DIVERSIFICATION IN EUROPEAN STOCK MARKETS: COUNTRY VS. INDUSTRY

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Abstract

The European Union and the introduction of the Euro make the connection between European countries much stronger. Because of these institutional changes one might expect that country effects diminish over time and that diversification strategies concentrate more on the industrial composition of the portfolio. So far empirical evidence has yielded rather mixed results. Hence, we would like to shed light on this discussion with another specification. Using recent data we find that more efficient portfolios can be found by diversifying over industries compared to diversification over countries.

Keywords: EMU, European stock markets, integration, portfolio diversification

JEL Classification: G11, G15

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1. Introduction

The extent to which financial markets and countries have become more integrated has been the topic of extensive debate. Especially in the European Monetary Union (EMU) the number of institutional changes has been large. These changes and especially the introduction of the euro are part of the integration process of several European countries into the European Monetary Union[1]. Theory suggests that country effects within Europe should diminish over time and thus that the level of integration between these countries should rise.

Prior empirical research mainly found that country effects were more important than industry effects (e.g. Roll, 1992; Heston & Rouwenhorst, 1994; Griffin & Karolyi, 1998; Rouwenhorst, 1999). These papers concluded that investing according to a pure country strategy outperformed a strategy based on information from industries only. More recent research, however, shows that the domination of country effects may have diminished (e.g. Carrieri, Errunza & Sarkissian, 2000; Cavaglia, Brightman & Aked, 2000; Isakov & Sonney, 2002; Adjaoute & Danthine, 2001). Industry effects play a significant role in explaining the cross-section of stock returns and may overtake the country effects in the near future.

It looks like industry effects are slowly getting more important, while country effects are losing field. This conclusion is confirmed by the extension of the Rouwenhorst (1999) methodology. In his original paper he concludes that country effects are more important than industry effects with a sample that lasts till 1998. On his website[2] he presents the results when the sample is lengthened until July 2000. A plot depicts that industry effects have risen sharply since 1998 and Rouwenhorst concludes that industry effects are nowadays at least as important as country effects.

In this study we want to contribute to this discussion by introducing a different research design. First of all, we study the correlation coefficient between European countries and European industries. With a parsimonious multivariate GARCH model we are able to construct the conditional covariance matrix, which we will use to study the time behaviour of the average correlation coefficient. Most other research in this area does not study time

[1] see Hardouvelis, Malliaropulos & Priestley (2001) for a more detailed discussion about European integration

varying correlation coefficients. At most, a structural break is inserted and the correlations before and after that break are compared (e.g. Adjaoute & Danthine, 2001). Secondly, we investigate the implications for portfolio diversification of a representative investor with a mean-variance objective function. This provides a benchmark to study the diversification opportunities. Using very recent data – the sample ends in October 2002 – we find that diversification over industries gives more efficient portfolios. Our results show that the institutional changes in Europe decrease the use of pure country allocation schemes within Europe.

This paper is organised as follows. In the following section we describe our methodology. In Section 3 we discuss the data series that we use. The results are presented in Section 4 and Section 5 concludes.

2. Methodology / Econometric Specification

We use a multivariate model in order to study the changing correlations between the different European countries over time. The multivariate model for asset returns can be written as:

$$\begin{aligned} R_t &= E(R_t \mid F_{t-1}) + \varepsilon_t \\ \varepsilon_t \mid F_{t-1} &= z_t H_t^{1/2} \\ z_t &\sim N(0, I) \end{aligned} \quad (1)$$

where R_t represents a vector returns on time t, F_{t-1} is all information up to time t-1, ε_t and z_t are both vectors and follow a multivariate normal distribution. H_t is the time-varying covariance matrix. The expectation of the asset return ($E(R_t|F_{t-1})$) can be represented by a constant or by a time series containing all information up to time t-1. In the rest of this paper we assume a constant mean for all indices, but in future research this can be extended with the 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 covariance matrix of the error term ε_t. An important part of this model is the specification of H_t, because the number of parameters can be very high as soon as the number of variables is higher than two or three. In our case (using 10 industry and 11 country

