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"MEASURING DIVERSIFICATION BENEFITS OF EUROPEAN EQUITY PORTFOLIOS. THE EFFECTS OF EMU ON COUNTRY VERSUS SECTOR ALLOCATION STRATEGIES"

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MEASURING DIVERSIFICATION BENEFITS OF EUROPEAN EQUITY PORTFOLIOS. THE EFFECTS OF EMU ON COUNTRY VERSUS SECTOR ALLOCATION STRATEGIES

1. INTRODUCTION

Evidence that large benefits are available to investors who diversify their portfolio has been available from the early literature. Diversification helps investors to reduce the risk of an investment while holding the expected return constant. Portfolio risk can be reduced through diversification since returns on individual assets are imperfectly correlated with each other. Several studies document low correlations between index returns in different countries and argue that the benefits of international diversification outweigh the numerous costs, including higher direct trading costs, regulatory and cultural differences, and currency and political risks.

In general the basic requirements for investors to be able to benefit from diversification are: the existence of partially integrated and informationally efficient financial markets. On the one hand markets must be at least partially integrated for an investor to be able to benefit from international diversification. This arises from the fact that structural barriers to international investment, such as transaction, information and hedging costs, restrict the free flow of capital across borders. On the other hand, in entirely integrated markets, investors can profit from diversification only if the assets in the domestic and foreign markets have different risk-return characteristics. Therefore in the context of European Monetary Union (EMU) it is important to examine whether diversification opportunities have been altered as a consequence of the process of economic and monetary integration.

EMU has been the single most important event for international financial markets since the collapse of the Bretton-Woods system of fixed exchange rates. EMU has reduced the risk and information costs of European cross-border investment for all type of investors and has eliminated some formal barriers for institutional investors. It has important implications on asset demands because it reduced existing barriers to international investment, leading to a convergence of investment opportunity sets across European countries.

The introduction of the euro as the single unit of account has at least two possible implications for portfolio reallocation in the Euro area. First, it corresponds mechanically to the disappearance of currency risks, and second, it is part of a broader set of structural changes. Structural changes include standardized pricing of financial assets, improved transparency of financial markets and reduced transaction and information costs, and thus the removal of barriers to intra-European portfolio allocation.

In summary, the removal of structural barriers within EMU implies an improvement of diversification opportunities leading to a convergence of investment opportunity sets across European countries. However, increased integration of financial markets might also have caused stronger co-movements among national equity markets, thus reducing the potential gains from country diversification. In addition, the role of country risk among EMU countries is bound to decrease suggesting that portfolio shifts from the country to the sectoral level may occur.

Therefore we are interested in answering the question as to *what the optimal asset allocation strategy is for a Euroland investor* through examining the evolution of returns per unit of risk both at the country and at the sectoral level. In this context it is important:

- to analyze the extent to which optimal allocations are modified by the advent of the single currency, and
- to examine the evolving risk-return characteristics of European equity investments as economic and monetary integration has proceeded and their implications for international diversification within the euro area.

Examining the evolution of risk-return characteristics of seven country and ten sector indices we found that during the convergence period to EMU cross country correlation of returns had indeed increased implying that perhaps the traditional country allocation model should be abandoned in favor of an approach based on a diversification across industrial sectors. However, taking a better look at the pure-euro period (after 1999), cross country correlations seem to have decreased suggesting that diversification benefits at the country level have not been impaired after all.

In order to evaluate the statistical significance of the diversification gains of country and sector allocation strategies over others we apply potential performance tests developed in Jobson and Korkie (1982) and Gibbons, Ross and Shanken (1989). Using these tests our purpose is to investigate the performance of alternative diversification strategies and evaluate the possible impact of EMU on the risk and return trade-offs for European investors. We conduct our empirical investigation using monthly returns for sector and country indices (Datastream total return indices) from March 1975 to March 2002. Further we investigate the potential contribution of international diversification to portfolio performance including, apart from the EMU index, the world index and a set of currencies in the set of assets under investigation.

Our results indicate that from a European perspective both countries and sectors provide significant diversification benefits from 1998 with countries being more significant. However when we impose a constraint on short selling, country allocation remains significant whereas sector allocation no more provides significant diversification benefits. This suggests that diversification gains from sector allocation are dependent on the ability to short the sector portfolio. Overall, our results suggest that despite the convergence to EMU, country allocation strategies are still beneficial to European investors.

Our results show further that including the world index to a European based portfolio (EMU index) does not provide an increase in performance. However when examining a portfolio which also includes a set of currencies vis-à-vis the euro the results indicate that there are significant diversification gains suggesting that there are benefits from international diversification for EMU investors, nevertheless these benefits stem from currency effects and not from country effects.

The study proceeds as follows. In Section 2 we present a description of the effects of EMU on portfolio diversification. Section 3 describes the basic principles of portfolio theory. Section 4 provides an overview of the existing literature on country versus sector portfolio allocation strategies. Section 5 describes the data and the methodology which is applied. Section 6 reports the empirical results Finally Section 7 concludes.

2. EMU & PORTFOLIO DIVERSIFICATION

2.1 EMU and European Integration

The extent to which European equity markets have become more integrated has important implications both for investors' portfolio allocation decisions and for policy-makers in meeting the challenges of European integration and shaping policy responses to more integrated and interdependent financial markets in Europe.

The financial capital market of the community has been completely liberalized since the mid-1980's. Perhaps the cultural diversity of countries may help to separate to some degree the national stock markets, especially for small, less well-informed investors. But implementation of new technology (e.g. inter-exchange networks of securities pricing and settlement, electronic trading systems which enable remote trading) and the EC approximation of national rules about access to and conduct in stock markets have greatly increased integrative pressures.

2.1.1 Definition and Significance of European Integration

In a broader sense economic integration is defined as the elimination of economic frontiers between two or more economies. In turn, an economic frontier is any demarcation over which actual and potential mobilities of goods, services and production factors, as well as communication flows, are relatively low.

The fundamental significance of economic integration is the increase of actual or potential competition. From the vantage point of one country this competition is engendered by the participants of each country reaching out beyond the traditional confines of the economy.

Economic integration refers both to market integration and economic policy integration. Market integration is and remains the essence of economic integration, as is clear from the definition of the latter. Most economic policies directly relate to market conduct, or to structure, performance or distributive outcomes of markets. *Market integration* is a behavioral notion indicating that activities of market participants in different regions or Member States are geared to supply and demand conditions in the entire Union. Usually, this will also show up in significant cross-frontier movements of goods, services and production factors. In a market of perfectly homogenous goods or services or one type of financial capital, market integration can be measured by the degree of price convergence.

European economic integration is driven by efforts to reduce or eliminate the public role of territorial frontiers with European neighbors as economic frontiers. But as the definition implies, this is a necessary, not a sufficient condition for economic integration. Demarcations within and between national economies may remain, perhaps as a result of great disparities in the levels of development, or perhaps as a result of business collusion in a region or country. Even discrepancies in the availability, speed and quality of information might sometimes serve as an economic frontier.

The Maastricht Treaty has caused a sea-change in the pursuit of an integrated European financial area. The internal market for financial services was seriously tackled for the first time, preceded by the abolition of exchange and capital controls. The abolition is complete and without reciprocity for third countries. However, one should not jump to the conclusion that cross-border capital mobility is now close to perfect and comparable to domestic capital mobility. Financial flows are some-what discouraged by the relatively high costs of cross-border payments (especially for smaller transactions) and by the handling of settlement risk.

The overall framework for a properly functioning single market for financial services requires far-reaching approximation and indeed centralization in other sensitive financial fields. These functional linkages entail major policy implications for national economic, fiscal and monetary policies. Thus, such a broad notion of a European financial area consists of four elements:

- The internal market for financial services.
- Free movement of financial capital and money.
- A single currency.
- A common regime for the tax treatment of investors and a common accounting standard.

As regards to the third element, in the pre-EMU stages of the Maastricht Treaty, the existence of different currencies (which are not irrevocably fixed) led to risk-based price differentials between transactions denominated in different currencies. However, even with the establishment of a single currency, failing to address the fourth element may severely undermine the economic incentives for cross-border consumption of some financial services, even though –formally- free movement of services is not impaired.

Turning to an important direct effect of EMU, we note that, formally, the European Commission's Second Banking Directive and Investment Services Directive should have created a single European market in financial services by the end of the 90's. Yet, in practice several obstacles beyond those raised by the now eliminated issues of currency conversions and currency risk had remained. One of these obstacles are national regulations bearing on the portfolios of pension funds and life insurance companies that restrict their holdings of foreign assets. Given the importance of the asset base of these institutions prior to the introduction of the euro, these regulations in principle imposed a substantial restriction on intra-European capital flows. A direct implication of the euro is the de facto elimination of at least one of these restrictions, the so-called 80% matching rule, which requires pension fund and insurance companies in most EU member states to hold at least 80% of their assets in the same currency as their liabilities, which is usually the home currency.

2.1.2 The Impact of the EURO

To begin with the most basic and possibly most persuasive direct effect of monetary union, the introduction of a single unit of account, has standardized the expression of prices of financial products and vastly simplified financial transactions. All prices and financial flows are now denominated in euros. As has often been noted, with respect to financial and non-financial markets alike, this standardization yields important economies in transaction costs, because it makes financial markets more transparent, and it constitutes an obvious pre-requisite to the constitution of a single European capital market. These direct gains consist mostly of the time saved comparing or posting prices in several currencies and the value lost in sub-optimal transactions by imperfectly informed participants.

Among all financial markets, the foreign exchange market has been affected most directly by the introduction of the euro, with implications for the cost of currency conversions and for the risk of cross-country positions. Going hand in hand with the decrease in intra-European currency conversion costs is the elimination of intra-European currency risk. Although the anticipation of EMU had reduced exchange rate volatility among EMS member states in the second half of the 1990s to very low levels, exchange rate risk had traditionally been an important component of intra-European market risk, in particular for longer-term contracts. It is useful to recall, for example, that as recently as in summer 1996 the French franc fell and rose by more than 1 percent against the German mark in less than three months, and the Italian lira fluctuated by almost 6 percent over a slightly longer period.

The elimination of an intra-European currency risk premium, implies that investors do not have to hold different portfolios across countries in order to hedge against unanticipated changes in the cost of their consumption basket. The thrust of the literature on whether exchange rate volatility had a negative effect on trade due to uncertainty and hedging costs is that the impact is probably rather small because practically all fluctuations relevant to trade transactions can be covered at small costs in the forward market (see IMF 1984 and Pelkmans 1988a).

Actually assessing the importance of this source of risk for international investors quantitatively is a delicate task. Some elements of an answer to this question have been provided by De Santis, Gerard and Hillion (1998) who argue that if currency risk is priced, currency investments become an important asset class to include and manage for every international investor. Thus in this framework, the adoption of the single currency can have a significant impact on international portfolio strategies. However, they show that, in the 1990s, non-EMU currency risk (in particular the risk associated with the US dollar) was quantitatively much larger and thus most of the benefits of currency risk management accrues from managing non-EMU currency risk whereas little or no additional benefits arise from managing within-EMU risk; a finding that leads them to suggest that the disappearance of EMU-currency risk might have only a limited impact on portfolio investors.

However, although intra-EU currency risk is certainly much smaller in magnitude compared to non-EU currency risk, it seems to have been significant both in terms of size and volatility. According to Hardouvelis et. al. (2001a), intra-EU currency risk was significantly priced in European equity portfolios until 1999, accounting to about 14% of the total equity risk premium. Furthermore, its volatility accounted for about one quarter of the volatility of the equity premium.

2.1.3 Integration of European Equity Markets

Stock market integration has been an important implication of EMU. The introduction of the euro as the single unit of account has standardized pricing of financial assets, improved transparency of financial markets and reduced investors' transaction and information costs, thus, removing barriers to intra-European portfolio allocation. In addition, without a change in the domestic law, the single currency nullified the legal barriers within EMU on the foreign currency composition of assets held by institutional investors like pension funds and life insurance companies, which were typically restricted by currency matching rules or by maximum weights on foreign assets.

The existence of barriers to international investment implies that investors face different investment opportunity sets and, consequently, choose different optimal portfolios, depending on their country of residence. French and Poterba (1991) and Tesar and Werner (1992) find that investors' portfolios are biased towards home assets compared with what standard portfolio theory would predict in integrated international stock markets. Since EMU implies fewer barriers and a broadening of investment opportunity sets across European countries, we expect to observe an increase in integration of European stock markets, (see for example Hardouvelis, Malliaropulos and Priestley, 2001a).

Economic variables influence stock returns through the underlying cash flows or the discount rates. If the relevant economic forces are international then they should simultaneously affect all equity returns across the world. However, if the relevant economic forces are mainly domestic or regional, then the correlation of returns across countries will only be high if business cycles move in tandem. This is because markets may be segmented by national regulations, transaction and information costs, independently of the existence of foreign exchange risk.

If markets are segmented then they will be affected by local risk factors only. Markets can be segmented because of formal or informal barriers that preclude free investment world-wide. Even if the underlying economics are linked, returns may not move closely because stock prices are established in separate worlds.

Whether international capital markets are segmented or integrated is closely related to the issue of international diversification. The recent literature considers a capital market fully integrated into a world capital market if assets with the same risk have identical expected returns, irrespective of the country in which they are traded. The underlying risk factor is assumed to be the same for all assets. However, this does not imply that investors must have unlimited access to these markets, and the existence of restrictions on foreign investment does not necessarily preclude the existence of an internationally integrated market (Bekaert & Harvey, 1995).

Conversely, markets may be fully integrated even when investors are exposed to currency risk if they face the same investment opportunity set. Hence, the impact of EMU on stock market integration should primarily be seen as the result of removing barriers to intra-European investment flow rather than eliminating foreign exchange risk.

2.2 Portfolio Diversification

According to *Modern Portfolio Theory* investors should select the best combination of investment to either maximize return for a given level of risk or minimize risk for a given level of return. However, the risk of a portfolio is more complex than a simple average of the risk on individual assets. It depends on whether the returns on individual assets tend to move together or whether some assets give good returns when others give bad returns.

Diversification helps investors to reduce the risk of an investment while holding the expected return constant. One can reduce the portfolio risk, if defined as the standard deviation, through diversification by virtue of the law of large numbers, since returns on individual assets are imperfectly correlated with each other. For example in the case of two assets (1 and 2), when the correlation coefficient ρ is less than unity then the risk of the portfolio, as defined by the standard deviation σ_p , will be less than the combined risk of the two assets (σ_1 and σ_2):

$$\sigma_p = \sqrt{x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2 x_1 x_2 \rho \sigma_1 \sigma_2} \qquad (1)$$

The extent to which financial assets are correlated therefore is of vital importance to portfolio management since the combination of assets with very low correlations will lead to a lower level of risk. In this framework we expect an increase in cross-country correlations of equity returns due to the convergence to EMU and thus we may expect a decrease of diversification benefits from country allocation strategies.

The basic notion of diversification involves spreading a portfolio over many investments to avoid excessive exposure to a single source of risk. In simple English this means, *Don't put all your eggs into one basket.* This is the very essence of investing. In fact, all portfolio principles are directed towards achieving diversification to minimize risk. It is therefore important that the average investor also diversify his investments.

Proper diversification must take at least three factors into account. The first factor is the time factor. A person's choice of investment should partly depend on his investment time horizon. For example, if the individual requires the funds within six months, then the investment should be planned using short term investment vehicles. The second and third factors are tied together. Investors must decide how much return they want to aim at and what kind of risk tolerance they have towards the investment. This step is important, because it will help facilitate the types of investment that are suitable to the investor's needs and help them avoid the most common investment mistakes. These principles can be applied to different asset classes ranging from stocks, bonds, and options. The process is very simple, since you can diversify in many ways. You can buy a combination of well researched and undervalued stocks from different industries and different countries.

Evidence that large benefits are available to investors who diversify their portfolio to hold foreign assets has been available from the early literature. Grubel (1968) and Levy and Sarnat (1970) were among the first to reach this conclusion. Their studies document low correlations between index returns in different countries and argue that the benefits of international diversification outweigh the numerous costs, including higher direct trading costs, regulatory and cultural differences, and currency and political risks. It is not clear, however, how these gains from diversification arise. Many analysts maintain that the gains stem from the diversity of economic conditions underlying foreign capital markets due to differences in monetary and fiscal policies, movements in interest rates, budget deficits, and national growth rates. Others propose that the benefits from international diversification come largely from the diversity of industrial structures across countries.

As far as market integration is concerned, markets must be at least partially integrated for an investor to be able to benefit from international diversification. On the one hand, in completely segmented markets foreign investment is not possible by definition. On the other, in entirely integrated markets investors can profit from international diversification only if the assets in the domestic and foreign markets have different risk-return characteristics. In this case the market portfolio, i.e. the optimal portfolio in the asset pricing model might be different for domestic and the international set of investment opportunities. Otherwise, the potential gains from international diversification are the same as those that can be achieved through domestic diversification.

2.2.1 The Home Bias Puzzle

An important puzzle in international finance is the strong bias of portfolio holdings toward domestic securities (French and Poterba, 1991; Tesar and Werner, 1995). Many studies show that the proportion of assets held domestically is sub-optimal and that a shift of some funds into overseas assets would reduce the volatility of portfolio returns without reducing the level of returns. During the 60's and 70's, the explanation for this puzzle was that structural barriers to international investment restricted the free flow of capital across borders. As a consequence, domestic investors were limited to the set of domestic assets regardless of the benefits of international diversification. Since then, however, structural barriers between markets have fallen but the observed levels of international diversification have remained low.

To understand the basic problem confronting the investor consider the difference between costless and costly portfolio reallocation. Suppose an individual is endowed with a set of domestic assets and portfolio reallocation is costless. If the set of available assets is expanded to include international assets, portfolio theory implies that the individual reallocates the portfolio such that the portfolio is on the portfolio frontier. If the newly available international assets are not redundant, the new portfolio includes both domestic and international assets. Because the individual is not subject to impediments to portfolio reallocation, the individual quickly transitions to the new portfolio allocation. The domestic bias of the portfolio is eliminated quickly. If the individual's portfolio reallocation is subject to transaction costs, the individual actively reallocates the portfolio only if the marginal benefit of diversification is greater than the marginal cost of reallocation. If the diversification benefits are small and are outweighed by the cost of reallocation, the individual may passively reallocate the portfolio through the accumulation of capital gains (Rowland, 1999).

A second class of explanations for under-diversification focuses on investor behavior. One important possibility is that return expectations vary systematically across groups of investors. Specifically, investors are believed to be relatively more optimistic about the performance of their own markets. Another factor that may partially explain the home bias phenomenon is that investors are better informed about assets in their own country than about foreign assets. Consistent with this explanation, Ahearn, Griever and Warnock (2000) with an analysis of U.S. holdings of foreign assets, have shown that information costs are an important factor behind the home bias phenomenon. Specifically they found that U.S. holdings of a country's equities are positively related to the share of that country's stock market that is listed on U.S. exchanges and attributed this finding to the fact that foreign firms that list on U.S. exchanges are obliged to provide standardized, credible financial information, therby reducing information costs incurred by U.S. investors.

Returning to the case of EMU, although the convergence of the economic structures of EMU country members may possibly have decreased the diversification benefits from country allocation strategies, EMU also has positive effects for diversification. The elimination of intra-European barriers to investment such as transaction and information costs implies that diversification opportunities in EMU may have increased. Thus we would expect a decrease of the "home-bias" phenomenon within Euroland.

2.3 Implications of EMU for Optimal Portfolio Allocations

The European Monetary Union has been the single most important event for international financial markets since the collapse of the Bretton-Woods system of fixed exchange rates. EMU has reduced the risk and information costs of European cross-border investment for all type of investors and has eliminated some formal barriers for institutional investors. It has important implications on asset demands because it reduced existing barriers to international investment, leading to a convergence of investment opportunity sets across European countries.

Specifically, a decrease in transaction costs between two financial markets increases asset prices in the area, induces agents to develop more risky projects, increases the number of assets and pushes owners of projects to sell more of their project on the stock markets, so that diversification increases. This happens because a decline in transaction costs increases demand for assets in the area, so that the effective size of the market is enlarged (Martin and Rey, 2000).

One other type of indirect barrier that has received considerable attention recently is information costs. A number of recent empirical studies provide evidence that information costs affect the composition of investors’ portfolios. For example, there is evidence that foreign equity portfolios are skewed towards the equities of large firms, for which more information is readily available. Portes and Rey (1999) provide evidence that information flows are an important determinant of cross-border equity transactions. When investors contemplate purchasing equity in a foreign company they must glean from published accounts information that is based on accounting principles and disclosure requirements that may differ greatly from those in their home country. Moreover, the credibility of this information is determined to a large extent by the regulatory environment, which also varies considerably from country to country. Cross-country differences in accounting principles, disclosure requirements, and regulatory environments – which together can be thought of as investor protection regulations – give rise to information costs that must be borne by foreign investors.

However, while the euro directly implies a decrease in explicit and implicit transaction costs (such as the cost of currency conversion and of currency risk) and information costs, this does not automatically signify that the cost of cross-border investment in Europe falls to the level of within country investment. In fact, as documented in Danthine, Giavazzi, Vives and von Thadden (1999) and Danthine, Adjaoute, et.al. (1999), several important obstacles for intra-European capital flows remain which are at the heart of the uncertainty about the effectiveness and extent of the single European capital market.

The main problem is that, within Europe, cross-border payments and securities settlement are substantially more expensive and complicated than domestic ones. As observed recently by Padoa-Schioppa (1999), the euro area has 18 large-value systems, 23 securities settlement systems and 13 retail payments systems. The United

States has 2 large payments systems, 3 securities settlement systems and 3 retail payments systems. Danthine, Adjaoute et al. (1999) observe that while the processing of domestic trades has become highly standardized, cross-border processing is still structured and organized in a complicated and often inefficient way in almost all European countries.

An important indirect effect of the euro has been to expose these heterogeneities and barriers within Europe and to put pressure on politicians and market participants to adopt measures and institutional reforms fostering a greater degree of harmonization and efficiency in financial market transactions. Concerning payment systems in general, EMU has certainly brought some progress; the establishment of TARGET and EURO1, the settlement systems for large transactions of the European System of Central Banks and the European Banking Association, respectively, and the implementation (in August 1999) of the EU Directive 97/5/EC of January 19997 on cross-border credit transfers are some of the most visible improvements in the wake of EMU.

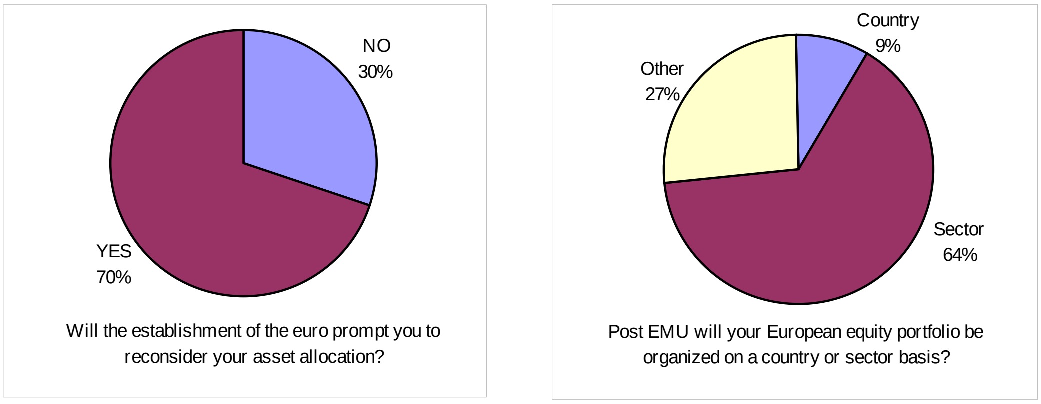
2.3.1 Country versus Sector Allocation Strategies in Euroland

As noted above, EMU changes the definition of the home market, and should reinforce the move from managing portfolios of European equities along national lines towards sectoral lines. Equity market strategists and academic researchers continue to debate the merits of distinguishing equity markets along national or sectoral lines for investment purposes. The issue here is whether (for example) an investor should compare the share prices of German banks with the share prices of other German companies or with those of banks in other European countries.

EMU has led to increased stability in exchange rates and convergence of bond yields and interest rates in the countries joining the monetary union. In principle this might have increased the correlations between national equity markets as the determinants of corporate profits and risk premia move more closely. Increasing correlation between returns of course can be explained by several factors including globalization of stock markets, removal of impediments to capital movements, better communications and trading systems, increasing share of foreign quotations on stock markets, and the increasing determination of a firm’s share price by developments in other economies because of expanding overseas sales and direct investments.

