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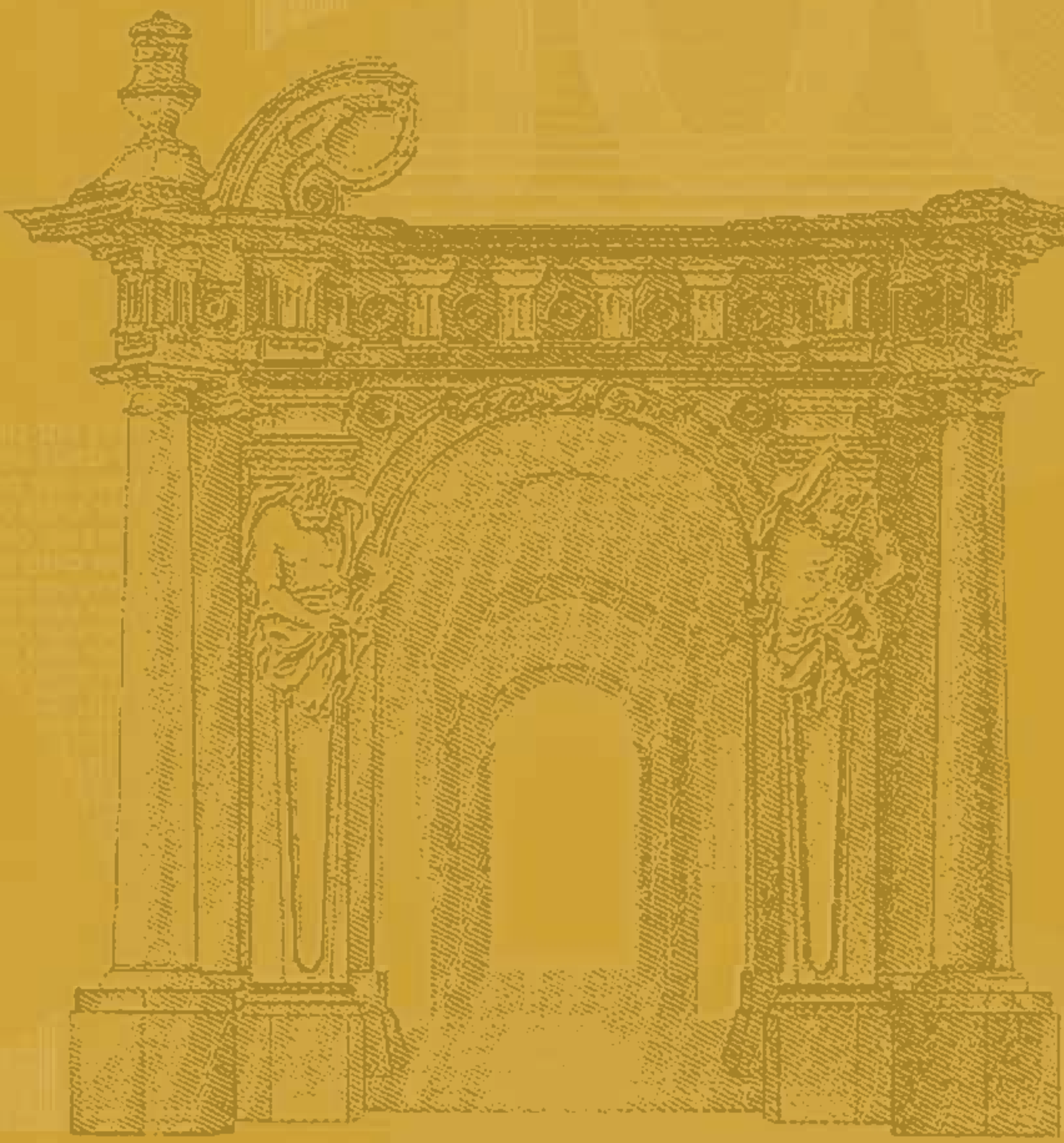

DIVERSIFICATION IN EURO AREA STOCK MARKETS: COUNTRY VERSUS INDUSTRY

by Gerard A. Moerman

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In 2004 all publications will carry a motif taken from the €100 banknote.

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Abstract

The harmonisation of fiscal and economic policy within the European Monetary Union (EMU) has had a considerable impact on the economies of member countries in the past decade. In particular, several studies indicate that the proceeding economic integration among euro area countries has important consequences for the factors driving asset returns in financial markets. This study concentrates on the implications of the changing structure of security returns for asset management. Using recent euro area stock markets data, we find clear evidence that diversification over industries yields more efficient portfolios than diversification over countries. We show that this result is robust with respect to the information technology-hype and different volatility regimes. This contrasts with e.g. Rouwenhorst (1999), who finds, based on a different methodology and a different sample period, that country diversification strategies are superior. We regard this paper as a robustness check challenging the existing strand of literature and show that Rouwenhorst's (1999) conclusions seem to be outdated.
Keywords: EMU, euro area stock markets, portfolio diversification, industry factors, country factors

JEL Classification: G11, G15

Non-technical summary

The extent to which financial markets and countries have become more integrated has been a topic of intensive debate. This holds especially for the capital markets in the euro area, because of the rapid changes caused by the unification process in Europe and the introduction of the common currency. This paper investigates the consequences for an investor by directly comparing the results of a country-based investment strategy with the results of an industry-based strategy.

The literature in this area concentrates on the country and industry effects, following the seminal paper of Heston and Rouwenhorst (1994). If country effects are higher than industry effects, it suggests that country factors are more important in explaining asset returns and hence that an investor is better off by diversifying over countries compared to diversification over industries. Most of the existing literature in the previous decade showed that country effects clearly dominated the industry effects, both on a global scale as well as in Europe. More recent papers showed that this dominance was slowly decreasing. Furthermore, there is some criticism on the methodology that these papers use. Several authors show that the methodology is somewhat restrictive and that other models should be developed to study the topic. This paper can be seen as a robustness check challenging the results of the existing strand of literature by using an alternative methodology and an up-to-date sample period. We do this by taking the view of the investor and study the amount of diversification opportunities based on the different strategies instead of trying to explain the asset returns.

The basis of this paper goes back to the fundamentals of financial theory: an investor should spread his investments over different assets such that the idiosyncratic risk can be diversified. A very intuitive way to do this is by plotting the mean-variance frontiers, based on the well-known Markowitz (1952) methodology. Both visually and statistically we compare the frontiers based on a pure country-based and a pure industry-based strategy.

The data used in the paper consists of MSCI country and industry indices rather than a set of individual stocks in order to keep the calculations tractable. The sample period is relatively short (1995-2002) reflecting the fact that euro area stock markets have experienced substantial structural changes in the recent history. A joint stock return distribution based on a longer history might therefore not be sufficiently representative. With this dataset, it follows that an investor would have been better off by diversifying over industries compared to diversification over countries. This result holds both for the total sample period considered (1995-2002) as well as for both sub-periods (pre-euro and post-euro).

The sample period considered has one interesting feature: it contains the IT-hype around the turn of the millennium. Asset prices of IT- and internet-stocks seemed to rise sky-high. This phenomenon was very industry-specific and it might influence our results and bias the results in favor of industry diversification. Therefore, we performed a robustness check by neglecting the IT- and internet-industry. Our conclusions stayed the same, though the difference between industry diversification and country diversification was not as clear as in the normal case. Not as a surprise, an investor that considers both types of indices can find a better diversified portfolio. The robustness checks show this result even clearer.

Also, we consider the robustness of our results with respect to different volatility regimes. This is done using a new approach with which we can estimate the conditional covariance matrix. This allows us to control for one of the most characteristic features of stock returns: volatility clustering. The estimated covariance matrix contains conditional estimates for all variances and covariances. This information can then be used to form a conditional mean-variance frontier on each period in time. We don't show all the frontiers, but select some on the basis of the time-varying volatility. Both in the case of a high volatility period and a low volatility period it follows that an investor is better off by diversifying over industries compared to diversification over countries.