[2] http://mayet.som.yale.edu/geert

indices) it is necessary to find alternative ways to estimate the conditional covariance matrix. Different studies proposed methods to study the changing correlations between assets, e.g. Longin & Solnik (1995) and Engle (2000). We will use the orthogonal-GARCH method as proposed by Alexander (2000). This method uses a specific transformation of the covariance matrix, which reduces the number of parameters dramatically. This section covers the methodology in more detail.[3]

First of all, the unconditional covariance matrix Σ is estimated from the model

$$R_t = m + e_t \qquad e_t \sim N(0, \Sigma) \tag{2}$$

with μ equal to the unconditional mean of the asset returns. Then, the unconditional covariance matrix is diagonalized using the eigenvalues and eigenvectors of the matrix. This can be done such that all eigenvectors are orthogonal to each other.

$$\Sigma = V \Lambda V^{-1} \tag{3}$$

V is the matrix containing the eigenvectors and Λ is a diagonal matrix containing the eigenvalues. V is assumed to be time invariant. Since the matrix V is constructed such that all eigenvectors are orthogonal, we can construct orthogonal error series by transforming the residuals ε_t, which were found by the regression in equation 2.

$$h_t = V e_t \sim N(0, \Lambda) \tag{4}$$

By construction, the series $\eta_{i,t}$ (i=1,….,N) are all independent (because the eigenvectors are chosen orthogonally). We propose to apply GARCH(1,1) to all separate orthogonal error series $\eta_{i,t}$, such that we can study the behaviour of the variances over time. Combining the univariate results gives a time varying (diagonal) covariance matrix Λ_t. This matrix can now be transformed back to a covariance matrix for the original series, $R_{i,t}$ (i=1,….,N), using the following relation:

$$H_t = V \Lambda_t V^{-1} \tag{5}$$

The resulting H_t can thus be interpreted as a conditional covariance matrix.

[3] In some recent work Van der Weide(2002) proposes a generalized version of the Orthogonal GARCH, also called GO-GARCH.

As soon as this conditional covariance matrix is known we conduct an analysis on the behaviour of the variances and correlations over time. We will study the average correlation coefficient over all Euro participating countries by regressing the average correlation coefficient on a time trend. We expect this figure to rise over time, because of a higher rate of integration of these countries. Furthermore, we will present the implications for a mean-variance investor.

3. Data

We use both industry and country indices in this research from Morgan Stanley Capital Investment (MSCI). The country indices are all EMU-participating countries except for Luxembourg (following MSCI). The industrial indices are the MSCI sector indices for the EMU-area. These ten indices are constructed from the same capital markets as the eleven country indices.

The sample consists of monthly returns from January 1995 until October 2002. Since the euro was only introduces 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 translated all returns into German Marks. Tables 1 and 2 present the statistics for the country and the industry indices.

4. Results

4.1 The time-variation in correlation coefficients

In this section, we discuss the main results we have obtained by applying the methodology introduced in section 2 to our sample of monthly MSCI index returns. Using this orthogonal-GARCH procedure we are able to estimate the time-varying covariance matrix for all series at the same time, allowing us to study the time behaviour of the correlation coefficients. The average correlation coefficient , that we use in this paper, can be seen as a measure for the amount of diversifiable risk. Hence, lower correlations mean higher diversification opportunities. The methodology is applied to both country and industry indices separately.

Due to the institutional changes in Europe (with an emphasis on the end of the exchange rate risk) one would expect that country indices become more alike and thus that the correlation between these countries would rise. However, countries will never be perfectly correlated because of different industrial composition and other differences (e.g. different inflation rates). Heston & Rouwenhorst (1994) and Griffin & Karolyi (1998), however, showed that the industrial composition of a country does explain only little of the time-variation of the cross-section of returns. Our expectations for the industry indices are ambivalent. On one hand, the argument of integration that makes the correlation of countries rise can also be applied on individual stocks and thus (after aggregation) on industry indices. Furthermore it is very hard to estimate the effect of the introduction of the Euro on the average industry correlation, since these indices are already country-diversified portfolios.