In general, the increased integration of European financial markets might have caused stronger co-movements among European equity markets, thus reducing the potential gains from country diversification in Euroland. Also the role of country risk among EMU countries is bound to decrease suggesting that portfolio shifts from the country to the sectoral level may occur.

Ultimately the question of whether investors will look at sectors or countries when making investment decisions is empirical, and previous survey evidence strongly indicates that investors will base their decisions on sectors rather than countries. Figure 1 presents the results of a survey that Goldman Sachs, together with the investment consultants Watson Wyatt, undertook of their client base asking about the impact of EMU on behavior[1]. The aggregate value of funds under management covered by the above survey was approximately USD 2700 billion.



(a) (b)

Figure 1: The Goldman Sachs/Watson Wyatt EMU Survey

Out of the fund managers surveyed, a full 70 % said that EMU would lead them to reconsider their approach to asset allocation (Figure 1a). When asked whether they would organize their European equity portfolio on a country or a sector basis (Figure 1b) 64% of the fund managers said that European equity portfolios would be organized on a sector basis. Only 9% said that portfolios would be

[1] "The Goldman Sachs/Watson Wyatt EMU Survey – Summary of Results", Sandy Rattray & Richard Boomgaardt, Goldman Sachs Equity Derivatives Research, 17 June 1998.

organized on a country basis, the remaining 27% saying “other”, probably indicating a mixture of country and sector factors. Linked to this finding there is strong evidence from the survey that fund managers increasingly find the country of listing of a company within Euroland to be irrelevant.

Whatever the case for the actual benefits of country versus sector allocation strategies, EMU undoubtedly promises great change for financial markets in Europe. For investors in all classes of assets, the key change is the removal of existing distinctions between national markets. Some of this will be prompted by changes in regulations. Further changes will be prompted by the increased correlations between some national markets. In particular, this will lead to growing credit markets. Ultimately, Euroland financial markets may grow to match those in the US. However, this will take a very long time and there are structural barriers to such growth. Nonetheless, the way that investors will change their behavior when investing in European financial markets is very important.

If these changes materialize, the euro will have had another important indirect effect. Through the reorganization of the workings of the asset management industry in Europe, data on firms and sectors will become increasingly better comparable, information will flow more efficiently inside financial firms and across firms, and ultimately there will be more and better information. In the framework of the informational theory of the home-bias problem outlined above this implies that cross-border investments will increase and hence that the European financial markets will become more integrated. It is worth repeating that this prediction is not based on the traditional presumption of currency-induced barriers to international investment. To the contrary, as currency risk is considered to play a minor role for the home bias, its abolition, too, is relatively uninteresting. What matters is the convergence of fundamentals across the euro zone, which improves international information flows and makes country-based investment strategies relatively less interesting, therefore increasing the value of pan-European strategies.

3. PORTFOLIO THEORY

3.1 Constructing a Portfolio Based on the Efficient Frontier

Constructing a portfolio includes a wide variety of activities which range from defining the portfolio's objective and the opportunity set from which the portfolio is to be drawn, to estimating the relevant characteristics of the individual assets in the asset universe. The first step in constructing a portfolio is to set out explicitly the objective that one is pursuing and also the nature of any constraints which might delimit the range of assets eligible for inclusion in the portfolio, or the amount of any single asset that may be held. The objective we are pursuing is based on the Markowitz mean/variance model according to which decisions are made on the basis of selecting the best combination of assets to maximize return for a given level of risk or minimize risk for a given level of return.

The identification of the universe of assets from which it is proposed to construct the portfolio is an important task of portfolio selection. The number of assets which are available for purchase is virtually infinite ranging from bonds and equity to commodities, and we therefore confine our attention to a specific set of assets. For example, in this study we are interested on measuring the diversification benefits of European equity portfolios and thus we consider that portfolios can be constructed by county and sector indices within Euroland.

There are several reasons why equity prices are interesting. First, they contain leading information on future developments in aggregate demand and output, and thus may reveal, from a different angle, whether an increase in cyclical coherence has actually taken place. Second, cross-country equity market correlation has been shown to vary inversely with: a) the importance of country-specific shocks, e.g. due to national economic policies, other country-specific demand/supply factors, exchange rate changes; b) the differences in the sectoral composition of national outputs, as reflected by the composition of stock market indices, which make national stock market performance diverge when sectoral shocks occur. If equity markets turn out to be highly correlated across countries, this should imply that nation-specific disturbances are relatively unimportant and that economic structures are broadly similar.

It must be noted however that once a portfolio is constructed the performance must be monitored through time, that is portfolio management is a continuous process. The commercial and financial world is in a continuous state of change and the practice of portfolio management involves a continual response to such change by altering the composition of the portfolio when and where appropriate. For example if EMU has altered the characteristics of returns within Europe, by increasing the correlations of cross country returns, then a portfolio consisting only of country indices will possibly be no longer optimal for an investor who wishes to diversify the risk of his/her investment.

The next step in the construction of a portfolio is to assemble the basic data on all assets. Following Markowitz' mean-variance paradigm, which assumes that the mean and standard deviation of the distribution of one period returns are sufficient statistics for evaluating the prospects of an investment portfolio which consists of *N* assets, these data consist of the forecasts of the expected rates of return, over the period in question, for each of the *N* assets, the *N* variances and the $N(N-1)/2$ covariances between each pair of assets. In general, in the *N*-asset case, let the weights $w_1, w_2, \ldots, w_N$ denote the proportions of the initial wealth invested in each of the *N* assets. Then the expected rate of return on the portfolio is:

$$E(R_p) = \sum_{i=1}^{N} w_i E(R_i) \qquad \text{(2a)}$$

where $E(R_i)$ is the expected rate of return on the *i*th asset. Denoting $w_1, w_2, \ldots, w_N$ by the column vector w, and $E(R_1), E(R_2), \ldots, E(R_N)$ by the column vector μ_p, the above equation can be expressed as:

$$E(R_p) = w'\mu_p \qquad \text{(2b)}$$

where a prime denotes the transpose of a vector. Also the variance of a portfolio may be expressed as:

$$V_p = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j C_{ij} \qquad \text{(3a)}$$

where σ_i^2 is the variance of the *i*th asset and C_{ij} $(i \neq j)$ is the covariance between the *i*th and *j*th assets. Similarly in matrix notation:

$$V_p = w'\Sigma w \qquad \text{(3b)}$$

where Σ is the variance-covariance matrix of the N assets.

Having assembled the above information, one is in a position to proceed with the primary task of selecting an optimal portfolio having regard to one's own objectives and, specifically, one's attitude towards risk. The process of selecting an optimal portfolio can then be based on the concept of efficient portfolios. An efficient portfolio exists when the portfolio's expected return has the smallest portfolio variance for that particular level of expected return.

A specific choice of weights, the elements of the vector w, will thus imply a portfolio having a specific expected return, and a specific variance. Thus it follows that from any given set of N assets an infinite number of possible portfolios may be generated. The problem of portfolio selection may then be stated as that of choosing a vector of weights, w, which identifies that particular portfolio within the opportunity set which best satisfies the investor's objectives. The opportunity set can be represented in expected return – standard deviation space as illustrated in Figure 2 by the shaded area to the right of the curve *PP'* which includes all possible risk-return combinations of the N assets. Any point within this area represents a possible portfolio with its own risk and expected return.

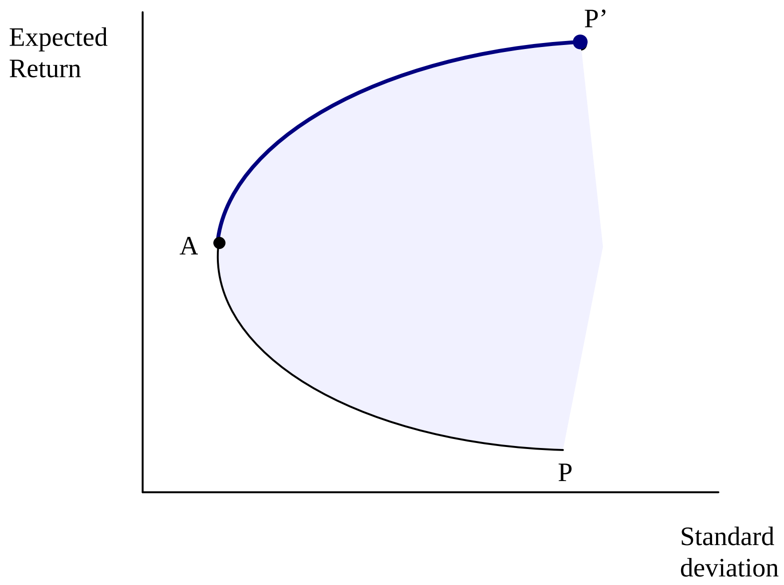


Figure 2: The Opportunity Set & The Efficient Frontier

The upper section of the boundary of the opportunity set *AP* contains all portfolios which maximize return for a given level of risk and minimize risk for a given level of return. This section of the opportunity set is also known as the ‘efficient frontier’. Specifically, to determine an efficient portfolio, an expected return level is chosen and assets are substituted until the portfolio combination with the smallest variance at that return level is found, subject to the constraint that the weights must sum to unity. As this process is repeated for other expected returns, the set of efficient portfolios is generated. This yields the following problem:

$$\left.\begin{aligned} &\text{Minimize} \quad \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j C_{ij} \\ &\text{Subject to: 1)} \quad \sum_{i=1}^{N} w_i = 1 \\ &\qquad\qquad\quad \text{2)} \quad R_p = \sum_{i=1}^{N} w_i R_i \end{aligned}\right\} \quad (4)$$

Up to now in the analysis, no assumption has been made about the investors’ risk preferences, but rather an efficient set of portfolios is provided from which he may choose from. In other words, once the efficient set has been determined, all the investor has to do is to select from this efficient set the portfolio which corresponds to his/her risk preferences. Thus the investor can decide on the minimum expected return he will accept and try to minimize the risk associated with this return, or alternatively he can decide on the maximum amount of risk he is willing to accept an try to maximize the return given this restraint. In this study we examine the case of the risk-averse investor.

3.2 Utility maximization of a risk-averse investor

The desirability of a portfolio is expressed by the values of expected return $E(R_p)$ and standard deviation σ_p keeping in mind that investors choose among alternative portfolios on the basis of mean-variance optimization. The preferences of a particular investor can then be represented graphically by a family of indifference curves, each curve representing equal investor satisfaction all along its length. Figure

3 presents a family of indifference curves for a risk-averse investor. Each indifference curve can be considered as the risk-return trade-off which must be made to maintain a constant utility.

For example, consider portfolio A with expected return μ_A and standard deviation σ_A which lies on the indifference curve I_2. The area to the right of curve I_2 contains all points representing portfolios which are inferior to portfolio A, whereas the area to the left contains points representing portfolios which are preferred to portfolio A. However curve I_2 itself contains all the points representing portfolios which the investor considers equivalent to portfolio A. In addition, since portfolio B is preferred to portfolio A ($\mu_B > \mu_A$ and $\sigma_B = \sigma_A$), every point on the indifference curve I_3 must be preferred to every point on I_2.

Observing the indifference curves one can see that they are positively sloped and concave from above. This is because we are considering the case of a risk-averse investor who prefers larger returns and dislikes risk and thus the higher the curve, the more desirable the situations lying along it.

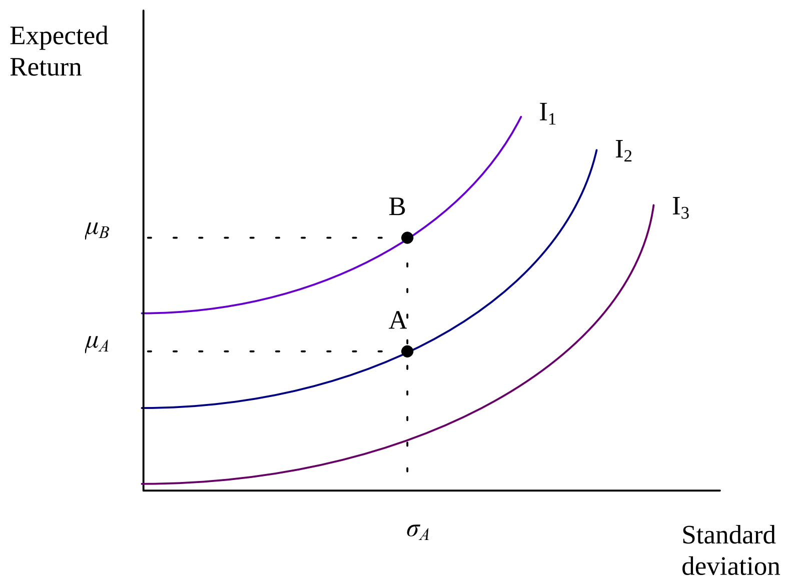


Figure 3: Indifference Curves of a Risk-Averse Investor

Returning to the issue of finding the optimal portfolio, to simplify the analysis we may assume that the preferences of a risk averse investor can be represented by the indifference curves in Figure 4, that is they are parallel to one another and linear. Hence, the portfolio problem boils down to finding the feasible risk-return combination lying on the best attainable indifference curve. This combination is represented by point B. At this point the efficient set is tangent to the indifference curve. Thus point B represents the optimal portfolio for the investor who's risk preferences correspond to the specific indifference curves.

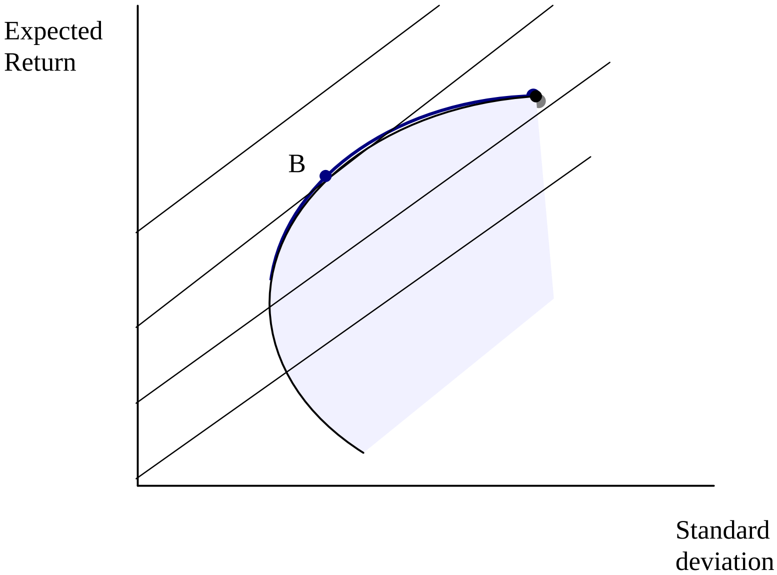


Figure 4: Optimal Portfolio of a Risk-Averse Investor

3.3 The Efficient Frontier with Riskless Borrowing and Lending

Sharpe pursued further the idea of borrowing and lending money in securities portfolios because these considerations make some previously efficient portfolios inefficient. Lending is best viewed as an investment in a particular security with no risk. By definition, its expected return equals the pure interest rate and since the outcome is certain, the standard deviation of return is zero. Combining a riskless security with a risky security gives $E(R_p)$, σ_p values lying along a straight line through the points representing the two securities. The risky security could in fact be a portfolio of many risky securities. Combining it with a riskless security would give the same results. Combinations between the points are obtained by lending and investing in the risky security. The case of riskless borrowing and lending can best be illustrated by Figure 5.

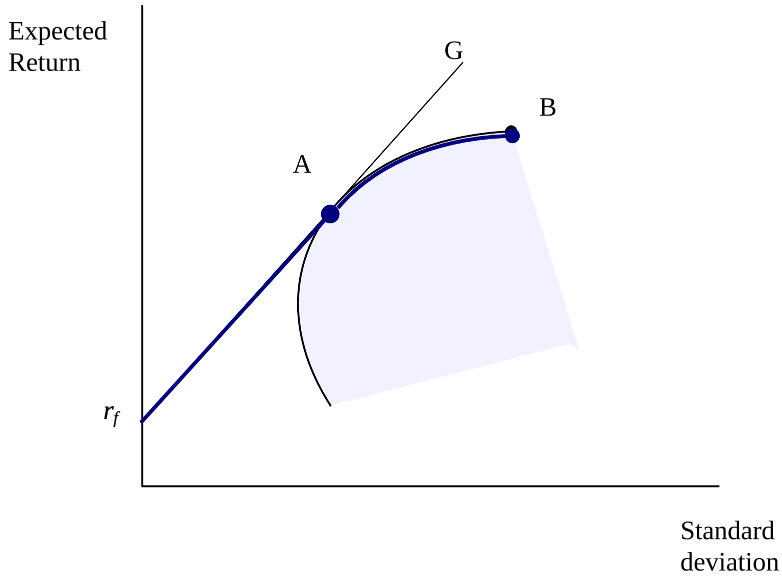


Figure 5: The Efficient Frontier with Riskless Lending

In Figure 5 point A represents the risky security (it is a portfolio of risky assets). Combinations of the riskless and risky security above point A along the line r_fG are obtained by borrowing money and investing the proceeds of the loan (along with the investors' own funds) in the risky security whereas combinations below point A represent lending - investing money in the riskless and risky assets. In our analysis we consider riskless lending and thus the combinations that are below point A. The inclusion of a riskless security makes part of the efficient frontier linear and any point on the new efficient linear frontier (r_fA) can be obtained by an appropriate combination of the riskless security and portfolio A. The complete new efficient frontier is now the curve r_fAB.

Denoting by F the riskless security, the new portfolio consisting of a combination of A and F with weights w_1 and $(1 - w_1)$ respectively, will have the following return and risk characteristics:

$$E(R_p) = w_1 E(R_A) + (1 - w_1) r_f \quad (5)$$

where $E(R_A)$ and r_f are the returns of *A* and *F* respectively and since *F* is riskless and thus

$\sigma_F = 0$:

$$\sigma_p = w_1 \sigma_A, \quad V_p = w_1^2 V_A \quad (6)$$

thus we can express w_1 as : $w_1 = \frac{\sigma_p}{\sigma_A}$ and by substituting w_1 in equation (5) and rearranging, we obtain:

$$E(R_P) = r_f + \frac{E(R_A) - r_f}{\sigma_A} \sigma_P \quad (7)$$

which is a linear equation in the variables $E(R_p)$ and σ_p, having an intercept r_f and a slope $(E(R_A) - r_f)/\sigma_A$ which represents the ratio of excess return to standard deviation. Thus the locus of all possible combinations of *A* and *F* is the straight line joining them. For points below point *A* the investor invests part of his/her funds in the riskless asset and part in portfolio A, whereas for point *A,* he puts all his funds in portfolio A. Although the riskless security *F* may be combined with any portfolio on the efficient frontier, the concept of dominance implies that there is typically one unique portfolio *A* which, when combined with *F*, will dominate all combinations with other risky portfolios below *A* on the efficient boundary since it has the greatest ratio of excess return to standard deviation. *A* is located at the point of tangency between the straight line originating from *F* and the efficient set.

Thus in the case of a riskless asset, the portfolio problem boils down to finding that portfolio *P,* with the greatest ratio of mean excess return $(E(R_P) - r_f)$ to standard deviation that satisfies the constraint that the sum of the proportions invested in the assets equals 1. In equation form thus we have the objective function:

$$\left.\begin{array}{ll} \text{Maximize} & \dfrac{E(R_P) - r_f}{\sigma_P} \\ \textbf{Subject to} & \sum_{i=1}^{N} w_i = 1 \end{array}\right\} \quad (8)$$

In other words, the efficient set of portfolios is comprised of the portfolios that minimize portfolio variance for a given mean excess return μ, subject to the constraint that investment proportions sum to one. There are standard solutions to the above problem, for example it can be solved by the method of Langrangian multipliers. Specifically, given a population of *N* assets with mean excess return vector $\mu_{(N\times 1)}$ and covariance matrix $\Sigma_{(N\times N)}$, the vector $X_{m(N\times 1)}$ of risky asset proportions is obtained from minimization of the Lagrangian:

$$L = X_m'\Sigma X_m - \lambda_1(X_m'\mu - \mu_P) - \lambda_2(X_m'e - 1) \tag{9}$$

where λ_1 and λ_2 are the multipliers and $e_{(N\times 1)}$ is the unit vector. The first extremum conditions provide the proportions vector:

$$X_m = \Sigma^{-1}\mu / e'\Sigma^{-1}\mu \tag{10}$$

which forms the tangency portfolio in mean-standard deviation space with mean excess return and return variance:

$$\mu_m = \mu' X_m = \mu'\Sigma^{-1}\mu / e'\Sigma^{-1}\mu = a / b \tag{11}$$

$$\sigma_m^2 = X_m'\Sigma X_m = \mu'\Sigma^{-1}\mu / (e'\Sigma^{-1}\mu)^2 = a / b^2 \tag{12}$$

where $a = \mu'\Sigma^{-1}\mu$ and $b = e'\Sigma^{-1}\mu$ are the efficient set constants.

4. PREVIOUS LITERATURE

4.1 Gerard, Hillion & de Roon (2001)

This study analyzes the role of industrial structure and country factors in cross country returns and their impact on international portfolio strategies. Their methodology looks at the performance of industry vs. country portfolios in terms of the Jensen measure, which indicates whether industry or country portfolios offer investors diversification benefits. They use monthly returns for industry and country indices for the G7 countries from January 1974 to November 1998 (MSCI database & Datastream indices).

To analyze whether restricting to either country or industry portfolios is suboptimal relative to investing in a portfolio of country & sector indices they estimated the following regressions:

$$r_t^y = a_y + B_y r_t^x + \varepsilon_t^y \quad \text{and} \tag{13}$$

$$r_t^x = a_x + B_x r_t^y + \varepsilon_t^x \tag{14}$$

where r_t^y and r_t^x denote excess return vectors of a set of industry and country indices respectively. If the Jensen measures a_y or a_x are different from zero, then portfolios that are based on countries or industries only are inefficient relative to portfolios of countries & industries combined. They also introduced a new test to compare the relative efficiency of industry vs. country portfolios which may be used to make a direct comparison between industry & country portfolios. The test they suggest is based on the notion that if country and industry only portfolios are equally efficient, then the maximum Sharpe ratios of the two sets must be equal and they make use of the relationship between the maximum Sharpe ratios and the Jensen regressions. Specifically, the increase in the maximum Sharpe ratios is determined by the adjusted Jensen measures, using:

$$\theta^2 - \theta_x^2 = a_y' \Sigma_{yy}^{-1} a_y, \tag{15}$$

$$\theta^2 - \theta_y^2 = a_x' \Sigma_{xx}^{-1} a_x \tag{16}$$

where Σ_{ii} is the covariance matrix of ε_t^i in the initial regressions presented above and θ, θ_x and θ_y are the maximum Sharpe ratios of the combined set of assets, the country portfolio and the industry portfolio respectively. Therefore they argue that the difference between the two Sharpe ratios can be determined by

$$\lambda = \theta_y^2 - \theta_x^2 = a_y' \Sigma_{yy}^{-1} a_y - a_x' \Sigma_{xx}^{-1} a_x \tag{17}$$

and the hypothesis can be formulated as H_0: $\lambda = 0$. They then suggest a test based on the weighted least square type regressions

$$\Sigma_{yy}^{-\frac{1}{2}} r_t^y = c_y + D_y r_t^x + u_t^y, \tag{18}$$

$$\Sigma_{xx}^{-\frac{1}{2}} r_t^x = c_x + D_x r_t^y + u_t^x \tag{19}$$

where $c_y = \Sigma_{yy}^{-\frac{1}{2}} a^y$ and $c_x = \Sigma_{xx}^{-\frac{1}{2}} a^x$ leading to $\lambda = c_y' c_y - c_x' c_x$. Thus they argue that the hypothesis H_0: $\lambda = 0$ can be tested by estimating the weighted least square type regressions and since it is a nonlinear restriction on the intercepts, a Wald test statistic for the above restriction will, under the null and standard regularity conditions by asymptotically χ_1^2 distributed.

From the above spanning tests, Gerard, Hillion & de Roon found that industries outperform countries but countries do not outperform industries. In other words they found that an industry portfolio is sufficient for the entire set of indices (H_0: $a_x = 0$ not rejected) but a country portfolio is not (H_0: $a_y = 0$ rejected). The authors further argue that the fact that they cannot reject efficiency for the country based portfolio suggests that the maximum attainable Sharpe ratio is higher for industries than for countries. They indeed found that the maximum Sharpe ratio for the industries is higher, however the difference between the two maximum Sharpe ratios was not found to be statistically significant. Also, under short selling restrictions they found that country portfolios yield higher Sharpe ratios than industry portfolios and thus argue that the superior performance of the industry portfolios in terms of the spanning test is highly dependent on the ability to short the industry portfolio.

