)).

Table 5-14

Variance-covariance matrix of correlations between economic and monetary variables

Variables	Bond rates	Inflation rates	Exchange rates	GDP growth rates	Imbalance trade
1982-89					
Bond rates	0.0339				
Inflation rates	0.0074	0.0310			
Exchange rates	0.0120	0.0102	0.0322		
GDP growth rates	0.0038	0.0244	0.0091	0.1299	
Imbalance Trade	-0.0072	0.0009	-0.0048	0.0047	0.0186
1990-96					
Bond rates	0.1177				
Inflation rates	0.0152	0.0512			
Exchange rates	-0.0127	-0.0026	0.0315		
GDP growth rates	0.0106	0.0143	0.0128	0.1465	
Imbalance Trade	-0.0363	-0.0002	0.0055	-0.0012	0.0317
1982-96					
Bond rates	0.0516				
Inflation rates	0.0133	0.0350			
Exchange rates	0.0071	0.0045	0.0240		
GDP growth rates	0.0053	0.0102	0.0054	0.0808	
Imbalance Trade	-0.0170	0.0025	-0.0027	-0.0031	0.0267

Although weak multicollinearity exists between the five factors (analysed in the next section), we studied the individual relationship between each factor and the stock market correlations, using a simple regression. The results (Table 5-15) show that the imbalance in trade has a significant relationship with the stock market integration in all periods.

Table 5-15

Results of simple regressions between correlations of stock markets and correlations of each economic and monetary variables

Variable	Period	R^2	Adj. R^2	Df	Sig.	Beta	P-value
Rate of GDP	1982-89	0.00	-0.01	90	0.95	0.00	0.00
	1990-96	0.08	0.07	90	0.00	0.11	9.88
	1982-96	0.04	0.03	90	0.02	0.12	5.53
Exchange rates	1982-89	0.03	0.03	90	0.05	0.19	4.05
	1990-96	0.05	0.04	90	0.02	0.17	5.90
	1982-96	0.09	0.08	90	0.00	0.27	11.64
Inflation rates	1982-89	0.06	0.06	90	0.01	0.31	8.07
	1990-96	0.00	-0.01	90	0.62	0.03	0.26
	1982-96	0.04	0.04	90	0.02	0.18	5.45
Bond rates	1982-89	0.21	0.20	90	0.00	0.54	31.28
	1990-96	0.45	0.44	90	0.00	0.31	94.52
	1982-96	0.26	0.26	90	0.00	0.38	42.15
Inbalance Trade	1982-89	0.19	0.19	90	0.00	-0.68	21.44
	1990-96	0.22	0.22	90	0.00	-0.38	25.74
	1982-96	0.21	0.20	90	0.00	-0.44	23.29

The difference observed in correlations of inflation rates between both periods is consistent with the results of chapter 4 (the increase in stock market correlations) and the results of section 5.5.2 (the decrease in the inflation rate correlations).

For Government bond rates, results were significant in all periods, which means that in the majority of pairs of countries a high bond return correlation was associated with a high equity return correlation.

- Solnik et al. (1996, p. 31) argue that "Stock markets could be increasingly correlated when interest rates move together worldwide. The German stock market might become increasingly correlated with the French stock market at the same time that German and French bond markets become increasingly synchronised".

Over the entire period correlations of exchange rates, bonds and commercial deficit show significant influence on the correlation of returns.

5.7 MULTICOLLINEARITY BETWEEN THE ECONOMIC AND MONETARY VARIABLES

Multicollinearity arises when two or more variables (or combinations of variables) involved in the equation are highly (but not perfectly) correlated with each other and this makes interpretation of the coefficients quite difficult (Pindyck and Rubinfeld, 1998).

Given the nature and consequences of multicollinearity, it is a question of degree and not of kind. "The meaningful distinction is not between the presence and the absence of multicollinearity, but between its various degrees" (Gujarati, 1995).

Since multicollinearity is essentially a sample phenomenon, we do not have one unique method of detecting it or measuring its strength. The measures that we used to diagnose multicollinearity were Tolerance (TOL) and variance inflation factor (VIF). For the k-variable regression model (Y, intercept, and k-1 regressors), the variance of a partial regression coefficient can be expressed as:

$$\text{var}(\beta_j) = \frac{\sigma^2}{\sum X_j} \cdot \left(\frac{1}{1 - R^2{}_j} \right) \qquad \text{Equation 5.5}$$

$$\text{var}(\beta_j) = \frac{\sigma^2}{\sum X_j} VIF_j \cdot \qquad \text{Equation 5.6}$$

Where

β_j - is the partial regression coefficient of the regressor X_j

R^2_j – is the R^2 in the auxiliary regression of X_j on the remaining k-2 regressors

VIF – is the variance-inflation factor

As R^2_j increases toward unity, that is, as the collinearity of X_j with the other regressors increases, the VIF also increases and in the limit it can be infinite. The larger the value of VIF_j, the more collinear is the variable X_j. As a rule of thumb, if the VIF of a variable exceeds 10, that variable is said to be highly collinear (Gujarati, 1995).

The measure of tolerance (TOL) is defined as

$$TOL_j = (1 - R^2_j) \qquad \text{or} \qquad TOL_j = (1/VIP_j) \qquad \text{Equation 5.7}$$

$TOL_j = 1$ if X_j is not correlated with the other regressors, whereas it is zero if it is perfectly related to the other regressors.

The results (Table 5.16) show that there is no serious multicollinearity between the regressors, because all values of VIF are comparatively very small to the value of 10 expressed by the rule of thumb. Also values of Tolerance are near to one, which indicates absence of multicollinearity.

Table 5-16

Collinearity statistics

Independent Variables	1982-89		1990-96		1982-96	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Exchange rates	0.791	1.264	0.907	1.103	0.940	1.064
Rate of growth of GDP	0.844	1.185	0.924	1.082	0.948	1.055
Inflation rates	0.757	1.322	0.918	1.090	0.801	1.248
Bond rates	0.798	1.253	0.596	1.677	0.657	1.522
Inbalance trade	0.882	1.134	0.631	1.586	0.728	1.373
Dependent Variable: Correlations between stock market returns						

5.8 CONCLUSIONS

European economic and monetary integration was investigated by calculating the level of correlation of economic and monetary variables between E.U. countries, E.U. countries and the U.S. and Japan, and between the U.S. and Japan. We also examined whether countries that exhibit high correlations of economic and monetary variables also exhibit high correlations between their stock markets.

The results show that monetary variables for countries within the European Union are more correlated with each other than they are with the U.S. and Japan or Japan with the U.S.. The European countries showing the highest affinity with E.U. patterns are France and Belgium and the least affinity is shown by Greece and the U.K.. Portugal, Denmark, Holland and the U.K. became noticeably more integrated in the 1990s than in 1980s.

All economic and monetary variables have become more similar within the E.U. in contrast with those between the E.U. and the U.S. or Japan, measured by the level of dispersion of correlations observed in each variable.

This seems to indicate that E.U. countries are more integrated with each other than with the two largest economies outside the E.U.. Although we used a different approach this corroborates the Freimann (1998) results of a trend toward "integration" in the E.U. over time and above global effects. The connection between correlations of economic and monetary variables and correlations of stock returns was also analysed using a multiple regression model, with the correlation coefficient of returns of each pair of markets as the dependent variable and correlations between economic and monetary indicators (exchange rates, inflation rates, Government bond rates, and growth rate of

GDP, and Commercial Deficit / total trade) for each pair of countries as independent variables.

The results indicate a positive correlation between stock markets returns correlation and economic variable correlation in both sub-periods and in the entire period. These results indicate that countries that share common economic and monetary characteristics also have more correlation in their equity market returns.

The adjusted R^2 of the multiple regression model is high and the ANOVA F test is significant in both sub periods and in the entire sample period. The results show that there is no serious multicollinearity between the regressors, because all values of VIF are comparatively very small to the value of 10 expressed by the rule of thumb.

Analysing the beta coefficients from the regression model, the results show that beta of exchange rates, bonds and the imbalance trade are significant. Solnik (1984) found a weak relation between currency movements and stock markets returns in the period 1971-82. However our results are for the period 1982-96. The results are also consistent with previous findings (Cheng and Zhang 1997, Ratner and Leal 2000) although we used a different approach and different sample.

In relation to inflation rates we found a decrease in correlations between E.U. countries from the 1980s to 1990s whereas Tucker et al. (1991) found an increase from the 1970s to 1980s. It was the only variable that correlations between E.U. countries haven't increased from the 1980s to 1990s.

In summary countries within the European Union are shown to have closer economic and monetary linkages with each other than they have with the U.S. or Japan. Generally

correlations were also higher between larger European countries within the E.U. than between small E.U. countries. The results also show that countries with correlated economic and monetary variables have high correlations between their stock market returns.

CHAPTER 6 EVOLUTION OF EUROPEAN SYSTEMATIC RISK

6.1 PURPOSE OF THE CHAPTER

The purpose of this chapter is to analyse the European systematic risk components of volatility within each E.U. stock market. The approach is based on the analysis of betas between returns in each E.U. stock market and returns on the European Index, "where beta, or systematic risk, is the time series regression coefficient relating rates of return of individual securities and/or portfolios to the overall stock market rates of return" Robichek and Cohn (1974, p. 439).

The E.U. security markets account for 28% of world market capitalisation with the U.S. accounting for almost 45% and the Japanese stock market a further 18%, so we also examine European betas both against Japan and the U.S.. Capitalisation is based on Morgan Stanley Capital International data (Figure 6.1).

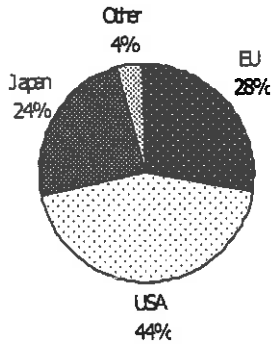

Figure 6-1
Market capitalisation: % of the world market in 1998
(Source: Morgan Stanley Capital International)

The research question ask whether economic and monetary integration in Europe is creating a more homogeneous group of countries exhibiting more similar (and higher) systematic risk against the common European benchmark than against the U.S. and Japanese markets. If European integration is a powerful phenomena the progress of economic, monetary and financial integration in Europe should be marked by a progressive increase in the value of member countries betas with respect to volatility in the European Union as a whole.

The study considered the systematic risk given by betas of each European country in three parts, based on a multi-index model:

- With the European Union weighted index;
- With the American stock market; and
- With the Japanese stock market.

Multi-index models introduce extra indices in circumstances where risk pricing is not solely determined within a single national market (Roll and Ross, 1984). As cross border investment grows, investors are able to diversify their national risk so the behaviour of non-national markets should provide additional information. The multi-index return model allows us to observe the betas behaviour of each European country against the European benchmark and against American and Japanese markets simultaneously and compare the values across countries and over time.

Because of the potential multicollinearity between the variables, the multi-index return model with three variables was also decomposed in three single-index return models based on the European benchmark, U.S. market and Japanese market. For these single-index models the same analysis is repeated. The aim is to clarify the European betas

independently of the American or Japanese markets. The assumption underlying the single-index model is that national stock prices move together only because of a common movement with a "global" market (Sharpe, 1963).

The results of European economic and monetary integration analysed in Chapter 5 and also based on the conclusions of European cross countries correlations analysed in chapter 4 lead us to expect that:

- There should be an increase in the proportion of risk occurred for the European systematic risk between the 1980s and the 1990s for all of E.U. stock markets;
- The process of integration should be reflected in beta coefficients for European markets against the European benchmark that are much larger than beta coefficients against U.S. and Japanese markets;
- The difference between the betas with the European benchmark and the betas with other markets (U.S. and Japan) should grow from the first to the second period;
- Betas, especially for large European stock markets, should be significant;

Based on the empirical evidence of chapter 4 we also expect different changes for betas of small and large capital markets and this is again accomplished by separating European markets in size groups.

This chapter is structured in the following way. Section one discusses the purpose of the chapter and expected results from earlier literature and previous chapters. In section two the previous works are discussed and in section three the data is presented. In section four the methodology is described, while in section five the empirical results are discussed.

6.2 PREVIOUS WORKS

In this section we examine the literature in both single-index model and multi-index models. Several models are discussed as well as some empirical evidence on their results. We also included a discussion of some multi-index models using fundamental (economic) data that have been developed as a step toward building a general equilibrium model of security returns.

Two approaches are used to calculate the systematic and specific risk: One is based on the single-index model developed by Sharpe (1963), which assumes that stocks move together only because of a common co-movement with the market. The other is the multi-index model, which is an attempt to capture additional influences that cause securities to move together Ross (1976). This utilises a set of indices (economic factors or portfolio groups, for example industries) that account for common movements in stock prices beyond that accounted for the market index itself.

An early exponent of multi-index modelling was King (1966), who found that extra market covariance was associated with industries over and above market effects. He found that over time in the period studied, 1927-60, about half of the total variation in a stock's price was accounted for by the market index while an average of another 10% was accounted by industry factors.

Cohen and Pogue (1967) examined the use of the specialised multi-index model based on standard industrial classifications. Single index models and a multi-index model with a market index and industry index were then used. They concluded that compared with the multi-index model the single-index model provides lower estimates of risk and is much simpler to use.

Agmon and Lessard (1977) used regression analysis to test a multi-index model on portfolios of U.S. multinational stocks, based on the national index and the world index. They found that the estimates of beta parameters were usually statistically significant, implying that both indices influence returns. According to the authors, this finding suggests that movements in stock returns can best be described by a two-factor model rather than by the sole use of either a national index or a world index.

They hypothesised that the sensitivity of multinational corporations (MNCs) to the national or world market would depend on their degree of multinationality. MNCs with a greater degree of international business are expected to be less sensitive to the national market and more sensitive to the world market than domestic companies. The authors found that the influence of the national U.S. index was lower than that of the world index for portfolios of MNCs with a higher proportion of international business. The results support their hypothesis.

If companies with high exposure to international business in the 1960s and 1970s are more influenced by the world index than by the national index, we should expect that with an increased level of international trade in the 1990s national markets would be even more influenced by international factors.

Some of these issues have been explored in previous work using multi-index models. Chen, Roll, and Ross (1986) used time series of % changes in the following variables: inflation rates, the term structure of interest rates, risk premia (difference between returns on Aaa and Baa bonds), and change in industrial production for data from 1958 to 1984.

The aim was to investigate the sensitivity of stock returns to macroeconomic variables. Although they find that the macrovariables are significant explanatory influences on pricing, they do not claim to have found an optimal set of state variables for asset pricing.

Brumeister and McElroy (1988) have integrated tests of the factor models: CAPM and APT. The first APT test is constructed using a multi-index model where returns are assumed to be generated by the following five indices: Default risk (return on long-term government bonds - return on long-term corporate bonds), time premium (returns on long-government bonds – one month Treasury Bill rate), deflation (expected inflation - actual inflation), change in expected sales and the market return not captured by the first four variables as an error term. The data was monthly total returns (including dividends) from 1972 to 1982. They fitted the model to 70 firms and found that around 60% of the regression parameters β were significantly different from zero at the 5% level. The results show that the four factors account for about 25% (R^2 =0.24) of the S&P composite index and each of the four coefficients is significant. The results also show that default risk appears with a significant negative coefficient, whereas change in sales appears with significant positive coefficients. Deflation and time premium had an ambiguous impact on stock returns.

Berry, Brumeister and McElroy (1988) extended the work performed by Brumeister and McElroy (1988) using economic sectors and industrial sectors. They concluded that different sectors have different types of risk. For example, the financial sectors have a larger sensitivity to the default risk (measured by the beta of the default risk variable) than other sectors. Also they obtained different betas for the four variables from different industrial sectors.

Sorensen et al. (1989) used the following five economic and monetary variables to explain the return on securities:

- Economic growth (year-to-year changes in total industrial production)
- Business cycle (difference in return on corporate bonds and U.S. Treasuries)
- Long-term interest rates (the yield change in 10-year Treasuries)
- Short-term interest rates (the yield change in 1-month U.S. Treasury bills)
- Inflation shock (Changes in the Consumer Price Index (CPI)

Thomas (1988) assessed the sensitivity of returns for each stock market to world market returns. If stock markets are related, each national market would most likely be somewhat sensitive to the world market. Thomas suggests that for portfolios of international stocks, only the international systematic risk of the securities is relevant, since unsystematic risk can be diversified away by international diversification. He applied the following regression model to monthly data on 15 national markets:

$$R_N = \alpha_i + \beta_i R_w + u$$

Where ER_N - is the return of a particular national market, and R_w is the return of the world market, alpha is the intercept, beta is the slope coefficient estimating the sensitivity of the national market to the world market, and u is an error term.

His findings show that betas estimated were positive and significantly different from zero for all national markets. This result implies that each given national market is somewhat influenced by the world market. The average market beta estimated by applying the regression model separately to each national market was about 0.53. The adjusted R^2 ranged from 0.02 to 0.46. It was less than 0.20 for 12 of the 15 markets,

suggesting that the world market could explain only a small percentage of the variation in most national equity market returns.

Fama and French (1993) constructed a model to explain returns on both stocks and bonds. In addition to using the returns on a market portfolio of stocks, they use the returns on following other portfolios:

- The differences in return on a portfolio of small stock and a portfolio of large stocks
- The differences in return between a portfolio of high book to market stocks and a portfolio of low book to market stocks
- The difference between the monthly long-term government bond return and one-month Treasury Bill return
- The difference in the monthly return on a portfolio of long-term corporate bonds and a portfolio of long-term government bonds.

Note that all variables are either the return of portfolio of assets or the differences in the return of two portfolios of assets. They concluded that, at minimum, their results show that five factors do a good job explaining common variation in bonds and stock returns.

According to Elton and Gruber (1995) an important characteristic of these multi-index or APT models is that they are extremely general and in some way very different from each other. This generality is both a strength and a weakness. Although it allows us to describe equilibrium in terms of any multi-index model, it gives no evidence as to what might be an appropriate multi-index model. The question is that whereas for example for the single-index model and CAPM the correct index (I_k) is defined, for the multi-factor model and the APT the set of indices (I_k's) is not defined by the theory.

In the finance literature there are two solutions using the multi-index models. One is to estimate simultaneously I_k's and β_{ik}'s (Roll and Ross 1980, Cho et al. 1984, Dhrymes et al. 1984). An alternative solution is to specify a set of factors I_k's and then to estimate the β_{ik}'s (King 1966, Cohen and Progue 1967, Agmon and Lessard 1977, Fama and French 1993) using a multi-index model based on a set of portfolios as independent variables and return of each European market as the dependent variable. This was the application used in this chapter.

In our study the independent variables are three market indices (the E.U. weighted index, U.S. index and Japanese index) intended to capture the composition of the world systematic risk. The dependent variable is country returns with the betas in the equation measuring the extent to which the periodic return of a market moves with these indices.

6.3 DATA

In this chapter return indices of European Union stock market, U.S. and Japan were used, based on monthly total return data from Morgan and Stanley Capital International Indices and from IFC for Portugal and Greece.

As in the previous chapters the data cover the period 1982 to 1996 and we again partition the data into two periods. The split is pre and post 1990, given our expectation that there should be differences in terms of degrees of market segmentation between the decades of the 1980s and the 1990s, with 1990 representing the abolition of exchange controls throughout the European union.