The conclusion of this paper is that combining the fundamental economic theory of Markowitz (1952) with a recent sample period shows that a better portfolio can be constructed when industry indices are used instead of country indices only. The best portfolio can be constructed considering both types of indices simultaneously. These results are shown to be robust with respect to the IT-bubble around the turn of the century and with respect to different volatility regimes. Therefore, we conclude that a pure-country diversification strategy for the euro area seems to be outdated. In other words, the traditional top-down allocation scheme, where it is first decided how to divide the money over several countries and secondly how to spread the investments within a country, seems no longer optimal.

1. Introduction

The extent to which financial markets and countries have become more integrated has been the topic of extensive debate. Capital markets in the euro area are an interesting subject of study, because of the rapid changes caused by the unification process and the introduction of a common currency. Our research question concerns the consequences of the ongoing European integration for investors in the euro area in terms of stock market diversification. In this paper we concentrate on the differences between investments strategies based on country factors and on industry factors[1].

Prior empirical research found that country factors dominated industry factors in explaining stock returns (e.g. Roll, 1992; Heston and Rouwenhorst, 1994; Griffin and Karolyi, 1998; Rouwenhorst, 1999). These papers concluded that investing according to a pure country strategy outperformed a strategy based on information from industries only. In terms of portfolios, Heston and Rouwenhorst (1995) show that more diversification gains can be obtained when an investor diversifies over countries (compared to diversification over industries).

More recent research, however, finds mixed results. According to Carrieri, Errunza and Sarkissian (2000), Gerard, Hillion and De Roon (2002) and Adjaouté and Danthine (2001a, 2001b) the dominance of country effects has diminished, but industry factors are still less important than country factors. On the other hand, Cavaglia, Brightman and Aked (2000) and Isakov and Sonney (2002) show that industry factors (almost) match the country factors and expect that industry factors will become even more important. This conclusion is confirmed by the extension of the Rouwenhorst (1999) methodology. In his original paper he concludes that country effects still dominated industry effects in the nineties (based on a

[1] For a more detailed discussion on European integration and changes in the European regulation system, see e.g. Hardouvelis, Malliaropulos and Priestley (1999), De Menil (1999) or Adjaouté and Danthine(2002)

sample until August 1998), while a figure on his website shows that the industry effects will take over during 2000[2].

Brooks and Del Negro (2002a, 2002b, 2002c) discuss this topic on a global scale from different points of view. The first paper focuses on the fact that the rise in the industry effects coincided with the information technology/internet “bubble” (hereafter IT-hype). When one corrects for this phenomenon it follows that the upward trend of the industry effects is less pronounced. In their second paper Brooks and Del Negro (2002b) use an adjusted version of the Heston and Rouwenhorst (1994,1995) methodology to investigate the relative importance of industry, region and within-region effects. They conclude that regional effects can explain the country effects for 60 up to 90%.

The third paper of Brooks and Del Negro (2002c) discusses the drawbacks of the Heston and Rouwenhorst (1994,1995) methodology, which is followed by most other papers. This methodology follows a dummy approach where all companies are a member of exactly one country and one industry. Clearly, this is a very strong assumption, especially for big multinational firms. Brooks and Del Negro (2002c) show that a less restrictive model performs better (according to the Akaike and the Schwarz Information Criterium). A similar argument is put forward by Adjaouté and Danthine (2002), who also criticise the standard Heston and Rouwenhorst (1994,1995) methodology.

Summarising, it seems that until approximately the middle of the nineties country factors were dominant factors in explaining stock returns. Around the turn of the century more and more signals show that industry effects are increasing. Some studies (for example: Cavaglia, Brightman and Aked, 2000; Brooks and Del Negro, 2002a) report that on a global scale industry effects are taking over, however, this result is no longer valid as soon as one corrects for the IT-hype. For the European area, the evidence is a little bit more in favour of the industry factors, even after correcting for the extreme rise in the information technology

[2] K.Geert Rouwenhorst, K.Geert Rouwenhorst’s homepage, Yale School of Management, http://mayet.som.yale.edu/geert (accessed March 02, 2004).

assets. However, all of these results are based on the restricted Heston and Rouwenhorst (1994, 1995) methodology, while Brooks and Del Negro (2002c) show that an unrestricted version of this model is statistically preferred.

In this study we want to test whether sector-based diversification strategies obtain higher diversification benefits than country-based strategies, applied in the euro area markets. A priori, a confirmation of this hypothesis would not be a surprise, since it is expected/forecasted by economists. Already during the run-up to the introduction of the common currency, economists expected sector-based diversification strategies to become more important and slowly institutional investors redesigned their departments to take this into account. However, Rouwenhorst (1999) could not find any evidence of this expected shift with a sample until mid 1998. We revisit this issue with recent data and compare it with the results of Rouwenhorst (1999), amongst others.

This paper is not aimed at contributing to the (methodological) discussion on the relative significance of country and industry factors. Rather, we concentrate on the consequences of the changing structure of asset returns in Europe for asset management. This is also our main contribution to the literature: we go on step further and directly investigate the consequences of the changes in the markets for the portfolios of the investors.

The comparison of portfolios is done by standard mean-variance analysis. Using industry and country indices from the period 1995 till 2002 we construct mean-variance frontiers and directly compare the efficient portfolios. We show that industry-based diversification yields more efficient portfolios than country-based diversification in the euro area nowadays. The result is in compliance with the expectations based on economic theory, but in contrast with previous studies like Rouwenhorst (1999). We also show that this is result is robust to changes in volatility and robust with respect to IT-hype around the turn of the millennium. The implication for asset managers is that they should generally no longer base their euro area portfolio on a country-diversification strategy.

The paper is organised as follows. In the section 2 we describe the methodology used in this paper. In Section 3 we discuss the data. The results are presented in Section 4 and Section 5 concludes.

2. Methodology and model specification

The main research question that we want to answer in this paper is whether diversifying over countries or diversifying over industries is the better strategy for the euro area. Then, before discussing the details of the methodology used, let us briefly review some underlying economic intuition.

When we consider the pricing of European stocks, several different factors are important. For a specific European stock we can distinguish three different types of factors: country specific factors, industry specific factors and other (European) factors (see also Carrieri, Errunza and Sarkissian, 2000). European factors, like the interest rate (which is equal for all European Monetary Union members after the introduction of the common currency) and the exchange rate of the euro with other currencies like the U.S. dollar and the Japanese yen, are the common factors that drive all stock returns. We expect that the shocks from these common factors will have the same impact during the integration process or may even become more important.

The effect of country specific factors is expected to decline over time during the integration process of the European countries. For example, the above mentioned interest rate is no longer a country specific factor as of the introduction of the common currency. Also, as of 1999 the exchange rates between EMU countries were fixed, which eliminates the exchange rate risk. On the other hand, some country factors will still remain. Investment barriers (like transaction costs) for investing in stocks of other European countries are lowered over time, but the costs of international investments are still higher than the costs of investing in domestic stocks. The difference between these costs may be an important reason for the home-bias effect[3] and the explanation for the relevance of the country factors. Other examples of country factors are differences in tax regimes, inflation rates, economic activity, legislation and natural events (like flooding) that have an impact on the economy.

The last set of factors is the industry factors. This type of factors is very important for pricing of individual stocks. R&D investments, mergers, acquisitions or bankruptcies within an industry drive market share, market value and returns of firms in that industry. We do not expect that the impact of industry shocks has changed very much over time in Europe. However, the relative importance with respect to country specific factors is expected to increase.

Clearly, the numbers of factors that might have an influence on stock returns is very large, too large to specify them all. Moreover, we don't know the importance of each different variable and sometimes it is hard to find correct data that represent the (risk) factors we described. Therefore, like most papers in this field, we will not try to specify all possible factors[4]. Several of these studies show that the proceeding economic integration among euro area countries has important consequences for the factors driving asset returns in financial markets. In this study we want to concentrate on the implications of the changing structure of security returns for asset management. This will be done using the conventional theory of mean-variance analysis. The approach is relatively straightforward and intuitively appealing. In order to keep the calculations tractable we apply this methodology to stock indices rather than a broad set of individual stocks.

Section 2.1 discusses the Markowitz (1952) mean-variance methodology. In the following section we describe the spanning and intersection tests that we use to compare the different efficient frontiers and the last section covers a multivariate GARCH-methodology. This approach is used to see whether are conclusions are robust for different volatility regimes.