The authors also used Style analysis (Sharpe 1994) to examine the “mimicking abilities” of country and industry portfolios. Their objective was to find a positive weight portfolio such that the portfolio return mimics as closely as possible the returns on a target fund, so to determine the styles of the industries in terms of the countries (mimicking abilities of country portfolio), they estimated the following regression:

$$r_{j,t}^{y} = a_j + \sum_{i=1}^{n} b_{i,j} r_{i,t}^{x} + e_{j,t}^{y}, \text{ s.t.} b_{i,j} \geq 0 \ \ \forall i, j, \ \sum_{i=1}^{n} b_{i,j} = 1 \qquad (20)$$

where n is the number of assets in the mimicking portfolio and $b_{i,j}$ is the *style* of the industry. They estimated a similar regression to also examine the mimicking abilities of industry indices relative to a country portfolio.

Their findings suggest that countries are better able to mimic industries than vice versa, and industries never have a higher mean return than their mimicking country portfolio, whereas countries often do have higher mean returns than the mimicking industry portfolios. It should be noted however that the authors based their conclusions from the style analysis on the robustness of the regressions (R^2) and not on tests of the intercepts.

Finally the authors also tested the benefits from the world index and currency deposits (USD, DEM, GBP) as suggested by the ICAPM yield and found that portfolios constructed from the world index plus the currencies yield little benefits over either country or industry based portfolios. However under short selling restrictions the ICAPM portfolio outperforms both country and industry based portfolios and yields significantly higher Sharpe ratios.

4.2 Ehling & Ramos (2002)

In this paper the authors addressed the question if country allocation really offers benefits over industry allocation. To do so they based their strategy on a spanning test introduced by Kan and Zhou (2001). More specifically they considered two type of regressions:

$$R_t^C = a^C + \beta^C R_t^I + \varepsilon_t^C, \qquad t = 1, \ldots, T \qquad (21)$$

$$R_t^I = a^I + \beta^I R_t^C + \varepsilon_t^I, \qquad t = 1, \ldots, T \qquad (22)$$

where R_t^C denotes a vector of raw returns of m countries at time t and R_t^I a vector of raw returns of n industries at time t and a^I, a^C, β^C, β^I are the parameters to be estimated. According to Kan and Zhou the necessary and sufficient conditions for mean spanning are that both $H_0\!:\!a^C = 0 \times 1I$ and $H_0\!:\!\beta^C \times 1I = 1$ where *I* is a vector of ones. The components of the spanning test hypothesis are then separated so that the first hypothesis tests if the tangency portfolio has a zero weight in the *N* assets (industries), that is the two sets of assets (countries and industries) have the same mean whereas the second hypothesis tests if the global minimum variance portfolio has zero weights in the test assets (industries), that is if countries are enough to get all the diversification benefits. To measure industry diversification benefits the same hypotheses are tested for a^I, and β^I.

Using weekly data (Datastream country and sector indices) from 1988 to the end of 2001 the authors divided the whole period into 3 sub-periods (Pre-convergence, convergence and euro) to assess the impact of EMU on portfolio diversification. They also divided the country indices into 4 groups to represent pure EMU, EC members, EC candidates and non EC members.

Their results indicate that country allocation has a higher mean over the whole sample they examined. According to their findings, in the first two periods industries under-performed countries and in the euro period industry allocation strategies are as good as country allocation strategies, that is they have the same mean. Their results were robust except when they imposed short selling restrictions. Without short selling they found that part of the out-performance of countries over industries is reduced. We must note that as far as short selling is concerned the findings of *Ehling & Ramos* are contradicting to the results of *Gerard, Hillion & DeRoon (2001)* who found that sector performance decreased when short selling restrictions were imposed and that in this case countries out perform sectors.

Finally, the empirical results in this paper show that overall the mean variance spanning hypothesis is rejected and the authors conclude that in the euro period the advantage of country portfolios over industry portfolios seems to disappear however, investors should include both country indices as well as industry indices in their portfolios and that investing only in sectors or countries does not exhaust the benefits of diversification. Also when testing mean variance spanning for each country group they did not find differences in the results from each group, suggesting that EMU is either not responsible for their results, or it affected all the countries in Europe regardless if they joined the EMU or not.

4.3 Adjaoute, Bottazzi, Danthine et .al. (2000)

The above analysis aimed at estimating the extent to which optimal allocations are modified by the euro by examining the evolving risk-return characteristics of European equity investments. The authors used weekly data on national stock market indices and sector indices (Datastream Global Equity Indices) for 11 Euroland countries from September 10th 1990 to April 19th 1999.

For the purpose of their study, they partitioned the whole sample into two subsamples of equal size (December 31st 1990-December 26th 1994 and January 2nd 1995-December 28th 1998) which represent the pre-convergence and convergence periods to the EMU. They presented the evolution of country-pair correlations for the two periods. All country pair correlations were higher in the convergence period indicating that benefits from diversification across countries have decreased. Correlations of ten sector indices were also presented for the two sub-periods and were also found to be higher in the convergence period. However the increase of country correlations was more profound than sector correlations.

In order to examine the statistical significance of the changing structure of the variance-covariance and correlation matrices of country indices in the pre convergence and convergence periods, tests of the stability of the above matrices were used. The tests that were used are the Jenrich (1970) and Box (1949) χ^2 statistics.

For the test based on covariance matrices, the Box test was based on a ratio of determinants: $|m_{1v} + m_{2v}| / |m_{1v}| + |m_{2v}|$, while the principle input for the Jenrich statistic was the quantity $trace(m_{1v} - m_{2v}) / (m_{1v} + m_{2v})$ where m_{1v} and m_{2v} denote the variance-covariance matrices of the first sub-sample and second sub-sample respectively. The statistics are asymptotically distributed as chi squares with $\frac{n(n+1)}{2}$ degrees of freedom, where n is the number of assets (countries). The same statistics were used to test the stability of correlation matrices by replacing covariance matrices with correlation matrices and by adjusting the degrees of freedom to $\frac{n(n-1)}{2}$.

They found strong evidence that both the correlation and variance-covariance matrices are unstable over time. The null hypothesis of equality of the two matrices was rejected implying that the diversification benefits during the convergence period are different from those in the pre-convergence period, however the stability of covariance and correlation matrices of sector indices was not tested. From this analysis they concluded that allocating simultaneously across sectors and countries is a superior investment option.

Following the examination of correlations across countries and sectors, Adjaoute, Bottazzi, Danthine et .al extended their analysis by focusing on the characteristics of optimal portfolios to examine the impact of EMU on optimal portfolios as well as to address the issue of the "home bias". They reported the characteristics of the Minimum Variance Portfolio (MVP) and the Tangent Portfolio (TP) by considering diversification in Euroland either across countries, across sectors within the same country or across countries and sectors without short-selling constraints for the pre-convergence and convergence periods. Specifically they computed the expected return E(R_p), variance V(R_p), as well as the Sharpe ratio of the MVP and TP:

$$E(R_p) = W'_{s,T}\mu_{s,T} \tag{23}$$

$$V(R_p) = W'_{s,T}\Omega_{s,T}W_{s,T} \tag{24}$$

$$Sharpe = \frac{E(R_p)}{\sqrt{V(R_p)}} \tag{25}$$

where $\mu_{s,T}$ denotes the vector of expected returns for a chosen investment opportunity set '*s*' over a sample period *T*, $\Omega_{s,T}$ is the variance covariance matrix associated with the expected returns of the selected investment opportunity set and $W_{s,T}$ is the vector of weights. They provided the above performance measurements for the MVP and TP of country indices within Euroland, sector indices within Germany (German perspective), sector indices within France (French perspective) and of sector indices within Euroland (allocation by countries and sectors using sector indices of Euroland countries).

Comparing the three strategies for the convergence period they found that the results of the strategy consisting of diversifying by sectors across all of Euroland are impressively superior both in terms of the Sharpe ratios and risk of the MVP and that such a strategy would also have permitted a minimal loss of performance between the pre-convergence and the convergence periods despite the increase in correlation of returns. They also found that a strategy of diversifying "at home" across industry would have been very costly, however they note that limiting one’s investment horizon to the home country would have entailed a minimal loss of performance for either the French or the German investors if the alternative was a pure country allocation strategy across Euroland.

From their extensive study, Adjaoute, Bottazzi, Danthine et .al. conclude that based on equity correlations the results indicate that the European sectoral investment strategy dominates and that the impact of the euro on optimal portfolio strategies is probably less important but again, the valid alternative portfolio allocation strategy in the post convergence era seems to be the one focusing on sectors and countries simultaneously. However it is important to note once again that no short selling restrictions were imposed in this study and additionally the statistical significance of the alternative diversification gains was not measured.

4.4 Adjaoute &, Danthine. (2001)

Adjaoute & Danthine revisited the issue of portfolio diversification in Euroland with more data since their previous study. They constructed weekly returns for country and sector indices (Datastream total market indices) from October 7, 1988 to March 30, 2001 and defined once again a pre-convergence period extending from October 7 1988 to December 31 1994 and a convergence period going from January 1 1995 to March 30 2001. Examining the characteristics of equity returns in these two sub-periods they found results that confirm their previous study (increased country & sector correlations in the convergence period). However they also examined in isolation the post January 1999 data and defined a pre-euro period which corresponds to the same length period prior to January 1 1999. Examining this pure-Euro period they found that country pair correlations have decreased, the same result was obtained also for 7 out of 10 sectors.

Based on these conflicting results with respect to their previous study they adopted an alternative methodology focusing on the time series of return dispersions to examine whether their findings are a result of a possible cyclical behavior of country and sector correlations. Specifically to examine the existence of cycles they based their study on the notion of cross-sectional dispersion introduced by Roulet and

Solnik (2000) according to which the more dispersed the returns of *n* financial assets are, the more scope there is for portfolio diversification.

Given that dispersion is defined in terms of the *n* assets existing at time *t,* they generated a time series of cross-section dispersion of returns and analyzed its properties in the standard time series framework. For country indices, they calculated a standard deviation across ten index returns for each week so using the whole sample data they obtained a sample of 652 weekly dispersions. A similar approach was used to generate a sector cross-sectional standard deviation for each week. They applied the Hodrick-Prescott methodology to extract a trend from their very volatile data. Focusing on the time series of return dispersions they identified significant low frequency movements in return dispersions both at the sector and the country level, and they also observed that dispersions, once smoothed out, are always higher at the sector level.

Based on their results and on the notion that there is a direct and inverse relation between dispersion and global correlation (higher dispersion implies lower correlation and higher diversification gains) they concluded that the most recent post-euro period is associated with a significant upswing with dispersions and hence that diversification opportunities in the Euro-area have not been impaired as a consequence of EMU. Also they concluded that their results confirm the superiority of diversification across country and sector dimensions. However, they noted that it is not clear whether the increase in dispersions (decrease of correlations) is indicative of a trend shift, perhaps associated with the euro, or if it constitutes a purely cyclical phenomenon.

4.5 Rouwenhorst (1998)

Rouwenhorst addressed the issue of country vs sector portfolio allocation based on a study of the country and sector composition of equity returns in Europe. Specifically he analyzed the returns of all 953 stocks in the Morgan Stanley Capital International (MSCI) indices of twelve European countries between 1978 and August of 1998 (Austria, Belgium, Denmark, France, Germany, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom). Each firm was assigned to one of seven broad industry categories defined by the Financial Times Actuaries:

Basic Industries, Capital Goods, Consumer Goods, Energy, Finance, Transportation, Utilities.

The analysis was based on the assumption that the return on each stock can be decomposed into four components: a common factor (a) which is shared among all securities, an industry factor (b) and a country factor (γ) to represent the influence of the industry and country that the stock belongs to, and an idiosyncratic disturbance (e). The return on a stock ***i*** that belongs to industry ***j*** and country ***k*** is:

$$R_{i,t} = a_t + \beta_{j,t} + \gamma_{k,t} + e_{i,t} \qquad (26)$$

He estimated a cross-sectional regression of returns on a set of industry and country dummies to obtain the realizations of the common factor, industry factors and country factors:

$$R_i = a + \beta_1 I_{i1} + \beta_2 I_{i2} + \cdots\cdots + \beta_7 I_{i7} + \gamma_1 C_{i1} + \gamma_2 C_{i2} + \cdots\cdots + \gamma_{12} C_{i12} + e_i \qquad (27)$$

where $I_{ij}=1$ if firm ***i*** belongs to industry ***j*** (zero otherwise), and $C_{ik}=1$ if firm ***i*** belongs to country ***k*** (zero otherwise). A time series of estimated industry and country effects were obtained by running the cross-sectional regression for each month.

Based on the above model, Rouwenhorst found that since 1982 country effects in stock returns have been larger than industry effects in the economically integrated countries of Europe. His findings show that this continued to be the case during the 1993-1998 period, despite the convergence of interest rates and the harmonization of fiscal and monetary policies following EMU. He concludes that the country composition of European portfolios are still more important than the sector composition and that the room for country selection continues to be large in Europe.

4.6 Further Literature on Country & Sector Factors

It must be noted that several other studies have been conducted using similar methodology as Rouwenhorst (1998) which analyze country and industry factors in returns. More specifically, using three years of daily data for 24 countries over the 1988, to 1991 period, *Roll (1992)* finds that approximately 40% of country returns volatility is explained by industry factors, while approximately 20% is attributable to exchange rate changes. *Heston and Rouwenhorst (1994)* however, using monthly data for 12 European countries over the 1978-92 period and a different empirical approach, show that Roll's methodology significantly overstates the role of industry factors in country returns. Further, they find that differences in industrial structure have a negligible impact and account for less than 1% of the cross sectional variance in country index returns.

Griffin and Karolyi (1998) using the same methodology, confirm the results of Heston and Rouwenhorst using weekly returns from 1992 to 1995 on a larger sample of countries and industries. Using a finer industry classification scheme, they uncover significant differences in the role of country and industry factors between traded good and non-traded good industries. For industries in the traded good sector country factors are dominant and industry factors are negligible. For the non-traded good sector, the role of country factors, while still dominant, is reduced and the industry factors become significant.

Hameling, Harasty & Hillion (2001) also addressed the issue of disentangling the various effects which drive equity returns. Using the constituents of the SSB World Primary Market Index from 1990 to 2001 they applied a multi-factor approach to individual stocks to estimate "pure" country, sector and style factor returns. The authors also investigated the significance of each factor in the cross-sectional regressions. The authors show that the significance of country factors has been falling since 1991, while the opposite has occurred (although to a lesser extent) for sector factors. They conclude that diversification benefits and return potentials of sector-based approaches have dramatically increased in the late 1990's and were comparable to country-based approaches in the first half of 2001. Nevertheless, they argue that country factors remain influential, and there is no sign that this importance is being severely altered.

5. DATA & METHODOLOGY

5.1 Data

To address the issue of what the optimal portfolio allocation strategy is for a Euroland investor we assume that portfolio allocation strategies in EMU consist of diversification: across countries, across sectors, or across countries & sectors. Datastream stock market indices are used to construct monthly euro-denominated total returns (i.e. dividends re-invested) on EMU countries and EMU sectors. The sample is from February 1975 to March 2002. We use seven country indices for which data were available over the sample and ten sector indices:

- Country indices: Austria, Belgium, France, Germany, Ireland, Italy, Netherlands
- Sector indices: Basic Industries (BASIC), Cyclical Consumer Goods (CYCGD), Cyclical Services (CYSER), Non-Cyclical Consumer Goods (NCYCG), Non-Cyclical Services (NCYSR), General Industrials (GENIN), Resources (RESOR), Utilities (UTILS), Information Technology (ITECH), Financials (TOTLF).

Excess returns are calculated by subtracting the lagged one month euro Deutschmark interest rate from the stock return. In order to test for the effects of international allocation for EMU investors, we used the excess return of the world index and a set of currency returns. Data for the world index are Datastream world index returns denominated in euro in excess of the lagged one month euro Deutshmark interest rate. Currency returns are the rate of depreciation of the euro vis-à-vis the US dollar, the British pound and the Japanese Yen.

5.1.1 Characteristics of the data

Summary statistics of the returns for the seven country and ten sector indices can be found in Tables 1 through 8. In Tables 1-4, we report the descriptive statistics of the country indices for the whole sample and for three subperiods. The first subperiod extends from 1990-1995 representing the pre-convergence to EMU, the second from 1995-1999 representing the convergence period and the third from 1999-2002 representing the pure euro period.

Throughout the whole sample the average monthly returns for the country indices ranged from 0.2% to 1.09% with standard deviation from about 5% to 7%. However, the whole sample includes a very long period where many important structural changes occurred in Europe, and thus we must take a better look at the three subperiods. Examining the pre-convergence period one can observe that the average returns had decreased and were negative for the six out of seven countries, with mean return for Ireland of –0.027% and –0.26% for Germany and standard deviation for all countries between 4% and 7%. The convergence period seems to be followed by an increase of returns for all seven countries where six out of seven countries experienced a mean return from 1% to 2%. This reflects the fact that during this period almost all stock markets in the world experienced a dramatic increase in value. Turning to the period of interest, we observe a decrease of mean returns for the pure euro period with three countries experiencing negative mean returns.

Similarly Tables 5 through 8 present the descriptive statistics for the 10 sector indices. During the whole sample, mean returns for the sector indices appear to be in the same range as for the country indices as they vary from 0.3% to around 1% but the standard deviation of returns is over 6.5% for all sectors with Financials having a standard deviation of 10%. During the pre-convergence period returns for the 10 sector indices range from –0.01 to 0.6% and are higher than those of the country indices while the standard deviation is again higher for most of the sectors with Financials having the highest of about 8%. The pre-convergence period is followed by an increase of returns in all sectors through the convergence period where the monthly mean return for sectors ranged approximately from 0.5% to 2.6%. The increase in returns during this period is in line with the general increase in value of all stock markets mentioned earlier. Turning to the last sub-period which represents the pure euro period, the mean return for all sectors was negative and less than the country returns in the same period with standard deviations reaching over 8% for two sectors.

COUNTRY INDICES WHOLE SAMPLE (1975:3 2002:3)							
	AUSTRIA	**BELGIUM**	**FRANCE**	**GERMANY**	**IRELAND**	**ITALY**	**NETHER.**
Mean	0.002066	0.005536	0.008586	0.004122	0.010906	0.007702	0.008002
Median	-0.00136	0.00373	0.012295	0.005508	0.013692	-0.0028	0.009423
Max	0.301568	0.193732	0.174311	0.14077	0.192931	0.27112	0.129753
Min	-0.21215	-0.28454	-0.25	-0.26962	-0.36633	-0.23302	-0.27222
Std. Dev.	0.056988	0.047539	0.059087	0.048063	0.062353	0.070689	0.044683
Skewness	0.720015	-0.50016	-0.39343	-0.74428	-0.7323	0.435153	-0.81145
Kurtosis	8.543742	7.863911	4.632346	6.681444	7.384354	4.207611	7.672642
Jarque-Bera	444.2582	333.914	44.46668	213.5364	289.3529	30.00503	331.3292
Prob.	0	0	0	0	0	0	0
Obs	325	325	325	325	325	325	325

Table 1: Descriptive Statistics for Country Indices (Whole Sample)

COUNTRY INDICES PRE-CONVERGENCE (1990:1 1994:12)							
	AUSTRIA	**BELGIUM**	**FRANCE**	**GERMANY**	**IRELAND**	**ITALY**	**NETH.**
Mean	-0.00441	-0.0048	-0.00259	-0.0026	-0.00027	-0.00526	0.001955
Median	-0.00133	-0.00758	-0.00242	0.001748	-0.00466	-0.01531	0.003114
Maxi	0.195656	0.108202	0.102073	0.080061	0.192931	0.20234	0.084177
Min	-0.21215	-0.12592	-0.164	-0.15237	-0.18674	-0.16203	-0.08054
Std. Dev.	0.07337	0.04371	0.050849	0.046567	0.063005	0.069554	0.035012
Skewness	-0.37665	-0.27602	-0.34079	-0.83788	0.203263	0.58099	0.118494
Kurtosis	4.111681	3.428615	3.395787	4.302032	3.964681	3.28671	2.591931
Jarque-Bera	4.583341	1.241496	1.578878	11.44624	2.785345	3.640681	0.565986
Prob	0.101097	0.537542	0.454099	0.003269	0.24841	0.161971	0.753525
Obs	61	61	61	61	61	61	61

Table 2: Descriptive Statistics for Country Indices (Pre-Convergence)

COUNTRY INDICES CONVERGENCE (1995:1 1998:12)							
	AUSTRIA	**BELGIUM**	**FRANCE**	**GERMANY**	**IRELAND**	**ITALY**	**NETHER.**
Mean	0.000691	0.017153	0.013352	0.012641	0.020069	0.013349	0.017116
Median	0.006875	0.019538	0.019948	0.020301	0.023531	0.001125	0.023695
Max	0.147455	0.111015	0.149772	0.113669	0.136657	0.208563	0.109458
Min	-0.2054	-0.11899	-0.16623	-0.16903	-0.23294	-0.16235	-0.13967
Std. Dev.	0.057259	0.045964	0.057001	0.051808	0.054338	0.074773	0.05165
Skewness	-0.7706	-0.47335	-0.53097	-1.20332	-1.91721	0.141369	-1.04642
Kurtosis	5.593833	3.747313	4.353949	5.309654	11.25228	3.040656	4.573829
Jarque-Bera	18.20659	2.909455	5.921743	22.25275	165.6058	0.163186	13.71385
Prob.	0.000111	0.233464	0.051774	0.000015	0	0.921647	0.001052
Obs	48	48	48	48	48	48	48

Table 3: Descriptive Statistics for Country Indices (Convergence)

COUNTRY INDICES PURE-EURO (1999:1 2002:3)							
	AUSTRIA	**BELGIUM**	**FRANCE**	**GERMANY**	**IRELAND**	**ITALY**	**NETH.**
Mean	-0.00181	-0.0043	0.007619	0.001412	-0.00025	0.00315	0.003975
Median	0.006886	-0.00343	-0.00058	0.00531	0.005699	0.001494	-0.00407
Maxi	0.068306	0.090721	0.101329	0.10688	0.083966	0.150869	0.102827
Min	-0.07274	-0.14462	-0.07907	-0.09044	-0.11788	-0.10224	-0.0781
Std. Dev.	0.032592	0.036666	0.046752	0.048091	0.042717	0.050448	0.042838
Skewness	-0.32621	-1.06839	0.09967	0.168108	-0.50112	0.672413	0.448113
Kurtosis	2.898325	7.668984	2.238248	2.348043	3.153135	4.18591	2.860096
Jarque-Bera	0.708474	42.84344	1.007504	0.874394	1.670381	5.224281	1.337038
Prob	0.701709	0	0.604259	0.645844	0.433792	0.073377	0.512467
	39	39	39	39	39	39	39
Obs							

Table 4: Descriptive Statistics for Country Indices (Pure-Euro)

SECTOR INDICES WHOLE SAMPLE (1975:3 2002:3)										
	BASIC	**CYCGD**	**CYSER**	**GENIN**	**ITECH**	**NCYCG**	**NCYSR**	**RESOR**	**TOTLF**	**UTILS**
Mean	0.009209	0.004267	0.004575	0.003178	0.006135	0.004635	0.005773	0.005512	0.012194	0.005628
Median	0.010667	0.005872	0.003333	0.002004	0.00391	0.003637	0.008177	0.006465	0.012922	0.004981
Maximum	0.1993	0.237359	0.194595	0.393298	0.217985	0.21648	0.224349	0.276211	0.360773	0.213077
Minimum	-0.33222	-0.26451	-0.26882	-0.21731	-0.25055	-0.22881	-0.26433	-0.263	-0.42145	-0.26621
Std. Dev.	0.072703	0.069577	0.071472	0.078514	0.069056	0.068773	0.073136	0.071682	0.101021	0.068941
Skewness	-0.47376	-0.25109	-0.30535	0.38316	-0.18153	-0.17281	-0.26165	-0.03538	-0.09198	-0.15153
Kurtosis	5.096504	4.11979	3.884983	5.31105	3.368873	3.562573	3.50037	3.899876	4.598231	3.848523
Jarq-Bera	71.67784	20.39524	15.65623	80.27769	3.62744	5.903354	7.098782	11.03351	35.04837	10.99367
Prob	0	0.000037	0.000398	0	0.163046	0.052252	0.028742	0.004019	0	0.0041
Obs	325	325	325	325	325	325	325	325	325	325