There was a clear change in policies from the 1980s to 1990s as was discussed in chapter 3. In the 1980s most EC countries were still using capital controls and were not yet ready to abandon them. Also there were large differences between some economic and monetary indicators between countries, such as interest rates.

At the beginning of the 1990s most of the capital controls were gone, which allowed funds to increase foreign weightings. Furthermore, the Commission published new legislation, including the Second Banking Directive (1989) which created a single passport for financial companies across European financial markets. Also the establishment of a common market reduced tariffs on trade, as well as legal barriers to the free movement of labour and capital. By the 1990s there was a common external tariff and a common trade policy towards third-party countries, and the Competition Rules policy limited the influence of monopoly power and national subsidies in inter-country commerce. The Regional Policy redistributed income from rich members to the poor members and thereby promoted economic and social cohesion through the EU's called Structural Funds (Hansen and Nielsen, 1997). In the middle of the 1990s, a common monetary policy and fixed exchange rates increased this different financial environment within the European Union from the 1980s and 1990s.

6.4 METHODOLOGY

In this chapter the relevant measure is a market's betas based on two models: the single-index model and the multi-index model.

6.4.1 The multi-index model

Because our objective is to analyse the development of systematic risk of European markets alongside a globalisation programme, in our multi-index model we use three betas:

- the beta related with the European Union weighted index;
- the beta related with the American stock market; and
- the beta related with the Japanese stock market.

To examine whether the relationship of national risk to European systematic risk is more important than systematic risk related with the American or the Japanese markets the following multi-index return model was used

$$R_i = \alpha_i + \beta_{EUi} R_{EU} + \beta_{USi} R_{US} + \beta_{JAPi} R_{JAP} + e_i \qquad \text{Equation 6.1}$$

Where:

- R_i - rate of return on the market *i*
- α_i - the intercept of the regression model
- β_{EUi} – the beta of the market *i* with the European index
- β_{USi} - the beta of the market *i* with the U.S. market
- β_{JAPi} - the beta of the market *i* with the Japanese market
- R_{EU} - the rate of return of the benchmark European Index
- R_{US} - the rate of return of the U.S. market
- R_{JAP} - the rate of return of the Japanese market
- e_i - the residual component of the model

Generally multi-index models have been used to investigate economic factors by Keran (1971), Homa and Jaffee (1971), and Malkiel and Quandt (1972), Robichek and Cohn (1974), Chen, Roll and Ross (1986), Brumeister and McElroy (1988), Berry, Brumeister and McElroy (1988), and Sorensen et al. (1989). Also multi-index models have been used to study structural portfolio characteristics (for example industries) that account for movements in stock prices not explained by market risk. This is the case for example of King (1966), Cohen and Progue (1967), Agmon and Lessard (1977), and Fama and French (1993).

However, while it is common to find factors explaining past returns over a particular period of time, it is harder to find factors giving robust out of sample predictions.

Since the returns that we are using as the dependent variable are index returns for the national markets and are fully diversified for national specific risk, the next level of risk is international. According to Drummen and Zimmermann (1992) and Haluk (1996) a high beta, approaching 1 for a European market *i* against the European benchmark index (or with the other two markets) suggests that market *i* is "integrated" into the global European index (or with the other markets in the cases of β_{USi} or β_{JAPi}). If β_{EUi} decreases over time toward zero, the market under consideration becomes less "integrated" with the European benchmark (or with the U.S. or Japanese markets).

The implication of integration is also stronger the higher the R^2 and hence the more of the variation of returns in country *i* is explained by the risk factors.

6.4.2 The single-index model

The single-index model as Sharpe (1963, 1964) proposed compares each E.U. market with the European weighted index

$$R_i = \alpha_i + \beta_{EUi} R_{EU} + e_i \qquad \text{Equation 6.2}$$

Where

- R_i - return on the market index in country *i*
- α_i - the intercept for country *i*
- β_{EUi} – the beta of the market *i* with the European index
- R_{EU} - returns on the benchmark European Index
- e_i - the residual component of the model

Note that the expected return of a stock has two components: a unique part α_i and a market-related part βR_m. The first part is independent of the European index and the second (β_i) in the expression measures how sensitive the market's returns are to the return of the European index (Copeland and Weston, 1988). A β_i of 2 means that a market's return is expected to increase (decrease) by 2% when the European index increases (decreases) by 1%.

For the single index the only reason that stocks vary together systematically is because of a common co-movement with the market. There is no attempt to identify underlying factors such as economic variables, industry effects, etc. or to divide the market risk into several components that account for the co-movements between securities markets.

6.4.3 European benchmark index

To perform this analysis a European Benchmark Index was calculated from national returns weighted by capitalisation of each European market. The European benchmark is therefore a weighted-average index constructed using 13 markets i.e. returns in Europe other than returns in *i*. This procedure is because large markets have large weights in the European Index (for example the British market accounts for more than 40%) and thus would be a significant determinant of the European weighted returns if this procedure had not been followed.

The market capitalisation values for each E.U. market used to compute the European Benchmark index and large/small sub indices are the same as used in chapter 4. The weighted-average European index for each country was constructed by weighting the respective rate of return by the proportional weights given by market capitalisation

$$EU^{\,i}_{\text{Index}} = \sum_{i=1}^{m} R_t^i * \left[\frac{mc_t^{\,i}}{\sum_{i=1}^{m} mc_t^{\,i}} \right] \qquad \text{equation 6.3}$$

Where:

- EU^{i}_{Index} - European market index excluding the country analysed
- R_t^i - Rate of return of market *i* at month *t*
- mc_t^i - capitalisation of market *i* at month t
- $\sum_{i=1}^{m} mc_t^{\,i}$ = total European market capitalization at month *t*
- m = 13 European stock markets (excluding the stock market under analysis)

6.5 EMPIRICAL RESULTS

6.5.1 Evolution of European systematic risk

The aim of this section is to analyse systematic risk in each European stock market from the 1980s to 1990s. Given the strong increase in correlations between European stock markets shown in Chapter 4 and the growing correlation between European economic and monetary variables displayed in chapter 5, it is expected that there would be a marked increase in β_{EUi} between the two periods. We should also expect that β_{EUi} are positive and statistically significant. In addition, if integration has occurred β_{EUi} should be larger than β_{USi} or β_{JAPi}.

Because our main objective in this chapter is not the value of the betas but the comparison between them over the two periods, standardised beta coefficients were used.[10]

Standardised coefficients describe the relative importance of the independent variable in a multiple regression model. To calculate the standardised coefficients, one simply performs a linear regression in which each variable is normalised by subtracting its mean and dividing by its estimated standard deviation. The standardised coefficients bear a close relationship to the estimated coefficients of the original non-normalised multiple regression model. In other words, the standardised coefficients adjust the estimated slope parameter by the ratio of the standard deviation of the independent

[10] The unstandardised beta coefficients of the multiple regression are in the appendix.

variable to the standard deviation of the dependent variable. The normalised regression makes beta coefficients more directly comparable for variables subject to different dispersion (Pindyck and Rubinfeld, 1998).

The standardised betas from the multiple regression results are by definition lower than simple coefficients and as generally recognised are smaller than 1 (Kinnear and Gray, 1994).

Also the betas of the E.U. market with the U.S. and Japanese indices partially reflect some multicollinearity between the three independent variables. One way to solve the multicollinearity problem is to remove the independent variable, which is correlated with the other independent variables (Kvanti et al., 1992). In our study the three independent variables are correlated with each other, especially the E.U. index and the U.S. index. This led us to repeat the analysis using a single index model between each independent variable and the dependent variable (each E.U. stock market). The results are shown in section 6.5.6, based also on the standardised beta coefficients[11].

As the results indicate (Figure 6.2) the betas obtained against their respective European benchmarks increased strongly from the first to the second period, i.e. all betas have increased strongly from the 1980s to the 1990s. On an equal weighted-average the betas increased from 0.38 in the period 1982-89 to 0.63 in the 1990s.

[11] The unstandardised beta coefficients of the simple regression are in the appendix.

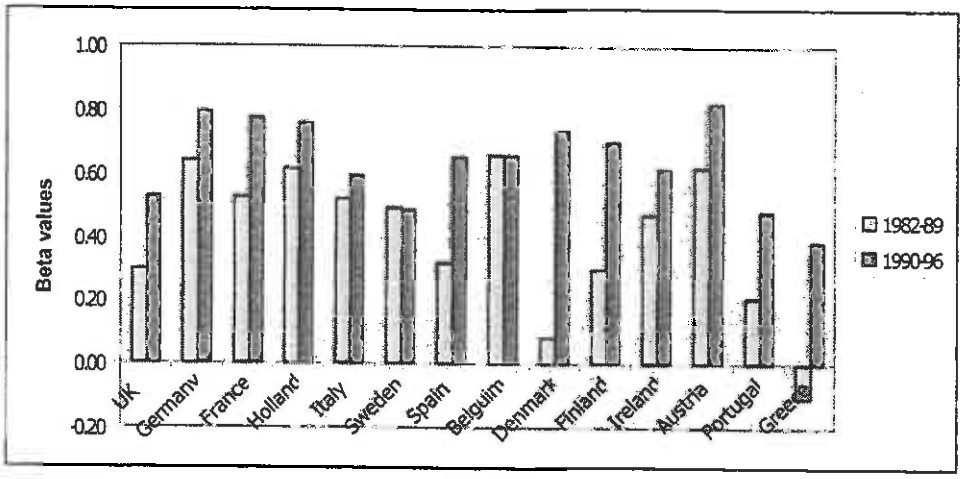

Figure 6-2

Beta values against E.U. returns index - Comparison between the two periods

6.5.2 Level of adjustment of the model

The implication of integration is also stronger if the R^2 is higher. The adjusted R^2 (Table 6.1) of this multi-index return model for almost all European markets is high and the ANOVA F test is significant for almost all of them at 5% level. The exceptions were Greece and Finland on the first period and only the Greek market on the second period. Although this multi-index model has a high R^2 for the majority of stock market returns, large markets have higher R^2 than small markets. Moreover the R^2 were higher on the second period than on the first, essentially because the European returns are becoming more interdependent. These results indicate that there was an increasing systematic European risk influence for all E.U. stock markets.

Table 6-1

Adjusted R^2 of the three-variable index model

Market	1982-89	1990-96	Changes	1982-96
Large				
UK	0.60	0.58	-3%	0.60
Germany	0.35	0.53	53%	0.42
France	0.44	0.65	47%	0.53
Sub mean	*0.46*	*0.59*	*32%*	*0.51*
Small				
Holland	0.61	0.73	21%	0.65
Italy	0.25	0.35	42%	0.30
Sweden	0.28	0.44	55%	0.36
Spain	0.24	0.63	164%	0.41
Belgium	0.49	0.61	24%	0.52
Denmark	0.16	0.44	172%	0.25
Finland	-0.11	0.37	448%	0.29
Ireland	0.65	0.55	-14%	0.59
Austria	0.19	0.40	114%	0.27
Portugal	0.15	0.31	112%	0.19
Greece	0.03	0.05	77%	0.02
Sub mean	*0.27*	*0.44*	*110%*	*0.35*
Mean	*0.36*	*0.52*	*71%*	*0.43*

These results show a higher R^2 than those found by Thomas (1988) who used the world index instead of our three indices. His results showed a range of R^2 between 0.02 and 0.46.

6.5.3 Comparison between betas

Table 6.2 shows that the beta for the European market benchmark generally is much larger than betas against U.S. or Japanese markets. In the first period, only in three cases (Denmark, UK and Portugal) was β_{EUi} smaller than β_{USi} or β_{JAPi}. In 1990s all β_{EUi} were much larger than β_{USi} or β_{JAPi}, which means that European risk is a more important source of systematic risk than volatility in American or Japanese stock markets.

Table 6-2

Betas of three variables return model

Market	1982-89			1990-96			1982-96		
	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}
Large									
UK	0.29	0.54	0.03	0.53	0.34	0.00	0.38	0.48	0.02
Germany	0.64	-0.04	-0.01	0.80	-0.05	-0.05	0.70	-0.04	-0.02
France	0.53	0.11	0.12	0.77	0.04	0.02	0.66	0.03	0.10
Sub mean	*0.49*	*0.20*	*0.05*	*0.70*	*0.11*	*-0.01*	*0.58*	*0.16*	*0.03*
Small									
Holland	0.62	0.18	0.06	0.76	0.15	0.00	0.66	0.18	0.02
Italy	0.52	-0.12	0.16	0.59	-0.21	0.23	0.55	-0.14	0.18
Sweden	0.49	0.10	-0.04	0.49	0.10	0.22	0.49	0.07	0.12
Spain	0.32	0.15	0.12	0.65	-0.04	0.29	0.50	-0.01	0.26
Belguim	0.66	-0.04	0.15	0.66	0.04	-0.01	0.66	0.01	0.08
Denmark	0.09	0.35	0.04	0.73	-0.15	0.07	0.44	0.04	0.09
Finland	0.30	-0.17	0.00	0.70	-0.13	0.01	0.64	-0.16	0.02
Ireland	0.47	0.34	0.08	0.62	0.05	0.19	0.59	0.13	0.16
Austria	0.62	-0.18	-0.24	0.82	-0.29	-0.09	0.74	-0.33	-0.07
Portugal	0.21	-0.08	0.37	0.48	0.04	0.13	0.30	-0.03	0.25
Greece	-0.10	0.33	-0.12	0.39	-0.14	-0.07	0.24	-0.05	-0.06
Sub mean	*0.38*	*0.08*	*0.05*	*0.63*	*-0.05*	*0.09*	*0.53*	*-0.03*	*0.10*
Mean	*0.43*	*0.14*	*0.05*	*0.66*	*0.03*	*0.04*	*0.55*	*0.06*	*0.06*

Using multiple regression analysis and 5% level of significance the results show that on the first period the majority of betas against the E.U. weighted index were statistically significant but only few betas against U.S. and Japanese markets were significant. On the second period all betas against the European index were statistically significant whereas only 4 out of 14 cases were the betas against American or Japanese statistically significant (Figure 6.3).

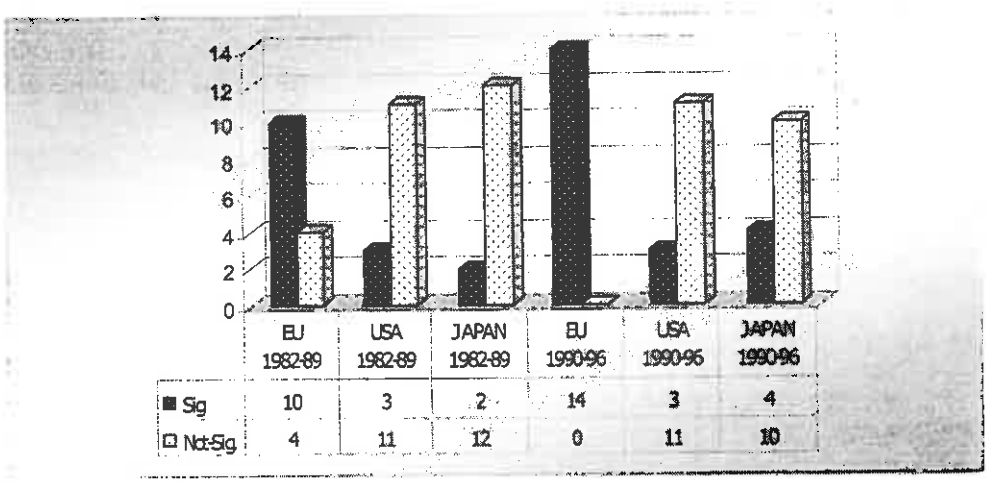

Figure 6-3
Number of significant betas against E.U., U.S. and Japan indices

Based on the correlation results in chapter 4, betas against American market were expected to be larger than betas against the Japanese market. This is confirmed only in two cases: U.K. and Holland. In the other cases the results are not very clear. Maybe this is due to the existence of multicollinearity between the three variables in the model. This will be discussed in the next sections.

6.5.4 Increase in beta differences

The hypothesis that the beta against E.U. market would have increased its difference from the Japanese or U.S. betas is also supported by the results (Figure 6.4):

$(\beta_{EUi} - \beta_{USi})$ in the second period > $(\beta_{EUi} - \beta_{USi})$ in the first period, and

$(\beta_{EUi} - \beta_{JAPi})$ in the second period > $(\beta_{EUi} - \beta_{JAPi})$ in the first period.

Based in this three-variable return index model the results (Figure 6.4) give us two conclusions. First the excess of E.U. beta over Japan or over U.S. beta was bigger in the second period than in the first. Belgium is an exception but the excess on the first period

was already very large and it reduced only a little on the second period. A second conclusion is that the excess of E.U. beta over Japan or over U.S. beta increased more against the Japanese market than against the American market.

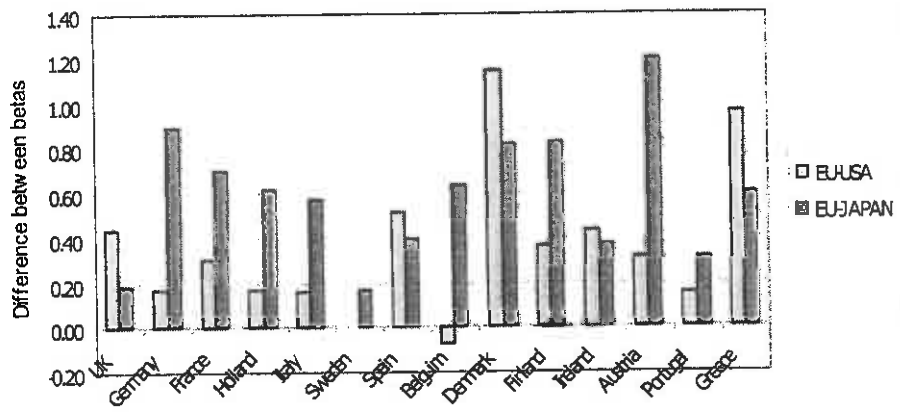

Figure 6-4

The excess of E.U. beta over Japan and U.S. betas: absolute increase from 1980s to 1990s

6.5.5 Multicollinearity between variables in the multi-index model

In this section we investigate whether there is multicollinearity between the three variables included in the multiple regression model: E.U. weighted index, U.S. index, and Japanese index.

The measure used to diagnose multicollinearity was the Tolerance (TOL) and variance inflation factor (VIF_j), as used in chapter 5 (section 5.9). The larger the value of VIF_j, the more collinear is the variable X_j with the other variables in the model. As a rule of thumb, if the VIF of a variable exceeds 10, that variable is said to be highly collinear with the others (Gujarati, 1995).

If there is high multicollinearity between the variables, orthogonalisation, which is a statistical technique that makes two or several factors independent of each other, should be used and this involves regressing a factor against one or several other factors and taking the residuals of the regression as the orthogonalised variables (Drummen and Zimmermann, 1992).

The measure of tolerance (TOL) to detect multicollinearity is defined as

$$TOL_j = (1 - R^2_j) \qquad \text{Equation 6.4}$$

Or

$$TOL_j = (1/VIF_j) \qquad \text{Equation 6.5}$$

$TOL_j = 1$ if X_j is not correlated with the other regressors, whereas it is zero if it is perfectly related to the other regressors.