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[3] See e.g. Cooper and Kaplanis (1994) and Lewis (1999)

2.1. Mean-variance frontiers

The unconditional portfolio optimization problem will be solved according to the methodology proposed by Markowitz (1952) who solves the problem from the point of view of an investor with a mean-variance perspective. Given the means – which are estimated by the historical averages - and the covariance matrix of both the country and the industry indices we plot the mean-variance frontiers. The standard Markowitz (1952) mean-variance efficient frontiers follow from this optimization problem.

$$\begin{aligned} &\min_{w} && \frac{1}{2} w' \Sigma w \\ &s.t. && w'\mu = R, \\ & && w'\iota = 1 \end{aligned} \qquad (1)$$

where *w* represents the weight invested in each index, μ is the average return, Σ represents the corresponding covariance matrix of the return indices and ι is a vector with all elements equal to one. The investor minimizes the amount of risk of his portfolio as measured by the portfolio variance given a certain demanded return R and subject to the budget restriction that all weights should sum up to one. In this paper we will do the analysis for country and industry indices separately to get two efficient frontiers. Additionally, we perform the same analysis for all investment opportunities (country and industry indices together) to see the influence of the added indices. Naturally, this frontier will give the best investment opportunities, since the other two investment strategies are nested.

2.2 Spanning and intersection tests

In the unconditional analysis we use spanning and intersection tests to find out whether an investor can gain by considering more investment opportunities. The tests are described in for example DeRoon and Nijman (2001) and are based on regression analysis. Intuitively, they are relatively straightforward. An investor chooses an efficient portfolio given one set of

[4] See Fratzscher (2002) for a specification that includes several important factors. He finds that the central driving force in the financial integration process in Europe is reduced exchange rate volatility and the monetary policy convergence of interest rates and inflation rates.

investment opportunities (in our case indices). The introduction of the second set of indices increases the number of investment opportunities. The test gives an answer to the question whether the investor can significantly improve his portfolio by investing in the other indices as well. In other words, from a mean-variance frontier point-of-view, adding assets to the current portfolio will lead by definition to a shift of the frontier. A rejection of the spanning test means that this shift is statistically significant. The intersection test tests whether an investor can improve his efficient portfolio given a certain risk-preference or risk-free rate. The spanning test compares the whole set of efficient portfolios and tests whether the addition of the other set of indices gives significantly better portfolios. The rest of this section explains the tests in detail.

Regression analysis can be used to test whether the inclusion of extra investment opportunities really enlarges the efficient set of portfolios. For example, when we test whether the inclusion of industry indices is important, we need to regress the returns of the industry indices on the country indices returns (compare equation 20 of DeRoon and Nijman, 2001):

$$R_{ind,t} = \alpha + \beta \cdot R_{cou,t} + \varepsilon_t \qquad (2)$$

where $R_{ind,t}$ is Kx1 vector of industry index returns for time t, $R_{cou,t}$ is a *Lx1* vector of country index returns for time t, ε_t is a *Kx1* vector of normally distributed error terms, α is a *Kx1* vector of constants and β is a *KxL* vector of slope coefficients. The test for intersection and spanning can now be defined as a Wald-test on the estimated parameters. The restrictions imposed by the null hypothesis of intersection are:

$$\alpha - \eta \cdot \left(\iota_{ind} - \beta \cdot \iota_{cou}\right) = 0 \qquad (3)$$

where ι_{ind} and ι_{cou} are *Kx1* and *Lx1* unit vectors respectively with all elements equal to one. From the dimensions it is clear that the intersection test is a Wald-test of *K* restrictions at the same time, where *K* is equal to the number of new investment opportunities introduced. The test-statistic has a χ^2-distribution with *K* degrees of freedom. The intersection test tests, given a specific value of η, whether mean-variance investors can improve their mean-variance efficient set by including the other set of indices. η can be seen as the interest rate. We used a rate of 3% per annum, thus η=1.0025 (the monthly rate in gross return)[5].

The null hypothesis of the spanning test can be stated by the following restrictions:

$$\alpha = 0 \quad and \quad \beta \cdot \iota_{cou} - \iota_{ind} = 0 \tag{4}$$

This test consists of *2*K* restrictions and the Wald-statistic is χ^2-distributed with *2*K* degrees of freedom. It is easy to see that this test is more restrictive than the intersection test: if the restrictions in equation (4) holds, by definition the restrictions in equation (3) holds. For a more detailed discussion on the characteristics of the specific tests, see DeRoon and Nijman (2001).

To summarise, in case the intersection test is rejected, it means that the mean-variance frontiers of the country indices and of both types of indices do not intersect for this specific interest rate and that this investor can find a significantly better portfolio by spreading his investments over both investment categories. When the hypothesis of spanning is rejected, we can conclude that the country indices do not span the universe of both types of indices or, in other words, that every investor is better off considering both investment categories.

2.3. Conditional Covariance Matrix

It is a stylised fact that the volatility of stock returns is not constant over time (heteroskedasticity). Especially over shorter horizons (e.g. when returns are measured on a daily or weekly basis) stock returns tend to display volatility clustering. This characteristic is important for managers that try to time the market. In addition, time-varying return volatility and cross-correlation also matters from a risk management perspective. One of the first models that incorporated this feature is the ARCH-model developed by Engle (1982), later generalized by Bollerslev (1986) to the GARCH-model. This section covers a multivariate version of the GARCH-model in order to capture the dynamics of the volatilities and correlations.

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[5] The results are fairly robust. There are some minor changes in the p-values of the tests, but these do not change the conclusions.

We will use this model to check the validity of our conclusions with respect to different volatility regimes. Combining the historical means (μ) and a conditional covariance matrix (H_t) in the investor's minimization problem (as described in section 2.1) results in the conditional mean-variance frontier. We are mainly interested in three different cases:

1. A period when the overall volatility is very low on average
2. A period when the overall volatility is very high on average
3. The last time period considered.

The first two cases are used as robustness tests on the analysis. Hence, we consider two different volatility regimes. The last case is interesting, because it takes all information into account. As said before, euro area stock markets have experienced substantial structural changes since the introduction of the euro, and joint stock return distributions estimated over samples which extend far back into the past might not any more be sufficiently representative. Therefore, the last conditional covariance matrix might be insightful.

It is very important to have an accurate estimate of the conditional covariance matrix. However, this is not a trivial issue, especially when the number of variables becomes large (because the number of parameters increases exponentially). We will use a special methodology for estimating the covariance matrix: principle components GARCH or O-GARCH, as proposed by Alexander (2000). The remainder of this section explains the model in more detail.

We use a multivariate GARCH-model or, more accurately, Orthogonal GARCH also known as Principal Component GARCH (which is nested in the more general BEKK model, see Van der Weide, 2002) in order to estimate a time-varying covariance matrix. Most research concerning the time behaviour of the correlation coefficient uses a bivariate model (e.g. Longin and Solnik, 1995), which gives a detailed description of the co-movements of the two time series considered. However, we are more interested in the time patterns for all indices in one system. Therefore, employing a multivariate model instead of using a number of different bivariate models is an important improvement.

The multivariate model for asset returns can be written as:

$$R_t = E(R_t) + \varepsilon_t \qquad \varepsilon_t \sim N(0, H_t) \tag{5}$$

where R_t represents a vector returns on period t (this can be the returns all country indices returns, the returns of all industry indices or the returns of both types of indices) and the vector ε_t represents the error terms, which are assumed to be jointly conditionally normally distributed. H_t is the time-varying covariance matrix. In this paper we will use the historical average of the returns for the expectation of the asset return ($E(R_t)$). In future research this can be extended by conditioning on information variables, like the dividend yield, the term structure spread, the short-term interest rate and the default spread.

The matrix H_t is the conditional covariance matrix of the vector error term ε_t. An important part of this model is the specification of H_t, because the number of parameters can be very large as soon as the number of return series is higher than two or three. In our case (using 10 industry and 11 country indices) it is necessary to find alternative ways to estimate the conditional covariance matrix. Different studies[6] proposed methods to study the changing correlations between assets. We use the Orthogonal-GARCH method (hereafter O-GARCH) as proposed by Alexander (2000). This method transforms the series into independent series (the unobserved economic variables or the principal components), which reduces the number of parameters dramatically[7].