Figure 1 shows the 6-month moving average of the average correlation coefficient that we found by applying the orthogonal GARCH procedure on both the country and the industry indices. The first, most striking, observation is that there is a big time-variation in the correlation coefficients and this pattern is almost the same for the country and the industry correlations. Apparently, all stock indices are sensitive for the same kind of shocks, which make all correlations go up or down. Individual correlations (between two countries or two industries) also show this type of behaviour. Some further research will be needed to understand this time-behaviour, however, we will leave this question since it is not directly related to our research question.

We are mostly interested in answering the question whether the average correlation coefficient of country indices has risen over time. Clearly, figure 1 can not give us the answer, since the correlation coefficients are very volatile and dependent on some business cycle like pattern. It looks like both investment types share a common factor. We can, however, compare the series with each other. Figure 2 is a plot of the difference between the average correlation coefficient of the countries minus the average correlation coefficient of the industries. Although this picture also shows similar patterns, the beginning of 1998 can be seen as a turning point. Before that time the industry indices were more correlated with each other than the country indices were. From 1998 onwards this is the other way around, except for the end of sample, where the correlations are very close to each other.

We attribute this change to the institutional changes in the EMU-area. At first sight, the beginning of 1998 might not seem a logical turning point, since the introduction of the Euro was only one year later. However, the fact that the common currency would be introduced was known earlier, which explains that this effect can be found even before January 1999. Hardouvelis, Malliaropulos & Priestley (2001) find similar results. They study European market integration with a model similar to the integration model of Bekaert & Harvey (1995). Their results suggest that most countries are fully integrated with the European market at the end of their sample (June 1998). Our result, that the average country correlation is higher than the average industry correlation, is in line with that.

Concluding, the average correlation coefficient of both the country and the industry indices is very volatile. Hence, it is hard to draw conclusions from the absolute value of this coefficient. Therefore, our results need to be interpreted with care, because of the aggregation of coefficients after a complex estimation procedure. In the following section we will study the results for portfolio diversification opportunities using mean-variance analysis.

4.2 Mean-variance analysis

The previous section discussed the correlations between countries and between industries. The correlation coefficient can be seen as an indication for the diversification opportunities, but naturally this information has to be combined with the expected returns and the variances in order to get a view of possible diversification opportunities. Mean-variance analysis is a meaningful tool for this purpose.

Figure 3 depicts the capital market lines for the total sample for three types of investments: country indices only, industry indices only and both types of indices. 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 3). 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 into his portfolio.

Taking into account the average correlation coefficients from the previous section, the difference between the capital market lines might be a little counterintuitive, since the correlation coefficients are very close to each other. This difference must then be found in the expected returns and the standard deviation, which are stated in table 1 and 2. In order to make this comparison easier, figure 4 depicts a scatter plot that shows all indices by their means and standard deviations. From this figure it is obvious why an investor would be better off by investing along a pure industry investment strategy compared to investing in country indices only. Especially two industries had a very high return compared to their standard deviation: Consumer Staples and Health Care. Their average return over the whole sample was over 1 percent per month, while their standard deviation was around 5 percent per month. E.g. in the case of the Consumer Staples industry only two countries had a higher return (Spain and Finland), while none of the countries has a lower variance.

It looks like the time that country effects were more important than industry effects is over, as far as Europe is concerned. All of this can be considered as a result of the ongoing process of political and economical integration within the European Monetary Union. This contradicts with literature that discuss country and industry effects during the nineties (most notably Heston & Rouwenhorst, 1994; Griffin & Karolyi, 1998; Rouwenhorst, 1999). On the other hand, we can strengthen the results of Cavalia, Brightman & Aked (1999) and Isakov & Sonney (2002). They concluded that times are changing and that industry effects are getting more important. The following sections will take a look at the mean-variance properties of some sub samples.