Table 5: Descriptive Statistics for Sector Indices (Whole Sample)

SECTOR INDICES PRE-CONVERGENCE (1990:1 1994:12)										
	BASIC	**CYCGD**	**CYSER**	**GENIN**	**ITECH**	**NCYCG**	**NCYSR**	**RESOR**	**TOTLF**	**UTILS**
Mean	0.006309	-0.00014	-0.00086	-0.00207	0.004657	0.000869	0.006337	0.006428	0.006167	-0.00115
Median	0.009705	0.010547	0.008918	0.00266	0.0038	0.005771	0.016471	0.009776	0.010764	-0.00109
Maximum	0.136668	0.131362	0.150715	0.137899	0.150568	0.136101	0.147575	0.126866	0.148572	0.136634
Minimum	-0.177728	-0.19892	-0.23379	-0.19703	-0.1783	-0.20781	-0.1617	-0.17675	-0.17841	-0.19551
Std. Dev.	0.064178	0.0693	0.074502	0.071702	0.068183	0.071287	0.069736	0.067887	0.080478	0.066063
Skewness	-0.33727	-0.84914	-0.7753	-0.52011	-0.24627	-0.58554	-0.48435	-0.5117	-0.2607	-0.45328
Kurtosis	3.376643	3.727334	4.052291	3.339078	2.997409	3.454939	3.042833	3.039448	2.670762	3.467553
Jarq-Bera	1.492148	8.532834	8.77915	2.992601	0.60648	3.945958	2.35057	2.622242	0.950661	2.601116
Prob	0.474225	0.014032	0.012406	0.223957	0.738422	0.139042	0.308731	0.29518	0.62168	0.27238
Obs	61	61	61	61	61	61	61	61	61	61

Table 6: Descriptive Statistics for Sector Indices (Pre-Convergence)

SECTOR INDICES CONVERGENCE (1995:1 1998:12)										
	BASIC	**CYCGD**	**CYSER**	**GENIN**	**ITECH**	**NCYCG**	**NCYSR**	**RESOR**	**TOTLF**	**UTILS**
Mean	0.011046	0.00555	0.008636	0.006697	0.014587	0.012614	0.020411	0.015295	0.026183	0.014354
Median	0.0102	0.010144	0.003427	0.010153	0.017022	0.008835	0.01973	0.014474	0.031256	0.009452
Maximum	0.1993	0.137843	0.140195	0.134254	0.137617	0.099008	0.129581	0.135357	0.170604	0.169666
Minimum	-0.15575	-0.12121	-0.12037	-0.18635	-0.11316	-0.09911	-0.0993	-0.15362	-0.18126	-0.16304
Std. Dev.	0.060363	0.050727	0.047252	0.056928	0.049502	0.043796	0.045438	0.055312	0.073809	0.053426
Skewness	0.166075	-0.24636	-0.14042	-0.5702	-0.17197	-0.23941	-0.36302	-0.92618	-0.31076	-0.33083
Kurtosis	4.897081	3.711061	4.500379	4.708704	4.031676	2.966014	3.436097	4.613436	3.051755	5.734341
Jarq-Bera	7.418478	1.496766	4.66001	8.440336	2.365293	0.460858	1.434632	12.06879	0.777908	15.82884
Prob	0.024496	0.473131	0.097295	0.014696	0.306467	0.794193	0.48806	0.002395	0.677765	0.000365
Obs	48	48	48	48	48	48	48	48	48	48

Table 7: Descriptive Statistics for Sector Indices (Convergence)

SECTOR INDICES PURE-EURO (1999:1 2002:3)										
	BASIC	**CYCGD**	**CYSER**	**GENIN**	**ITECH**	**NCYCG**	**NCYSR**	**RESOR**	**TOTLF**	**UTILS**
Mean	-0.00319	-0.0063	-0.00574	-0.01683	-0.01349	-0.00631	-0.01238	-0.01376	0.005055	-0.00751
Median	0.003547	0.002904	-0.00556	-0.01316	-0.01738	-0.00593	-0.02047	-0.01608	-0.00106	-0.0046
Maximum	0.144941	0.186013	0.144514	0.131594	0.151408	0.188444	0.197752	0.121416	0.306593	0.143507
Minimum	-0.13645	-0.20531	-0.136	-0.16271	-0.14454	-0.15047	-0.17968	-0.12547	-0.20504	-0.14432
Std. Dev.	0.060699	0.067259	0.061057	0.06256	0.070042	0.068224	0.080038	0.05656	0.087986	0.053988
Skewness	0.005373	-0.1299	0.296205	-0.1113	0.332323	0.723491	0.476794	0.250335	0.778775	-0.05306
Kurtosis	3.246896	4.970418	3.455047	3.678149	2.715667	4.707744	3.337085	3.084405	5.439769	4.318015
Jarq-Bera	0.099244	6.418815	0.906779	0.82783	0.849225	8.141488	1.662302	0.418917	13.61496	2.841186
Prob	0.954589	0.040381	0.63547	0.661057	0.654023	0.017065	0.435548	0.811023	0.001105	0.241571
Obs	39	39	39	39	39	39	39	39	39	39

Table 8: Descriptive Statistics for Sector Indices (Pure-Euro)

5.1.2 Correlation structure of Country and Sector Indices

As mentioned earlier, the extent to which financial assets are correlated is crucial for portfolio allocation decisions since low correlation contributes to an increase in the performance of a portfolio. Low correlation among country portfolio returns has been an empirical regularity in international equity markets for a long time and early studies [Grubel (1968), Levy and Sarnat (1970), and Solnik (1974)] have documented low correlations between index returns in different countries. Previous literature has given several explanations for why cross-country correlation of returns is low. Some studies claim that the low correlation results from the diverse industrial structures in each country, others claim that it results from differential economic and technological development, or from the existence of formal or informal barriers to foreign investors. Consequently, one would expect that cross country correlations would have increased during the convergence to EMU reflecting the structural changes that have taken place, the elimination of currency risk, etc.

To examine the evolution of cross country correlations and cross industrial correlations Figures 6 and 7 present the evolution of correlations for country and sector indices respectively in two large sub-periods. Examining Figure 6 we observe that country correlations have increased between all country indices after 1989 compared to the previous period. The same does not hold for sector indices as seen in Figure 7. Correlation between sector returns has decreased between most sectors after 1989, however it is very important to note that correlation between country returns has been lower in both periods compared to sector returns.

More specifically, from 1975 to 1989 cross country correlations were much lower ranging from 0.1 to 0.5, whereas for sector returns during the same period correlations were over 0.5 between all sectors. The period after 1989 however seems to be accompanied by a large increase of correlation between country returns. From 1989-2002 the average correlation between 22 country pairs was 0.61 compared to an average correlation of 0.36 in the previous period. The same does no hold for correlation between sector returns which in the 1989-2002 period has decreased for 28 out of 45 sector pairs. However sector pair correlations are still higher than country pair correlations averaging 0.76 after 1989.

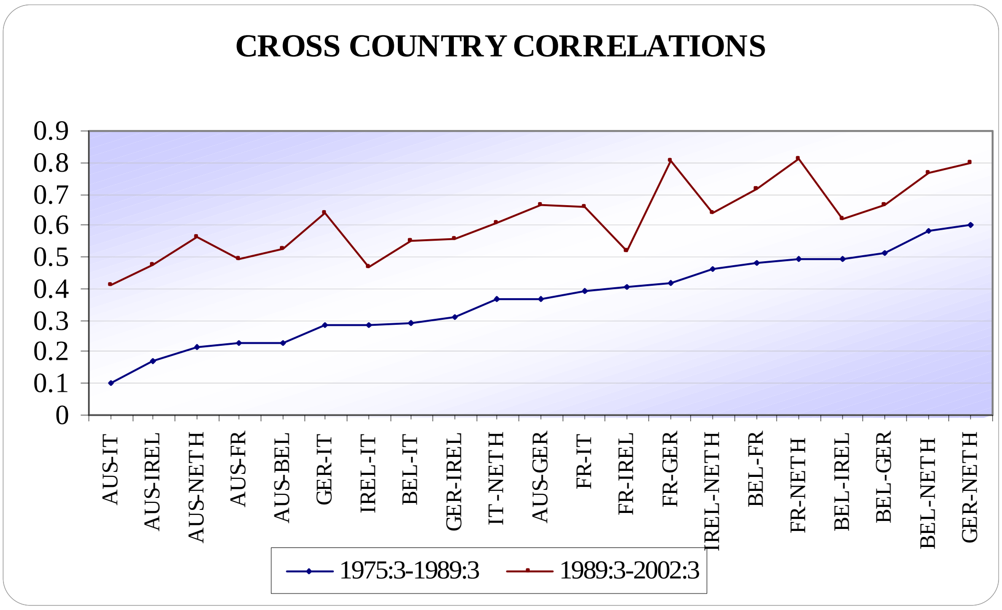


Figure 6: Evolution of Cross Country Correlations (1975-1989, 1989-2002)

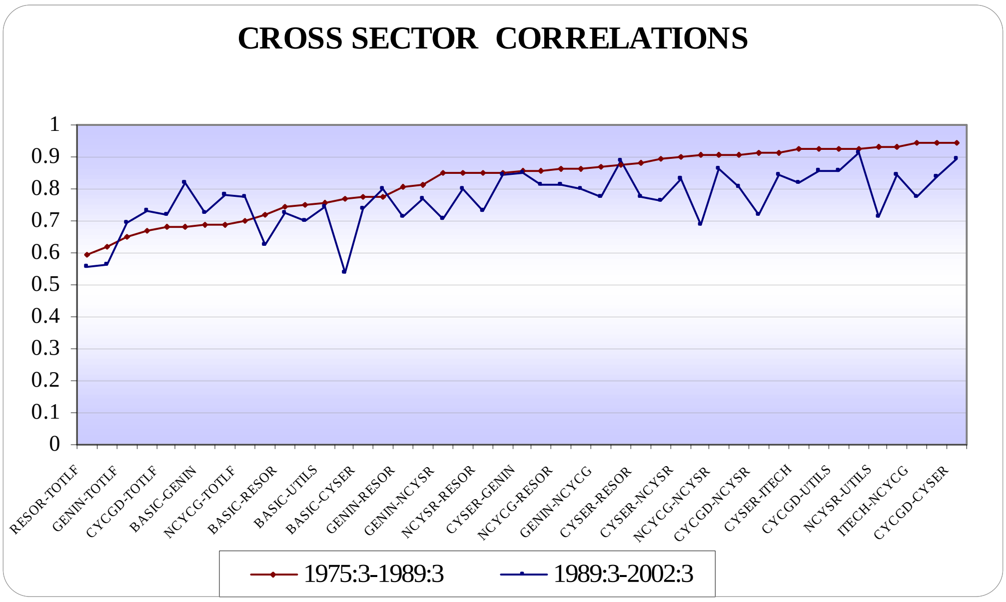


Figure 7: Evolution of Cross Sector Correlations (1975-1989, 1989-2002)

The evolution of correlation of returns in the two large sub-periods which is presented in the above figures is in line with the argument that perhaps diversification should be sought by a portfolio consisting of sector indices, since country indices no longer exhibit very low correlations. However investors cannot base their diversification strategies on correlation estimates over such large periods, thus we must examine the correlation of returns in smaller sub-periods which can provide some insight on the characteristics of country and sector returns after EMU. Figures 8 and 9 present country and sector pair correlations on three smaller sub-periods which can represent the pre-convergence (1990-1996), convergence (1996-1999) and pure euro (1999-2002) periods.

Taking a closer look at the correlation of returns during the 90's the picture is quite different. Country pair correlations seem to have increased during the convergence period compared to the pre-convergence period but surprisingly have decreased during the pure-euro period to levels lower than the pre-convergence period for 11 out of 22 country pairs. For example, during the pure-euro period the correlation between Belgium and Italy is as low as 0.08 compared to 0.7 in the previous period and the average correlation between all pairs is approximately 0.48. Sector pair correlations also seem to have decreased during the convergence and pure-euro periods, however not as much as the country pairs. More specifically, even though during the pre-convergence period almost all sector pair correlations were over 0.8, during the pure-euro period the average correlation is 0.57 for all pairs while the correlation of the sector pairs ITECH-TOTLF and BASIC-NCYSR are below 0.2.

The evolution of return correlations for country indices after 1990 indicates that correlation between countries is still low and suggests that perhaps EMU has not impaired diversification opportunities in the Euro-area. Also the decrease of correlations both at the country and at the sector level suggests that the previous increase in correlations during the convergence period may not have been due to the process of economic and monetary integration. Other explanations however can be given for the observed evolution of correlations. For example the increase during the convergence period may be explained by the large movements in financial markets during this period. Recent academic research (Longin and Solnik, 1995, and Karolyi and Stulz, 1996) suggests that large movements in financial markets are more highly correlated than overall movements. Also, Adjaoute and Danthine (2001) examined the evolution of country and sector correlation and found similar results for the period after 1990. In order to provide an explanation for this evolution, the authors focused on the time series of return dispersions and identified low frequency movements in dispersions which as they point out may be suggestive of cycles and long swings in correlations.

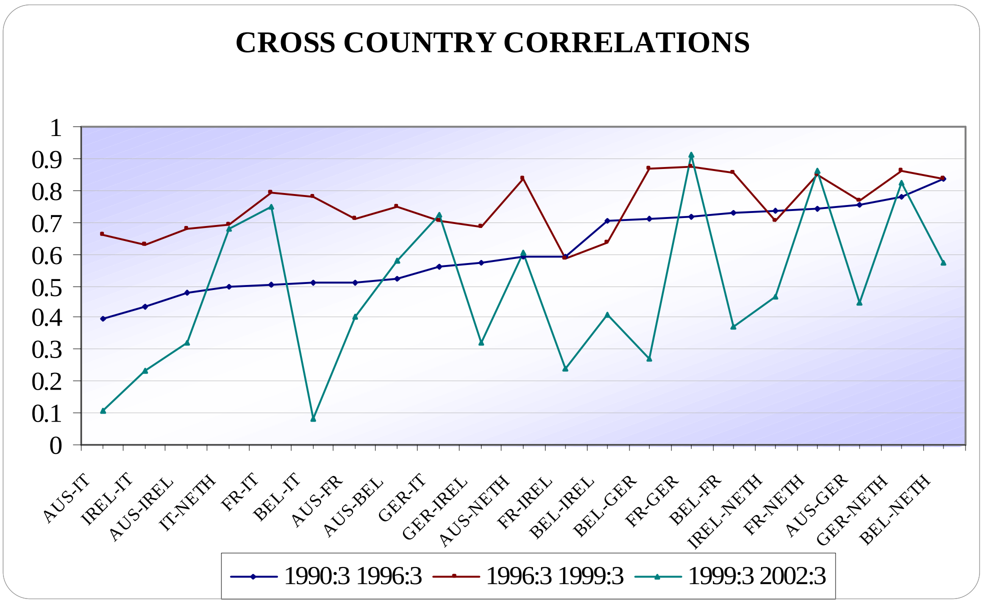


Figure 8: Evolution of Cross Country Correlations in the 1990’s

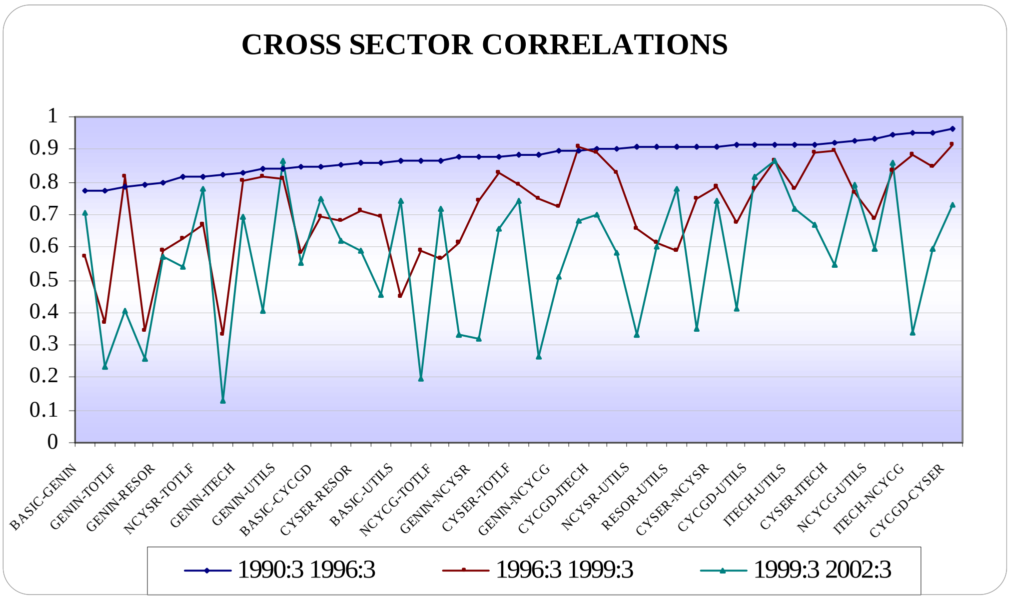


Figure 9: Evolution of Cross Sector Correlations in the 1990’s

5.2 Methodology

To establish the best asset allocation strategy, alternative portfolios are constructed 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 ratio.** The Sharpe ratio measures the maximum performance of optimal portfolios (it is the excess return per unit of risk of the tangency portfolio).

We consider a set of *N* risky assets with mean excess return vector μ and covariance matrix Σ. Denoting by *x* the vector of proportions of the *N* risky assets, the efficient set of portfolios consisting of the *N* risky assets is comprised of the portfolios that minimize portfolio variance for a given mean excess return μ_p, subject to the constraint that investment proportions sum to one, $x'e = 1$. In the presence of a riskless asset, the efficient set becomes the set of linear combinations of the riskless asset and a unique risky asset.

The mean excess return and variance of the tangency portfolio are:

$$\mu_m = a/b,\ \sigma_m^2 = a/b^2, \text{ where } a = \mu'\Sigma^{-1}\mu \text{ and } b = e'\Sigma^{-1}\mu \tag{27}$$

a and *b* are the efficient set constants and *e* is the (*N* x 1) unit vector. The Sharpe measure of performance of any portfolio *p* with proportions vector x_p is

$$S_p = x_p'\mu_p / (x_p'\Sigma x_p)^{1/2} = \mu_p / \sigma_p \tag{28}$$

The Sharpe ratio of the tangency portfolio is the maximum performance of the portfolio of the *N* assets:

$$S_m = \mu_m / \sigma_m = (a/b)(b/\sqrt{a}) = \sqrt{a} \tag{29}$$

The reward to risk ratio $\sqrt{a}$ (or its square, *a*) of the tangency portfolio is referred to as the potential performance of a one-period buy and hold portfolio of the *N* assets. Following we consider a subset N_1 of the *N* risky assets and we are interested in comparing the potential performance of the two sets of assets $\sqrt{a_1}$ and $\sqrt{a}$ respectively. In Figure 10 the blue curve represents the efficient set of the *N* assets and the red curve represents the efficient set of the N_1 assets. We are interested in testing the difference of the slopes of rays through the origin which measure the potential performance of the optimal portfolios. In other words we wish to test the maximum performance of the *optimal portfolio* of the N assets to that of the again *optimal portfolio* of the subset N_1 assets.

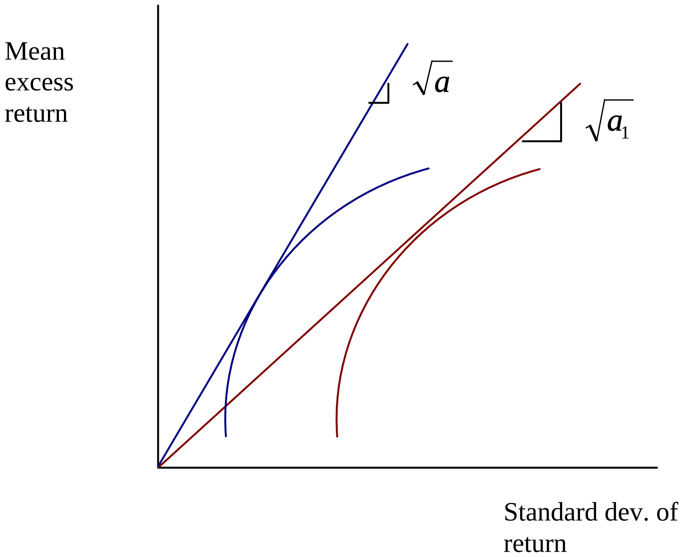


Figure 10: Potential Performance of Two Optimal Portfolios

The whole set of N assets consists of N_1 and N - N_1 assets. Hence if two portfolios consisting of the two sets of assets N and N_1 respectively have the same maximum performance then we may conclude that the additional N - N_1 assets do not provide additional diversification gains to the whole set of N assets. For example consider a portfolio which consists of EMU country and sector indices and a second portfolio which consists of EMU country indices only. If the two portfolios have the same performance, then the sector indices do not provide diversification benefits.

5.2.1 Measuring the Significance of Diversification Gains

To measure whether diversification actually produces *statistically significant* gains, we test the hypothesis that the potential performances of the two sets N_1 and N are identical: H_0: $\alpha_1 = \alpha$, if the null hypothesis cannot be rejected, then we consider that the subset of assets N_1 is jointly efficient with respect to the full set of assets N, or alternatively, if the null hypothesis is rejected then the N - N_1 assets contribute to an increase in performance of the combined portfolio of the N assets. Given a random sample of T excess returns on the N assets, the maximum likelihood estimators of μ, Σ and α are given by $\bar{r} = \frac{1}{T}\sum_{t=1}^{T} r_t$, $S = \frac{1}{T}\sum_{t=1}^{T}(r_t - \bar{r})(r_t - \bar{r})'$, $\hat{a} = \bar{r}'S^{-1}\bar{r}$, where r_t is the ($N \times 1$) vector of excess returns.

Throughout our analysis we use three test statistics for testing the potential performance equivalence of the different asset sets . Two likelihood ratio test statistics introduced by Jobson and Korkie (1982) are used:

$$\phi_{1,2} = (T - N_1 - \frac{(N - N_1)}{2} - 1)\log(\frac{1+\hat{a}}{1+\hat{a}_1}) \sim \chi^2_{N-N_1} \qquad (30)$$

$$\varphi_{1,3} = \frac{(T - N_1)(\hat{a} - \hat{a}_1)}{(N - N_1)(1+\hat{a}_1)} \sim F_{N-N_1,T-N} \qquad (31)$$

Under the null hypothesis, $\varphi_{1,2}$ is asymptotically χ^2 distributed with $N - N_1$ degrees of freedom, whereas $\varphi_{1,3}$ is F distributed[2] with $N - N_1$ and $T - N$ degrees of freedom. The power of the test statistics is studied by Jobson and Korkie for alternative sample sizes and number of assets. The authors show that the power of the tests increases significantly with the number of observations. The third statistic we use was introduced by Gibbons, Ross and Shanken (1989) to test portfolio efficiency. It is a Wald statistic which under the null follows an exact central F distribution with N and $T - N - N_1$ degrees of freedom:

$$GRS = \frac{(T - N - N_1)(\hat{a} - \hat{a}_1)}{N(1+\hat{a}_1)} \sim F_{N,T-N-N_1} \qquad (32)$$

In order to test for changes in portfolio performance over time, the statistics are computed recursively using a window size of 20 years in order to insure the highest possible power of the statistics. We roll the window from March 1995 to March 2002 and assess changes in performance of the portfolios over time. Short selling is generally allowed.

[2] Originally Jobson & Korkie had incorrectly stated that the statistic follows asymptotically an F distribution but in fact the F distribution is exact for every $T > N$. The correction can be found in Jobson & Korkie, 1985.

6. EMPIRICAL RESULTS

6.1 Benefits of country versus sector allocation in EMU

To evaluate the diversification benefits of country allocation we examine whether country indices contribute to an increase in performance of a portfolio consisting of both country and sector indices we compare the maximum performance of a portfolio consisting of EMU country indices and sector indices (full portfolio) to a portfolio consisting of sector indices only (restricted portfolio). The maximum performance of the portfolios is measured in terms of their Sharpe ratios. At each point in time we compute the Sharpe ratio of the portfolios using data over the last twenty years and the window is rolled over one observation ahead in order to assess changes in the performance of the portfolios over time.