We define the standardised return series as follows:

$$x_{it} = \frac{R_{it} - \mu_i}{\sigma_i} \tag{6}$$

[6] See e.g. Longin and Solnik (1995) and Engle (2000). Especially the last method is very interesting when one wants to study the time-behaviour of volatilities and correlations in the euro area.

[7] In some recent work Van der Weide(2002) proposes a generalized version of the Orthogonal GARCH, also called GO-GARCH. This version should have less identification problems and give better estimation results, especially when the data are independent. In our case the data are far from independent and some preliminary tests showed that the differences of GO-GARCH compared to O-GARCH are not large. Since we use monthly data in this paper and the GO-GARCH model has more parameters (caused by the estimation of the so-called rotation matrix) we stick to the O-GARCH model.

where μ_i and σ_i are the mean and standard deviation for the return series R_i. Let X be the matrix representation of x_{it}. Furthermore, let V be the matrix of eigenvectors of X'X and Λ the corresponding diagonal matrix containing the eigenvalues. Then, the principal components (or the unobserved economic factors) are given by:

$$P = XV \tag{7}$$

By definition the created risk factors are uncorrelated. We can easily show that the covariance matrix of P is indeed diagonal:

$$Var(P) = P'P = V'X'XV = V'V\Lambda = \Lambda \tag{8}$$

The variance of the standardised and original return series is then equal to:

$$\begin{aligned} Var(X) &= Var(PV') = V\Lambda V' \\ Var(R) &= Var(R - \mathrm{M}) = Var(D \cdot X) = DV\Lambda V'D' \end{aligned} \tag{9}$$

where M is constant matrix containing the average for each return series and D equals the diagonal matrix with σ_i its principal diagonal.

The O-GARCH method is based on this orthogonal transformation. Instead of estimating very large covariance matrix with an exploding number of parameters with a growing number of return series, we can approximate the conditional covariance matrix by estimating univariate GARCH on each of the orthogonal series p_{it}.[8] This will result in a time-varying diagonal covariance matrix for X: Λ_t. Under the assumption that the transformation is also valid in the conditional case, the conditional covariance matrix of the original series H_t is then equal to:[9]

$$H_t = D'V\Lambda_t V'D \tag{10}$$

This conditional covariance matrix will be used for the creation of conditional mean-variance frontiers.

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[8] Since we use monthly data and hence the number of observations is relatively small, we do not estimate GARCH(1,1) for all series p_{it}, because not all components contain heteroskedasticity. This concerns the principal components belonging to the lowest eigenvalues. These are exactly the components that have low influence. For a longer discussion on this topic, see Alexander (2000).
[9] See Alexander (2000) for a discussion on this restriction.

3. Data

In empirical finance having the right dataset is very important, especially for this project. On the one hand we would like to have a very long sample of country and industry indices returns. On the other hand, we want to be able to compare the results of the different sets of indices with each other. Preferably, to be comparable, the stock indices should be constructed out of the same pool of stocks. Since we concentrate on the stocks in the euro area, it is very hard to find a dataset that combines these two characteristics (unless one creates the indices himself). We chose to use the MSCI indices that only start in 1995, because the second argument is a little more important. On top of that, one can argue that euro area markets have changed so much over time, that longer time series might not be representative for the current and future distribution of returns.

We use both industry and country indices from MSCI for all EMU-participating countries except Luxembourg[10]. The industry indices are the MSCI sector indices for the European Monetary Union area, which are based on exactly these eleven countries. The sample consists of monthly returns from January 1995 until October 2002. Since the euro was introduced on January 1st 1999, the first part of our sample still contains exchange rate risk. Therefore, we take the view of a German investor and translate all returns into German Marks. Using the US dollar/German mark exchange rate from Datastream we transformed all dollar denoted MSCI indices into German marks. The MSCI indices are price indices, since gross indices were not available for the industry indices. Table 1 presents the statistics for the country and the industry indices.

4. Results

This section presents the results of the methodology described in section 2. In section 4.1 the efficient frontiers are based on country indices, industry indices and both types of indices are

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[10] In the creation of the MSCI industry indices, MSCI also neglects the stocks from Luxembourg. Therefore, we ignored these stocks as well in order to keep the datasets comparable.

discussed. By definition, the most efficient frontiers can be found by considering both types of indices simultaneously. Comparing pure country and pure industry indices shows that diversifying over industries gives more diversification opportunities. Sections 4.2 and 4.3 present robustness tests for these conclusions. We show that the results are robust with respect to the exclusion of the IT-bubble related indices and with respect to different volatility regimes respectively.

4.1 Unconditional mean-variance frontiers

This section describes the results based on the full sample and two sub periods. Figure 1 depicts the unconditional mean-variance frontier of the total sample for three types of investments: country indices only, industry indices only and both types of indices. By definition, the best portfolio can be constructed when both investment categories are considered at the same time. Comparing countries and industries with each other we can clearly see that (over the whole sample) investing in industry indices gave much more diversification opportunities than a pure country investment strategy. From a more statistical point of view, we can say that both spanning tests are rejected (see table 2 and section 2.2 on the explanation of the tests). This means that neither the country indices nor the industry indices span the mean-variance frontier for both types of investment categories. In other words, a mean-variance investor can always gain by adding the other type of indices to his portfolio.

The introduction of the euro in January 1999 is a natural moment to split our sample in two halves. Figures 2 and 3 present the mean-variance frontiers of both sub samples. During the pre-euro period (figure 2) a pure country-allocation scheme resulted in a similar performance as a pure industry-allocation scheme. A diversification scheme that uses both types of indices gives the best performance, which is also supported by the spanning and intersection tests (see table 2)[11]. In the second sub sample (figure 3) it is clear that a more efficient portfolio can be created using industry indices compared to using country indices only. In this sample there is no exchange rate risk anymore, which could be the reason that investors are better off investing in industries. The hypothesis of intersection is not rejected (which is the case for all samples), but the hypothesis that industry indices span the investment frontier of both types of indices can also not be rejected. In other words, this statistic says that the addition of country indices is not very valuable given a mean-variance efficient industry index allocated portfolio. The result is a clear indication that investing in industry indices is more important than investing in country indices nowadays.

This is in contrast with the previous literature. During the nineties the so-called country effects were more important than the industry effects (Heston and Rouwenhorst, 1994, 1995; Griffin and Karolyi, 1998; Rouwenhorst, 1999). Because of the integration process in the European area it was expected that country effects would diminish over time and that industry effects would take over, but research did not find evidence for that yet. More recent research gives ambiguous results. On a global scale, industry effects are getting more important, but it is not clear whether industry factors are currently more important than country factors. Our result clearly suggests that the country-diversification strategy for the euro area is outdated and that an investor (who considers indices only) should at least base his portfolio on industry factors.

4.2 Robustness checks with respect to the IT-hype

Isakov and Sonney (2002) and Brooks and Del Negro (2002a) correctly state that the rise in the industry effects coincided with the rise of the technology stocks. A robustness check on the sensitivity of our conclusions with respect to this phenomenon is therefore appropriate. We

[11] The mean-variance frontiers for the subsamples show a clear outperformance for the diversification over both types of indices. This can partly be explained by the fact that the number of observations (four years instead of almost eight) influences the estimation of the frontiers. Therefore, we should also take the more statistical intersection- and spanning tests into account. The results of these tests can be found in table 2. The tests are described in section 2.2.

follow Isakov and Sonney (2002) and Brooks and Del Negro (2002a) by studying the conclusions in case the regarding indices are left out of the sample.

Figure 4, 5 and 6 show the mean-variance frontiers based on a restricted sample: excluding the IT-industry, excluding IT and the Telecom industries and excluding IT, Telecom and Finland, respectively[12]. We should add that correcting for this phenomenon is very hard. The hype around the end of the century not only directly influenced the rise (and fall) of the IT-related stocks, but it can be argued that it also changed the investor's view about stocks and investments in general. Therefore, excluding some indices from the analysis might not be sufficient to fully control for the effects of this phenomenon.[13]

Before discussing the changes in the results we should repeat that the historical means used are based on a relatively short sample. We should therefore interpret the results discussed in this section with care. The statistics of the minimum variance portfolio (MVP) and the Sharpe ratio for all investment categories and all three robustness tests are presented in table 3. Looking at table 3 we see that excluding some of the possible indices had an influence on the performance. Especially in the case of excluding 2 out of 10 industry indices it makes sense that the Sharpe ratio should decline. However, our main conclusions are still valid. Even in the case where we compare investing in all country indices with investing in only 5 industry indices (figure 6), still, the better diversification opportunities can be found by diversifying over industries. This evidence suggests that the rise in the technology markets has only strengthened the trend of more important industry factors. These robustness tests also show that diversifying over both categories remains the best strategy.