4.3 Mean-variance analysis for subsamples

A natural split in our sample is of course January 1999. This approximately divides the sample in two equal halves and – more importantly – it marks the introduction of the common currency. Figures 5 and 6 present the capital market lines of both sub samples. In the second sub sample it is clear that a more efficient portfolio can be created using industry indices only compared to using country indices. In this sample there is no more exchange rate risk, which could be the reason that investors are better off investing in industries. The hypothesis of not intersection is not rejected (which is not the case for all samples), but also 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. This is a clear indication that investment in industry indices is more important than investing in country indices, which strengthens our conclusion that the results of Rouwenhorst (1999) and others are outdated.

The results before 1999 (figure 5) are very similar. The analysis shows that already in this period industries are doing better than countries. The differences are not as big as they are in the last sub sample with the most recent data. However, we can conclude that the ´takeover´ of the industries started before 1999. Comparing this with our results discussed in section 4.1 this is not very strange. Using the orthogonal GARCH methodology we found that the average correlation coefficient of the countries is higher than the industry correlation coefficient after the beginning of 1998.

For completeness, let us consider a last sub sample: 1995:01 - 1998:02. February 1998 is the turning point in the orthogonal GARCH analysis, where the average country correlation coefficient becomes larger than the average industry correlation. Figure 7 shows that investing in country indices would gain slightly more diversification opportunities than investments in industry indices. However, this difference is neglectable, since the spanning tests (table 3) show that neither the country nor the industry indices span the frontier of efficient portfolios consisting of both country and industry indices. More importantly, this figure (combined with the other figures) shows that there is a time trend in Europe. Because of the institutional changes within the European Monetary Union country indices get more correlated with each other and thus contain less diversification opportunities. Our conclusion is that an investor is better off by investing in industry indices only, although the best strategy remains to consider all possible investments.

5. Conclusions

The ongoing process of integration within the European Union is often the subject of debate. Due to a number of institutional changes under which the introduction of the Euro per January 1st 1999, European financial markets are getting more correlated with each other. This paper dealt with the consequences of these changes on the diversification opportunities within the Euro-zone. Special attention was paid to the difference between country and industry effects. Well-known papers that cover this subject (Roll, 1992; Heston & Rouwenhorst, 1994; Griffin & Karolyi, 1998; Rouwenhorst, 1999) find that country effects are more prevalent than industry effects. Recent research (Cavaglia, Brightman & Aked, 1999; Isakov & Sonney, 2002) finds that country effects are losing field. We show that industries are more important than countries with respect to diversification opportunities.

In the first part of the paper we use an orthogonal GARCH approach to study the time variation in correlation coefficients. First of all, it follows that correlations are very volatile and seem to follow a business cycle type of pattern. Secondly, we find that the difference in the average correlation coefficient between countries and industries has changed. In the first part of our sample the average industry correlation was higher than the average country correlation. From the beginning of 1998 this is exactly the other way around. This implies that diversification opportunities in industry indices should increase compared to diversification between country indices. The second part of our paper provides some evidence for this. We plot the capital market lines of three investment categories (country indices only, industry indices only and both types of indices) for different samples. Country indices performed better in the period until 1998. Using more recent sub samples we find that the investor would have been better out by investing in industries. This altogether shows that country effects are slowly vanishing over time and that industries are getting more important.

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Tables 1 and 2

Table 1 (above) shows the average 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. Table 2 (below) presents the statistics for the MSCI industry indices.

Country (MSCI index)	Total sample 95:01 – 02:10		Subsample I 95:01 – 98:12		Subsample 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		Subsample I 95:01 – 98:12		Subsample 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

Tables 3

Table 3 presents the results of the spanning and intersection tests, which are taken from DeRoon & Nijman (2001). Regression analysis can be used to test whether the inclusion of some extra investment opportunities really enlarges the efficient set of portfolios. E.g., 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)):

$$R_{ind,t+1} = a + b \cdot R_{cou,t+1} + e_{t+1} \qquad \text{(A.1)}$$

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:

$$a - h \cdot \left(i_{ind} - b \cdot i_{cou}\right) = 0 \qquad \text{(A.2)}$$

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 4% per annum, thus η=1.00333 (the monthly rate in gross return)
The hypothesis of the spanning test can be stated by the following restrictions:

$$a = 0 \quad and \quad b \cdot i_{cou} - i_{ind} = 0 \qquad \text{(A.3)}$$

Table 3 is divided into two parts. The first parts gives 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 table 3b it is the other way around