The results (Table 6.3) show that there is a weak multicollinearity between all three variables because all values of VIF are very small compared to the critical value of 10. In the case of the E.U. index and the U.S. index, tolerance values are above zero but rarely above 0.5 indicating that there is some multicollinearity. Because of this possibility the results are re-examined in the next section using the single index return model to verify if this weak multicollinearity affected the conclusions (differences in betas).

Table 6-3

Collinearity statistics of the three-variables return model

Dependent Variable	Independent Variables	1982-89		1990-96		1982-96	
		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Austria	EU index	0.40	2.52	0.53	1.89	0.45	2.24
	USA	0.41	2.42	0.60	1.66	0.49	2.03
	JAPAN	0.79	1.27	0.78	1.29	0.79	1.27
Belgium	EU index	0.40	2.50	0.53	1.87	0.45	2.22
	USA	0.41	2.43	0.61	1.65	0.50	2.01
	JAPAN	0.79	1.26	0.78	1.29	0.79	1.26
Denmark	EU index	0.40	2.49	0.53	1.88	0.45	2.22
	USA	0.42	2.40	0.60	1.66	0.50	2.01
	JAPAN	0.79	1.27	0.78	1.29	0.79	1.26
France	EU index	0.41	2.45	0.54	1.87	0.45	2.21
	USA	0.42	2.40	0.61	1.65	0.49	2.02
	JAPAN	0.80	1.25	0.78	1.29	0.80	1.25
Germany	EU index	0.37	2.72	0.51	1.95	0.42	2.36
	USA	0.39	2.59	0.59	1.69	0.47	2.11
	JAPAN	0.78	1.28	0.77	1.30	0.78	1.28
Greece	EU index	0.40	2.50	0.53	1.88	0.45	2.23
	USA	0.41	2.41	0.60	1.66	0.50	2.02
	JAPAN	0.79	1.27	0.78	1.29	0.79	1.27
Italy	EU index	0.40	2.50	0.53	1.87	0.45	2.21
	USA	0.41	2.45	0.60	1.68	0.49	2.04
	JAPAN	0.80	1.25	0.79	1.27	0.80	1.25
Holland	EU index	0.41	2.45	0.54	1.85	0.46	2.18
	USA	0.42	2.37	0.61	1.63	0.51	1.98
	JAPAN	0.79	1.26	0.78	1.29	0.79	1.26
Spain	EU index	0.40	2.47	0.54	1.85	0.45	2.20
	USA	0.42	2.40	0.60	1.66	0.50	2.02
	JAPAN	0.79	1.26	0.79	1.27	0.80	1.25
Sweden	EU index	0.40	2.50	0.55	1.84	0.45	2.20
	USA	0.42	2.41	0.61	1.64	0.50	2.01
	JAPAN	0.79	1.27	0.79	1.27	0.80	1.26
UK	EU index	0.55	1.83	0.60	1.67	0.57	1.76
	USA	0.56	1.79	0.69	1.45	0.63	1.59
	JAPAN	0.79	1.27	0.76	1.31	0.78	1.28
Ireland	EU index	0.28	3.52	0.54	1.87	0.40	2.48
	USA	0.30	3.36	0.61	1.65	0.45	2.25
	JAPAN	0.78	1.28	0.78	1.29	0.80	1.25
Portugal	EU index	0.28	3.53	0.53	1.87	0.40	2.48
	USA	0.30	3.38	0.61	1.65	0.44	2.25
	JAPAN	0.78	1.28	0.78	1.29	0.80	1.25
Finland	EU index	0.38	2.60	0.53	1.88	0.51	1.97
	USA	0.34	2.96	0.60	1.66	0.56	1.78
	JAPAN	0.79	1.27	0.78	1.29	0.79	1.27

6.5.6 The results with the single-index model

In this section individual market returns were regressed against each variable in the three-variable multi-index model independently. The objective is to see whether the values of beta for each variable (the European, the U.S. and the Japanese indices) estimated independently are similar to those found in the three-index model.

The results (Table 6.4) from the single index models confirm the strong increase in the level of betas against European index from the first to the second period, and that the betas from European benchmark generally are again much larger than betas against U.S. or Japanese markets, in both periods.

These empirical results (Table 6.4) generally show higher betas for the factors using the single index models and also more betas with the U.S. market are statistically significant. The reason for these small differences is the existence of some multicollinearity between the E.U. index and the American index.

Table 6-4

European betas based on single-index model

Market	1982-89			1990-96			1982-96		
	B_{EU}	B_{USA}	B_{Japan}	B_{EU}	B_{USA}	B_{Japan}	B_{EU}	B_{USA}	B_{Japan}
Large									
UK	0.66	0.75	0.38	0.72	0.63	0.37	0.68	0.71	0.36
Germany	0.61	0.46	0.27	0.74	0.44	0.32	0.66	0.45	0.29
France	0.66	0.56	0.40	0.81	0.54	0.40	0.72	0.55	0.40
Small									
Holland	0.78	0.67	0.40	0.85	0.62	0.40	0.80	0.65	0.38
Italy	0.50	0.34	0.33	0.56	0.24	0.42	0.53	0.30	0.39
Sweden	0.55	0.46	0.22	0.65	0.47	0.47	0.59	0.45	0.37
Spain	0.49	0.44	0.33	0.76	0.47	0.57	0.60	0.45	0.46
Belgium	0.70	0.53	0.43	0.79	0.52	0.36	0.73	0.52	0.39
Denmark	0.37	0.43	0.22	0.67	0.33	0.36	0.49	0.39	0.29
Finland	0.17	0.07	0.02	0.62	0.31	0.29	0.54	0.27	0.26
Ireland	0.79	0.77	0.44	0.74	0.50	0.49	0.77	0.65	0.46
Austria	0.38	0.20	-0.03	0.60	0.20	0.20	0.49	0.20	0.13
Portugal	0.31	0.25	0.43	0.57	0.38	0.37	0.36	0.27	0.35
Greece	0.10	0.21	-0.03	0.27	0.08	0.07	0.17	0.15	0.03

With the single index model, generally higher, betas occur for E.U. countries with the U.S. market than with the Japanese market, which reinforce the previous conclusions that generally E.U. markets are more related with the American market than with the Japanese market. Also between the two intervals, betas with the U.S. index returns are mostly falling while betas with the E.U. index are rising. It is notable that these results tend to be clearer for large markets; Japanese market betas of some small E.U. markets (Italy, Spain and Denmark) became bigger than their U.S. market betas.

In addition the results show that the betas across Europe are more equal on the second period than in the first, irrespective of the benchmark, i.e. the level of dispersion of betas reduced from the 1980s to 1990s (Figure 6.5)

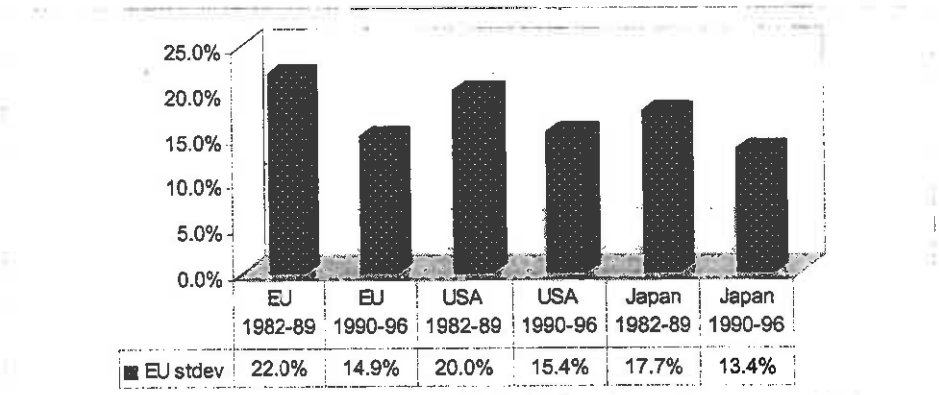

Figure 6-5
Level of dispersion of betas

The single index model also confirms the hypothesis that betas against the European benchmark will become larger relative to the betas of other markets (U.S. and Japan) from the first to the second period (Figure 6.6)

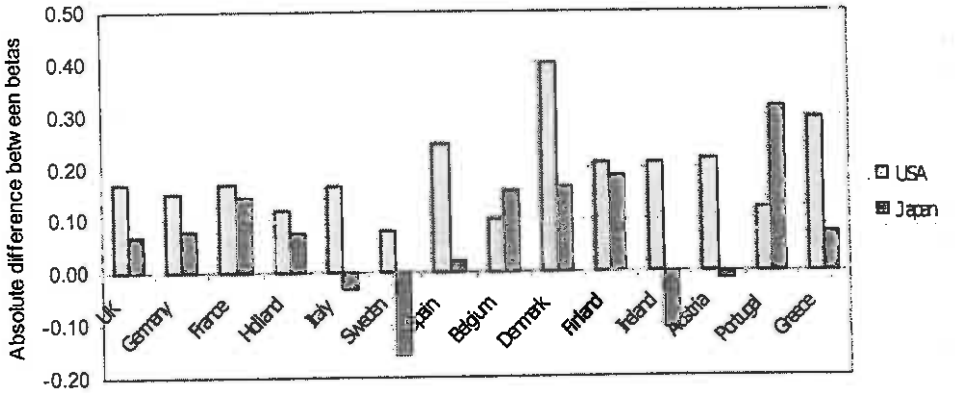

Figure 6-6

The excess of E.U. beta over Japan and U.S. betas using three single-index return models. The absolute increase from the 1980s to 1990s

The results show that in four cases (Italy, Spain, Austria and Portugal) the differences in betas of E.U. index and Japanese Index decreased from the 1980s to 1990s. Nevertheless there remains a large excess of E.U. beta over Japan beta in the 1990s (Table 6.4).

The high beta with the E.U. index compared with U.S. or Japan indicates the growing alignment of European markets to the European weighted index and these growing betas coincide with growing European economic and monetary integration.

6.6 CONCLUSIONS

The main conclusions of this chapter are:

- Beta coefficients against European benchmark are much larger than beta coefficients against U.S. and Japanese markets; this indicates that the connections between European markets are stronger than those created by global trends towards integration.

- All betas obtained against the European benchmark increased strongly from the first to the second period, i.e. between the 1980s and 1990s. This confirms that integration between European markets have been increasing alongside economic and monetary integration.

- The betas with the European benchmark are larger relative to the betas with other markets (U.S. and Japan) in the second period than in the first. This supports a conclusion that the common European factors have been increasing in importance.

- European betas were more equal on the second period than in the first, i.e. the level of dispersion of betas reduced from the 1980s to 1990s. This supports a conclusion that sensitivity to European index returns has become more similar for countries within the E.U..

- All betas of the European benchmark were statistically significant at 5% level and the majority of betas against U.S. index became significant at 5% level in the 1990s.

These results were obtained based on a return model with a reasonably high R^2 for all European markets (on average 36% in 1980s and 52% in 1990s) and the ANOVA F test is significant at 5% level for all of them, with only one exception: the Greek market.

The existence of some weak multicollinearity between the variables didn't affect the main conclusions and when a single index return model was used it reinforced the main results obtained using the three variable index return model.

The final conclusion is that there is an increased-shared risk within European Union stock markets. This European trend is more noticeable after the European Union process; i.e. it was stronger in the 1990s than in 1980s. It is also stronger for large European stock markets than for small markets.

CHAPTER 7 CHANGES IN THE VOLATILITY OF THE EUROPEAN STOCK MARKETS

7.1 PURPOSE OF THE CHAPTER

In chapter 4 the integration of European stock markets within E.U. was compared with their connection to the U.S. and Japanese markets using a correlation of returns matrix. We also investigated in chapter 5 if the countries with more correlated economic and monetary indicators also have more correlated stock markets. In chapter 6 the systematic risk of each E.U. stock markets was examined to understand if there is a group of markets in Europe exhibiting convergent systematic risk.

This chapter provides an alternative perspective on the implications for European investment arising from the integration of European stock markets. The aim is to examine the absolute volatility of each European stock market.

The volatility is a component of Markowitz (1952) optimal portfolio. Volatility also matters because correlation does not completely reflect the absolute volatility which determines returns variation.

In this chapter we examine how the volatility of E.U. stock markets change from the 1980s to the 1990s, i.e. did economic and monetary integration accompany a reduction in volatility within each European market between the two periods. A complication in doing this is the occurrence of the 1987 crisis (Le 1991, Drummen and Zimmermann 1992). Tests of robustness are used to eliminate distortion arising from this source.

This is an important issue because globalisation means risk reduction, and return improvement opportunities that any country can offer independently are less relevant than the incremental risk/return a market offers within a global portfolio. For this purpose returns that are low or uncorrelated with returns on the regional/global market offer most scope for risk reduction.

This chapter is structured in the following way. Section one presents the purpose of the chapter. Section two discusses the previous literature about the subject. Section three shows the data and the methodology while in section four the empirical results are analysed. In the last section a summary of the main conclusions is presented.

7.2 PREVIOUS WORKS

From an asset allocation perspective, uncorrelated volatility provides good portfolio diversification opportunities, and integration is both likely to increase the correlation of volatility but also to influence the dispersal of returns.

Although there are many studies of volatility, the majority are not concerned with the main focus of this research which is whether European equity markets are becoming less risky with the European integration process and whether the distribution of volatility between national and regional levels is changing. In this section detailed accounts are given of relevant literature and their conclusions are summarised in table 7.1.

Allan (1982) studied the historical statistics relating to 18 international capital markets for the 10-year period 1972-81, including U.S., Japan and 10 E.U. markets (Austria,

Belgium, Denmark, France, Germany, Italy, Holland, Spain, Sweden and U.K.). Data was gathered from Capital International Indices, except for S&P Composite and Tokyo Stock Exchange. Annual returns have been determined by compounding monthly rates of total return, in local currency and dollars.

They found that European markets were generally more volatile than the U.S. or Japan, but less volatile than other Asian markets. The Japanese market (15%) had less volatility than the U.S. market (16.2%) during the sample period. Using a five-year period's overlapping data, they also found that the large markets became less volatile over that period.

They also found that the volatility was higher when calculated in U.S. dollars for all markets because the coefficients of correlation between local currency market returns and currency movements relative to U.S. dollar were positive.

Hunter and Coggin (1990) also examined the volatility of the most important stock markets. Quarterly total % returns (price change plus dividend) from Morgan Stanley for the period 1970-1986 were used. This includes twelve countries (U.S., Japan, Australia, Norway and 8 E.U. countries: Belgium, France, Germany, Italy, Holland, Spain, Sweden and U.K.). Annualised total returns and standard deviations (measuring the volatility) for the period, in local currencies and U. S. dollars, were calculated.

The results indicate that, on average, E.U. markets were more volatile during the period than U.S. or Japanese markets. The volatility of E.U. markets was on a simple average around 21% whereas the volatility of the U.S. market was 18.8% and the Japanese market 18.2%. However, the results displayed that three E.U. markets (Belgium, Germany and Holland) had volatility very similar and less than the U.S. and Japan,

between 16% and 17%. We should note that these three countries are part of the "core" of the E.U. since the beginning and they have strong economic links. The results also confirm Allan's findings that when the volatility was calculated in US dollars the numbers increased for all countries. The simple average of the volatility for E.U. in US dollars was 24.6%.

Le (1991) also examines the volatility of the U.S. and Japan and 14 other stock markets, including 8 European Union markets (Belgium, France, Germany, Holland, Italy, Spain, Sweden and U.K.), using monthly data of equity market indices collected for the period October 1984 to December 1989. The period was divided into two subperiods: October 1984 to June 1987 and November 1987 to December 1989.

Index prices (without dividends) were converted to dollars. The monthly rate of return for each country was defined as the percentage change in the dollar value of its index of common stock. The indices used were obtained from *The Economist and The Wall Street Journal.* The risk was defined as the standard deviation of monthly rate of returns.

The results show that after the October 1987 stock market crisis, the volatility was higher than in the previous period, particularly for U.K. and U.S. markets. On a simple average, the volatility of E.U. market increased from 22.5% to 32.4%. The U.S. market volatility increased from 14.5% to 24.5%, while in contrast Japanese market volatility decreased from 22.5% to 15.6%. It should be noted that 1987 influenced the calculation of volatility of all markets in both periods, although it had larger influence in the second period after the crash. They also found that the European markets were less volatile than the Asian-Pacific markets, except the Japanese market.

Drummen and Zimmermann (1992) analysed the volatility of 11 European countries (Belgium, Denmark, France, Germany, Italy, Holland, Norway, Spain, Sweden, Switzerland and U.K.) The analysis was based on indexes composed by simple average of the largest (in terms of market capitalisation) and the most liquid stocks in each country, over the 1986-89 period. They used annualised daily data with stock prices adjusted for stock splits and rights issues. They did not include dividends.

They found very high volatilities for all E.U. markets between 30% and 40% in seven countries and the other between 40% and 50%. However, we should note that this includes the turbulent period of the October 1987 crash.

Odier and Solnik (1993) investigated whether global diversification was still beneficial from the risk/return viewpoint. They analysed the volatility of the major markets (U.S., Japan, Germany and U.K.) and also the MSCI indexes for Europe, for EAFE (Europe, Australia and Far East) and the World Index. Quarterly data came from Morgan and Stanley's International (MSCI) from the period 1970-1990, and they analysed the data for two periods: 1970-1990 and 1980-1990. The volatility was measured by the standard deviation of returns in local currency.

The results indicate that the U.S. market (16.1%) was less risked than other markets and it had the same risk over a period of ten or twenty years. The European markets had more risk than the Japanese markets. Measuring in Yen, the volatility of the Japanese market was 18.4% in the period 1970-1990. They concluded that for Japanese, and especially for American, investors to invest abroad in European markets means to "buy" some high volatility. They also concluded that the volatility of these stock markets had

not been stable over time. However found no evidence of increased volatility for these markets in the period.

Tang (1995) also examines the volatility of international stock markets. Monthly data of the national stock indexes of 11 countries, collected from Datastream, are used in the analysis: 2 in North America (United States and Canada), 5 in Europe (United Kingdom, France, Germany, Italy, and Switzerland), and 4 in the Asian-Pacific region (Australia, Hong Kong, Japan, and Singapore). Stock returns are defined as logarithmic price relatives (i.e. ln P_t/P_{t-1} where P_t, and P_{t-1} are the stock indexes at time t and time t-1 respectively). The monthly sample period covers from January 1970 to January 1990.

The results show that the Japanese market offers lower risk or standard deviation. The results hold true no matter what the investment horizon because they used different periods of time. The average risk for an E.U. country was around 22% whereas the U.S. market was 17% and the Japanese market 15%.

In a recent study Beckers (1999) examined the volatility of European stock markets. The objective was to establish whether there has been a significant change in the average volatility over ten years.

He took daily prices of equity indices from Financial Times International from January 1988 until December 1997 for twelve countries including most European Union members, Norway, Switzerland, the U.S. and Japan. Portugal and Greece were not covered in the study. For these markets they calculated the average annualised quarterly volatility (based on daily data) and also the trend in annualised volatility over the ten years.

The results indicate that (with the exception of Finland, Italy and Spain) there is a downward trend in volatility. The results for the U.S. and to some degree for Japan indicate that this phenomenon is not restricted to Europe.