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[12] The exclusion of the Information Technologies and Telecommunication Serviced industries is clear (also following the literature). We also tested the exclusion of Finland, since Nokia heavily influences the stock market of Finland. In 2000 (at the top of IT bubble and the middle of our sample) Nokia represent 64% of the total Finnish market value! Furthermore, we should add that also most other country indices contain some IT-stocks and are thus influenced by this market. However, we cannot correct for that, since we are working with indices. Given the good performance of these stocks the mean-variance frontier should be even lower when we could correct for that. This fact also strengthens the results we report.

[13] We thank the referee of the ECB working paper series for this point.

4.3 Robustness with respect to differences in volatility

The second test we perform, deals with the robustness of our results with respect to different volatility regimes. For that purpose we use the O-GARCH methodology as described in section 2.3, which is a possible multivariate parameterization of a model with GARCH-components. Basically, the method identifies the principal components of the stock indices. For each component we test for the presence of heteroskedasticity and estimate a GARCH(1,1) process if this is the case.

This procedure is followed three times: for country indices only, for industry indices only and for both types of indices simultaneously. Table 4 gives the estimates of the GARCH-parameters for all the principles components that contained conditional heteroskedasticity. The table shows that the number of components for which the null hypothesis of no heteroskedasticity is rejected is relatively low: 4,3 and 2 for all indices, only country indices or only industry indices respectively. The variances of all other components are constant over time and do not play an important role for this robustness test.

The conditional volatilities are plotted in figure 7. For sake of brevity we only plotted the time-varying volatilities of the principle components when we consider both types of investments simultaneously. Figure 7 shows that there is quite some substantial variation in the conditional volatilities. Hence, we want to check whether our conclusions are valid for all possible volatility regimes. In order to check that we consider the efficient frontiers based on two different periods: a period with a relatively high volatility and a period with a relatively low volatility. In general, the volatilities seem to be high around the introduction of the euro. Therefore, we chose December 1998 as the high volatility period. Two years later the average volatility seems to have hit a low: December 2000 is taken as the low volatility period.

Figures 8 and 9 present the efficient frontiers based on the conditional covariance matrix (resulting from the O-GARCH methodology) for the high and the low volatility period respectively. These pictures show that our conclusions are also robust over different volatility regimes. Although the differences are less pronounced when the volatility is low, a portfolio based on industry indices has a clearly better mean-variance ratio than a portfolio based on country indices in both periods considered. The only noticeable difference is the higher (lower) portfolio variance, which can be deduced from the shift of the whole efficient frontier to the right (left). For completeness we also plotted (in figure 10) the efficient frontiers based on the last conditional covariance matrix in our sample and again we find a similar pattern amongst the frontiers. The results of this section only strengthen our conclusions and show that an investor in the euro area stock markets cannot neglect industry factors.

5. Conclusions

The ongoing process of integration within the European Union and the euro area in particular is the subject of much debate. Due to the harmonisation of monetary and policy rules, most notably the introduction of the euro per January 1st 1999, European financial markets are getting more correlated with each other (see e.g. Adjaouté and Danthine, 2002; Hardouvelis, Malliaropoulos and Priestley, 1999). This paper deals with the consequences of these changes on the diversification opportunities within the euro-zone. Special attention is paid to the difference between country and industry effects. Several papers that cover this subject (Roll, 1992; Heston and Rouwenhorst, 1994, 1995; Griffin and Karolyi, 1998; Rouwenhorst, 1999) document that country effects are more prevalent than industry effects. Recent research (Cavaglia, Brightman and Aked, 1999; Isakov and Sonney, 2002) reports that country effects are losing field, which can partly be explained by the IT-hype during the late nineties (Brooks and Del Negro, 2002a). Furthermore, there is criticism on the restrictive Heston and Rouwenhorst (1994,1995) methodology (Adjaouté and Danthine, 2002; Brooks and Del Negro, 2002c). In this paper we revisit the issue for the euro area stock markets and with a different approach we show that industries are more important than countries with respect to diversification opportunities.

We plot the mean-variance frontiers of three investment policies (country indices only, industry indices only and both types of indices) for different samples. Our conjecture, that the performance of a pure country investment strategy is decreasing, is supported by the results in this paper. The unconditional analysis until January 1999 shows that an industry strategy gave similar results as a country strategy. Using more recent samples we report evidence that the diversification opportunities between countries have been decreasing. In the most recent samples or based on the recent conditional covariance matrix it is clear that diversifying over industries is much better strategy than diversifying over countries. Unsurprisingly, the best portfolio can be constructed when the investor considers both categories simultaneously, suggesting that country specific factors still play at least some role in the determination of stock returns and their correlation across euro area stock markets. Concluding, given our methodology, the traditional top-down allocation scheme, where it is first decided how to divide the money over several countries and secondly how to spread the investments within a country, seems to be outdated for the euro area stock markets.

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Table 1

Panel A (above) shows the average monthly return and standard deviation for all the MSCI indices of the countries that form the Euro-zone (Luxembourg excluded). The statistics are presented for both the whole sample and two different sub samples. Panel B (below) presents the statistics for the MSCI industry indices.

Country (MSCI index)	Total sample 95:01 – 02:10		Sub sample I 95:01 – 98:12		Sub sample II 99:01 – 02:10	
	Return	St.dev	Return	St.dev	Return	St.dev
Germany	0.5574	7.041	1.8063	5.722	-0.7458	8.053
Belgium	0.5107	5.141	2.1042	4.372	-1.1521	5.397
Spain	1.1743	7.061	2.8206	7.232	-0.5436	6.521
Finland	2.1825	11.731	3.1747	9.011	1.1471	14.051
France	0.8673	6.097	1.8442	5.732	-0.152	6.358
Greece	0.7444	9.372	2.6109	9.837	-1.2032	8.536
Ireland	0.6332	5.776	2.0359	4.876	-0.8306	6.311
Italy	0.8143	7.555	2.1954	8.617	-0.6268	6.021
Netherlands	0.7538	5.961	2.0227	5.279	-0.5703	6.390
Austria	0.0439	5.445	0.2643	6.043	-0.186	4.799
Portugal	0.5126	6.468	2.143	6.629	-1.1886	5.898

Industry (MSCI EMU index)	Total sample 95:01 – 02:10		Sub sample I 95:01 – 98:12		Sub sample II 99:01 – 02:10	
	Return	St.dev	Return	St.dev	Return	St.dev
Energy	1.0991	5.924	1.5038	5.825	0.6768	6.061
Materials	0.5255	6.176	1.0536	5.653	-0.0254	6.697
Industrials	0.6777	7.044	1.1145	6.114	0.2218	7.943
Consumer Discretionary	0.4073	7.052	1.7348	5.714	-0.978	8.051
Consumer Staples	1.0493	4.678	2.3986	4.894	-0.3586	4.030
Health Care	1.0886	5.201	2.0024	5.072	0.135	5.216
Financials	0.732	7.302	2.2364	6.960	-0.8379	7.394
Information Technology	1.9314	11.729	3.5212	8.686	0.2724	14.143
Telecom. Services	1.2003	9.564	2.8392	6.306	-0.5098	11.901
Utilities	0.6591	4.781	2.1323	4.469	-0.8781	4.653

Table 2

This table presents the results of the spanning and intersection tests, which are taken from DeRoon and Nijman (2001). Regression analysis can be used to test whether the inclusion of some extra investment opportunities really enlarges the efficient set of portfolios. For example, when we test whether the inclusion of industry indices is important, we need to regress the returns of the industry indices on the country indices returns (compare equation 20 of DeRoon and Nijman (2001)):

$$R_{ind,t+1} = \alpha + \beta \cdot R_{cou,t+1} + \varepsilon_{t+1} \quad \text{(A.1)}$$