Table 3a: P-values of the tests based on the parameter estimates of this regression:

$$R_{ind,t+1} = a + b \cdot R_{cou,t+1} + e_{t+1}$$

p-values	95:01 – 02:10	95:01 – 98:12	99:01 – 02:10	95:01 – 98:02
Intersection test	0.796	0.169	0.965	0.059
Spanning test	0.000	0.000	0.020	0.003

Table 3b: P-values of the tests based on the parameter estimates of this regression:

$$R_{coud,t+1} = a + b \cdot R_{ind,t+1} + e_{t+1}.$$

p-values	95:01 – 02:10	95:01 – 98:12	99:01 – 02:10	95:01 – 98:02
Intersection test	0.996	0.465	0.960	0.066
Spanning test	0.012	0.026	0.832	0.006

Figure 1

This figure presents the average correlations coefficient between countries and the average correlation coefficient between industries over time. The correlations are found using the orthogonal GARCH approach described in the Methodology section.

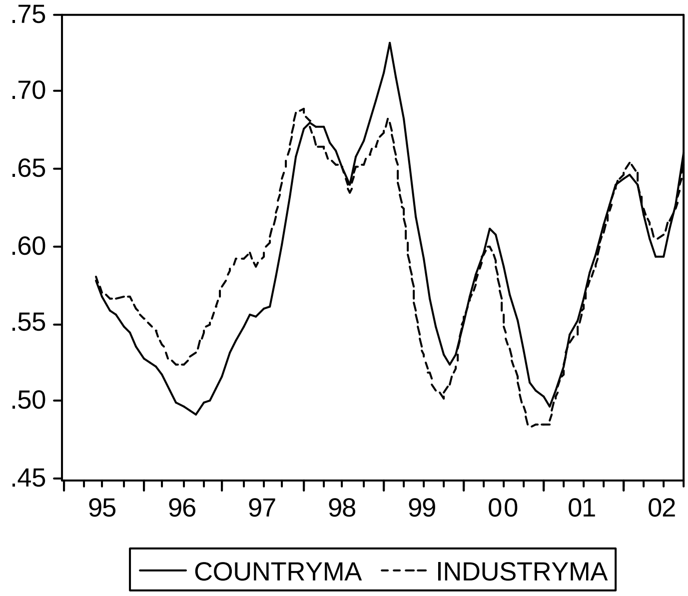

Figure 2

This plot depicts the difference in the average correlation coefficient of countries minus industries. The correlations are calculated using the orthogonal GARCH approach as described in the methodology section.

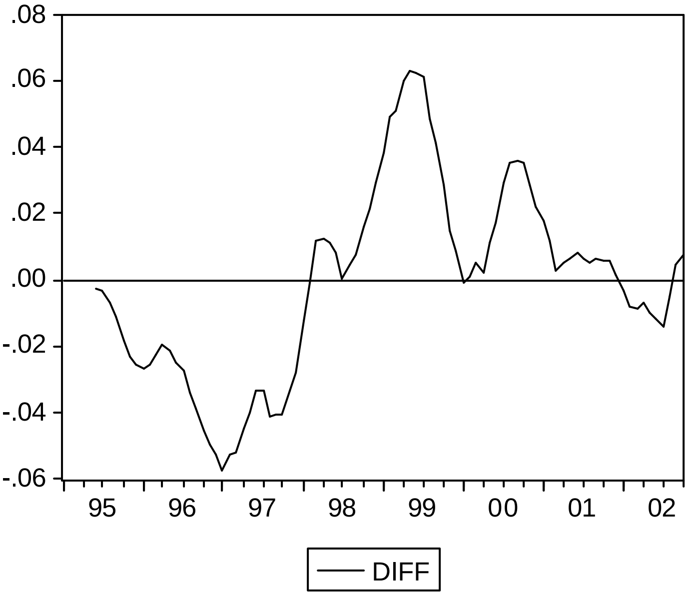

Figure 3:

This figure plots the capital market lines for three investment categories over the whole sample. The solid red line represents all investment possibilities when only country indices are considered. The dashed blue line is the capital market line for the industry indices. The dotted black line considers both types of indices.