To analyse changes in volatilities, two five-year subperiods were compared. The results indicate that Europe, the U.S. and Japan have all experienced lower risk in the last five years subperiod (whether comparisons of European outcomes are based on equal-weighting or capitalisation-weighting).

The question that can be asked is whether recent reductions in volatility are temporary or structural. It is hard to believe that the typical stock market volatility would continue to decrease in the next decade as it has over recent years. A reversion toward the long-term mean therefore seems more likely than a continued decline. Whether this reduction in risk dimensionality also leads to lower portfolio risk depends crucially on the correlation structure between stock markets.

Beckers (1999) also discusses the impact of European Monetary Union on the currency risk embedded in European equity portfolios. The results show that even with different currencies almost all the risk in the equity portfolio is local market risk, with the currency risk and the correlation between currency and the local market playing a relatively minor role in the make up of the total risk number.

This means we should expect to find little effect as European countries use a common currency (the Euro). European investors didn't experience much currency induced volatility even prior to the Euro.

In another recent study Hanna et al. (1999) examined the risk and return of equity market indexes of the G-7 group of industrialised nations from January 1988 to December 1997. The market indexes under study were the S & P 500, the Toronto Stock Exchange (TSE) 300 Composite Index, the Financial Times Index of London, the Paris CAC 40, the Frankfurt DAX, the Milan MIBtel, and the Tokyo Nikkei 225.

Monthly data were gathered from *The Wall Street Journal.* Means and standard deviation (measuring the volatility) are computed on the monthly return data in U.S. dollars. They provided a relative comparison of the different markets both on a return basis and a risk basis. The objective was to identify the foreign markets that would make most contribution to diversification.

The results show that the United States market (11%) was the most stable (i.e. the smallest standard deviation of returns) across this period. The United States market also had the greatest annual mean rate of return. This means that the United States market was clearly the dominant market in this time period. The Frankfurt DAX had a comparable rate of return, but had a standard deviation of returns (18%) that was over sixty percent larger than that of the S & P 500. The volatility for the Toronto 300 (17%) was the most comparable to the S & P 500.

A summary of these studies and their main findings is presented in table 7.1.

The question is to know whether the European economic and monetary integration is accompanied by E.U. stock markets becoming more volatile than major markets outside the European Union, i.e. in the U.S. and Japan; and if these changes have different patterns between large and small E.U. markets. We also want to examine if the

European economic and monetary integration is leading to a more equal level of risk among E.U. stock markets.

Table 7-1

Summary of studies and main findings

Authors	No. of countries	Time Period	Main findings
Allan (1982)	18	1972-81	• EU markets were more volatile than U.S. or Japan • Large markets became less volatile over the period • The volatility was higher in USD than in local currency
Hunter and Coggin (1990)	12	1970-86	• EU markets were more volatile than U.S. or Japanese markets,.except 3 E.U. markets (Belgium, Germany and Holland) that had less • The volatility was higher in USD than in local currency
Le (1991)	14	1984-87 1987-89	• After 1987 crash, the volatility was higher particularly for UK and US, except for the Japanese market • EU markets were less volatile than the Asian-Pacific markets, except the Japanese market
Drummen and Zimmermann (1992)	11	1986-89	• Very high volatilities for all E.U. markets (this includes 1987 crash)
Odier and Solnik (1993)	4 US, UK, Japan and Germany	1970-80 1980-90	• US market was less risked than other markets • EU markets had more risk than the Japanese market • The volatility have not been stable over time • No evidence of increased volatility in the periods
Tang (1995)	11	1970-90	• Japanese market offers lower risk
Beckers (1999)	12	1988-92 1993-97	• There is a downward trend in volatility for the majority of markets. All markets showed lower risk in second period • Almost all the risk in an equity portfolio is local market risk, currency risk is small
Hanna et al. (1999)	7 (G-7)	1988-97	• U.S. market was the most stable across this period • U.S. market was the dominant market in the period

7.3 DATA AND METHODOLOGY

In this chapter we used Morgan Stanley Capital International monthly total return indices converted to returns using logarithmic first differences. The data covers the period of 1982 to 1996 and we follow usual practice by partitioning the data into two periods. The European Benchmark Index described in section 6.4 was used.

In this chapter, volatility is measured by annualised standard deviation of monthly rate of total returns as it was done in previous studies (Allan 1982, Hunter and Coggin 1990, Le 1991, Drummen and Zimmermann 1992, Odier and Solnik 1993, Tang 1995, Beckers 1999, Hanna et al. 1999). The annualised standard deviation is based on the following formula

$$\sigma_A(R^i) = \sigma(R^i) * \sqrt{12} \qquad \text{equation 7.1}$$

Where

- σ_A – annualised standard deviation of returns in market i
- R^i – monthly rate of returns of market *i*
- 12 – 12 months

7.4 EMPIRICAL RESULTS

7.4.1 Changes in the volatility of the European Union stock markets from the 1980s to the 1990s

This section reports the volatility behaviour of each European market in each period individually and as a group from the 1980s to 1990s, compared with the volatility of American and Japanese markets.

The first observation is that on average the total volatility of the E.U. markets and U.S. market decreased from the 1980s to 1990s, in distinct contrast to the Japanese market where there was an increase in the volatility during the same period (Figure 7.1). U.S. volatility was lower and dropped more.

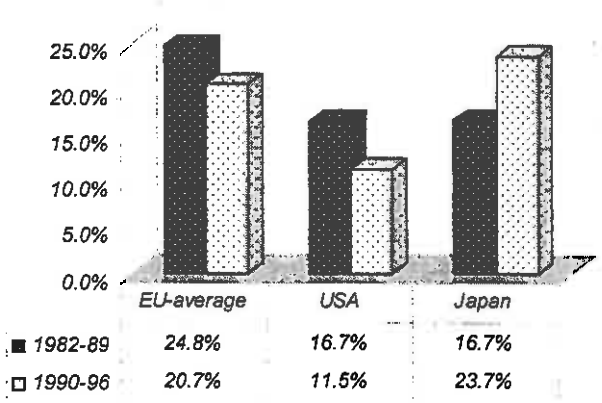

Figure 7-1
Volatility of stock markets scale on vertical

These results corroborate only part of the findings achieved by Beckers (1999) who used data from 1988 to 1997 and found a decrease in the volatility of E.U., American

and Japanese markets. The Japanese result reflects the sample period contradicting findings using earlier periods (Tang, 1995).

Also our results indicate that the volatility of the small markets as a group within the E.U. was higher than the volatility of large markets in both periods (Figure 7.2), although both categories show a fall.

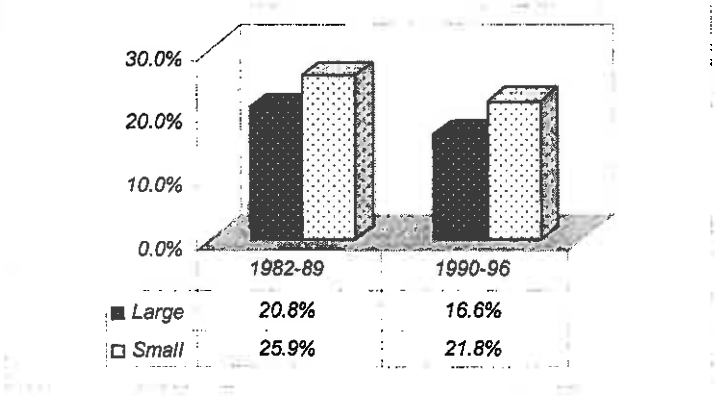

Figure 7-2
Volatility of E.U. stock markets segmented by large and small markets

At the national level the majority of European markets also experienced lower volatility in the 1990s than in the 1980s (Figure 7.3).

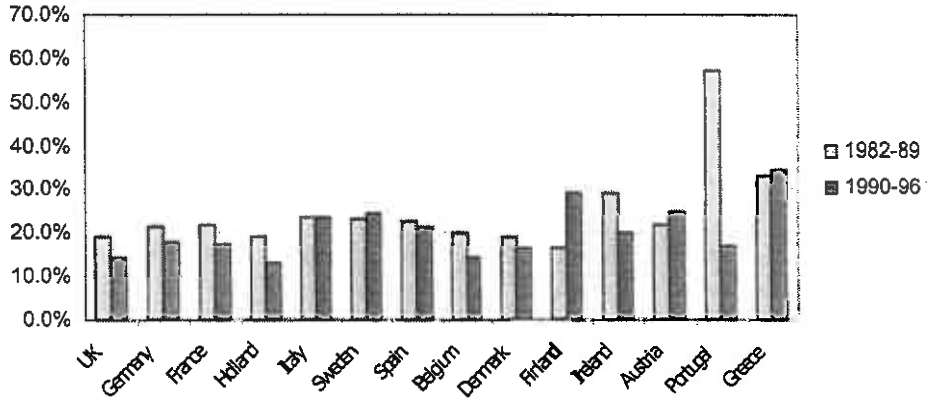

Figure 7-3
Volatility of the European Union stock markets

Our results for the small markets differ from Beckers (1999) who found increased volatility from the 1980s to 1990s. He found increases in Finland, Italy and Spain whereas we found slight increases in Sweden, Austria and Greece[12].

7.4.2 Sensitivity to 1987

The aim of this section is to see if some years can be considered outliers with extremely high or low volatility.

Some previous studies (Le 1991, Drummen and Zimmermann 1992) note the major common effect of the 1987 crash on the majority of international stock markets. When the annual volatility of monthly returns for each market was calculated for each year of our analysis, unsurprisingly 1987 showed extremely high volatility.

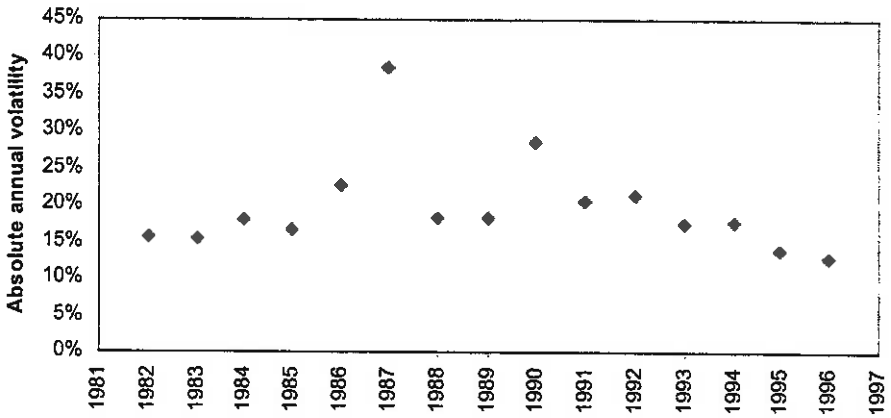

Figure 7-4
Simple average of annual volatility of all markets

[12] In the first period only two years of data (1988 and 1989) were available for Finland so our data and our results coincide with his results.

If we consider each market individually (table 7.1 in appendix) we can confirm that 1987 was an exception for the majority of the markets. Only in the cases of Austria and Greece in 1990 and Italy in 1986 were there other years with higher volatility. However even in the cases of Austria and Greece volatility was very high in 1987.

The standard deviation of the volatility of the E.U. stock market show that the year 1987 is an outlier during the period 1982-90, with three standard deviations over the mean (Table 7.2). The results also show that the 1987 crash did not carry over since the following year of 1988 had volatility close to the average of the period.

Table 7-2
The standard deviation of the E.U. stock markets volatility per year

Year	Standard deviation
1982	4.9%
1983	5.6%
1984	5.0%
1985	6.0%
1986	8.0%
1987	20.7%
1988	7.1%
1989	7.7%
1990	13.8%
1991	8.2%
1992	9.8%
1993	4.6%
1994	3.5%
1995	6.2%
1996	3.8%
Mean	7.7%
Stdev	4%

Given these results for the year of 1987 so we rework the comparisons excluding the 1987 volatility episode from the first period 1982-89, for comparisons with the volatility in the 1990s.

In the second period, although the year 1990 also had a high average volatility (30%) for E.U. markets, this was strongly influenced by the volatility of Austrian and Greek stock markets. If these two markets are excluded the average volatility of the E.U. markets (25%) becomes close to the other year, and the standard deviation of the volatility of all E.U. markets would be reduced from 13.8% to 6.5%.

7.4.3 The impact of the 1987 crash on the volatility of the European stock markets during the 1980s period

The aim of this section is to report the volatility of each European market in the period 1982-89 excluding the effects of the year 1987.

The exclusion of 1987 from the first sub-period 1982-89 was implemented consistently in calculating the volatility of European Union markets, United States and Japan.

When the year 1987 is excluded, the results continue to display a clear reduction of volatility in every European market for this 1982-89 period (Table 7.3). The 1987 shock affected all stock markets around the world simultaneously with some small markets (Portugal, Ireland and Greece) experiencing major boosts to volatility through 1987 (Table 7.3).

Table 7-3

Annual volatility of E.U. stock market returns in 1982-89 including and excluding 1987

EU Market	1982-89	1982-89*	Changes
UK	19.1%	14.9%	-4.2%
Germany	21.4%	17.9%	-3.6%
France	21.7%	19.8%	-1.9%
Holland	19.2%	16.1%	-3.1%
Italy	23.8%	23.3%	-0.4%
Sweden	23.0%	19.9%	-3.1%
Spain	22.5%	19.4%	-3.2%
Belgium	20.0%	17.5%	-2.5%
Denmark	19.2%	18.5%	-0.7%
Finland	16.4%	16.4%	n.a.
Ireland	29.1%	20.4%	-8.7%
Austria	21.9%	20.4%	-1.4%
Portugal	57.2%	37.1%	-20.1%
Greece	33.1%	27.1%	-6.0%
* Without the year 1987			

When 1987 is excluded, differences in volatility between the two periods (1980s and 1990s) did not change other than for the Portuguese, Greek and Finish markets (Table 7.4).

Table 7-4

Changes in the volatility of E.U. stock market returns from 1980s to 1990s

EU Market	1982-89*	1990-96	Changes
UK	14.9%	14.3%	-0.6%
Germany	17.9%	17.9%	0.0%
France	19.8%	17.5%	-2.3%
Holland	16.1%	12.9%	-3.2%
Italy	23.3%	23.5%	0.2%
Sweden	19.9%	24.7%	4.8%
Spain	19.4%	21.5%	2.1%
Belgium	17.5%	14.4%	-3.1%
Denmark	18.5%	16.6%	-1.9%
Finland	16.4%	29.2%	12.8%
Ireland	20.4%	20.1%	-0.3%
Austria	20.4%	25.1%	4.7%
Portugal	37.1%	17.1%	-20.0%
Greece	27.1%	34.6%	7.6%
* Without the year 1987			

Of these countries Portugal joined the European Economic Community in 1985 when its economic and monetary indicators were very different from those of the core of other European Union countries. However in the 1990s Portuguese economic and monetary indicators became more correlated with other E.U. economies and this can be associated with a large reduction in Portuguese stock market volatility (Table 7.5).

Table 7-5

Correlations between economic and monetary variables

Economic and monetary variables	EU mean		Portugal		Greece	
	1980s	1990s	1980s	1990s	1980s	1990s
Exchange rates	0.57	0.63	0.56	0.67	0.42	0.75
Inflation rates	0.22	0.16	0.28	0.34	0.15	0.06
Growth of GDP	0.39	0.40	0.31	0.57	0.54	0.40
Government Bond Yields	0.73	0.76	0.51	0.84	0.36	-0.04
Imbalance Trade	16%	16%	19%	21%	26%	42%

Although Greece joined the EEC (in 1981) before Portugal, the correlation of Greek economic and monetary variables with other European economies continues to be low and Greece experienced no decline in stock market volatility (Table 7.5).

The correlation of volatilities of E.U. countries in the two periods is 0.24 excluding 1987 and 0.07 including 1987, suggesting rather low predictability for volatility.

As a group the volatility of E.U. stock markets changed less from the 1980s to 1990s than American and Japanese markets. The markets as a group show a slight decrease between the 1980s (excluding 1987) and 1990s, echoing the U.S., while there is a strong increase in the Japanese market volatility (Figure 7.5).

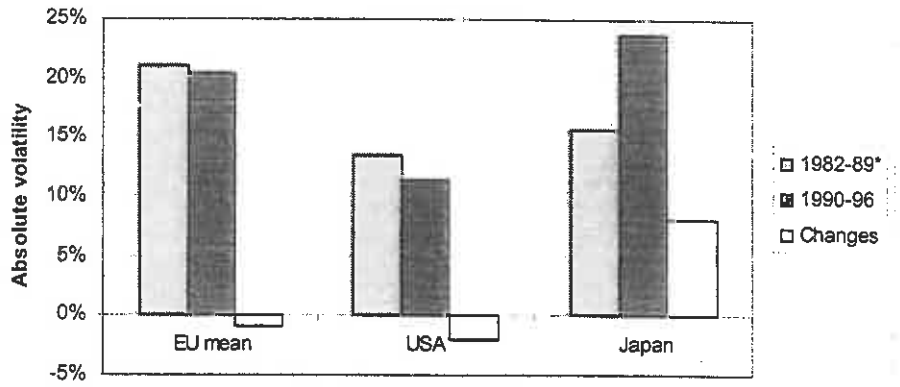

Figure 7-5
Changes in volatility between 1980s and 1990s, excluding the year 1987

Although this reduction in volatility has occurred in the E.U. it is not exclusively a European phenomenon because the volatility of U.S. index is also reduced. This would be consistent with global factors: cross-border investment, multinational companies and so on, rather than European factors driving volatility

7.5 CONCLUSIONS

The first conclusion is that on average the total volatility of the E.U. markets and U.S. market seems to decrease from the 1980s to 1990s, in distinction to the Japanese market where there was an increase in the volatility during the same period including and excluding the year 1987 (Table 7.6).

Table 7-6

Summary of stock market volatility

Markets	1982-89	1982-89 Excluding 1987	1990-96
EU mean	24.8%	20.9%	20.7%
USA	16.7%	13.5%	11.5%
Japan	16.7%	15.6%	23.7%

Also on average the volatility of the E.U. stock markets was larger than the volatility of the American market in both periods. This confirms the previous results using data from the 1970s and 1980s (Hunter and Coggin 1990, Odier and Solnik 1993).

The results also show that the volatility of stock markets around the world in the 1980s was strongly influenced by the year 1987. The annual volatility of returns of the year 1987 was extremely high compared with the other years during our sample period. All European markets were affected by the volatility of the year 1987 with Portugal, Ireland and Greece affected most. If the year 1987 is excluded from the analysis there were small downward trend in volatility between the 1980s and the 1990s for the majority of markets. The exceptions were Portugual which showed a large decrease, and the Greek market which showed a volatility increase. These exceptions seem to be the result of differences in the convergence of economic and monetary indicators of these to countries with the other E.U. countries. From the 1980s to 1990s the Portuguese economic and monetary indicators (interest rates, inflation rates, exchange rates and the growth of GDP) became more correlated with the other countries. On a simple average these correlations increased from 0.41 in 1980s to 0.61 in the 1990s. In contrast Greece experienced a decline in correlations with other E.U. countries from 0.37 to 0.29 during this period.