Figure 11 presents the Sharpe ratios of the two portfolios from March 1995 to March 2002. The Sharpe ratio of the combined portfolio is higher for the whole period with the difference ranging from 9 to 13 percentage points between 1995 and 2002 and over the same period the full portfolio was on average 31% higher than the restricted portfolio implying that countries do provide an increase in performance. The maximum performance of both portfolios is increasing throughout the whole period but that of the combined portfolio of countries and sectors is increasing faster, with the highest difference with the restricted portfolio occurring after 1999, thus indicating that there are increasing country effects after that period.

Figure 12 presents the marginal significance levels of the recursive performance statistics. The χ^2 statistic and the *GRS F* statistic both indicate that the performance of the full portfolio is not significantly different from the performance of the sector portfolio. However, the Jobson & Korkie *F* statistic indicates that after 1998 investing in a portfolio consisting of both country and sector indices provides greater diversification benefits than a portfolio of just sector indices, or, alternatively, that after 1998 there are significant effects of country allocation. At this point it is important to note that according to Jobson & Korkie (1982) although the power of the alternative tests is equivalent for large sample sizes, the $\varphi_{1,3}$ statistic appears to be the best as it follows an exact *F* distribution whereas the $\varphi_{1,2}$ statistic does not perform as well until at least sample size 120.

In the same manner, to investigate the diversification benefits which arise from sector allocation we examine the maximum performance of a portfolio consisting of EMU countries and sectors to a portfolio consisting of country indices only. If the difference between the maximum performance of the two portfolios is significant, then we conclude that sector indices do contribute to an increase of performance. Figure 13 presents the Sharpe ratios of the two portfolios, whereas Figure 14 presents the marginal significance levels of the performance statistics. Observing the performance of the two portfolios we see that again the full portfolio has a higher Sharpe ratio throughout the whole period with the difference ranging from 7 to 15 percentage points. With the exception of 2000 as can be seen by the significance levels of the performance statistics, the null hypothesis cannot be rejected and thus the difference between the two portfolios does not seem to be significant. However, it must be pointed out that over time, the significance of sector allocation increases a fact that reflects the decrease of sector pair correlations during the late ‘90s.

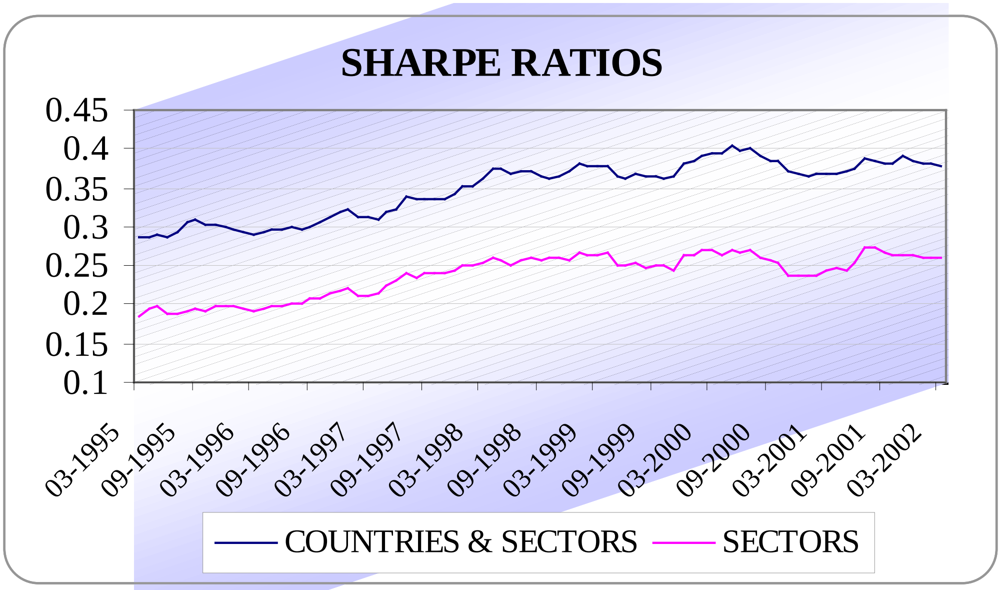


Figure 11: Sharpe Ratios, Countries & Sectors vs Sectors

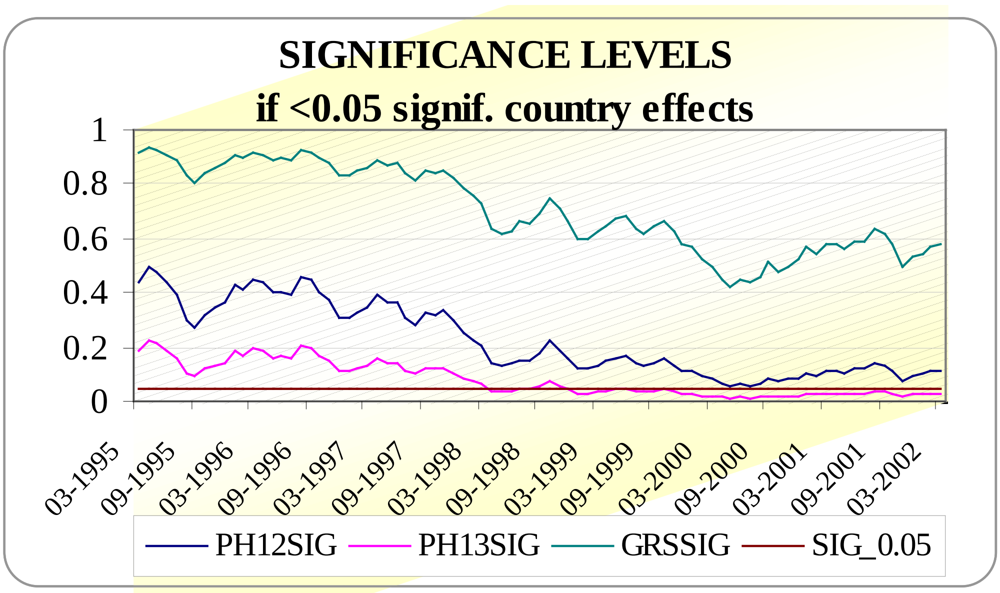


Figure 12: Significance Levels – Country Effects

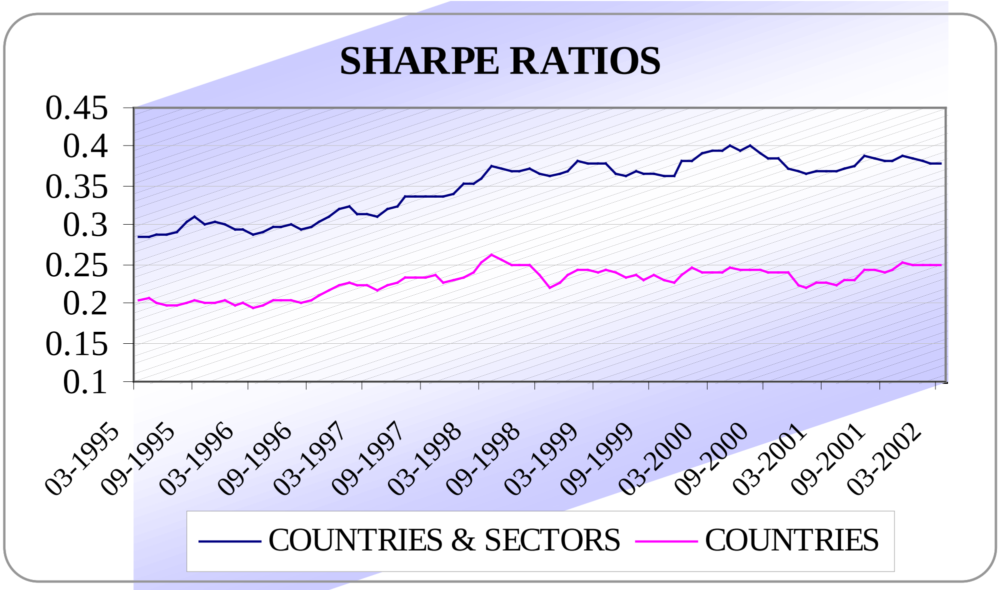


Figure 13: Sharpe Ratios, Countries & Sectors vs Countries

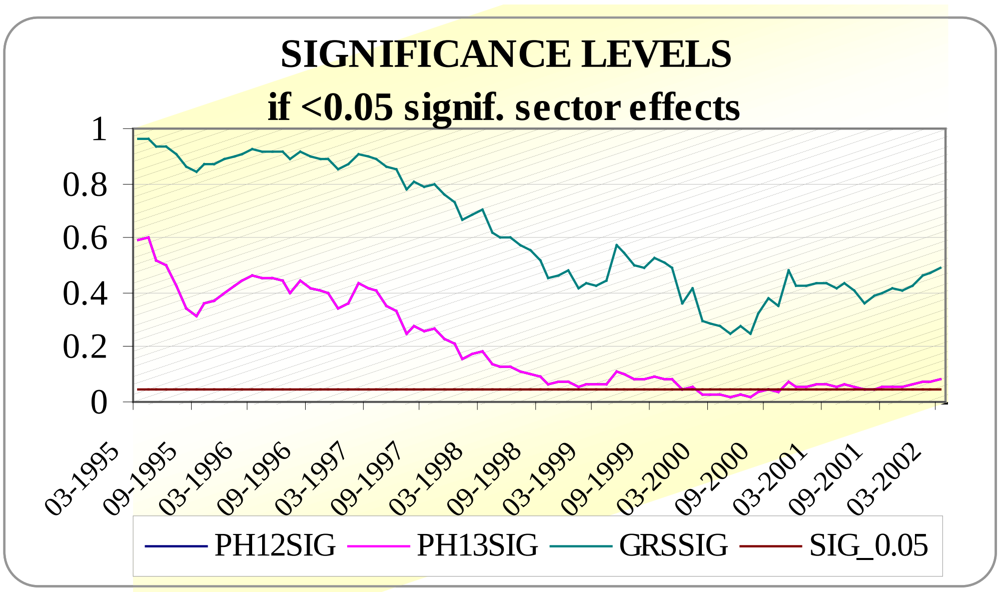


Figure 14: Significance Levels – Sector Effects

6.1.1 Country versus Sector allocation in EMU with Short Selling Constraints

Comparing the maximum performance of a portfolio of country and sectors with that of portfolios consisting of sectors or countries only we saw that after 1998 there have been significant country effects and that only during 2000 were there significant sector effects. However, it is important to note that the portfolios that were examined earlier may contain short positions which may not always be possible in practice since many investors face short selling constraints. To overcome this problem we compare the maximum Sharpe ratios of the same portfolios which do not contain short positions, and hence in our analysis we impose the additional constraint that the proportion of each asset in the portfolio is positive.

Figures 15 and 17 presents the maximum performance of the full portfolio (country & sector indices) and that of a portfolio of sector indices only (country effects) and country indices only (sector effects) respectively, with the additional short selling constraint, and Figures 16 and 18 present the recursive statistics. Firstly, examining country effects in portfolio allocation we see in Figure 15 that the Sharpe ratio of the full portfolio is higher than that of the sector portfolio throughout the whole period with the difference ranging from 5 to 11 percentage points in the absence of short selling, a difference that has not changed a great deal from the previous case where short selling was present. Indeed Figure 16 shows that according to the *J & K F* statistic the difference between the two Sharpe ratios has been significant after 1998 indicating that there are significant country effects even when short selling is prohibited.

In contrast to the case of country effects, Figure 17 reveals that the short selling constraint does have an important impact on sector effects. We observe that the performance of the full portfolio is higher than that of the country portfolio, but the difference is much smaller ranging from only 1 to 4 percentage points compared to an average difference of 12 percentage points when short selling was present. The significance levels of all three statistics confirm that the difference between the maximum performance of the two portfolios is not significant and hence that sector indices do not contribute significantly to an increase in performance when short selling is prohibited.

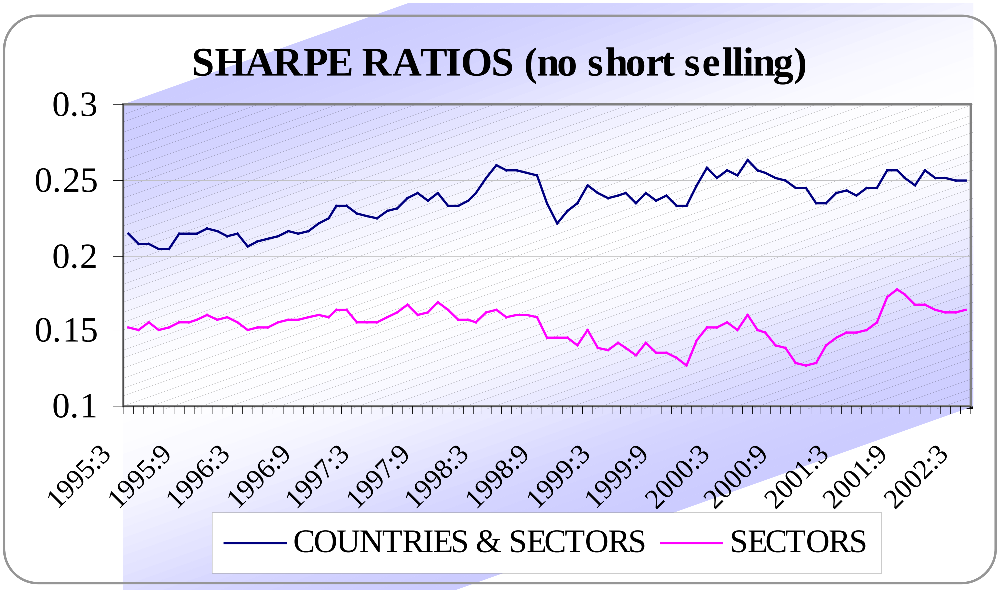


Figure 15: Sharpe Ratios/No Short Selling, Countries & Sectors vs Sectors

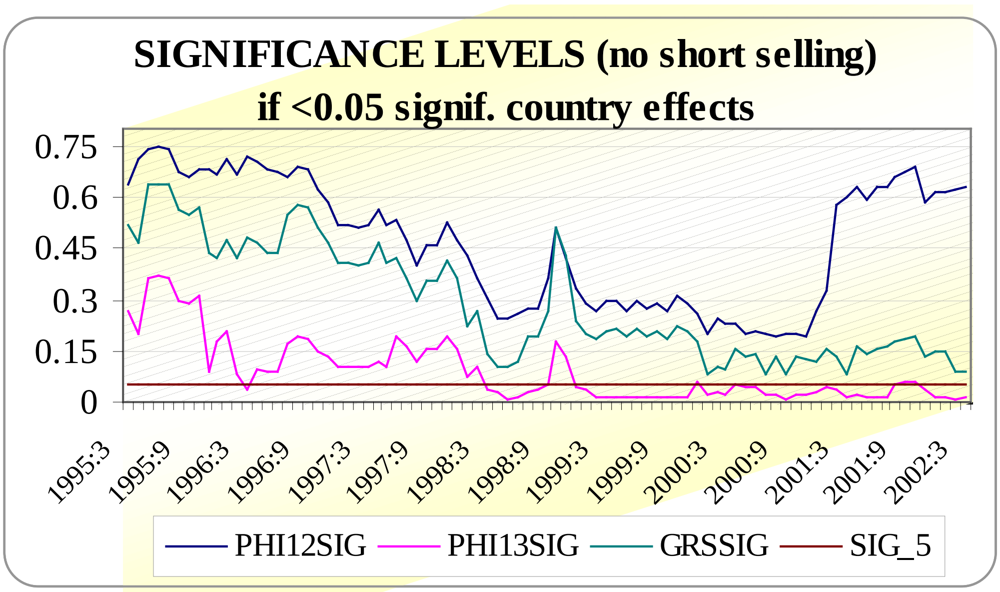


Figure 16: Significance Levels – Country Effects/No Short Selling

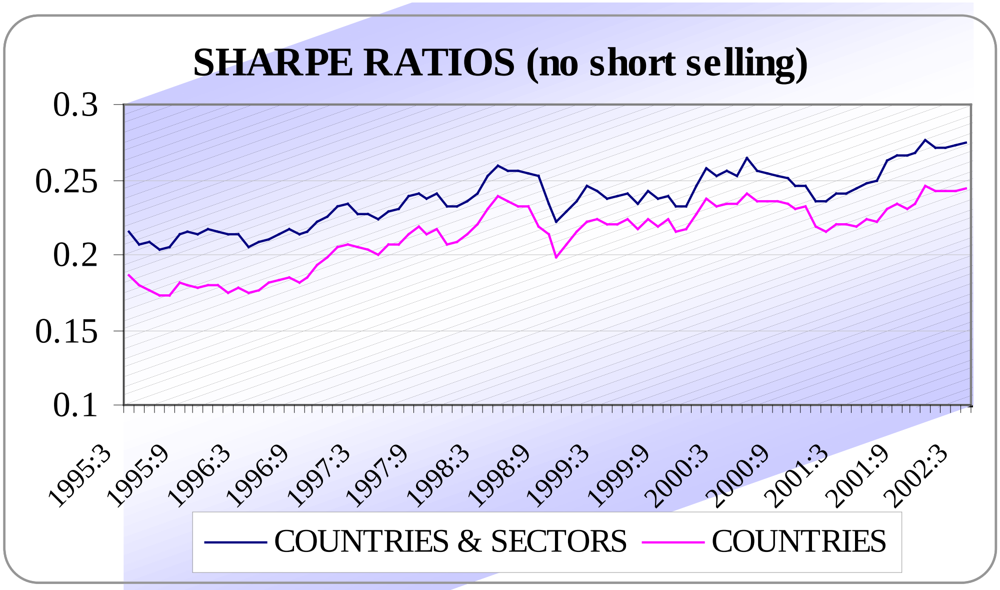


Figure 17: Sharpe Ratios/No Short Selling, Countries & Sectors vs Countries

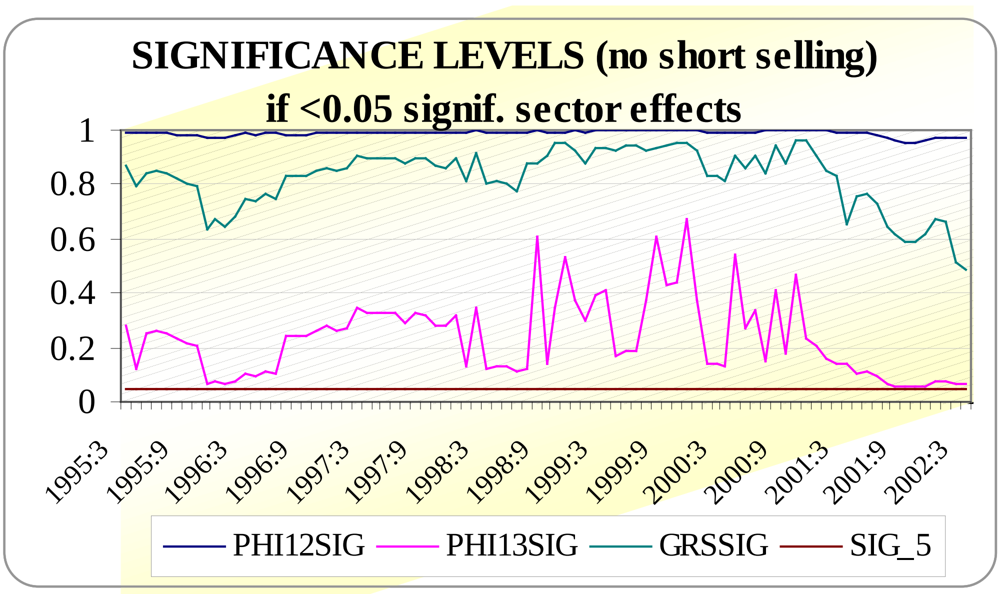


Figure 18: Significance Levels – Sector Effects/No Short Selling

In summary, when examining the diversification benefits of country versus sector allocation in Euroland we found some evidence that after 1998 there have been significant country effects in portfolio allocation and only during 2000 were there significant sector effects. Furthermore when we imposed short selling constraints, country effects were not affected and remained significant after 1998 (based on one statistic only) whereas sector effects were no longer significant. Thus, we may conclude that the significance of sector effects during 2000 were mainly due to short selling. This result can also be noticed by the effect of the short selling constraint on the country and sector portfolios.

Namely, we observed that although the sector portfolio had a higher average Sharpe ratio of 0.27 from 1995 to 2002 compared to the average ratio of 0.26 of the country portfolio, this is no longer the case if short selling is prohibited. In the absence of short selling, the sharpe ratio of the sector portfolio fell on average by 48% ranging from 0.12 to 0.17, whereas that of the country portfolio only by 18% ranging from 0.17 to 0.24 from 1995 to 2002. We thus can see that the sector portfolio is quite sensitive to the short selling constraint. Finally we must note that the results from the above analysis confirm the findings of Gerard, Hillion and de Roon (2001) which also suggest that when short selling is not allowed, the performance of sectors is no longer significant and is lower than the performance of countries.

6.2 Country Allocation Strategies

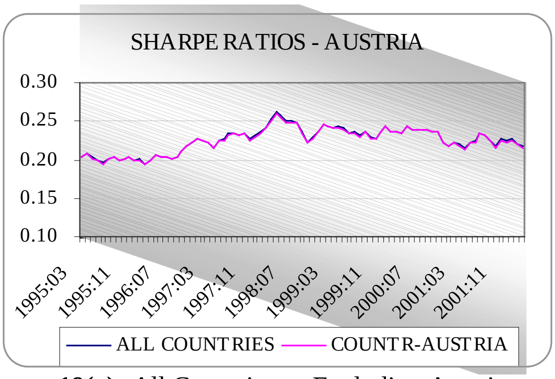
When choosing to diversify across countries it is interesting to examine which specific components of a portfolio (which consists of country indices only) actually provide diversification benefits. To measure the contribution of a specific country to the performance of a portfolio consisting of all country indices, we compare the maximum performance of a portfolio consisting of all seven EMU countries (Austria, Belgium, France, Germany, Ireland, Italy, Netherlands-full portfolio) to that of a portfolio consisting of all the countries minus the country of interest (restricted portfolio). If the country of interest contributes a great deal to the whole set of countries then the Sharpe ratio of the portfolio which does not include it will be lower than that of the full portfolio. Figures 19a-19g each present the Sharpe ratio of the full portfolio compared to the Sharpe ratio of a portfolio which does not include the country of interest.

For example Figure 19a presents the Sharpe ratio of a portfolio consisting of all seven country indices and the Sharpe ratio of a portfolio which includes all country indices except Austria. We observe that excluding Austria from the full portfolio has almost no effect on the maximum performance of the portfolio throughout the whole period from 1995 to 2002. Similarly Figures 19 b, c and e show that excluding Belgium, France or Italy respectively from the full portfolio does not decrease performance in any way, as the Sharpe ratios of the full portfolio and restricted portfolios are almost identical in each case. On the other hand Figure 19d indicates that there is a small decrease in the performance of the portfolio when Germany is excluded and the same holds for Ireland at least until 1998 as shown by Figure 19f. The country which seems to contribute the most to the performance of the full portfolio is Netherlands. Figure 19g indicates that when Netherlands is excluded from the full set of assets (all seven country indices), the Sharpe ratio of the restricted portfolio is less than that of the full portfolio for the whole period and the difference is larger than in the case of excluding any other country.

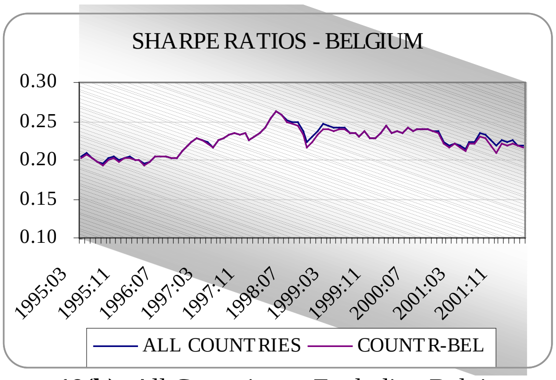
Based on the Sharpe ratios of the above portfolios, we divide the seven country indices into two groups. The first group includes Austria, Belgium, France and Italy which individually do not appear to contribute to the performance of the full portfolio and the second includes the countries which appear to contribute to the performance of the full portfolio, that is Germany, Ireland and Netherlands. To establish whether each group has significant effects on portfolio allocation we compare the maximum performance of the full portfolio first to that of a portfolio which does not include Austria, Belgium, France and Italy (significance of first group) and second to that of a portfolio which does not include Germany, Ireland and Netherlands (significance of second group). Figures 20 and 22 present the Sharpe ratios and Figures 21 and 23 the marginal significance levels.