The test for intersection and spanning can now be defined as a Wald-test on the estimated parameters. The restrictions imposed by the hypothesis of intersection are:

$$\alpha - \eta \cdot (\iota_{ind} - \beta \cdot \iota_{cou}) = 0 \quad \text{(A.2)}$$

The intersection test tests whether there is one specific value of η such that mean-variance investors cannot improve their mean-variance efficient set by including the other set of indices. η can be seen as the interest rate, we used a rate of 3% per annum, thus η=1.0025 (the monthly rate in gross return)
The hypothesis of the spanning test can be stated by the following restrictions:

$$\alpha = 0 \quad and \quad \beta \cdot \iota_{cou} - \iota_{ind} = 0 \quad \text{(A.3)}$$

The table is divided into two parts. Panel A presents the p-values of the different tests done when the inclusion of industry indices is considered. In case the intersection test is rejected, it means that the mean-variance frontiers of the country indices and of both types of indices do not intersect for this specific interest rate. When the hypothesis of spanning is rejected, we can conclude that the country indices do not span the universe of both types of indices. For panel B it is the other way around

Panel A: P-values of the tests based on the parameter estimates of this regression:

$$R_{ind,t+1} = \alpha + \beta \cdot R_{cou,t+1} + \varepsilon_{t+1}$$

p-values	95:01 – 02:10	95:01 – 98:12	99:01 – 02:10
Intersection test	0.754	0.177	0.956
Spanning test	0.000	0.000	0.020

Panel B: P-values of the tests based on the parameter estimates of this regression:

$$R_{coud,t+1} = \alpha + \beta \cdot R_{ind,t+1} + \varepsilon_{t+1}.$$

p-values	95:01 – 02:10	95:01 – 98:12	99:01 – 02:10
Intersection test	0.997	0.442	0.965
Spanning test	0.012	0.026	0.832

Table 3

This table presents the statistics concerning the conditional mean-variance frontiers (figures 8 till 10) all based on the unconditional covariance matrix. The third column presents the mean and standard deviation of the Mean Variance Portfolio (MVP) and the Sharpe ratio for all investment categories when all indices are included. Columns 2 to 4 give the same characteristics when IT is not included, IT and Telecom are not included or IT, Telecom and Finland are not included, respectively. For calculating the Sharpe ratio an annualized interest rate of 3% was used.

Investment Category		All included	IT excluded	IT and Telecom excluded	IT, Telecom and Finland excluded
Countries	MVP: mean	0.353	0.353	0.353	0.332
	MVP: st. dev	4.30	4.30	4.30	4.30
	Sharpe ratio	0.266	0.266	0.266	0.229
Industries	MVP: mean	1.039	1.158	1.082	1.082
	MVP: st. dev	3.61	3.68	3.71	3.71
	Sharpe ratio	0.377	0.354	0.301	0.301
Both categories	MVP: mean	0.762	0.827	0.781	0.753
	MVP: st. dev	2.97	3.01	3.08	3.09
	Sharpe ratio	0.451	0.439	0.425	0.397

Table 4

This table presents the GARCH-parameters for all principal components that contain conditional heteroskedasticity. We used the standard ARCH-LM test with a confidence level of 10% to test for conditional heteroskedasticity. In case the null hypothesis of no heteroskedasticity is rejected, we estimate a GARCH(1,1) model on the time series of the principal component:

$$PC_{it} = c_i + \varepsilon_{it} \qquad \varepsilon_{it} \sim N(0, h_{it})$$
$$h_{it} = \omega + \alpha \cdot \varepsilon_{it-1}^2 + \beta \cdot h_{it-1}$$

GARCH-parameter		ω	α	β
All	Pr.comp. 1	8.721	0.317 **	0.000
	Pr.comp. 2	2.493	0.215 **	0.644 **
	Pr.comp. 3	19.414	0.262 **	0.000
	Pr.comp. 4	71.237	0.164 **	0.758 **
Countries only	Pr.comp. 1	12.130	0.140 **	0.189
	Pr.comp. 2	18.267	0.221 **	0.000
	Pr.comp. 3	35.712	0.164 **	0.756 **
Industries only	Pr.comp. 1	3.723 **	0.440 **	0.000
	Pr.comp. 2	36.729	0.181 **	0.744 **

Note that the actual level of ω is not relevant, because of the transformation from the original series to the principal component series.

** means that the regarding parameter is statistically significant from zero based on a 95% confidence interval

Figure 1:

This figure plots the mean-variance frontiers for three investment categories over the whole sample. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

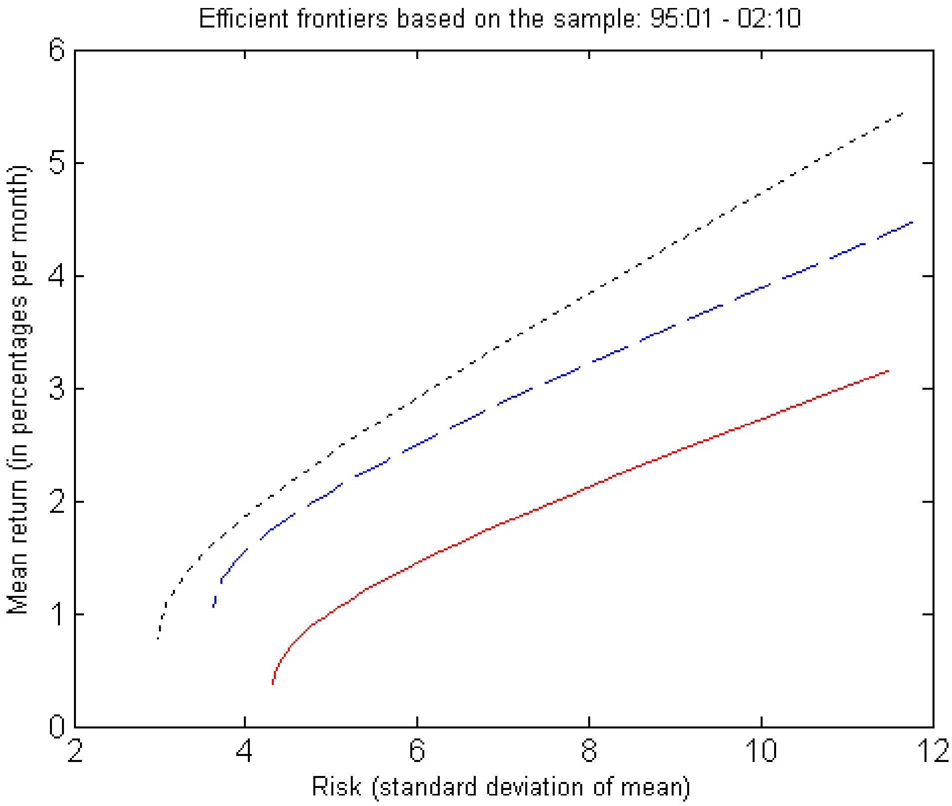


Figure 2:

This figure plots the mean-variance frontiers for three investment categories over the first sub sample (95:01 – 98:12). The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier line for the industry indices. The dotted line considers both types of indices.