Also the results indicate that the volatility of the small markets as a group was higher than the volatility of large markets in both periods, including or excluding 1987. These markets also show in chapter 6 lower European systematic risk than the large markets, indicating that the volatility of small markets are more influenced by domestic factors than by international factors compared with the large E.U. markets, although they may also have been influenced by cross-border flows.

If volatilities are not predictable as we argue in section 7.4, this will be a factor contributing to the instability of weights in optimal European portfolio considered in chapter 8.

CHAPTER 8 NATIONAL INVESTORS OPTIMUM PORTFOLIOS IN E.U. MARKETS

8.1 PURPOSE OF THE CHAPTER

This chapter intends to calculate optimal weights for national investors efficient portfolios in the E.U. member countries. The issue considers how the higher correlation between economic and monetary indicators discussed in chapter 5 and also between stock markets discussed in chapter 4 have changed weights in European optimal portfolios in the 1990s compared with the 1980s.

If the European capital market is integrated, the intuition is that the optimal portfolio for each E.U. member's perspective should be similar, with returns differing only in respect of efficient currency adjustments, with convergence to the Euro eliminating this difference.

There is though a counter concern that the supply of assets across countries may not coincide with the optimum portfolio required, and therefore a pattern of excess and shortfall in the demand for assets may arise, destabilising returns during the adjustment process and leading to possibly severe hunting effects where the oversupply/undersupply characteristics become more important than fundamental risk/return factors. In these circumstances the alignment of fundamentals may not occur in the short to medium term.

To investigate this possibility, the optimal portfolio from the perspective of each European Union investor was estimated to establish two features:

1. The weights of the optimal portfolio for representative investors from different European countries at a given point in time.

2. Changes in weights over time as European integration increases the correlations of economic and monetary factors.

This chapter is structured in the following way: section one considers the main objectives and the expected results. Section two presents the data and section three presents the methodology used to optimise the portfolios. In section four the influence of the change in correlations in optimal weights are analysed. Sections five and six compare the optimal solutions and investigate the relationship between optimal weights, return and risk; and the last section presents and discusses the main findings.

8.2 DATA

The main data of this chapter consists of Morgan Stanley's Capital International total return indices, which includes changes in stock prices and dividends. As continuous compounding indices, logarithm first differences define returns in the investor's home currency with contemporaneous exchange rates from Datastream used to define sterling returns.

Interest rates data for the risk free rate were obtained from OECD and from IMF sources. Monthly data covering the period 1982-1996 were also used. As in previous chapters, the sample period was divided into two periods: 1982-89 and 1990-96. The objective of this division is to demonstrate changes reflecting the stronger European economic and monetary integration in the second period.

8.3 METHODOLOGY

8.3.1 The selected optimisation model

The optimised European portfolio was based on the variance/covariance portfolio optimisation model, developed by Markowitz (1952, 1959) and the optimal market portfolio was defined by the maximisation of the Sharpe Index (Sharpe, 1963) along the efficient frontier. Optimising with respect to this index avoids the need to set a constant prior level of return or risk and follows the methodology used by Grubel (1968), Levy and Sarnat (1970), Jankus (1998), Cavaglia et al. (2000) and Adjaoute and Danthine (2001).

The calculations of the optimal portfolio for each European investor was based on the following programming problem:

$$Max\ (\overline{R}_p - \overline{R}_F) / \sigma_p \qquad \text{equation 8.1}$$

Subject to:

$$\sum_{i=1}^{n} x_i = 1 \qquad \text{equation 8.2}$$

and

$$x_i \geq 0 \qquad \text{equation 8.3}$$

which constrains all asset weights to sum 1 and greater or equal to 0 (i.e. short-selling is excluded).

The exclusion of short-selling is normal, firstly because it may not be possible in all European stock markets (for example Portugal); secondly because most large investors

such as pension, mutual funds and insurance funds operate only on long transactions; and finally because short-selling creates portfolios that may be extremely sensitive to other issues such as contagion and default risk.

The mean and standard deviation of portfolio is given by the two following functions:

$$\overline{R}_p = \sum_{i=1}^{n} x_i r_i \qquad \text{equation 8.4}$$

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{i=1}^{n} x_i^2 \sigma_i^2 + x_j^2 \sigma_j^2 + 2 x_i x_j \operatorname{cov}_{ij} \qquad \text{equation 8.5}$$

$$\operatorname{cov}_{ij} = \sigma_i \sigma_j \rho_{ij} \qquad \text{equation 8.6}$$

Where:

$\overline{R}_p$ = portfolio mean returns %

x_i = the proportion of the portfolio invested in market i

r_i = the % returns in market i

σ_p^2 = the portfolio variance

ρ_{ij} = the correlation coefficient between returns in market i and market j

cov_{ij} = the covariance of returns between market i and market j

8.3.2 Methodology to calculate optimal portfolios

The steps involved in preparing the optimised portfolio for each currency reference were as used by Grubel (1968), Levy and Sarnat (1970), Jankus (1998), Cavaglia et al. (2000) and Adjaoute and Danthine (2001):

1. To calculate own currency returns and for each country index, and to adjust these to reference currency returns for each representative investor using cross currency returns.

2. To calculate the variance/covariance matrix from the currency perspective of each national investor.

3. To calculate the local currency mean of risk-free rate of return for each representative investor.

4. The optimisation of the European portfolio was calculated using the Markowitz model, and Sharpe Index. Using this methodology the optimum E.U. portfolio for each national investor was calculated, based on the own currency variance/covariance matrix. Results were calculated monthly for a two-year (24 months) window.

8.3.3 Methodology to compare the optimal weight solutions

In comparing the portfolios of investors from different countries, the sum of the absolute differences between the portfolio weights in each two-year window was used. This means that for any period the maximum difference in weights is 2, or 200%, with the minimum difference 0.

Let us take three theoretical examples (Table 8.1) comparing two matrixes of weights.

Table 8-1

Method used to calculate the differences between matrixes (examples)

Markets	A	B	C	D	E	SUM
Investor A						
Period 1	10%	0%	50%	40%	0%	
Period 2	0%	60%	0%	0%	40%	
Abs. differences 2-1	10%	60%	50%	40%	40%	200%
Investor B						
Period 1	10%	0%	30%	40%	20%	
Period 2	10%	0%	30%	40%	20%	
Abs. differences 2-1	0%	0%	0%	0%	0%	0%
Investor C						
Period 1	10%	0%	30%	40%	20%	
Period 2	0%	60%	20%	40%	0%	
Abs. differences 2-1	10%	60%	10%	0%	20%	100%

The example is based on the weights (%) of the total portfolio invested in each of the five assets (A,B,C,D and E). Two consecutive periods and the difference between them are analysed. In the case of investor A, the sum of the absolute differences is 2 (or in percentage terms 200%). This means that the two weight solutions are completely different with no commonality between the two periods. In the case of investor B the sum of the absolute differences is 0. This means that the two solutions are identical and that there has been no change, while in the case of investor C the sum of the absolute differences is 100%, which means that the two weight solutions have been subject to an intermediate level of change between the periods.

This calculation process was used for all comparisons between weights matrices over time and between investors in this chapter.

8.3.4 Risk-free rate of return

8.3.4.1 Selected risk-free rates

When a risk-free investment is included in addition to risky securities, the Sharpe ratio gives the risk/return gradient or market line and defines the optimum portfolio (short selling prohibited) with the highest Sharpe ratio as the point of tangency or highest point of contact with the efficient frontier (Sharpe 1963, 1964).

The risk-free rate is a theoretical concept, but defined in financial research as the yield on short term Treasury Bill (Reilly and Brown, 2000). Where the short term Treasury Bill rates were not available, the nearest comparable rate available in the databases was used. The risk-free rates of return (R_F) used for, by investor are listed in Table 8.2.

Table 8-2

Risk-free rates selected per investor

COUNTRY	RISK-FREE RATES OF RETURN
Belgium	BG TREASURY BILL RATE - 3 MONTH
France	FR TREASURY BILL DISCOUNT - 3 MONTH
Italy	IT TREASURY BILL RATE – 3 MONTH
UK	UK THREE MONTH TREASURY BILL RATE
Ireland	IR SHORT-TERM INT.RATE-3-MTH.TREASURY BILLS
Finland	EURO-CURRENCY (LDN) GUILDER 3 MONTH
Denmark	EURO-CURRENCY (LDN) DANISH KRN.3 MTH
Germany	EURO-CURRENCY (LDN) D-MARK 3 MONTH
Spain	ES SHORT-TERM INT.RATE - 3-MONTH INTERBANK LOANS
Sweden	SD SHORT-TERM INT.RATE-3-MONTH TREASURY DISCOUNT NOTE
Finland	FN LONG-TERM RATE-YIELD ON TAXABLE PUBLIC BONDS(3-6 YEARS)
Austria	OE GOVERNMENT BOND YIELD
Portugal	PT GOVERNMENT BOND YIELD
Greece	GR DISCOUNT RATE

8.3.4.2 Variability of risk-free rates

European risk-free rates decreased over our sample period and for the majority of markets they were smaller in the 1990s than in the 1980s (Table 8.3).

Table 8-3
Risk-free rate of return - Mean of the period

Investor	1982-89	1990-96
Austria	7.7	7.2
Belgium	9.5	7.1
Denmark	11.4	8.2
France	10.2	7.8
Germany	5.6	6.7
Greece	20.1	19.4
Italy	14.1	11.1
Holland	6.2	6.6
Spain	14.7	11.1
Sweden	11.5	9.7
UK	10.7	8.0
Ireland	12.1	8.9
Portugal	17.3	13.1
Finland	12.2	9.6
EU mean	*11.7*	*9.6*
EU Stdev	*4.0*	*3.4*
EU Stdev (Proportionate)	*34%*	*35%*

Although the dispersion of risk-free rates among E.U. economies decreased between periods, the proportionate standard deviation (equation 8.7) of the rates among E.U. markets was largely unchanged (Table 8.3).

$$\text{Stdev (proportionate)} = \frac{\text{Stdev}}{\text{Mean}} \qquad \text{equation 8.7}$$

The proportionate standard deviation offsets common inflation differences between the two periods.

8.4 INFLUENCES OF MARKET INTEGRATION IN OPTIMAL PORTFOLIO WEIGHTS

8.4.1 Correlation and risk/returns - a theoretical example

In this section we will demonstrate some of the behaviour of a portfolio's optimal weights when variables in the optimisation model change with a theoretical portfolio of three markets. The theoretical example, based on Newton and Wood's work (1999), considers a portfolio consisting of two correlated large markets (A and B) with relatively low risk and a more risky, smaller and less correlated market (C). We extend the Newton and Wood analysis by quantifying the change in whole optimal solutions when risk and return of market C changes for different levels of correlation between market C and the other two markets. The initial data is summarised in Table 8.4.

Table 8-4
Characteristics of the markets

Market behaviour	A	B	C
Correlation of A with:	1	0.5	0.2
Correlation of B with:		1	0.2
Mean return % per year	11%	11%	13%
Standard deviation of returns per year	18%	18%	26%

In table 8.5 we display the changes in optimal weights when correlations between market C and two other markets increase (reflecting more "integration" between the small market and the large markets) for different level of returns on the small market.

Table 8-5

Sensivity of asset allocation to correlation and returns

% Return on C	Correlation of C with A and B	Asset allocation			Portfolio		% change in allocation
		A	B	C	risk %	return %	
13	0.2	0.35	0.35	0.30	14.8	11.6	0.0
14	0.2	0.33	0.33	0.34	15.0	12.0	8.2
15	0.2	0.31	0.31	0.38	15.3	12.5	16.0
16	0.2	0.30	0.30	0.40	15.6	13.1	23.2
13	0.3	0.36	0.36	0.28	15.3	11.5	0.0
14	0.3	0.34	0.34	0.32	15.6	12.0	10.4
15	0.3	0.31	0.31	0.38	16.0	12.5	20.3
16	0.3	0.29	0.29	0.42	16.4	13.1	29.7
13	0.4	0.38	0.38	0.24	15.7	11.5	0.0
14	0.4	0.35	0.35	0.30	16.1	11.9	13.4
15	0.4	0.31	0.31	0.38	16.7	12.5	26.3
16	0.4	0.28	0.28	0.44	17.3	13.2	38.8
13	0.5	0.40	0.40	0.20	16.0	11.4	0.0
14	0.5	0.36	0.36	0.28	16.6	15.3	17.7
15	0.5	0.31	0.31	0.38	17.3	12.5	35.2
16	0.5	0.27	0.27	0.46	18.3	13.3	52.6

The results show the higher the correlation of C with A and B, the more sensitive the allocation of funds to C become for given return differentials. For example, when the level of correlations between market C and the other two markets are 0.2 and return on C varies from 13% to 16% (this means in relative terms an increase of 23%), the range of changes on the weights of market C vary between 0.30-0.40 (an increase of 33%). However when the level of correlations is 0.50, the weight of market C varies between 0.2 and 0.46 (an increase of 130%) (Table 8.5).

Therefore, the results show that changes in return generate large changes in the composition of the portfolio for constituents subject to an increase in correlation. Effectively an increase in correlations creates higher sensitivity towards any risk/return advantage C may have and increases the share of investment allocated to C (Figure 8.1).

This result, of course, is independent of the absolute size of the investments to be moved across border to C or the size of the security market in C.

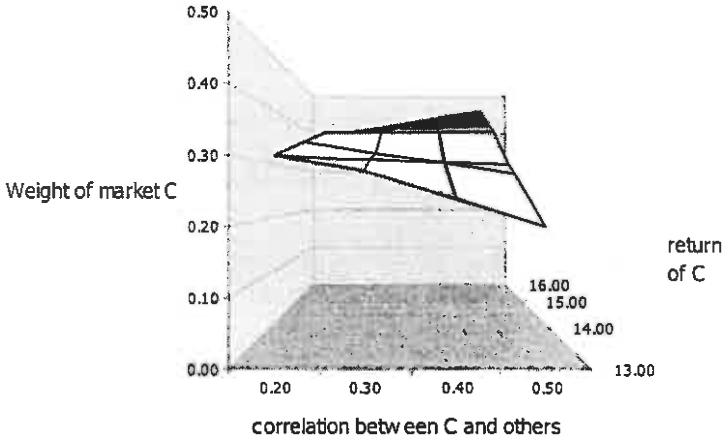

Figure 8-1
Weights of market C for different levels of returns and correlations

8.4.2 Increase in correlations for different level of returns - a real example

The previous analysis is repeated using real data based on three E.U. stock markets through the 1980s and 1990s (discussed in Chapter 4 and 7). Two large and highly correlated markets (Germany and France) and a small market (Denmark) were considered. Table 8.6 displays the main characteristic of each market based on the average results of both periods: 1980s and 1990s.

Table 8-6

Characteristics of the markets

Market behaviour	Germany	France	Denmark
1982-89			
Correlation of Germany with:		0.6	0.29
Correlation of France with:			0.36
Annual return (Arithmetic mean)	18.1%	24.9%	18.0%
St. deviation of returns (Annual mean)	21.4%	21.7%	19.2%
1990-96			
Correlation of Germany with:		0.69	0.63
Correlation of France with:			0.47
Annual return (Arithmetic mean)	6.4%	6.2%	6.1%
St. deviation of returns (Annual mean)	17.9%	17.5%	16.6%

In this case we considered both return increases and decreases for Denmark. The historical mean return appears in the third row on each panel of data. The results (Table 8.7) indicate that higher correlations of return for Denmark with France and Germany generate larger changes in the weight of the Danish market in the optimal portfolio.

For example, during the 1990s with higher correlation the range of weights for the Danish market varies between 0.27 and 0.44, whereas in the 1990s the range varies between 0 and 0.80.

Table 8-7

Asset allocation for different levels of return, for Danish representative investor

Period	% Return on Denmark	% Change	Asset allocation			Portfolio		Differences on total w_i
			Germany	France	Denmark	risk %	return %	
1982-89	16	-11%	0.057	0.675	0.268	17.9	22.1	18%
	17	-6%	0.049	0.636	0.315	17.6	22.1	9%
	18	0%	0.042	0.599	0.359	17.3	22.1	0%
	19	6%	0.035	0.565	0.400	17.1	22.3	8%
	20	11%	0.028	0.534	0.438	16.9	22.6	16%
1990-96	5.42	-11%	0.674	0.326	0.000	16.5	6.3	58%
	5.76	-6%	0.674	0.326	0.000	16.5	6.3	58%
	6.10	0%	0.439	0.270	0.291	15.1	6.3	0%
	6.44	6%	0.208	0.215	0.578	14.8	6.4	57%
	6.78	11%	0.029	0.172	0.800	15.3	6.7	102%

Also the solutions have larger weight changes in the 1990s than in the 1980s (last column). For example, when return on the Danish market increases by 11% (third column), the optimal solution changes by 16% in the 1980s, whereas it changes by 102% in the 1990s.

The change on asset allocation results for different levels of return on the small markets confirms the previous conclusions from the theoretical example. Also the change on total differences on optimal solutions when returns on small markets change also corroborates the conclusions obtained from the theoretical example. Clearly, weight changes of this magnitude for small markets have major implications for "weight of money" effects as mobile capital moves across borders. "Hot market" and "hot sector" effects may occur, in turn raising returns above equilibrium levels.

8.4.3 Increase on correlations for different level of risk - a theoretical example

We also consider in our examples the effects on optimal weights of reducing the risk of market C at the same time that its correlation with other markets increases. These results (Figure 8.2) lead to conclusions similar to those found for changes in returns in that, with higher correlations, the sensitivity of weights to changes in risk differences becomes higher.

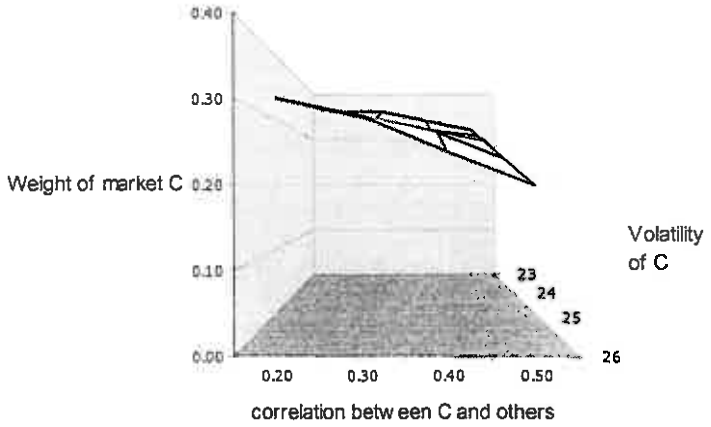

Figure 8-2
Weights of market C for different levels of volatility and correlations

8.4.4 Increase in correlations for different level of risk - a real example

In addition, an example with three E.U. markets based on real data is considered. This sensitivity test again looked at France, Germany and Denmark using the same three E.U. stock markets and data summarising the 1980s and 1990s presented in Table 8.8. Also in this case, we considered changes on risk of market C (Denmark) in two directions: when it increases and when it decreases. The initial optimal solution is highlighted in each panel.