Looking at Figure 20 we observe that the Sharpe ratios of the full portfolio and the portfolio consisting only of Germany, Ireland and Netherlands are very similar and differ on average only by 0.1 percentage points. The tests also clearly do not reject the null hypothesis that the two Sharpe ratios are equal indicating that Austria, Belgium, France and Italy do not provide significant diversification benefits. Excluding Germany, Ireland and The Netherlands from the full portfolio also does not change the picture significantly as the tests indicate that the second group also does not provide significant diversification benefits either. However the difference in the Sharpe ratios of the full and restricted portfolio in this case is visible and on average 0.5 percentage points.

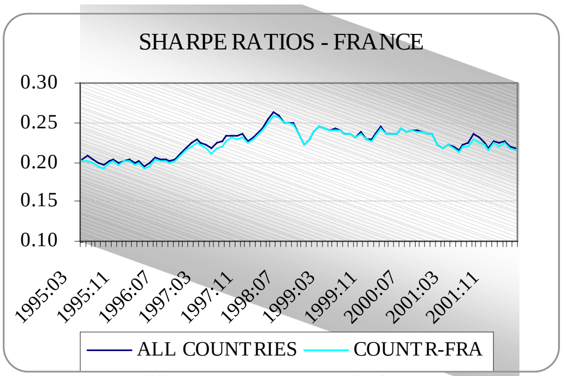
Concluding, our results indicate that including Austria, Belgium, France and Italy to a portfolio of country indices does not change the performance of the portfolio and the same holds for including Germany, Ireland and The Netherlands to the full portfolio. Hence in terms of significant diversification benefits investing in either a portfolio consisting of the first group of countries or a portfolio consisting of the second group of countries is an equivalent investment strategy. However we must note that the portfolio consisting of Germany, Ireland and The Netherlands has an average Sharpe ratio of 0.22 whereas the average Sharpe ratio for the portfolio consisting of the rest of the EMU countries is only 0.17.



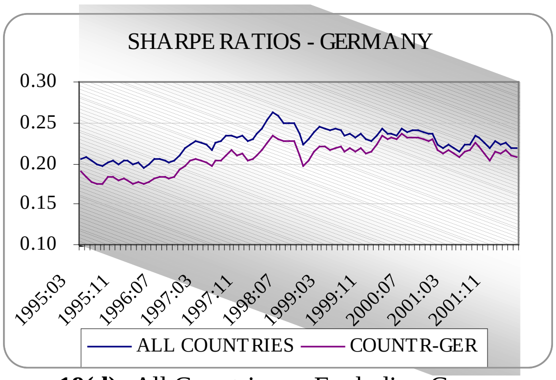
19(a): All Countries vs Excluding Austria



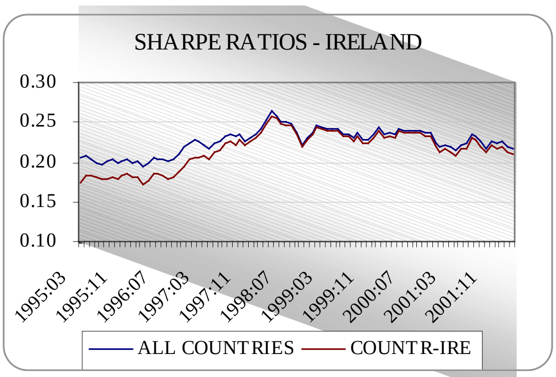
19(b): All Countries vs Excluding Belgium



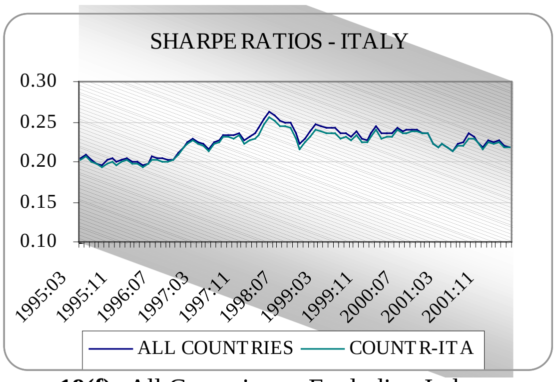
19(c): All Countries vs Excluding France



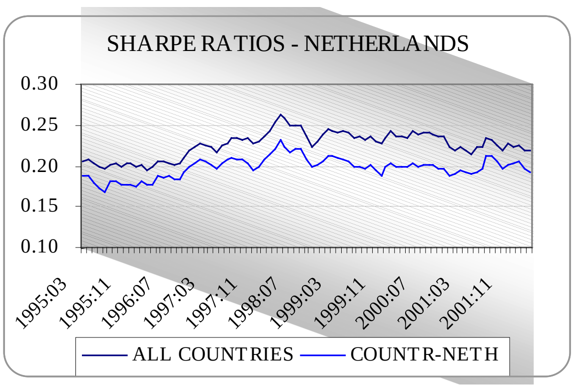
19(d): All Countries vs Excluding Germany



19(e): All Countries vs Excluding Ireland



19(f): All Countries vs Excluding Italy



19(g): All Countries vs Excluding Netherlands

Figure 19: Sharpe Ratios, Country Allocation

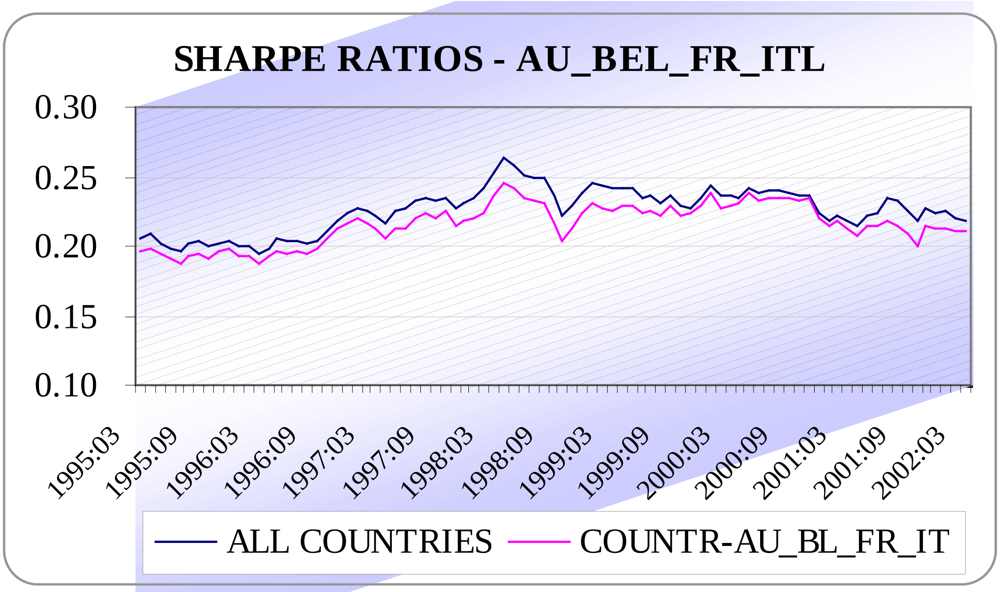


Figure 20: Sharpe Ratios, All Countries vs Germany, Ireland, Netherlands

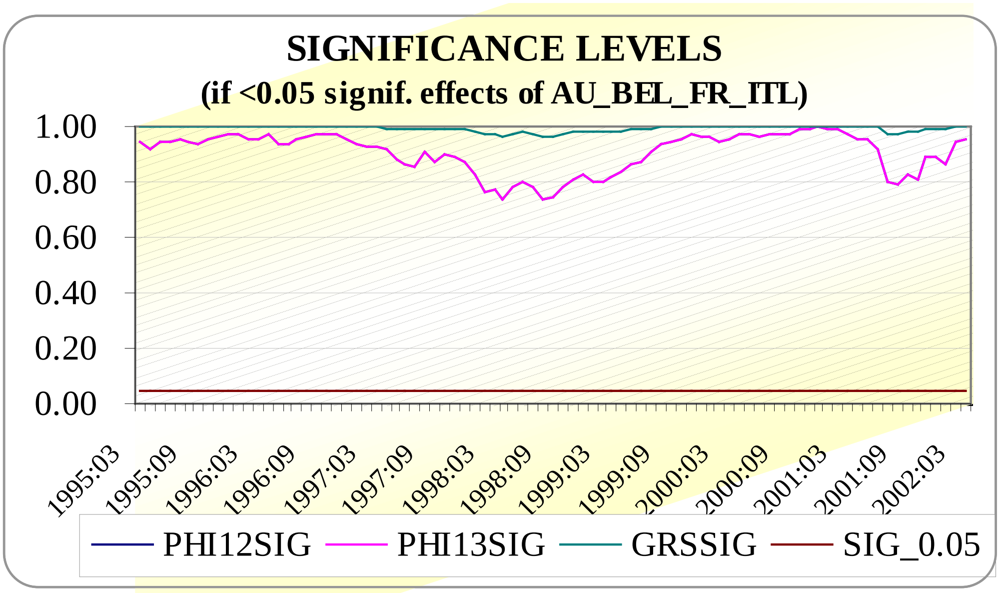


Figure 21: Significance Levels – Effects of Austria, Bel. France & Italy

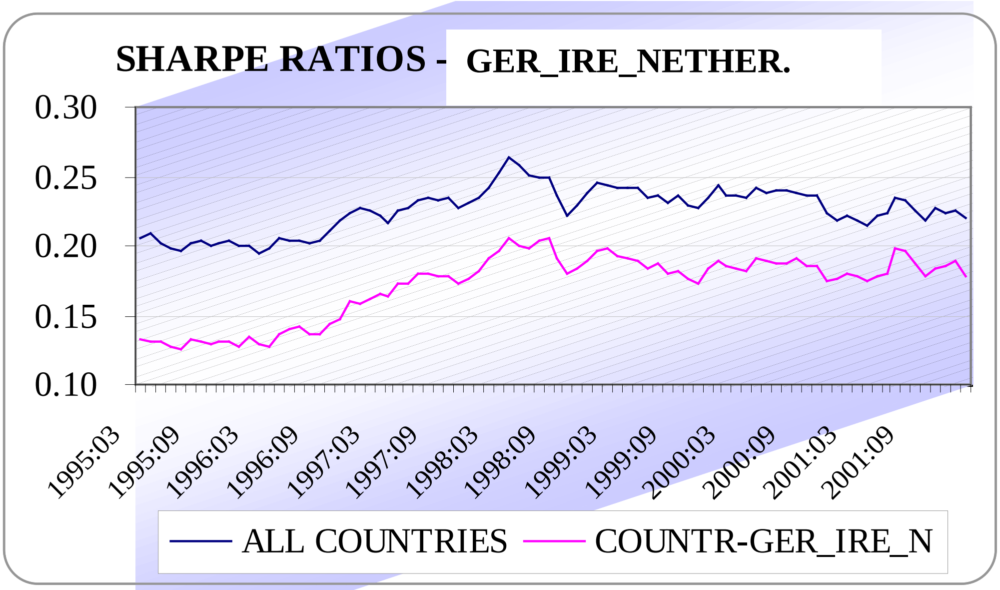


Figure 22: Sharpe Ratios, All Countries vs Austria, Bel., France, Italy

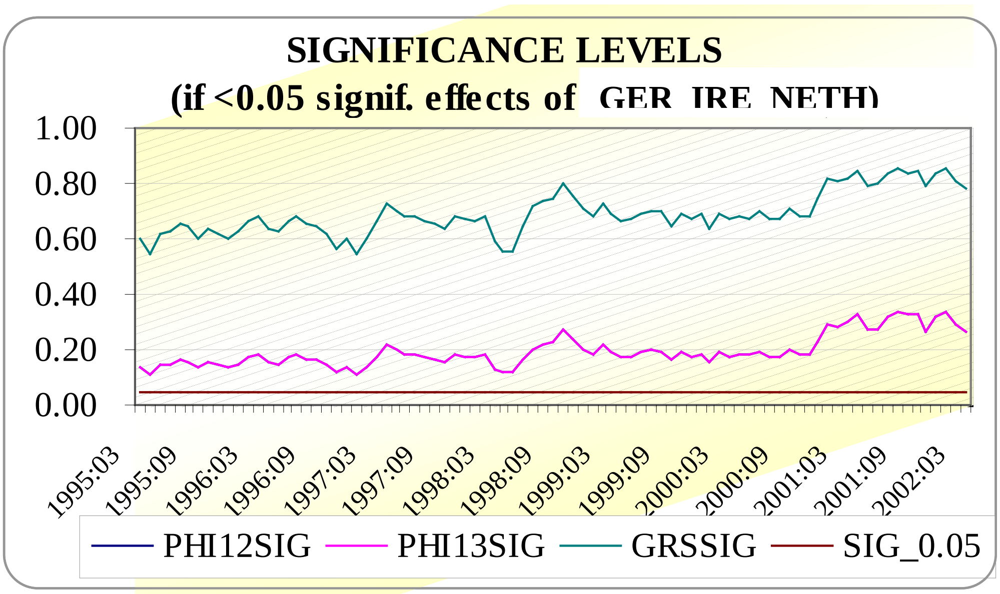


Figure 23: Significance Levels – Effects of Germany, Ireland, Neth.

6.3 Sector Allocation Strategies

Similarly, when deciding to diversify across sectoral lines, it is useful to distinguish whether all sector indices actually provide diversification benefits and which specific sectors contribute the most to an increase in the performance of the portfolio. Following the same process as in the case of country allocation, to establish whether a specific sector provides diversification benefits we examine the Sharpe ratio of a portfolio consisting of all ten sector indices (full portfolio) to that of a portfolio in which the sector of interest is excluded (restricted portfolio). If the Sharpe ratios of the two portfolios are not different then we consider that the sector of interest does not change the performance of the full portfolio.

Figures 24a to 24j present the Sharpe ratios of the full portfolio compared to the restricted portfolio for each of the ten sector indices. We observe from Figures 24b, f, h, and j that when we exclude CYCGD, NCYCG, RESOR and UTILS respectively from the portfolio, the maximum performance is not altered and thus the Sharpe ratios of the full and restricted portfolios seem to be identical. Therefore we assume that the above sectors individually do not contribute to the performance of the full portfolio of all ten sectors. Furthermore, Figures 24a, c, d, e, g and i, indicate that when the sectors BASIC, CYSER, GENIN, ITECH, NCYSR and TOTLF respectively are excluded, then the maximum performance of the restricted portfolio is less than that of the full portfolio, although the difference seems to be quite small in the cases of NCYSR and ITECH.

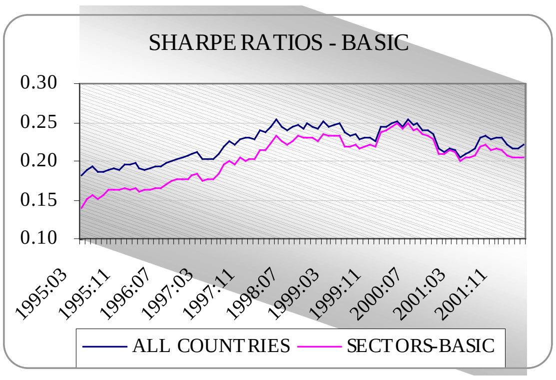
Based on the sharpe ratios of the above portfolios, we divide the ten sector indices into two groups. The first group includes CYCGD, NCYCG, RESOR and UTILS which individually do not appear to contribute to the performance of the full portfolio and the second includes the remaining sectors which appear to contribute to the performance of the full portfolio. To establish whether each group has significant effects on portfolio allocation we compare the maximum performance of the full portfolio first to that of a portfolio which does not include CYCGD, NCYCG, RESOR and UTILS and second to that of a portfolio which does not include BASIC, CYSER, GENIN, ITECH, NCYSR and TOTLF. Figures 25 and 27 presents the Sharpe ratios and Figures 26 and 28 the marginal significance levels.

Figure 25 indicates that the maximum performance of the portfolio which does not include the first group of sectors does not seem to be different to that of the full portfolio. Namely, the Sharpe ratio of both portfolios ranges from 0,18 to 0,25 and the average difference between the Sharpe ratio of the portfolios is only 0.01. The marginal significance levels as shown by Figure 26 clearly do not reject the null hypothesis that the Sharpe ratios of the two portfolios are equal and thus we conclude that there are no significant effects of CYCGD, NCYCG, RESOR and UTILS in portfolio allocation among sectors, or alternatively excluding the above sectors from the portfolio does not lead to a decrease in the performance of the investor's portfolio.

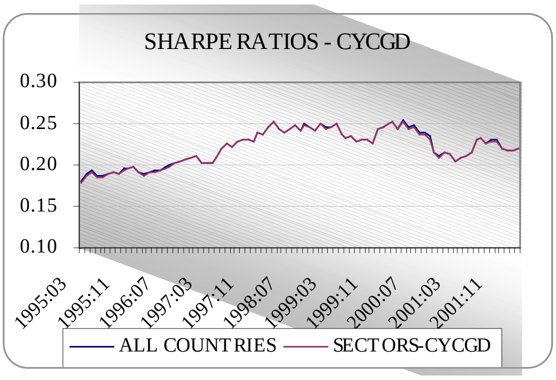
Figure 27 presents the maximum performance of the full portfolio and the maximum performance of a portfolio in which BASIC, CYSER, GENIN, ITECH, NCYSR and TOTLF are excluded. The Sharpe ratios of the two portfolios in this case appear to be different, ranging from 0.18 to 0.25 for the full portfolio and from 0.09 to 0.14 for the restricted portfolio. The difference of the maximum performance of the two portfolios is on average 11 percentage points and seems to be increasing after 1997. Indeed, the marginal significance levels show that there have been significant effects of the second group of sectors between 1997 and 2000 according to the χ^2 statistic at the 0.05 level and at the 0.1 level according to the F statistic. However, after 2001 the difference between the maximum performance of the two portfolios does not appear to be significant.

The above analysis indicates that the effects of CYCGD, NCYCG, RESOR and UTILS have been highly insignificant throughout the whole period and that excluding these sectors from the whole set of the ten sector indices does not change the maximum performance of the portfolio. On the other hand BASIC, CYSER, GENIN, ITECH, NCYSR and TOTLF had significant effects on portfolio allocation from 1997 to 2001 as indicated by the marginal significance levels, whereas in terms of Sharpe ratios, the maximum performance of a portfolio which does not include these sectors on average seemed to be up to 0.14 lower than the performance of the full portfolio.

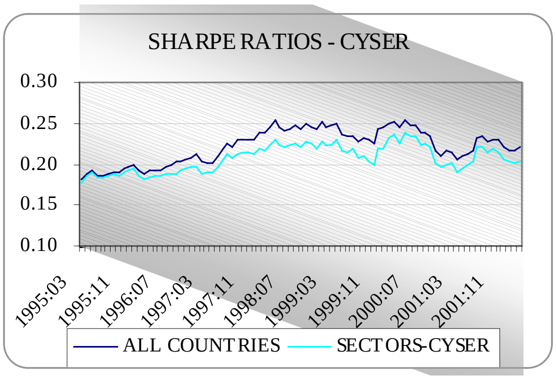
Finally comparing the two groups, we must point out that throughout the whole period the average Sharpe ratio of the portfolio consisting of BASIC, CYSER, GENIN, ITECH, NCYSR and TOTLF was 0.21 compared to that of the portfolio of CYCGD, NCYCG, RESOR and UTILS which was only 0.11. In other words the former group of sectors seem on average to provide maximum performance almost 100% higher that the latter group.



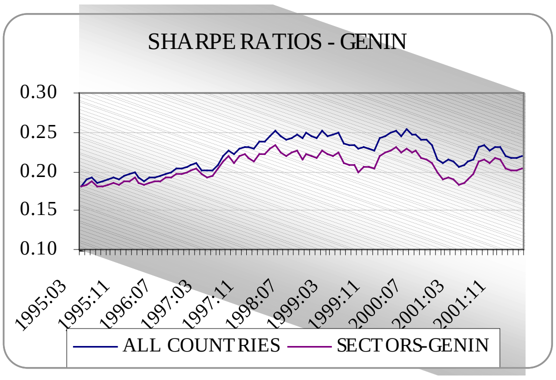
24(a): All Sectors vs. excluding BASIC



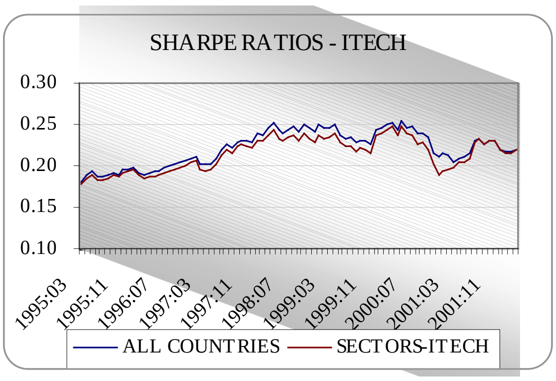
24(b): All Sectors vs. excluding CYCGD



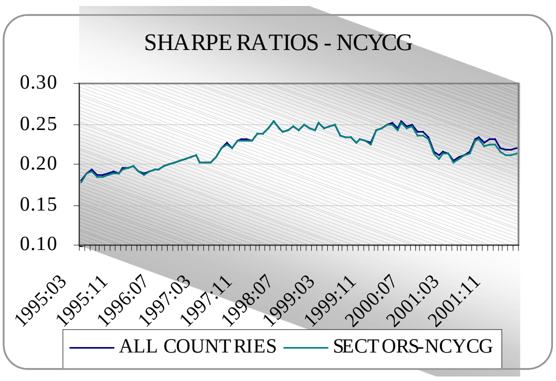
24(c): All Sectors vs. excluding CYSER



24(d): All Sectors vs. excluding GENIN

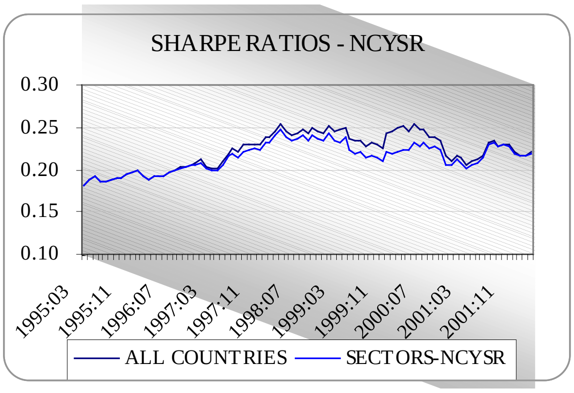


24(e): All Sectors vs. excluding ITECH

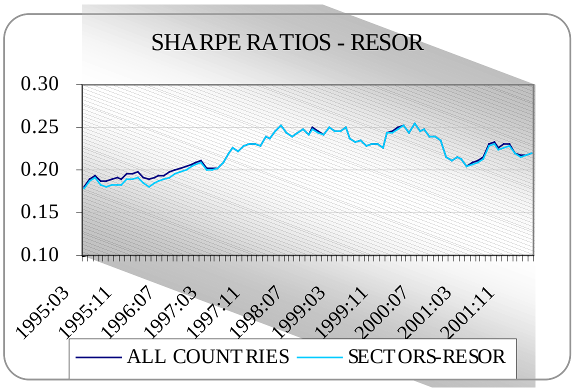


24(f): All Sectors vs. excluding NCYCG

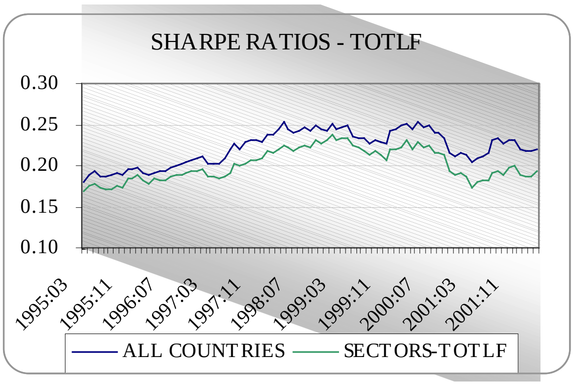
Figure 24: Sharpe Ratios, Sector Allocation