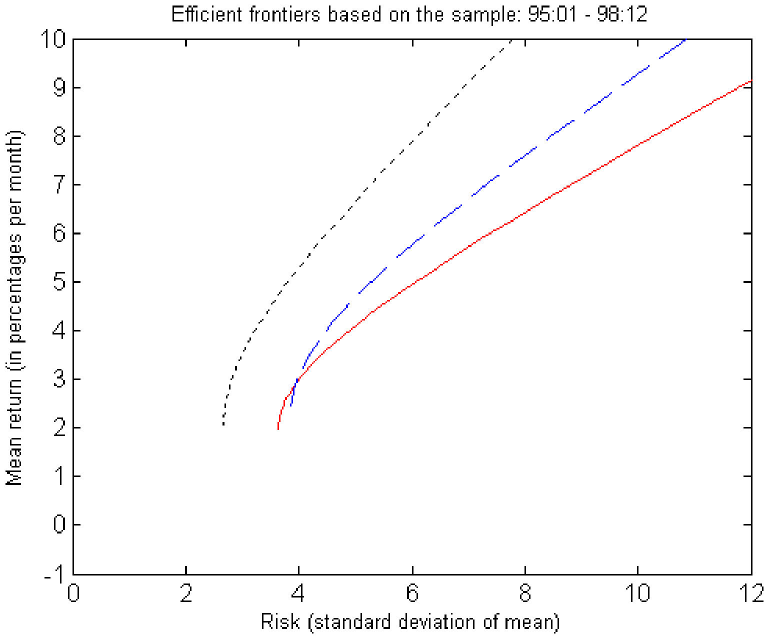


Figure 3:

This figure plots the mean-variance frontiers for three investment categories over the second sub sample (99:01 – 02:10). The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

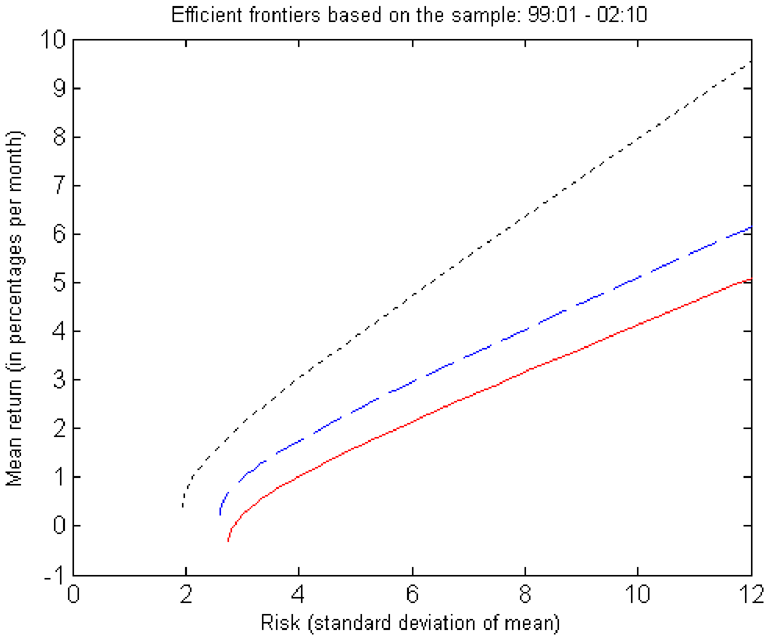


Figure 4:

This figure plots the unconditional mean-variance frontier with the exclusion of the IT-sector. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

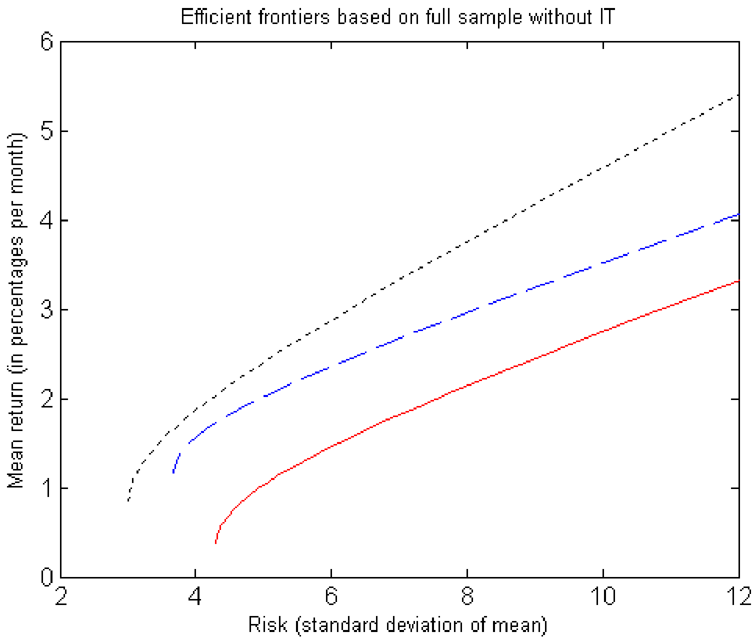


Figure 5:

This figure plots the unconditional mean-variance frontier with the exclusion of the IT and Telecom sectors. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

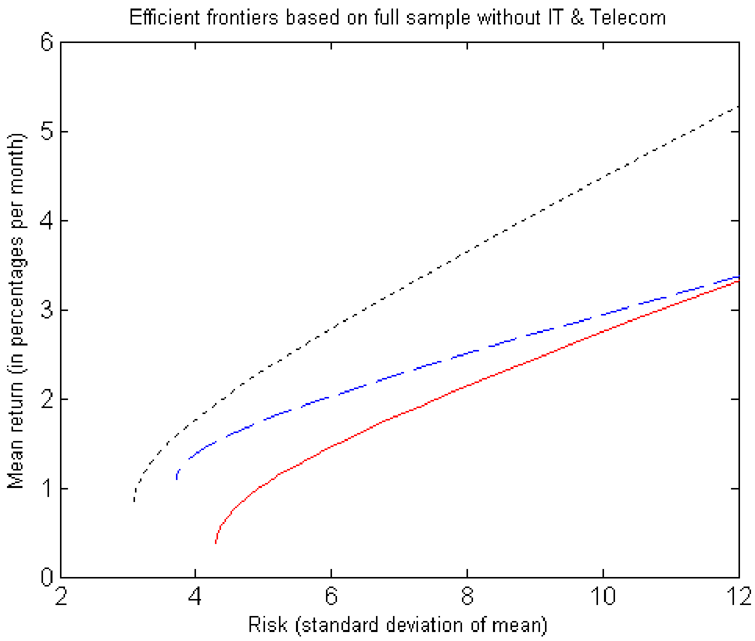


Figure 6:

This figure plots the unconditional mean-variance frontier with the exclusion of the IT-, the Telecom-sector and Finland. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

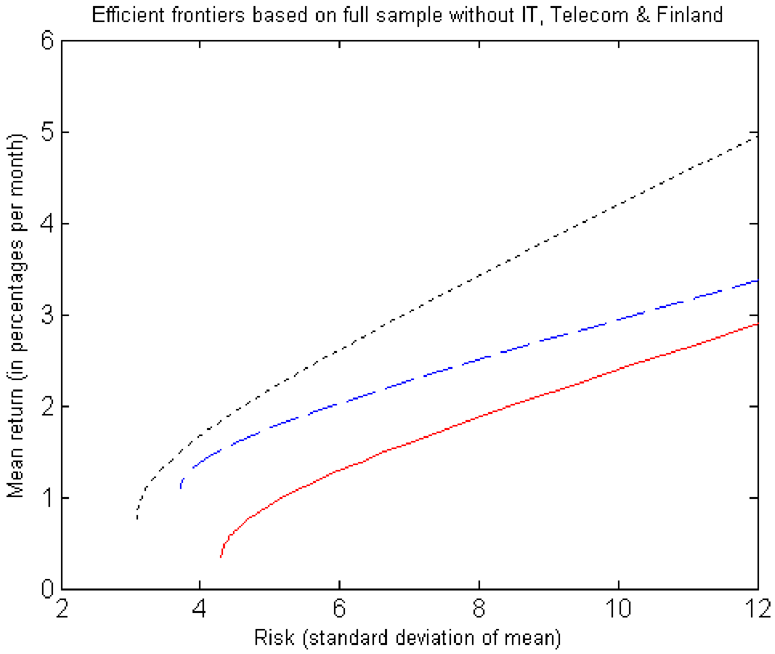


Figure 7

When both types of indices are considered, the test for conditional heteroskedasticity is rejected in four (our of 21) cases. A GARCH(1,1) model is estimated for these principle components. This figure shows the four resulting conditional volatilities.