Table 8-8
Asset allocation for different levels of risk for Danish returns

Period	% Volatility on Denmark	% Change	Asset allocation			Portfolio		Differences on total w_i
			Germany	France	Denmark	risk %	return %	
1982-89	17.2	-10%	0.030	0.523	0.447	16.2	21.6	18%
	18.2	-5%	0.036	0.563	0.401	16.8	22.9	9%
	19.2	0%	0.042	0.599	0.359	17.3	22.1	0%
	20.2	5%	0.047	0.633	0.320	17.8	22.4	8%
	21.2	10%	0.052	0.664	0.284	18.2	22.6	15%
1990-96	14.87	-10%	0.329	0.236	0.435	14.2	6.2	29%
	15.74	-5%	0.386	0.254	0.360	14.7	6.2	14%
	16.60	0%	0.439	0.270	0.291	15.1	6.3	0%
	17.46	5%	0.488	0.284	0.228	15.5	6.3	13%
	18.33	10%	0.538	0.295	0.171	15.8	6.3	24%

The results reinforce the conclusion obtained with the theoretical example that optimal weights have more sensitivity to the changes in relative risk in an environment of higher correlations. The results confirm that weight volatility is increasing for given differences in risk as the correlation of Denmark with France and Germany increases.

Again there are indications that in practice "hot market" phenomena may result through weight of money effects as all investors seek to increase weights in the same market.

In summary, the results illustrate how optimal weights are strongly related with the level of correlation between markets, and when the correlations increase optimal weights are more sensitive to differences in market returns and market risks.

8.5 REPRESENTATIVE NATIONAL INVESTORS OPTIMUM PORTFOLIOS IN E.U. MARKETS

8.5.1 Portfolio weights of security market and economic convergence

The objective of this section is to show the changes in country weights over time in the optimal portfolio nationals of each E.U. country should hold. Economic and monetary integration and increased correlation of economic and monetary indicators of E.U. countries (Chapter 5) were accompanied by higher correlations among E.U. stock markets (Chapter 4) and as argued in section 8.7, higher correlations between markets increases the sensitivity of optimal weights to changes in the relative risk and return of each market. This can result in larger changes in optimal solutions, especially in the 1990s where correlations were higher than in the 1980s.

The first analysis was to test how the solutions changed month by month over time for each national investor by using the methodology of section 8.4.3 and calculating:

$$abs \left| X_t^i - X_{t-1}^i \right| \qquad \text{equation 8.8}$$

Where:

abs = the absolute values

X_t^i = matrix of optimal weights for investor based in country i in month t

X_{t-1}^i = matrix of optimal weights for investor i in month t-1

After the optimal own currency portfolios of each E.U. investor country are calculated, the changes in weights for each of these investors is calculated. The results (Figure 8.3)

show higher variability in optimal weights in the 1990s than in the 1980s for all country/investors other than the U.K..

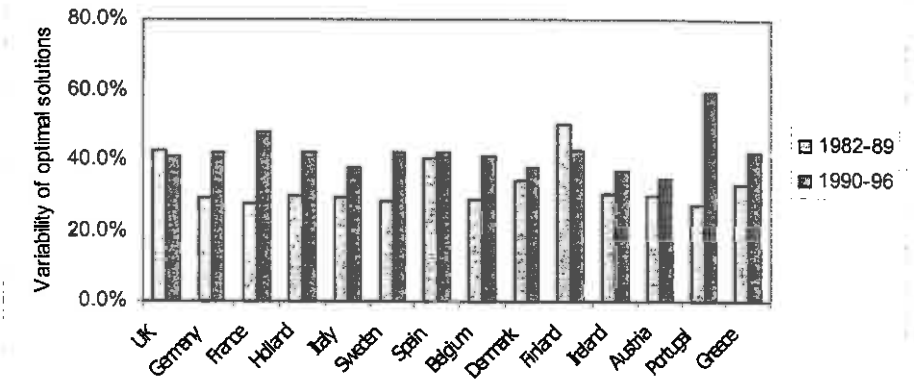

Figure 8-3
Variability of optimal weight per country/investor - Averages over the period

An average of optimal weights for all investors also indicates more variability in the 1990s than in the 1980s (Figure 8.4).

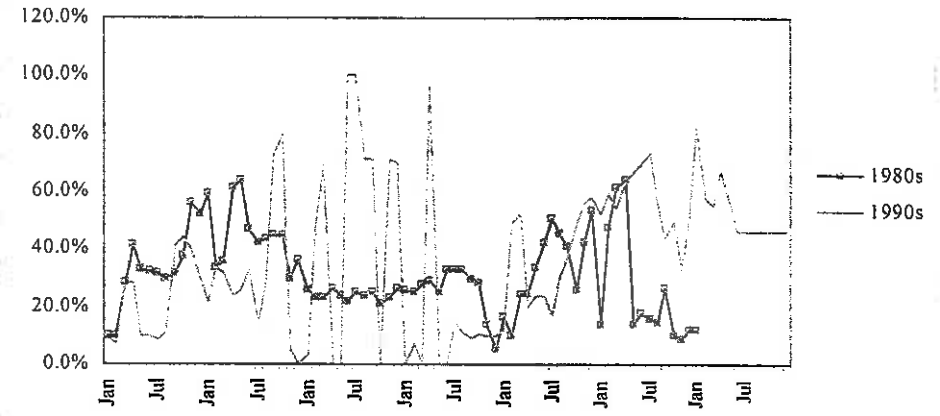

Figure 8-4
Monthly variability of optimal weights - Average of all E.U. investors per month

The major episodes in volatility of optimal weights in the second period were associated with the 1992 and 1993 crises in the European Monetary System (EMS). The

correlations between stock markets were higher in the second period and in this environment the optimal weights are more sensitive to the changes in risk and rate of returns of each market.

8.5.2 Differences between optimal weight solutions among E.U. national investors

This section considers changes in the optimal weight solutions between different E.U. country/investors in the 1980s and 1990s, and also compares the final results of both periods.

The main reason for the existence of differences between optimal weight solutions among different country/investors is the effects of exchange rates on the rate of return and consequently on the relative risk of each foreign stock market. Higher correlations again make the optimal solutions more sensitive to the changes in relative market returns and market risk, with large differences in optimal weights between investors from different European countries as measured by the absolute differences of optimal weight solutions (using the methodology discussed in the section 8.3.3).

Because for every investor we have 13 pairs of comparative results with other E.U. investors per month, the average of the differences between optimal weights was taken, i.e. the average of the difference between the representative national investor and the 13 other national investors.

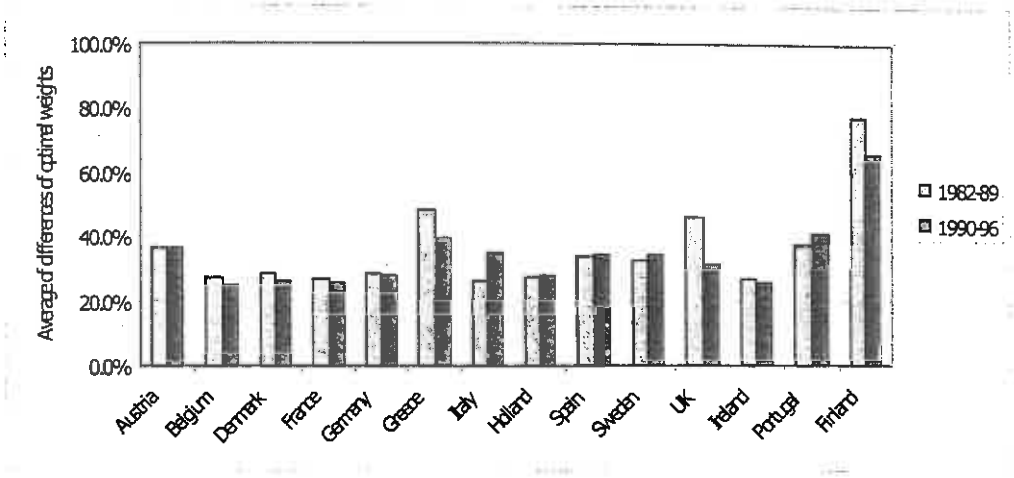

Figure 8-5

Average differences between optimal weight among E.U. national investor

The results show that the optimal solutions differed less between investors in the 1990s than in the 1980s, except in the case of Italy. Increasing correlation of returns was combined with decreasing dispersion of risk as currency effects start to disappear, with the net change between the periods quite small.

T-test results (Table 8.9) show that these differences are statistically significant in only four cases: UK, Italy, Finland and Greece.

Table 8-9

Differences of optimal weights between E.U. investors - Comparison of means between 1980s and 1990s per investor

Investors	t	df	Sig. (2-tailed)
Austria	0.117	12	0.909
Belgium	0.992	12	0.341
Denmark	0.809	12	0.434
France	0.421	12	0.681
Germany	0.056	12	0.957
Greece	3.191	12	0.008
Italy	-2.707	12	0.019
Spain	-0.047	12	0.963
Holland	-0.370	12	0.718
Sweden	-0.664	12	0.519
UK	5.183	12	0.000
Ireland	0.406	12	0.692
Portugal	-1.739	12	0.108
Finland	4.329	12	0.001
95% Confidence Interval of the Difference			

Despite average differences across the period being smaller in the 1990s than in the 1980s, Figure 8.6 shows that major irregularities continued and these were again associated with the exchange rate crises of 1992.

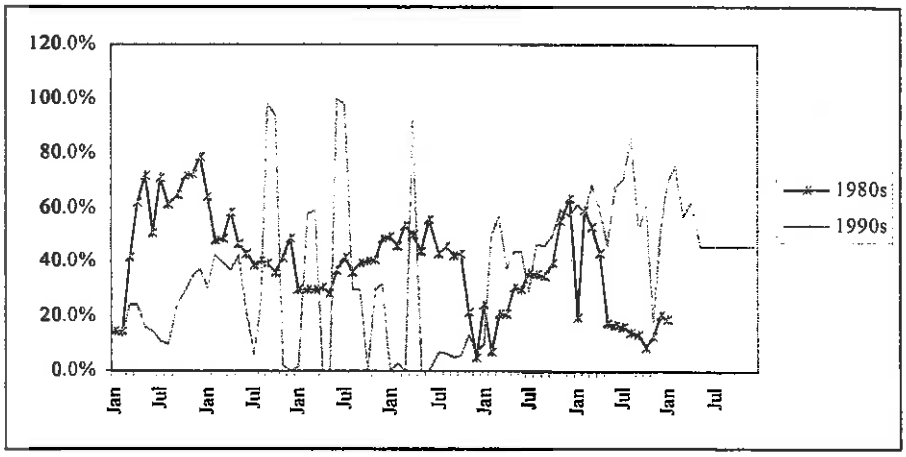

Figure 8-6
Monthly differences between investors - Average of all pairs of E.U. investors

The dispersion of optimal weight solutions amongst representative national investors tended to be more unstable in the 1990s than in the 1980s, mainly due to the 1992-93 EMS crisis. High volatility of exchange rates can create very different market returns for different foreign market investors.

Another conclusion from the results (Figure 8.7) is that the pairs of investors with the largest differences between optimal weights in the 1980s are generally the same as those with large differences in the 1990s. Figure 8.7 shows the comparison of the differences between optimal weights in both periods for all pairs of representative investors, a total of 91 (14*13 / 2) observations, and as we can note the results follow a line close to 45 degrees. The nearer they are to the line, the more similar the results for the same pair of investors in both periods showing considerable persistence in the variance covariance effects between market pairs.

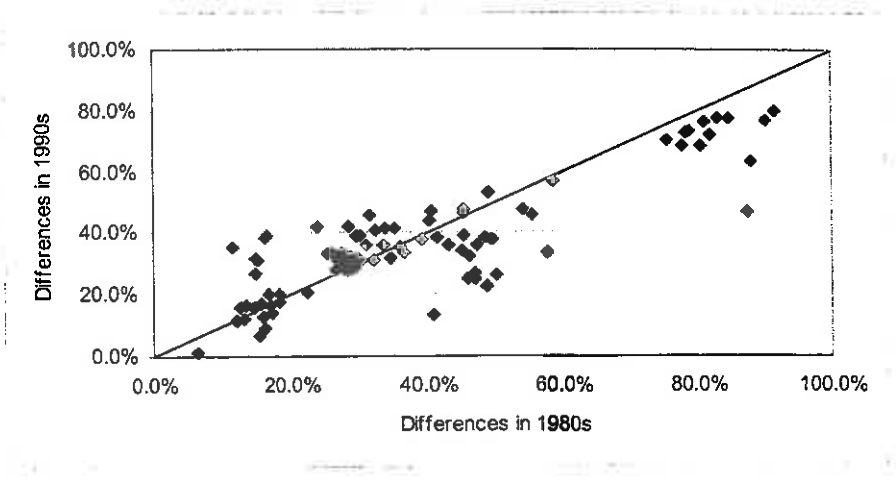

Figure 8-7

Differences in optimal weight between pairs of investors in 1980s and 1990s

8.5.3 Level of concentration of optimal weights

In this section the number of markets entering the optimal solution was examined with theory suggesting that the efficient frontier will have smaller convexity when the correlation between all assets is high than when it is low (Figures 8.8).

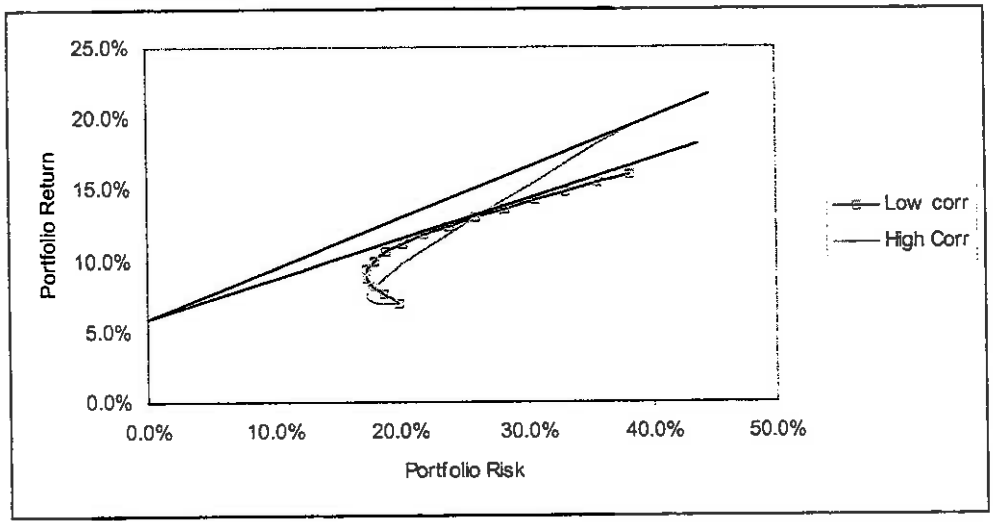

Figure 8-8

Efficient frontier and the capital market line with low correlations

With low correlations and high convexity of the efficient frontier, the capital market line is likely to reach tangency with the efficient frontier, and involve investment in most available assets. With high correlation and low convexity the capital market line is more likely to contact the highest return-highest risk markets with optimal solutions composed of lower numbers of assets (markets).

Let us follow an example with real data from the 1980s and 1990s discussed in Chapters 4 and 7. Table 8.10 displays the main characteristic of two large markets (Germany and France) and a small market (Spain).

Table 8-10
Characteristics of the markets

Market behaviour	Germany	France	Spain
1982-89			
Correlation of Germany with:		0.6	0.28
Correlation of France with:			0.39
Annual return (Arithmetic mean)	18.1%	24.9%	23.4%
St. deviation of returns (Annual mean)	21.4%	21.7%	22.5%
1990-96			
Correlation of Germany with:		0.69	0.62
Correlation of France with:			0.7
Annual return (Arithmetic mean)	6.4%	6.2%	11.5%
St. deviation of returns (Annual mean)	17.9%	17.5%	19.4%

The results from this example are displayed in Table 8.11, with the historical means highlighted and the other results simulated by changing the Spanish return.

Table 8-11

Asset allocation for different levels of return on Spain

Period	% Return on Spain	% Change	Asset allocation			Portfolio		Differences on total w_i
			Germany	France	Spain	risk %	return %	
1982-89	21.4	-8.5%	0.056	0.593	0.351	18.2	23.3	13%
	22.4	-4.3%	0.051	0.565	0.384	18.2	23.6	6%
	23.4	0.0%	0.047	0.537	0.416	18.1	24.0	0%
	24.4	4.3%	0.043	0.511	0.446	18.1	24.4	6%
	25.4	8.5%	0.039	0.486	0.475	18.2	24.9	12%
1990-96	10.52	-8.5%	0.000	0.000	1.000	19.4	10.5	0%
	11.01	-4.3%	0.000	0.000	1.000	19.4	11.0	0%
	11.50	0.0%	0.000	0.000	1.000	19.4	11.5	0%
	11.99	4.3%	0.000	0.000	1.000	19.4	12.0	0%
	12.48	8.5%	0.000	0.000	1.000	19.4	12.5	0%

Although the example is limited because we used the average of each period, it shows that the optimal solution of this example on the 1990s is concentrated only in one market: the market with the highest return and highest risk (Spanish market).

Figure 8.9 shows the number of markets in all optimal solutions in the 1980s and 1990s and shows how the number of assets in optimal portfolios may be expected to shrink in the 1990s.

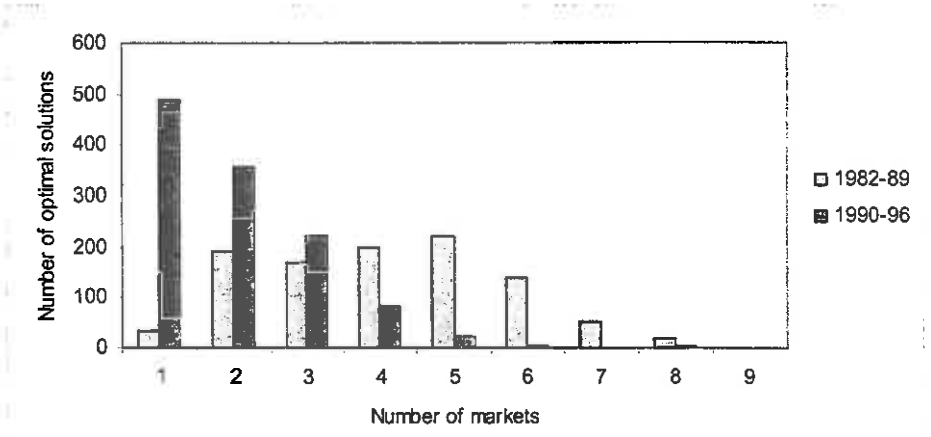

Figure 8-9

Number of markets in optimal solutions

To calculate the level of market concentration by representative national investor over time, the following formula is used:

$$\text{Level of concentration} = 1 - \text{Stdev } X_t^i \qquad \text{equation 8.9}$$

Where X_t^i – vector of optimal weights for investor *i* in month *t*.

The standard deviation of each optimal solution (each optimal solution is a vector of weights adding to 1) represents the dispersion of weights across all E.U. markets for each national investor. For instance, if the level of dispersion is 0.3 (30%) then the level of concentration will be:

$$1 - 0.3 = 0.7 \ (70\%)$$

Based on the previous analysis we should expect more concentration for each investor in the second period than in the first.