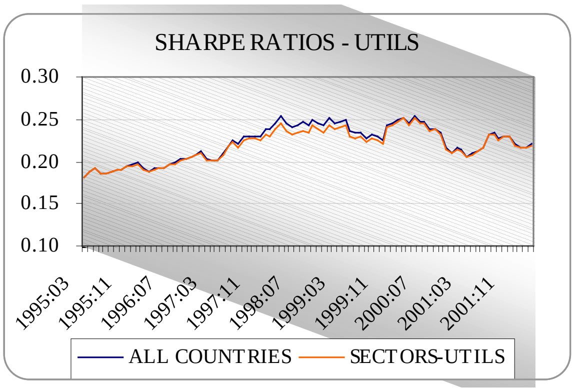
24(g): All Sectors vs. excluding NCYSR



24(h): All Sectors vs. excluding RESOR



24(i): All Sectors vs. excluding TOTLF



24(j): All Sectors vs. excluding UTILS

Figure 24 (continued): Sharpe Ratios, Sector Allocation

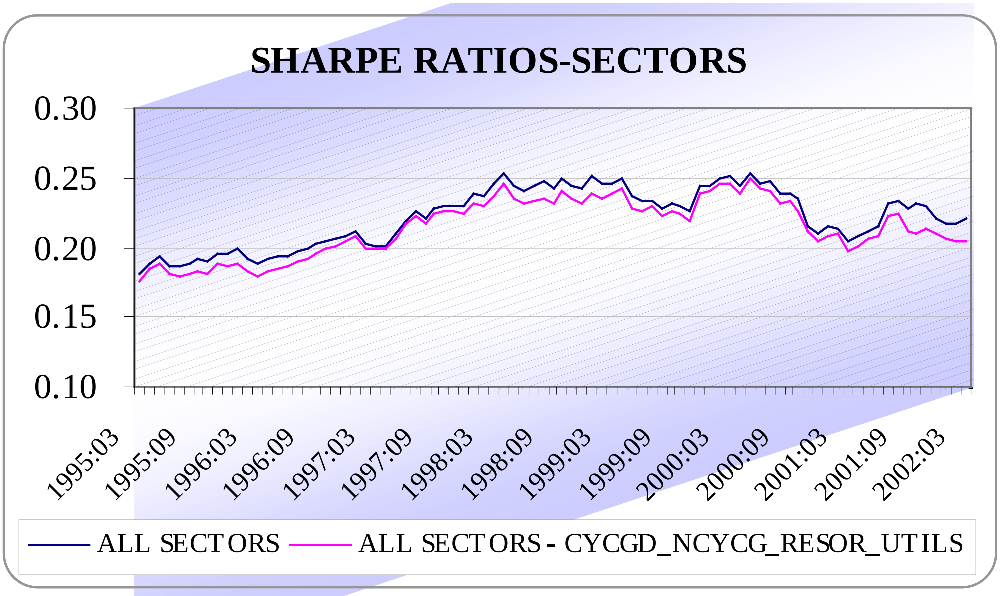


Figure 25: Sharpe Ratios, All Sectors vs BAS, CSER, GEN, IT, NCSR & F

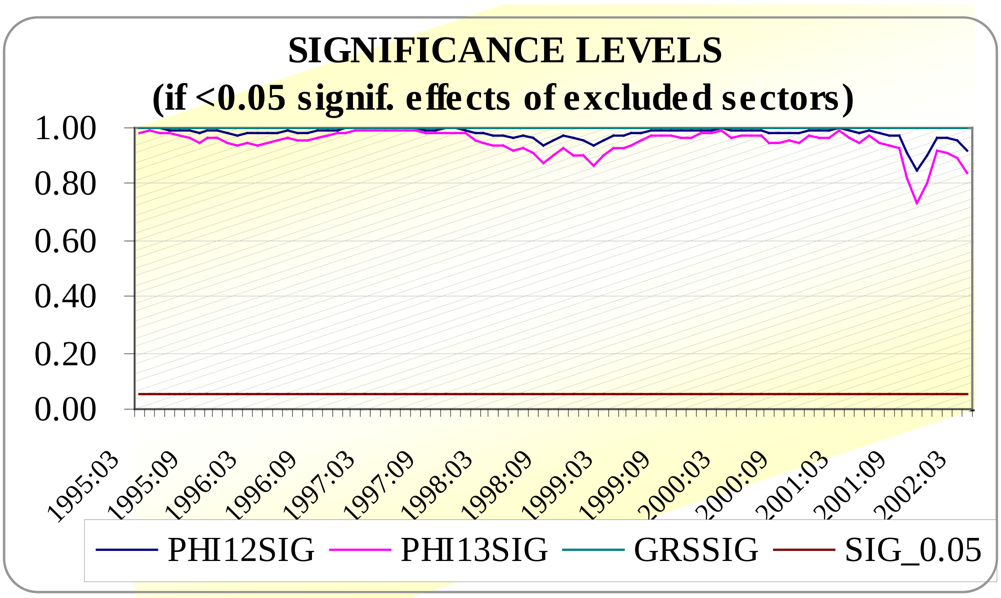


Figure 26: Significance Levels – Effects of CYCGD, NCYCG, RESOR, UTILS

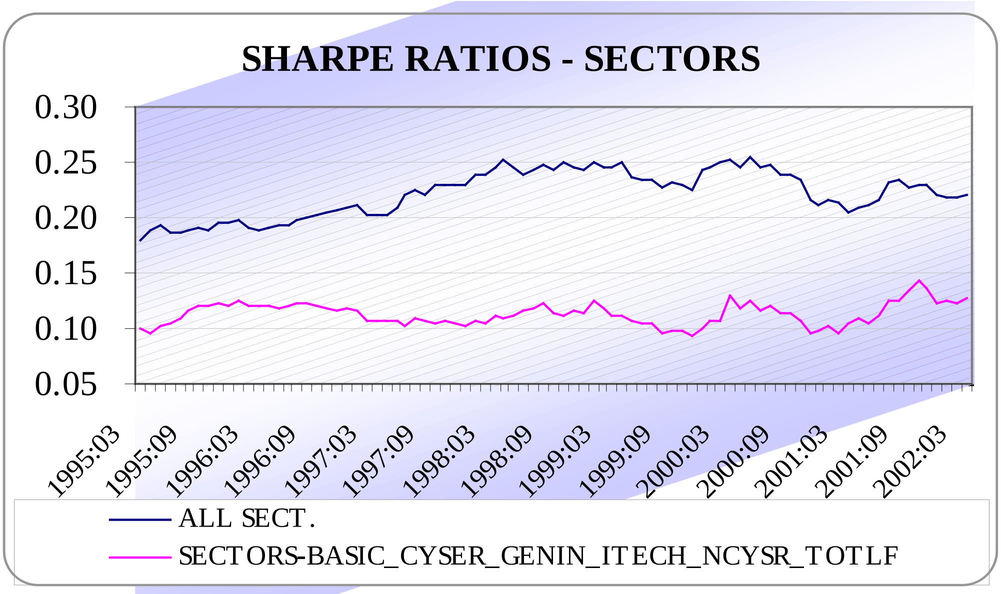


Figure 27: Sharpe Ratios, All Sectors vs. CYCGD, NCYCG, RESOR UTILS

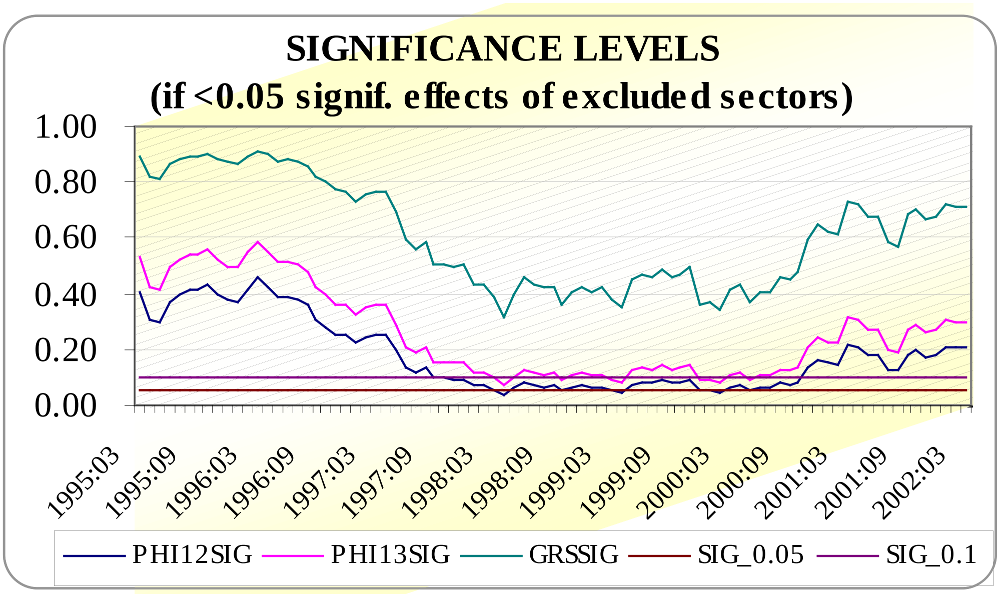


Figure 28: Significance Levels – Effects of BAS, CSER, GEN, IT, NCSR, F

6.4 Efficiency of EMU index

We test whether the EMU index is efficient compared to its country and sector components by comparing the Sharpe ratio of the EMU index to a portfolio consisting of the country indices plus the EMU index and to a portfolio consisting of the sector indices plus the EMU index. If the difference between the maximum performance of the portfolio consisting of the EMU index and the country indices (sector indices) and that of the EMU index is not significant then we consider that the EMU index is efficient with respect to its country (sector) components. Figures 29 and 31 present the Sharpe ratios and Figures 30 and 32 the marginal significance levels of the recursive statistics.

The Sharpe ratios of the portfolio of the EMU index plus the country indices seem to be quite higher than the maximum performance of the EMU index alone, specifically the former ranging from 0.25 to 0.30 whereas the latter only from 0.14 to 0.22. The average difference between the performance of the two portfolios is 10 percentage points with the highest difference occurring during 1995. However the difference seems to be decreasing from 1996, a fact which suggests that the EMU index efficiency with respect to its country components has been increasing from 1996. The significance levels in fact show that the EMU index was not efficient before 1996, however it has been efficient ever since and its efficiency with respect to its country components seems to be increasing.

Next, the broad portfolio of the EMU index plus the sector indices has maximum performance ranging from 0.26 to 0.32, much higher than the performance of the EMU index alone. The difference between the performance of the two portfolios seems to be increasing throughout 1998-2000 indicating that the efficiency of the EMU index has been decreasing with respect to the sector portfolio during that period. In fact at the end of 1998 the difference reached up to 18 percentage points. The tests suggest that prior to 1998 the EMU index was efficient with respect to its sector components however the same does not hold for the end of 1998 and 2000 at the 0.05 significance level whereas it is inefficient throughout the period 1998-2002 at the 10% significance level. In other words, an investor may incur significant losses when holding the EMU index portfolio relative to a broad portfolio of EMU countries and sectors due to the inefficiency of the EMU index relative to its sector components.

For investors who wish to diversify across country lines, our findings suggest that diversification benefits of intra-EU country allocation can be achieved solely by investing in the EMU index. In other words after 1996 the EMU index seems to better represent the EMU countries. On the other hand however after 1998 the EMU index does not capture the benefits which can be achieved through allocating in sectors. We may thus conclude that investors who wish to diversify both at the country and at the sectoral level, besides investing in the EMU index, will have to include EMU sector indices in their portfolio in order to achieve all possible diversification benefits.

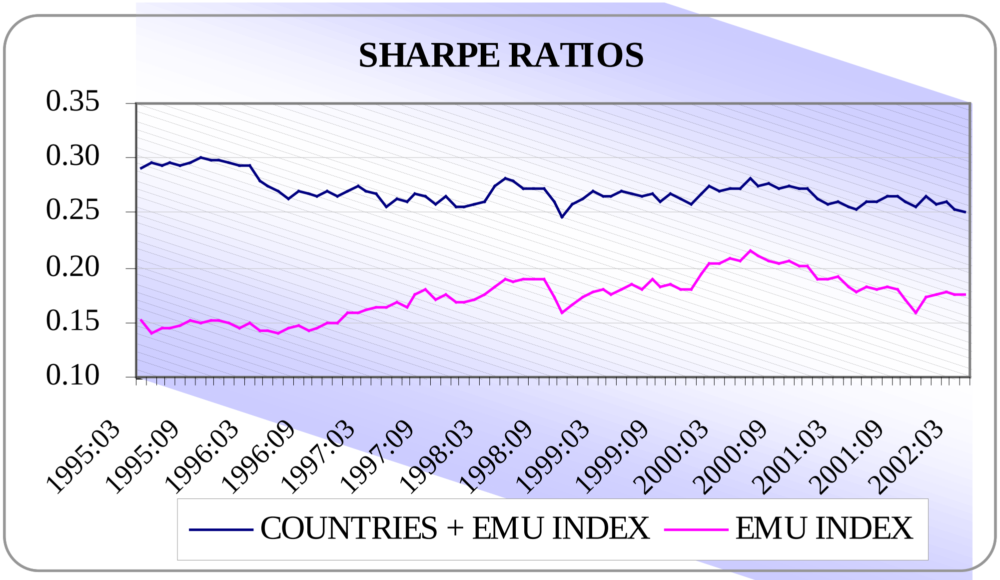


Figure 29: Sharpe Ratios, EMU Countries & EMU Index vs EMU Index

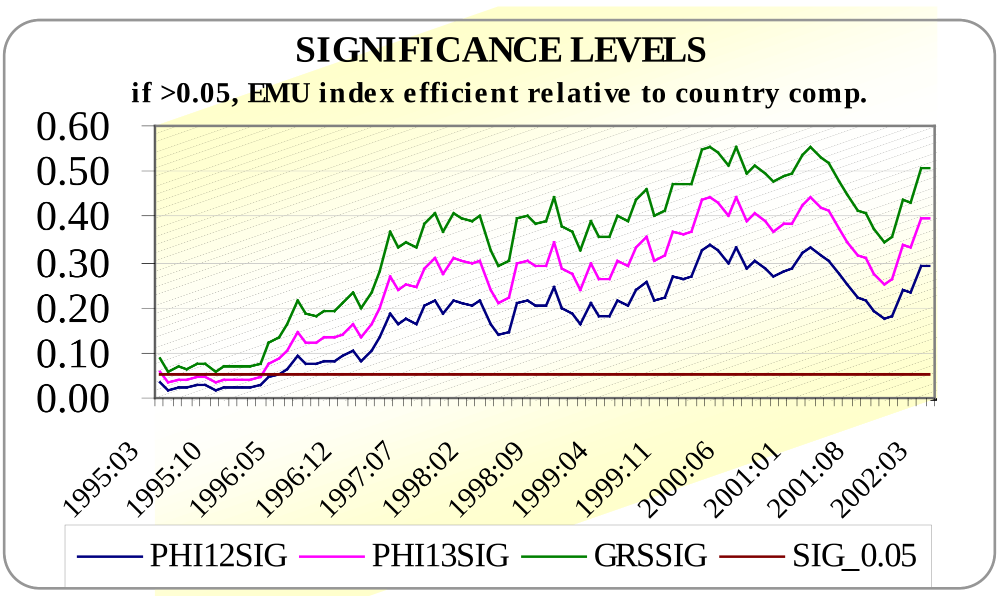


Figure 30: Significance Levels – Efficiency of EMU index/country comp.

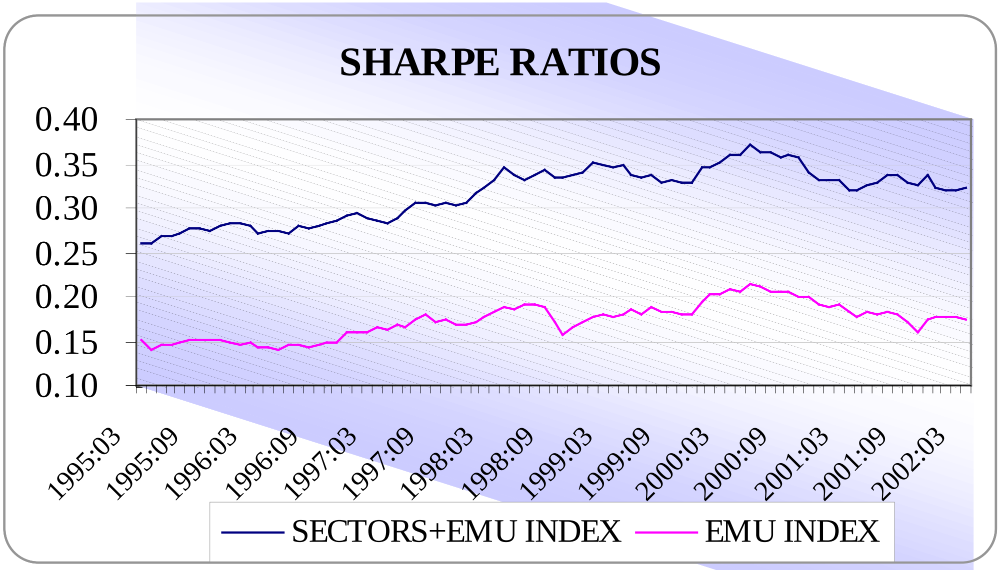


Figure 31: Sharpe Ratios, EMU Sectors & EMU Index vs EMU Index

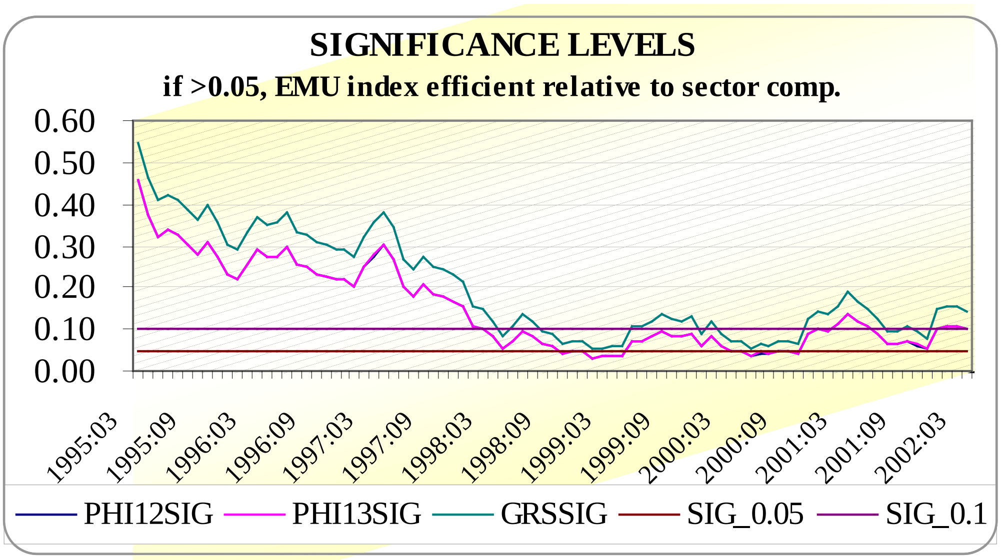


Figure 32: Significance Levels – Efficiency of EMU index/sector comp.

6.5 Benefits from international diversification for EMU investors

In order to test whether a European investor can benefit from international diversification we compare the Sharpe ratios of the EMU index to a portfolio which consists of the EMU index plus the rest of the world. To do so we excluded from the WORLD index the portion which corresponds to EMU so that the adjusted WORLD index represents the rest of the world. If EMU investors can benefit from including the rest of the world in their portfolio then the portfolio of the EMU index plus the adjusted WORLD index should have higher maximum performance than the EMU index. Figure 33 presents the Sharpe ratios of the two portfolios which appear not to differ. The average difference between the performances of the two portfolios is only 1 percentage point while the marginal significance levels which are presented in Figure 34 indicate that throughout the whole period the difference between the Sharpe ratios is not significant. We thus may conclude that there are no significant effects from diversifying beyond EMU.

Also, we compare the Sharpe ratios of the adjusted WORLD portfolio to that of a portfolio which consists of the EMU index plus the adjusted WORLD portfolio to establish whether diversifying in EMU provides significant effects compared to diversifying only beyond EMU. Figure 35 presents the Sharpe ratios which on average differ only by 2 percentage points, whereas Figure 34 presents the significance levels. The tests suggest that there is no significant difference in the maximum performance of the two portfolios indicating that there are no significant effects of EMU on portfolio allocation internationally. That is portfolio allocation either only within EMU or only within the rest of the WORLD provides the same benefits to an investor.

From the above analysis we may conclude that EMU investors do not gain from international diversification and that is suffices to invest only within EMU in order to gain all possible diversification benefits. In this context, our findings reflect the further globalization that financial markets have been experiencing in the past two decades. Indeed international correlation of returns confirm the above findings. Specifically since 1975 the correlation of returns between the adjusted World index and the EMU index has been increasing and in the period 1995-2002 reached the level of 0.88.