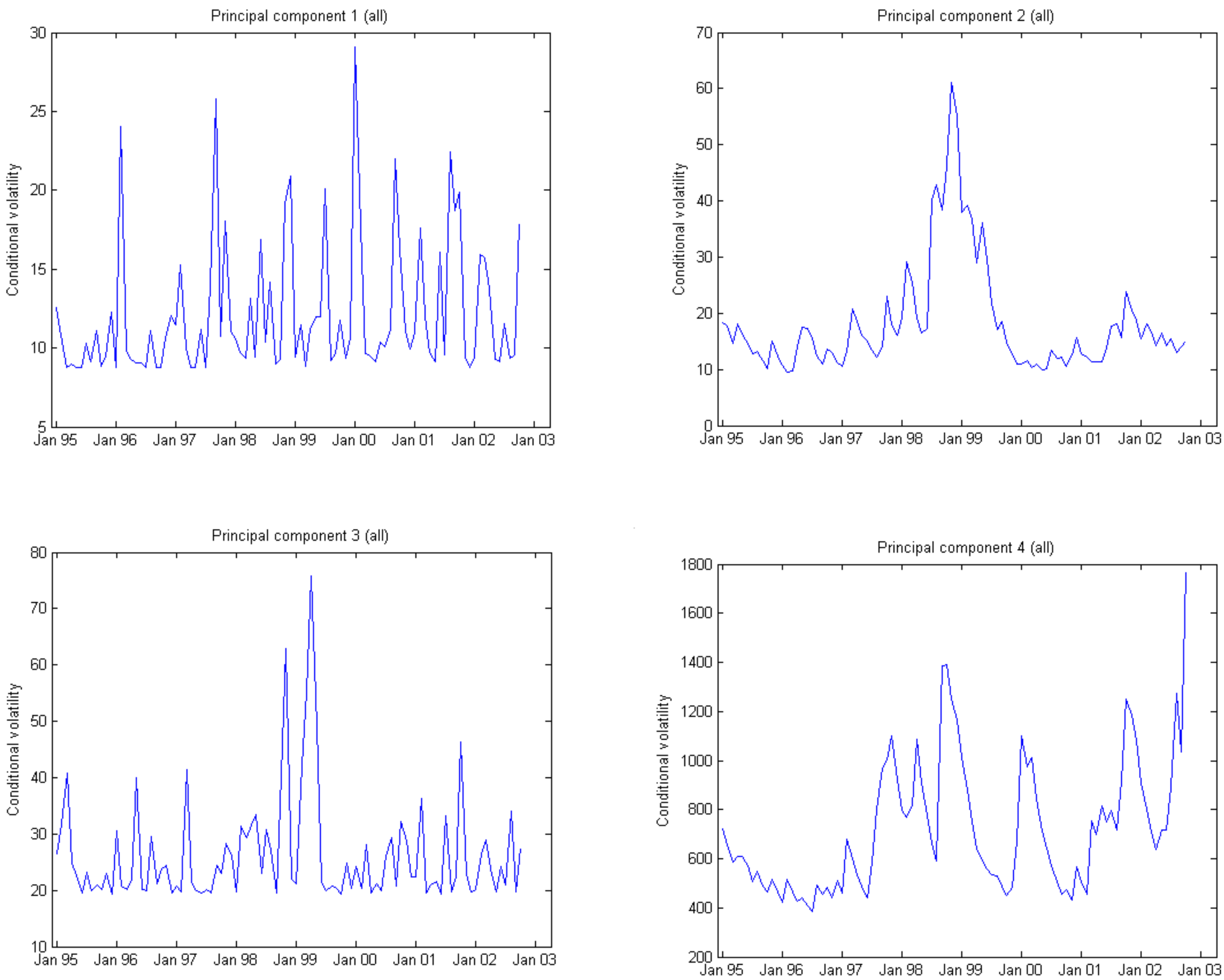


Figure 8:

This figure plots the conditional mean-variance frontiers on a specific time period in the sample. The frontiers are based on the mean return of the whole sample and the conditional covariance matrix of December 1998. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

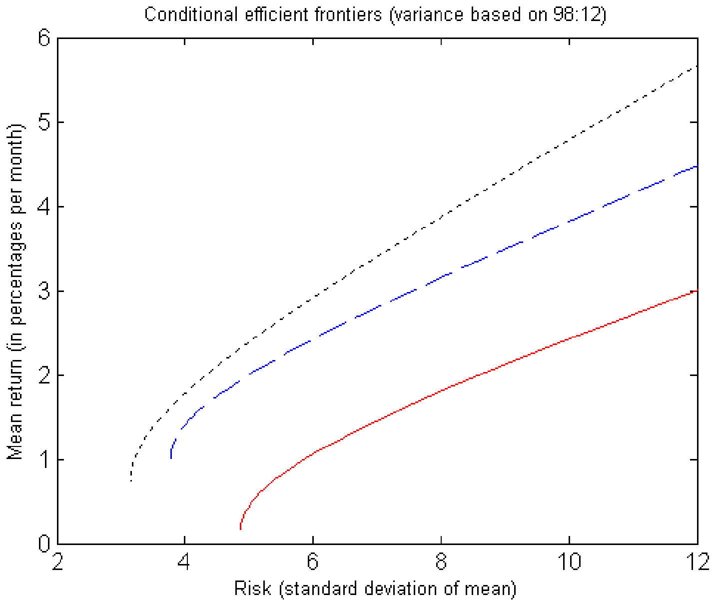


Figure 9:

This figure plots the conditional mean-variance frontiers on a specific time period in the sample. The frontiers are based on the mean return of the whole sample and the conditional covariance matrix of December 2000. The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.

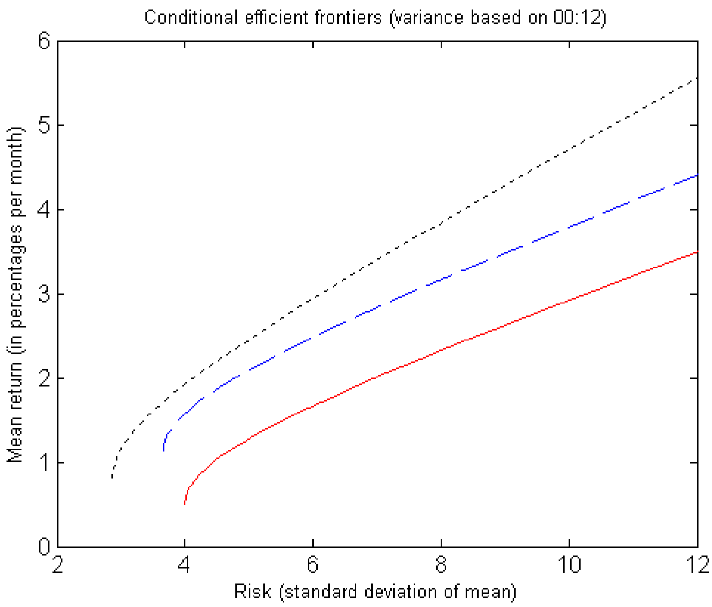
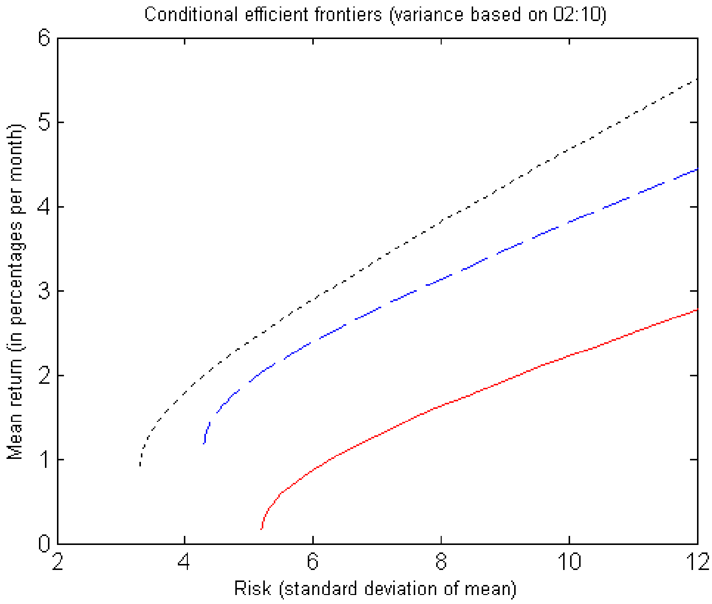


Figure 10:

This figure plots the conditional mean-variance frontiers on a specific time period in the sample. The frontiers are based on the mean return of the whole sample and the conditional covariance matrix of October 2002 (last month in the sample). The solid line represents all investment possibilities when only country indices are considered. The dashed line is the mean-variance frontier for the industry indices. The dotted line considers both types of indices.



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