Table 8-12
Level of concentration - Average of the period per investor

Investor	1982-89	1990-96
UK	53.0%	81.3%
Germany	51.9%	83.9%
France	52.9%	85.3%
Holland	52.7%	84.0%
Italy	53.3%	77.6%
Sweden	52.1%	78.7%
Spain	55.4%	83.6%
Denmark	55.2%	84.3%
Belgium	53.9%	85.9%
Finland	75.2%	94.7%
Ireland	55.2%	83.7%
Austria	53.4%	84.9%
Portugal	52.2%	85.7%
Greece	55.1%	83.4%
EU mean	*55.1%*	*84.1%*

The results in Table 8.12 show that on average the implied level of concentration per investor is much higher in the 1990s than in the 1980s, for all investors. When averaging is performed across all months in the 1980s and 1990s, the results (Figure

8.10) can confirm that across investors the optimal portfolios imply investments being concentrated across fewer markets during the 1990s than the 1980s.

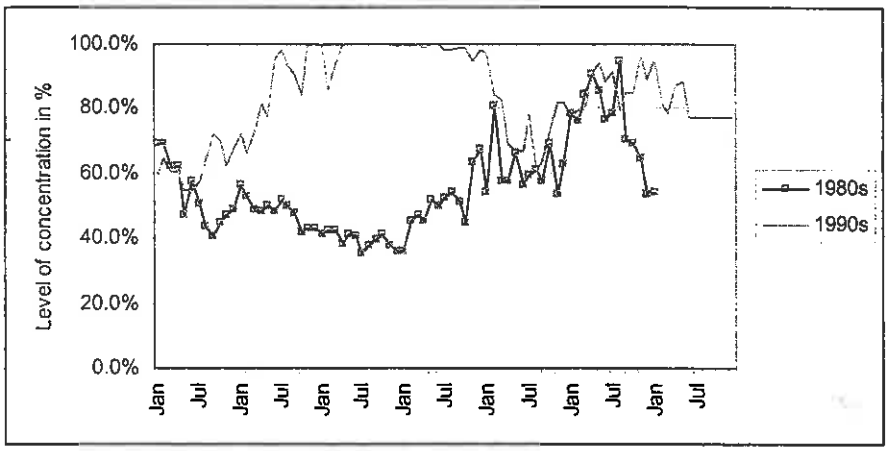

Figure 8-10
Monthly concentration of optimal weights - Average of all E.U. investors

8.6 RETURN OR RISK AS DRIVER OF OPTIMAL WEIGHTS

8.6.1 Definition of the variables

To determine the role of market return and market risk in optimal weights, an analysis of the relationship between these variables was performed. This analysis allows us to observe whether the conclusions change from the 1980s to the 1990s.

Because the level of returns and risk are very different in different months, a standard measure based on relative excess return and relative excess risk was used to give a relative dimension of return and risk for each month.

The relative excess returns were calculated in the following way:

$$Excess\ R_i = \frac{R_i - mean\ R_i}{Std\ R_i} \qquad \text{equation 8.10}$$

This equation measures the excess returns on each month relatively to the variability of returns during the period.

The relative excess risk was calculated based on the following expression:

$$Excess\ Risk_i = \frac{Risk_i - mean\ Risk_i}{Std\ Risk_i} \qquad \text{equation 8.11}$$

These two measures allow us to analyse return and risk relative to the mean of the period. Based on portfolio theory and our maximisation criterion of the Sharpe index, we should expect a larger weight for countries providing risk/returns over the mean than for countries under the mean.

However, in the 1990s the markets with higher returns are generally those included most frequently in optimal solutions, a result which would not occur unless the incremental returns were larger than incremental risk.

For this analysis two different relationships were measured:

- The relationship between the relative excess returns of E.U. markets and the optimal weights they secure;
- The relationship between the relative excess risk of E.U. markets and the optimal weights they secure.

The objective is to observe which variable, return or risk, is more relevant for the selection of optimal weights, and if this relation changed from the 1980s to the 1990s.

8.6.2 Graphic analysis

Figure 8.11 shows monthly excess return (calculated using equation 8.10) against the weight that the market has in the optimal solutions for that month for all investors all markets and all months. The same analysis is performed replacing the monthly excess return by the excess risk (equation 8.11) shown in Figure 8.12. The results show that in both the 1980s (Figures 8.11 and 8.12) and 1990s (Figures 8.13 and 8.14) returns over the mean are more relevant for optimal weights than risk over the mean.

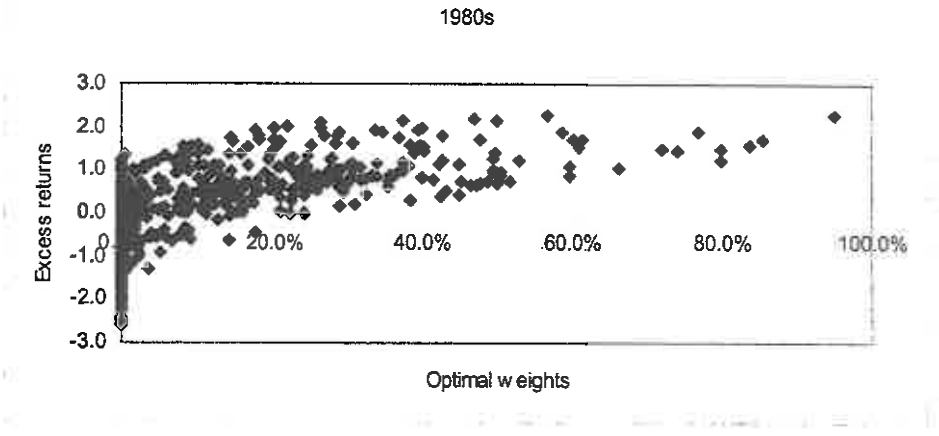

Figure 8-11
Optimal weight of each market and the representative excess returns in 1980s

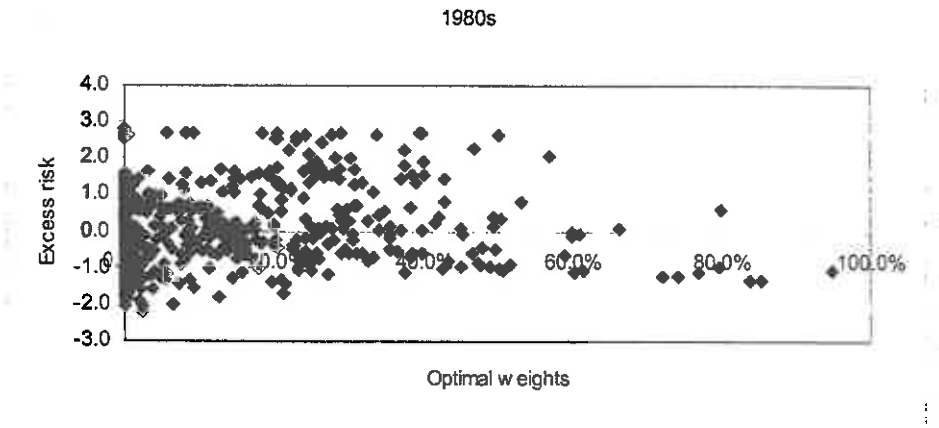

Figure 8-12
Optimal weight of each market and the representative excess risk in 1980s

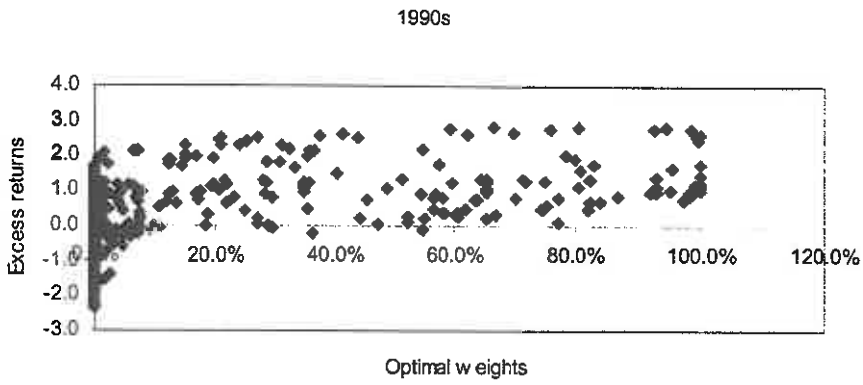

Figure 8-13
Optimal weight of each market and the representative excess returns in 1990s

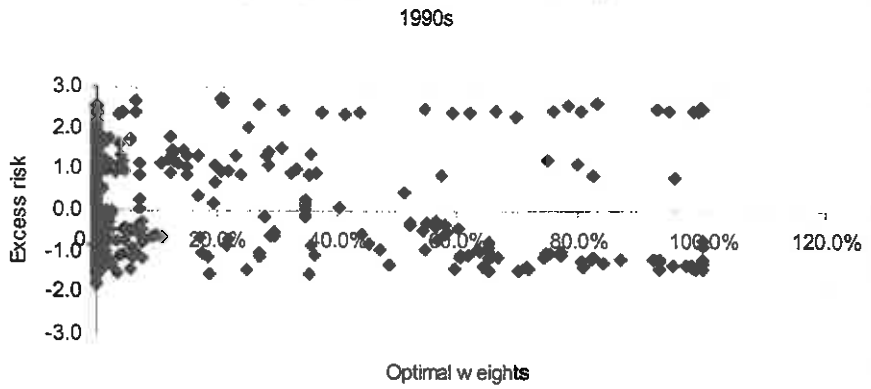

Figure 8-14
Optimal weight of each market and the representative excess risk in 1990s

The expected positive relationship between the level of returns and investment weight is apparent but an expected negative relationship between market risk and the investment weight is not evident.

To illustrate the trade off, a three-dimensional graphic based on excess returns (from the equation 8.10), excess risk (from the equation 8.11) and optimal weights was used.

The results (Figures 8.15 and 8.16) show high levels of optimal weights related to a high level of market returns but with relative risk having little influence.

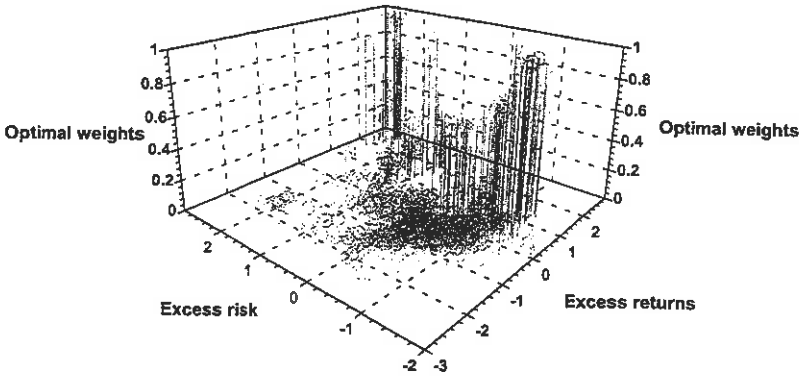

Figure 8-15
Excess returns, excess risk and optimal weights in 1980s

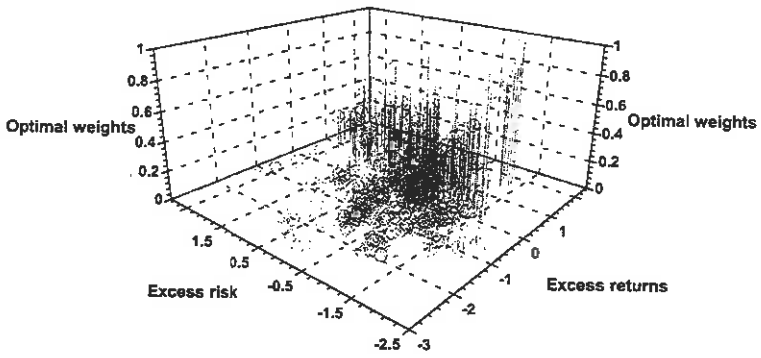

Figure 8-16
Excess returns, excess risk and optimal weights in 1990s

8.6.3 The multi-regression model

To further analyse the role of market return and market risk in determining optimal weights, a multiple regression model was used with optimal weight of each market as the dependent variable and the representative excess returns and excess risk of the same market as independent variables.

$$W_{it} = \alpha + \beta \text{ Excess } R_{it} + \beta \text{ Excess Risk}_{it} \qquad \text{equation 8.12}$$

Where W_{it} is the weight of market *i* at month *t* in the optimal solution.

The independent variables are the same that we used in the graphic analysis: excess return of each market (from equation 8.10) and excess risk (from equation 8.11). Monthly observations (1008) measured in investor currency were used.

The multiple regression results (Table 8.13) support the following conclusions:

- In both periods returns were more important than risk in determining optimal weights, because $\beta_{Ri} > \beta_{Risk}$;
- In the 1990s higher returns were more relevant for the optimal weights than in the 1980s. The β of the returns is higher in the second period (0.126) than in the first (0.105), i.e. the slope of the regression between excess returns and optimal weights is higher in the 1990s.
- The β of risk is negative in both periods confirming the theoretical expectation that there should be an inverse relationship between market risk and optimal weights.

Table 8-13

Multiple regression of relative risk and relative return determinants of weights

Summary	1982-89	1990-96
R^2	0.40	0.27
Adj. R^2	0.40	0.27
Stand. Error	0.12	0.20
Df	802	923
F test	263.01	170.76
Sign.	0.000	0.000
Coefficients		
α	0.091	0.091
β_{Ri}	0.105	0.126
β_{Risk}	-0.015	-0.024

Note that the R^2 of the multiple regression is high and statistically significant. These results confirm the importance of the level of returns for the optimal weights and also that in the 1990s the optimal weights were essentially markets with the highest risk.

8.7 CONCLUSIONS

Economic and monetary integration was accompanied by growing correlations among E.U. stock markets (discussed in Chapter 4). The implications of this are an expectation of an increase in the instability of investor weights in European optimal portfolios in the 1990s compared with the 1980s, if investors were following optimisation strategies.

The results also show that over time more national investors would rationally choose the same optimum countries in their portfolios. The differences between the optimal solutions for different investors seem to be smaller in the 1990s than in the 1980s. The highest period of instability occurred in 1992-93 with the EMS exchange rate crisis creating very different market returns for different national investors. This creates large differences in optimal weights between investors from different European countries, especially when correlations between markets are very high.

The study also indicates that there were different patterns in the level of concentration of optimal weights between the 1980s and 1990s. In the 1980s theoretical optimal weights involved more markets than in the 1990s, irrespective of whether they are large or small countries.

In the 1990s, not only were a smaller number of countries involved in periodic optimum portfolios but also markets with the highest level of returns increasingly dominated the

implied optimal solutions. This is due to the high correlation between markets and low convexity of the efficient frontier. In this case, the capital market line generally intersects the highest return markets, even when these markets have a high level of risk. This means that markets with above average risk appear in optimal portfolios, particularly during the 1990s.

We also show a stronger relationship between market returns and optimal weights than between market risk and optimal weight, indicating that market returns were driving optimal weights.

If the small markets appear in optimal solution with a large weight, this should imply an increase in demand of the shares of this market from other country investors. If the demand is larger than the size of the market, we should expect an increase in share prices in the next period.

Table 8.14 shows the average of optimal weights per period, the relative size of each market to total E.U. market capitalisation, and the potential demand measured by the relative GDP of each country to the total E.U. GDP. Seven small markets appear in optimal E.U. portfolio with a weight larger than the dimension of the market. Although the table shows only the average, this happened frequently when we consider monthly results.

Table 8-14

Average of optimal weights and the size of the market

Markets	Optimal weights		Relative market size		Potential demand	
	1980s	1990s	1980s	1980s	1980s	1990s
Austria	13.4%	2.1%	0.5%	1.0%	2.3%	2.4%
Belguim	17.8%	2.9%	2.8%	2.6%	3.0%	3.1%
Denmark	17.9%	6.4%	1.3%	1.8%	1.7%	1.6%
Finland	0.0%	0.0%	1.2%	0.9%	1.4%	1.3%
France	5.0%	0.8%	10.2%	14.0%	17.7%	17.0%
Germany	3.8%	0.1%	18.2%	15.7%	22.6%	23.6%
Greece	8.8%	18.3%	0.2%	0.5%	1.7%	1.8%
Holland	4.3%	49.9%	7.5%	8.0%	4.2%	4.3%
Ireland	0.0%	0.0%	0.6%	0.6%	0.7%	0.8%
Italy	4.7%	1.6%	7.0%	5.4%	16.5%	16.2%
Portugal	0.0%	0.0%	0.9%	0.9%	1.6%	1.8%
Spain	15.8%	0.0%	3.3%	4.4%	7.8%	8.2%
Sweden	7.6%	13.2%	4.3%	4.0%	2.7%	2.4%
U.K.	1.0%	4.5%	41.9%	40.2%	16.2%	15.5%
E.U.	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

This can contribute to a major interest of some small or emerging markets, which periodically have high return (Solnik, 1998), if European investors follow optimisation strategies. It can also create incentives to stock market alliances between small and large markets. It is a different perspective for alliances that are usually only based on reduction of costs.

A lower number of markets in optimal solutions can also incentive alliances between markets or can contribute to an increase in companies listed in more than one market. Also a lower number of markets in optimal solutions can apply for more cross-border investments and reduce the home bias in portfolios of institutional investors, because lower a number of markets investing implies less transaction and information costs.

CHAPTER 9 CONCLUSIONS AND FURTHER RESEARCH

9.1 RESEARCH OBJECTIVES

This research examines changes in European financial and economic integration and considers whether this is a European or global phenomenon. Generally the literature finds a global common trend to economic and financial integration (Solnik 1984, Asprem 1989, Chen and Zhang 1997, Freimann 1998, Ratner and Leal 2000) and some significant relationships between stock market returns and selected economic and monetary variables. However the linkage between economic and monetary variables and stock market behaviour (Chen et al. 1986) and the global/E.U. generalisation is still relatively unexplored especially in the light of E.U. harmonisation activities.

This study extended previous research by examining how financial, economic and monetary indicators of European Union countries as a block correlate with those of the U.S. and Japan, and whether effects differ between large and small markets within the E.U.. We updated the four economic variables used by Tucker et al. (1991), Solnik (1984), and Freimann (1988) but additionally added imbalance in trade as an indicator of economic disequilibrium.

Although this research mainly concerned about financial and economic integration, we extended this by considering the investment implications of the changing risks and correlations of markets arising from integration. We investigated the optimal portfolios for representative European Union resident investors in the E.U., to examine the implications for cross-border investment flows.

9.2 SUMMARY OF RESEARCH FINDINGS

9.2.1 Economic and monetary integration

The results show countries within European Union are linked economically and monetarily more strongly with each other than with the U.S. or Japan. Our findings show that overall economic and monetary variables are more correlated across European countries in the 1990s than they were in the 1980s. Secondly the results show that correlations between all economic and monetary variables were higher within the E.U. than between the E.U., the U.S. or Japan. Although we used a different approach and more variables, this corroborates the Freimann (1998) results of a trend toward economic "integration" in the E.U. over time.

9.2.2 Stock market integration

Financial integration implies correlation coefficients should increase over time and if European integration is a discernible phenomenon, intra E.U. correlations should increase more rapidly than those between European countries, the E.U. and the Japanese and U.S. stock markets.