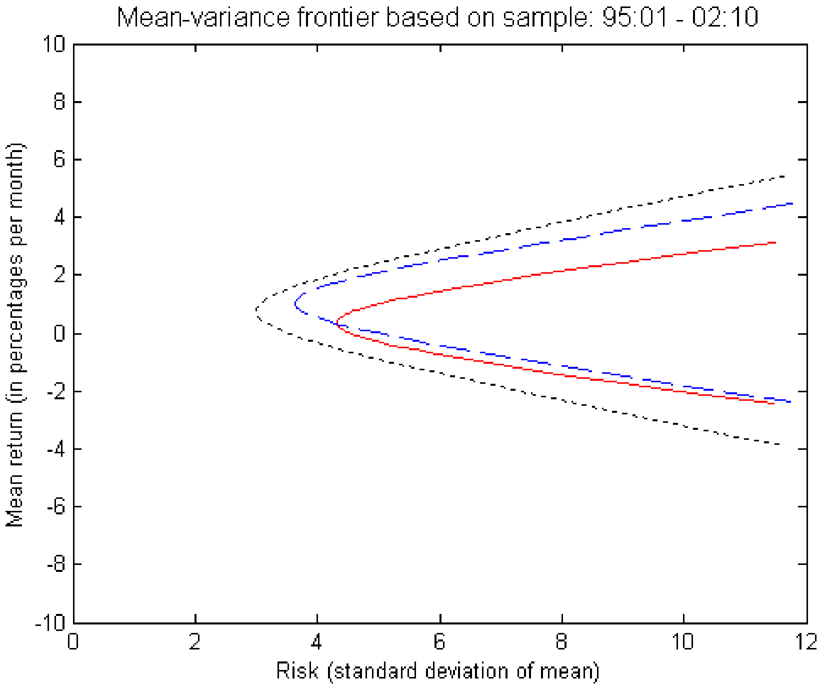

Figure 4:

This scatter plot presents all countries and industries considered. Each dot represents the mean and standard deviation of one specific index. All country indices are given by blue squares and all industry indices are denoted by pink circles.

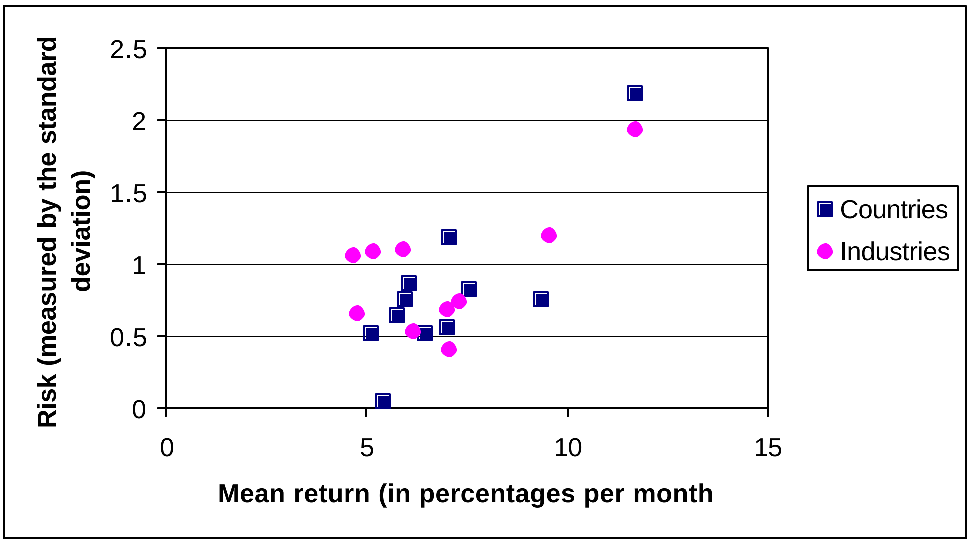

Figure 5:

This figure plots the capital market lines for three investment categories over the first sub sample (95:01 – 98:12). The solid red line represents all investment possibilities when only country indices are considered. The dashed blue line is the capital market line for the industry indices. The dotted black line considers both types of indices.