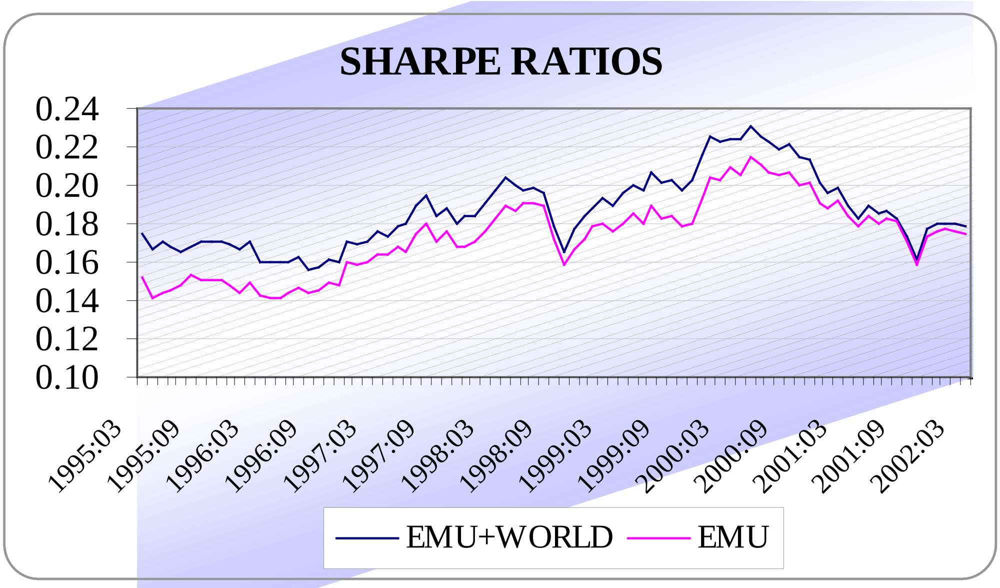


Figure 33: Sharpe Ratios, EMU& WORLD vs. EMU Index

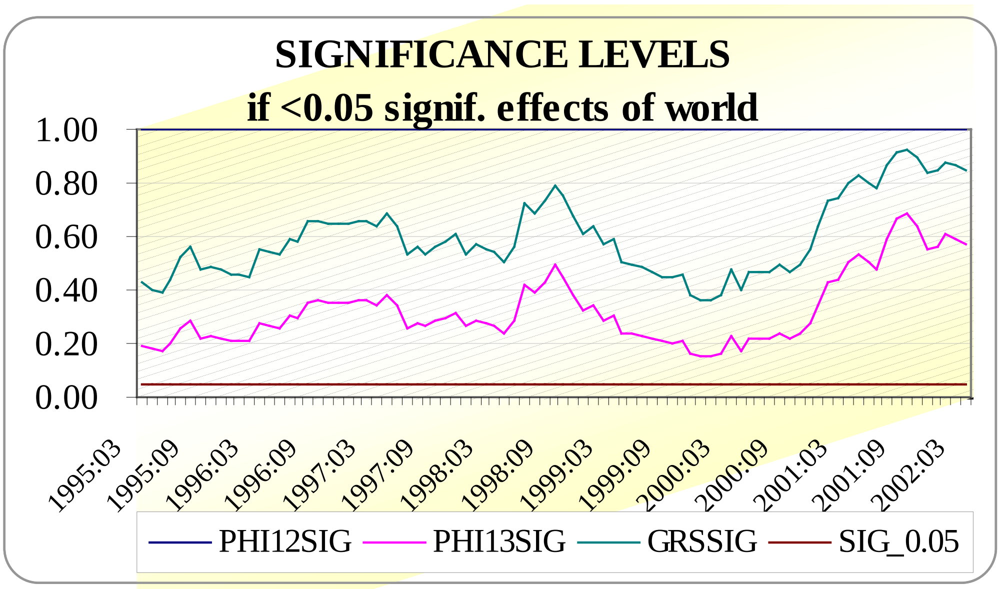


Figure 34: Significance Levels – Effects of Rest of the World

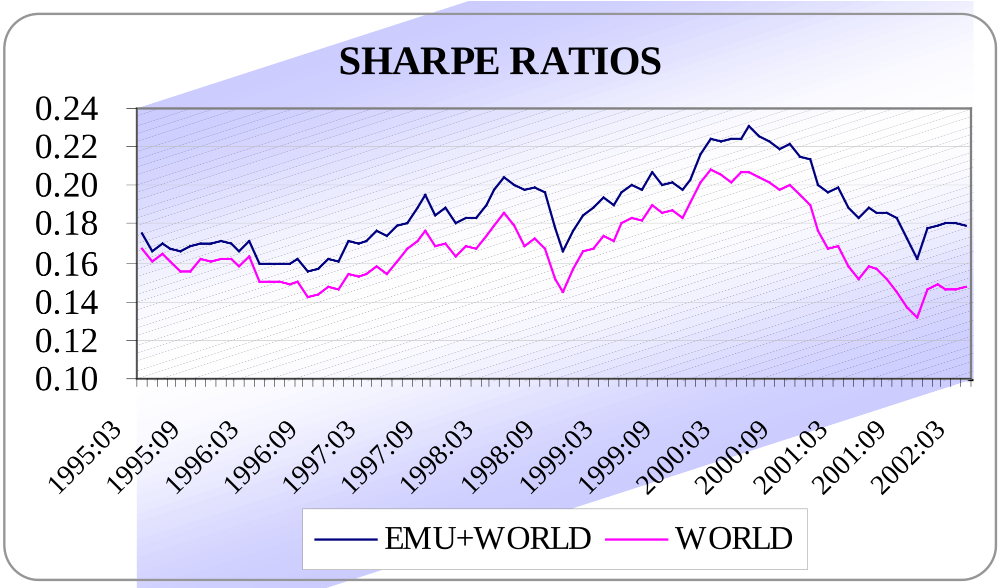


Figure 35: Sharpe Ratios, EMU & WORLD vs. WORLD Index

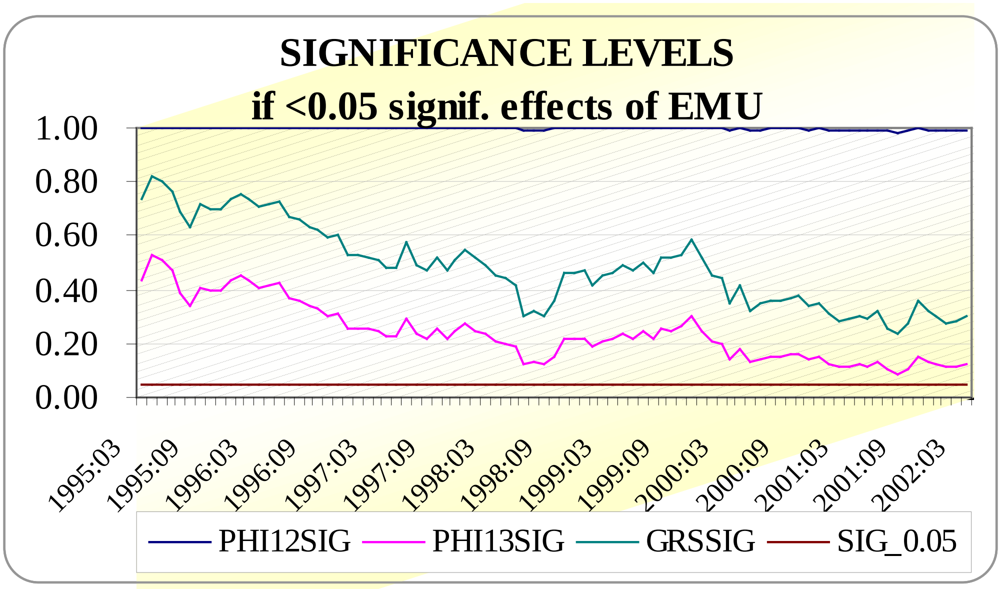


Figure 36: Significance Levels – Effects of EMU Index

6.5.1 The role of currencies in international diversification

From the previous section our findings suggested that diversifying beyond EMU does not lead to an increase in performance for EMU investors. However it is important to address the issue of currency effects, and whether international diversification including a set of currencies (US dollar, British pound and Japanese yen) can provide greater benefits to EMU investors. To do so we compare the Sharpe ratios of a portfolio consisting of the EMU index, the adjusted WORLD index and a set of currencies vis-à-vis the euro (full portfolio) to the Sharpe ratios of the EMU index. The former portfolio is the ICAPM portfolio (Adler and Dumas 1983). If asset pricing according to ICAPM holds, then the ICAPM portfolio should be an efficient portfolio in the sense that it outperforms the EMU index. In fact the ICAPM portfolio gives a Sharpe ratio of around 0.37 throughout the sample compared to an average 0.17 Sharpe ratio for the EMU index as can be seen by Figure 37. Figure 38 presents the significance levels which clearly indicate that the the Sharpe ratio of the ICAPM portfolio is significantly higher than the Sharpe ratio of the EMU index throughout the whole period. That is we can say that the ICAPM is an efficient portfolio, and there are significant effects from international diversification.

On the other hand, the contribution of EMU to the performance of the ICAPM portfolio is very small, as indicated by the difference in the Sharpe ratios between the full portfolio and the portfolio consisting of the rest of the world and the currencies (Figure 39). Figure 40 reports the results of the efficiency test of the EMU index compared to the ICAPM portfolio. The test clearly show that investors do not experience a significant increase in performance from including EMU in their portfolio, suggesting that the EMU index is inefficient with respect to the ICAPM portfolio.

The above analysis of international diversification benefits indicates that investors experience an increase in performance when including the rest of the world and a set of currencies in their portfolio but not when including the rest of the world only. This suggests that there is an increase in performance from international diversification for EMU investors which stems from currency effects and not from country effects. If this is the case, then the world index ought to be inefficient relative to a portfolio which includes the world index and a set of currency deposits. Indeed as shown by Figure 41 the Sharpe ratios of the ICAPM portfolio (which consists of world index + currencies) fluctuates between 0.32 and 0.38 and is significantly higher than the Sharpe ratios of the world index, which fluctuates in a range between 0.19 and 0.22. Observing the test statistics (Figure 42), the F statistics appear significant at the 1% level, suggesting that the world index is inefficient relative to the ICAPM portfolio. Hence, we conclude that there are significant effects from currency allocation to international investors.

More specifically, if an EMU investor switches from the EMU portfolio to the ICAPM portfolio, the Sharpe Ratio of his portfolio increases from 0.17 to 0.37, that is a 118% increase. In other words the performance of the EMU portfolio amounts to 46% of the performance of the ICAPM portfolio indicating that the remaining 54% of the performance of the ICAPM portfolio is due to currency and international country effects. On the other hand however if the EMU investor switches from the World Portfolio (defined as the EMU index plus the adjusted World index) to the ICAPM portfolio then the Sharpe ratio increases from 0.19 to 0.37, indicating that the performance of the World portfolio is 51% that of the ICAPM and thus we may say that 49% of the performance of the ICAPM is due to currency effects. Overall from the perspective of a EMU investor, 49% of the performance of the ICAPM portfolio is explained by currency effects, 46% is due to the EMU index and only the remaining 5% due to international country allocation beyond EMU.

In summary, our findings from the analysis of international diversification indicate that EMU investors do benefit from international diversification. However, these benefits arise from currency effects and not from country effects. Our results are quite interesting compared to the existing literature on international diversification. Up to now the literature focused either on the diversification effects of world allocation (see for example B. Ziobrowski & A. Ziobrowski, 1995) which suggests that foreign diversification improves portfolio performance or on the significance of foreign exchange risk (De Santis et. al., 1998) which indicates that managing currency risk significantly affects portfolio returns. But nobody has quantified the importance of foreign exchange risk in a world portfolio.

Specifically, by isolating country effects of international diversification we found conflicting results to the previous literature which implies that international country allocation provides diversification benefits. Our findings on the other hand confirm the ICAPM literature suggesting that strategies which simultaneously optimize equity and currency holdings generate significantly higher performance than strategies that exclude currencies. Furthermore we were able to disentangle and to quantify the benefits which arise from country and currency effects in international diversification concluding that managing foreign exchange risk provides significant benefits whereas foreign country allocation does not.

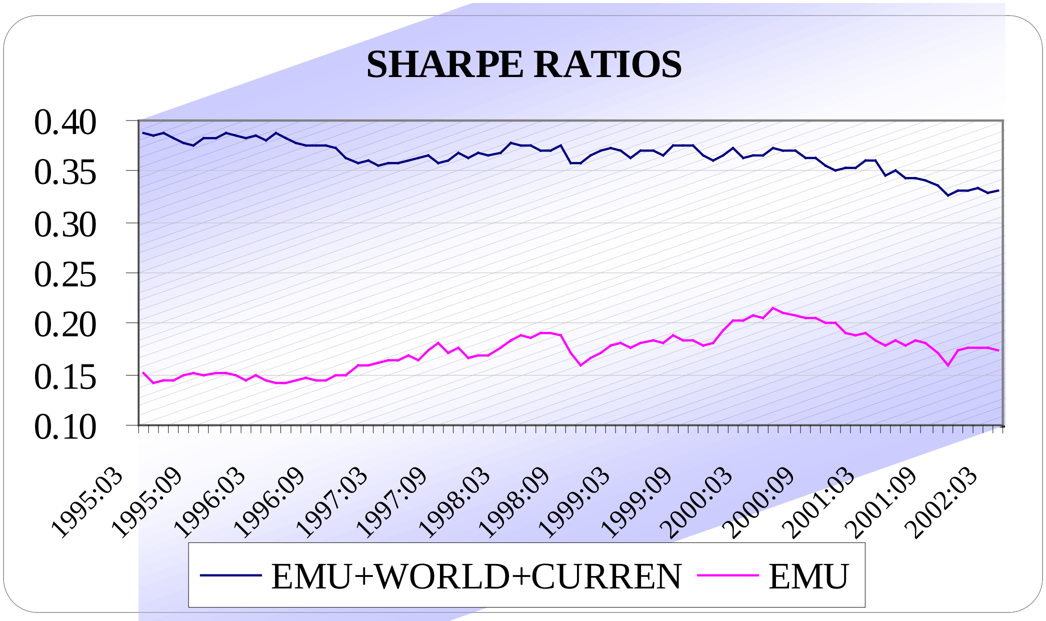


Figure 37: Sharpe Ratios, ICAPM vs. EMU Index

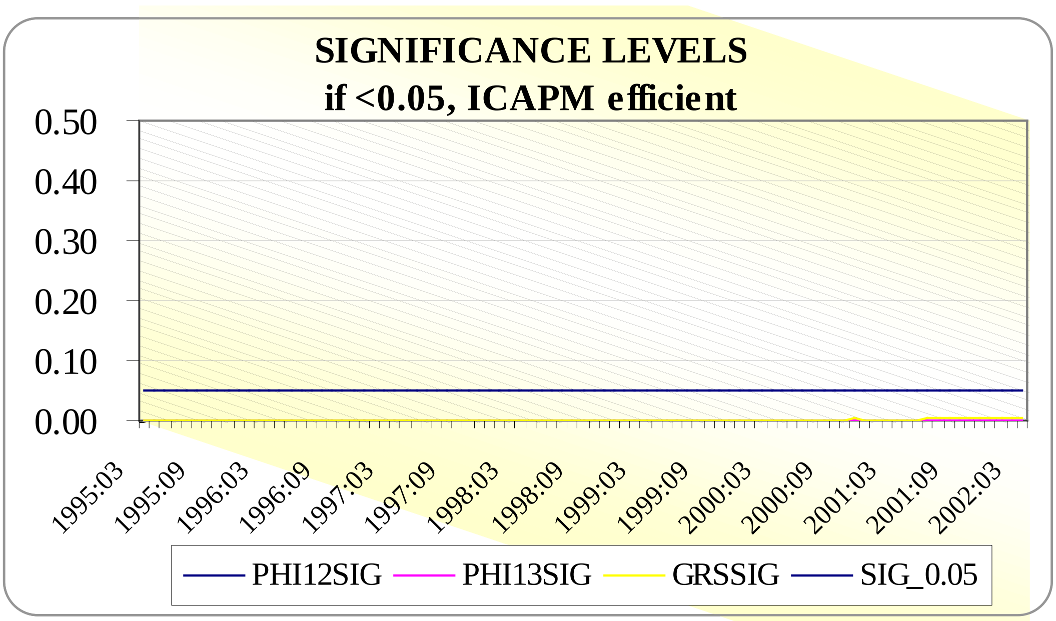


Figure 38: Significance Levels – Effects of World & Currencies

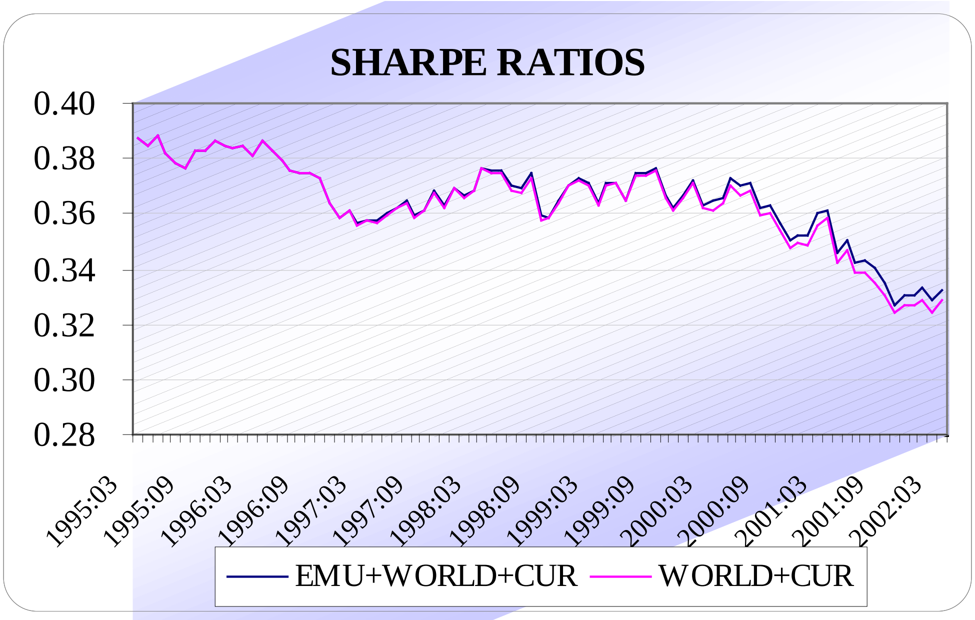


Figure 39: Sharpe Ratios, ICAPM vs. World & Currencies

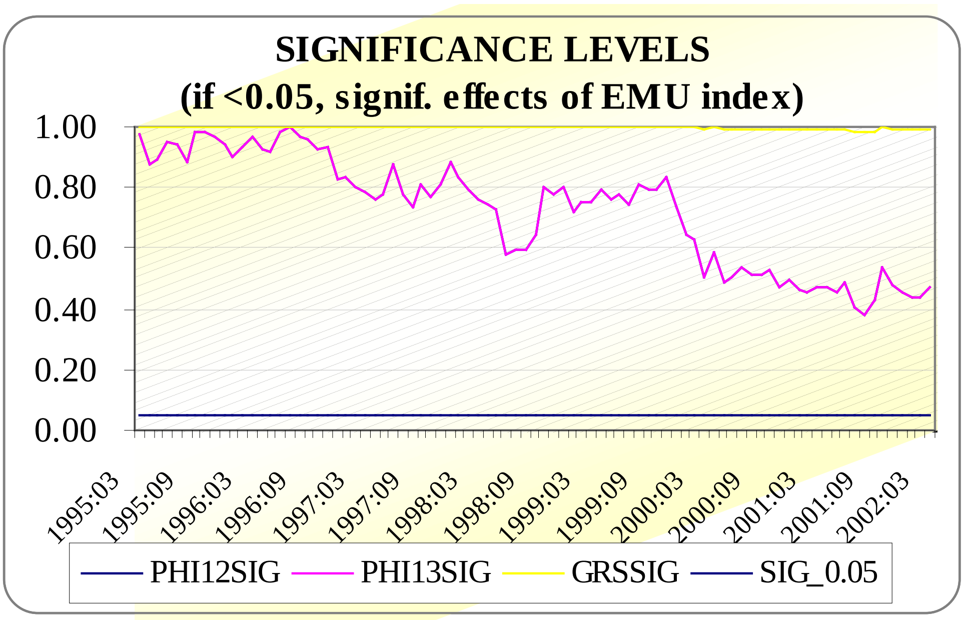


Figure 40: Significance Levels – Effects of EMU Index

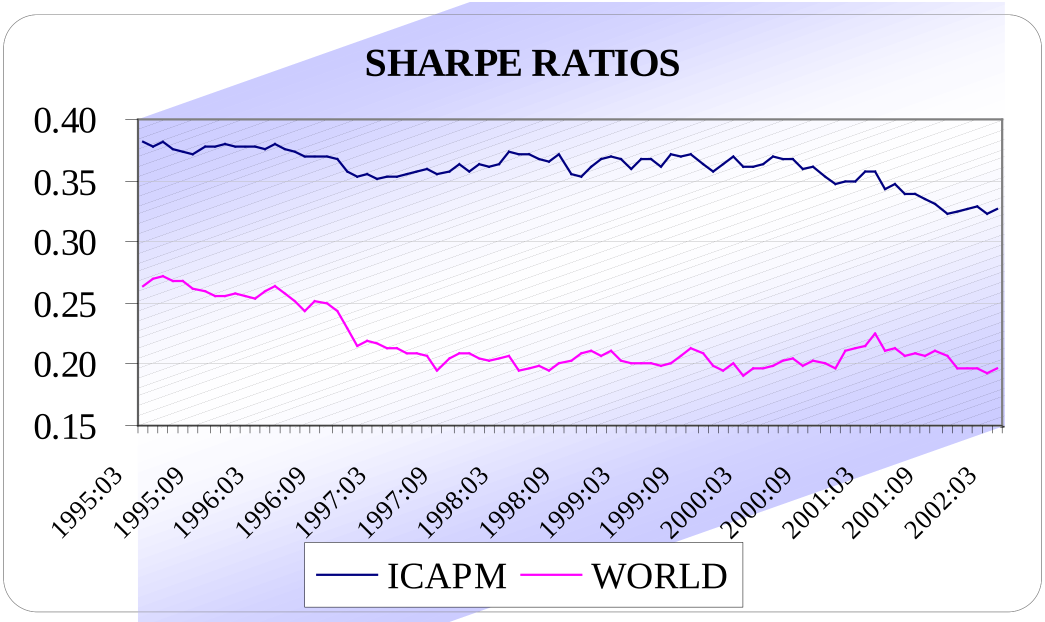


Figure 41: Sharpe Ratios, ICAPM vs. World

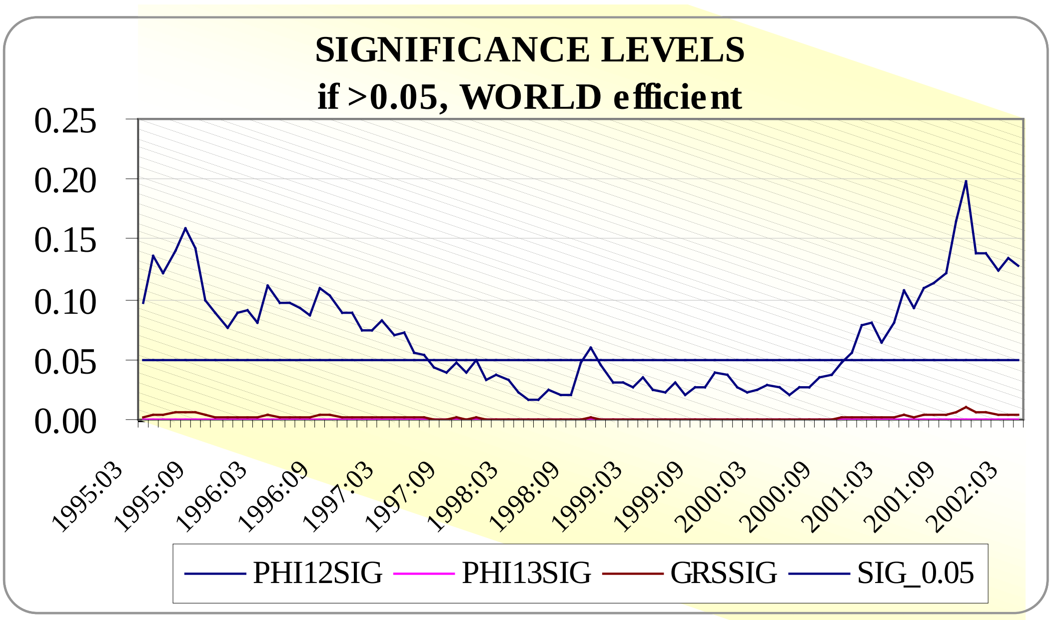


Figure 42: Significance Levels – Effects of Currencies

7. SUMMARY & CONCLUSIONS

In this study, we examined whether the process of economic and monetary integration in the context of EMU has altered the risk-return trade-offs of several portfolio allocation strategies from the perspective of an EMU investor. Intuition suggests that the convergence of economic structures within EMU along with the elimination of country risk would increase the correlation of equity returns along country lines prompting a shift towards sector allocation strategies. First, examining the evolution of correlations of equity returns at the country and sector level we found that during the convergence period to EMU cross country correlations had indeed increased to high levels, whereas in the same period cross sector correlations had decreased. However, the evolution of correlations in the pure-euro period after 1999 presents a different picture. Cross country correlations have decreased in the euro period to levels even lower that the pre-convergence period implying that the increase that was observed in the preceding period was not due to the convergence to EMU.

Using tests of potential portfolio performance we investigated the performance of alternative diversification strategies in order to evaluate the statistical significance of diversification benefits of country and sector allocation strategies within EMU. Our results indicate that after 1998 there are significant effects from country allocation. Sector allocation also seems to contribute to an increase of performance albeit sector effects do not seem to be as significant as country effects. Additionally, when we imposed short selling constraints in our analysis, country effects remain significant while sector allocation no longer provides significant diversification benefits, a finding which is in line with the results of Gerard, Hillion & De Roon (2001). In other words when short selling is prohibited the country portfolio seems to outperform the sector portfolio contributing significantly to an increase in the performance of a full portfolio of EMU countries and sectors. It is also important to note that the Sharpe ratios of all portfolios which consist of either country or sector indices seem to be increasing throughout the whole period, a fact which suggests that EMU through the elimination of intra-European investment barriers has brought about positive effects for portfolio diversification.

Furthermore in the context of pure country allocation strategies we investigated the contribution of each country to the performance of a portfolio consisting of all EMU country indices. We found that individually no country provides a large increase in performance, however examining two subsets of countries our results indicate that investing in either Austria, Belgium, France and Italy or Germany, Ireland and Netherlands is an equivalent investment strategy and that that in terms of significant diversification benefits neither group of countries contributes significantly to an increase in the performance of a portfolio which consists of all EMU country indices. Similarly, we examined which sectors contribute the most in the case of a pure sector allocation strategy. We found that excluding Cyclical Consumer Goods, Non Cyclical Consumer Goods, Resources and Utilities from a full portfolio of all EMU sector indices does not change the maximum performance of the portfolio. On the other hand Basic Industries, Cyclical Services, Gen. Industrials, Information Technology, Non Cyclical Services and Financials do provide significant diversification benefits to an EMU investor who follows a pure sector allocation strategy.

Next, testing the efficiency of the EMU index with respect to its country and sector components, we found that although it has become increasingly efficient with respect to its county components, investors may incur significant losses when holding the EMU index portfolio relative to a broad portfolio of EMU countries and sector after 1998 due to a decrease in the efficiency of the index with respect to its sector components. Finally, we examined the potential benefits from international diversification for EMU investors. Our findings suggest that EMU investors can benefit significantly from international diversification, however these benefits arise from currency effects (U.S. dollar, Japanese yen, and British pound) and not from country effects.

Concluding, our results suggest that EMU along with the introduction of the euro has not impaired diversification benefits within Euroland. On the other hand diversification benefits at the country level seem to have increased indicating that the convergence of economic structures and the elimination of country and currency risk have not drastically affected the portfolio trade-offs for European investors. Also, according to our results, managing non-EMU currency risk does provide benefits to EMU investors, a result which confirms the findings of De Santis, Gerard and Hillion

(1998). Hence, our findings suggest that the disappearance of intra-European currency risk in itself is probably not a major event for investors.

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