The results confirm European integration exceeds a general trend to globalisation. It was found that correlations between European stock markets have increased rapidly in the period 1982-96 while correlations between the E.U./U.S., E.U./Japan and U.S./Japan show no positive trend.

So far as Europe is concerned, the increase in correlations was stronger between small peripheral markets and large markets and with the E.U. generally, which raises concerns about the long-term survival of these markets.

The results reflect previous findings (Johnson and Soenen 1993, and Solnik et al. 1996), but European effects are sufficiently noticeable to indicate significant financial economic and monetary integration created within the European Union, especially for smaller economies.

9.2.3 Stock markets integration reflects the economic and monetary integration

This connection was analysed using a multiple regression model, with the correlation coefficient of returns of each pair of markets as the dependent variable and correlations between economic and monetary indicators for each pair of countries as independent variables. The results show a positive and significant (with an adjusted R^2 of 0.43) correlation between stock markets returns and economic variables in both sub-periods and over the entire period, confirming a link between economic integration and stock market integration. This corroborates partial findings in the literature (Solnik 1984, Asprem 1989, Tucker et al. 1991, Ratner and Leal 2000). However, this may also be driven by corporate cross-border integration and the emergence of European companies, the extreme example being Nokia.

The detailed results also show that beta of exchange rates, bonds and the imbalance trade are significant. This contradicts the Solnik (1984) results showing a weak relation between currency movements and stock markets returns in the period 1971-82. The results using a different approach and different sample are consistent with other findings (Cheng and Zhang 1997, Ratner and Leal 2000).

9.2.4 European total and systematic risk

We also investigated whether European economic and monetary integration has reduced the total volatility of E.U. stock markets compared with the U.S. and Japan. In addition, we assessed whether European economic and monetary integration has led to a more uniform risk among E.U. stock markets.

Studies on international stock markets show that E.U. markets were generally more volatile (riskier) than the U.S. or Japan in the 1970s and 1980s (Hunter and Coggin 1990, Odier and Solnik 1993). Although confirming the previous findings, in addition our results indicate that on average the total volatility of both E.U. and U.S. markets seem to decrease from the 1980s to 1990s (in contrast with the Japanese market), and the volatility across E.U. markets was more similar in the 1990s than in the 1980s.

Solnik (1974), Lessard (1976), Drummen and Zimmermann (1992), Heston and Rouwenhorst (1994), and Griffin and Stulz (1997) concluded that international factors were weaker than domestic. It seems though that economic and monetary integration in Europe is creating a homogeneous group of countries exhibiting more similar and higher systematic risk against the European benchmark than against U.S. and Japanese markets.

To investigate this, we specify a multi-factor model explaining national stock market returns in terms of three returns representing Europe, the U.S. and Japan.

The empirical results indicate that betas for all national E.U. markets against the European benchmark have increased strongly from the 1980s to 1990s, indicating that European systematic risk explains an increasing amount of risk in European Union

stock markets. This European trend is more observable after the European Union process and it is stronger for large European stock markets than for small markets.

This confirms that integration between European markets has been increasing alongside economic and monetary integration. Moreover, the co-ordination process has applied across the E.U. and not simply some countries, because the dispersion of European betas reduced from the 1980s to 1990s.

The results also indicate beta coefficients of E.U. countries against the European benchmark are much larger than beta coefficients against U.S. and Japanese markets, and also the differences between the betas with the European benchmark and the betas with other markets (U.S. and Japan) increased from the 1980s to the 1990s. This supports a conclusion that European factors have stronger effects in E.U. stock markets than the global factors, and that the common European factors have been increasing in importance.

9.2.5 European economic and financial integration and changes in the optimal European portfolio

The potential for investors to reduce national systematic risk by diversifying their portfolios internationally was noted by Grubel (1968), Levy and Sarnat (1970) and Solnik (1974). More recent works also indicate the continuing benefits from international diversification (Eun and Resnick 1994, Markellos and Costas 1997, Jankus 1998, Cavaglia et al. 2000, Adjaoute and Danthine 2001) with several studies indicating the potential of emerging stock markets (including some E.U. markets) for international portfolios (Divecha, et al. 1992, Speidell and Sappenfield 1992, Khanna 1996, Masters 1998).

However, while these studies (based on the Markowitz model and Sharpe Index technique) examine the benefits of international investments in terms of reducing the level of portfolio risk or increasing the level of portfolio returns, they generally neglect the size and stability of optimal weights found in the diversification process and we therefore consider these in the context of European economic and financial integration.

Our empirical results show that the new economic and financial environment provoked by the European integration process implies noteworthy changes in the stability of weights in optimal European portfolio.

First, as correlations become higher optimal weights become more sensitive to changes in market returns and market risks. As a result, there was an increase in the instability of investor weights in European optimal portfolios in the 1990s compared with the 1980s.

Secondly, the results show that investors should choose more similar country weights in their optimal portfolios. The differences between optimal solutions of different national investors seem to be smaller in the 1990s than in the 1980s, although the way that they vary is more unstable in the 1990s than in the 1980s.

Third, the findings indicate that the level of concentration of optimal weights was higher in the 1990s than in the 1980s, for all countries. In the 1980s, optimal weights were dispersed over more markets whereas in the 1990s they were concentrated in a smaller number of markets.

In the 1990s, not only were a smaller number of countries involved in periodic optimum portfolios but also markets with the highest level of returns dominated the optimal solutions. This is due to the high correlation between markets and low convexity of the

efficient frontier. In this case the capital market line generally intersects the highest return markets, even when these markets have a high level of risk. This situation gives us optimal solutions composed of a low numbers of assets.

The findings also indicate that market returns rather than correlation or risk differences were most influential in driving optimal weights. This reflects the stronger relationship between market returns and optimal weights than between market risk and optimal weight.

The results show that markets with above average risk appear most heavily weighted in optimal portfolios, particularly during the 1990s. The reason is that markets with the highest returns dominated the optimal solutions in this period and usually markets with higher returns also have higher risk.

This means that as economic and monetary integration increase, the theoretical optimal European portfolio is increasingly dominated by the E.U. stock market with the highest returns at any point in time. If the risk is becoming more similar for E.U. investors then they should pay more attention to the level of forecast returns. As funds move into the favoured market, it will create self-sustaining returns given the weight of money, and the likely consequence is to reinforce the trend until it is reversed by some stochastic event and an alternative market replaces it.

9.3 THEORECTICAL CONTRIBUTION

This research aims to contribute to an understanding of economic and financial integration between countries and how it affects the optimal portfolio of European Union investors. The current research adds to the literature in the following ways.

1. It represents an attempt to mix an analysis of economic and monetary integration and stock market integration. Generally previous studies are concerned only about one of these two types of integration. We extended the previous works by considering both perspectives using a common methodology. The results give evidence that stock market integration is related with economic integration, namely with interest rates, exchange rates and trade.

2. We also expanded previous research by examining additionally financial, economic and monetary integration of European Union countries as a block compared with the U.S. and Japan. The results show that financial, economic and monetary European integration is a regional phenomenon more than a reflection of a global trend toward integration.

3. This research took a different perspective on international systematic risk compared with previous studies that examined the level of systematic risk of returns for each stock market in relation to world market returns (Thomas 1988, Harvey 1995). Other research investigated sector effects alongside national and international market effects (King 1966, Agmon 1972, 1973, Lessard 1976, Solnik 1974, Zimmermann 1992, Roll 1992, Heston and Rouwenhorst 1994, Griffin and Stulz 1997). In our study the results show that the common European factors have been increasing in importance compared with two other sources of risk, and the

sensitivity to European index returns has become more similar for countries within the E.U.. This confirms that there is an increased-shared risk within European Union stock markets compared with national specific risk, and integration between European markets has been increasing alongside economic and monetary integration.

4. Portfolio theory suggests that markets with returns over the mean and risk under the mean should be in optimal solutions more than markets with returns below the mean or risk over the mean. Although the research findings corroborate the theory, the behaviour of optimal weights is also of interest. First our results show that the new economic and financial environment creates more instability on the composition of the theoretical optimal European portfolio. Secondly in an environment of high correlations, there is a stronger relationship between market returns and optimal weights than between market risk and optimal weight. Thirdly the consequence is that a lower number of markets appear in the optimal portfolio.

9.4 PRACTICAL CONTRIBUTIONS

The results of this research are relevant for European Union investors and companies for several reasons.

1. European integration is creating an economic and financial zone to compete with other large economies or economic zones. A study of how economic and monetary European integration has been reflected in European stock markets will therefore be of interest both for European investors and companies seeking capital within the E.U.. Also we expected a future increase in the proportion of assets from different

E.U. markets in the portfolios of E.U. institutional investors and companies' balance sheets, as a result of the elimination of important barriers and the increase in the monetary integration.

2. Given the results showing a trend toward "Europeanisation" rather than globalisation, European investors should see the European markets as an integrated financial zone, albeit one offering less diversifiable portfolio risk. To have significant reductions in portfolio risk they might have also included investments outside the European zone, namely in markets less correlated with the E.U. market, such as the U.S. or Japan. This still leaves them with the problem of selecting weights for the European portion of their portfolio.

3. Our results indicate that as stock market integration grows in the European Union, investors' optimal portfolios favour higher return/higher risk markets. If these results translate into actions there will be an increasing tendency to overshoot, producing higher volatility in European markets.

4. In a financial zone with a high level of integration between markets, the results also show that over time more national investors would rationally (based on optimisation strategies) choose the same optimum countries in their portfolios. This raises the question of the viability of listing and trading in smaller markets, since liquidity will be higher in large markets. This explains the current trend to alliances between markets and a reduction in home bias by investors.

5. The study also indicates an increase in the level of concentration of optimal weights when markets become more integrated, and this can lead to a reduction of transaction and information costs in optimal European portfolios.

9.5 FURTHER RESEARCH

The findings of the research suggest several avenues for further research.

1. The time factor associated with the need for consistent research and development data places limitations on this research. After the end of our sample period, there were more significant changes in the European Union, namely the completion of the euro programme. Also a longer time period obviously would help in providing stronger support for some of these conclusions.

2. Another limitation is that the variables used to investigate economic and monetary integration, although not chosen arbitrarily, are also not exhaustive. The inclusion of other variables can provide new insights and give more robustness to our conclusions. So it would not be unreasonable for future tests to be carried out using more economic and monetary variables.

3. Economic integration of Europe's non-E.U. markets should provide additional diversification. Switzerland and the extension of E.U. membership to East Europe may provide incremental diversification.

4. No research to separate sovereign integration from corporate integration appears to exist. Increasing integration of securities markets may reflect the development of corporations with little or no home bias in their operations in terms of the national market in which they are listed. The reduction in specific country effects may simply be the reduction in the country focus of quoted entities.

5. Finally, with currency pegging and the development of other trading blocs (NAFTA, Mercosul and ASEAN), the results of this research can be compared with other economic and monetary zones.

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APPENDIX 1 – Correlation matrices between E.U. stock market returns

Correlation matrix between rate of returns of E.U. stock markets for the period 1982-89

Markets	Austria	Belguim	Denmark	France	Germany	Greece	Italy	Holland	Spain	Sweden	UK	Ireland	Portugal
Austria	1.00												
Belguim	0.22	1.00											
Denmark	-0.04	0.32	1.00										
France	0.35	0.62	0.36	1.00									
Germany	0.47	0.56	0.29	0.60	1.00								
Greece	0.25	0.06	-0.06	0.10	0.06	1.00							
Italy	0.28	0.46	0.23	0.52	0.42	0.00	1.00						
Holland	0.31	0.57	0.35	0.51	0.61	0.05	0.44	1.00					
Spain	0.19	0.38	0.14	0.39	0.28	0.04	0.41	0.39	1.00				
Sweden	0.23	0.40	0.22	0.33	0.37	-0.03	0.43	0.46	0.31	1.00			
UK	0.23	0.57	0.28	0.52	0.48	0.11	0.35	0.70	0.44	0.51	1.00		
Ireland	0.28	0.63	0.40	0.55	0.49	0.14	0.38	0.66	0.63	0.65	0.82	1.00	
Portugal	0.12	0.19	0.02	0.13	0.13	0.48	0.18	0.27	0.30	0.33	0.35	0.40	1.00
Finland	0.18	-0.03	0.13	0.11	0.07	-0.33	0.08	0.22	0.34	0.39	0.13	0.28	-0.22

Correlation matrix between rate of returns of E.U. stock markets for the period 1990-96

Markets	Austria	Belguim	Denmark	France	Germany	Greece	Italy	Holland	Spain	Sweden	UK	Ireland	Portugal
Austria	1.00												
Belguim	0.43	1.00											
Denmark	0.48	0.61	1.00										
France	0.47	0.74	0.47	1.00									
Germany	0.71	0.69	0.63	0.69	1.00								
Greece	0.32	0.23	0.21	0.28	0.24	1.00							
Italy	0.42	0.53	0.53	0.52	0.54	0.30	1.00						
Holland	0.50	0.81	0.62	0.77	0.71	0.20	0.51	1.00					
Spain	0.47	0.61	0.63	0.70	0.62	0.30	0.57	0.67	1.00				
Sweden	0.36	0.50	0.54	0.54	0.56	0.32	0.45	0.57	0.75	1.00			
UK	0.44	0.64	0.52	0.70	0.58	0.13	0.38	0.74	0.58	0.50	1.00		
Ireland	0.46	0.68	0.63	0.59	0.60	0.29	0.47	0.70	0.62	0.52	0.64	1.00	
Portugal	0.36	0.46	0.44	0.55	0.45	0.38	0.44	0.55	0.54	0.50	0.42	0.53	1.00
Finland	0.48	0.47	0.48	0.39	0.50	0.17	0.52	0.57	0.56	0.60	0.53	0.48	0.29

Correlation matrix between rate of returns of E.U. stock markets for the period 1982-96

Markets	Austria	Belguim	Denmark	France	Germany	Greece	Italy	Holland	Spain	Sweden	UK	Ireland	Portugal
Austria	1.00												
Belguim	0.31	1.00											
Denmark	0.21	0.43	1.00										
France	0.41	0.66	0.41	1.00									
Germany	0.58	0.61	0.43	0.64	1.00								
Greece	0.28	0.13	0.06	0.18	0.14	1.00							
Italy	0.36	0.49	0.36	0.52	0.47	0.14	1.00						
Holland	0.37	0.64	0.44	0.59	0.64	0.11	0.46	1.00					
Spain	0.33	0.46	0.35	0.52	0.42	0.16	0.49	0.49	1.00				
Sweden	0.31	0.44	0.37	0.42	0.45	0.14	0.44	0.49	0.52	1.00			
UK	0.32	0.59	0.37	0.58	0.52	0.11	0.37	0.71	0.49	0.50	1.00		
Ireland	0.38	0.65	0.52	0.57	0.54	0.22	0.43	0.67	0.63	0.57	0.74	1.00	
Portugal	0.19	0.26	0.16	0.24	0.20	0.41	0.24	0.32	0.34	0.33	0.35	0.42	1.00
Finland	0.42	0.35	0.40	0.32	0.42	0.10	0.47	0.51	0.54	0.57	0.45	0.44	0.17

APPENDIX 2 – Unstandardised betas of simple and multiple regressions of chapter 6

Unstandardised betas of the multiple regression model

Market	1982-89			1990-96			1982-96		
	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}
Large									
UK	0.62	0.62	0.03	0.84	0.43	0.00	0.75	0.56	0.02
Germany	1.06	-0.05	-0.02	1.23	-0.08	-0.04	1.15	-0.08	-0.02
France	0.81	0.14	0.16	1.16	0.07	0.02	0.97	0.09	0.09
Sub mean	*0.83*	*0.24*	*0.06*	*1.08*	*0.14*	*-0.01*	*0.95*	*0.19*	*0.03*
Small									
Holland	0.82	0.20	0.07	0.77	0.17	0.00	0.79	0.21	0.01
Italy	0.91	-0.17	0.23	1.15	-0.44	0.23	1.03	-0.28	0.23
Sweden	0.75	0.14	-0.06	0.92	0.21	0.23	0.83	0.10	0.14
Spain	0.48	0.20	0.17	1.08	-0.07	0.26	0.74	0.03	0.25
Belguim	0.86	-0.04	0.18	0.84	0.05	-0.01	0.85	0.01	0.07
Denmark	0.10	0.40	0.04	0.90	-0.22	0.05	0.48	0.11	0.07
Finland	0.40	-0.25	0.01	1.50	-0.33	0.01	1.28	-0.38	0.02
Ireland	0.70	0.50	0.12	0.91	0.09	0.16	0.84	0.28	0.15
Austria	0.87	-0.23	-0.31	1.52	-0.62	-0.10	1.19	-0.48	-0.11
Portugal	0.61	-0.24	0.49	0.63	0.06	0.10	0.59	-0.01	0.40
Greece	-0.22	0.66	-0.23	0.98	-0.43	-0.10	0.35	0.15	-0.10
Sub mean	*0.57*	*0.11*	*0.06*	*1.02*	*-0.14*	*0.07*	*0.82*	*-0.02*	*0.10*
Mean	*0.70*	*0.17*	*0.06*	*1.05*	*0.00*	*0.03*	*0.88*	*0.08*	*0.07*

Unstandardised betas of each E.U. market from the simple regression model

Market	1982-89			1990-96			1982-96		
	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}	B_{EU}	B_{USA}	B_{JAP}
Large									
UK	1.38	0.85	0.43	1.14	0.79	0.22	1.27	0.84	0.30
Germany	1.00	0.59	0.34	1.14	0.68	0.24	1.06	0.62	0.28
France	1.02	0.72	0.51	1.22	0.82	0.30	1.10	0.76	0.39
Sub mean	*1.13*	*0.72*	*0.43*	*1.17*	*0.76*	*0.25*	*1.15*	*0.74*	*0.32*
Small									
Holland	1.03	0.77	0.46	0.86	0.70	0.22	0.95	0.75	0.31
Italy	0.87	0.49	0.47	1.09	0.48	0.42	0.97	0.49	0.45
Sweden	0.84	0.63	0.30	1.22	1.02	0.49	0.99	0.75	0.42
Spain	0.72	0.60	0.44	1.25	0.88	0.52	0.93	0.68	0.49
Belguim	0.91	0.63	0.51	0.84	0.65	0.22	0.89	0.64	0.34
Denmark	0.45	0.49	0.25	0.82	0.48	0.25	0.60	0.49	0.26
Finland	0.22	0.10	0.02	1.33	0.79	0.35	1.09	0.63	0.31
Ireland	1.17	1.14	0.67	1.09	0.88	0.42	1.14	1.04	0.48
Austria	0.54	0.26	-0.04	1.11	0.44	0.21	0.78	0.32	0.15
Portugal	0.90	0.72	1.27	0.71	0.57	0.27	0.83	0.67	0.58
Greece	0.20	0.41	-0.05	0.67	0.23	0.10	0.39	0.36	0.05
Sub mean	*0.71*	*0.57*	*0.39*	*1.00*	*0.65*	*0.32*	*0.87*	*0.62*	*0.35*
Mean	*0.92*	*0.64*	*0.41*	*1.08*	*0.70*	*0.28*	*1.01*	*0.68*	*0.33*