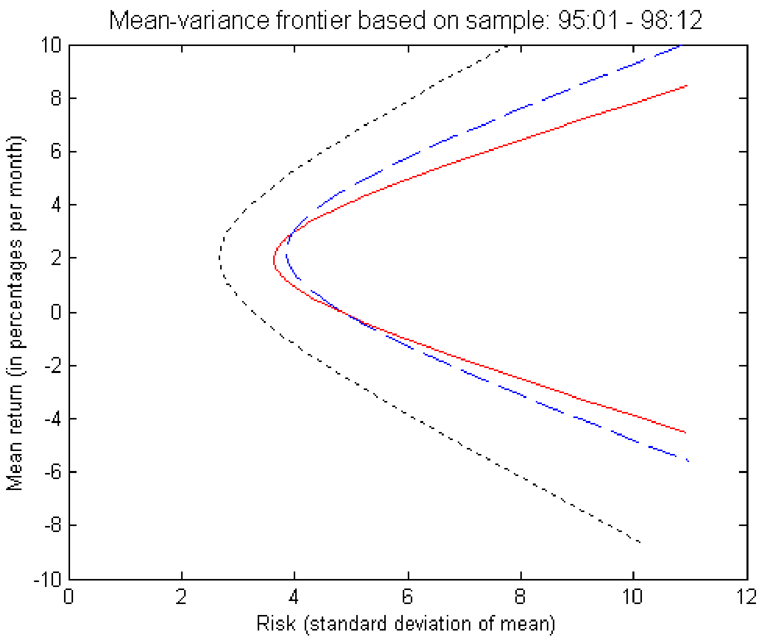

Figure 6:

This figure plots the capital market lines for three investment categories over the second sub sample (99:01 – 02:10). The solid red line represents all investment possibilities when only country indices are considered. The dashed blue line is the capital market line for the industry indices. The dotted black line considers both types of indices.

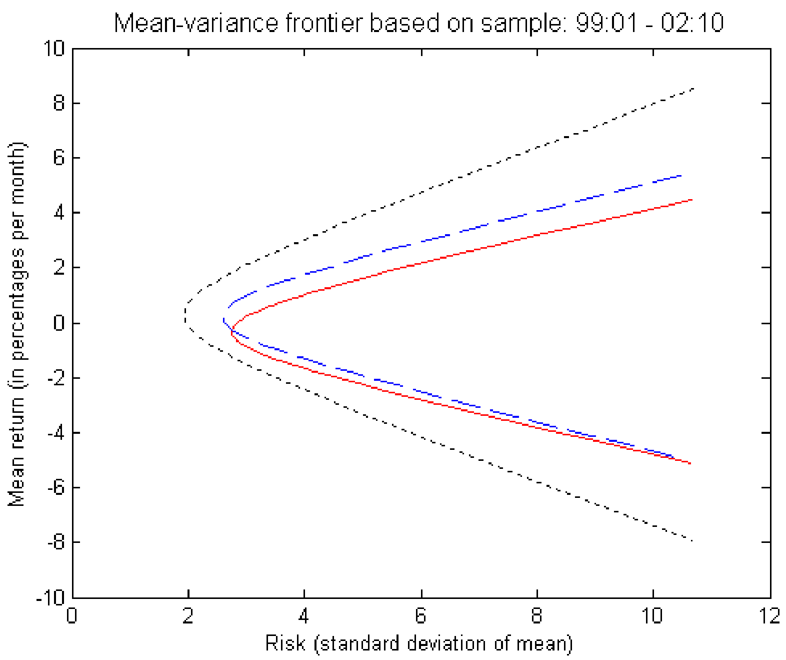

Figure 7:

This figure plots the capital market lines for three investment categories over the period 95:01 till 98:02. The solid red line represents all investment possibilities when only country indices are considered. The dashed blue line is the capital market line for the industry indices. The dotted black line considers both types of indices.